

TEKTRONIX®

**DM43-DM40
DIGITAL
MULTIMETER**

SERVICE

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97005

Serial Number



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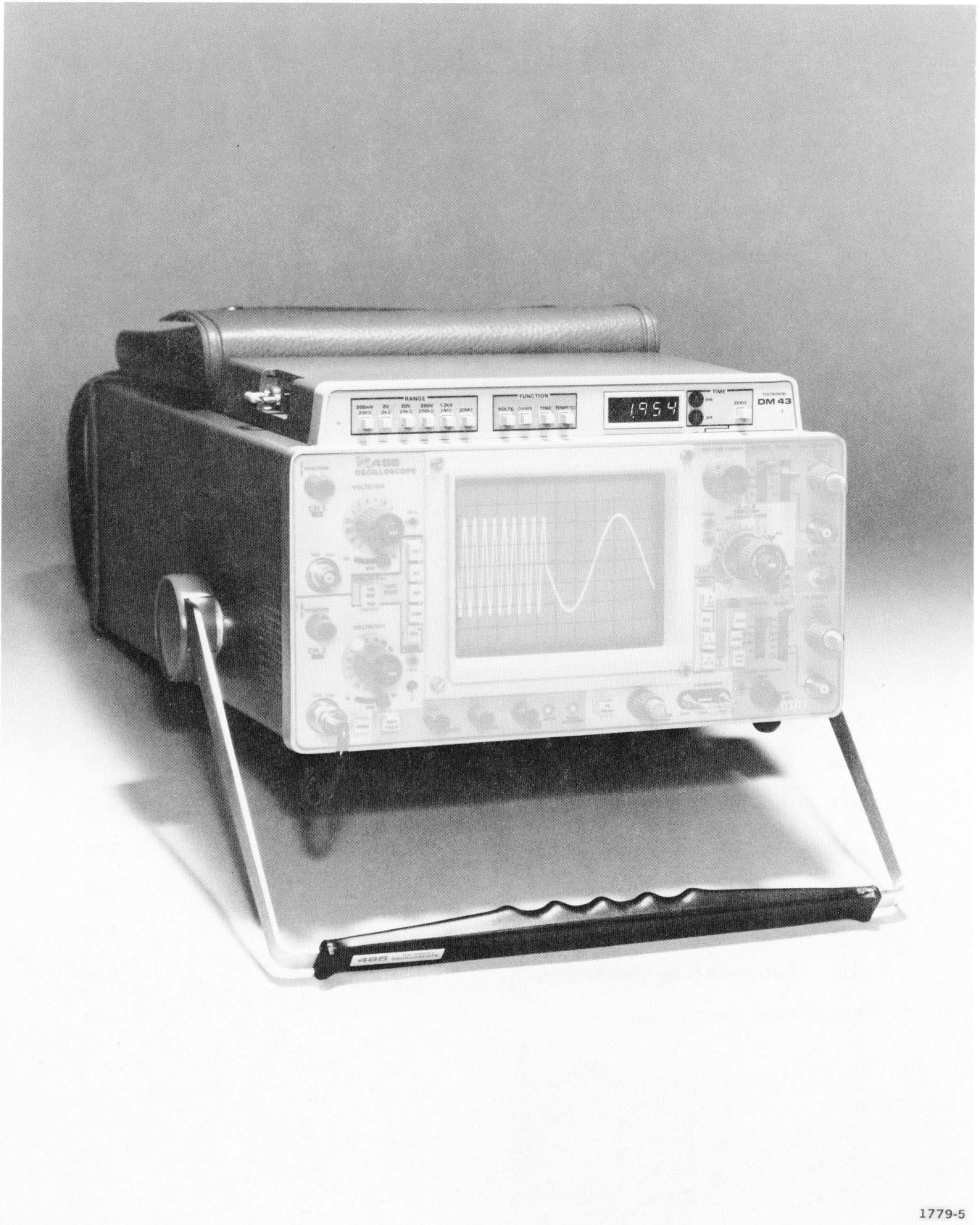
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Fig. 1-1. DM43-DM40 Digital Multimeter.

SPECIFICATION

Introduction

The Tektronix DM43 is a digital multimeter added to the top of the 464, 465, 466, or 475 oscilloscope that measures dc voltage, resistance, temperature, and differential delay time (time between two points on oscilloscope trace).

The digital multimeter front panel contains the readout display, function, and range controls. Input terminals are located on the left side of the multimeter.

The readout is a 3½ digit display using five 7-segment light emitting diodes. The decimal point is positioned by the Range setting in Volts and the Ohms function, the oscilloscope Time/Div setting and high-low range circuit of the multimeter in Time function, and by the function switch in Temperature function.

A negative polarity indication is automatic for negative dc voltages and temperatures with no polarity indication for positive measurements. A blinking display indicates over-range.

The DM40 is identical to the DM43, except that the temperature function, temperature probe, and temperature probe connector as well as the temperature converter circuitry is deleted.

The following specification applies over an ambient temperature range of +15°C to +35°C, except where otherwise indicated.

ELECTRICAL

Dc Voltage

Ranges: 0 to 1.2 kV in .2 V, 2 V, 20 V, 200 V and 1.2 kV steps.

Resolution: 100 μ V.

Accuracy: Within 0.1% of reading, ± 1 count.

Input Impedance: 10 M Ω on all ranges. User has option to remove a wire strap to increase input impedance to approximately 1000 M Ω on .2 V and 2 V ranges.

Rejection Ratio

Normal Mode: At least 60 dB at 50 Hz and 60 Hz power-line frequencies.

Common Mode: At least 100 dB at dc, and 80 dB at 50 Hz and 60 Hz power-line frequencies.

Recycle Time

Approximately 3.3 measurements per second.

Response Time

Within 0.5 second.

Maximum Safe Input Voltage

200 mV and 2 V Ranges: ± 500 V (dc + peak ac) between + and COMMON inputs.

20 V, 200 V, and 1.2 kV Ranges: ± 1200 V (dc + peak ac) between + and COMMON inputs or between + and chassis.

Common Floating Voltage

± 500 V (dc + peak ac) to chassis.

Resistance

Ranges: 0 to 20 M Ω in 200 Ω , 2 k Ω , 20 k Ω , 200 k Ω , 2 M Ω , and 20 M Ω steps.

Resolution: 0.1 Ω .

Accuracy: 200 Ω , 2 k Ω , and 20 M Ω ranges, within 0.75%, ± 1 count. 20 k Ω , 200 k Ω , and 2 M Ω ranges, within 0.3%, ± 1 count.

Recycle Time: Approximately 3.3 measurements per second.

Response Time: 200 Ω through 200 k Ω , within 1 second. 2 M Ω and 20 M Ω , 5 seconds.

Maximum Safe Input Voltage: 120 V rms between + and COMMON inputs for an indefinite time.

Temperature (With P6430 Probe) DM43 Only

Range: -55° C to $+150^{\circ}$ C in one range.

Accuracy (with constant temperature and infinite heat source). Probe calibrated to DM 43.

TABLE 1-1

DM43 Temp	$+15^{\circ}$ C to $+35^{\circ}$ C	
P6430 Tip Temp	-55° C to $+125^{\circ}$ C	$+125^{\circ}$ C to $+150^{\circ}$ C
Accuracy	Within 2° C	Within 3° C
DM43 Temp	-15° C to $+15^{\circ}$ C and $+35^{\circ}$ C to $+55^{\circ}$ C	
P6430 Tip Temp	-55° C to $+125^{\circ}$ C	$+125^{\circ}$ C to $+150^{\circ}$ C
Accuracy	Within 3° C	Within 4° C

Specifications—DM43-DM40 Service

Time (Differential) Delay

Accuracy: +15°C to +35°C: within 1% of reading, ±1 count.
 -15°C to +15°C and +35°C to +55°C within 1.5% of reading, ± 1 count for 475 and within 2.5% of reading, ± 1 count for 464-465-466.

Zero Reference: Initial Reset, 0000, ± 1 count.

ENVIRONMENTAL

Temperature

Storage: -55°C to +75°C

Operating: -15°C to +55°C

Calibration: +15°C to +35°C

Altitude

Storage: to 50,000 feet.

Operating: to 15,000 feet, maximum operating temperature decreased 1°C/1,000 feet above 5,000 feet.

Humidity

Operating and Storage: 5 cycles (120 hours) referred to MIL-E-16400F. Instrument must be in operation at least two hours.

Vibration

Operating: 15 minutes, along each of three major axes at a total displacement of 0.025 inches, p-p (4 gs at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in one-minute sweeps. Hold for 3 minutes at 55 Hz. All major resonances must be above 55 Hz.

Shock

Operating and Non-Operating: 30 gs, ½ sine, 11 ms duration, 2 shocks per axis, each direction, for a total of 12 shocks.

PHYSICAL

Finish

Anodized front panel with blue-plastic cover.

**TABLE 1-2
WEIGHTS AND DIMENSIONS**

Option and Mainframe	465-475 with DM43-DM40	464-466 with DM43-DM40
Weight With Panel Cover, Accessories, and Accessory Pouch.	29.5 lb(13.4 kg)	31.0 lb(14.0 kg)
Without Panel Cover, Accessory Pouch and Accessories.	26.5 lb(12.0 kg)	28.0 lb(12.7 kg)
Domestic Shipping Weight	36.9 lb(16.7 kg)	38.9 lb(17.6 kg)
Export Shipping Weight	Approx 52.2 lb (23.6 kg)	Approx 56.9 lb 25.8 kg)
Height With Feet and Pouch.	7.2 in(18.3 cm)	7.2 in(18.3 cm)
Without Pouch.	7.2 in(18.3 cm)	7.2 in(18.3 cm)
Width With Handle.	12.9 in(32.8 cm)	12.9 in(32.8 cm)
Without Handle.	11.5 in(29.2 cm)	11.5 in (29.2 cm)
Depth Including Panel Cover.	18.1 in(46.0 cm)	21.7 in(55 cm)
Handle Extended.	20.3 in(51.5 cm)	23.7 in(60.0 cm)

ACCESSORIES

Standard

1—Probe Package (DM43 only)	010-6430-00
1 Pair—Test Leads	003-0120-00
1—DM43-DM40 Service Manual	070-1729-00
1—Accessory Pouch	016-0594-00
1—Operators Manual (dependent on type of oscilloscope)	
for: 464-466 and DM43-DM40	070-1737-00
465 and DM43-DM40	070-1738-00
475 and DM43-DM40	070-1739-00

Optional

1 Pair—Test leads	012-0427-00
One test lead with probe on one end and banana plug on the other. One test lead with grounding clip on one end, banana plug on the other.	

OPERATING INFORMATION

Introduction

This section of the manual permits the operator to become familiar with the functions of controls and connectors. The controls and readout are located on the DM front panel. The connectors are on the left side of the DM. The instrument serial number is on the bracket under the rear of the top cover.

CONTROLS AND CONNECTORS

A brief description of the function of each control and connector is given here. More detailed operating information is given in the DM43-DM40 Operators Manual.

RANGE Switch

Selects from 200 mV to 1.2 kV dc in five ranges.

Selects from 200 Ω to 20 M Ω in six ranges.

FUNCTION Switch

VOLTS—Selects dc voltage mode.

OHMS—Selects resistance mode.

TEMP (DM43 Only)—Selects temperature mode, -55°C to $+150^{\circ}\text{C}$, in one range. Range switch is not functional in Temperature.

TIME—Provides a time readout between any selected reference point on the oscilloscope sweep and any other point on the sweep, controlled by the DELAY TIME POSITION control. The oscilloscope Time/Div setting selects three lamp conditions to indicate units of time: microsecond (μs) lamp, millisecond (ms) lamp, or no lamp (to indicate seconds). The RANGE switch is not functional in Time.

ZERO Pushbutton

Resets time readout to 0000 and provides a reference point on the delaying sweep horizontally positioned by the DELAY TIME POSITION control.

Input Connectors

Two banana jacks that provide positive (red) and common (black) input for voltage and resistance measurements.

Probe Connector (DM43 Only)

Two-pin, locking receptacle for attaching a Tektronix P6403 Temperature Probe.

CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the DM43-DM40 Digital Multimeter. Each circuit is described in detail.

The block diagram, located in the Diagrams section at the back of the manual, shows the relationship of each circuit to other circuits in the instrument.

Complete schematic drawings of the circuits are shown in the Diagrams section. Refer to these diagrams throughout the following circuit description for electrical values and relationships.

Digital Logic

Digital logic techniques are used to perform many functions within the instrument. The functions and operation of the logic circuits are described using logic symbology and terminology. All logic functions are described using positive logic convention. Positive logic is a system of notation in which the more positive of two levels (HI) is called the true, or 1, state. The more negative level (LO) is called the false, or 0, state. The HI-LO method of notation is used in this description. The specific voltages that constitute a HI or LO state vary from one device to another.

It should be noted that not all of the integrated circuit devices in this instrument are digital logic devices. The functions of non-digital devices are described individually using operating waveforms to illustrate their functions.

See Table 3-1 for logic symbols and truth tables for the digital-logic devices in this instrument.

DETAILED DESCRIPTION

See Block Diagram—Schematic Diagrams Section

Volts Range Switching

Resistors R2305A, B, C, and D and switch S2310 provide the input range switching for the volts input. R2305A, B and C provide attenuation for the ranges above 2 V, while maintaining 10 M Ω input resistance.

A wire jumper (user option) may be disconnected to change the input resistance, from 10 M Ω to 1000 M Ω , on the 200 mV and 2 V positions of the RANGE switch.

In the 200 mV and 2 V ranges, the input resistance is maintained at 10 M Ω , but the input signal is not attenuated.

The signal from the attenuators is fed to U2406, the analog integrated circuit, pin 15.

R2301, R2302, and R2303 (either R2301 alone in the 200 mV and 2 V positions or R2302 or R2303 in series with the parallel combination of the input dividers) provides the input resistance to the 2-pole active filter, U2402. This active filter has a -3 dB point of 4.3 Hz and has approximately 40 dB of rejection at 43 Hz, increasing at 12 dB per octave.

The input attenuator provides for a maximum of 2 volts into the analog integrated circuit, U2406. If the attenuator output exceeds 2 volts, the display blinks, indicating over range.

The networks R2334, R2335, CR2334, and R2337, R2338, CR2338, clamp the voltage to prevent the analog integrated circuit input from going more than 4 volts from ground.

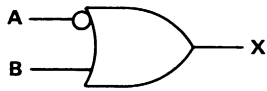
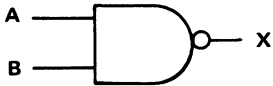
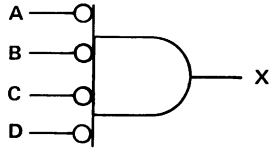
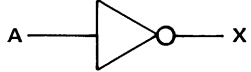
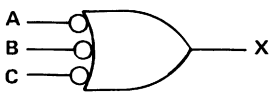
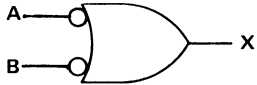
Ohms Converter

The ohms converter consists of U2312, Q2326, Q2322, and VR2326, providing a current source of about 1.2 mA, which develops 1 volt across R2324. This 1 volt across R2324 (1 volt between $-$ Input and output) also forces 1 volt between $+$ Input and output of U2312.

This floating source provides a precision current (for each range) to the resistor being measured, producing a precision voltage that is measured by the analog-digital measuring circuit.

The divider resistors (R2305A, B, C, and D), plus R2308, provide the resistance that determines the current through the resistor being measured.

TABLE 3-1
Logic Symbols and Truth Tables

Device	Symbol	Description	Input/Output Table																																																		
LO-state indicator		OR gate with LO-state indicator at the A input: The output of this gate is HI if either the A input is LO or the B input is HI.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	HI	HI	LO	LO	HI	HI	HI																																
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NAND gate		A device with two or more inputs and one output. The output of the NAND gate is LO if and only if all of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	HI	HI	LO	HI	HI	HI	LO																																
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NAND gate		A device having four or more inputs may have the input edge lengthened.	<table border="1"> <thead> <tr> <th colspan="4">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>HI</td> <td>HI</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>LO</td> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>LO</td> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>LO</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input				Output	A	B	C	D	X	HI	HI	HI	HI	LO	HI	HI	HI	LO	LO	HI	HI	LO	LO	LO	HI	LO	LO	LO	LO	LO	LO	LO	LO	HI	LO	LO	LO	HI	LO	LO	LO	HI	HI	LO	LO	HI	HI	HI	LO
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Inverter		A device having one input and one output.	<table border="1"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>HI</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> </tr> </tbody> </table>	Input	Output	A	X	HI	LO	LO	HI																																										
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R2316, R2317, and R2318 provide bias-current compensation to U2312 to reduce the error caused when bias current becomes an appreciable part of measurement current (2 M Ω and 20 M Ω ranges).

The active filter, U2402, is disconnected in the 20 M Ω range to speed the measurement process.

Over range (blinking display) occurs if the resistance being measured is too large for the range being used.

Temperature Converter

A 20.48 kHz pulse from U2342A¹ is applied to U2344, which operates as a divide-by-ten flip flop. Q2342 and Q2346 amplify the square wave from U2344.

When Q2352 is off, the current to the probe, through R2353 and R2354, is approximately one-tenth the on current. The change in base-to-emitter voltage of the temperature sensing transistor in the probe is proportional to the junction temperature when the collector current is switched between two levels. The collector-to-base voltage of the temperature sensing transistor in the probe is held constant at 0 volts.

When Q2342 is off and Q2346 is on, Q2352 is off and the voltage at pin 2 of U2352 goes negative. U2352 output goes positive, reducing the temperature variable base-emitter current of the sensing transistor until pin 2 of U2352 is at ground. The result is a positive-going square wave, at the output of U2352, having an output amplitude proportional to the probe base-emitter junction temperature.

Q2354 is on and Q2356 is off due to the action of Q2342 and Q2346. A dc voltage (amplitude proportional to temperature), appears across C2363. The opposite occurs when Q2342 and Q2346 change states, with the exception that Q2356 turns on, shorting the negative voltage to ground, and Q2354 is off, preventing the discharge of C2363.

The dc voltage across C2363 is applied to feedback amplifier U2366. R2367 adjusts the gain. R2362 compensates the offset voltage in U2366.

U2366 output, 10 mV/ $^{\circ}$ C, is applied through S2300D and R2336 to U2406 input.

¹ For instruments having serial numbers, B010920 and up (DM43) and B010500 and up (DM40), the clock is an emitter-coupled multi (Q2392-Q2394-Q2396) with the repetition rate (20.48 kHz) determined by R2394-R2395-C2391.

Time Converter

The time converter measures the voltage at the Delay Time Position control and converts that voltage to a voltage proportional to time.

The converter codes the delay-time voltage in 1-2-5 (related to Time/Div setting on the oscilloscope), places the decimal point, and indicates seconds (no light), milliseconds, or microseconds.

The converter includes a memory circuit, U2372, Q2372, Q2374, Q2376, and memory capacitor C2374. When the zero button is pushed, a charge is stored on C2374. This charge is fed to two buffers, Q2374 and U2378, and fed back to U2372 input, providing a reference voltage.

R2372, Time Zero, nulls input offset voltage. When the ZERO button is pressed and released, the circuit remembers the voltage from the Delay Time Position control.

The output voltage of buffer amplifier U2384 always follows the Delay Time Position control voltage. A voltage divider between U2378 and U2384 outputs permits range switching with the Time/Div cam switches in the oscilloscope. The divider gives 2.0 volts output for the twos, 1.0 volt for the ones, and 0.5 volt for the fives positions of the Time/Div switch. The cam switch also provides the decimal point, and ms- μ s switching logic.

R2384, Time Adj, calibrates the voltage applied to the output divider.

The divider output is fed through S2300C and R2336 to U2406 input.

Analog-Digital Voltmeter

The voltmeter circuit takes the analog signal from one of the input converters and converts this analog signal to multiplexed Binary Coded Decimal (BCD) information.

The analog integrated circuit, U2406, is an integrator with R2412-R2413 the integrator input, and C2412 the integrating capacitor.

VR2406, R2406, and R2407 provide the reference voltage to U2406, with R2406 the reference current setting control.

Circuit Description—DM43-DM40 Service

U2342B¹ supplies the clock pulses to the digital integrated circuit, U2442. U2342B is a retriggerable, one-shot multi having an output repetition rate of 20.48 kHz. 20.48 kHz provides 50 Hz and 60 Hz power-line frequency rejection.

The analog integrated circuit gets its control from the digital integrated circuit, U2442. The signal tells the analog integrated circuit whether to measure or zero, and provides an Up-Down logic signal. The Up-Down logic, in conjunction with the comparison signal from the analog integrated circuit, functions to maintain equilibrium in the analog integrated circuit as described in the Auto-Zero description.

The integrator gain is switchable (X1 or X10) and is controlled by Q2422. When Q2422 is off, the value of resistance between input buffer output and integrator input is 100 k Ω (R2412). When Q2422 is on, R2412 is paralleled by R2413, R2414, and Q2422 in series, reducing the resistance between buffer out and integrator in by a factor of 10. Thus, X10 gain switching is accomplished by Q2422, which is turned on and off by Q2426.

When the 200 Ω -200 mV button is pushed in (in either OHMS or VOLTS function) Q2426 is turned on, Q2422 is turned on and the integrator gain is increased by a factor of 10.

Auto-Zero Interval

During the Zero interval, the input buffer in U2406 (see Fig. 3-1) is switched to ground. This buffer supplies the relatively minor current, through R2412, to the integrator input summing junction. The Auto-Zero amplifier output, A/Z Filter, and the pulsed reference current of Ref Out constitute the major currents into the integrator input summing node, Int In.

The reference current is pulsed at a 50% duty cycle by the control logic. The on state of the reference current corresponds to the down state of the Up-Down logic. Equilibrium is attained by the closed-loop system of integrator and Auto-Zero amplifiers when the sum of the average currents at the integrator summing junction equals zero.

The current in R2405 is constant and the storage capacitor C2405, maintains the Auto-Zero amplifier at the equilibrium voltage when the switch occurs at the end of the zero interval. The output of the integrator during the Auto-Zero interval is shown in the timing diagram, Fig. 3-2.

¹ Ibid.

Measure Interval (see Fig. 3-3)

At the start of the measure interval the Measure-Zero logic switches the analog input, at terminal 15, into the input buffer amplifier. The additional current at the integrator summing junction disrupts the balance achieved during the Auto-Zero interval, driving the integrator output away from the Auto-Zero equilibrium maintained by C_{storage}, C2405.

A comparator, sensing the deviation from equilibrium, transmits this change to the control logic, which attempts to restore equilibrium by using one of the two available duty cycles of the Up-Down logic from U2442.

The Up-Down logic is "up" (HI) 1 clock cycle and "down" (LO) 7 cycles for a high comparator output, and "down" (LO) 1 clock cycle and "up" (HI) 7 cycles for a low comparator output. See Fig. 3-3 for Measure Interval Timing diagram.

The synchronous Up-Down Binary Coded Decimal (BCD) counter increments by each clock pulse when the Up-Down logic is "up" (HI) and decrements by each clock pulse when the Up-Down logic is "down" (LO). Consequently, the total count, for the complete Auto Zero-Measure cycle, is the algebraic sum of the counts.

The polarity of V_{in} is sensed by the state of the Up-Down logic when the BCD counter state is zero. This information stored in the "sign" flip-flop in U2442, is fed to the Static Latch (in U2442) once each Measure-Zero cycle.

The BCD counter accumulates a number of counts proportional to the analog voltage input, at terminal 15, U2406, during the measure interval, as the control logic attempts to maintain equilibrium. The counter continues to count until the integrator output equals the Auto-Zero equilibrium voltage and the Up-Down logic is "down". At this time, the BCD count is put on "hold" and its contents transferred to the static latches (with underrange information from the counter contents, 5% of full scale). The counter is then cleared.

The contents of the static latches are multiplexed to the data output buffer in BCD format. The data output format is an interlaced scan, in a 1-3-2-4 sequence, where digit 4 is the most significant figure. The presence of a count of 2000 (100% of full scale) or greater, in the BCD counter causes the 3 1/2 digit display to blink off during Auto-Zero time interval.

The BCD information from pins 13, 14, 15, and 16, U2442, is fed into the decoder driver, U2484. The BCD information is converted to 7-segment information to drive the light-emitting diodes in the display.

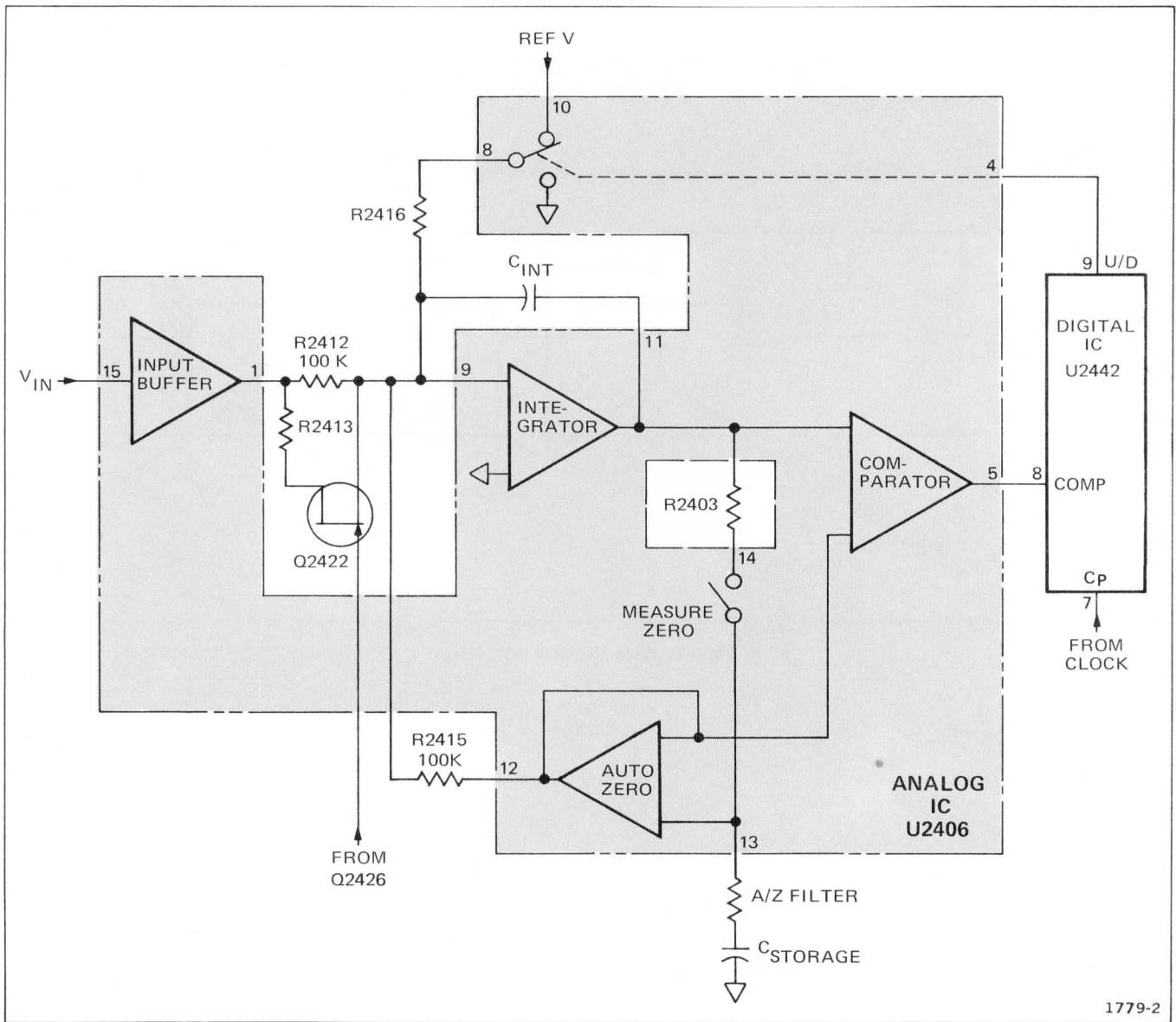


Fig. 3-1. Diagram of analog integrated circuit basic circuitry.

The digits, from the digital integrated circuit, U2442, pins 1, 2, 3, and 4 go to 4 inputs of a buffer, U2446C, B, F, and E. The buffer outputs drive Q2450, Q2452, Q2454, and Q2458, the digit drivers.

The overrange signal for U2430, comes from U2436B, which detects a low state, during Auto-Zero time, on all of the digit drivers. U2430 is the memory that detects whether the voltmeter is in its low or high range and is used in time function only.

If U2436B detects a low (LO) state on all four inputs, its output goes high (HI), is inverted by Q2434, and switches U2430 to the opposite state. U2430 maintains this state until reset.

The switching action of U2430 causes the count to uprange at a count of 2000 and downrange at a count of 99 (on time function only). U2430 decodes the underrange signal from U2432A. If digit 4, from D4, U2464E output, and bit 4, from B4, U2482A output are both high, during digit 4 time, U2432A has an AND condition, producing a pulse that sets U2430, Pin 8, to its low (LO) state, pin 6 high (HI), U2430 signal, at pin 8, drives Q2426, which turns Q2422 on in low time ranges and off in high time ranges.

U2430 output at pin 6 drives the decimal point switching, U2464, U2432, U2474, and U2482. These integrated circuits decode the decimal point input from the cam switch in time, the range switch in volts and ohms, and the function switch in temperature.

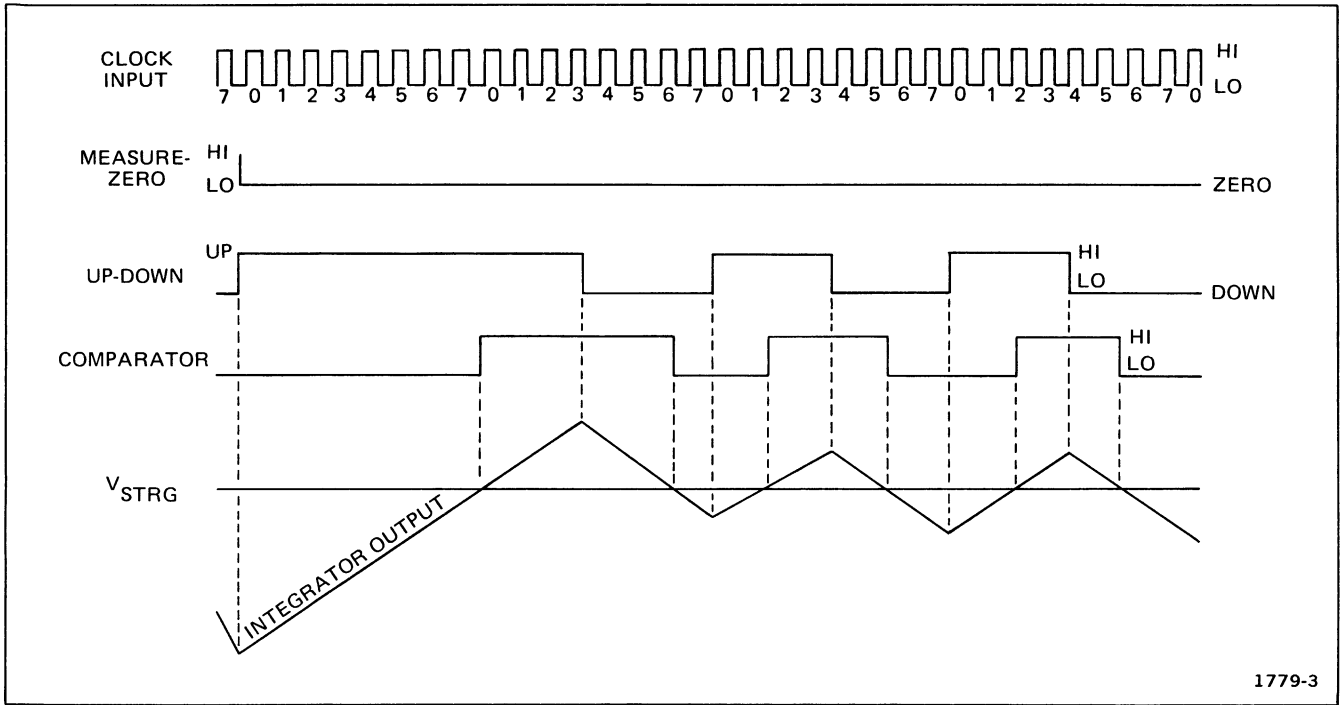


Fig. 3-2. Auto-Zero Interval timing.

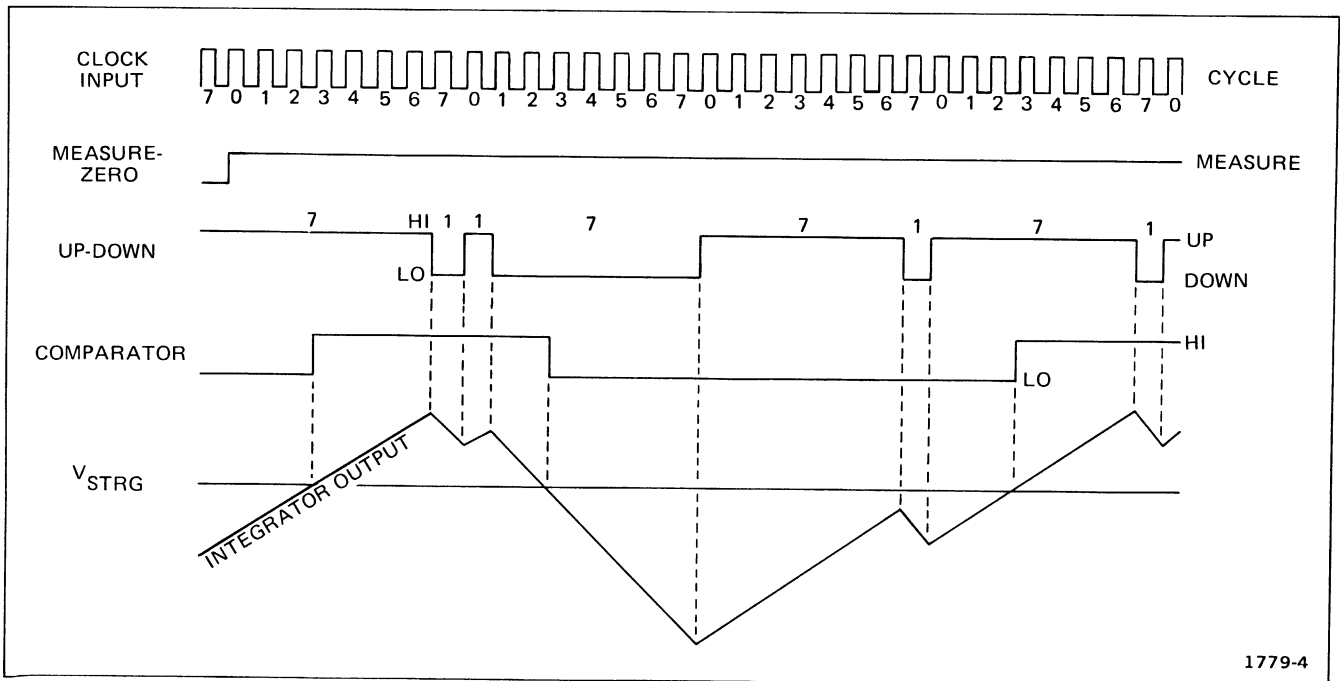


Fig. 3-3. Measure Interval timing.

Power Supply

The power supply is a floating supply that uses the Option 7 windings on the oscilloscope power transformer to provide three regulated voltages, +12 V, +5 V, and -12 V.

The +12 volts is regulated by integrator circuit regulator, U2614, which contains a reference voltage, output driver, buffers, etc.

The +5 volts is regulated by integrated circuit regulator U2624, which also contains a reference voltage, drivers,

buffers, etc.

The -12 volt supply reference voltage is the +12 volt supply across R2635. R2634 is the feedback resistor. Q2638 and Q2634 are the comparator, Q2636 is the output regulator, and Q2632 is a current limit.

Ground 2 is the ground for the analog circuits and ground 1 is the digital ground return.

MAINTENANCE

CIRCUIT BOARD REMOVAL

Main Board

- a. Remove 2 multi-pin connectors at right edge of board and 1 multi-pin connector at rear of board.
- b. Remove 2 screws that fasten bracket (at rear of Main board) to channels (main chassis) in oscilloscope.
- c. Move circuit board far enough toward rear of oscilloscope to release front edge of DM front panel from oscilloscope front panel.
- d. Lift DM assembly away from oscilloscope.

Readout Board

- a. Remove Main circuit board from oscilloscope as described previously.
- b. Remove 3 screws (back side of Main board) that fasten Main board to plastic front panel.
- c. Unplug front-panel and Readout board assembly from Main circuit board.

- d. Remove two screws that fasten Readout board to front panel.

- e. Lift Readout board away from front panel. The ms and μ s lamps pull out of front panel with Readout board.

Power-Supply Board

- a. Unsolder 5 leads (white-brown, white-red, white-orange, white-yellow, and white-green) from power-transformer terminals.

- b. Remove 2 screws from ends of power-supply chassis (toward rear of oscilloscope and to right of the shield).

- c. Remove remaining screw that fastens power-supply chassis to main chassis (accessible from opposite side of main chassis below power transformer. A screwdriver, having at least a 4-inch shaft, is needed to reach screw. A magnetic screwdriver is recommended to replace screw.

PERFORMANCE CHECK/CALIBRATION

Calibration Interval

To ensure instrument accuracy, check the performance or calibrate the instrument each time the oscilloscope is checked or calibrated.

Performance Check

The instrument performance can be checked without removing the top cover or making internal adjustments, by performing only the Performance Check Procedure. This procedure does not check every facet of the instrument's performance; rather, it is concerned primarily with those portions of the instrument essential to measurement accuracy and correct operation. The Performance procedure is also useful as an aid in troubleshooting and preventive maintenance. To aid in locating a step in the Performance Check procedure, an index is provided preceding the procedure.

Calibration Procedure

Completion of each step in the Calibration Procedure ensures that the instrument meets the electrical specifications given in this manual and the Horizontal System section of the oscilloscope manuals.

Where possible, instrument performance is checked before an adjustment is made. For best overall instrument performance, make each adjustment to the exact setting, even if the CHECK is within allowable tolerance. It is necessary to remove the DM top cover and oscilloscope covers to have full access to the internal adjustments and test points. To aid in locating a step in the Calibration procedure, an index is provided preceding the procedure.

Procedure Arrangement

This Performance Check—Calibration Procedure consists of eight parts, as follows:

1. Test Equipment Required for DM43-DM40 and 464-465-466.
2. DM43-DM40 Performance Check.
3. DM43-DM40, with 464-465-466 Horizontal System Performance Check.
4. DM43-DM40 Calibration Procedure.
5. DM43-DM40, with 464-465-466 Horizontal System Calibration Procedure.
6. DM43-DM40, with 475, Additional Test Equipment Required.
7. DM43-DM40, with 475, Horizontal System Performance Check.
8. DM43-DM40, with 475, Horizontal System Calibration Procedure.

After completing either the Performance Check or Calibration Procedure, for either oscilloscope group, return to the oscilloscope procedure at the section following the Horizontal System.

TEST EQUIPMENT REQUIRED (FOR DM43-DM40 AND 464-465-466)

The test equipment, listed in Table 5-1, or equivalent, is required for complete calibration of the DM43-DM40 with the 464, 465, or 466 oscilloscope. The additional test equipment listed in Table 5-12 is required to calibrate the 475 Horizontal system.

Specifications given for the equipment are the minimum necessary for accurate calibration. Therefore, the equipment used must meet or exceed the listed specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the appropriate instruction manual if more information is needed.

If only a Performance Check is to be performed, not all of the listed equipment is required. Items used for only the Calibration Procedure are indicated by a footnote (¹). The remaining pieces of equipment are common to both procedures.

Calibration Equipment Alternatives

All of the listed test equipment is required to completely check and calibrate the DM43-DM40. However, complete checking or calibration may not always be necessary or desirable. The user may be satisfied with checking only selected characteristics, thereby reducing the amount of test equipment actually required.

Performance Check-Calibration—DM43-DM40 Service

The Performance Check and Calibration Procedure are based on the items of equipment given as examples in the tables. When other equipment is substituted, control settings or calibration setups might need to be altered. If the exact item of equipment given as an example in the test equipment is not available, first check the specification column carefully to see if any other equipment might suffice. Then check the usage column to see what this item is used for. If used for a check or adjustment that is of little or no importance

to your measurement requirements, the item and corresponding step(s) can be deleted.

The following procedure is written to completely check and adjust the DM43-DM40 to the Performance Requirements listed in the Specification section. If the applications for which you will use the DM43-DM40 do not require the available performance from the instrument, the procedures and required equipment list can be shortened accordingly.

**TABLE 5-1
Test Equipment Required (464-465-466 Only)**

Description	Minimum Specification	Use	Example
Digital Voltmeter ¹	Range, 0 to 5 V; voltage accuracy, within 0.1%; display, 4½ digits.	DM reference voltage	Tektronix DM 501, Digital Multimeter
Test Oscilloscope	Bandwidth, 1 MHz; deflection factor, 1 volt/div; accuracy, within 3%.	Check A Trigger Holdoff	Test oscilloscope used for other steps in Calibration Procedure
Time-Mark Generator	Marker outputs, 2 ns to 0.5 s; marker accuracy, within 0.1%; trigger output, 1 ms to 0.1 µs, coincident with time markers.	Horizontal timing checks and adjustments	Tektronix 2901 Time-Mark Generator
Voltage Standard	Voltage range, 10 mV to 1.2 kV; accuracy, within 0.01%.	DM voltage ranges	Fluke, Model 341A DC Voltage Calibrator
Resistance Standard	Ohms range, 10 Ω to 18 MΩ; accuracy, within 0.03%.	Ohms ranges	ESI Dekabox, Model DB62
Termination (1 required)	Impedance, 50 Ω; connectors, BNC.	Signal termination	Tektronix Part Number 011-0049-01
Cable (1 required)	Impedance, 50 Ω; connectors, BNC; length, any convenient.	Signal interconnection	Tektronix Part Number 012-0057-01
Screwdriver ¹	Length, three-inch; bit size, 3/32 inch.	Adjust variable resistors	Xcelite R-3323
Screwdriver, low-capacitance ¹	Bit size, 3/32 inch.	Adjust variable capacitors	J.F.D. Electronics Corp., adjustment tool, Number 5284
Light Shield	Folding viewing hood for oscilloscope.	Measuring delay time jitter	Tektronix Part Number for: 464-466, 016-0592-00; 465-475, 016-0180-00
Shorting Strap	Banana to banana patch cord.	Calibration adjustment	
Temperature Equalizing Block		Temperature check and calibration	See Fig. 5-1 A and B

¹ Used for calibration procedure only.

TABLE 5-1 (continued)
Test Equipment Required (464-465-466 Only)

Description	Minimum Specification	Use	Example
Oil Testing Thermometer	Range, 0°C to +125°C; accuracy, within 1/5°C.	Temperature check and calibration	ASTM 67C, Nurnberg Catalog Number 5790
Temperature Bath and Bath Cooler	Range, 0°C to +125°C.	Temperature check and calibration	Neslab Instruments Model TE 9/100 Stirred Bath and Model PBC-4 Bath Cooler

DM43—DM40 PERFORMANCE CHECK

INDEX TO PERFORMANCE CHECK

PROCEDURE

DM Only

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DM and 464-465-466 Horizontal System

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1. CHECK 2-VOLT RANGE, ZERO, AND POLARITY

- a. Connect a voltage standard to DM input (red and black connectors on DM side panel).
- b. Set DM FUNCTION to VOLTS, RANGE to 2.
- c. Set voltage standard to +1.8000 V.

d. CHECK—DM reading for 1.800, ± 3 counts (1.797 to 1.803) and note that no polarity sign is displayed for + readings.

e. Switch voltage standard polarity to —.

f. CHECK—DM reading for 1.800, ± 3 counts (1.979 to 1.803) and that the minus sign is displayed.

g. Connect shorting strap between DM input connectors.

h. CHECK—DM reading for .0000, ± 1 count.

i. Remove shorting strap.

2. CHECK 200 mV RANGE

a. Set DM RANGE to 200 mV. Connect voltage standard to DM input.

b. Set voltage standard to -0.1800 V.

c. CHECK—DM reading for -180.0 , ± 3 counts (-179.7 to -180.3).

d. Set voltage standard to $+0.1800$ V.

e. CHECK—DM reading for 180.0, ± 3 counts.

3. CHECK VOLTAGE RANGES



Dangerous voltages are present from the voltage standard and the DM input connectors. When checking the high-voltage ranges (200 V and 1.2 kV), reduce the voltage standard output or place on standby when not actually measuring.

- a. Set DM RANGE switch and voltage standard output to each position shown in Table 5-2.
- b. CHECK—That readout is within limits shown. Voltage accuracy in Table 5-2 is 0.1%, ± 1 count.

TABLE 5-2
Voltage Accuracy

DM RANGE	Voltage Standard Output	Readout	Limits
1.2 kV	1.2 kV	1.200	1.197 to 1.203
1.2 kV	180.0 V	0.180	0.178 to 0.182
200 V	180.0 V	180.0	179.7 to 1.803
200 V	18.00 V	018.0	017.8 to 018.2
20 V	18.00 V	18.00	17.79 to 18.03
20 V	1.800 V	01.80	01.87 to 01.82
2 V	1.800 V	1.800	1.797 to 1.803
2 V	0.1800 V	0.180	0.178 to 0.182
200 mV	0.1800 V	180.0	179.7 to 180.3
200 mV	0.0100 V	010.0	009.8 to 010.2

4. CHECK OHMS LIMITING

- a. Connect voltage standard to DM input.
- b. Set DM FUNCTION to OHMS and RANGE to 2 kΩ.
- c. Set voltage standard output to -200 volts.
- d. CHECK—That DM readout blinks.
- e. Set voltage standard output to +200 volts.

- f. CHECK—That DM readout blinks.
- g. Turn voltage standard off and disconnect voltage standard from DM.

5. CHECK OHMS FUNCTION

- a. Set DM FUNCTION to OHMS.
- b. Set DM RANGE to 20 kΩ.
- c. Connect a resistance standard to DM input.
- d. Set resistance standard to 18,000 Ω.

TABLE 5-3
Ohms Ranges

DM Range	Resistance Standard	DM Reading	Limits ²
200 Ω	10 Ω	010.0 ¹	009.8 to 010.2
200 Ω	180 Ω	180.0	178.5 to 181.5
2 kΩ	180 Ω	0.180	0.177 to 0.183
2 kΩ	1.8 kΩ	1.800	1.785 to 1.815
20 kΩ	1.8 kΩ	01.80	0.178 to 01.82
20 kΩ	18 kΩ	18.00	17.93 to 18.07
200 kΩ	18 kΩ	018.0	017.8 to 018.2
200 kΩ	180 kΩ	180.0	179.3 to 180.7
2 MΩ	180 kΩ	0.180	0.178 to 0.182
2 MΩ	1.8 MΩ	1.800	1.793 to 1.807
20 MΩ	1.8 MΩ	01.80	01.77 to 01.83
20 MΩ	18 MΩ	18.00	17.85 to 18.15

- e. CHECK—DM reading for 18.00, ±7 counts.
- f. CHECK—OHMS ranges as shown in Table 5-3.

¹ Lead resistance may cause error when measuring the 10 Ω range. Lead resistance typically adds 0.1 Ω to DM reading. If in doubt, measure lead resistance and add to DM reading in the table.

² Accuracy:
For 20 kΩ, 200 kΩ, and 2 MΩ ranges, within 0.3%, ±1 count.
For 200 Ω, 2 kΩ, and 20 MΩ ranges, within 0.75%, ±1 count.

6. CHECK TEMPERATURE (°C) FUNCTION

NOTE

The probe furnished with the DM43 is calibrated to the instrument. If another probe is used with the instrument, the temperature section of the DM43 should be recalibrated.

a. Connect temperature probe to DM temperature input connector.

b. Suspend temperature probe¹ and reference thermometer into a container (preferably insulated) of water and crushed or shaved ice. Let enough ice melt to stabilize water temperature.

-or-

Suspend temperature probe¹ and reference thermometer in water and antifreeze solution in a circulating bath. See Table 5-1, Test Equipment Required.

c. CHECK—That DM reading is within 2°C of thermometer reading.

d. Remove temperature probe and thermometer from the water and place in temperature probe equalizing block (see Fig. 5-1) at room temperature. Use dielectric fluid shown in Fig. 5-1.

e. Let temperature probe and thermometer temperature stabilize.

f. CHECK—That DM reading is within 2°C of thermometer reading.

¹ Submerge temperature probe so that liquid level is not above bottom of bulge in probe body.

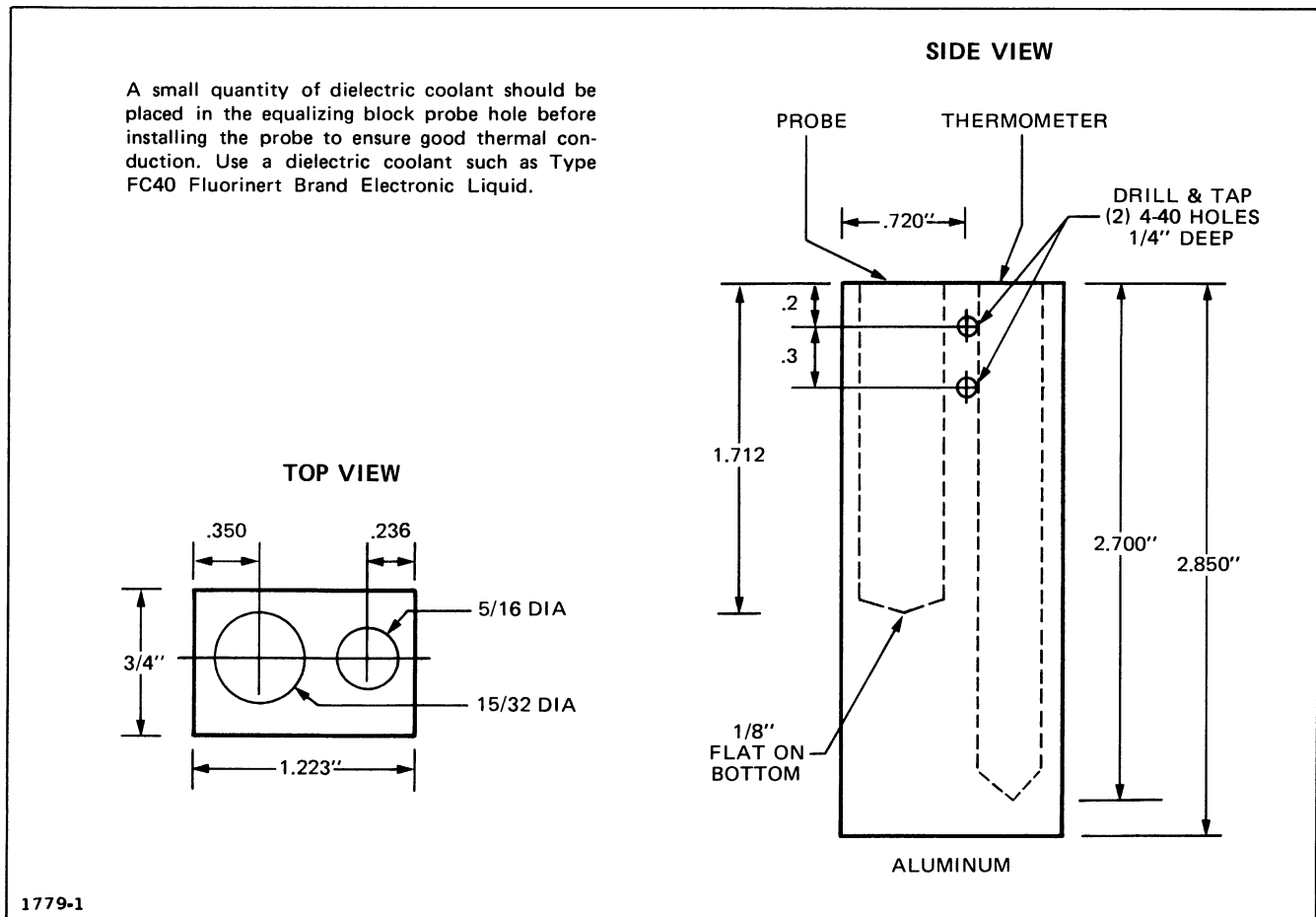


Fig. 5-1. Temperature Probe equalizing block.

HORIZONTAL SYSTEM PERFORMANCE CHECK

7. CHECK SWEEP START AND STOP (A SWEEP CAL)

- a. Connect time-mark generator to CH 1 input through 50-ohm BNC cable and 50-ohm termination.
- b. Set time-mark generator for 1 ms and 0.1 ms time markers.
- c. Set HORIZ DISPLAY to A INTEN.
- d. Set A TIME/DIV to 1 ms and B TIME/DIV to 1 μ s. Adjust TRIGGER LEVEL controls for stable display.
- e. Set DELAY TIME POSITION fully counterclockwise (ccw).
- f. CHECK—That intensified portion of sweep is on 2nd small time marker.
- g. Horizontally position 2nd small time marker (intensified) to left (zero) graticule line.
- h. Set DELAY TIME POSITION control fully clockwise.
- i. CHECK—That intensified portion of sweep is at right graticule line (10.2 divisions).

8. CHECK HORIZONTAL GAIN

- a. Set A and B TIME/DIV to 1 ms.
- b. Apply 1 ms time markers to oscilloscope input.
- c. Set HORIZ DISPLAY to A and horizontally position display to set 1st time marker at left graticule line.
- d. CHECK—For 1 time marker/division, within 2% (9.8 to 10.2 for 11th time marker).
- e. Set time-mark generator for 0.1 ms time markers.
- f. Press X10 MAG (IN) button in.
- g. CHECK—That X10 MAG lamp is on when X10 MAG button is pushed in.
- h. CHECK—For 1 time marker/division, within 3% (9.7 to 10.3 for 11th time marker).
- i. CHECK—Sweep accuracy over any 2 division portion

of sweep is within 1% (0.1 major division).

- j. Release X10 MAG button to out position.

- k. Set time-mark generator for 1 ms time markers.

l. CHECK—That linearity over any 2-division portion of sweep is within 1% (0.1 major division).

9. CHECK MAGNIFIER REGISTRATION

- a. Push X10 MAG button in.
- b. Set time-mark generator for 5 ms time markers, and horizontally position middle time marker to center graticule line.
- c. Release X10 MAG button.
- d. CHECK—That middle time marker starts at graticule center line, with 0.2 major division.

10. CHECK A SWEEP LENGTH

- a. Set HORIZ DISPLAY to A.
- b. Set time-mark generator for 1 ms and .1 ms time markers.
- c. CHECK—That sweep length is between 10.5 and 11.5 divisions.

11. CHECK VAR TIME/DIV RANGE

- a. Set A TIME/DIV to 2 ms and VAR TIME/DIV fully counterclockwise.
- b. Set time-mark generator to 5 ms.
- c. CHECK—That at least 1 time marker/division can be displayed by adjusting VAR TIME/DIV.
- d. CHECK—That UNCAL lamp lights when VAR TIME/DIV is out of detent position.

Performance Check—DM43-DM40 Service

e. Return VAR control to detent position.

50 Hz power-line frequency.

12. CHECK HORIZONTAL POSITION CONTROL RANGE

- a. Set POSITION fully clockwise and FINE to midrange.
- b. CHECK—That sweep starts to right of graticule center line.
- c. Set POSITION fully counterclockwise and FINE to midrange.
- d. CHECK—That sweep starts to left of graticule center line.

13. CHECK DELAY TIME JITTER

a. Set time-mark generator for 1 ms time markers.

b. Set: A TRIG MODE AUTO
A TIME/DIV 1 ms
B TIME/DIV .2 μ s
HORIZ DISPLAY A INTEN

c. Attach a light shield to graticule housing.

CALIBRATION AID—Low repetition rate of the check makes viewing difficult. Additional intensity may be obtained by using storage. For those instruments with storage:

Push VAR PERS in and adjust INTEN, STORAGE LEVEL, and VIEW TIME for stable display.

d. Position intensified portion of display to 2nd time marker with DELAY TIME POSITION and set HORIZ DISPLAY to B DLY'D. Position marker to graticule center.

e. CHECK—That jitter is 1 major division or less for 60 Hz power-line frequency, or 2.5 major divisions or less for 50 Hz power-line frequency.

f. Set HORIZ DISPLAY to A INTEN, and position intensified portion of display to 10th time marker. Set HORIZ DISPLAY to B DLY'D and adjust marker to graticule center.

g. CHECK—That jitter is 1 major division or less for 60 Hz power-line frequency or 2.5 major divisions or less for

14. CHECK TIME ZERO

a. Set: A TIME/DIV .2 ms
B TIME/DIV .5 μ s
DELAY TIME POSITION Fully ccw
HORIZ DISPLAY A INTEN

b. Set time-mark generator for 0.1 ms markers.

c. Turn DELAY TIME POSITION to intensify the third time marker.

d. Press DM TIME ZERO button.

e. CHECK—DM reading for .0000, ± 1 count.

15. CHECK TIME FUNCTION

a. Switch HORIZ DISPLAY to B DLY'D.

b. Position displayed time marker to graticule center.

c. Press TIME ZERO.

d. Turn DELAY TIME POSITION to place 16th succeeding marker to graticule center.

e. CHECK—DM reading for 1.600, ± 3 counts.

f. CHECK—That ms light is on.

16. CHECK B SWEEP TIMING

a. Set time-mark generator for 1 ms time markers.

b. Set: DELAY TIME POSITION Fully ccw
B TRIGGER SOURCE NORM
B TRIGGER LEVEL Stable display
A and B TIME/DIV 1 ms
HORIZ DISPLAY B DLY'D

c. CHECK—For 1 time marker/division, within 2% (9.8 to 10.2 for 11th time marker).

17. CHECK HIGH SPEED MAGNIFIED TIMING

- a. Set: HORIZ DISPLAY A
 A TRIG MODE AUTO
 A TIME/DIV .05 μ s
 X10 MAG button In

b. Set time-mark generator for 10 ns time markers.

c. Adjust A TRIGGER LEVEL for stable display.

d. CHECK—For time marker/2 divisions, within 3% (9.7 to 10.3 for 6th time marker). This applies to full sweep length, excluding the 1st and last 10 divisions of magnified sweep length.

NOTE

To determine first portion to be excluded, release X10 MAG. Position sweep start to 1.5 divisions to left of graticule center line. Push X10 MAG—the first 10 divisions of sweep is magnified to the left and is off screen. To determine the last portion to be excluded on the 0.5 μ s/div range, release X10 MAG. Position sweep stop 1.5 divisions to right of graticule center line. Push X10 MAG in—the last 50 ns of sweep is magnified to the right and is off screen.

18. CHECK A AND B MAGNIFIED ACCURACY

- a. Push X10 MAG in. Set HORIZONTAL DISPLAY to A.

b. CHECK—A TIME/DIV accuracy using control settings, display, and limits shown in Table 5-4. Exclude portion of sweep indicated (see NOTE, after step 20d).

- c. Set: HORIZ DISPLAY B DLY'D
 B TIME/DIV .05 μ s

d. Set time-mark generator for 10 ns time markers.

e. CHECK—B TIME/DIV accuracy using control settings, display, and limits shown in Table 5-4. Exclude the portions of the sweep indicated (see NOTE, after step 20d).

TABLE 5-4
A and B Magnified Accuracy

A and B Time/Div Settings	Time Mark Generator	Markers Displayed Per Div	Measure To Marker	Portions of Total Length To be Excluded
.05 μ s	10 ns	1 per 2 div	6	1st and last 10 div
.1 μ s	10 ns	1	11	1st and last 5 div
.2 μ s	10 ns	2	21	1st and last 2.5 div
.5 μ s	50 ns	1	11	
1 μ s	.1 μ s	1	11	
2 μ s	.1 μ s	2	21	
5 μ s	.5 μ s	1	11	
10 μ s	1 μ s	1	11	
20 μ s	1 μ s	2	21	
50 μ s	5 μ s	1	11	
.1 ms	10 μ s	1	11	
.2 ms	10 μ s	2	21	
.5 ms	50 μ s	1	11	
1 ms	.1 ms	1	11	
2 ms	.1 ms	2	21	
5 ms	.5 ms	1	11	
10 ms	1 ms	1	11	
20 ms	1 ms	2	21	
50 ms	5 ms	1	11	
A Sweep Only				
.1 s	10 ms	1	11	
.2 s	10 ms	2	21	
.5 s	50 ms	1	11	

NOTE

Limits: 9.7 to 10.3 div for +20°C to +30°C
 or 9.6 to 10.4 div for -15°C to +20°C
 and +30°C to +55°C.

19. CHECK A AND B TIME/DIV ACCURACY

- a. Set: HORIZ DISPLAY B DLY'D
 A and B TIME/DIV .05 μ s
 X10 MAG button Out

b. Set time-mark generator for 50 ns time markers (sine wave).

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c. CHECK—B TIME/DIV accuracy, using control settings, display, and limits shown in Table 5-5.

d. Set: HORIZ DISPLAY A
 A TIME/DIV .05 μ s

e. Set time-mark generator for 50 ns time markers.

f. CHECK—A TIME/DIV accuracy, using control settings, display, and limits shown in Table 5-5.

20. CHECK DELAY-TIME ACCURACY

a. Set: X10 MAG button Out
 B TRIGGER SOURCE STARTS AFTER
 DELAY
 A TIME/DIV .2 μ s
 B TIME/DIV .05 μ s
 DELAY TIME POSITION Ccw
 HORIZ DISPLAY B DLY'D

b. Set time-mark generator for 0.1 μ s time markers.

c. Turn DELAY TIME POSITION clockwise (and Horizontal POSITION if necessary) to position 3rd time marker to graticule center.

d. Press TIME ZERO.

e. Turn DELAY TIME POSITION to position the 17th time marker to graticule center.

f. CHECK—That DM reading is within limits shown in Table 5-6. The accuracies for the checks are: within 1%, ± 1 count for +15°C to +35°C and within 1.5% for -15°C to +15°C and +35°C to +55°C.

g. CHECK—Delay-time accuracy for each setting listed in Table 5-6.

NOTE

When making delay time accuracy checks, it may be necessary to switch HORIZ DISPLAY to A INTEN to locate proper time marker.

TABLE 5-5
A & B Timing Accuracy

A and B Time/Div Settings	Time Mark Generator	Markers Displayed Per Div	Measure To Marker
.05 μ s	50 ns	1	11
.1 μ s	.1 μ s	1	11
.2 μ s	.1 μ s	2	21
.5 μ s	.5 μ s	1	11
1 μ s	1 μ s	1	11
2 μ s	1 μ s	2	21
5 μ s	5 μ s	1	11
10 μ s	10 μ s	1	11
20 μ s	10 μ s	2	21
50 μ s	50 μ s	1	11
.1 ms	.1 ms	1	11
.2 ms	.1 ms	2	21
.5 ms	.5 ms	1	11
1 ms	1 ms	1	11
2 ms	1 ms	2	21
5 ms	5 ms	1	11
10 ms	10 ms	1	11
20 ms	10 ms	2	21
50 ms	50 ms	1	11
A Only			
.1 s	.1 s	1	11
.2 s	.1 s	2	21
.5 s	.5 s	1	11

NOTE

Limits: 9.8 to 10.2 div for +20°C to +30°C or 9.7 to 10.3 div for -15°C to +20°C and +30°C to +55°C.

21. CHECK MIXED SWEEP ACCURACY

a. Set: DELAY TIME POSITION Fully cw
 B TRIGGER SOURCE STARTS AFTER DELAY
 B TRIGGER LEVEL Fully ccw
 HORIZ DISPLAY A
 A TIME/DIV 1 ms
 B TIME/DIV .5 ms

b. Set time-mark generator for 1 ms time markers.

TABLE 5-6
Delay-Time Accuracy

Time Mark Generator	A Time/Div	B Time/Div	Time Marker At Graticule Center Initially	Center Marker Number	DM Reading Limits	
					+15° C to +35° C	-15° C to +15° C +35° C to +55° C
.1 μ s	.2 μ s	.05 μ s	3	17	1.385 to 1.415	1.378 to 1.422
.5 μ s	.5 μ s	.05 μ s	2	9	03.45 to 03.55	03.43 to 03.57
1 μ s	1 μ s	.1 μ s	2	10	07.91 to 08.09	07.87 to 08.13
1 μ s	2 μ s	.1 μ s	3	19	15.83 to 16.17	15.75 to 16.25
5 μ s	5 μ s	.5 μ s	2	10	039.5 to 040.5	039.3 to 040.7
10 μ s	10 μ s	1 μ s	2	10	079.1 to 080.9	078.7 to 081.3
10 μ s	20 μ s	1 μ s	3	19	158.3 to 161.7	157.5 to 162.5
50 μ s	50 μ s	5 μ s	2	10	0.395 to 0.405	0.393 to 0.407
.1 ms	.1 ms	10 μ s	2	10	0.791 to 0.809	0.787 to 0.813
.1 ms	.2 ms	10 μ s	3	19	1.583 to 1.617	1.575 to 1.625
.5 ms	.5 ms	50 μ s	2	10	03.95 to 04.05	03.93 to 04.07
1 ms	1 ms	.1 ms	2	10	07.91 to 08.09	07.87 to 08.13
1 ms	2 ms	.1 ms	3	19	15.83 to 16.17	15.75 to 16.25
5 ms	5 ms	.5 ms	2	10	039.5 to 040.5	039.3 to 040.7
10 ms	10 ms	1 ms	2	10	079.1 to 080.9	078.7 to 081.3
10 ms	20 ms	1 ms	3	19	158.3 to 161.7	157.5 to 162.5
50 ms	50 ms	5 ms	2	10	0.395 to 0.405	0.393 to 0.407
.1 s	.1 s	10 ms	2	10	0.791 to 0.809	0.787 to 0.813
.1 s	.2 s	10 ms	3	19	1.583 to 1.617	1.575 to 1.625
.5 s	.5 s	50 ms	2	10	03.95 to 04.05	03.93 to 04.07

c. Horizontally position 1st time marker to left graticule line and note A sweep timing error between 2nd and 10th time markers.

d. Change HORIZ DISPLAY to MIX and position 1st time marker to left graticule line.

e. CHECK—That mixed sweep accuracy is within 2% (7.84 to 8.16 for 8 divisions of display plus A Sweep error noted in part c).

f. Set time-mark generator for 0.1 μ s time markers.

g. Set: HORIZ DISPLAY A
A TIME/DIV .2 μ s
B TIME/DIV .1 μ s

h. Horizontally position 1st time marker to left graticule line and note A Sweep timing error between 3rd and 19th time markers.

i. Change HORIZ DISPLAY to MIX and position 1st time marker to left graticule line.

j. CHECK—That mixed sweep accuracy is within 2% (7.84 to 8.16 for centered 8 division display plus A sweep error noted in part h).

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22. CHECK B ENDS A

- | | | |
|---------|---------------------|--------------------------------|
| a. Set: | HORIZ DISPLAY | A INTEN |
| | A TIME/DIV | 1 ms |
| | B TIME/DIV | .1 ms |
| | B TRIGGER SOURCE | STARTS AFTER DELAY |
| | A TRIG HOLDOFF | B ENDS A |
| | DELAY TIME POSITION | About 1 turn cw from fully ccw |
| | INTENSITY | A Sweep visible |
| | A TRIG LEVEL | Fully cw |

- b. Disconnect time-mark generator.
- c. Rotate DELAY TIME POSITION through its range.
- d. CHECK—That A Sweep ends after B intensified portion at any DELAY TIME POSITION setting.

23. CHECK A TRIGGER HOLDOFF

- | | | |
|---------|-------------------|------------|
| a. Set: | HORIZ DISPLAY | A |
| | A TIME/DIV | 10 μ s |
| | A TRIGGER HOLDOFF | NORM |
| | A TRIG LEVEL | Fully ccw |

- b. Set test oscilloscope:

Vertical Mode	CH 1
CH 1 Volts/Div	1 volt
Horiz Mode	A Sweep
A Trigger Slope	—
A Trigger Mode	Auto
- c. Connect A +GATE output (on rear of oscilloscope on which DM43-DM40 is mounted) to CH 1 input of test oscilloscope via 50 Ω cable and 50 Ω termination.
- d. Adjust test oscilloscope Time/Div and Var Volts/Div so that negative portion of +Gate (holdoff time) is 1 major division in length.
- e. Rotate A TRIGGER HOLDOFF control clockwise, but not into B ENDS A detent.
- f. CHECK—That holdoff time of A +GATE is increased at least 10 times.
- g. Set A TRIGGER HOLDOFF to NORM.

24. CHECK TIME FUNCTIONS

2, 1, and 0.5 Dividers

- | | | |
|---------|---------------------|-----------|
| a. Set: | A TIME/DIV | .2 ms |
| | DELAY TIME POSITION | Fully ccw |

b. Press TIME ZERO. Turn DELAY TIME POSITION clockwise to obtain a count of 1.600.

c. Switch TIME/DIV to .1 ms and read 0800 counts on DM.

d. Switch TIME/DIV to 50 μ s and read 0400 counts on DM. If DM reading is not exact on each range, verify that all timing ranges are within specifications (1%, \pm 1 count).

ms and μ s Lights

a. Neither light should be on from X-Y to 50 ms on TIME/DIV switch.

b. Ms light should be on from 20 ms through 50 μ s; the μ s light should be on from 20 μ s through .05 μ s.

High/Low Ranges

The DM switches from "low" range to "high" range at a count of 2000. Readout then displays 0200 and decimal shifts 1 place to right. This auto-ranging functions only in "time" mode.

To check ranging:

a. Set A and B TIME/DIV to .2 ms, and DELAY TIME POSITION fully ccw.

b. Press TIME ZERO and turn DELAY TIME POSITION very slowly clockwise past .1999 (on DM).

c. Note that decimal point shifts 1 position to right (display changes from .2000 to 0.200).

The DM switches from "high" range to "low" range at a count of 0100.

To check ranging:

a. Turn DELAY TIME POSITION very slowly counter-

clockwise past 0.100 (on DM).

b. Note that decimal point moves 1 position to left and reading changes from 0.099 to .0999.

NOTE

All 3 decimal points light when TIME/DIV is in X-Y, $.1 \mu s$, and $.05 \mu s$, indicating that differential time cannot be measured on these switch positions.

DM43—DM40 CALIBRATION

See **ADJUSTMENT LOCATIONS** pullout page for adjustments and test points.

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PROCEDURE

1. CHECK—ADJUST DM REFERENCE VOLTAGE

- a. Set DM FUNCTION to VOLTS.

- b. Set DM RANGE to 2 V.

- c. Connect test DVM between test points 2406 (black lead) and 2407 (red lead).

- d. CHECK—Test DVM reading for +4.87 volts.

- e. ADJUST—R2406, Reference, for +4.87 volts.

- f. Remove test DVM.

2. CHECK—ADJUST 2-VOLT ADJUST, ZERO, AND POLARITY

- a. Connect voltage standard to DM input (red and black connectors on DM side panel).

- b. Set DM FUNCTION to VOLTS, RANGE to 2.

- c. Set voltage standard to +1.8000 V.

- d. ADJUST—R2417, 2-Volt Adjust, for DM reading of 1.800 (no polarity sign is displayed for + readings).

- e. Switch voltage standard polarity to — and note DM reading (note that minus sign is displayed). If reading is not 1.800, ± 3 counts (1.797 to 1.803), ADJUST C2408 until same reading is displayed when switching voltage standard polarity between + and —.

- f. Switch voltage standard polarity to +.

- g. RECHECK—DM reading for 1.800.

- h. ADJUST—R2417, if necessary, for DM reading of 1.800.

- i. Switch voltage standard polarity to —.

- j. CHECK—For DM reading of 1.800, ± 1 count.
- k. Switch voltage standard to zero output (or standby) and disconnect leads from DM.
- l. Connect shorting strap between DM input connectors.
- m. CHECK—DM reading for .0000, ± 1 count.

3. CHECK—ADJUST 200 mV RANGE

- a. Set DM RANGE to 200 mV. Connect voltage standard to DM input.
- b. Set voltage standard to +0.1800 V.
- c. CHECK—DM reading for 180.0, ± 3 counts (179.7 to 180.3).
- d. ADJUST—R2412, 200 mV Adjust, for a DM reading of 180.0. Set voltage standard for -0.1800 V.
- e. CHECK—DM reading for -180.0, ± 1 count. Minus sign should be displayed.

4. CHECK INPUT LIMITING

- a. Connect test DVM between test point 2331 and DM ground. Set DM FUNCTION to VOLTS, RANGE to 2.
- b. Set voltage standard to -5.8 volts.
- c. CHECK—Test DVM reading for -3.7 volts, ± 0.3 volts.
- d. Set voltage standard for +5.8 volts.
- e. CHECK—Test DVM reading for +3.7 volts, ± 0.3 volts.

5. CHECK VOLTAGE RANGES

WARNING

Dangerous voltages are present from the voltage standard and on the DM circuit board and input connectors when checking high voltage ranges (200 V and 1.2 kV). Reduce voltage standard output or place on standby when not using high voltage ranges.

- a. Set DM RANGE switch and voltage standard output to each position shown in Table 5-7.

**TABLE 5-7
Voltage Ranges**

DM Range	Voltage Standard Output	Readout	Limits
1.2 kV	1.200 kV	1.200	1.197 to 1.203
1.2 kV	180.0 V	0.180	0.178 to 0.182
200	180.00 V	180.0	179.7 to 180.3
200	18.00 V	018.0	017.8 to 018.2
20	18.00 V	18.00	17.97 to 18.03
20	1.800 V	01.80	01.78 to 01.82
2	1.800 V	1.800	1.797 to 1.803
2	0.1800 V	0.180	0.178 to 0.182
200 mV	0.1800 V	180.0	179.7 to 180.3
200 mV	0.0100 V	010.0	009.8 to 010.2

- b. CHECK—That readout is within tolerance shown. Voltage accuracy in table is 0.1%, ± 1 count.

6. CHECK OHMS LIMITING

- a. Connect voltage standard to DM input.
- b. Set DM FUNCTION to OHMS and RANGE to 2 k Ω .
- c. Set voltage standard output to -200 volts.
- d. CHECK—That DM readout blinks and ohms current limit lamp is lighted.

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e. Set voltage standard output to +200 V. DM display should blink. If voltage standard has a current limit light, this light should be off.

f. Turn voltage standard off and disconnect voltage standard from DM.

7. CHECK—ADJUST OHMS FUNCTION

a. Set DM FUNCTION to OHMS.

b. Set the DM RANGE to 20 kΩ.

c. Connect resistance standard to DM input.

d. Set resistance standard to 18,000 Ω.

e. CHECK—DM reading for 18.00, ± 7 counts.

f. ADJUST—R2328, Ohms Adjust, for a DM reading of 18.00.

g. CHECK—Ohms ranges, as shown in Table 5-8.

8. CHECK—ADJUST TEMPERATURE (°C) FUNCTION

NOTE

The probe furnished with the DM43 is calibrated to the instrument. If another probe is used with the instrument, the temperature section of the DM43 should be recalibrated.

a. Connect temperature probe to DM temperature input connector.

b. Suspend temperature probe³ and reference thermometer into a container (preferably insulated) of water and crushed or shaved ice. Let enough ice melt to stabilize water temperature.

-or-

Suspend temperature probe³ and reference thermometer in water and antifreeze solution in a circulating bath (see Table 5-1, Test Equipment Required).

c. CHECK—That DM reading is within 2°C of thermometer reading.

TABLE 5-8

Ohms Ranges

DM Range	Resistance Standard Setting	DM Reading	Limits ²
200 Ω	10 Ω	010.0 ¹	009.8 to 010.2
200 Ω	180 Ω	180.0	178.5 to 181.5
2 kΩ	180 Ω	0.180	0.177 to 0.183
2 kΩ	1.8 kΩ	1.800	1.785 to 1.815
20 kΩ	1.8 kΩ	01.80	01.78 to 01.82
20 kΩ	18 kΩ	18.00	17.93 to 18.07
200 kΩ	18 kΩ	018.0	017.8 to 018.2
200 kΩ	180 kΩ	180.0	179.3 to 180.7
2 MΩ	180 kΩ	0.180	0.178 to 0.182
2 MΩ	1.8 MΩ	1.800	1.793 to 1.807
20 MΩ	1.8 MΩ	01.80	01.77 to 01.83
20 MΩ	18 MΩ	18.00	17.85 to 18.15

d. ADJUST—R2362, Offset, for same DM reading as reference thermometer.

e. Remove temperature probe and thermometer from water and place in temperature probe equalizing block (see Fig 5-1) at room temperature. Use dielectric fluid shown in Fig. 5-1.

f. Let temperature probe and thermometer temperature stabilize.

g. CHECK—That DM reading is within 2°C of thermometer reading.

h. ADJUST—R2367, Gain, for same DM reading as reference thermometer.

i. Remove probe and thermometer from temperature equalizing block.

¹ Lead resistance may cause an error when measuring 10Ω range. Lead resistance typically adds 0.1Ω to DM reading. If in doubt, measure lead resistance and add to DM reading in table.

² Accuracy: For 20 kΩ, 200 kΩ, and 2 MΩ ranges, within 0.3%, ±1 count. For 200 Ω, 2 kΩ, and 20 MΩ ranges, within 0.75%, ±1 count.

³ Submerge temperature probe so that liquid level is not above bottom of bulge in probe body.

464—465—466 HORIZONTAL SYSTEM CALIBRATION PROCEDURE

See

ADJUSTMENT LOCATIONS

pullout page for adjustments and test points.

NOTE

All Horizontal System adjustments not accessible through holes in DM circuit board are located on oscilloscope Interface circuit board. Refer to oscilloscope service manual for adjustment locations.

9. CHECK—ADJUST SWEEP START AND STOP (A SWEEP CAL)

- a. Connect time-mark generator to CH 1 input through a 50-ohm BNC cable and 50-ohm termination.
- b. Set time-mark generator for 1 ms and .1 ms time markers.
- c. Set HORIZ DISPLAY to A INTEN.
- d. Set A TIME/DIV to 1 ms and B TIME/DIV to 1 μ s. Adjust TRIGGER LEVEL for a stable display.
- e. Set DELAY TIME POSITION fully counterclockwise.
- f. CHECK—That intensified portion of display is on 2nd small time mark. Horizontally position 2nd small time mark to 1st small graticule mark (0.2 major division from zero graticule line).
- g. ADJUST—R1115, Sweep Start, to intensify 2nd small time marker.
- h. Horizontally position 2nd small time marker (intensified) to left (zero) graticule line.
- i. Set DELAY TIME POSITION control fully clockwise.
- j. CHECK—Display for intensified portion of sweep at right (10th) graticule line (10.2 divisions).
- k. ADJUST—R1145 to intensify time marker at right (10th) graticule line (10.2 divisions).

- l. INTERACTION—Repeat steps e through k for no visible interaction.

10. CHECK—ADJUST HORIZONTAL GAIN

- a. Set A and B TIME/DIV to 1 ms.
- b. Apply 1 ms time markers to oscilloscope input.
- c. Set HORIZ DISPLAY to A and horizontally position display to set 1st time marker at zero (left) graticule line.
- d. CHECK—For 1 time marker/division, within 2%, (9.8 to 10.2 for 11th time marker).
- e. ADJUST—R1257 (for 464 or 466) or R1237 (for 465), X1 Gain, for exactly 1 time marker/division over the full 10 divisions.
- f. Set time-mark generator for 0.1 ms time markers.
- g. Press X10 MAG button in.
- h. CHECK—That X10 MAG lamp is on when X10 MAG button is in.
- i. CHECK—For 1 time marker/division, within 3% (9.7 to 10.3 for 11th time marker).
- j. ADJUST—R1253 (for 464 or 466) or R1238 (for 465), X10 Gain, for exactly 1 time marker/division over the full 10 divisions.
- k. CHECK—That sweep accuracy over any 2-division portion of 10 divisions of sweep is within 5% (0.1 major division).
- l. Release X10 MAG to out position.

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- m. Set time-mark generator for 1 ms time markers.
- n. CHECK—That linearity over any 2-division portion of sweep is within 5% (0.1 major division).

11. CHECK—ADJUST MAGNIFIER REGISTRATION

- a. Push X10 MAG in.
- b. Set time-mark generator for 5 ms time markers and horizontally position middle time marker to center graticule line.
- c. Release X10 MAG button.
- d. CHECK—That middle time marker starts at center line, within 0.2 major division.
- e. ADJUST—R1255 (464 or 466) or R1225 (465), Mag Reg, so middle marker starts at graticule center line.
- f. INTERACTION—Repeat steps a through e until there is no display shift between magnifier on and off.
- g. Release X10 MAG to out position.

12. CHECK A SWEEP LENGTH

- a. Set HORIZ DISPLAY to A.
- b. Set time-mark generator for 1 ms and .1 ms time markers.
- c. CHECK—That sweep length is between 10.5 and 11.5 divisions.

13. CHECK VAR TIME/DIV RANGE

- a. Set: A TIME/DIV 2 ms
 VAR TIME/DIV Fully ccw
- b. Set time-mark generator to 5 ms.

- c. CHECK—That at least 1 time marker/division can be displayed by adjusting A VARIABLE TIME/DIV.
- d. CHECK—That UNCAL lamp lights when VAR TIME/DIV is out of detent.
- e. Return VAR to detent position.

14. CHECK HORIZONTAL POSITION CONTROL RANGE

- a. Set POSITION fully clockwise and FINE midrange.
- b. CHECK—That sweep starts to right of graticule center line.
- c. Set POSITION fully counterclockwise and FINE to midrange.
- d. CHECK—That sweep starts to left of graticule center line.

15. CHECK DELAY TIME JITTER

- a. Set time-mark generator for 1 ms time markers.
- b. Set: A TRIG MODE AUTO
 A TIME/DIV 1 ms
 B TIME/DIV .2 μ s
 HORIZ DISPLAY A INTEN

- c. Attach a light shield to graticule housing.

CALIBRATION AID—Low repetition rate of the check makes viewing difficult. Additional intensity may be obtained by using storage. For those instruments with storage:

Push VAR PERS in and adjust INTEN, STORAGE LEVEL, and VIEW TIME for stable display.

- d. Position intensified portion of display to 2nd time marker with DELAY TIME POSITION and set HORIZ DISPLAY to B DLY'D. Position marker to graticule center.

e. CHECK—That jitter is 1 major division or less for 60 Hz power-line frequency, or 2.5 major division or less for 50 Hz power-line frequency.

f. Set HORIZ DISPLAY to A INTEN, and position intensified portion of display to 10th time marker. Set HORIZ DISPLAY to B DLY'D and adjust marker to graticule center.

g. CHECK—That jitter is 1 major division or less for 60 Hz power-line frequency or 2.5 major divisions or less for 50 Hz power-line frequency.

16. CHECK—ADJUST TIME ZERO

a. Set: A TIME/DIV .2 ms
 B TIME/DIV .5 μs
 DELAY TIME POSITION Fully ccw
 HORIZ DISPLAY A INTEN

b. Set time-mark generator for .1 ms time markers.

c. Turn DELAY TIME POSITION to intensify 3rd time marker.

d. Hold DM TIME ZERO in.

e. ADJUST—R2372, Time Zero, for .0000 reading (while holding TIME ZERO button in). Release DM TIME ZERO. Display should remain at .0000.

17. CHECK—ADJUST TIME

a. Switch HORIZ DISPLAY to B DLY'D.

b. Position displayed time marker to graticule center.

c. Press TIME ZERO.

d. Turn DELAY TIME POSITION to place 16th succeeding time marker to graticule center.

e. ADJUST—R2384, Time Adj, for a reading of 1.600 and note that ms light is on.

f. Repeat part c (in TIME ZERO Adj) through part e (in TIME Adj) to correct for interaction.

18. CHECK—ADJUST B SWEEP TIMING

a. Set time-mark generator for 1 ms time markers.

b. Set: DELAY TIME POSITION Fully ccw
 B TRIGGER SOURCE NORM
 B TRIG LEVEL Stable display
 A & B TIME/DIV 1 ms
 HORIZ DISPLAY B DLY'D

c. CHECK—1 time marker/division, with 2% (9.8 to 10.2 for 11th time marker).

d. ADJUST—R1175, B Sweep Cal, for exactly 1 time marker/division over full 10 divisions.

19. CHECK—ADJUST 20 μs TIMING

a. Set: A TIME/DIV 20 μs
 B TIME/DIV .2 μs
 HORIZ DISPLAY A INTEN
 DELAY TIME POSITION Fully ccw
 B TRIGGER SOURCE STARTS AFTER DELAY

b. Set time-mark generator for 10 μs time markers.

c. CHECK—2 time markers/division, within 2% (9.8 to 10.2 for 21st time marker).

d. Turn DELAY TIME POSITION to intensify 3rd time marker.

e. Set HORIZ DISPLAY to B DLY'D.

f. Position displayed time marker to graticule center.

g. Press DM TIME ZERO.

h. Turn DELAY TIME POSITION clockwise to produce DM reading of 160.0.

NOTE

DM reading changes from 20.00 to 020.0 at approximately 5th time marker (1 graticule division from reference in step c). The 160.0 reading is obtained at 16th time marker from step c reference (8 graticule divisions from step reference).

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i. ADJUST—C1136 to position displayed marker to graticule center. Note that μ s light is on.

m. INTERACTION—Repeat procedure until there is no error between DM readings at .0000 and 1.400.

20. CHECK—ADJUST .2 μ s TIMING

a. Set: A TIME/DIV .2 μ s
B TIME/DIV .05 μ s
DELAY TIME POSITION Fully ccw
HORIZ DISPLAY A

b. Set time-mark generator for .1 μ s time markers.

c. CHECK—Display for 2 time markers/division, within 2% (9.8 to 10.2 for 21st time marker).

d. Set HORIZ DISPLAY to A INTEN.

e. Position center of intensified portion of display to approximately 1.5 major divisions from left graticule line.

f. Set HORIZ DISPLAY to B DLY'D.

g. Push X10 MAG in.

h. Adjust A TRIGGER LEVEL and HOLDOFF for stable display

i. Turn DELAY TIME POSITION control clockwise until rising portion of next time mark is at graticule center line.

j. Press DM TIME ZERO.

k. Turn DELAY TIME POSITION clockwise exactly 14 time markers (count marks). DM readout indicates approximately 1.400. Note position of 14th time marker and adjust DELAY TIME POSITION for DM reading of 1.400.

l. ADJUST—C1137 to position rising portion of 14th time marker to graticule center.

21. CHECK—ADJUST .1 μ s (B SWEEP)

a. Set: A TIME/DIV .1 μ s
B TIME/DIV .1 μ s
X10 MAG Out
HORIZ DISPLAY B DLY'D
DELAY TIME POSITION Fully ccw

b. Set time-mark generator for .1 μ s time markers.

c. CHECK—Display for 1 time marker/division, within 2% (9.8 to 10.2 for 11th time marker).

d. ADJUST—C1167 for 1 time marker/division.

22. CHECK—ADJUST HIGH SPEED MAGNIFIED TIMING

a. Set time-mark generator for 10 ns time markers.

b. Set: HORIZ DISPLAY A
A TRIG MODE AUTO
A TIME/DIV .05 μ s
X10 MAG Button In

c. Adjust A TRIGGER LEVEL for stable display.

d. CHECK—For 1 time marker/2 divisions within 3% (9.7 to 10.3 for 6th time marker). This applies to full sweep length excluding the 1st and last 10 divisions of magnified sweep length.

NOTE

To determine first portion to be excluded, release X10 MAG. Position sweep start to 1.5 divisions to left of graticule center line. Push X10 MAG in—first 10 divisions of sweep is magnified to left and is off screen. To determine last portion to be excluded on 0.5 div range, release X10 MAG. Position sweep stop 1.5 divisions to right of graticule center line. Push X10 MAG in—last 50 ns of sweep is magnified to right and is off screen.

e. ADJUST—C1262 and C1265 (for 464 and 466), or C1261 and C1281 (for 465), for 1 cycle/2 divisions, with a low-capacitance screwdriver, excluding 1st and last 10 divisions (off screen).

23. CHECK A AND B MAGNIFIED ACCURACY

- a. Push X10 MAG in. Set HORIZ DISPLAY to A.
- b. CHECK—A Time/Div accuracy using control settings, display, and limits shown in Table 5-9. Exclude portion of sweep indicated (see NOTE, step 22d).
- c. Set: HORIZ DISPLAY B DLY'D
 B TIME/DIV .05 μ s
- d. Set time-mark generator for 10 ns time markers.
- e. CHECK—B TIME/DIV accuracy using control settings, display, and limits shown in Table 5-9. Exclude the portions of the sweep indicated (see NOTE, step 22d).

24. CHECK B AND A TIME/DIV ACCURACY

- a. Set: HORIZ DISPLAY B DLY'D
 A & B TIME/DIV .05 μ s
 X10 MAG Button Out
- b. Set time-mark generator for 50 ns time markers (sine wave).
- c. CHECK—B Time/Div accuracy, using control settings, display, and limits shown in Table 5-10.
- d. Set: HORIZ DISPLAY A
 A TIME/DIV .05 μ s
- e. Set time-mark generator to 50 ns time markers (sine wave).
- f. CHECK—A Time/Div accuracy, using control settings, display, and limits shown in Table 5-10.

25. CHECK DELAY-TIME ACCURACY

- a. Set time-mark generator for .1 μ s time markers.

TABLE 5-9

A and B Magnified Accuracy

A and B Time/Div Settings	Time Mark Generator	Markers Displayed Per Div	Measure To Marker	Portions of Total Length To Be Excluded
.05 μ s	10 ns	1 per 2 div	6	1st and last 10 div
.1 μ s	10 ns	1	11	1st and last 5 div
.2 μ s	10 ns	2	21	1st and last 2.5 div
.5 μ s	50 ns	1	11	
1 μ s	.1 μ s	1	11	
2 μ s	.1 μ s	2	21	
5 μ s	.5 μ s	1	11	
10 μ s	1 μ s	1	11	
20 μ s	1 μ s	2	21	
50 μ s	5 μ s	1	11	
.1 ms	10 μ s	1	11	
.2 ms	10 μ s	2	21	
.5 ms	50 μ s	1	11	
1 ms	.1 ms	1	11	
2 ms	.1 ms	2	21	
5 ms	.5 ms	1	11	
10 ms	1 ms	1	11	
20 ms	1 ms	2	21	
50 ms	5 ms	1	11	
A Sweep Only				
.1 s	10 ms	1	11	
.2 s	10 ms	2	21	
.5 s	50 ms	1	11	

NOTE

Limits: 9.7 to 10.3 div for +20°C to +30°C or 9.6 to 10.4 div for -15°C to +20°C and +30°C to +55°C.

- b. Set: X10 MAG Button Out
 B TRIGGER SOURCE STARTS AFTER DELAY
 A TIME/DIV .2 μ s
 B TIME/DIV .05 μ s
 DELAY TIME POSITION Ccw
 HORIZ DISPLAY B DLY'D

- c. Turn DELAY TIME POSITION clockwise (and Horiz POSITION if necessary) to position the 3rd time marker to graticule center.

TABLE 5-10
A and B Timing Accuracy

Time/Div Settings A and B	Time Mark Generator	Markers Displayed Per Div	Measure To Marker
.05 μ s	50 ns	1	11
.1 μ s	.1 μ s	1	11
.2 μ s	.1 μ s	2	21
.5 μ s	.5 μ s	1	11
1 μ s	1 μ s	1	11
2 μ s	1 μ s	2	21
5 μ s	5 μ s	1	11
10 μ s	10 μ s	1	11
20 μ s	10 μ s	2	21
50 μ s	50 μ s	1	11
.1 ms	.1 ms	1	11
.2 ms	.1 ms	2	21
.5 ms	.5 ms	1	11
1 ms	1 ms	1	11
2 ms	1 ms	2	21
5 ms	5 ms	1	11
10 ms	10 ms	1	11
20 ms	10 ms	2	21
50 ms	50 ms	1	11
A Only			
.1 s	.1 s	1	11
.2 s	.1 s	2	21
.5 s	.5 s	1	11

NOTE

Limits: 9.8 to 10.2 div for +20°C to +30°C or 9.7 to 10.3 div for -15°C to +20°C and +30°C to +55°C.

NOTE

When making Delay Time accuracy checks it may be necessary to switch HORIZ DISPLAY to A INTEN to locate proper time mark.

26. CHECK MIXED SWEEP ACCURACY

- a. Set: DELAY TIME POSITION Fully ccw
 B TRIGGER SOURCE STARTS AFTER DELAY
 B TRIGGER LEVEL Fully ccw
 HORIZ DISPLAY A
 A TIME/DIV 1ms
 B TIME/DIV .5 ms

b. Set time-mark generator for 1 ms.

c. Horizontally position 1st time marker to left graticule line and note A Sweep timing error between 2nd and 10th time markers.

d. Change HORIZ DISPLAY to MIX and position 1st time marker to left graticule line.

e. CHECK—That MIXED sweep accuracy is within 2% (7.84 to 8.16 for 8 divisions of display, plus A sweep error noted in step c).

f. Set time-mark generator for .1 μ s.

- g. Set: HORIZ DISPLAY A
 A TIME/DIV .2 μ s
 B TIME/DIV .1 μ s

h. Horizontally position 1st time marker to left graticule line and note A Sweep timing error between 3rd and 19th time markers.

i. Change HORIZ DISPLAY to MIX and position first time marker to left graticule line.

j. CHECK—That MIXED Sweep accuracy is within 2% (7.84 to 8.16 for centered 8-division display, plus A Sweep error noted in part h).

d. Press TIME ZERO.

e. Turn DELAY TIME POSITION to position the 17th time marker to graticule center.

f. CHECK—That DM reading is within the limits shown in Table 5-11. Accuracies for this check are: within 1%, ± 1 count for +15°C to +35°C and within 1.5% for -15°C to +15°C and +35°C to +55°C.

g. CHECK—Delay time accuracy for each setting listed in Table 5-11.

TABLE 5-11
Delay-Time Accuracy

Time Mark Gen	A Time/Div	B Time/Div	Time Marker At Graticule Center Initially	Center Marker Number	DM Reading Limits	
					+15° C to +35° C	-15° C to +15° C +35° C to +55° C
.1 μs	.2 μs	.05 μs	3	17	1.385 to 1.415	1.378 to 1.422
.5 μs	.5 μs	.05 μs	2	9	03.45 to 03.55	03.43 to 03.57
1 μs	1 μs	.1 μs	2	10	07.91 to 08.09	07.87 to 08.13
1 μs	2 μs	.1 μs	3	19	15.83 to 16.17	15.75 to 16.25
5 μs	5 μs	.5 μs	2	10	039.5 to 040.5	039.3 to 040.7
10 μs	10 μs	1 μs	2	10	079.1 to 080.9	078.7 to 081.3
10 μs	20 μs	1 μs	3	19	158.3 to 161.7	157.5 to 162.5
50 μs	50 μs	5 μs	2	10	0.395 to 0.405	0.393 to 0.407
.1 ms	.1 ms	10 μs	2	10	0.791 to 0.809	0.787 to 0.813
.1 ms	.2 ms	10 μs	3	19	1.583 to 1.617	1.575 to 1.625
.5 ms	.5 ms	50 μs	2	10	03.95 to 04.05	03.93 to 04.07
1 ms	1 ms	.1 ms	2	10	07.91 to 08.09	07.87 to 08.13
1 ms	2 ms	.1 ms	3	19	15.83 to 16.17	15.75 to 16.25
5 ms	5 ms	.5 ms	2	10	039.5 to 040.5	039.3 to 040.7
10 ms	10 ms	1 ms	2	10	079.1 to 080.9	078.7 to 081.3
10 ms	20 ms	1 ms	3	19	158.3 to 161.7	157.5 to 162.5
50 ms	50 ms	5 ms	2	10	0.395 to 0.405	0.393 to 0.407
.1 s	.1 s	10 ms	2	10	0.791 to 0.809	0.787 to 0.813
.1 s	.2 s	10 ms	3	19	1.583 to 1.617	1.575 to 1.625
.5 s	.5 s	50 ms	2	10	03.95 to 04.05	03.93 to 04.07

27. CHECK B ENDS A

- a. Set: HORIZ DISPLAY A INTEN
A TIME/DIV 1 ms
B TIME/DIV .1 ms
B TRIGGER SOURCE STARTS AFTER DELAY
A TRIG HOLDOFF B ENDS A
DELAY TIME POSITION About 1 turn cw from fully ccw position
INTENSITY A Sweep visible
A TRIG LEVEL Fully cw

b. Disconnect time-mark generator.

c. Rotate DELAY TIME POSITION through its range.

d. CHECK—That A Sweep ends after B intensified portion at any DELAY TIME POSITION setting.

28. CHECK A TRIGGER HOLDOFF

- a. Set: HORIZ DISPLAY A
A TIME/DIV 10 μs
A TRIG HOLDOFF NORM
A TRIG LEVEL Fully cw

- b. Set test oscilloscope:
Vertical Mode CH 1
CH 1 Volts/Div 1 volt
Horiz Mode A Sweep
A Trigger Slope —
A Trig Mode Auto

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- c. Connect A +GATE output (on rear of oscilloscope on which DM43-40 is mounted) to CH 1 input of test oscilloscope via 50-ohm cable and 50-ohm termination.
- d. Adjust test oscilloscope Time/Div and Var Volts/Div so that negative portion of + GATE (holdoff time) is 1 major division in length.
- e. Rotate A TRIG HOLDOFF control clockwise, but not into B ENDS A detent.
- f. CHECK—That holdoff time of A + GATE is increased 10 times, or more.
- g. Set A TRIG HOLDOFF to NORM.
- h. Disconnect all test equipment.

29. CHECK TIME FUNCTIONS

2, 1, and 0.5 Dividers

- a. Set: A TIME/DIV .2 ms
DELAY TIME POSITION Fully ccw
- b. Press TIME ZERO. Turn DELAY TIME POSITION clockwise to obtain count of 1.600.
- c. Switch TIME/DIV to .1 ms and read 0800 counts on DM readout.
- d. Switch TIME/DIV to 50 μ s and read 0400 counts on DM readout. If DM reading is not exact on each range, verify that all timing ranges are within specifications (1%, ± 1 count).

ms and μ s Lights

- a. Neither light should be on from X-Y to 50 ms on TIME/DIV switch.
- b. Ms light should be on from 20 ms through 50 μ s; μ s light should be on from 20 μ s through .05 μ s.

High/Low Ranges

The DM switches from "low" range to "high" range at a count of 2000. Readout then displays 0200 and decimal

shifts 1 place to right. This auto-ranging functions only in "time" mode.

To check ranging:

- a. Set A and B TIME/DIV to .2 ms, DELAY TIME POSITION fully ccw.
- b. Press TIME ZERO, and turn DELAY TIME POSITION very slowly past .1999.
- c. Note that decimal point shifts 1 position to right (display changes from .2000 to 0.200).

The DM switches from the "high" range to the "low" range at a count of 0100.

To check ranging, turn DELAY TIME POSITION very slowly past 0.100 and note that decimal point moves 1 position to left and reading changes from 0.100 to .1000.

NOTE

All three decimal points light when TIME/DIV is in X-Y, .1 μ s, and .05 μ s, indicating that differential time cannot be measured on these switch positions.

This completes the DM procedure. Return to the oscilloscope calibration procedure.

DM AND 475 HORIZONTAL SYSTEM PERFORMANCE CHECK/CALIBRATION

ADDITIONAL TEST EQUIPMENT REQUIRED FOR 475

In addition to the test equipment listed in Table 5-1 for the

464-465-466 and DM43-DM40, the test equipment listed in Table 5-12 is also required to check and adjust the 475 Horizontal System. Refer to the Test Equipment Required discussion on page 5-1 for additional information.

TABLE 5-12
Test Equipment Required for 475

Description	Minimum Specification	Use	Example
1. Digital Voltmeter ¹	Range, 0 to 150 V; dc voltage accuracy, within 0.15%; display, 4½ digits.	Horiz centering adjustment	a. Tektronix DM 501 Digital Multimeter ²
2. Test Oscilloscope	Bandwidth, dc to 100 MHz; minimum deflection factor, 5 mV/div; accuracy, within 3%.	A Trigger holdoff. High speed timing	a. Tektronix 465 Oscilloscope with 2 P6065 (X10) probes. b. Tektronix 475 Oscilloscope with 2 P6075 (X10) probes.
3. Amplitude Calibrator	Amplitude accuracy, within 0.25%; signal amplitude, 2 mV to 20 V; output signal, 1 kHz square wave.	X Gain check and adjust	a. Tektronix PG 506 Calibration Generator ² .
4. Sine-Wave Generator	Frequency, 350 kHz to above 200 MHz; output amplitude, variable from 15 mV to 4 V, p-p; output impedance, 50 ohms; reference frequency, 50 kHz to 350 kHz; amplitude accuracy, constant within 3% of amplitude at reference frequency as output frequency changes.	X-Y bandwidth	a. Tektronix SG 503 Leveled Sine-Wave Generator ² . b. Tektronix 191 Constant Amplitude Signal Generator. Use at frequencies 100 MHz and below.
5. Current Probe ¹	Sensitivity, 1 mA/mV; bandwidth, 8.5 kHz to 100 MHz.	Major recalibration of high-speed timing	a. Tektronix P6022 ac Current Probe.
6. 500 MHz Filter	Impedance, 50 ohms, frequency, adjustable; connectors, BNC.	High speed check and adjust	a. Tektronix 500 MHz Filter. 067-0684-00 Calibration Fixture.
7. Termination	Impedance, 50 ohms; connectors, BNC.	Signal termination	a. Tektronix Part Number 011-0049-01.
8. Cable	Impedance, 50 ohms; connectors, BNC; length, 42 inches.	Signal interconnection	a. Tektronix Part Number 012-0057-01.
9. Time-Mark Generator	Marker outputs, 2 ns to 0.5 s; marker accuracy, within 0.1%; trigger output, 1 ms to 0.1 μs, coincident with time markers.	Horizontal timing checks and adjustments	a. Tektronix TM 501 Time Mark Generator ² .

¹ Used for calibration procedure only; not used for performance check.

² Requires a TM-Series power module.

PERFORMANCE CHECK

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Control Settings:

	Display	
INTENSITY		midrange
FOCUS		midrange
Horizontal POSITION		midrange
	Vertical	
VOLTS/DIV		.5 V
VAR VOLTS/DIV		calibrated detent
AC-GND-DC		DC
INVERT		off (button out)
VERT MODE		CH 1
100 or 20 MHz BW		full bandwidth (push in, then re- lease)
	Trigger (A and B)	
COUPLING		AC
LEVEL		0
SLOPE		+
A TRIGGER SOURCE		NORM
B TRIGGER SOURCE		STARTS AFTER DELAY
TRIG MODE		AUTO
A TRIG HOLDOFF		NORM
	Sweep	
A and B TIME/DIV		1 ms
VAR TIME/DIV		calibrated detent
DELAY TIME POSITION		fully counterclock- wise (ccw)

HORIZ DISPLAY
X10 MAG button

A
off (button out)

20. CHECK VARIABLE TIME/DIVISION RANGE

- a. Set time-mark generator for 5 millisecond time marks. Connect through a 42-inch, 50-ohm BNC cable and a 50-ohm BNC termination to CH 1 input.
- b. Set A TRIGGER LEVEL for stable triggered display, then set VAR TIME/DIV fully counterclockwise.
- c. CHECK—That VAR TIME/DIV UNCAL light is illuminated.
- d. CHECK—For at least 6 time marks between 1st and last graticule lines.
- e. Return VAR TIME/DIV control to calibrated detent.

21. CHECK SWEEP LENGTH AND HORIZONTAL POSITION RANGE

- a. Set time-mark generator for 1 millisecond time marks.
- b. CHECK—Sweep length for at least 10.1 divisions.
- c. Turn POSITION and FINE (Horiz) fully clockwise. (Also check that each control will position trace.)
- d. CHECK—That start of sweep is to right of graticule center.
- e. Turn POSITION and FINE (Horiz) fully counterclockwise.
- f. CHECK—That end of sweep is to left of graticule center.
- g. Recenter POSITION and FINE (Horiz).

22. CHECK A TIMING ACCURACY

- a. Set TIME/DIV to 0.01 μ s, time-mark generator for 10 nanosecond time marks, TRIG MODE to NORM, and A TRIGGER LEVEL for stable triggered display.

NOTE

Unless otherwise stated, set POSITION and FINE (Horiz) so first time mark will coincide with first graticule line and check that a time mark will coincide with last vertical graticule line.

- b. CHECK—That TIME/DIV settings from 0.01 μ s to 5 ms/division at 1st and 11th graticule lines are within 1% from +20°C to +30°C; within 3% from –15°C to +55°C.

NOTE

Turn INTENSITY full on, note start of sweep and exclude first 25 nanoseconds from start of sweep when checking 0.01 and 0.02 μ s/division. Set time-mark generator as necessary to provide 1 or more time marks/division as each TIME/DIV setting is selected throughout horizontal check procedure.

- c. CHECK—That TIME/DIV settings from 10 ms to 0.5 s/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 3% from –15°C to +55°C.

23. CHECK A INTENSIFIED TIMING ACCURACY

- a. Set HORIZ DISPLAY to A INTEN, TIME/DIV to 0.05 μ s, and time-mark generator for 50 nanosecond time marks (DELAY TIME POSITION should be fully counterclockwise).

- b. CHECK—That TIME/DIV settings from 0.05 μ s to 0.5 s/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 4% from –15°C to +55°C.

24. CHECK A INTENSIFIED MAGNIFIED TIMING ACCURACY

- a. Set TIME/DIV to 0.05 μ s, time-mark generator for 5 nanosecond time marks, and press X10 MAG to on.

- b. CHECK—That TIME/DIV settings from 0.05 μ s to 0.5 s/division at 1st and 11th graticule lines are within 3% from +20°C to +30°C; within 4% from –15°C to +55°C (see following note).

NOTE

Turn INTENSITY fully on, note start of sweep and exclude first 25 nanoseconds from start of sweep or first 2 major unblanked divisions at normal intensity (whichever is greater) and all beyond the 100th division when checking magnified sweep rates.

25. CHECK A MAGNIFIED TIMING ACCURACY

- a. Set TIME/DIV to 0.01 μ s, A TRIGGER SOURCE to EXT, and A TRIGGER COUPLING to LF REJ.

- b. Set time-mark generator for 2 nanosecond time marks and connect trigger output through a 42-inch, 50-ohm BNC cable and a 50-ohm BNC termination to A TRIGGER external input (if a 2901 time-mark generator is used, set trigger selector for 0.1 microsecond triggers).

Insert a 500 megahertz filter between 50-ohm BNC termination and CH 1 input. Adjust filter for minimum unwanted modulation from time mark generator, as necessary, whenever 2 and 5 nanosecond time marks are used in this step.

- c. Set CH 1 VOLTS/DIV to maintain a convenient display amplitude and set A TRIGGER LEVEL for stable display. (It may be necessary to adjust A TRIGGER HOLDOFF for best triggered display through this step.)

- d. CHECK—That TIME/DIV settings from 0.01 to 0.05 μ s/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 4% from –15°C to +55°C.

- e. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval at all TIME/DIV settings (see following note).

NOTE

If waveform has modulation, check 2 division accuracy between adjacent time marks of equal amplitude.

Turn INTENSITY full on, note start of sweep and exclude first 25 nanoseconds from start of sweep or first 2 major unblanked divisions at normal intensity (whichever is greater) and all beyond the 100th division when checking magnified sweep rates.

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f. Remove the trigger cable setup from A TRIGGER external input, set A TRIGGER SOURCE to NORM and A TRIGGER COUPLING to AC. Remove 500 megahertz filter, if used. If CH 1 input was grounded in previous checks, set CH 1 AC-GND-DC switch to DC.

g. Set TIME/DIV to 0.1 μ s, set time-mark generator for 0.1 microsecond time marks and set CH 1 VOLTS/DIV to maintain a convenient display amplitude.

h. CHECK—That TIME/DIV settings from 0.1 μ s to 5 ms/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.

i. CHECK—That TIME/DIV settings from 10 ms to 0.5 s/division at 1st and 11th graticule lines are within 3% from +20°C to +30°C; within 4% from -15°C to +55°C.

26. CHECK DIFFERENTIAL DELAY TIME ACCURACY

- a. Set: HORIZ DISPLAY A INTEN
- A TIME/DIV 1 ms
- DELAY TIME POSITION fully ccw

b. Pull knob to unlock DLY'D SWP and set to 5 μ s. Set X10 MAG to out position.

c. Set time-mark generator for 1 millisecond time marks.

d. Turn DELAY TIME POSITION to intensify the 2nd displayed time marker.

e. Set HORIZ DISPLAY to B DLY'D. Turn DELAY TIME POSITION to set leading edge of nearest time marker to graticule center.

f. Push DM TIME ZERO.

g. Turn DELAY TIME POSITION to each succeeding time marker and note DM reading for each. See Table 5-13 for required accuracies.

h. CHECK—Delay time accuracy for each condition listed in Table 5-14, columns 1, 2, and 3, using following procedure:

- (1) Set HORIZ DISPLAY to A INTEN.
- (2) Turn DELAY TIME POSITION to intensify time marker indicated in column 4.
- (3) Set HORIZ DISPLAY to B DLY'D. Turn DELAY TIME POSITION to set displayed time marker to graticule center.
- (4) Push DM TIME ZERO.
- (5) Turn DELAY TIME POSITION to position time marker indicated in column 5 to graticule center.
- (6) DM reading should be within limits shown in column 6 or 7.

TABLE 5-13
Differential Delay Time Accuracy

Time-Marker Displayed	DM Reading	
	+15°C to +35°C ($\pm 1\%$, ± 1 count)	-15°C to +15°C +35°C to +55°C ($\pm 1.5\%$, ± 1 count)
3	.9899 to 1.011	.9849 to 1.016
4	1.979 to 2.021	1.969 to 2.031
5	2.969 to 3.031	2.954 to 3.046
6	3.959 to 4.041	3.939 to 4.061
7	4.949 to 5.051	4.929 to 5.076
8	5.939 to 6.061	5.909 to 6.091
9	6.929 to 7.071	6.894 to 7.106
10	7.919 to 8.081	7.879 to 8.121

27. CHECK DELAY-TIME JITTER

- a. Set A TIME/DIV to 1 ms and DLY'D SWP to .2 μ s. Turn DELAY TIME POSITION fully counterclockwise.
- b. Set time-mark generator for 1 millisecond time marks.

TABLE 5-14
Delay Time Accuracy

Time Mark Gen (1)	A Time/Div (2)	B Time/Div (3)	Time Marker at Graticule Center Initially (4)	Center Marker Number (5)	DM Reading	
					+15°C to +35°C (1%, ± 1 count) (6)	-15°C to +15°C +35°C to +55°C (1.5%, ± 1 count) (7)
50 ns	.05 μs	.01 μs	2	10	0.395 to 0.405	0.393 to 0.407
.1 μs	.1 μs	.01 μs	2	10	0.791 to 0.809	0.787 to 0.813
.2 μs	.1 μs	.02 μs	2	10	1.583 to 1.617	1.575 to 1.625
.5 μs	.5 μs	.05 μs	2	10	03.95 to 04.95	03.93 to 04.07
1 μs	1 μs	.1 μs	2	10	07.91 to 08.09	07.87 to 08.13
2 μs	2 μs	.2 μs	2	10	15.83 to 16.17	15.75 to 16.25
5 μs	5 μs	.5 μs	2	10	039.5 to 040.5	039.3 to 040.7
10 μs	10 μs	1 μs	2	10	079.1 to 080.9	078.7 to 081.3
20 μs	20 μs	2 μs	2	10	158.3 to 161.7	157.5 to 162.5
50 μs	50 μs	5 μs	2	10	0.395 to 0.405	0.393 to 0.407
.1 ms	.1 ms	10 μs	2	10	0.791 to 0.809	0.787 to 0.813
.2 ms	.2 ms	20 μs	2	10	1.583 to 1.617	1.575 to 1.625
.5 ms	.5 ms	50 μs	2	10	03.95 to 04.05	03.93 to 04.07
1 ms	1 ms	.1 ms	2	10	07.91 to 08.09	07.87 to 08.13
2 ms	2 ms	.2 ms	2	10	15.83 to 16.17	15.75 to 16.25
5 ms	5 ms	.5 ms	2	10	039.5 to 040.5	039.3 to 040.7
10 ms	10 ms	1 ms	2	10	079.1 to 080.9	078.7 to 081.3
20 ms	20 ms	2 ms	2	10	158.3 to 161.7	157.5 to 162.5
50 ms	50 ms	5 ms	2	10	0.395 to 0.405	0.393 to 0.407
.1 s	.1 s	10 ms	2	10	0.791 to 0.809	0.787 to 0.813
.2 s	.2 s	20 ms	2	10	1.583 to 1.617	1.575 to 1.625
.5 s	.5 s	50 ms	2	10	03.95 to 04.05	03.93 to 04.07

c. Turn DELAY TIME POSITION control to position nearest time marker to graticule center.

d. CHECK—That jitter on leading edge of time marker does not exceed 1 major division for 60 Hz power line or 2.5 divisions for 50 Hz power line.

e. Turn DELAY TIME POSITION to view each time marker and check delay-time jitter for limits stated in part d.

28. CHECK MIX (MIXED SWEEP) TIMING ACCURACY

a. Set DLY'D SWP to 0.02 μs, A TIME/DIV to 0.05 μs, HORIZ DISPLAY to MIX and DELAY TIME POSITION fully clockwise.

b. Set time-mark generator for 50 nanosecond time-marks.

c. CHECK—That A TIME/DIV settings from 0.02 μs to 0.5 s/division at 2nd and 10th graticule lines (8 division

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timing) are within 3%. Exclude first 0.5 division from start of sweep when checking A sweep. Set DLY'D SWP at least 1 sweep setting faster than A sweep setting on all ranges. Set time-mark generator to maintain appropriate time marks.

d. Set DELAY TIME POSITION fully counterclockwise, DLY'D SWP to $0.05 \mu\text{s}$, A TIME/DIV to $0.1 \mu\text{s}$ and time-mark generator for 50 nanoseconds time marks.

e. CHECK—That DLY'D SWP settings from $0.05 \mu\text{s}$ to 0.5 s/division at 2nd and 10th graticule lines (8 division timing) are within 3%. Exclude first 0.2 division or 0.1 microsecond (whichever is greater) after the transition of A to B. Set DLY'D SWP at least 1 sweep setting faster than A sweep setting on all ranges. Set time-mark generator to maintain appropriate time marks.

f. Disconnect all test equipment.

29. CHECK X GAIN

a. Set TRIG MODE to AUTO, DLY'D SWP to lock knobs, TIME/DIV to X-Y, VERT MODE to CH 2 and X (CH 1) VOLTS/DIV to 5 mV.

b. Set amplitude calibrator to 20 millivolts and connect to X (CH 1) input through 42-inch 50-ohm BNC cable.

c. Set X (CH 1) and Y (CH 2) POSITION controls to set 2-dot display at graticule center.

d. CHECK—Deflection between the 2 displayed dots for 4 divisions within 3%.

e. Disconnect all test equipment.

30. CHECK X BANDWIDTH

NOTE

See Additional Test Equipment Required for 475, Table 5-12, for selection of sine-wave generator with an output of 100 megahertz and below.

a. Connect sine-wave generator output cable through 50-ohm termination to X input.

b. Set sine-wave generator for 4 division horizontal display of reference frequency.

c. Increase frequency of sine-wave generator until display is reduced to 2.8 divisions.

d. CHECK—Sine-wave generator for reading of 3 megahertz or higher.

e. Disconnect all test equipment.

CALIBRATION

See **ADJUSTMENT LOCATIONS** pullout page for adjustments and test points.

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NOTE

All Horizontal System adjustments not accessible through holes in DM circuit board are located on oscilloscope Interface circuit board. Refer to oscilloscope service manual for adjustment locations.

PROCEDURE

60. ADJUST HORIZONTAL GAIN

- a. Set time-mark generator for 1 millisecond time marks and connect through 42-inch, 50-ohm BNC cable and 50-ohm BNC termination to CH 1 input.
- b. Set A TRIGGER LEVEL for stable triggered display.

NOTE

Unless otherwise stated, set POSITION and FINE (Horiz) controls so 1st time mark will coincide with 1st vertical graticule line and check that a time mark coincides with last vertical graticule line.

- c. CHECK—That 1st and 11th time marks coincide with graticule lines within 1% from +20°C to +30°C; within 3% from -15°C to +55°C.
- d. ADJUST—Horizontal Gain R1155 for 1 time-mark/division.

NOTE

Effective range of R1155 is determined by selected value of R1154. Value of R1154 may be altered to obtain necessary range of R1155.

- e. Press X10 MAG and set time-mark generator for 0.1 millisecond time marks.
- f. CHECK—That X10 MAG light is illuminated.
- g. CHECK—That 1st and 11th time marks coincide with graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.
- h. Set X10 MAG to off and set time-mark generator for 1 millisecond time marks.

61. ADJUST INTENSIFIED GAIN

- a. Set HORIZ DISPLAY to A INTEN.
- b. CHECK—That 1st and 11th time marks coincide with graticule lines within 2% from +20°C to +30°C; within 3% from -15°C to +55°C.
- c. ADJUST—Intensified Gain R950 for 1 time-mark/division.

62. CHECK—ADJUST DELAY START AND DELAY STOP

- a. Connect time-mark generator to CH 1 input through 50-ohm BNC cable and 50-ohm termination.
- b. Set time-mark generator for .1 millisecond time marks.
- c. Set HORIZ DISPLAY to A INTEN.
- d. Set A TIME/DIV to .1 ms and B TIME/DIV to .05 μ s. Adjust TRIGGER LEVEL controls for stable display.
- e. Set DELAY TIME POSITION fully counterclockwise.
- f. CHECK—That start of intensified portion of display is on 1st time marker (top of intensified portion of time marker should be below top of marker).
- g. ADJUST—Delay Start R938 to position start of intensified portion (top) to center of time marker.
- h. Set DELAY TIME POSITION control fully clockwise.
- i. CHECK—That start of intensified portion is on 10th time marker.
- j. ADJUST—Delay Stop R936 to position start of the intensified portion (top) to center of 10th time marker.
- k. INTERACTION—Repeat parts e through j until there is no visible interaction.

63. CHECK—ADJUST TIME ZERO

- a. Set:

A TIME/DIV	.2 ms
B TIME/DIV	.5 μ s
DELAY TIME POSITION	Fully ccw
HORIZ DISPLAY	A INTEN
- b. Set time-mark generator for 0.1 millisecond time marks.
- c. Turn DELAY TIME POSITION to intensify 3rd time marker.
- d. Hold DM TIME ZERO in.

- e. ADJUST—Time Zero R2372 for .0000 reading (while holding TIME ZERO in). Release TIME ZERO. Display should remain at .0000.

64. CHECK—ADJUST TIME ADJUSTMENT

- a. Set HORIZ DISPLAY to B DLY'D.
- b. Position nearest time marker to graticule center.
- c. Press TIME ZERO.
- d. Turn DELAY TIME POSITION to place 16th succeeding time marker to graticule center.
- e. ADJUST—Time Adj R2384 for reading of 1.600 and note that ms light is on.
- f. INTERACTION—Repeat part b (in TIME ZERO Adj) through part e (in TIME Adj) until no interaction is noted.

65. ADJUST MAGNIFIED REGISTRATION

- a. Set DLY'D SWP to 1 ms (lock knobs) and HORIZ DISPLAY to A.
- b. Set time-mark generator for 5 millisecond time marks.
- c. Press X10 MAG, set center time mark of display to graticule center with POSITION (Horiz), then press and release X10 MAG to off.
- d. CHECK—That center time mark is within 0.5 division of graticule center.
- e. ADJUST—Magnified Registration R1130 to position center time mark to graticule center.
- f. Repeat parts c through e, as necessary, for minimum shift when switching from magnified to unmagnified.

66. CHECK VAR TIME/DIV RANGE

- a. Set VAR TIME/DIV fully counterclockwise.

- b. CHECK—That TIME/DIV UNCAL light is illuminated.
- c. CHECK—For at least 6 time marks in 10 divisions.
- d. Return VAR TIME/DIV control to calibrated detent.

67. CHECK SWEEP LENGTH AND HORIZONTAL POSITION RANGE

- a. Set time-mark generator for 1 millisecond time marks.
- b. CHECK—Sweep length for at least 10.1 divisions.
- c. Turn POSITION and FINE (Horiz) fully clockwise. (Also check that each control will position trace.)
- d. CHECK—That start of sweep is to right of graticule center.
- e. Turn POSITION and FINE (Horiz) fully counterclockwise.
- f. CHECK—That end of sweep is to left of graticule center.
- g. Recenter POSITION and FINE (Horiz).

68. CHECK—ADJUST 20 μ s TIMING

- a. Set A and B TIME/DIV to 20 μ s.
- b. Set time-mark generator for 20 microsecond time marks. Align 1st time marker with 1st graticule line using Horizontal POSITION and FINE.
- c. CHECK—That 1st and 11th time markers coincide with 1st and 11th graticule lines within 1% from +20°C to +30°C and within 3% from -15°C to +20°C and +30°C to +55°C.
- d. ADJUST—C1064 for 1 time-mark/division.
- e. Set HORIZ DISPLAY to A INTEN and unlock (pull) DLY'D SWP and set to .2 μ s.

- f. Set DELAY TIME POSITION to intensify 2nd time marker.
- g. Switch HORIZ DISPLAY to B DLY'D.
- h. Turn DELAY TIME POSITION to set displayed time marker to graticule center line.
- i. Push DM TIME ZERO.
- j. Set HORIZ DISPLAY to A INTEN.
- k. Turn DELAY TIME POSITION to intensify 10th time marker.
- l. Switch HORIZ DISPLAY to B DLY'D.
- m. Position displayed time marker to graticule center using DELAY TIME POSITION.
- n. CHECK—That DM reading is 160.0 within 1% \pm 1 count, (158.3 to 161.7).
- o. Turn DELAY TIME POSITION for DM reading of 160.0.
- p. ADJUST—C1023 to position displayed time marker to graticule center.
- q. INTERACTION—Repeat parts e through p until there is no visible interaction.

69. CHECK—ADJUST .2 μ s TIMING

- a. Set HORIZ DISPLAY to A. Set DLY'D SWP to 10 μ s to lock knobs.
- b. Set TIME/DIV to .2 μ s.
- c. Set time-mark generator for 0.2 microsecond time marks.
- d. CHECK—That 1st and 11th time markers coincide with 1st and 11th graticule lines within 1% from +20°C

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to +30°C and within 3% from –15°C to +15°C and +30°C to +55°C.

e. ADJUST—C1009 for 1 time marker/division.

f. Set HORIZ DISPLAY to A INTEN and unlock (pull) DLY'D SWP and set to .01 μ s.

g. Turn DELAY TIME POSITION to set start of intensified portion on leading edge of 2nd time marker.

h. Switch HORIZ DISPLAY to B DLY'D.

i. Turn DELAY TIME POSITION to set nearest time marker to graticule center line.

j. Push DM TIME ZERO.

k. Set HORIZ DISPLAY to A INTEN.

l. Turn DELAY TIME POSITION to set start of intensified portion on leading edge of 10th time marker.

m. Switch HORIZ DISPLAY to B DLY'D.

n. Position displayed time marker to graticule center, using DELAY TIME POSITION.

o. CHECK—That DM reading is 1.600 within 1% \pm 1 count (1.583 to 1.617).

p. Turn DELAY TIME POSITION for DM reading of 1.600.

q. ADJUST—C1025 to position displayed time marker to graticule center.

r. INTERACTION—Repeat parts g through q until there is no visible interaction.

70. ADJUST HORIZONTAL OUTPUT CENTERING

a. Set HORIZ DISPLAY to A, DLY'D SWP to 0.1 μ s (lock knobs), TIME/DIV to X-Y, VERT MODE to CH 2 and CH 1 AC-GND-DC switch to GND.

b. Set dot display to graticule center with X (CH 1) and Y (CH 2) POSITION.

c. Connect digital voltmeter (set to read at least 50 volts) negative lead to GND test point on main interface circuit board and compare readings between collectors (transistor cases) of Q1204 and Q1214.

d. Set POSITION (Horiz) for equal readings between transistor collectors of Q1204 and Q1214 and note final reading.

e. CHECK—For reading of +50 volts within 2 volts.

f. ADJUST—Horizontal DC Centering R1256 for a reading of +50 volts.

g. Disconnect digital voltmeter.

71. ADJUST HIGH-SPEED TIMING (VISUAL METHOD)

NOTE

This step is intended to check high-speed timing and, if necessary, perform minor recalibration. If timing cannot be adjusted to within specified accuracy, major recalibration will be performed in step 72.

a. Set TIME/DIV to 0.05 μ s, VERT/MODE to CH 1, press X10 MAG to on, set A TRIGGER SOURCE to EXT and A TRIGGER COUPLING to LF REJ.

b. Set time-mark generator for 5 nanosecond time marks and connect trigger output through 42-inch 50-ohm BNC cable and 50-ohm BNC termination to A TRIGGER external input. (If a 2901 time-mark generator is used, set trigger selector for 0.1 microsecond triggers).

Insert a 500 megahertz filter between the 50-ohm BNC termination and CH 1 input. Adjust filter for minimum unwanted modulation from time-mark generator, as necessary, throughout high-speed timing procedure.

c. Set CH1 VOLTS/DIV to maintain a convenient display amplitude in this step. Set A TRIGGER LEVEL for stable triggered display throughout high-speed timing procedure.

d. CHECK—That 1st and 11th time marks coincide with

graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.

e. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval. (See following note.)

NOTE

(1) If waveform has modulation, check 2 division accuracy between adjacent time marks of equal amplitude.

(2) Turn INTENSITY full on and position spot at start of sweep to graticule area with POSITION (Horiz).

Exclude the first 25 nanoseconds from start of sweep or first 25 major unblanked divisions at normal intensity (whichever is greater) and all beyond the 100th division when checking magnified sweep rates.

f. ADJUST—C1253 and C1233, in equal amounts, for 1 cycle/division.

g. Set TIME/DIV to 0.02 μs and set time-mark generator for 2 nanosecond time-marks.

NOTE

It may be necessary to adjust A TRIGGER HOLDOFF for best triggered display through this step.

h. CHECK—That 1st and 11th time marks coincide with graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.

i. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval.

j. ADJUST—C1179 for 1 cycle/division.

k. INTERACTION—Between 0.05 and 0.02 microsecond magnified timing. Set TIME/DIV to 0.05 μs, set time-mark generator for 5 nanosecond time marks and repeat parts d through i as necessary for best timing accuracy.

l. Set TIME/DIV to 0.01 μs.

m. CHECK—That 1st and 6th cycles coincide with grati-

cule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.

n. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval.

o. ADJUST—1 Nanosecond Timing R1075 for 1 cycle/2 divisions.

p. Set X10 MAG to off and set time-mark generator for 10 nanosecond time marks.

q. CHECK—That 1st and 11th cycles coincide with graticule lines within 1% from +20°C to +30°C; within 3% from -15°C to +55°C. Turn INTENSITY full on, note start of sweep and exclude first 25 nanoseconds from start of sweep. Return to normal intensity.

r. ADJUST—10 Nanosecond Timing R1080 for 1 cycle/division. (R1080 may not appear in early instruments. If not present, see note following part s.)

s. INTERACTION—Between 0.01 microsecond unmagnified and 0.01 microsecond magnified timing. Set X10 MAG to on and repeat parts m through q for best timing accuracy.

NOTE

If timing cannot be adjusted to within specified accuracy, proceed with step 72. If timing is within specified accuracy, proceed with step 73.

72. ADJUST HIGH-SPEED TIMING (CURRENT-PROBE METHOD)

NOTE

This step is intended for only major recalibration of high-speed timing. Any reference to 475 through calibration procedure refers to instrument under calibration.

a. Set TIME/DIV to 0.02 μs, center display on graticule with POSITION (Horiz) and press X10 MAG to on.

b. Set time-mark generator for 2 nanosecond time marks and set CH 1 VOLTS/DIV to maintain convenient display amplitude through this step.

- c. Connect current probe with passive termination to channel 1 of test oscilloscope. Set passive termination to 1 mA/mV.
- d. Connect probe head around crossed horizontal deflection plate leads. See Fig. 5-2 for location of leads and proper probe connection.
- e. Set test oscilloscope vertical mode to channel 1, time/division to 0.2 microseconds, X10 magnifier to on and channel 1 volts/division to 20 millivolts. Position current pulse at beginning of sweep to graticule center.
- f. CHECK—Test oscilloscope display for a symmetrical, flat-top current waveform similar to that in Fig. 5-3.

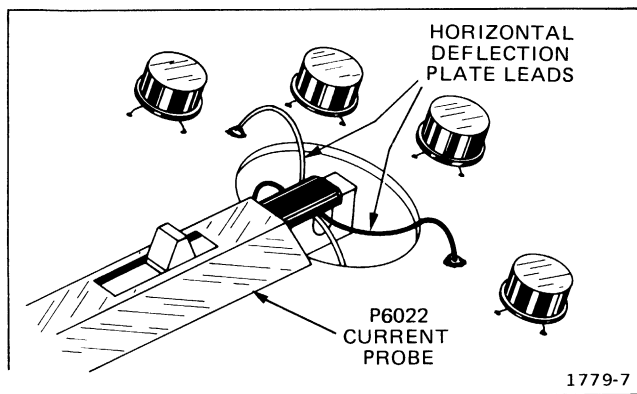


Fig. 5-2. Proper connection of Current Probe to Horizontal Deflection Plate leads for High-Speed Timing calibration.

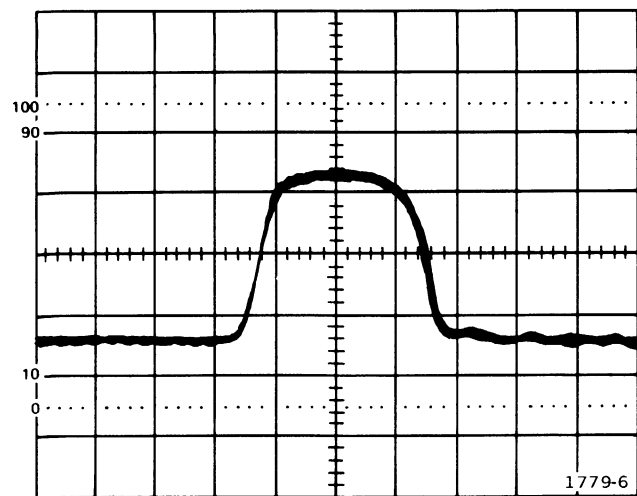


Fig. 5-3. Typical display on test oscilloscope when High-Speed Timing is properly adjusted. (475 set at 2 nanoseconds/division).

- g. ADJUST—C1253, C1233, C1179, R1185 and R1175 for a symmetrical, flat-top current waveform.
- h. CALIBRATION AID—Preset C1253 and C1233 for approximately 25% of maximum capacitance, preset C1179 near maximum capacitance (near clockwise stop) and preset R1185 near maximum resistance (near clockwise stop).

Adjust R1175 for a flat top and fast leading edge on current waveform at 475 TIME/DIV settings of 0.02 μ s and 0.01 μ s. Adjust R1185 for best overall flat top on current waveform with TIME/DIV set at 0.02 μ s. C1253 and C1233 may be adjusted individually for a symmetrical current waveform with a fast trailing edge.

- i. INTERACTION—Between all adjustments in this step. Repeat adjustment procedure in part g as necessary to obtain best symmetrical, flat-top current waveform.
- j. Set 475 TIME/DIV to 0.05 μ s and set time-mark generator for 5 nanosecond time marks.
- k. CHECK—That 1st and 11th cycles coincide with graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.
- l. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval (see following note).

NOTE

(1) If waveform has amplitude modulation, check 2-division accuracy between adjacent time marks of equal amplitude.

(2) Turn INTENSITY full on and position spot at start of sweep to graticule area with POSITION (Horiz).

Exclude first 25 nanoseconds from start of sweep or first 2 major unblanked divisions at normal intensity (whichever is greater) and all beyond 100th division when checking magnified sweep rates.

- m. ADJUST—C1253 and C1233, in equal amounts, for 1 cycle/division.
- n. Set TIME/DIV to 0.02 μ s and set time-mark generator for 2 nanosecond time marks.

NOTE

In following parts, it may be necessary to adjust R1185 and R1175 to maintain a symmetrical, flat-top current waveform.

- o. CHECK—That 1st and 11th cycles coincide with graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.
- p. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval.
- q. ADJUST—C1179 for 1 cycle/division.
- r. INTERACTION—Between 0.05 and 0.02 microsecond magnified timing. Repeat parts j through p as necessary for best timing accuracy.
- s. Set TIME/DIV to 0.01 μ s.
- t. CHECK—That 1st and 6th cycles coincide with graticule lines within 2% from +20°C to +30°C; within 4% from -15°C to +55°C.
- u. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval.
- v. ADJUST—1 Nanosecond Timing R1075 for 1 cycle/2 divisions.
- w. Disconnect current probe without disturbing deflection plate leads.
- x. INTERACTION—Between timing with current probe connected and timing without current probe. Repeat parts j through u for best timing accuracy. (Disregard note between n and o.)
- y. Set X10 MAG to off and set time-mark generator for 10 nanosecond time marks.
- z. CHECK—That 1st and 11th cycles coincide with graticule lines within 1% from +20°C to +30°C; within 3% from -15°C to +55°C. Exclude first 25 nanoseconds from start of sweep.
- aa. ADJUST—10 Nanosecond Timing R1080 for 1 cycle/

division. (R1080 may not appear in early instruments. If not present, proceed to part ac.)

- ab. INTERACTION—Between 0.01 microsecond unmagnified and 0.01 magnified timing. Press X10 MAG to on and repeat parts t, u, v, y, z and as for best timing accuracy, both magnified and unmagnified.
- ac. Set TIME/DIV to 0.1 μ s, CH 1 AC-GND-DC switch to DC and time-mark generator for 0.1 microsecond time marks.
- ad. CHECK—That 1st and 11th time marks coincide with graticule lines within 1% from +20°C to +30°C; within 3% from -15°C to +55°C.
- ae. ADJUST—C1009 for 1 time mark/division.

af. INTERACTION—Between adjustment of C1009 and high-speed timing. If adjustment was made in part ae, press X10 MAG to on and repeat parts j through v, y, z and aa for best timing accuracy.

ag. Remove the trigger cable setup from A TRIGGER external input, set A TRIGGER SOURCE to NORM and set A TRIGGER COUPLING to AC.

73. CHECK A TIMING ACCURACY

- a. Set CH 1 AC-GND-DC switch to DC, CH 1 VOLTS/DIV to 0.5 V and TRIG MODE to NORM.
- b. CHECK—That TIME/DIV settings from 0.01 μ s to 5 ms/division at 1st and 11th graticule lines are within 1% from +20°C to +30°C; within 3% from -15°C to +55°C. Set time-mark generator to maintain appropriate time marks through this step. Exclude first 25 nanoseconds from start of sweep when checking 0.01 and 0.02 μ s/division.
- c. CHECK—That TIME/DIV settings from 10 ms to 0.5 s/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 3% from -15°C to +55°C.

74. CHECK A INTENSIFIED TIMING ACCURACY

- a. Set HORIZ DISPLAY to A INTEN and DELAY TIME POSITION fully counterclockwise.

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b. CHECK—That TIME/DIV settings from 0.05 μ s to 0.5 s/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 3% from -15°C to +55°C. Set time-mark generator to maintain appropriate time marks.

75. CHECK A INTENSIFIED MAGNIFIED TIMING ACCURACY

a. Press X10 MAG to on.

b. CHECK—That TIME/DIV settings from 0.05 μ s to 0.5 s/division at 1st and 11th graticule lines are within 3% from +20°C to +30°C; within 4% from -15°C to +55°C. Set time-mark generator to maintain appropriate time marks. See NOTE following step 72, part I.

76. CHECK A MAGNIFIED TIMING ACCURACY

a. Set HORIZ DISPLAY to A.

b. CHECK—That TIME/DIV settings from 0.01 μ s to 5 ms/division at 1st and 11th graticule lines are within 2% from +20°C to +30°C; within 4% from -15°C to +55°C. Set time-mark generator to maintain appropriate time marks through this step. See NOTE following step 72, part I.

c. CHECK—That TIME/DIV settings from 10 ms to 0.5 s/division at 1st and 11th graticule lines are within 3% from +20°C to +30°C; within 4% from -15°C to +55°C.

d. CHECK—That accuracy is within 5% (0.1 division) over any 2 division interval at all TIME/DIV settings.

77. CHECK DIFFERENTIAL DELAY TIME ACCURACY

a. Set: HORIZ DISPLAY A INTEN
 A TIME/DIV 1 ms
 DELAY TIME POSITION Fully ccw

b. Pull to unlock DLY'D SWP knob and set to 5 μ s. Set X10 MAG to out position.

c. Set time-mark generator for 1 ms time markers.

d. Turn DELAY TIME POSITION to intensify 2nd displayed time marker.

e. Set HORIZ DISPLAY to B DLY'D. Turn DELAY TIME POSITION to set leading edge of nearest time marker to graticule center.

f. Push DM TIME ZERO.

g. Turn DELAY TIME POSITION to each succeeding time marker and note DM reading for each. See Table 5-15 for required accuracies.

TABLE 5-15
Differential Delay Time Accuracy

Time-Marker Displayed	DM Reading	
	+15°C to +35°C ($\pm 1\%$, ± 1 Count)	-15°C to +15°C +35°C to +55°C ($\pm 1.5\%$, ± 1 Count)
3	.9899 to 1.011	.9849 to 1.016
4	1.979 to 2.021	1.969 to 2.031
5	2.969 to 3.031	2.954 to 3.046
6	3.959 to 4.041	3.939 to 4.061
7	4.949 to 5.051	4.929 to 5.071
8	5.939 to 6.061	5.909 to 6.091
9	6.929 to 7.071	6.894 to 7.106
10	7.919 to 8.081	7.879 to 8.121

h. CHECK—Delay accuracy for each condition listed in Table 5-16, columns 1, 2, and 3, using following procedure.

- (1) Set HORIZ DISPLAY to A INTEN.
- (2) Turn DELAY TIME POSITION to intensify time marker indicated in column 4.
- (3) Set HORIZ DISPLAY to B DLY'D. Turn DELAY TIME POSITION to set displayed time marker to graticule center.
- (4) Push DM TIME ZERO.
- (5) Turn DELAY TIME POSITION to position time marker indicated in column 5 to graticule center.
- (6) DM reading should be within the limits shown in column 6 or 7.

TABLE 5-16
Delay Time Accuracy

Time Mark Generator (1)	A Time/Div (2)	B Time/Div (3)	Time Marker At Graticule Center Initially (4)	Center Marker Number (5)	DM Reading Limits	
					+15°C to +35°C (1%, ± 1 Count) (6)	-15°C to +15°C +35°C to +55°C (1.5%, ± 1 Count) (7)
50 ns	.05 μs	.01 μs	2	10	0.395 to 0.405	0.393 to 0.407
.1 μs	.1 μs	.01 μs	2	10	0.791 to 0.809	0.787 to 0.813
.2 μs	.2 μs	.01 μs	2	10	1.583 to 1.617	1.575 to 1.625
.5 μs	.5 μs	.02 μs	2	10	03.95 to 04.95	03.93 to 04.07
1 μs	1 μs	.05 μs	2	10	07.91 to 08.09	07.87 to 08.13
2 μs	2 μs	.1 μs	2	10	15.83 to 16.17	15.75 to 16.25
5 μs	5 μs	.2 μs	2	10	039.5 to 040.5	039.3 to 040.7
10 μs	10 μs	.5 μs	2	10	079.1 to 080.9	078.7 to 081.3
20 μs	20 μs	1 μs	2	10	158.3 to 161.7	157.5 to 162.5
50 μs	50 μs	2 μs	2	10	03.95 to 04.05	03.93 to 04.07
.1 ms	.1 ms	5 μs	2	10	0.791 to 0.809	0.787 to 0.813
.2 ms	.2 ms	10 μs	2	10	1.583 to 1.617	1.575 to 1.625
.5 ms	.5 ms	20 μs	2	10	03.95 to 04.05	03.93 to 04.07
1 ms	1 ms	50 μs	2	10	07.91 to 08.09	07.87 to 08.13
2 ms	2 ms	.1 ms	2	10	15.83 to 16.17	15.75 to 16.25
5 ms	5 ms	.2 ms	2	10	039.5 to 040.5	039.3 to 040.7
10 ms	10 ms	.5 ms	2	10	079.1 to 080.9	078.7 to 081.3
20 ms	20 ms	1 ms	2	10	158.3 to 161.7	157.5 to 162.5
50 ms	50 ms	2 ms	2	10	0.395 to 0.405	0.393 to 0.407
.1 s	.1 s	5 ms	2	10	0.791 to 0.809	0.787 to 0.813
.2 s	.2 s	10 ms	2	10	1.583 to 1.617	1.575 to 1.625
.5 s	.5 s	20 ms	2	10	03.95 to 04.05	03.93 to 04.07

78. CHECK DELAY-TIME JITTER

a. Set A TIME/DIV to 1 ms, and DLY'D SWP to .2 μs. Turn DELAY TIME POSITION fully counterclockwise.

b. Set time-mark generator for 1 ms time markers.

c. Turn DELAY TIME POSITION control to position nearest time marker to graticule center.

d. CHECK—That jitter on leading edge of time marker does not exceed 1 major division for 60 Hz power line or

2.5 divisions for 50 Hz power line.

e. Turn DELAY TIME POSITION to view each time marker and check delay-time jitter for limits stated in part d.

79. CHECK MIX (MIXED SWEEP) TIMING ACCURACY

a. Set DLY'D SWP to 0.02 μs, A TIME/DIV to 0.05 μs, HORIZ DISPLAY to MIX and DELAY TIME POSITION fully clockwise.

Calibration—DM43-DM40 Service (475)

- b. Set time-mark generator for 50 nanosecond time marks.
- c. CHECK—That A TIME/DIV settings from 0.02 μ s to 0.5 s/division at 2nd and 10th graticule lines (8 division timing) are within 3%. Exclude first 0.5 division from start of sweep when checking A sweep. Set DLY'D SWP at least 1 sweep setting faster than A sweep setting on all ranges. Set time-mark generator to maintain appropriate time marks.
- d. Set DELAY TIME POSITION fully counterclockwise, DLY'D SWP to 0.05 μ s and time-mark generator for 50 nanosecond time marks.
- e. CHECK—That DLY'D SWP settings from 0.05 μ s to 0.5 s/division at 2nd and 10th graticule lines (8 division timing) are within 3%. Exclude first 0.2 division or 0.1 microsecond (whichever is greater) after transition of A to B. Set DLY'D SWP at least 1 sweep setting faster than A sweep setting on all ranges. Set time mark generator to maintain appropriate time marks.
- f. Disconnect all test equipment.

80. ADJUST X GAIN

- a. Set TRIG MODE to AUTO, set DLY'D SWP to lock knobs and TIME/DIV to X-Y. Set VERT MODE to CH 2, X (CH 1) VOLTS/DIV to 5 mV, and X (CH 1) AC-GND-DC switch to DC.
- b. Set amplitude calibrator to 20 millivolts and connect to X (CH 1) input through a 42-inch, 50-ohm BNC cable.
- c. Set X and Y POSITION controls to set 2-dot display at graticule center.
- d. CHECK—Deflection between 2 displayed dots for 4 divisions within 3%.
- e. ADJUST—X Gain R1102 for 4 divisions of deflection between the 2 displayed dots.
- f. Adjust X VAR VOLTS/DIV and X POSITION for exactly 2 divisions between displayed dots at graticule center.
- g. Position right dot of display to extreme right graticule line.

- h. CHECK—Display for 0.2 division or less of compression or expansion.
- i. Position left dot of display to extreme left graticule line.
- j. CHECK—Display for 0.2 divisions or less of compression or expansion.
- k. Disconnect all test equipment.

81. ADJUST X-Y PHASE DIFFERENCE

- a. Return X VAR VOLTS/DIV to calibrated detent and set X AC-GND-DC switch to GND.
- b. Set Y VOLTS/DIV to 5 mV.

NOTE

See Additional Test Equipment Required for 475, Table 5-12, for selection of sine-wave generator with an output of 100 megahertz and below.

- c. Connect sine-wave generator output cable through a BNC female-to-BNC female adapter and a BNC T-connector to two 18-inch, 50-ohm BNC cables. Connect 18-inch cables through 50-ohm terminations to X and Y inputs.
- d. Set sine-wave generator for an 8-division display of reference frequency, then set X AC-GND-DC switch to DC.
- e. Center lissajous display on graticule with X and Y POSITION.
- f. CHECK—For 0.14 division or less of opening at center of lissajous display. (Measure horizontally.)
- g. ADJUST—L1103 for minimum opening of lissajous display.
- h. Increase frequency of sine-wave generator to 2 megahertz.

- i. CHECK—For 0.42 division or less of opening at center of lissajous display. (Measure horizontally.)
- j. Disconnect all test equipment.

82. CHECK X BANDWIDTH

- a. Connect sine-wave generator output cable through a 50-ohm termination to X input.
- b. Set sine-wave generator for 4 division horizontal display of reference frequency.
- c. Increase frequency of sine-wave generator until display is reduced to 2.8 divisions.
- d. CHECK—Sine-wave generator for a reading of at least 3 megahertz.
- e. Disconnect all test equipment.

83. CHECK B ENDS A OPERATION

- a. Set TIME/DIV to 1 ms, pull and unlock DLY'D SWP knob and set to 0.1 ms, set VERT MODE to CH 1, HORIZ DISPLAY to A INTEN and A TRIG HOLDOFF to B ENDS A detent.
- b. Increase INTENSITY until A sweep is visible.
- c. Turn DELAY TIME POSITION through its range.
- d. CHECK—That A sweep ends after intensified portion at all settings of DELAY TIME POSITION dial.

84. CHECK A TRIG HOLDOFF OPERATION

- a. Set HORIZ DISPLAY to A, A TRIG HOLDOFF to NORM and DLY'D SWP (B TIME/DIV) to 1 ms (lock knobs).
- b. Connect A +GATE (output connector on rear panel) to channel 1 of test oscilloscope through a 42-inch, 50-ohm BNC cable.
- c. Set test oscilloscope time/division to 1 millisecond, X10 magnifier to off, channel 1 volts/division to 2 volts and trigger slope to negative.
- d. Adjust A TRIG HOLDOFF for maximum time of negative pulse on test oscilloscope display. (Avoid setting near B ENDS A detent where negative portion decreases.
- e. CHECK—That maximum holdoff time is 9 or more times the TIME/DIV setting on 475.
- f. CHECK—475 TIME/DIV settings from 0.01 μ s to 0.5 s for maximum holdoff time of 9 or more times TIME/DIV setting on 475.

This completes the 475 Horizontal system. Return to the 475 Calibration Procedure (GATE OUTPUTS, EXTERNAL Z-AXIS, AND CALIBRATOR).

ELECTRICAL REPLACEABLE PARTS LIST

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	SEP	SEPARATELY
FXD	FIXED	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
0000A	Lemo USA	2015 2nd St.	Berkley, CA 94710
01002	General Electric Co., Industrial and Power Capacitor Products Dept.	John St.	Hudson Falls, NY 12839
01121	Allen-Bradley Co.	1201 2nd St. South	Milwaukee, WI 53204
01295	Texas Instruments, Inc., Components Group	P. O. Box 5012	Dallas, TX 75222
01884	Sprague Electric Co., Dearborn Electronics	P. O. Box 1076	Longwood, FL 32750
02111	Spectrol Electronics Corp.	17070 East Gale Ave.	City of Industry, CA 9174
03508	General Electric Co., Semi-Conductor Products Dept.	Electronics Park	Syracuse, NY 13201
04713	Motorola, Inc., Semiconductor Products Div.	5005 E. McDowell Rd.	Phoenix, AZ 85008
07263	Fairchild Semiconductor, A Div. of Fairchild Camera and Instrument Corp.	464 Ellis St.	Mountain View, CA 94040
07910	Teledyne Semiconductor	12515 Chadron Ave.	Hawthorne, CA 90250
12040	National Semiconductor Corp.	Commerce Drive	Danbury, CT 06810
14936	General Instrument Corp., Semiconductor Products Group	600 W. John St.	Hicksville, NY 11802
17856	Siliconix, Inc.	2201 Laurelwood Rd.	Santa Clara, CA 95050
22229	Solitron Devices, Inc.	8808 Balboa Ave.	San Diego, CA 92123
27014	National Semi-Conductor Corp.	2900 San Ysidro Way	Santa Clara, CA 95051
50579	Litronix Inc.	19000 Homestead Rd.	Cupertino, CA 95014
56289	Sprague Electric Co.		North Adams, MA 01247
71590	Centralab Electronics, Div. of Globe-Union, Inc.	5757 N. Green Bay Ave.	Milwaukee, WI 53201
71744	Chicago Miniature Lamp Works	4433 Ravenswood Ave.	Chicago, IL 60640
72982	Erie Technological Products, Inc.	644 W. 12th St.	Erie, PA 16512
73138	Beckman Instruments, Inc., Helipot Div.	2500 Harbor Blvd.	Fullerton, CA 92634
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 97005
80294	Bourns, Inc., Instrument Div.	6135 Magnolia Ave.	Riverside, CA 92506
81483	International Rectifier Corp.	9220 Sunset Blvd.	Los Angeles, CA 90069
84411	TRW Electronic Components, TRW Capacitors	112 W. First St.	Ogallala, NB 69153
90201	Mallory Capacitor Co., Div. of P. R. Mallory Co., Inc.	3029 E. Washington St.	Indianapolis, IN 46206
91637	Dale Electronics, Inc.	P. O. Boxz	

DM43

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number
		Eff	Dscont			
A1	670-3471-00	B010100	B010919	CKT BOARD ASSY:MAIN DVM(464,465,466,DM43)	80009	670-3471-00
A1	670-3471-05	B010920		CKT BOARD ASSY:MAIN DVM(464,465,466,DM43)	80009	670-3471-05
A1	670-3471-02	B010100	B010919	CKT BOARD ASSY:MAIN DVM(475,DM43)	80009	670-3471-02
A1	670-3471-06	B010920		CKT BOARD ASSY:MAIN DVM(475,DM43)	80009	670-3471-06
A2	670-3469-00			CKT BOARD ASSY:READOUT DVM(DM43/DM40)	80009	670-3469-00
A3	670-3470-00			CKT BOARD ASSY:POWER SUPPLY DVM(DM43/DM40)	80009	670-3470-00
C2315	285-0598-00			CAP., FXD, PLSTC:0.01UF, 5%, 100V	01002	64F10AC103
C2318	281-0629-00			CAP., FXD, CER DI: 33PF, 5%, 600V	72982	308-000COG0330G
C2336	281-0523-00			CAP., FXD, CER DI: 100PF, +/-20PF, 350V	72982	301-000U2M0101M
C2341	283-0051-00	B010100	B010919X	CAP., FXD, CER DI:0.0033UF, 5%, 100V	72982	8131N145COG332J
C2342	283-0051-00	B010100	B010919X	CAP., FXD, CER DI:0.0033UF, 5%, 100V	72982	8131N145COG332J
C2354	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2355	281-0546-00			CAP., FXD, CER DI: 330PF, 10%, 500V	72982	301-000X5P0331K
C2356	285-0808-00			CAP., FXD, PLSTC:0.1UF, 10%, 50V	01884	LP88A1A104K004
C2358	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2359	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2361	290-0524-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 10V	90201	TDC475M010EL
C2363	290-0340-00			CAP., FXD, ELCTLT: 10UF, 10%, 50V	56289	109D106X9050C2
C2366	283-0001-00			CAP., FXD, CER DI:0.005UF, +100-0%, 500V	72982	831-559E502P
C2369	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2372	285-0598-00			CAP., FXD, PLSTC:0.01UF, 5%, 100V	01002	64F10AC103
C2374	285-1031-00			CAP., FXD, PLSTC:0.56UF, 10%, 50V	84411	TEK-116
C2375	283-0080-00			CAP., FXD, CER DI:0.022UF, +80-20%, 25V	56289	19C611
C2377	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2383	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2388	290-0572-00			CAP., FXD, ELCTLT:0.1UF, 20%, 50V	56289	196D104X0050HA1
C2389	290-0572-00			CAP., FXD, ELCTLT:0.1UF, 20%, 50V	56289	196D104X0050HA1
C2391	285-0598-00	XB010920		CAP., FXD, PLSTC:0.01UF, 5%, 100V	01002	64F10AC103
C2402	285-0598-00			CAP., FXD, PLSTC:0.01UF, 5%, 100V	01002	64F10AC103
C2403	283-0703-00			CAP., FXD, MICA D:250PF, 1%, 100V	80009	283-0703-00
C2404	281-0629-00			CAP., FXD, CER DI: 33PF, 5%, 600V	72982	308-000COG0330G
C2405	285-0703-00			CAP., FXD, PLSTC:0.1UF, 5%, 100V	01002	64F24AC104
C2406	290-0524-00			CAP., FXD, ELCTLT: 4.7UF, 20%, 10V	90201	TDC475M010EL
C2407	281-0525-00			CAP., FXD, CER DI: 470PF, +/-94PF, 500V	72982	301-000X5U0471M
C2408	281-0160-00	B010100	B010919	CAP., VAR, CER DI: 7-25PF, 350V	72982	538-011B7-25
C2408	281-0093-00	B010920		CAP., VAR, CER DI: 5.5-18PF	72982	538-011C0P092R
C2409	281-0505-00			CAP., FXD, CER DI: 12PF, +/-1.2PF, 500V	72982	301-002COG0120K
C2412	285-0683-00	B010100	B010919	CAP., FXD, PLSTC:0.022UF, 5%, 100V	01002	64F15AC223
C2412	283-0239-00	B010920		CAP., FXD, CER DI:0.022UF, 10%, 50V	72982	8131N075WR5223K
C2422	283-0000-00			CAP., FXD, CER DI:0.001UF, +100-0%, 500V	72982	831-516E102P
C2430	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2432	281-0504-00			CAP., FXD, CER DI: 10PF, +/-1PF, 500V	72982	301-000COG0100F
C2434	283-0080-00			CAP., FXD, CER DI:0.022UF, +80-20%, 25V	56289	19C611
C2436	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2438	283-0080-00			CAP., FXD, CER DI:0.022UF, +80-20%, 25V	56289	19C611
C2442	290-0572-00			CAP., FXD, ELCTLT:0.1UF, 20%, 50V	56289	196D104X0050HA1
C2446	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2464	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2612	290-0325-00			CAP., FXD, ELCTLT: 330UF, +75-10%, 50V	56289	601D337G050FL4
C2613	283-0198-00			CAP., FXD, CER DI:0.22UF, 20%, 50V	72982	8131N075651224M
C2615	290-0527-00			CAP., FXD, ELCTLT: 15UF, 20%, 20V	90201	TDC156M020FL
C2622	290-0369-00			CAP., FXD, ELECT.: 800UF, +75-10%, 15V	56289	39D807G15FJ4

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2623	290-0369-00			CAP.,FXD,ELECT.:800UF,+75-10%,15V	56289	39D807G15FJ4
C2624	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8131N075651224M
C2626	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C2632	290-0325-00			CAP.,FXD,ELCTLT:330UF,+75-10%,50V	56289	601D337G050FL4
C2634	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2636	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C2661	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C2672	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C2673	283-0111-00	B010100	B010919X	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C2675	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C2676	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C2677	290-0530-00	B010100	B010919X	CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006FL
C2681	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
CR2314	152-0107-00			SEMICONV DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR2315	152-0324-00			SEMICONV DEVICE:SILICON,35V,100MA	03508	SE416
CR2334	152-0323-00			SEMICONV DEVICE:SILICON,35V,100MA	03508	SE365
CR2338	152-0323-00			SEMICONV DEVICE:SILICON,35V,100MA	03508	SE365
CR2352	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2357	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2422	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2438	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR2510	150-1001-01			LAMP,LED:RED,2V,100MA	50579	RL2
CR2520	150-1001-01			LAMP,LED:RED,2V,100MA	50579	RL2
CR2610	152-0488-00			SEMICONV DEVICE:SILICON,200V,1500MA	14936	KBPO2-8
CR2622	152-0423-00			SEMICONV DEVICE:SILICON,300V,3A	04713	1N5000
CR2623	152-0423-00			SEMICONV DEVICE:SILICON,300V,3A	04713	1N5000
DS2314	150-0131-00			LAMP,INCAND:120V,0.25A	71744	120PS
J2300	136-0139-00			JACK,TIP:	80009	136-0139-00
J2310	136-0138-00			JACK,TIP:	80009	136-0138-00
J2350	131-1652-00			CONNECTOR,RCPT,:1 FEMALE,1 MALE CONTACT	0000A	RA0302
L2375	120-0407-00			XFMR,TOROID:5 TURNS SINGLE	80009	120-0407-00
Q2322	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q2326	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q2342	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2346	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2352	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SBA8129
Q2354	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SBA8129
Q2356	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SBA8129
Q2372	151-0347-00			TRANSISTOR:SILICON,NPN	80009	151-0347-00
Q2374	151-1085-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	22229	2N4117A
Q2376	151-0126-00			TRANSISTOR:SILICON,NPN	07263	2N2484
Q2392	151-0188-00	XB010920		TRANSISTOR:SILICON,PNP	04713	2N3906
Q2394	151-0188-00	XB010920		TRANSISTOR:SILICON,PNP	04713	2N3906
Q2396	151-0223-00	XB010920		TRANSISTOR:SILICON,PNP	07263	S24848
Q2422	151-1022-00			TRANSISTOR:SILICON,JFE,SEL FROM 2N4392	80009	151-1022-00
Q2426	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2434	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q2438	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q2450	151-0207-00			TRANSISTOR:SILICON,NPN	03508	GET3415
Q2452	151-0207-00			TRANSISTOR:SILICON,NPN	03508	GET3415
Q2454	151-0207-00			TRANSISTOR:SILICON,NPN	03508	GET3415

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q2456	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2458	151-0207-00			TRANSISTOR:SILICON,NPN	03508	GET3415
Q2484	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2486	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q2632	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q2634	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q2636	151-0464-00			TRANSISTOR:SILICON,PNP	01295	TIP29C
Q2638	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
R816 ¹	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0
R930 ²	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0
R1110 ³	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0
R1140 ⁴	311-1701-00			RES.,VAR,NONWIR:50K OHM,20%,1W	01121	12M920
R2301	304-0824-00			RES.,FXD,COMP:820K OHM,10%,1W	01121	GB8241
R2302	315-0754-00			RES.,FXD,COMP:750K OHM,5%,0.25W	01121	CB7545
R2303	315-0824-00			RES.,FXD,COMP:820K OHM,5%,0.25W	01121	CB8245
R2305A,B	325-0185-00			RES.,FXD,FILM:9M OHM/900K OHM	91637	OBD
R2305C,D	XXX-XXXX-XX			RES.,FXD,FILM:90K OHM/10K OHM		
R2308	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	75042	CEAT9-1001B
R2314	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R2315	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035
R2316	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035
R2317	315-0105-00			RES.,FXD,COMP:1M OHM,5%,0.25W	01121	CB1055
R2318	315-0106-00			RES.,FXD,COMP:10M OHM,5%,0.25W	01121	CB1065
R2323	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R2324	321-0729-06			RES.,FXD,FILM:786 OHM,0.25%,0.125W	75042	CEAT9-7860C
R2325	315-0432-00			RES.,FXD,COMP:4.3K OHM,5%,0.25W	01121	CB4325
R2326	321-0190-09			RES.,FXD,FILM:931 OHM,1%,0.125W	75042	CEAT9-9310F
R2327	321-0668-00			RES.,FXD,FILM:4.63K OHM,0.5%,0.125W	75042	CEAT2-4631D
R2328	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	80294	3389F-P31-501
R2334	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R2335	315-0912-00			RES.,FXD,COMP:9.1K OHM,5%,0.25W	01121	CB9125
R2336	301-0824-00			RES.,FXD,COMP:820K OHM,5%,0.50W	01121	EB8245
R2337	315-0912-00			RES.,FXD,COMP:9.1K OHM,5%,0.25W	01121	CB9125
R2338	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325
R2341	315-0243-00	B010100	B010919X	RES.,FXD,COMP:24K OHM,5%,0.25W	01121	CB2435
R2342	315-0243-00	B010100	B010919X	RES.,FXD,COMP:24K OHM,5%,0.25W	01121	CB2435
R2343	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R2344	315-0272-00			RES.,FXD,COMP:2.7K OHM,5%,0.25W	01121	CB2725
R2345	315-0203-00			RES.,FXD,COMP:20K OHM,5%,0.25W	01121	CB2035
R2346	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R2347	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R2352	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R2353	321-0365-09			RES.,FXD,FILM:61.9K OHM,1%,0.125W	75042	CEAT9-6192F
R2354	322-0643-01			RES.,FXD,FILM:600K OHM,0.5%,0.25W	75042	CEBT0-6003D
R2355	321-0222-09			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816C20000F
R2356	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R2357	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R2358	321-0116-09			RES.,FXD,FILM:158 OHM,1%,0.125W	75042	CEAT9-1580F
R2361	321-0174-00			RES.,FXD,FILM:634 OHM,1%,0.125W	75042	CEAT0-6340F
R2362	311-1488-00			RES.,VAR,NONWIR:100 OHM,10%,0.75W	73138	89P-101K-SM
R2363	321-0190-09			RES.,FXD,FILM:931 OHM,1%,0.125W	75042	CEAT9-9310F
R2364	321-0446-09			RES.,FXD,FILM:432K OHM,1%,0.125W	75042	CEAT9-4323F
R2365	321-0397-09			RES.,FXD,FILM:133K OHM,1%,0.125W	75042	CEAT9-1333F

¹464, 466 DM43 only.

²475 DM43 only.

³465 DM43 only.

⁴464,465,466 DM43 only. Furnished as a unit with S1140.

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No. Eff Dscnt	Name & Description	Mfr Code	Mfr Part Number
R2366	321-0423-09		RES.,FXD,FILM:249K OHM,1%,0.125W	75042	CEAT9-2493F
R2367	311-1489-00		RES.,VAR, NONWIR:500 OHM,10%,0.75W	73138	89P-501K-SM
R2368	321-0222-00		RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R2369	315-0683-00		RES.,FXD,COMP:68K OHM,5%,0.25W	01121	CB6835
R2372	315-0471-00		RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R2373	311-1245-00		RES.,VAR, NONWIR:10K OHM,10%,0.50W	73138	72X-23-0-501K
R2374	315-0100-00		RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R2375	315-0242-00		RES.,FXD,COMP:2.4K OHM,5%,0.25W	01121	CB2425
R2376	315-0334-00		RES.,FXD,COMP:330K OHM,5%,0.25W	01121	CB3345
R2377	315-0334-00		RES.,FXD,COMP:330K OHM,5%,0.25W	01121	CB3345
R2384	311-1340-00		RES.,VAR, NONWIR:1K OHM,10%,0.50W	02111	43P102
R2385 ₁	321-1296-07		RES.,FXD,FILM:12K OHM,0.1%,0.125W	91637	MFF1816C15501C
R2385 ₂	321-1630-06		RES.,FXD,FILM:15.5K OHM,0.25%,0.125W		
R2386	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R2388	303-0392-00		RES.,FXD,COMP:3.9K OHM,5%,1W	01121	GB3925
R2391	315-0622-00	XB010920	RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R2392	315-0432-00	XB010920	RES.,FXD,COMP:4.3K OHM,5%,0.25W	01121	CB4325
R2393	315-0103-00	XB010920	RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R2394	321-0219-00	XB010920	RES.,FXD,FILM:1.87K OHM,1%,0.125W	75042	CEAT0-1871F
R2395	321-0301-00	XB010920	RES.,FXD,FILM:13.3K OHM,1%,0.125W	75042	CEAT0-1332F
R2396	315-0123-00	XB010920	RES.,FXD,COMP:12K OHM,5%,0.25W	01121	CB1235
R2397	315-0102-00	XB010920	RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R2398	315-0301-00	XB010920	RES.,FXD,COMP:300 OHM,5%,0.25W	01121	CB3015
R2402	315-0335-00		RES.,FXD,COMP:3.3M OHM,5%,0.25W	01121	CB3355
R2403	315-0134-00		RES.,FXD,COMP:130K OHM,5%,0.25W	01121	CB1345
R2405	315-0513-00		RES.,FXD,COMP:51K OHM,5%,0.25W	01121	CB5135
R2406	311-1260-00		RES.,VAR, NONWIR:250 OHM,10%,0.50W	73138	62PT-345-0
R2407	321-0175-00		RES.,FXD,FILM:649 OHM,1%,0.125W	75042	CEAT0-6490F
R2412	321-0644-00		RES.,FXD,FILM:100K OHM,0.25%,0.125W	75042	CEAT9-1003C
R2413	321-1643-07		RES.,FXD,FILM:11.03K OHM,0.1%,0.125W	91637	MFF1/8-16
R2414	311-1488-00		RES.,VAR, NONWIR:100 OHM,10%,0.75W	73138	89P-101K-SM
R2415	315-0104-00		RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R2416	321-1642-06		RES.,FXD,FILM:72.3K OHM,0.25%,0.125W	91637	MFF1/8-16
R2417	311-1339-00		RES.,VAR, NONWIR:5K OHM,10%,0.50W	02111	43P502
R2422	315-0364-00		RES.,FXD,COMP:360K OHM,5%,0.25W	01121	CB3645
R2423	315-0303-00		RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035
R2424	315-0242-00		RES.,FXD,COMP:2.4K OHM,5%,0.25W	01121	CB2425
R2425	315-0242-00		RES.,FXD,COMP:2.4K OHM,5%,0.25W	01121	CB2425
R2426	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R2427	315-0302-00		RES.,FXD,COMP:3K OHM,5%,0.25W	01121	CB3025
R2432	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R2433	315-0103-00		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R2434	315-0682-00		RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825
R2435	315-0301-00		RES.,FXD,COMP:300 OHM,5%,0.25W	01121	CB3015
R2436	315-0203-00		RES.,FXD,COMP:20K OHM,5%,0.25W	01121	CB2035
R2438	315-0102-00		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R2442	307-0106-00		RES.,FXD,COMP:4.7 OHM,5%,0.25W	01121	CB47G5
R2444	315-0361-00		RES.,FXD,COMP:360 OHM,5%,0.25W	01121	CB3615
R2445	315-0361-00		RES.,FXD,COMP:360 OHM,5%,0.25W	01121	CB3615
R2446	315-0361-00		RES.,FXD,COMP:360 OHM,5%,0.25W	01121	CB3615
R2447	315-0361-00		RES.,FXD,COMP:360 OHM,5%,0.25W	01121	CB3615
R2452	315-0561-00		RES.,FXD,COMP:560 OHM,5%,0.25W	01121	CB5615
R2453	315-0561-00		RES.,FXD,COMP:560 OHM,5%,0.25W	01121	CB5615

¹475 DM43 only.
²464,465,466 DM43 only.

Ckt No.	Tektronix		Serial/Model No.		Name & Description	Mfr	
	Part No.	Eff	Model No.	Dscont		Code	Mfr Part Number
R2454	315-0561-00				RES.,FXD,COMP:560 OHM,5%,0.25W	01121	CB5615
R2455	315-0222-00				RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R2456	315-0751-00				RES.,FXD,COMP:750 OHM,5%,0.25W	01121	CB7515
R2457	315-0181-00				RES.,FXD,COMP:180 OHM,5%,0.25W	01121	CB1815
R2458	315-0561-00				RES.,FXD,COMP:560 OHM,5%,0.25W	01121	CB5615
R2464	315-0471-00				RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R2465	315-0201-00				RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R2466	315-0201-00				RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R2467	315-0201-00				RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R2472	315-0752-00				RES.,FXD,COMP:7.5K OHM,5%,0.25W	01121	CB7525
R2473	315-0752-00				RES.,FXD,COMP:7.5K OHM,5%,0.25W	01121	CB7525
R2474	315-0752-00				RES.,FXD,COMP:7.5K OHM,5%,0.25W	01121	CB7525
R2482	315-0102-00				RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R2483	315-0511-00				RES.,FXD,COMP:510 OHM,5%,0.25W	01121	CB5115
R2484	315-0181-00				RES.,FXD,COMP:180 OHM,5%,0.25W	01121	CB1815
R2485	315-0301-00				RES.,FXD,COMP:300 OHM,5%,0.25W	01121	CB3015
R2486	315-0222-00				RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R2487	315-0751-00				RES.,FXD,COMP:750 OHM,5%,0.25W	01121	CB7515
R2488	315-0301-00				RES.,FXD,COMP:300 OHM,5%,0.25W	01121	CB3015
R2633	307-0114-00				RES.,FXD,COMP:6.2 OHM,5%,0.25W	01121	CB62G5
R2634	321-0274-00				RES.,FXD,FILM:6.98K OHM,1%,0.125W	75042	CEATO-6981F
R2635	321-0274-00				RES.,FXD,FILM:6.98K OHM,1%,0.125W	75042	CEATO-6981F
R2636	315-0392-00				RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R2675	307-0106-00				RES.,FXD,COMP:4.7 OHM,5%,0.25W	01121	CB47G5
R2677	307-0115-00	B010100	B010919X		RES.,FXD,COMP:7.5 OHM,5%,0.25W	01121	CB75G5
S1140 ¹							
S1150 ²	263-1086-00				ACTR ASSY,CAM S:	80009	263-1086-00
S1150 ³	263-1092-00				ACTR ASSY,CAM S:	80009	263-1092-00
S2300 ⁴	260-1687-00				SWITCH,PUSH:FUNCTION	71590	2KBC000220-833
S2310	260-1688-00				SWITCH,PUSH:RANGE	71590	2KBC006000-831
S2371	260-1686-00				SWITCH,PUSH:TIME	71590	2KAA010000-685
U2312	156-0223-00				MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	12040	LM308H
U2342	156-0405-00	B010100	B010919X		MICROCIRCUIT,DI:DUAL MULTIVIBRATOR	07263	9602PC
U2344	156-0079-00				MICROCIRCUIT,DI:DECADE COUNTER,TTL	07263	9390PC
U2352	156-0067-02				MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U2366	156-0067-02				MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U2372	156-0067-02				MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U2378	156-0105-00				MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2384	156-0105-00				MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2402	156-0105-00				MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2406	156-0477-00				MICROCIRCUIT,LI:ANALOG SECT A/D SYSTEM	17856	LD111
U2430	156-0038-00				MICROCIRCUIT,DI:J-K MASTER SLAVE FLIP-FLOP	01295	SN7472N
U2432	156-0030-00				MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2436	156-0165-00				MICROCIRCUIT,DI:DUAL 4-INPUT POS NOR GATE	01295	SN7425N
U2442	156-0476-00				MICROCIRCUIT,LI:DIG SECT A/D SYSTEM	17856	LD110
U2446	156-0140-00				MICROCIRCUIT,DI:HEX.BUFF,15V,TTL	01295	SN7417N
U2464	156-0030-00				MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2474	156-0047-00				MICROCIRCUIT,DI:3-INPUT NAND GATE	01295	SN7410N
U2482	156-0043-00				MICROCIRCUIT DI:2-INPUT NOR GATE	01295	SN7402N
U2484	156-0493-00				MICROCIRCUIT,DI:BCD TO 7 SEG DEC/DRIVER	07263	9368DC
U2486	156-0186-00				MICROCIRCUIT,DI:QUAD 2-INPUT NAND	01295	SN7403A
U2500	150-1011-00				INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FND70

¹ 464,465,466 DM43 only.
² 465 DM43 only.
³ 464,466 DM43 only.
⁴ 464,465,466,475 DM43 only.

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U2510	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FND70
U2520	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FND70
U2530	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FND70
U2540	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FND70
U2614	156-0285-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	UA7812
U2624	156-0277-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	UA7805
VR2326	152-0317-00			SEMICONV DEVICE:ZENER,0.25W,6.2V,5%	81483	1N3497
VR2361	152-0317-00			SEMICONV DEVICE:ZENER,0.25W,6.2V,5%	81483	1N3497
VR2377	152-0166-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
VR2388	152-0304-00			SEMICONV DEVICE:ZENER,0.4W,20V,5%	04713	1N968B
VR2389	152-0195-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6512
VR2406	152-0486-00			SEMICONV DEVICE:ZENER,6.2V,2%	07910	1N3497
VR2412	152-0306-00			SEMICONV DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B
DM40						
A1	670-3471-03	B010100	B010499	CKT BOARD ASSY:MAIN DVM(464,465,466,DM40)	80009	670-3471-03
A1	670-3471-07	B010500		CKT BOARD ASSY:MAIN DVM(464,465,466,DM40)	80009	670-3471-07
A1	670-3471-04	B010100	B010499	CKT BOARD ASSY:MAIN DVM(475,DM40)	80009	670-3471-04
A1	670-3471-08	B010500		CKT BOARD ASSY:MAIN DVM(475,DM40)	80009	670-3471-08
A2	670-3469-00			CKT BOARD ASSY:READOUT DVM(DM43/DM40)	80009	670-3469-00
A3	670-3470-00			CKT BOARD ASSY:POWER SUPPLY DVM(DM43/DM40)	80009	670-3470-00
C2315	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	64F10AC103
C2318	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000COG0330G
C2336	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,350V	72982	301-000U2M0101M
C2341	283-0051-00	B010100	B010499X	CAP.,FXD,CER DI:0.0033UF,5%,100V	72982	8131N145COG332J
C2342	283-0051-00	B010100	B010499X	CAP.,FXD,CER DI:0.0033UF,5%,100V	72982	8131N145COG332J
C2363	290-0340-00			CAP.,FXD,ELCTLT:10UF,10%,50V	56289	109D106X9050C2
C2372	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	64F10AC103
C2374	285-1031-00			CAP.,FXD,PLSTC:0.56UF,10%,50V	84411	TEK-116
C2375	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C2377	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2383	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C2388	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C2389	290-0572-00			CAP.,FXD,ELCTLT:0.1UF,20%,50V	56289	196D104X0050HA1
C2391	285-0598-00	XB010500		CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	64F10AC103
C2402	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	01002	64F10AC103
C2403	283-0703-00			CAP.,FXD,MICA D:250PF,1%,100V	80009	283-0703-00
C2404	281-0629-00			CAP.,FXD,CER DI:33PF,5%,600V	72982	308-000COG0330G
C2405	285-0703-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	01002	64F24AC104
C2406	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C2407	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
C2408	281-0160-00	B010100	B010499	CAP.,VAR,CER DI:7-25PF,350V	72982	538-011B7-25
C2408	281-0093-00	B010500		CAP.,VAR,CER DI:5.5-18PF	72982	538-011C0P092R
C2409	281-0505-00			CAP.,FXD,CER DI:12PF,+/-1.2PF,500V	72982	301-002C0G0120K
C2412	285-0683-00	B010100	B010499	CAP.,FXD,PLSTC:0.022UF,5%,100V	01002	64F15AC223
C2412	283-0239-00	B010500		CAP.,FXD,CER DI:0.022UF,10%,50V	72982	8131N075WR5223K
C2430	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C2432	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-000COG0100F
C2434	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611
C2436	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C2438	283-0080-00			CAP.,FXD,CER DI:0.022UF,+80-20%,25V	56289	19C611

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C2442	290-0572-00			CAP., FXD, ELCTLT:0.1UF, 20%, 50V	56289	196D104X0050HA1
C2446	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2464	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2612	290-0325-00			CAP., FXD, ELCTLT:330UF, +75-10%, 50V	56289	601D337G050FL4
C2613	283-0198-00			CAP., FXD, CER DI:0.22UF, 20%, 50V	72982	8131N075651224M
C2615	290-0527-00			CAP., FXD, ELCTLT:15UF, 20%, 20V	90201	TDC156M020FL
C2622	290-0369-00			CAP., FXD, ELECT.:800UF, +75-10%, 15V	56289	39D807G15FJ4
C2623	290-0369-00			CAP., FXD, ELECT.:800UF, +75-10%, 15V	56289	39D807G15FJ4
C2624	283-0198-00			CAP., FXD, CER DI:0.22UF, 20%, 50V	72982	8131N075651224M
C2626	290-0527-00			CAP., FXD, ELCTLT:15UF, 20%, 20V	90201	TDC156M020FL
C2632	290-0325-00			CAP., FXD, ELCTLT:330UF, +75-10%, 50V	56289	601D337G050FL4
C2634	290-0534-00			CAP., FXD, ELCTLT:1UF, 20%, 35V	56289	196D105X0035HA1
C2661	283-0080-00			CAP., FXD, CER DI:0.022UF, +80-20%, 25V	56289	19C611
C2672	290-0535-00			CAP., FXD, ELCTLT:33UF, 20%, 10V	56289	196D336X0010KA1
C2673	283-0111-00	B010100	B010499X	CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2675	290-0535-00			CAP., FXD, ELCTLT:33UF, 20%, 10V	56289	196D336X0010KA1
C2676	283-0111-00			CAP., FXD, CER DI:0.1UF, 20%, 50V	72982	8131N075651104M
C2677	290-0530-00	B010100	B010499X	CAP., FXD, ELCTLT:68UF, 20%, 6V	90201	TDC686M006FL
C2681	283-0080-00			CAP., FXD, CER DI:0.022UF, +80-20%, 25V	56289	19C611
CR2314	152-0107-00			SEMICOND DEVICE:SILICON, 375V, 400MA	80009	152-0107-00
CR2315	152-0324-00			SEMICOND DEVICE:SILICON, 35V, 100MA	03508	SE416
CR2334	152-0323-00			SEMICOND DEVICE:SILICON, 35V, 100MA	03508	SE365
CR2338	152-0323-00			SEMICOND DEVICE:SILICON, 35V, 100MA	03508	SE365
CR2422	152-0141-02			SEMICOND DEVICE:SILICQN, 30V, 150MA	07910	1N4152
CR2438	152-0141-02			SEMICOND DEVICE:SILICON, 30V, 150MA	07910	1N4152
CR2510	150-1001-01			LAMP, LED:RED, 2V, 100MA	50579	RL2
CR2520	150-1001-01			LAMP, LED:RED, 2V, 100MA	50579	RL2
CR2610	152-0488-00			SEMICOND DEVICE:SILICON, 200V, 1500MA	14936	KBP02-8
CR2622	152-0423-00			SEMICOND DEVICE:SILICON, 300V, 3A	04713	1N5000
CR2623	152-0423-00			SEMICOND DEVICE:SILICON, 300V, 3A	04713	1N5000
DS2314	150-0131-00			LAMP, INCAND:120V, 0.25A	71744	120PS
J2300	136-0139-00			JACK, TIP:	80009	136-0138-00
J2310	136-0138-00			JACK, TIP:	80009	136-0138-00
L2375	120-0407-00			XFMR, TOROID:5 TURNS SINGLE	80009	120-0407-00
Q2322	151-0192-00			TRANSISTOR:SILICON, NPN, SEL FROM MPS6521	80009	151-0192-00
Q2326	151-0192-00			TRANSISTOR:SILICON, NPN, SEL FROM MPS6521	80009	151-0192-00
Q2372	151-0347-00			TRANSISTOR:SILICON, NPN	80009	151-0347-00
Q2374	151-1085-00			TRANSISTOR:SILICON, JFE, N-CHANNEL	22229	2N4117A
Q2376	151-0126-00			TRANSISTOR:SILICON, NPN	07263	2N2484
Q2392	151-0188-00	XB010500		TRANSISTOR:SILICON, PNP	04713	2N3906
Q2394	151-0188-00	XB010500		TRANSISTOR:SILICON, PNP	04713	2N3906
Q2396	151-0223-00	XB010500		TRANSISTOR:SILICON, NPN	07263	S24848
Q2422	151-1022-00			TRANSISTOR:SILICON, JFE, SEL FROM 2N4392	80009	151-1022-00
Q2426	151-0301-00			TRANSISTOR:SILICON, PNP	04713	2N2907A
Q2434	151-0190-00			TRANSISTOR:SILICON, NPN	04713	2N3904
Q2438	151-0192-00			TRANSISTOR:SILICON, NPN, SEL FROM MPS6521	80009	151-0192-00
Q2450	151-0207-00			TRANSISTOR:SILICON, NPN	03508	GET3415
Q2452	151-0207-00			TRANSISTOR:SILICON, NPN	03508	GET3415
Q2454	151-0207-00			TRANSISTOR:SILICON, NPN	03508	GET3415
Q2456	151-0301-00			TRANSISTOR:SILICON, PNP	04713	2N2907A

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr Code	Mfr Part Number	
		Eff	Dscont				
Q2458	151-0207-00			TRANSISTOR:SILICON,NPN	03508	GET3415	
Q2484	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A	
Q2486	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A	
Q2632	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904	
Q2634	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906	
Q2636	151-0464-00			TRANSISTOR:SILICON,PNP	01295	TIP29C	
Q2638	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906	
R816 ¹	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0	
R930 ²	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0	
R1110 ³	311-1709-00			RES.,VAR,WW:20K OHM,10%,2W	80294	8136-22-0	
R1140 ⁴	311-1701-00			RES.,VAR,NONWIR:50K OHM,20%,1W	01121	12M920	
R2301	304-0824-00			RES.,FXD,COMP:820K OHM,10%,1W	01121	GB8241	
R2302	315-0754-00			RES.,FXD,COMP:750K OHM,5%,0.25W	01121	CB7545	
R2303	315-0824-00			RES.,FXD,COMP:820K OHM,5%,0.25W	01121	CB8245	
R2305A,B	325-0185-00			RES.,FXD,FILM:9M OHM/900K OHM	91637	OBD	
R2305C,D	XXX-XXXX-XX			RES.,FXD,FILM:90K OHM/10K OHM			
R2308	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	75042	CEAT9-1001B	
R2314	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015	
R2315	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035	
R2316	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035	
R2317	315-0105-00			RES.,FXD,COMP:1M OHM,5%,0.25W	01121	CB1055	
R2318	315-0106-00			RES.,FXD,COMP:10M OHM,5%,0.25W	01121	CB1065	
R2323	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225	
R2324	321-0729-06			RES.,FXD,FILM:786 OHM,0.25%,0.125W	75042	CEAT9-7860C	
R2325	315-0432-00			RES.,FXD,COMP:4.3K OHM,5%,0.25W	01121	CB4325	
R2326	321-0190-09			RES.,FXD,FILM:931 OHM,1%,0.125W	75042	CEAT9-9310F	
R2327	321-0668-00			RES.,FXD,FILM:4.63K OHM,0.5%,0.125W	75042	CEAT2-4631D	
R2328	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	80294	3389F-P31-501	
R2334	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325	
R2335	315-0912-00			RES.,FXD,COMP:9.1K OHM,5%,0.25W	01121	CB9125	
R2336	301-0824-00			RES.,FXD,COMP:820K OHM,5%,0.50W	01121	EB8245	
R2337	315-0912-00			RES.,FXD,COMP:9.1K OHM,5%,0.25W	01121	CB9125	
R2338	315-0332-00			RES.,FXD,COMP:3.3K OHM,5%,0.25W	01121	CB3325	
R2341	315-0243-00	B010100	B010499X	RES.,FXD,COMP:24K OHM,5%,0.25W	01121	CB2435	
R2342	315-0243-00	B010100	B010499X	RES.,FXD,COMP:24K OHM,5%,0.25W	01121	CB2435	
R2372	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715	
R2373	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72X-23-0-501K	
R2374	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005	
R2375	315-0242-00			RES.,FXD,COMP:2.4K OHM,5%,0.25W	01121	CB2425	
R2376	315-0334-00			RES.,FXD,COMP:330K OHM,5%,0.25W	01121	CB3345	
R2377	315-0334-00			RES.,FXD,COMP:330K OHM,5%,0.25W	01121	CB3345	
R2384 ⁵	311-1340-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	02111	43P102	
R2385 ⁶	321-1296-07			RES.,FXD,FILM:12K OHM,0.1%,0.125W	75042	CEAT9-1202B	
R2385	321-1630-06			RES.,FXD,FILM:15.5K OHM,0.25%,0.125W			
R2386	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025	
R2388	303-0392-00			RES.,FXD,COMP:3.9K OHM,5%,1W	01121	GB3925	
R2391	315-0622-00	XB010500		RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225	
R2392	315-0432-00	XB010500		RES.,FXD,COMP:4.3K OHM,5%,0.25W	01121	CB4325	
R2393	315-0103-00	XB010500		RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035	
R2394	321-0219-00	XB010500		RES.,FXD,FILM:1.87K OHM,1%,0.125W	75042	CEAT0-1871F	
R2395	321-0301-00	XB010500		RES.,FXD,FILM:13.3K OHM,1%,0.125W	75042	CEAT0-1332F	
R2396	315-0123-00	XB010500		RES.,FXD,COMP:12K OHM,5%,0.25W	01121	CB1235	

¹464, 466 DM40 only.

²475 DM40 only.

³465 DM40 only.

⁴464,465,466 DM46 only. Furnished as a unit with S1140.

⁵465 DM40 only.

⁶464,465,466 DM40 only.

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No.		Name & Description	Mfr	
		Eff	Dscont		Code	Mfr Part Number
R2397	315-0102-00	XB010500		RES., FXD, COMP: 1K OHM, 5%, 0.25W	01121	CB1025
R2398	315-0301-00			RES., FXD, COMP: 300 OHM, 5%, 0.25W	01121	CB3015
R2402	315-0335-00			RES., FXD, COMP: 3.3M OHM, 5%, 0.25W	01121	CB3355
R2403	315-0134-00			RES., FXD, COMP: 130K OHM, 5%, 0.25W	01121	CB1345
R2405	315-0513-00			RES., FXD, COMP: 51K OHM, 5%, 0.25W	01121	CB5135
R2406	311-1260-00		RES., VAR, NONWIR: 250 OHM, 10%, 0.50W	73138	62PT-345-0	
R2407	321-0175-00		RES., FXD, FILM: 649 OHM, 1%, 0.125W	75042	CEAT0-6490F	
R2412	321-0644-00		RES., FXD, FILM: 100K OHM, 0.25%, 0.125W	75042	CEAT9-1003C	
R2413	321-1643-07		RES., FXD, FILM: 11.03K OHM, 0.1%, 0.125W	91637	MFF1/8-16	
R2414	311-1488-00		RES., VAR, NONWIR: 100 OHM, 10%, 0.75W	73138	89P-101K-SM	
R2415	315-0104-00		RES., FXD, COMP: 100K OHM, 5%, 0.25W	01121	CB1045	
R2416	321-1642-06		RES., FXD, FILM: 72.3K OHM, 0.25%, 0.125W	91637	MFF1/8-16	
R2417	311-1339-00		RES., VAR, NONWIR: 5K OHM, 10%, 0.50W	02111	43P502	
R2422	315-0364-00		RES., FXD, COMP: 360K OHM, 5%, 0.25W	01121	CB3645	
R2423	315-0303-00		RES., FXD, COMP: 30K OHM, 5%, 0.25W	01121	CB3035	
R2424	315-0242-00		RES., FXD, COMP: 2.4K OHM, 5%, 0.25W	01121	CB2425	
R2425	315-0242-00		RES., FXD, COMP: 2.4K OHM, 5%, 0.25W	01121	CB2425	
R2426	315-0103-00		RES., FXD, COMP: 10K OHM, 5%, 0.25W	01121	CB1035	
R2427	315-0302-00		RES., FXD, COMP: 3K OHM, 5%, 0.25W	01121	CB3025	
R2432	315-0102-00		RES., FXD, COMP: 1K OHM, 5%, 0.25W	01121	CB1025	
R2433	315-0103-00		RES., FXD, COMP: 10K OHM, 5%, 0.25W	01121	CB1035	
R2434	315-0682-00		RES., FXD, COMP: 6.8K OHM, 5%, 0.25W	01121	CB6825	
R2435	315-0301-00		RES., FXD, COMP: 300 OHM, 5%, 0.25W	01121	CB3015	
R2436	315-0203-00		RES., FXD, COMP: 20K OHM, 5%, 0.25W	01121	CB2035	
R2438	315-0102-00		RES., FXD, COMP: 1K OHM, 5%, 0.25W	01121	CB1025	
R2442	307-0106-00		RES., FXD, COMP: 4.7 OHM, 5%, 0.25W	01121	CB47G5	
R2444	315-0361-00		RES., FXD, COMP: 360 OHM, 5%, 0.25W	01121	CB3615	
R2445	315-0361-00		RES., FXD, COMP: 360 OHM, 5%, 0.25W	01121	CB3615	
R2446	315-0361-00		RES., FXD, COMP: 360 OHM, 5%, 0.25W	01121	CB3615	
R2447	315-0361-00		RES., FXD, COMP: 360 OHM, 5%, 0.25W	01121	CB3615	
R2452	315-0561-00		RES., FXD, COMP: 560 OHM, 5%, 0.25W	01121	CB5615	
R2453	315-0561-00		RES., FXD, COMP: 560 OHM, 5%, 0.25W	01121	CB5615	
R2454	315-0561-00		RES., FXD, COMP: 560 OHM, 5%, 0.25W	01121	CB5615	
R2455	315-0222-00		RES., FXD, COMP: 2.2K OHM, 5%, 0.25W	01121	CB2225	
R2456	315-0751-00		RES., FXD, COMP: 750 OHM, 5%, 0.25W	01121	CB7515	
R2457	315-0181-00		RES., FXD, COMP: 180 OHM, 5%, 0.25W	01121	CB1815	
R2458	315-0561-00		RES., FXD, COMP: 560 OHM, 5%, 0.25W	01121	CB5615	
R2464	315-0471-00		RES., FXD, COMP: 470 OHM, 5%, 0.25W	01121	CB4715	
R2465	315-0201-00		RES., FXD, COMP: 200 OHM, 5%, 0.25W	01121	CB2015	
R2466	315-0201-00		RES., FXD, COMP: 200 OHM, 5%, 0.25W	01121	CB2015	
R2467	315-0201-00		RES., FXD, COMP: 200 OHM, 5%, 0.25W	01121	CB2015	
R2472	315-0752-00		RES., FXD, COMP: 7.5K OHM, 5%, 0.25W	01121	CB7525	
R2473	315-0752-00		RES., FXD, COMP: 7.5K OHM, 5%, 0.25W	01121	CB7525	
R2474	315-0752-00		RES., FXD, COMP: 7.5K OHM, 5%, 0.25W	01121	CB7525	
R2482	315-0102-00		RES., FXD, COMP: 1K OHM, 5%, 0.25W	01121	CB1025	
R2483	315-0511-00		RES., FXD, COMP: 510 OHM, 5%, 0.25W	01121	CB5115	
R2484	315-0181-00		RES., FXD, COMP: 180 OHM, 5%, 0.25W	01121	CB1815	
R2485	315-0301-00		RES., FXD, COMP: 300 OHM, 5%, 0.25W	01121	CB3015	
R2486	315-0222-00		RES., FXD, COMP: 2.2K OHM, 5%, 0.25W	01121	CB2225	
R2487	315-0751-00		RES., FXD, COMP: 750 OHM, 5%, 0.25W	01121	CB7515	
R2488	315-0301-00		RES., FXD, COMP: 300 OHM, 5%, 0.25W	01121	CB3015	
R2633	307-0114-00		RES., FXD, COMP: 6.2 OHM, 5%, 0.25W	01121	CB62G5	
R2634	321-0274-00		RES., FXD, FILM: 6.98K OHM, 1%, 0.125W	75042	CEAT0-6981F	

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R2635	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	75042	CEAT0-6981F
R2636	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R2675	307-0106-00			RES.,FXD,COMP:4.7 OHM,5%,0.25W	01121	CB47G5
R2677	307-0115-00	B010100	B010499X	RES.,FXD,COMP:7.5 OHM,5%,0.25W	01121	CB75G5
S1140 ¹						
S1150 ²	263-1086-00			ACTR ASSY,CAM S:	80009	263-1086-00
S1150 ³	263-1092-00			ACTR ASSY,CAM S:	80009	263-1092-00
S2300 ⁴	260-1689-00			SWITCH,PUSH:FUNCTION	71590	2KBC000120-832
S2310	260-1688-00			SWITCH,PUSH:RANGE	71590	2KBC00600-831
S2371	260-1686-00			SWITCH,PUSH:TIME	71590	2KAA010000-685
U2312	156-0223-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	12040	LM308H
U2342	156-0405-00	B010100	B010499X	MICROCIRCUIT,DI:DUAL MULTIVIBRATOR	07263	9602PC
U2372	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U2378	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2384	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2402	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U2406	156-0477-00			MICROCIRCUIT,LI:ANALOG SECT A/D SYSTEM		
U2430	156-0038-00			MICROCIRCUIT,DI:J-K MASTER SLAVE FLIP-FLOP	01295	SN7472N
U2432	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2436	156-0165-00			MICROCIRCUIT,DI:DUAL 4-INPUT POS NOR GATE	01295	SN7425N
U2442	156-0476-00			MICROCIRCUIT,LI:DIG SECT A/D SYSTEM	17856	LD111
U2446	156-0140-00			MICROCIRCUIT,DI:HEX.BUFF,15V,TTL	01295	SN7417N
U2464	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U2474	156-0047-00			MICROCIRCUIT,DI:3-INPUT NAND GATE	01295	SN7410N
U2482	156-0043-00			MICROCIRCUIT DI:2-INPUT NOR GATE	01295	SN7402N
U2484	156-0493-00			MICROCIRCUIT,DI:BCD TO 7 SEG DEC/DRIVER	07263	9368DC
U2486	156-0186-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND	01295	SN7463A
U2500	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FDN70
U2510	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FDN70
U2520	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FDN70
U2530	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FDN70
U2540	150-1011-00			INDICATOR:DIGITAL DISPLAY,7 SEG,RED	07263	FDN70
U2614	156-0285-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	UA7812
U2624	156-0277-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	UA7805
VR2326	152-0317-00			SEMICONV DEVICE:ZENER,0.25W,6.2V,5%	81483	1N3497
VR2377	152-0166-00			SEMICONV DEVICE:ZENER,0.4W,6.2V,5%	81483	69-9035
VR2388	152-0304-00			SEMICONV DEVICE:ZENER,0.4W,20V,5%	04713	1N968B
VR2389	152-0195-00			SEMICONV DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6512
VR2406	152-0486-00			SEMICONV DEVICE:ZENER,6.2V,2%	07910	1N3497
VR2412	152-0306-00			SEMICONV DEVICE:ZENER,0.4W,9.1V,5%	81483	1N960B

DIFFERENCES BETWEEN STANDARD TIMING BOARD AND DVM TIMING BOARD

A	670-3467-01			CKT BOARD ASSY:TIMING DVM(465)	80009	670-3467-01
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CHANGE TO:

R1111	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	75042	CEAT0-5621F
R1112	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	75042	CEAT0-4121F
R1113	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	75042	CEAT0-3920F

Electrical Parts List—DM43/DM40 Service

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A	670-3466-01			CKT BOARD ASSY:TIMING DVM(464/466)	80009	670-3466-01
CHANGE TO:						
R812	321-0154-00			RES.,FXD,FILM:392 OHM,1%,0.125W	75042	CEAT0-3920F
R815	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	75042	CEAT0-4121F
R817	321-0265-00			RES.,FXD,FILM:5.62K OHM,1%,0.125W	75042	CEAT0-5621F
R1142	321-0227-07			RES.,FXD,FILM:2.26K OHM,0.1%,0.125W		
R1143	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	75042	CEAT9-1001B
R1147	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	75042	CEAT9-1001B

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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 (μ F).
- Resistors = Ohms (Ω).

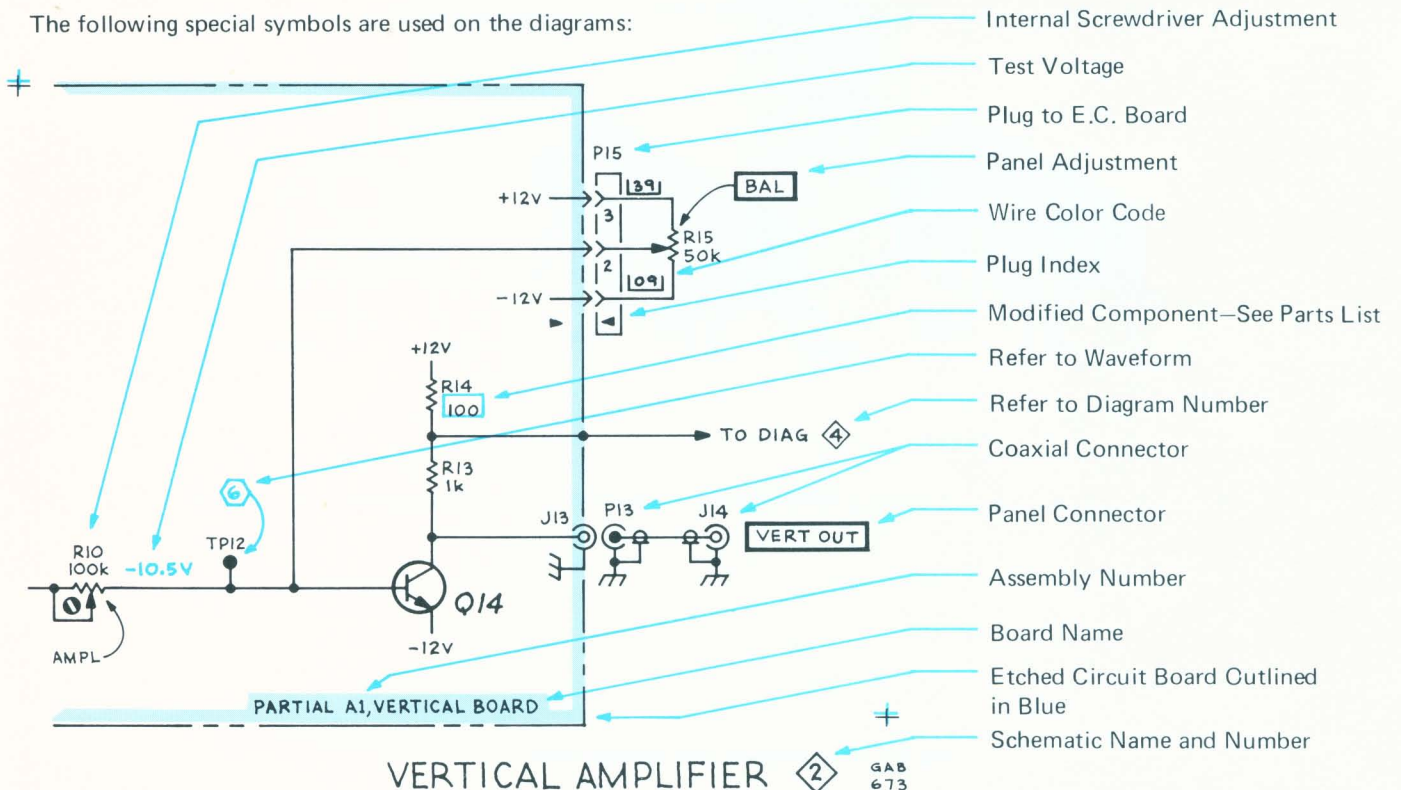
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

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 following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)	H	Heat dissipating device (heat sink, heat radiator, etc.)	RT	Thermistor
AT	Attenuator, fixed or variable	HR	Heater	S	Switch
B	Motor	HY	Hybrid circuit	T	Transformer
BT	Battery	J	Connector, stationary portion	TC	Thermocouple
C	Capacitor, fixed or variable	K	Relay	TP	Test point
CB	Circuit breaker	L	Inductor, fixed or variable	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	V	Electron tube
DL	Delay line	M	Meter	VR	Voltage regulator (zener diode, etc.)
DS	Indicating device (lamp)	P	Connector, movable portion	Y	Crystal
E	Spark Gap	Q	Transistor or silicon-controlled rectifier	Z	Phase shifter
F	Fuse	R	Resistor, fixed or variable		
FL	Filter				

The following special symbols are used on the diagrams:



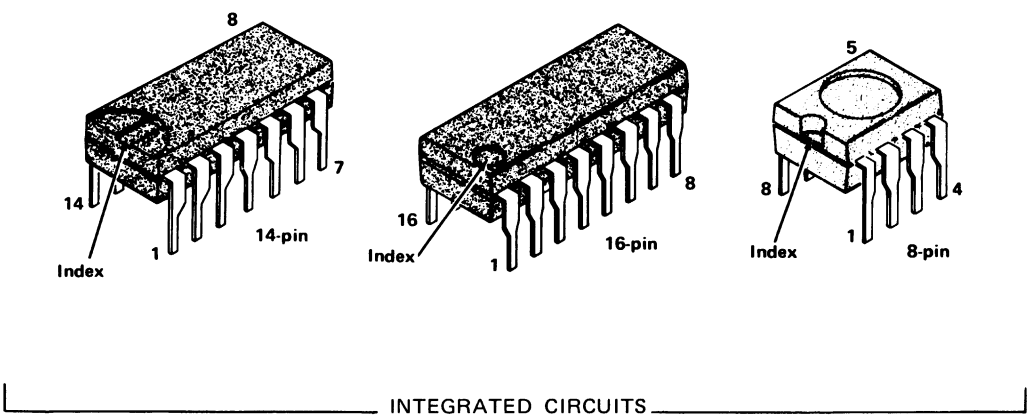
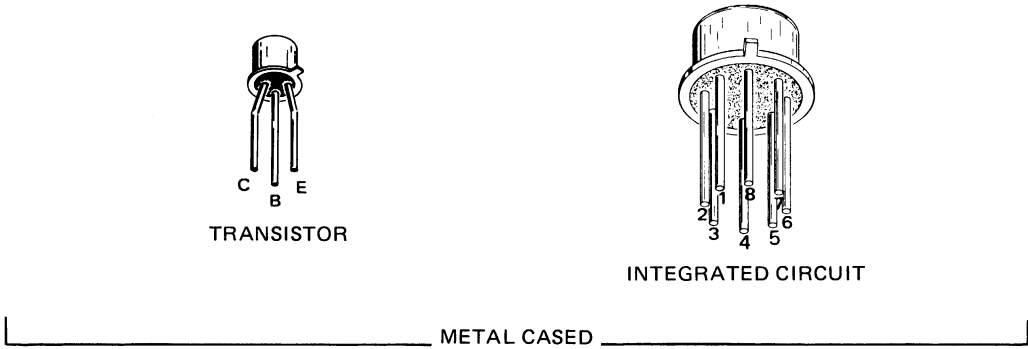
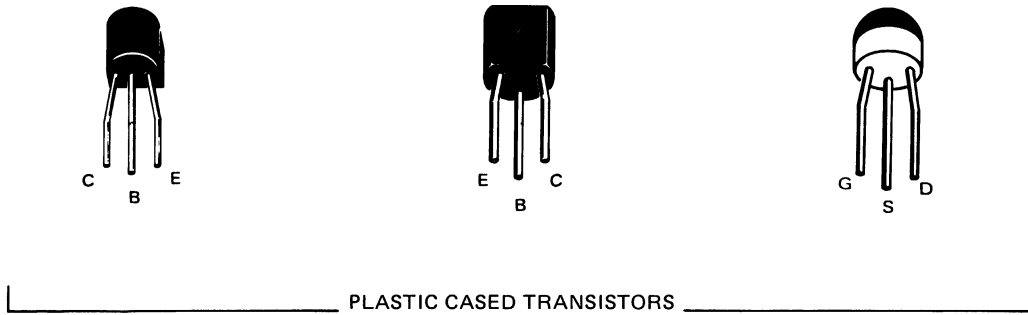
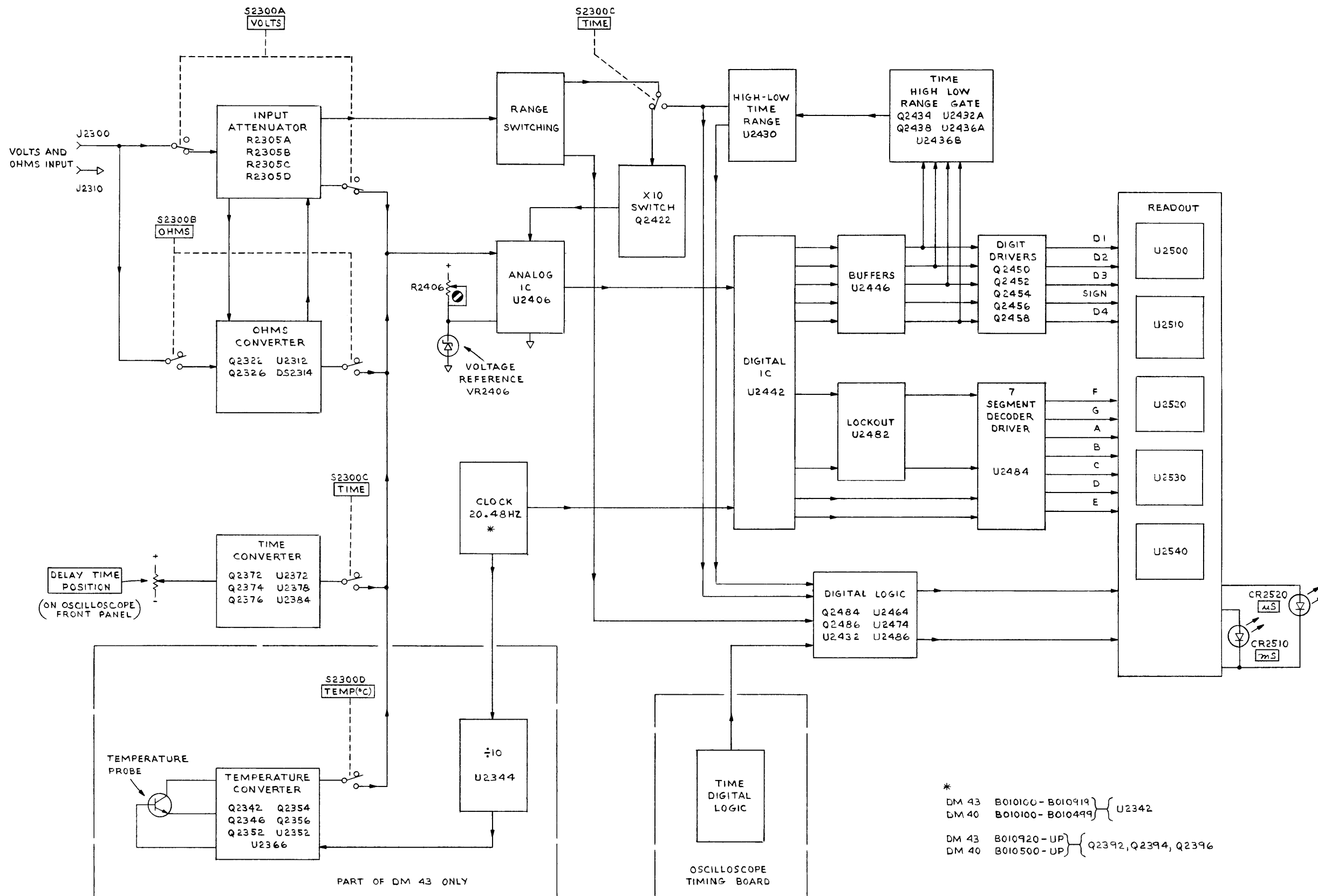


Fig. 7-1. Semiconductor lead configurations.



*
 DM 43 B010100 - B010919 } U2342
 DM 40 B010100 - B010499 }
 DM 43 B010920 - UP } Q2392, Q2394, Q2396
 DM 40 B010500 - UP }

ASSEMBLY A1

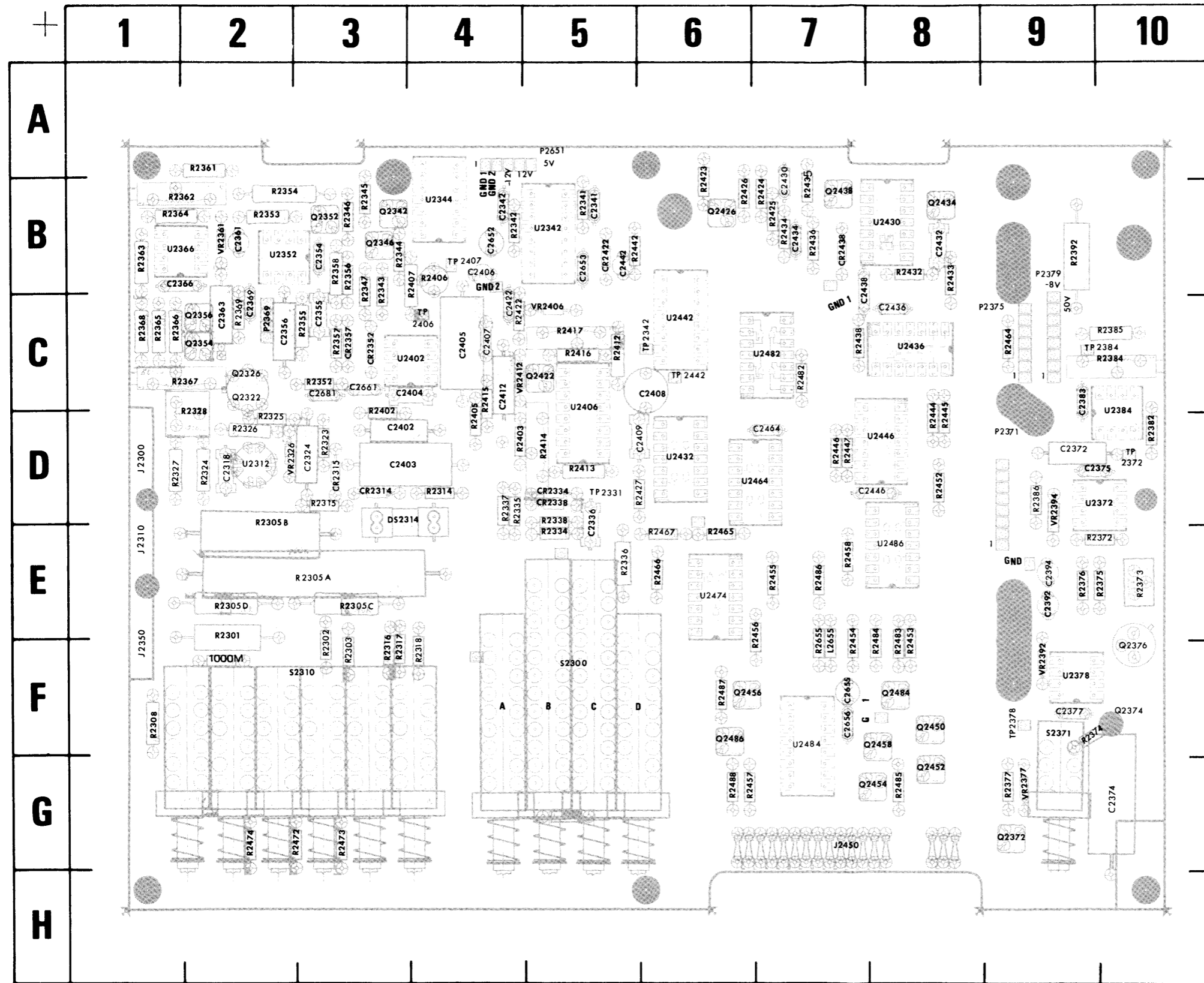


Fig. 7-2. A1—Main circuit board.

SN B010920 and up (DM 43)
SN B010500 and up (DM 40)

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2318	2D	Q2322	2C	R2368	1C	S2310	3F
C2324	3D	Q2326	2C	R2369	2C	S2371	9F
C2336	5D	Q2342	3B	R2372	9E		
C2341	5B	Q2346	3B	R2373	10E	TP2331	5D
C2342	4B	Q2352	3B	R2374	9F	TP2342	6C
C2354	3B	Q2354	2C	R2375	10E	TP2372	10D
C2355	3C	Q2356	2C	R2376	9E	TP2378	9F
C2356	2C	Q2372	9G	R2377	9G	TP2384	10C
C2361	2B	Q2374	10F	R2382	10D	TP2406	4C
C2363	2C	Q2376	10F	R2384	10C	TP2407	4B
C2366	1B	Q2422	5C	R2385	10C	TP2442	6C
C2369	2C	Q2426	6B	R2386	9D		
C2372	9D	Q2434	8B	R2392	9B	U2312	2D
C2374	10G	Q2438	7B	R2402	3C	U2342	5B
C2375	9D	Q2450	8F	R2403	4D	U2344	4B
C2377	9F	Q2452	8G	R2405	4C	U2352	2B
C2383	9C	Q2454	8G	R2406	4B	U2366	1B
C2392	9E	Q2456	6F	R2407	4B	U2372	9D
C2394	9E	Q2458	8F	R2412	5C	U2378	9F
C2402	3D	Q2484	8F	R2413	5D	U2384	10C
C2403	3D	Q2486	6F	R2414	5D	U2402	4C
C2404	4C			R2415	4C	U2406	5C
C2405	4C	R2301	2E	R2416	5C	U2430	8B
C2406	4B	R2302	3F	R2417	5C	U2432	6D
C2407	4C	R2303	3F	R2422	4C	U2436	8C
C2408	6C	R2305A	3E	R2423	6A	U2442	6C
C2409	5D	R2305B	2D	R2424	7B	U2446	8D
C2412	4C	R2305C	3E	R2425	7B	U2464	7D
C2422	4C	R2305D	2E	R2426	6B	U2474	6E
C2430	7B	R2308	1F	R2427	5D	U2482	7C
C2432	8B	R2314	4D	R2432	8B	U2484	7F
C2434	7B	R2315	3D	R2433	8B	U2486	8E
C2436	8C	R2316	3F	R2434	7B		
C2438	7B	R2317	3F	R2435	7B	VR2326	2D
C2442	5B	R2318	4F	R2436	7B	VR2361	2B
C2446	8D	R2323	3D	R2438	7C	VR2377	9G
C2464	7D	R2324	2D	R2341	5B	VR2392	9F
C2652	4B	R2325	2D	R2442	5B	VR2394	9D
C2653	5B	R2326	2D	R2444	8D	VR2406	5C
C2655	7F	R2327	1D	R2445	8D	VR2412	4C
C2656	7F	R2328	2C	R2446	7D		
C2661	3C	R2334	5E	R2447	7D	1000M	2F
C2681	3C	R2335	4D	R2452	8D		
		R2336	5E	R2453	8E		
		R2337	4D	R2454	7E		
CR2314	3D	R2338	5D	R2455	7E		
CR2315	3D	R2342	4B	R2456	6E		
CR2334	5D	R2343	3B	R2457	6G		
CR2338	5D	R2344	3B	R2458	7E		
CR2352	3C	R2345	3B	R2464	9C		
CR2357	3C	R2346	3B	R2465	6E		
CR2422	5B	R2347	3B	R2466	6E		
CR2438	7B	R2352	3C	R2467	6E		
		R2353	2B	R2472	2G		
DS2314	3D	R2354	2B	R2473	3G		
		R2356	3B	R2474	2G		
J2300	1E	R2357	3C	R2482	7C		
J 2310	1E	R2358	3B	R2483	8E		
J2350	1E	R2361	2A	R2484	8E		
J2450	7G	R2362	1B	R2485	8G		
		R2363	1B	R2486	7E		
P2369	2C	R2364	1B	R2487	6F		
P2371	9D	R2365	1C	R2488	6G		
P2375	9C	R2366	1C	R2655	7E		
P2379	9B	R2367	2C	S2300	5F		
P2651	5A						

ASSEMBLY A1

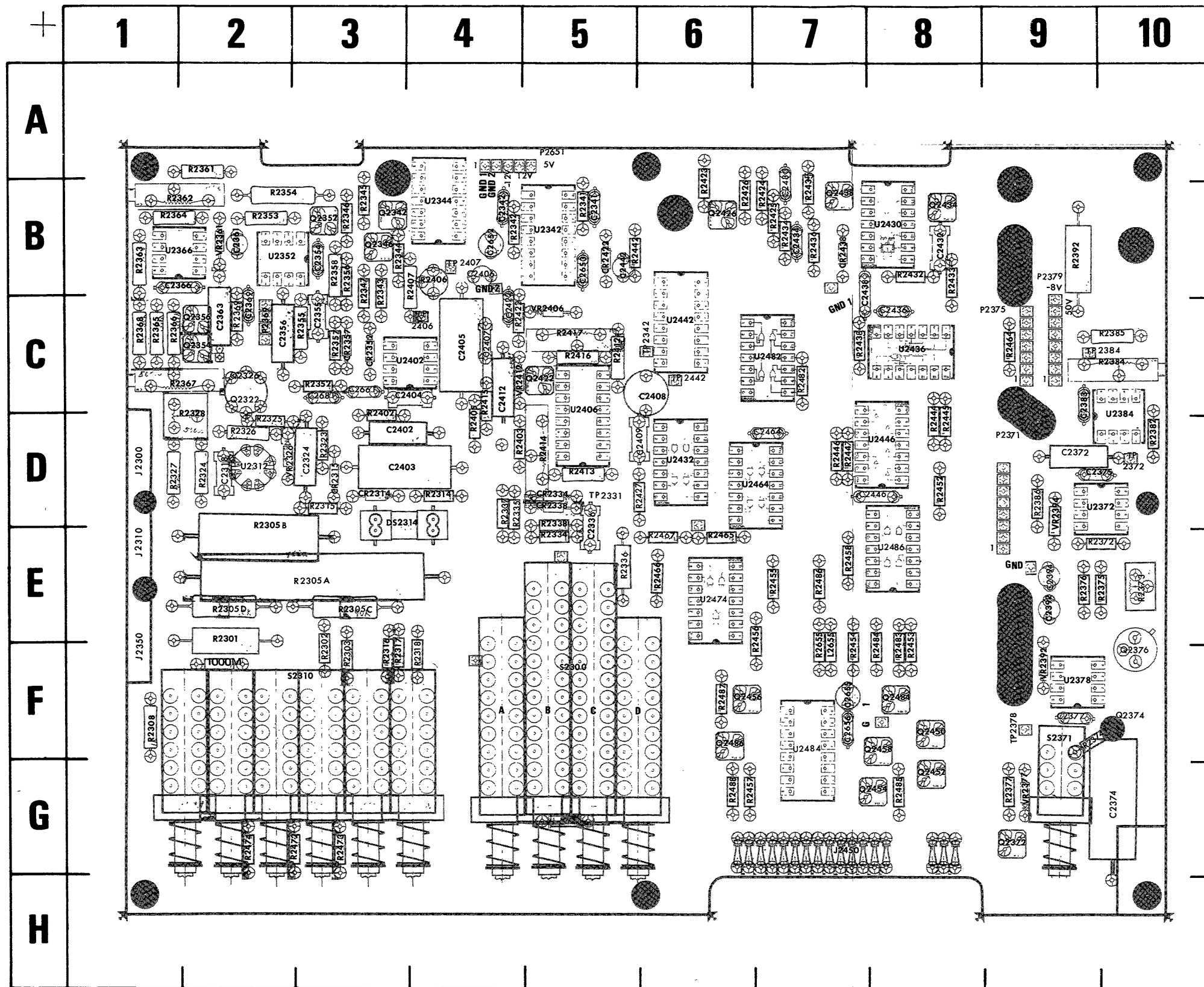
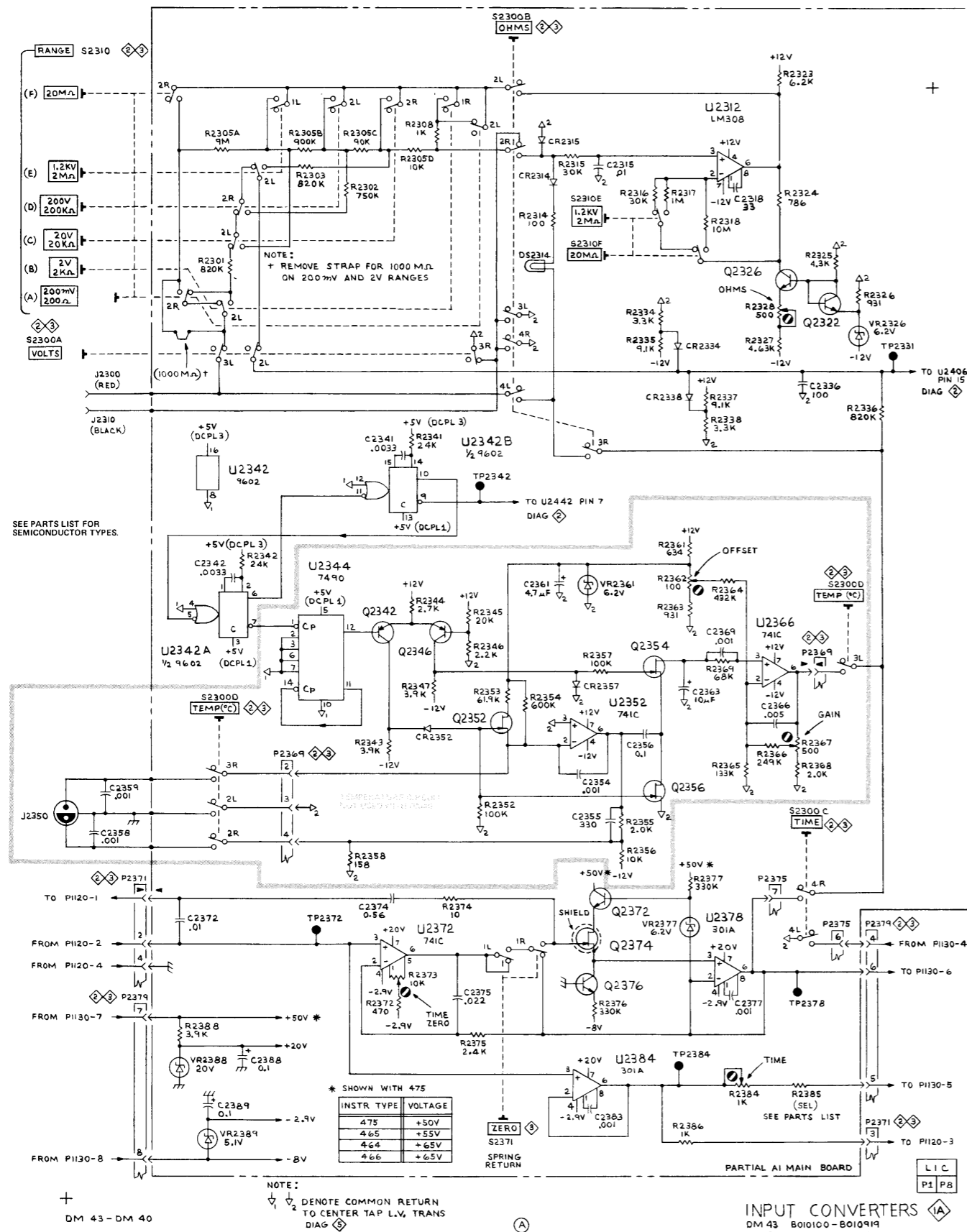


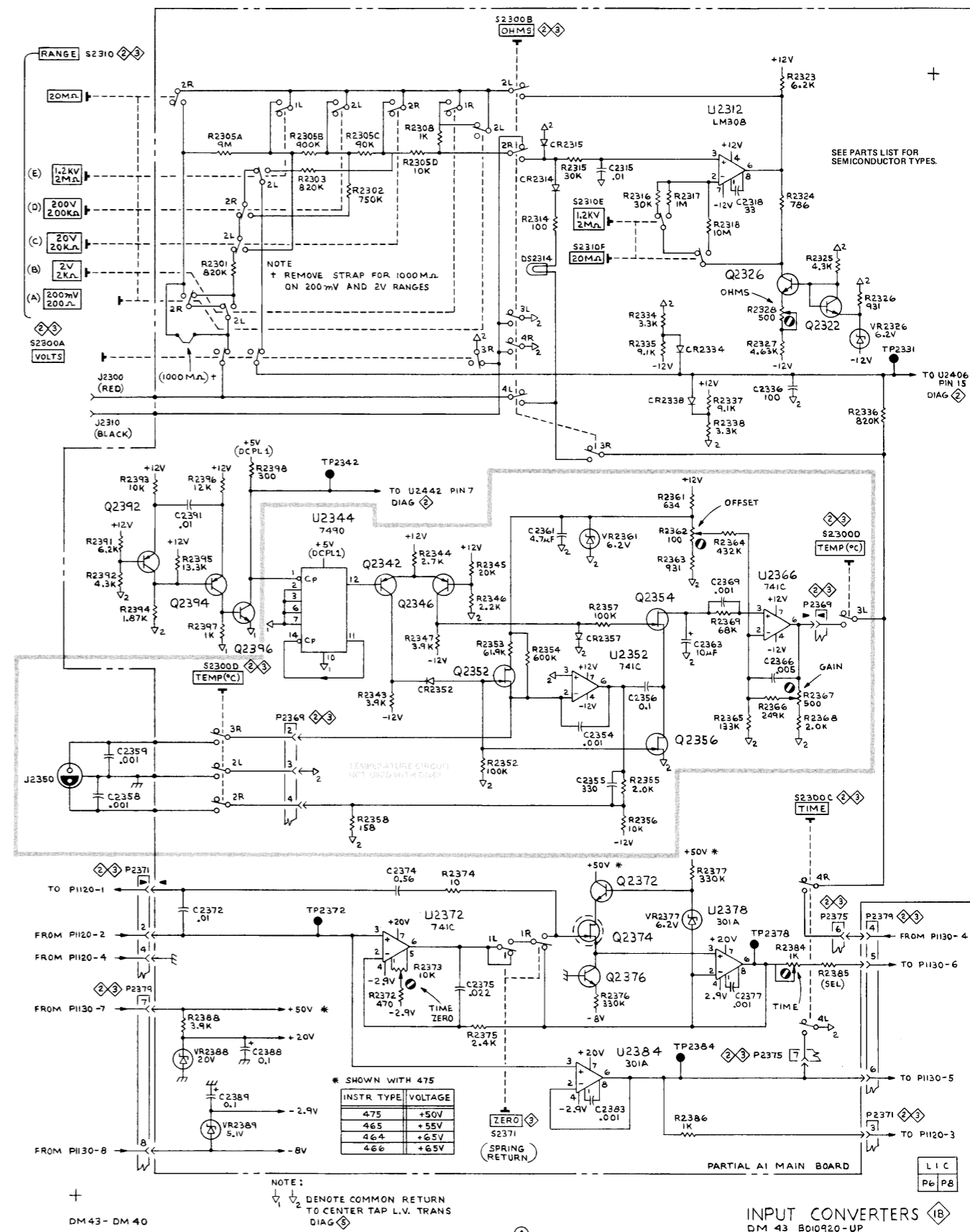
Fig. 7-2. A1—Main circuit board.

SN B010920 and up (DM 43)
SN B010500 and up (DM 40)

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C2318	2D	Q2322	2C	R2368	1C	S2310	3F
C2324	3D	Q2326	2C	R2369	2C	S2371	9F
C2336	5D	Q2342	3B	R2372	9E		
C2341	5B	Q2346	3B	R2373	10E	TP2331	5D
C2342	4B	Q2352	3B	R2374	9F	TP2342	6C
C2354	3B	Q2354	2C	R2375	10E	TP2372	10D
C2355	3C	Q2356	2C	R2376	9E	TP2378	9F
C2356	2C	Q2372	9G	R2377	9G	TP2384	10C
C2361	2B	Q2374	10F	R2382	10D	TP2406	4C
C2363	2C	Q2376	10F	R2384	10C	TP2407	4B
C2366	1B	Q2422	5C	R2385	10C	TP2442	6C
C2369	2C	Q2426	6B	R2386	9D		
C2372	9D	Q2434	8B	R2392	9B	U2312	2D
C2374	10G	Q2438	7B	R2402	3C	U2342	5B
C2375	9D	Q2450	8F	R2403	4D	U2344	4B
C2377	9F	Q2452	8G	R2405	4C	U2352	2B
C2383	9C	Q2454	8G	R2406	4B	U2366	1B
C2392	9E	Q2456	6F	R2407	4B	U2372	9D
C2394	9E	Q2458	8F	R2412	5C	U2378	9F
C2402	3D	Q2484	8F	R2413	5D	U2384	10C
C2403	3D	Q2486	6F	R2414	5D	U2402	4C
C2404	4C			R2415	4C	U2406	5C
C2405	4C	R2301	2E	R2416	5C	U2430	8B
C2406	4B	R2302	3F	R2417	5C	U2432	6D
C2407	4C	R2303	3F	R2422	4C	U2436	8C
C2408	6C	R2305A	3E	R2423	6A	U2442	6C
C2409	5D	R2305B	2D	R2424	7B	U2446	8D
C2412	4C	R2305C	3E	R2425	7B	U2464	7D
C2422	4C	R2305D	2E	R2426	6B	U2474	6E
C2430	7B	R2308	1F	R2427	5D	U2482	7C
C2432	8B	R2314	4D	R2432	8B	U2484	7F
C2434	7B	R2315	3D	R2433	8B	U2486	8E
C2436	8C	R2316	3F	R2434	7B		
C2438	7B	R2317	3F	R2435	7B	VR2326	2D
C2442	5B	R2318	4F	R2436	7B	VR2361	2B
C2446	8D	R2323	3D	R2438	7C	VR2377	9G
C2464	7D	R2324	2D	R2341	5B	VR2392	9F
C2652	4B	R2325	2D	R2442	5B	VR2394	9D
C2653	5B	R2326	2D	R2444	8D	VR2406	5C
C2655	7F	R2327	1D	R2445	8D	VR2412	4C
C2656	7F	R2328	2C	R2446	7D	1000M	2F
C2661	3C	R2334	5E	R2447	7D		
C2681	3C	R2335	4D	R2452	8D		
		R2336	5E	R2453	8E		
		R2337	4D	R2454	7E		
CR2314	3D	R2338	5D	R2455	7E		
CR2315	3D	R2342	4B	R2456	6E		
CR2334	5D	R2343	3B	R2457	6G		
CR2338	5D	R2344	3B	R2458	7E		
CR2352	3C	R2345	3B	R2464	9C		
CR2357	3C	R2346	3B	R2465	6E		
CR2422	5B	R2347	3B	R2466	6E		
CR2438	7B	R2352	3C	R2467	6E		
		R2353	2B	R2472	2G		
DS2314	3D	R2354	2B	R2473	3G		
		R2355	3B	R2474	2G		
J2300	1E	R2356	3B	R2482	7C		
J 2310	1E	R2357	3C	R2483	8E		
J2350	1E	R2358	3B	R2484	8E		
J2450	7G	R2361	2A	R2485	8G		
		R2362	1B	R2486	7E		
P2369	2C	R2363	1B	R2487	6F		
P2371	9D	R2364	1B	R2488	6G		
P2375	9C	R2365	1C	R2655	7E		
P2379	9B	R2366	1C	S2300	5F		
P2651	5A	R2367	2C				



INPUT CONVERTERS (A)
DM 43 801010-801019
DM 40 801010-801049



INPUT CONVERTERS (B)
DM 43 801020-UP
DM 40 801050-UP

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

INPUT CONVERTERS

1

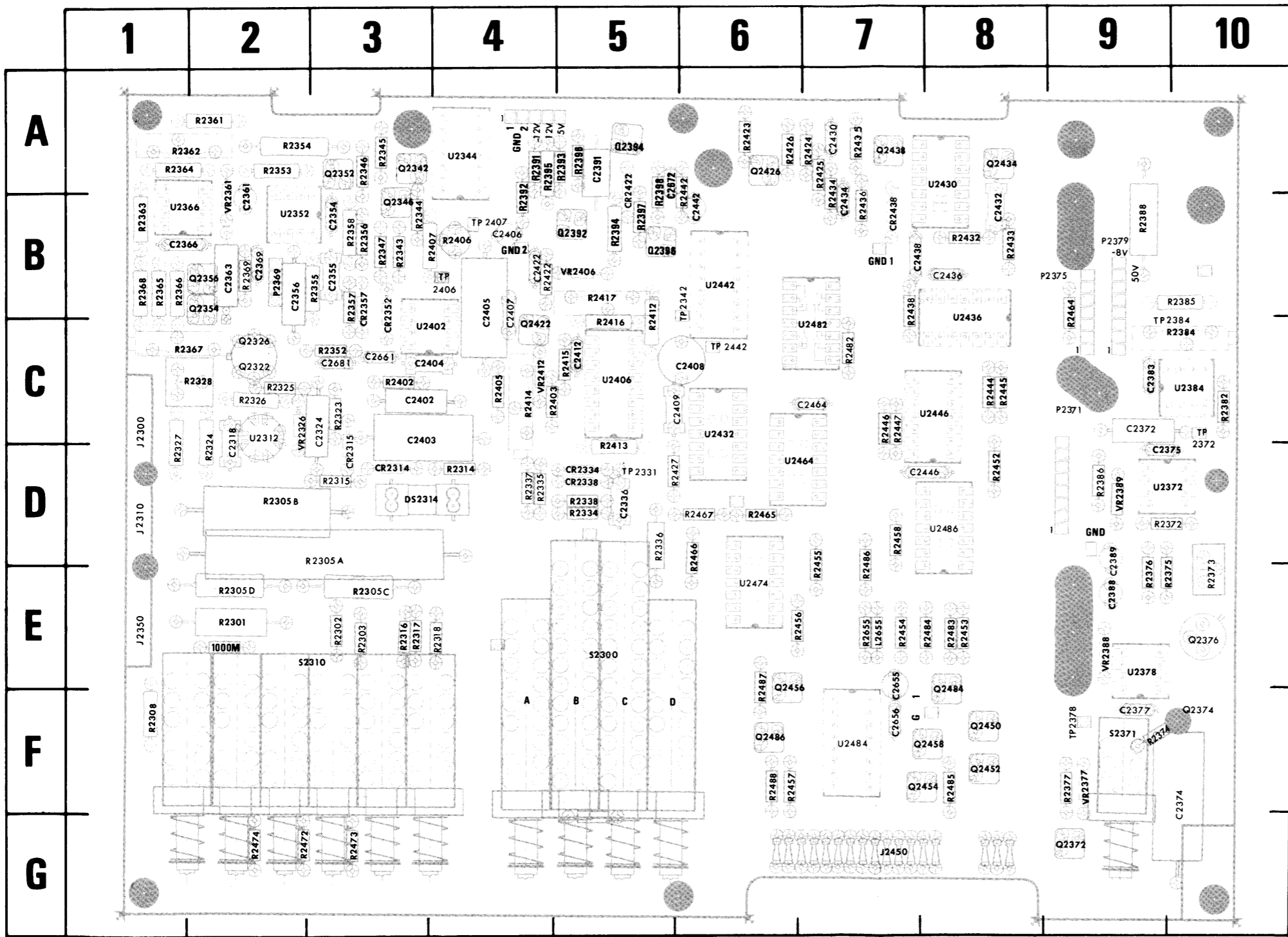
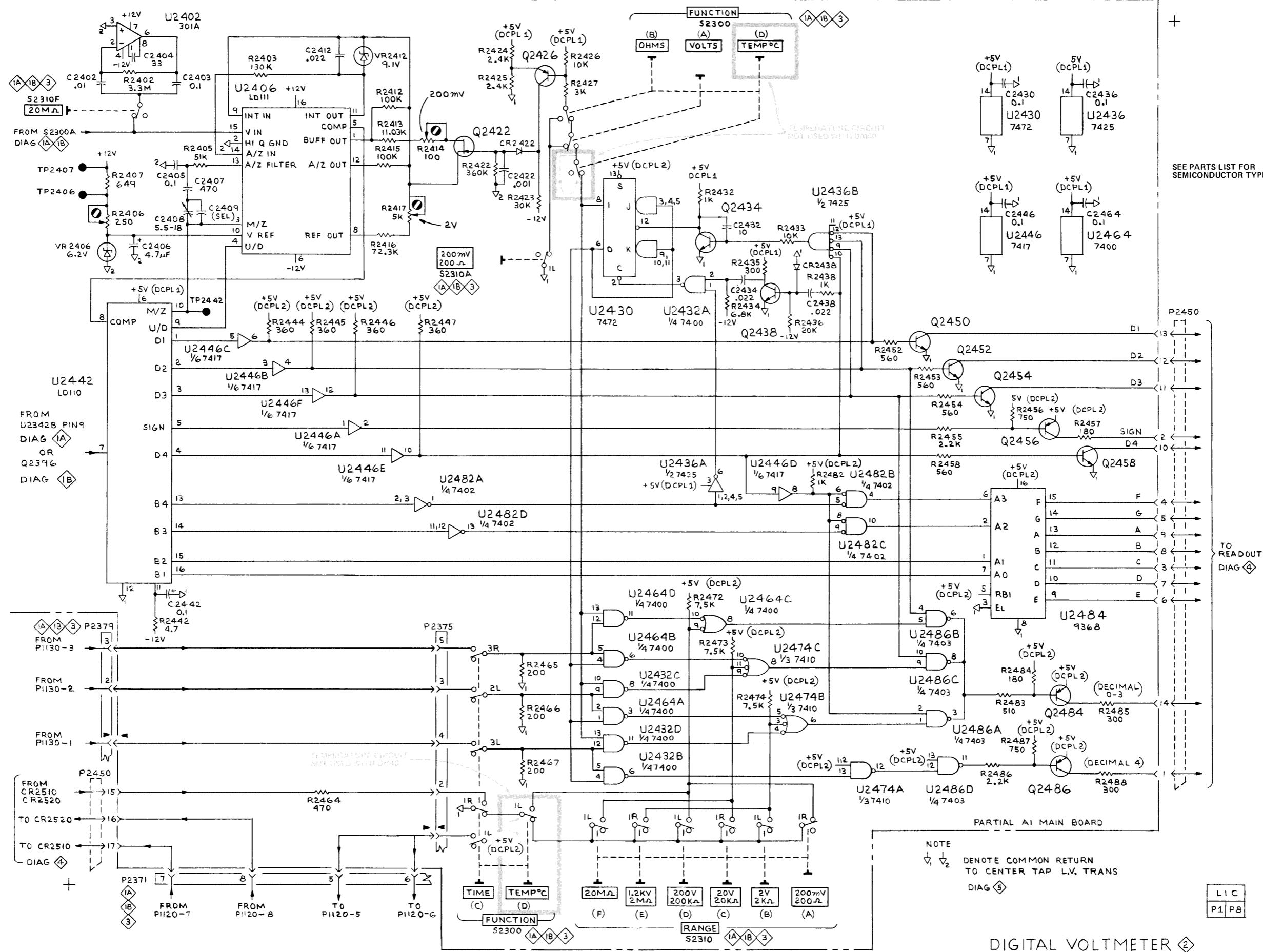


Fig. 7-3. A1—Main circuit board.
 Below SN B010920 (DM 43)
 Below SN B010500 (DM 40)

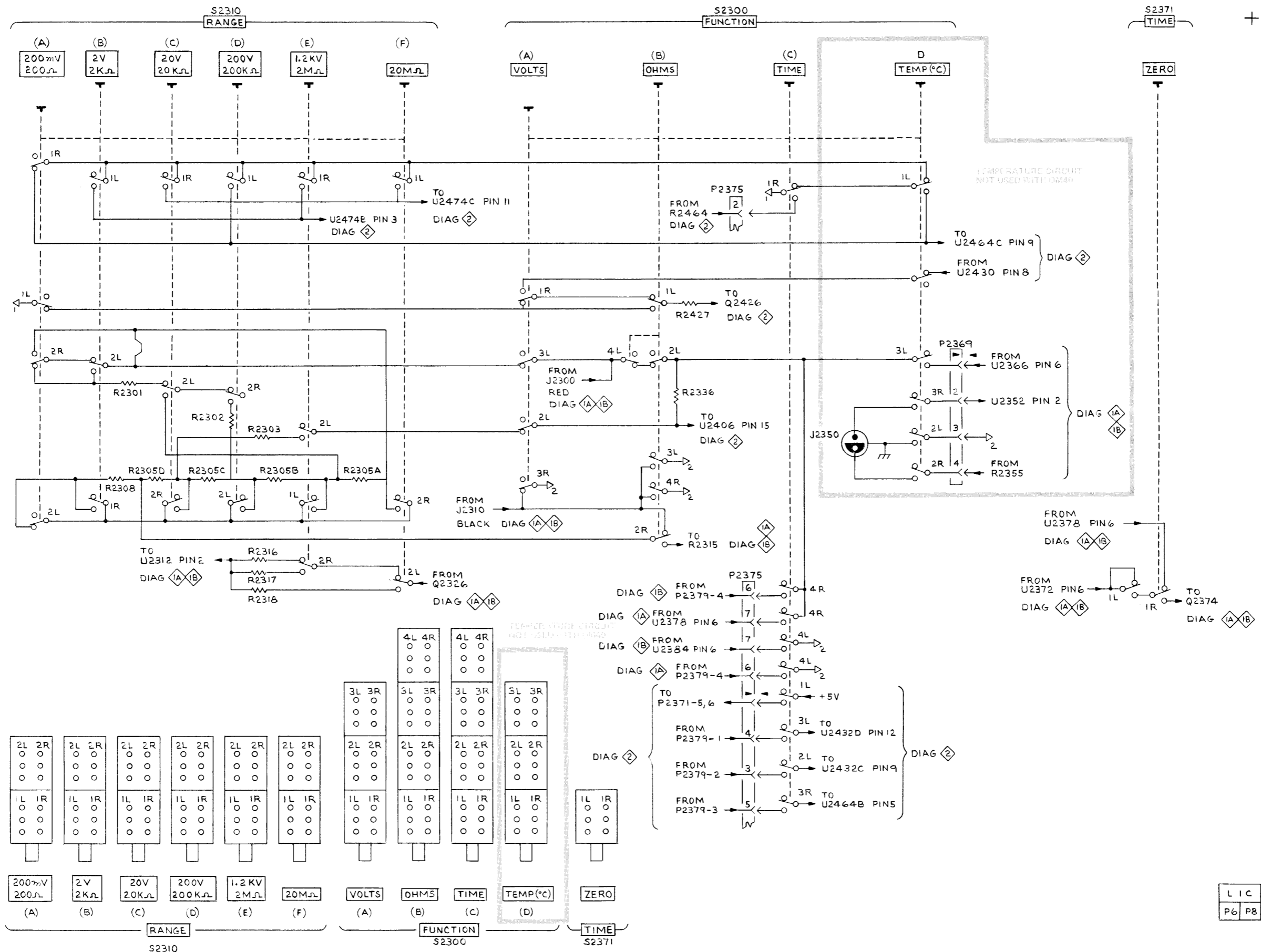
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C2318	2C	Q2322	2C	R2363	1B	R2472	2G
C2324	3C	Q2326	2C	R2364	1A	R2473	3G
C2336	5D	Q2342	3A	R2365	1B	R2474	2G
C2354	3B	Q2346	3B	R2366	1B	R2482	7C
C2355	3B	Q2352	3A	R2367	1C	R2483	8E
C2356	2B	Q2354	2B	R2368	1B	R2484	8E
C2361	2A	Q2356	2B	R2369	2B	R2485	8F
C2363	2B	Q2372	9G	R2372	10D	R2486	7D
C2366	1B	Q2374	10F	R2373	10E	R2487	6E
C2369	2B	Q2376	10E	R2374	9F	R2488	6F
C2372	9C	Q2392	5B	R2375	9E	R2655	7E
C2374	10F	Q2394	5A	R2376	9E		
C2375	10D	Q2396	5B	R2377	9F	S2300	5E
C2377	9F	Q2422	4C	R2382	10C	S2310	3E
C2383	9C	Q2426	6A	R2384	10C	S2371	9F
C2388	9E	Q2434	8A	R2385	10B		
C2389	9D	Q2438	7A	R2386	9D	TP2331	5D
C2391	5A	Q2450	8F	R2388	9B	TP2342	6B
C2402	3C	Q2452	8F	R2391	4A	TP2372	10C
C2403	3C	Q2454	8F	R2392	4A	TP2378	9F
C2404	3C	Q2456	6E	R2393	5A	TP2384	10C
C2405	4B	Q2458	8F	R2394	5B	TP2406	4B
C2406	4B	Q2484	8F	R2395	4A	TP2407	4B
C2407	4B	Q2486	6F	R2397	5B	TP2442	6C
C2408	6C			R2398	5B		
C2409	5C	R2301	2E	R2396	5A	U2312	2C
C2412	5C	R2302	3E	R2402	3C	U2344	4A
C2422	4B	R2303	3E	R2403	4C	U2352	2B
C2430	7A	R2305A	3D	R2405	4C	U2366	1B
C2432	8B	R2305B	2D	R2406	4B	U2378	9E
C2434	7B	R2305C	3E	R2407	3B	U2384	10C
C2436	8B	R2305D	2E	R2412	5B	U2402	3C
C2438	7B	R2308	1F	R2413	5C	U2406	5C
C2442	6B	R2314	4D	R2414	4C	U2430	8A
C2446	7D	R2315	3D	R2415	5C	U2432	6C
C2464	7C	R2316	3E	R2416	5C	U2436	8B
C2655	7E	R2317	3E	R2417	5B	U2442	6B
C2656	7F	R2318	4E	R2422	4B	U2446	8C
C2661	3C	R2323	3C	R2423	6A	U2464	6D
C2672	5A	R2324	2C	R2424	7A	U2474	10D
C2681	3C	R2324	7A	R2425	7A	U2482	6E
		R2325	2C	R2426	6A	U2484	7C
		R2326	2C	R2427	5D	U2486	7F
		R2327	1C	R2432	8B	U2486	8D
		R2328	2C	R2433	8B		
		R2334	5D	R2436	7A		
		R2335	4D	R2436	7B	VR2326	2C
		R2336	5D	R2438	7B	VR2361	2A
		R2337	4D	R2442	6A	VR2377	9F
		R2338	5D	R2444	8C	VR2388	9E
		R2343	3B	R2445	8C	VR2389	9D
		R2344	3B	R2446	7C	VR2406	5B
		R2345	3A	R2447	7C	VR2412	4C
		R2346	3A	R2452	8D	1000M	2E
		R2347	3B	R2453	8E		
		R2352	3C	R2454	7E		
J2300	1C	R2353	2A	R2455	7D		
J2310	1D	R2354	2A	R2456	6E		
J2350	1E	R2354	2A	R2456	6E		
J2450	7G	R2355	3B	R2457	6F		
		R2356	3B	R2458	7D		
		R2357	3B	R2464	9B		
		R2358	3B	R2465	6D		
P2369	2B	R2358	3B	R2466	6D		
P2371	9C	R2361	2A	R2467	6D		
P2375	9B	R2362	1A				
P2379	9B						



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

NOTE
 ↓ ↓ DENOTE COMMON RETURN TO CENTER TAP L.V. TRANS DIAG

L1C
P1 P8



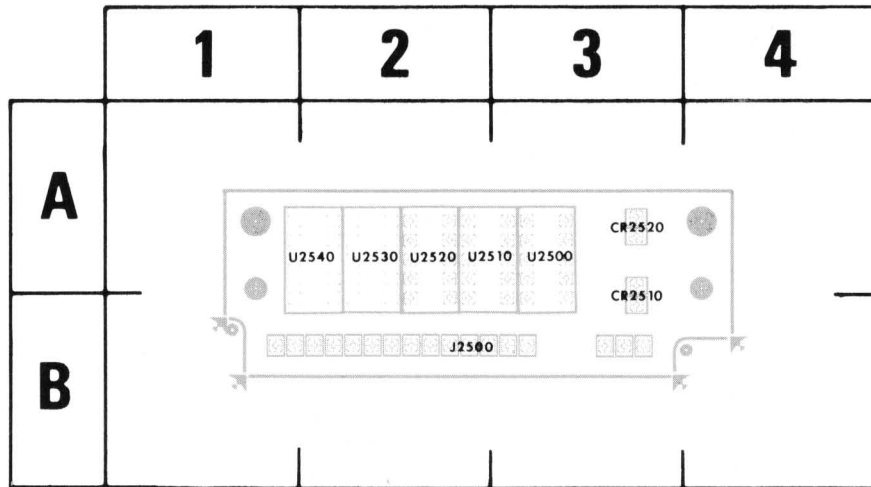
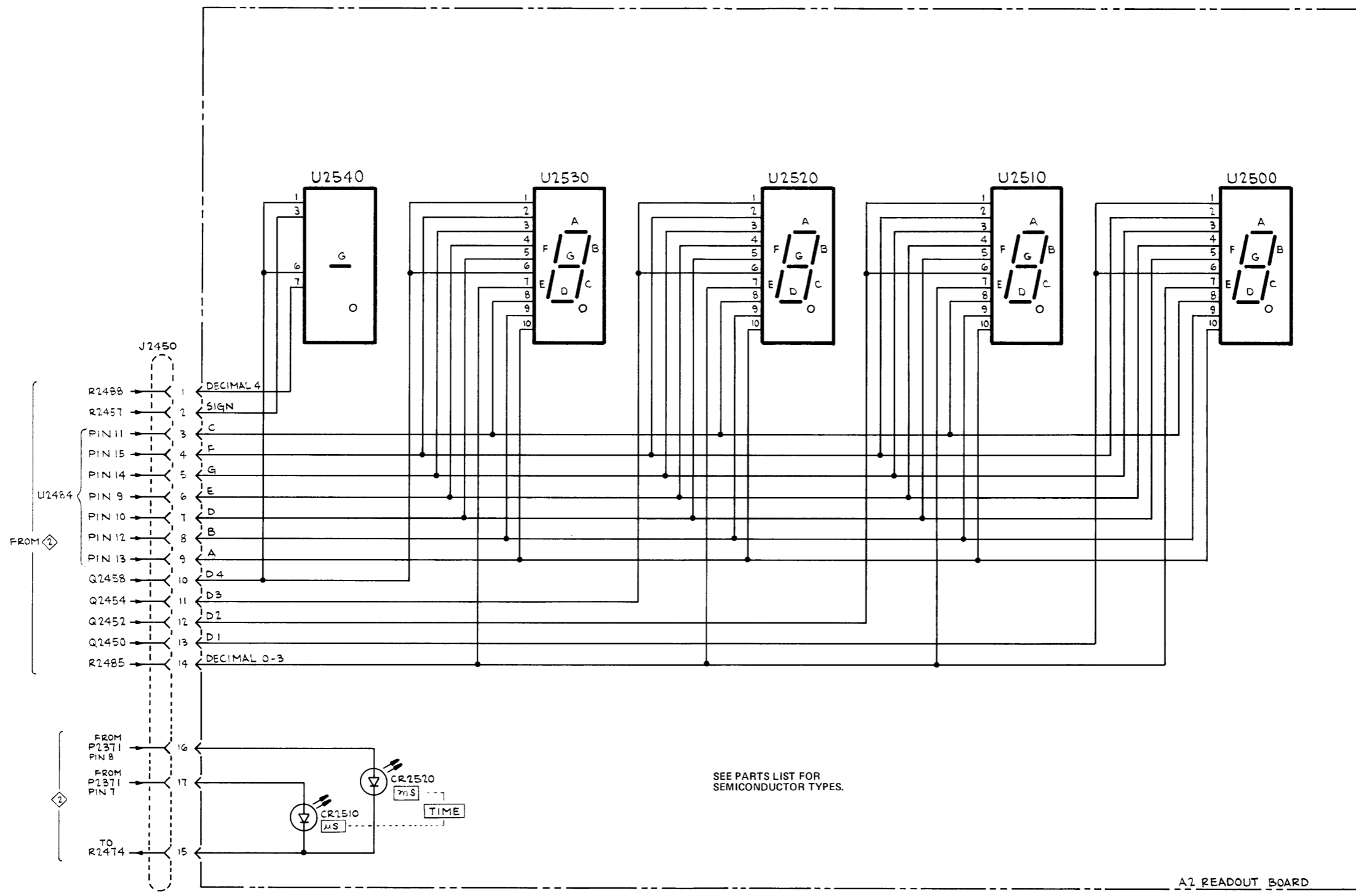


Fig. 7-4. A2-Readout circuit board.

CKT NO	GRID LOC
CR2510	3A
CR2520	3A
J2500	2B
U2500	3A
U2510	3A
U2520	2A
U2530	2A
U2540	2A

Ⓐ



READOUT 4

+

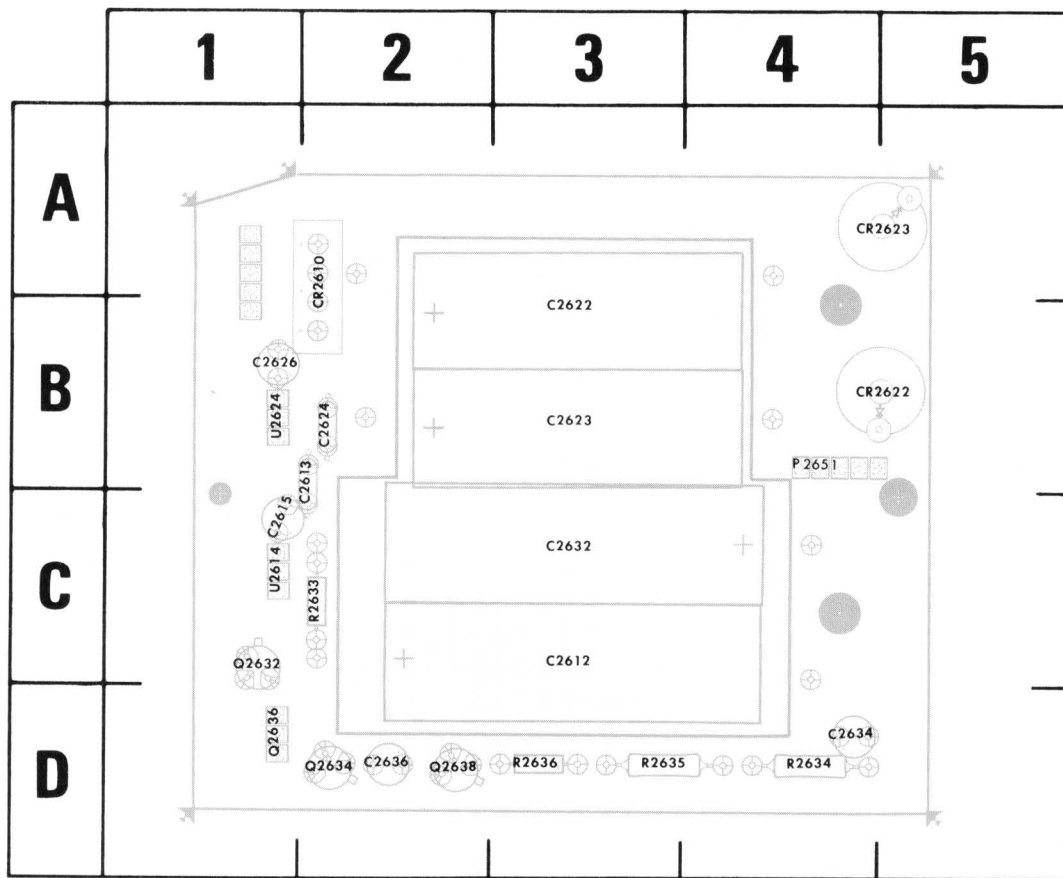
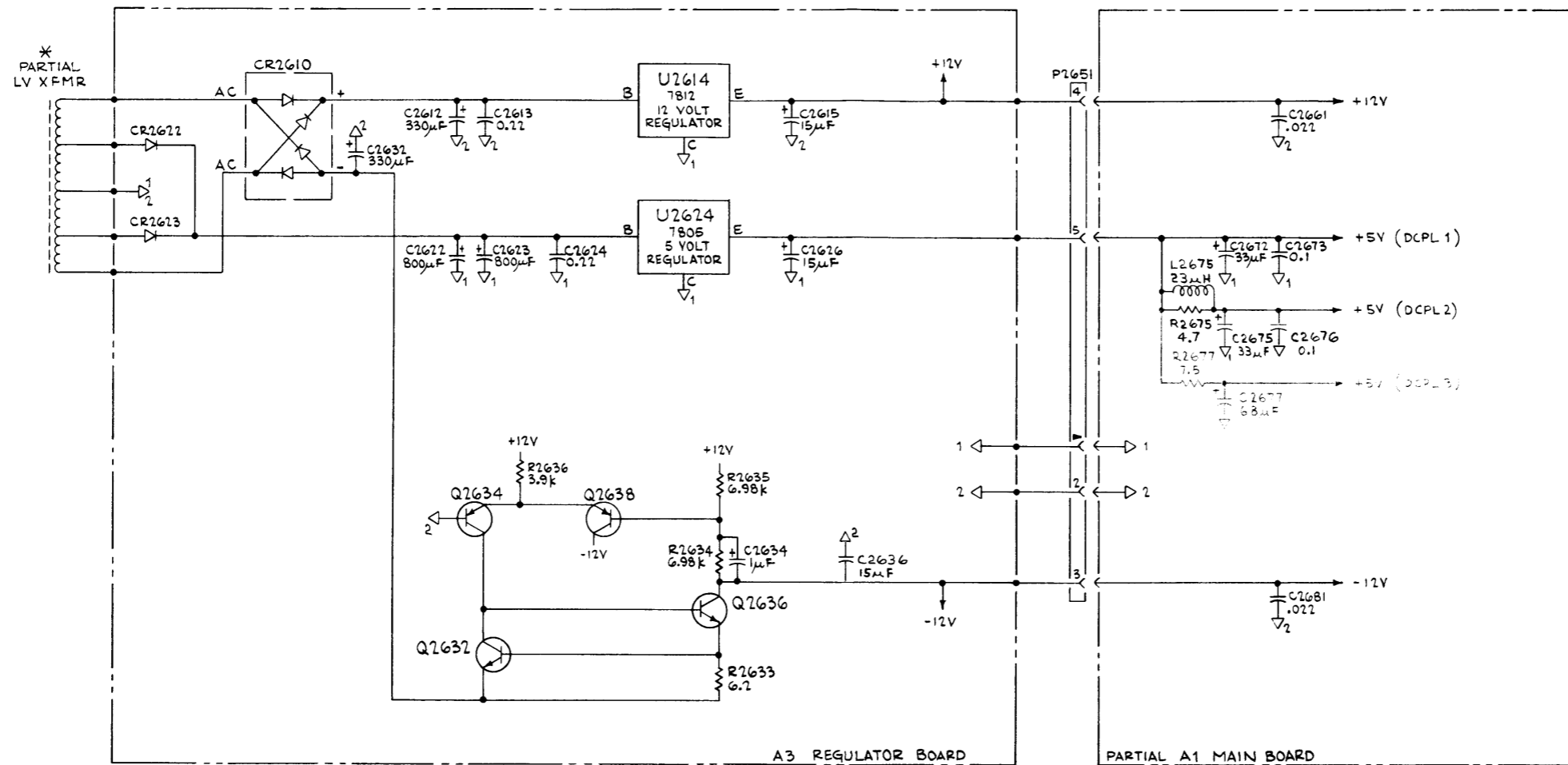


Fig. 7-5. A3—Power Supply circuit board.

CKT NO	GRID LOC	CKT NO	GRID LOC
C2612	3C	P2651	4B
C2613	2B		
C2615	1C	Q2632	1C
C2622	3B	Q2634	2D
C2623	3B	Q2636	1D
C2624	2B	Q2638	2D
C2626	1B		
C2632	3C	R2633	2C
C2634	4D	R2634	4D
C2636	2D	R2635	3D
		R2636	3D
CR2610	2A		
CR2622	5B	U2614	1C
CR2623	5A	U2624	1B

Ⓐ



*

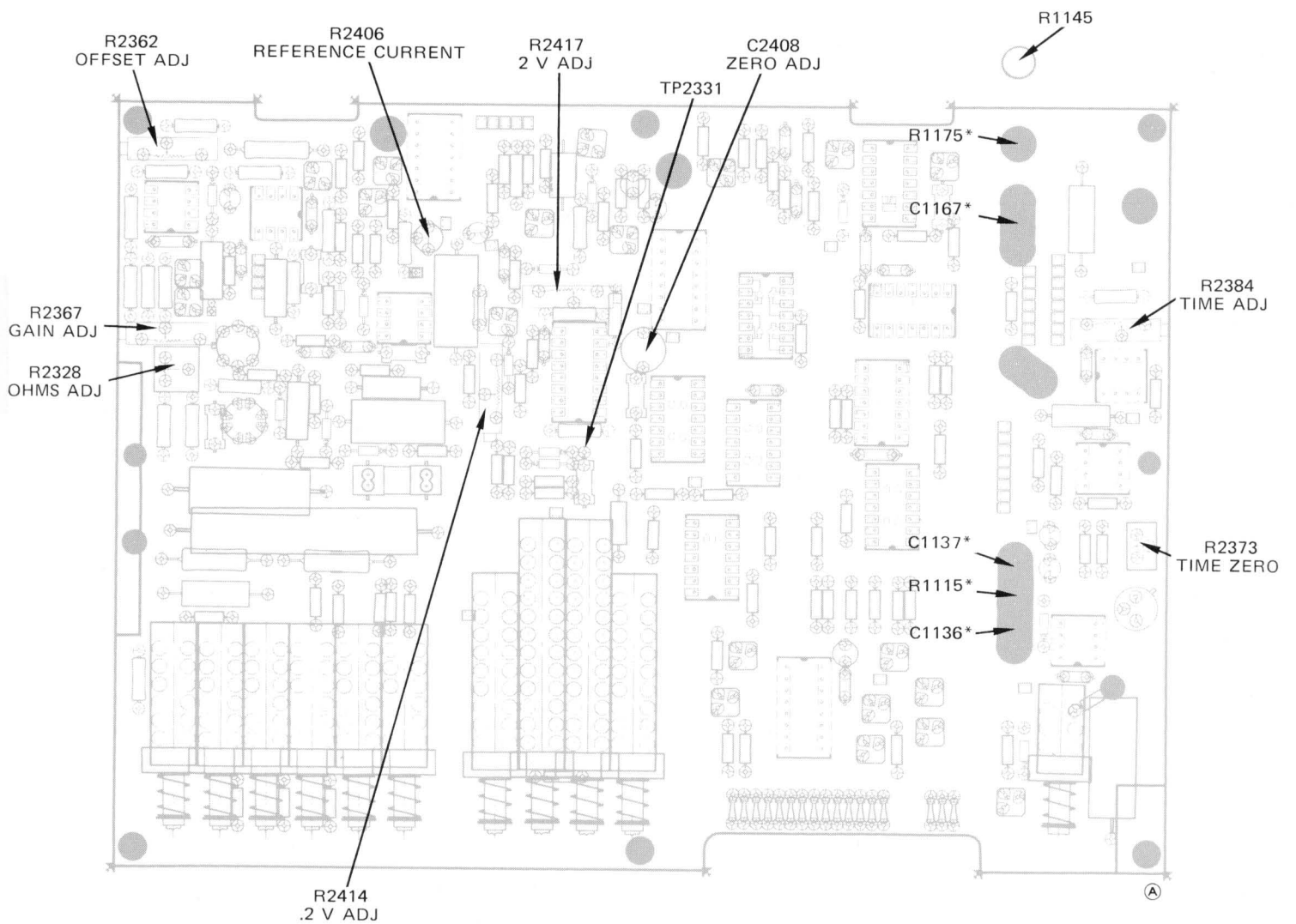
INSTR TYPE	415	465	464	466
LV XFMR	T1400	T1501	T1701	T1701
TERM NO.	10	10	14	14
	10A	10A	13	13
	11	11	12	12
	12A	12A	11	11
	12	12	10	10

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

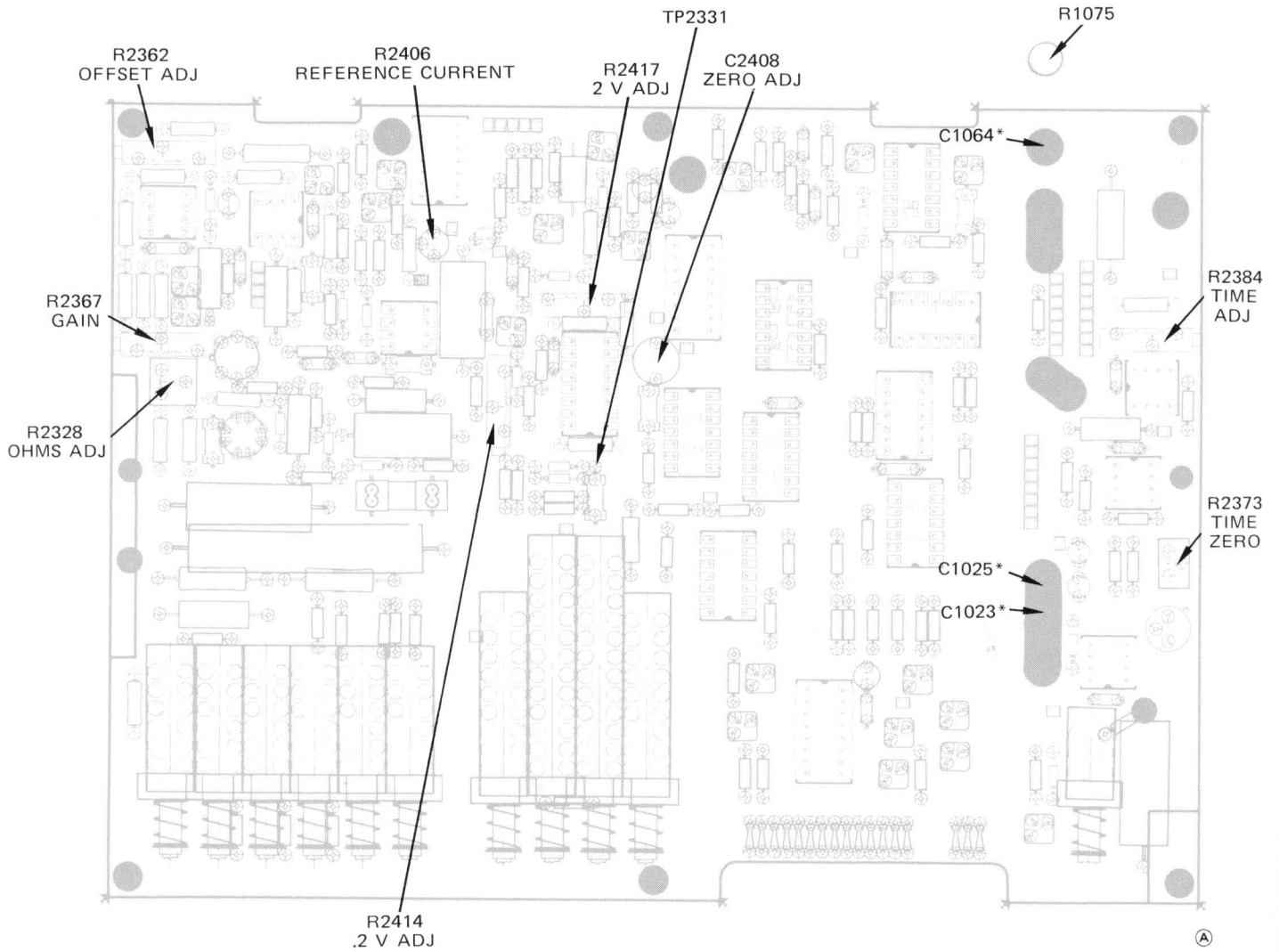
POWER SUPPLY

5



* THROUGH HOLE IN CIRCUIT BOARD TO
EDGE OF 464-465-466 TIMING BOARD.

Fig. 7-6. Adjustment locations for DM and 464-465-466 Timing board.



* THROUGH HOLE IN CIRCUIT BOARD TO
EDGE OF 475 TIMING BOARD.

Fig. 7-7. Adjustment locations for DM and 475 Timing board.

MECHANICAL REPLACEABLE PARTS LIST

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	<i>Name & Description</i>
					<i>Assembly and/or Component</i>
					<i>Attaching parts for Assembly and/or Component</i>
					--- * ---
					<i>Detail Part of Assembly and/or Component</i>
					<i>Attaching parts for Detail Part</i>
					--- * ---
					<i>Parts of Detail Part</i>
					<i>Attaching parts for Parts of Detail Part</i>
					--- * ---

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

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR. CODE	MANUFACTURER	ADDRESS	CITY, STATE, ZIP
0000A	Lemo USA	2015 2nd St.	Berkley, CA 94710
0000C	Gettig Engineering and Manufacturing Co.		Springmill, PA 16875
00779	AMP, Inc.	P. O. Box 3608	Harrisburg, PA 17105
01295	Texas Instruments, Inc., Components Group	P. O. Box 5012	Dallas, TX 75222
08261	Spectra-Strip Corp.	7100 Lampson Ave.	Garden Grove, CA 92642
12327	Freeway Washer and Stamping Co.	P. O. Box 05206	Cleveland, OH 44105
22526	Berg Electronics, Inc.	Youk Expressway	New Cumberland, PA 17070
23499	Gavitt Wire and Cable, Division of Amerace Esna Corp.	455 N. Quince St.	Escondido, CA 92025
28480	Hewlett-Packard Co., Corporate Hq.	1501 Page Mill Rd.	Palo Alto, CA 94304
29372	Tridair Industries, Fastener Div.	3000 W. Lomilita Blvd.	Torrance, CA 90505
71590	Centralab Electronics, Div. of Globe-Union, Inc.	5757 N. Green Bay Ave.	Milwaukee, WI 53201
71785	TRW Electronic Components, Cinch Connector Operations	1501 Morse Ave.	Elk Grove Village, IL 60007
73743	Fischer Special Mfg. Co.	446 Morgan St.	Cincinnati, OH 45206
75497	Lamson and Sessions Co., The	5000 Tiedeman Road	Cleveland, OH 44144
78189	Illinois Tool Works, Inc. Shakeproof Division	St. Charles Road	Elgin, IL 60126
79807	Wrought Washer Mfg. Co.	2100 S. O Bay St.	Milwaukee, WI 53207
80009	Tektronix, Inc.	P. O. Box 500	Beaverton, OR 97005
82647	Texas Instruments, Inc., Control Products Div.	34 Forest St.	Attleboro, MA 02703
83385	Central Screw Co.	2530 Crescent Dr.	Broadview, IL 60153
88245	Litton Systems, Inc., USECO Div.	13536 Saticoy St.	Van Nuys, CA 91409
97464	Industrial Retaining Ring Co.	57 Cordier St.	Irvington, NJ 07111

Mechanical Parts List—DM43/DM40 Service

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	200-1722-00			1						COVER,OSCP:UPPER FRONT (ATTACHING PARTS)	80009	200-1722-00
-2	212-0130-00			2						SCREW,MACHINE:8-32 X 0.50",PNH,STL - - - * - - -	29372	CA13036-8-3-8
	672-0461-00 ¹			1						CKT BOARD ASSY:MAIN DVM	80009	672-0461-00
	672-0462-00 ²			1						CKT BOARD ASSY:MAIN DVM	80009	672-0462-00
	672-0458-00 ³			1						CKT BOARD ASSY:MAIN DVM	80009	672-0458-00
	672-0457-00 ⁴			1						CKT BOARD ASSY:MAIN DVM (ATTACHING PARTS)	80009	672-0457-00
-3	213-0146-00			2						SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL	83385	OBD
-4	210-0803-00			2						WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL - - - * - - -	12327	OBD
-5	-----			-						. MAIN DVM ASSY INCLUDES: 1 . CKT BOARD ASSY:READOUT(SEE A2 EPL) (ATTACHING PARTS)		
-6	211-0180-00			2						. SCR,ASSEM WSHR:2-56 X 0.25 INCH,PNL BRS - - - * - - -	83385	OBD
-7	131-0787-00			17						. . CONTACT,ELEC:0.64 INCH LONG	22526	47359
-8	150-1001-00			2						. . LAMP,LED:RED,2V,100MA	28480	5082-4403
	337-0397-00	XB010330		1						. SHIELD,ELECTRICAL:DM43	80009	337-0397-00
	337-0397-00	XB010160		1						. SHIELD,ELECTRICAL:DM40	80009	337-0397-00
-9	366-1512-00 ⁵			11						. PUSHBUTTON:GRAY,0.18 SQ X 0.83 INCH L	80009	366-1512-00
	366-1512-00 ⁶			10						. PUSHBUTTON:GRAY,0.18 SQ X 0.83 INCH L	80009	366-1512-00
-10	426-1072-00			11						. FR,PUSHBUTTON:DM43	80009	426-1072-00
	426-1072-00			10						. FR,PUSHBUTTON:DM40	80009	426-1072-00
-11	333-1848-00			1						. PANEL,FRONT:DM 40	80009	333-1848-00
	333-1940-00			1						. PANEL,FRONT:DM 43 (ATTACHING PARTS)	80009	333-1940-00
-12	354-0195-00			3						. RING,RETAINING - - - * - - -	97464	6100-12-ST-PA
-13	426-1176-00			1						. FRAME,CAB:FRONT (ATTACHING PARTS)	80009	426-1176-00
-14	211-0116-00			3						. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-15	210-0586-00			3						. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL - - - * - - -	78189	OBD
-16	136-0138-00			1						. JACK,TIP:BANANA TYPE,BLACK PLASTIC	80009	136-0138-00
	136-0139-00			1						. JACK,TIP:BANANA TYPE,RED PLASTIC (ATTACHING PARTS FOR EACH)	80009	136-0139-00
-17	210-0465-00			1						. NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH BRS	73743	3095-402
-18	210-0223-01			1						. TERMINAL,LUG:0.25 INCH DIA,SE,60 DEG BEND	78189	210-14-07-2520N
-19	210-0940-00			1						. WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL - - - * - - -	79807	OBD
-20	131-1652-00 ⁵			1						. CONN,RCPT,ELEC:1 FEM,1 MALE CONTACT,W/HDWR (ATTACHING PARTS)	0000A	RA0302
-21	210-0302-00 ⁵			1						. TERMINAL,LUG:0.365 INCH ID - - - * - - -	0000A	RA0251
-22	407-1569-01			1						. BRACKET,ANGLE:INPUT (DM40)	80009	407-1569-01
	407-1569-00			1						. BRACKET,ANGLE:INPUT (DM43) (ATTACHING PARTS)	80009	407-1569-00
-23	211-0116-00			2						. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS - - - * - - -	83385	OBD
-24	210-0201-00			1						. TERMINAL,LUG:SE #4 (ATTACHING PARTS)	78189	2104-04-00-2520N
-25	210-0586-00			1						. NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL - - - * - - -	78189	OBD
-26	407-1568-00			1						. BRACKET,ANGLE:DMM MOUNTING (ATTACHING PARTS)	80009	407-1568-00
-27	211-0507-00			2						. SCREW,MACHINE:6-32 X 0.312 INCH, PNH, STL - - - * - - -	83385	OBD
-28	342-0239-00			1						. INSULATOR,PLATE:	80009	342-0239-00

1 464, 465 & 466 DM40 only.
2 475 DM40 only.
3 464, 465 & 466 DM43 only.
4 475 DM43 only.
5 DM43 only.
6 DM40 only.

Mechanical Parts List—DM43/DM40 Service

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Qty	Name & Description					Mfr Code	Mfr Part Number
					1	2	3	4	5		
1-29	386-3108-00			1	.	SUPPORT,CKT BOARD:				80009	386-3108-00
						(ATTACHING PARTS)					
-30	211-0116-00			3	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS				83385	OBD
						- - - * - - -					
-31	-----	-----		1	.	CKT BOARD ASSY:MAIN(SEE A1 EPL)					
	-----	-----		1	.	CKT BOARD ASSY:MAIN(SEE A1 EPL)					
	-----	-----		1	.	CKT BOARD ASSY:MAIN(SEE A1 EPL)					
	-----	-----		1	.	CKT BOARD ASSY:MAIN(SEE A1 EPL)					
-32	131-0183-00			1	.	TERM,FEED THRU:0.047 OD X 0.57" L				88245	42D969-9
						(ATTACHING PARTS)					
-33	358-0136-00			1	.	INSULATOR,BSHG:TEFLON				80009	358-0136-00
						- - - * - - -					
-34	131-0566-00			2	.	LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L				0000C	L-2007-1
	131-0566-C0			1	.	LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L				0000C	L-2007-1
-35	131-0608-00			28	.	CONTACT,ELEC:0.365 INCH LONG				22526	47357
	131-0608-00			32	.	CONTACT,ELEC:0.365 INCH LONG				22526	47357
-36	136-0220-00			12	.	SOCKET,PLUG-IN:3 PIN				71785	133-23-11-034
	136-0220-00			17	.	SOCKET,PLUG-IN:3 PIN				71785	133-23-11-034
-37	136-0235-00			1	.	SOCKET,PLUG-IN:6 CONTACT,ROUND				71785	133-96-12-062
-38	136-0252-04			51	.	CONTACT,ELEC:0.188 INCH LONG				22526	75060
-39	136-0260-02			2	.	SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE				01295	C931602
-40	136-0269-02			8	.	SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE				01295	C931402
	136-0269-02			9	.	SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE				01295	C931402
-41	136-0328-02			17	.	SOCKET,PIN TERM:HORIZ,CKT BOARD MTG				00779	86282-2
-42	136-0514-00			1	.	SOCKET,PLUG-IN:MICROCIRCUIT,8 CONTACT				82647	C930802
	136-0514-00			3	.	SOCKET,PLUG-IN:MICROCIRCUIT,8 CONTACT				82647	C930802
-43	344-0154-00			2	.	CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE				80009	344-0154-00
-44	214-0579-00			15	.	TERM.,TEST PT:0.40 INCH LONG				80009	214-0579-00
-45	214-0973-00			1	.	HEAT SINK,ELEC:0.28 X 0.18 OVAL X 0.187"H				80009	214-0973-00
-46	260-1686-00			1	.	SWITCH,PUSH:ZERO				71590	2KAA010000-685
-47	260-1687-00 ¹			1	.	SWITCH,PUSH:FUNCTION				71590	2KBC000220-833
	260-1689-00 ²			1	.	SWITCH,PUSH:FUNCTION				71590	2KBC000120-833
-48	361-0608-00			5	.	SPACER,PUSH SW:PLASTIC				80009	OBD
-49	260-1688-00			1	.	SWITCH,PUSH:RANGE				71590	2KBC006000-831
-50	361-0608-00			4	.	SPACER,PUSH SW:PLASTIC				80009	OBD
-51	179-2171-00 ¹			1	.	WIRING HARNESS:				80009	179-2171-00
-52	131-0707-00 ¹			4	.	CONTACT,ELEC:0.48"L,22-26 AWG WIRE				22526	47439
-53	352-0162-00 ¹			1	.	HOLDER,TERM.CON:4 WIRE BLACK				80009	352-0162-00
-54	175-0830-00			FT	.	WIRE,ELECTRICAL:7 WIRE RIBBON				08261	TEK-175-0830-00
	131-0707-00			7	.	CONTACT,ELEC:0.48"L,22-26 AWG WIRE				22526	47439
-55	352-0165-00			1	.	HOLDER,TERM.CON:7 WIRE BLACK				80009	352-0165-00
	672-0482-00 ³			1	.	CKT BOARD ASSY:POWER SUPPLY				80009	672-0482-00
	672-0453-00 ⁴			1	.	CKT BOARD ASSY:POWER SUPPLY				80009	672-0453-00
						(ATTACHING PARTS)					
	211-0008-00			3	.	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL				83385	OBD
	210-0938-00			3	.	WASHER,FLAT:0.109 ID X 0.25 INCH OD,STL				75497	AN960-3
						- - - * - - -					
	-----	-----		-	.	POWER SUPPLY ASSY INCLUDES:					
-56	-----	-----		1	.	CKT BOARD ASSY:(SEE A3 EPL)					
						(ATTACHING PARTS)					
-57	211-0116-00			2	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS				83385	OBD
						- - - * - - -					
				-	.	CKT BOARD ASSY INCLUDES:					
-58	136-0252-04			9	.	CONTACT,ELEC:0.188 INCH LONG				22526	75060
-59	-----	-----		1	.	SEMICONV DEVICE:CHASSIS MTG(SEE Q2632 EPL)					
	-----	-----		2	.	MICROCIRCUIT,LI:CHASSIS MTG(SEE U2614,2624EPL)					
						(ATTACHING PARTS)					
-60	343-0507-00			1	.	RETAINER,XSTR:BLACK PLASTIC				80009	343-0507-00
-61	210-0586-00			3	.	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL				78189	OBD
						- - - * - - -					
	342-0195-00 ²			1	.	INSULATOR,PLATE:TRANSISTOR				80009	342-0195-00
	342-0195-00 ¹	XB010200		1	.	INSULATOR,PLATE:TRANSISTOR				80009	342-0195-00
-62	342-0238-00			1	.	INSULATOR,PLATE:CIRCUIT BOARD				80009	342-0238-00
-63	348-0055-00			1	.	GROMMET,PLASTIC:0.25 INCH DIA				80009	348-0055-00
-64	348-0141-00			1	.	GROMMET,PLASTIC:U-SHP,0.625 X 0.658 INCH				80009	348-0141-00

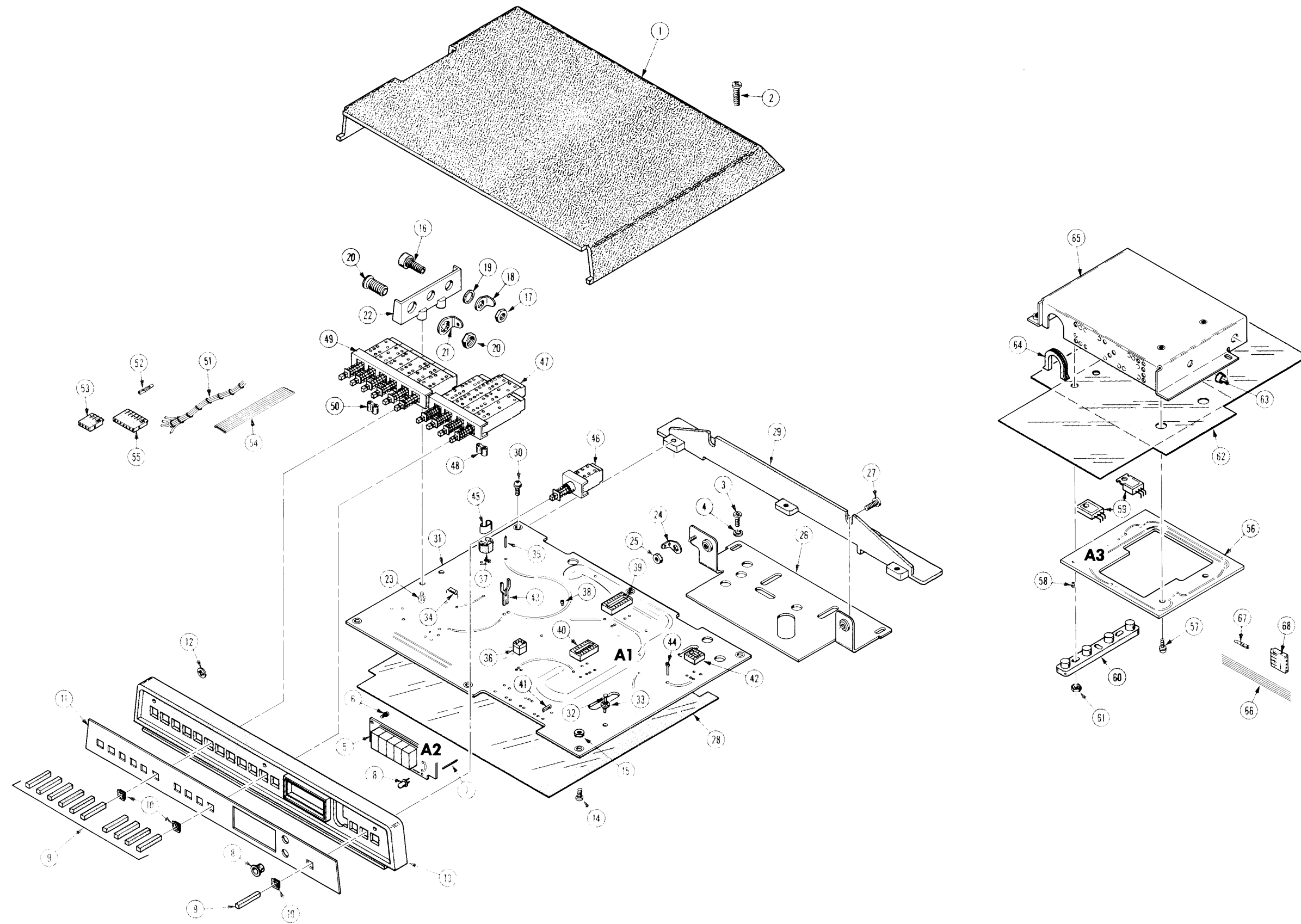
¹DM43 only.
²DM40 only.
³464, 466 DM43/DM40 only.
⁴465, 475 DM43/DM40 only.

Mechanical Parts List—DM43/DM40 Service

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Qty						Name & Description	Mfr	
					1	2	3	4	5		Code	Mfr Part Number
1-65	441-1171-00			1	.					CHAS,ELEK EQUIP:INVERTER	80009	441-1171-00
-66	175-0860-00 ¹			FT	.					WIRE,ELECTRICAL:5 WIRE RIBBON,24.75 INCH	23499	TEK-175-0860-00
	175-0860-00 ²			FT	.					WIRE,ELECTRICAL:5 WIRE RIBBON,13.50 INCH	23499	TEK-175-0860-00
-67	131-0707-00			5	.					CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
-68	352-0163-00			1	.					HOLDER,TERM.CON:5 WIRE BLACK	80009	352-0163-00

¹464 & 466 DM43/DM40 only.

²465 & 475 DM43/DM40 only.





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MANUAL CHANGE INFORMATION

PRODUCT DM43-DM40 Service

CHANGE REFERENCE C1/874

DATE 8-2-74

CHANGE:

DESCRIPTION

TEXT CORRECTION

Page 5-11 Table 5-6

Page 5-23 Table 5-11

CHANGE: DM Reading Limits, last column, to read:

DM Reading Limits

-15° C	to	+15° C
+35° C	to	+55° C

1.364 to 1.436

03.40 to 03.60

07.79 to 08.21

15.59 to 16.41

038.9 to 041.1

077.9 to 082.1

155.9 to 164.1

0.389 to 0.411

0.779 to 0.821

1.559 to 1.641

03.89 to 04.11

07.79 to 08.21

15.59 to 16.41

038.9 to 041.1

077.9 to 082.1

155.9 to 164.1

0.389 to 0.411

0.779 to 0.821

1.559 to 1.641

03.89 to 04.11

CHANGE:	DESCRIPTION
---------	-------------

Page 5-28 Table 5-13
 Page 5-38 Table 5-15

CHANGE TO:

Time-Marker Displayed	DM Reading	
	+15° C to +35° C (1%, ±1 count)	-15° C to +15° C +35° C to +55° C (1.5%, ±1 count)
3	0.989 to 1.011	0.984 to 1.016
4	1.979 to 02.03*	1.969 to 02.04*
5	02.96 to 03.04	02.94 to 03.06
6	03.95 to 04.05	03.93 to 04.07
7	04.94 to 05.06	04.91 to 05.09
8	05.93 to 06.07	05.90 to 06.10
9	06.92 to 07.08	06.88 to 07.12
10	07.91 to 08.09	07.87 to 08.13

* DM upranges at 2.000



MANUAL CHANGE INFORMATION

PRODUCT <u>DM43/DM40</u>	CHANGE REFERENCE <u>C3/874</u>
<u>Service</u>	DATE <u>8-22-74</u>

CHANGE:

DESCRIPTION

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTIONS

Page 6-12 DIFFERENCES BETWEEN STANDARD TIMING BOARD AND DVM TIMING BOARD

CHANGE: Heading and following text to read:

DIFFERENCES BETWEEN STANDARD TIMING BOARDS AND DM43/DM40 TIMING BOARDS

465

A7	670-3467-01	CKT BOARD ASSY:TIMING DM43/DM40 (465)
R1111	321-0265-00	RES.,FXD,FILM:5.62K OHM, 1%, 0.125W
R1112	321-0252-00	RES.,FXD,FILM:4.12K OHM, 1%, 0.125W
R1113	321-0154-00	RES.,FXD,FILM:392 OHM, 1%, 0.125W
R1142	321-0222-07	RES.,FXD,FILM:2K OHM, 0.1%, 0.125W
R1143	321-0193-07	RES.,FXD,FILM:1K OHM, 0.1%, 0.125W
R1144	321-0193-07	RES.,FXD,FILM:1K OHM, 0.1%, 0.125W

Page 6-13

CHANGE TO READ:

466/464

A7	670-3466-01	CKT BOARD ASSY: TIMING DM43/DM40 (466/464)
R812	321-0154-00	RES.,FXD,FILM:392 OHM, 1%, 0.125W
R815	321-0252-00	RES.,FXD,FILM:4.12K OHM, 1%, 0.125W
R817	321-0265-00	RES.,FXD,FILM:5.62K OHM, 1%, 0.125W
R1142	321-0222-07	RES.,FXD,FILM:2.0K OHM, 0.1%, 0.125W
R1143	321-0193-07	RES.,FXD,FILM:1.0K OHM, 0.1%, 0.125W
R1147	321-0193-07	RES.,FXD,FILM:1.0K OHM, 0.1%, 0.125W

Note: This insert replaces insert C2/874 dated 8-6-74.



MANUAL CHANGE INFORMATION

PRODUCT As listed below

CHANGE REFERENCE C4/1174

DATE 11-14-74

CHANGE:	DESCRIPTION
	DM43-DM40 SERVICE All Serial Numbers
	464 SERVICE All Serial Numbers
	466 SERVICE All Serial Numbers
TEXT, PARTS LIST, AND DIAGRAMS CORRECTIONS	
<p>The SWEEP START adjustment control for the 464 and 466 has been referred to as either R313 or R1115 in various portions of these manuals. The part is marked R1115 on all 670-2807- and 670-3466- circuit boards except possibly a few very early production versions.</p>	
<p>CHANGE: All references to this part from R313 to R1115 in Circuit Description (Fig. 3-5 for 464 and 466), Calibration Procedure (Step 1 of Timing Checks and Adjustments for 464 and 466), Electrical Parts List, Circuit Board Component Location Figures (Diagrams Section 464 and 466), Schematic Diagrams (Diagram 3 etc.), and Adjustment Locations 4.</p>	
<p>In addition, change circuit numbers for associated components as follows:</p>	
<p style="padding-left: 40px;">C812 to C1112</p>	
<p style="padding-left: 40px;">C315 to C1115</p>	
<p style="padding-left: 40px;">R812 to R1112</p>	
<p style="padding-left: 40px;">R314 to R1114</p>	
<p style="padding-left: 40px;">R915 to R1113</p>	
<p style="padding-left: 40px;">R816 to R1116</p>	
<p style="padding-left: 40px;">R817 to R1117</p>	
<p>Make the above changes wherever applicable in the three manuals listed above.</p>	

**TEKTRONIX®**committed to
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EFF SN B020000-upCHANGE REFERENCE M22,847
DATE 10-25-74

CHANGE:	DESCRIPTION	
ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES		
<u>DM43</u>		
	670-3471-05	CKT BRD ASSY:MAIN DMM (464,465,466;DM43)
	670-3471-06	CKT BRD ASSY:MAIN DMM (475;DM43)
Page 6-3		
REMOVE:		
C2404	281-0629-00	CAP.,FXD,CER DI:33PF,5%,600V
Page 6-7		
CHANGE TO:		
U2402	156-0067-02	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER, SELECTED
	670-3470-00	CKT BRD ASSY:POWER SUPPLY DMM (DM43-DM40)
Page 6-4		
ADD:		
CR2636	152-0066-00	SEMICOND DEVICE:SILICON,400V,1A (See attached sketch for schematic and board location details)
<u>DM40</u>		
	670-3471-07	CKT BOARD ASSY:MAIN DMM (464,465,466;DM40)
	670-3471-08	CKT BOARD ASSY:MAIN DMM (475;DM40)
Page 6-8		
REMOVE:		
C2404	281-0629-00	CAP.,FXD,CER DI:33PF,5%,600V
Page 6-12		
CHANGE TO:		
U2402	156-0067-02	MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED
	670-3470-00	CKT BOARD ASSY:POWER SUPPLY DMM (DM43-DM40)
Page 6-9		
ADD:		
CR2636	152-0066-00	SEMICOND DEVICE:SILICON,400V,1A (See attached sketch for schematic and board location details)

CHANGE:

DESCRIPTION

SCHMATIC CHANGES

DIAGRAM 5 POWER SUPPLY - Partial

CR2636 is physically located on A3 POWER SUPPLY REGULATOR BOARD

directly above C2634. See Fig. 7-5 in DM43-DM40 manual.

