



product

040-0814-02

M24533, M36877

DM44 - DIGITAL MULTIMETER

For TEKTRONIX® 465 Oscilloscopes*

Serial Numbers B052300 - B251074

This modification kit provides parts and instructions to install the DM44 DIGITAL MULTIMETER.

The DM44 provides the following:

- 1) A Digital Readout to replace the function of the ten-turn counting dial on the DELAY TIME POSITION control.
- 2) A precision DC voltmeter with ranges from 0-200mV to 0-1200V in five steps.
- 3) A precision ohmmeter with ranges from 0-200 Ω to 0-20M Ω in six decade steps.
- 4) A precision temperature probe with a range of -55°C to +150°C.
- 5) A 1/TIME function for making frequency measurements with an accuracy of 2% or better.

All of the above features are included in an assembly that mounts on top of the instrument inside a new wrap-around cover.

*The 465DM44 operates on 115-230 VAC only and cannot be used or installed in instruments with Option 7 (DC External Power).

NOTES

PARTS INCLUDED IN MODIFICATION KIT:

Ckt. No.	Quantity	Part Number	Description
	1 ea	----	Assembly, DM44 Main w/temperature probe, consisting of:
	1 ea	010-6430-00	Probe, P6430 temperature
	1 ea	672-0591-10	Circuit board assembly, Main
	1 ea	----	Assembly, DELAY TIME POSITION consisting of:
R1110	1 ea	311-1709-00	Resistor, 10-turn var, 20k Ω 2W
	1 ea	198-3519-00	Cable, 3-wire ribbon, w/connector
	1 ea	003-0120-00*	Leads, test, 1 pair
	1 ea	016-0594-00	Pouch, accessory, DM44
	1 ea	070-2036-01	Manual, DM44 Service
	1 ea	070-2038-00	Manual, 465/DM44 Operator
L1006	1 ea	108-0328-00	Coil, RF, 0.3 μ H
	1 ea	198-3161-00	Wire kit (consisting of four ribbon cables w/connectors)
	1 ea	200-1722-00	Cover, DM44 top
	1 ea	200-1723-00	Cover, 465DM44 front
	1 ea	210-0012-00 ¹	Washer, lock, 0.384 ID
	2 ea	210-0586-00 ³	Nut, hex, 4-40 x 0.25 w/lockwasher
	1 ea	210-0590-00 ¹	Nut, hex, 0.375-32 x 0.438
	2 ea	210-0803-00 ²	Washer, flat, 0.150 ID, 0.375 OD
	2 ea	210-0938-00 ³	Washer, flat, 0.109 ID, 0.250 OD
	1 ea	210-0978-00 ¹	Washer, flat, 0.375 ID, 0.500 OD
	2 ea	211-0008-00 ³	Screw, 4-40 x 0.250 PNH
	2 ea	212-0130-01 ⁴	Screw, 8-32 x 0.625 PNH
	2 ea	213-0146-00 ²	Screw, tapping, 6-20 x 0.312, PNH
C1036	1 ea	281-0579-00	Capacitor, cer, 21pF 5% 500V
R360, R1318	2 ea	315-0203-00	Resistor, cmpsn, 20k Ω 5% 0.25W
R1007	1 ea	315-0271-00	Resistor, cmpsn, 270 Ω 5% 0.25W
R363	1 ea	315-0473-00	Resistor, cmpsn, 47k Ω 5% 0.25W
	1 ea	337-1763-01	Shield, transformer
	1 ea	348-0063-00	Grommet, plastic, 0.500 ID
	1 ea	366-1563-00	Knob, gray plastic, 0.252 ID
	1 ea	437-0174-02	Cabinet, Oscilloscope
A3	1 ea	672-0453-00	Circuit board assembly, DM44 Power Supply
	1 ea	672-0471-03	Circuit board assembly, 465 Timing

*A deluxe set of Test Leads is available as an optional accessory.
Order 012-0427-00.

- 1 Mounting hardware for R1110 (DELAY TIME POSITION)
- 2 Mounting hardware for DM44 Main assembly
- 3 Mounting hardware for DM44 Power Supply assembly
- 4 Mounting hardware for DM44 Cover and Accessory Pouch

INSTRUCTIONS:

WARNING

DISCONNECT THE INSTRUMENT FROM THE AC POWER
BEFORE PROCEEDING.

A. TO REMOVE THE 465 CABINET:

- () 1. Install the front cover and set the instrument face down on a flat surface.
- () 2. Unwrap the power cord from the rear feet.
- () 3. Remove the four rear feet and the two screws securing the rear cabinet-ring assembly.
- () 4. Slide the wrap-around cabinet up to remove it from the instrument.

B. TO REMOVE THE 465 TRIGGER GENERATOR AND SWEEP LOGIC CIRCUIT BOARD:

- () 1. Remove the LOW LINE, READY, and TRIG light lenses from the front panel. (Pry them away from the front panel with your fingernails and pull straight out.)
- () 2. For serial numbers below B120000, remove one screw and unplug the Trigger View circuit board.
- () 3. For serial numbers above B120000, unsolder a red-brown wire, if present, from R690, a 10 Ω resistor on the Trigger circuit board.
- () 4. Disconnect the following cables:
 - () a. P530 - a five-wire ribbon cable to the B TRIGGER LEVEL/SLOPE control.
 - () b. P630 - a five-wire ribbon cable to the A TRIGGER LEVEL/SLOPE control.
- () 5. Use a small flat-bladed screwdriver to pry the POWER switch actuating rod from the plastic coupler; pull the rod out through the front panel.

6. Disconnect five miniature coaxial cable connectors from the top of the circuit board near the front and three from the bottom of the board near the rear:
 - () a. J573 (CH1 Trigger) white-brown.
 - () b. J575 (CH2 Trigger) white-red.
 - () c. J571 (Composite Trigger) white-orange.
 - () d. J1317 (A Gate) white-yellow.
 - () e. J1337 (B Gate) white-green.
 - () f. J1319 (Alt Sync) white-blue.
 - () g. J678 (A Trig View to J338) white-black-yellow.
 - () h. J688 (A Trig View to J339) white-black-orange.
- () 7. Disconnect P1040 (located on the bottom side of the circuit board, near the support post). The new Timing circuit board will have two wires soldered to the board; the white-brown-black wire will be connected to the front pin, and the white-gray wire will be connected to the rear pin.
- () 8. Unsolder C602-R602 from the A External Trigger Input connector
- () 9. Unsolder a bare wire from the B External Trigger Input connector.
- () 10. Unsolder a white-gray wire from the DELAY TIME POSITION variable resistor.
- () 11. Unsolder the wires connected to the bottom terminals of the A TRIGGER HOLDOFF variable resistor. (The red wire will be reconnected to the right bottom terminal and the black wire will be reconnected to the left bottom terminal, as viewed from the front panel.)
- () 12. Remove the POWER switch. The top of the switch is secured by a nut; the bottom is secured by a screw with washers and a nut, plus a plastic spacer fitting between the Sweep Logic circuit board and the Interface circuit board.
- () 13. Remove four screws and the standoff located at the top center of the Trigger Generator And Sweep Logic circuit board.
- () 14. Center the lever switches and lift out the circuit board assembly.

C. TO REMOVE THE 465 TIMING CIRCUIT BOARD:

- () 1. Unsolder the five wires connected to solder pads on the Timing circuit board.
- () 2. Remove the knobs from the VAR TIME/DIV control and the A and B TIME/DIV switches. (Be careful not to lose the plastic bushings behind the knobs.)
- () 3. Remove the X10 MAG and UNCAL light lenses. Pry them away from the instrument front panel with your fingernails and pull straight out.
- () 4. Remove the screw and the hex spacer securing the Timing circuit board to the instrument.
- () 5. Use a flat blade screwdriver to pry the Timing circuit board away from the Interface circuit board, being careful not to bend the connector pins as the boards separate.

D. TO INSTALL DM44 POWER SUPPLY:

- 1. For SN B052300 - B10000 only, alter the bulkhead next to the power transformer as follows:
 - () a. Remove the fuse holder cover.
 - () b. Remove the screws securing the fuse data plate to the rear panel. Pull the plate out to remove the two screws securing the power transformer mounting bracket to the rear subpanel.
 - () c. Remove the screw and hex nuts securing the power transformer bracket to the Interface circuit board.
 - () d. Swing the power transformer out and away from the bulkhead to remove the Mu-metal shield.
 - () e. Hold the new Mu-metal shield from the kit in place on the transformer side of the bulkhead, with the holes in the shield aligned with the existing holes in the bulkhead.

Mark the location of the two additional holes in the bulkhead as indicated in Fig. 1.

- () f. Taking precautions that no metal chips fall into the instrument, drill two additional holes as indicated.
- () g. Install the new Mu-metal shield on the crt side of the bulkhead. Install the 0.500-inch grommet from the kit to hold the shield in place.

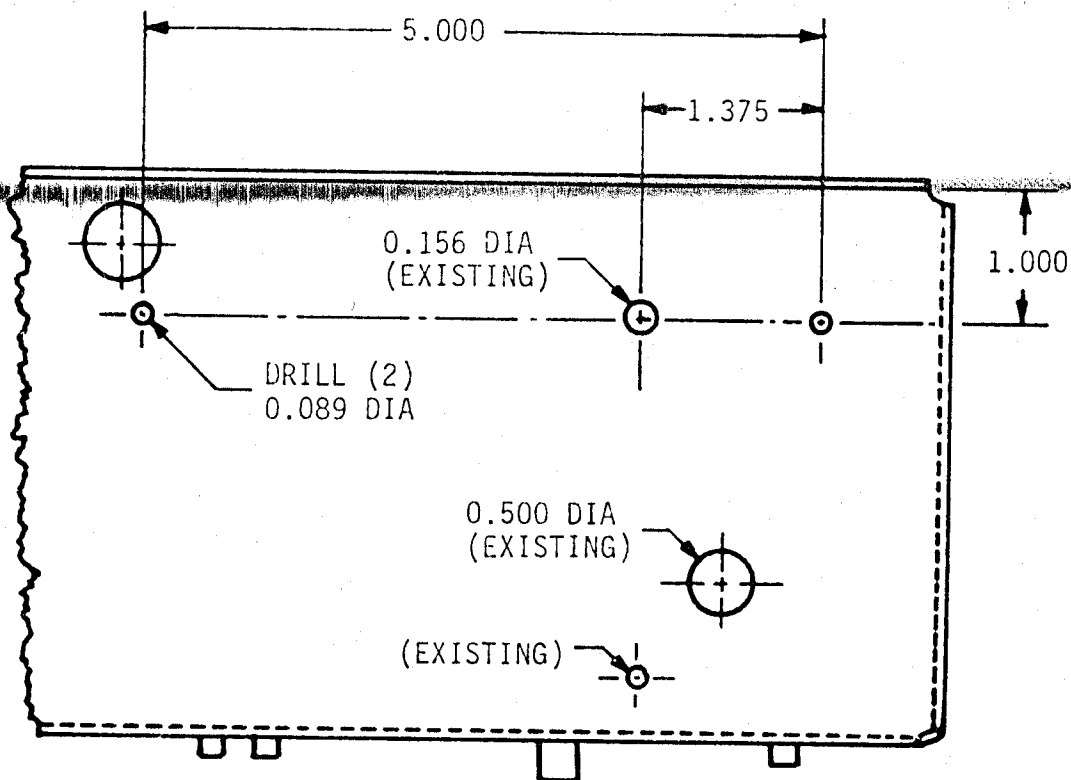


Fig. 1. Partial View of 465 Main Bulkhead.

- () 2. Place the DM44 Power Supply on the crt side of the bulkhead next to the shield, with the open side of the DM44 Power Supply chassis toward the top of the 465.
- () 3. Thread the bare end of the five-wire DM44 Power Supply cable through the new grommet; then dress the cable to the outside edge of the 465 power transformer.
- () 4. Fasten the DM44 Power Supply to the bulkhead, using two of the 4-40 x 0.250 screws from the kit. (For SN B052300 - B100000, use the 4-40 x 0.25 hex nuts from the kit as needed to secure the screws.)
- () 5. For SN B002300 - B105699 only. Reinstall the power transformer, the fuse data plate, and the fuse holder cover.

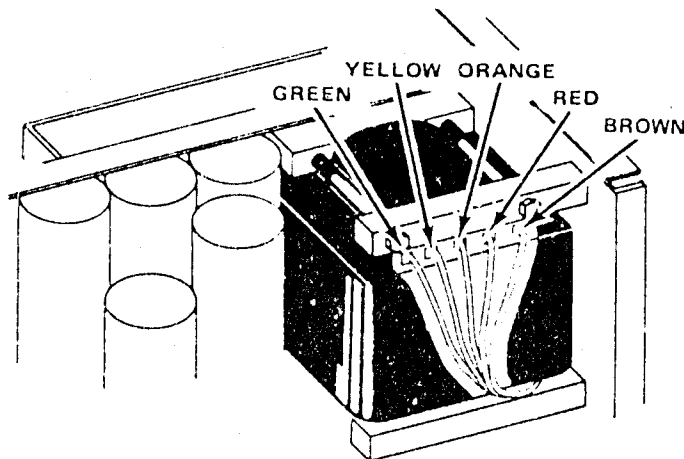


Fig. 2. Power Transformer Connections

- () 6. Solder the wires in the DM44 cable to the unused terminals on the power transformer as shown in Fig. 2 above.

E. TO REPLACE THE 465 DELAY TIME POSITION CONTROL (R1110)

- () 1. Remove the DELAY TIME POSITION 10-turn-counting dial and the mounting hardware for the control.
- () 2. Replace R1110, a $2k\Omega$ 10-turn variable resistor, with the $20k\Omega$ 10-turn variable resistor and hardware from the kit.
- () 3. Install the knob from the kit in place of the 10-turn counting dial removed in step E1.

F. TO INSTALL THE NEW TIMING CIRCUIT BOARD AND TO REINSTALL THE TRIG GEN AND SWP LOGIC CIRCUIT BOARD:

- () 1. Remove the pushbutton knobs from the original Timing circuit board and install them on the new Timing circuit board.
- () 2. Install the new Timing circuit board by performing steps C-2 through C-5 in reverse.
3. Make the following connections (refer to Fig. 3 for locations):

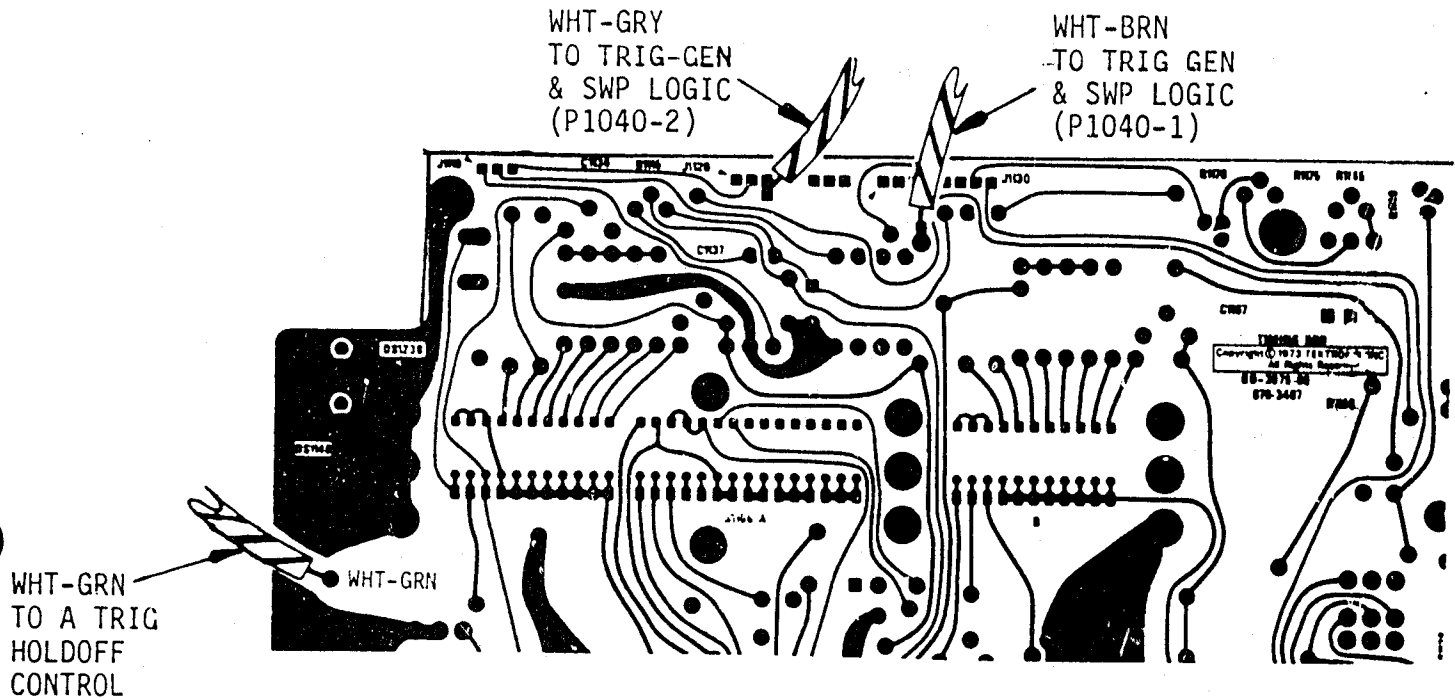


Fig. 3. Partial - Timing Circuit Board

- () a. Solder the white-gray wire (originally connected to the DELAY TIME POSITION control) to an unused solder pad connected to pin 3 of J1120.
- () b. Solder the white-brown wire to an unused solder pad near J1130.
- () c. Dress the white-green wire (from the A TRIG HOLDOFF control) next to the TRIG MODE switch pins so that it does not touch any moving shafts. Solder the wire to an unused solder pad on the circuit board adjacent to the shaft of the AUTO TRIG MODE switch.
- () d. Connect the three wire ribbon cable from the DELAY TIME POSITION variable resistor to J1110. Match the arrow on the connector holder to the arrow on the Timing circuit board.

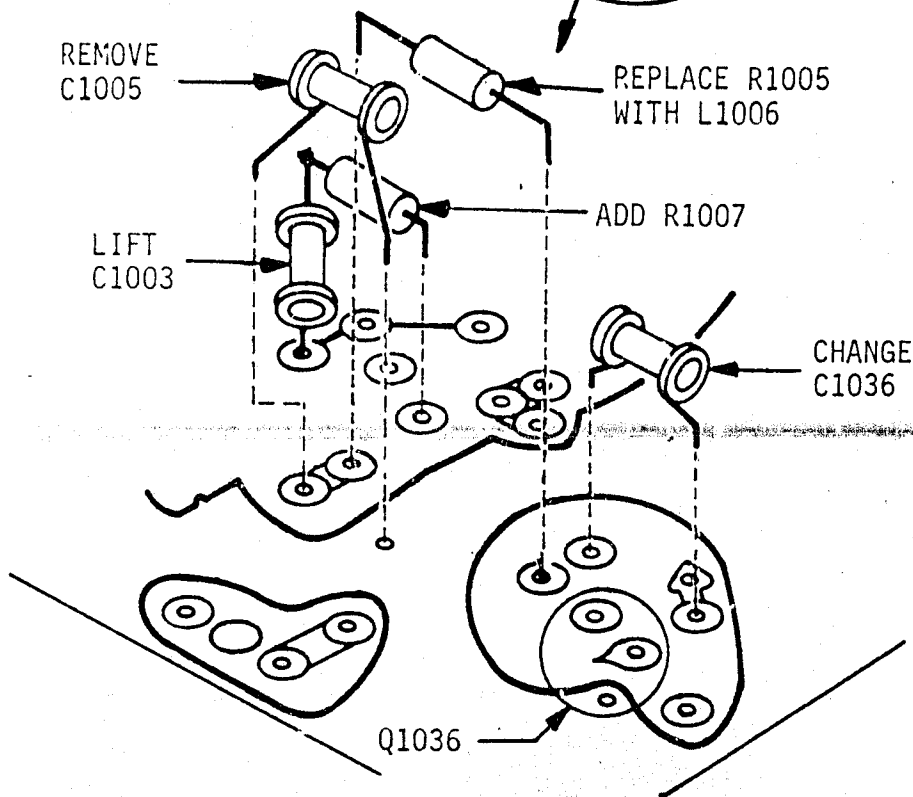
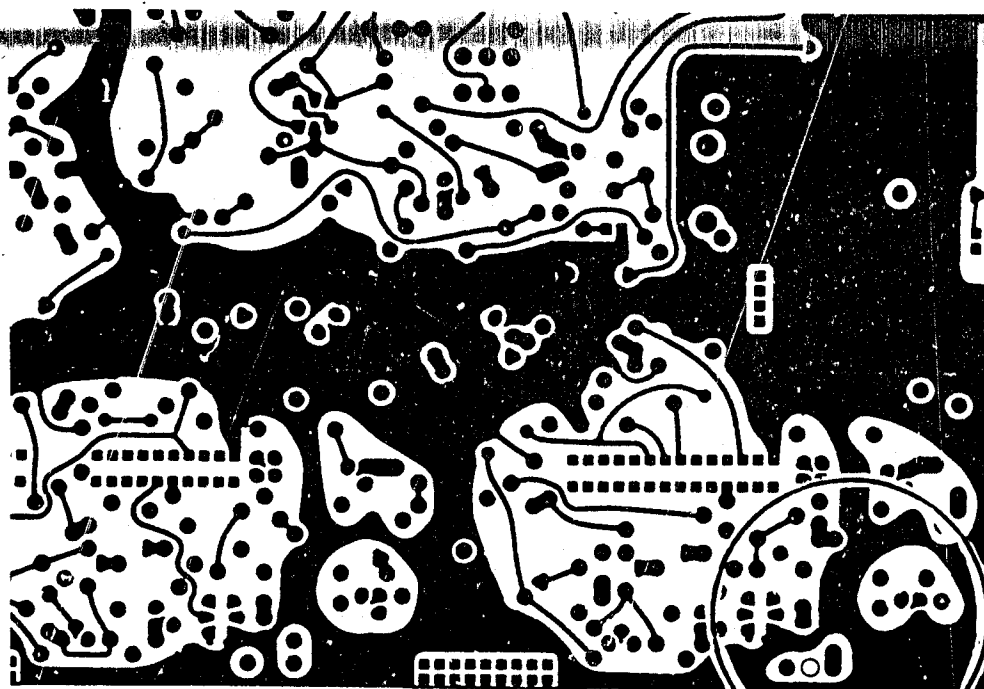


Fig. 4. Partial Interface Circuit Board.

- () 4. Reinstall the Trigger Generator and Sweep Logic circuit board by performing steps B-1 through B-9 and B11 through B-14 in reverse.

G. TO MODIFY THE INTERFACE CIRCUIT BOARD:

Make the following changes on the Interface circuit board (see Fig. 4 for locations):

- () 1. Remove C1005, a 33pF ceramic capacitor.
- () 2. Replace R1005, a 22 Ω 0.25W resistor, with L1006, the 0.3 μ H coil from the kit.
- () 3. Unsolder the lead of C1003 (a 91pF capacitor) that is connected to the emitter of Q1002B.
- () 4. Solder R1007, the 270 Ω resistor from the kit, tepee-fashion, between C1003 and the emitter of Q1002B.
- () 5. Replace C1036, an 18pF ceramic capacitor, with the 21pF ceramic capacitor from the kit.

H. TO MODIFY THE TRIG GEN AND SWP LOGIC CIRCUIT BOARD:

- () 1. Trim both leads of R1318, the 20k Ω resistor from the kit, to approximately 3/8-inch in length.
- () 2. As shown in Fig. 5, solder R1318 between the front end of CR1316 and the bare end of the orange wire in the three-wire ribbon cable from the kit.
- () 3. As shown in Fig. 6, solder the red wire in the two-wire ribbon cable from the kit to the front end (+5V) of R864 on the Trigger Generator and Sweep Logic circuit board.
- () 4. As shown in Fig. 6, solder the brown wire in the same two-wire ribbon cable to the bottom end (+15V) of R1170 on the Timing circuit board.

I. TO MODIFY THE VERTICAL MODE SWITCH CIRCUIT BOARD:

- () 1. Dress the bare ends of the red and brown wires in the three-wire ribbon cable (installed in step H-2) through the plastic grommet in the bulkhead just forward of the DM44 Power Supply, across the crt shield, and through the grommet in the bulkhead behind the Vertical Preamp circuit board.

2. Remove the Vertical Preamp and Vertical Mode Switch circuit boards as a unit, as follows:

- () a. Remove the knobs from the VOLTS/DIV switches and the Input AC-GND-DC switches.
- () b. Disconnect the Vertical Position shafts from the flexible couplers.
- () c. Remove the two UNCAL light lenses.
- d. Disconnect the following cables and wires from the Vertical Preamp circuit board:
 - () Nine coaxial cables (five from the front and four from the back of the circuit board). Make note of cable color-codes and locations to ensure proper installation during reassembly.
 - () P300 (six-wire ribbon cable) on the Interface circuit board.
 - () The delay line.
 - () P390 (eight-wire ribbon cable) on the Vertical Mode Switch circuit board.
 - () The ground braid connected between the front of the Vertical Preamp circuit board and the Interface circuit board.
- () e. Remove the covers from the Vertical Attenuators.
- () f. Unsolder both Input Coupling capacitors. Remove the capacitors by unplugging them from the Attenuator circuit boards.
- () g. Remove the four nuts securing the Attenuator chassis to the instrument's front sub-panel casting.
- () h. Remove the circuit board hold-down screw on the Vertical Mode Switch circuit board (accessible through a hole in the Vertical Preamp circuit board near the CH1 POSITION control).
- () i. Remove the two screws securing the rear of the circuit board to the instrument.
- () j. Remove the 3/16-inch post located below the CH2 Position control.
- () k. Remove the Vertical Preamp circuit board, the cam switch assembly, and the Vertical Mode Switch circuit board as an assembly by pulling the rear of the Vertical Preamp circuit board outward as needed; then slide the assembly to the rear until the front-panel control shafts clear the front casting.

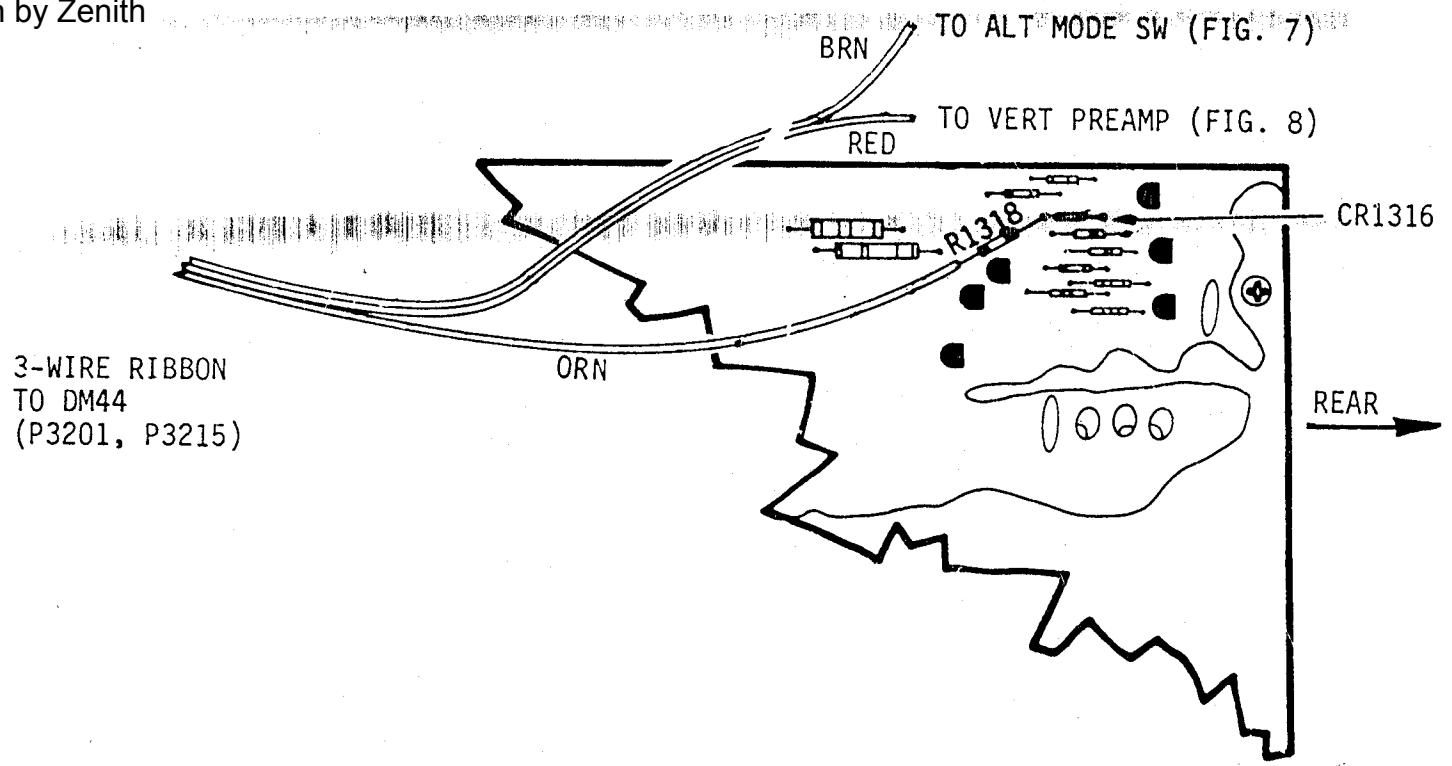


Fig. 5. Partial - Trig Gen & Swp Logic Circuit Board.

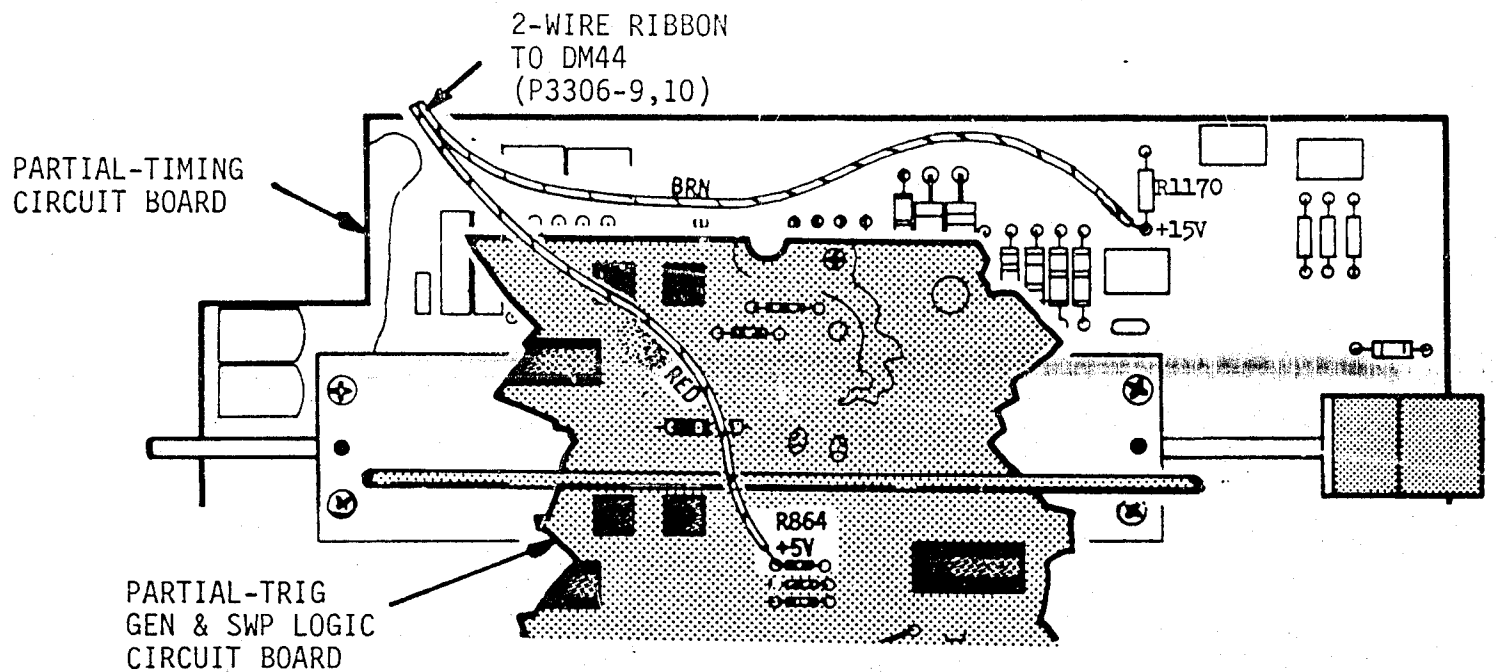


Fig. 6. Partial - Timing and Trig Gen & Swp Logic Circuit Boards.

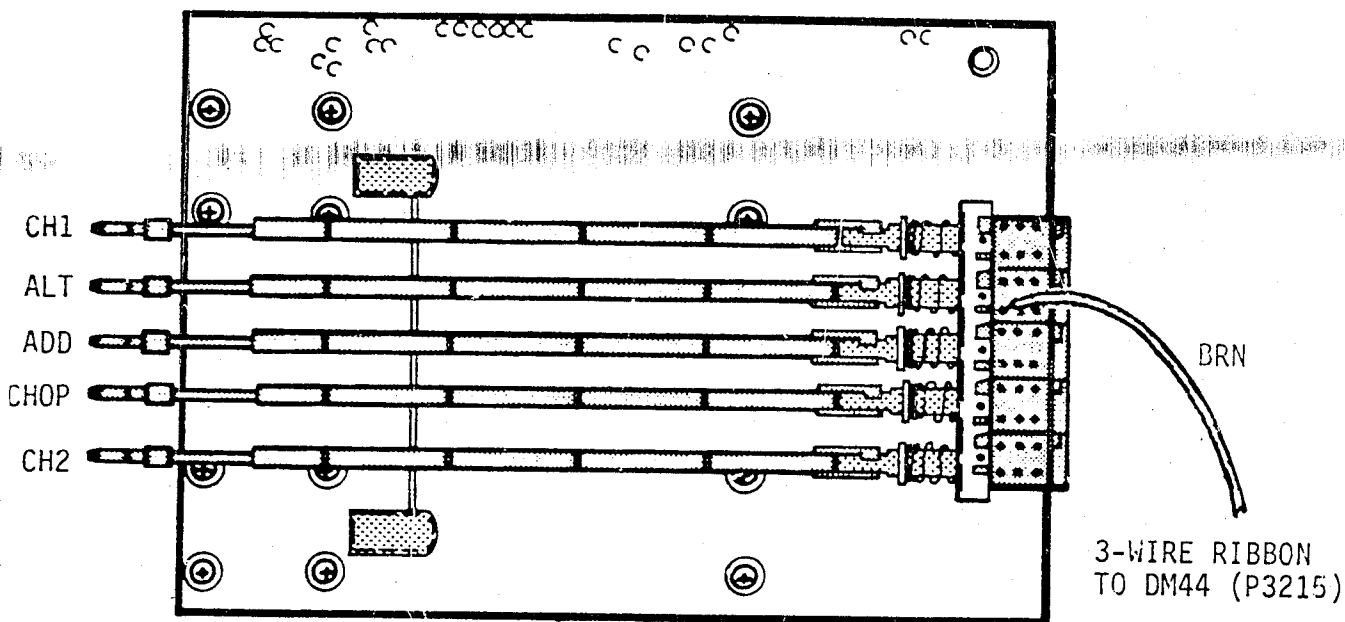
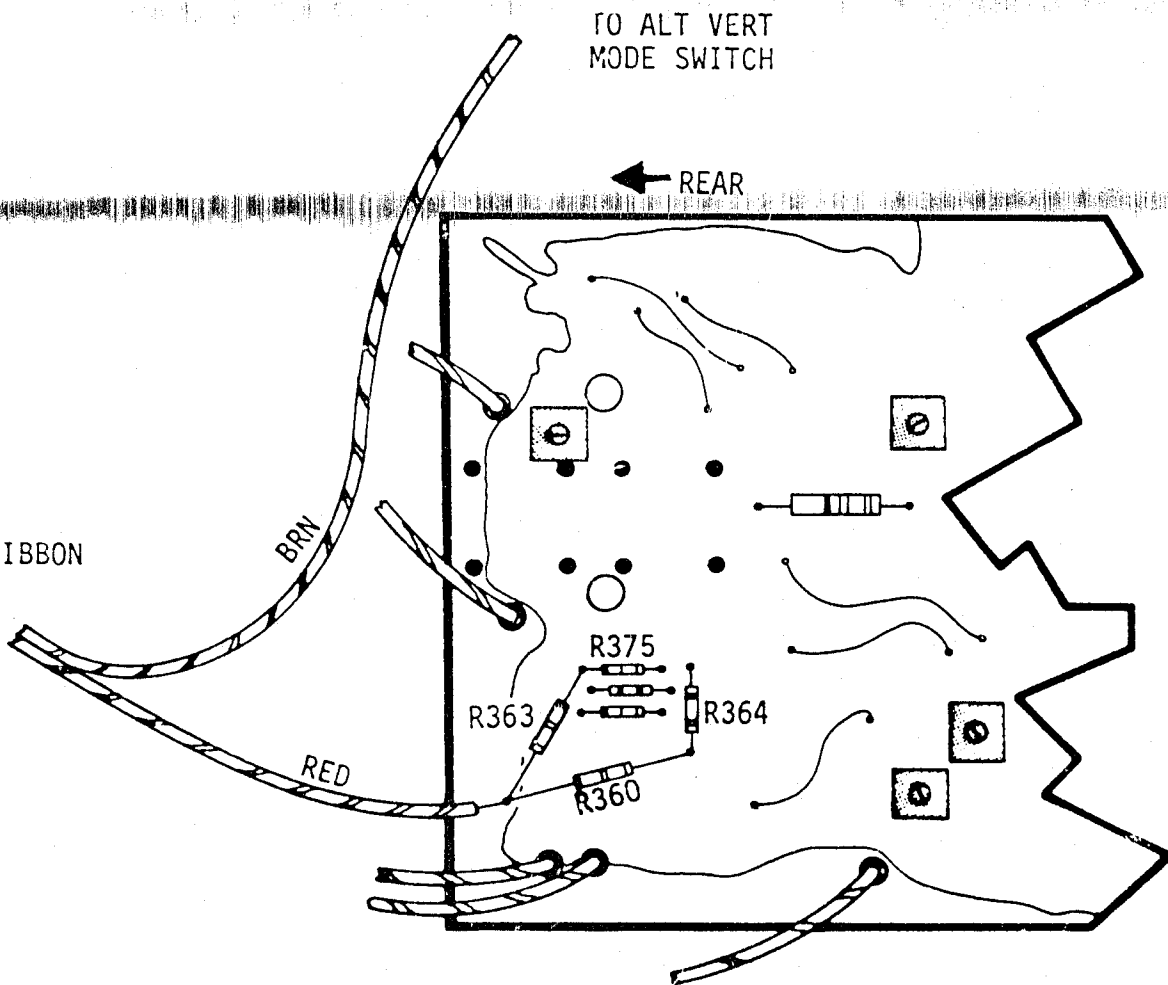


Fig. 7. Vertical Mode Switch Circuit Board

- () 3. Connect the brown wire in the three-wire ribbon cable to the ALT VERT MODE switch as shown in Fig. 7, above.

J. TO MODIFY THE VERTICAL PREAMP CIRCUIT BOARD:

- () 1. Trim the leads of R363, the 47k Ω resistor from the kit, and R360, one of the 20k Ω resistors from the kit, to about 0.5-inch in length.
- 2. Install the following components from the kit as shown in Fig. 8.
 - () a. Solder one end of R363 (47k Ω) to the rear lead of R375, a 2.37k Ω resistor.
 - () b. Solder one end of R360 (20k Ω) to the bottom lead of R364, a 1.58k Ω resistor.
 - () c. Connect R360 and R363 in series and solder the bare end of the red wire in the three-wire ribbon cable (installed in step H-2) to the junction of R360 and R363.
- () 3. Reinstall the Vertical Preamp circuit board, the cam switch assembly, and the Vertical Mode Switch circuit board by performing step I-2 in reverse.

3-WIRE RIBBON
TO DM44

K. TO INSTALL THE DM44 MAIN ASSEMBLY:

1. For SN B052300 - B105700 only: Drill two holes in the 465 main chassis as follows:
 - () a. Temporarily place the DM44 main assembly in place on top of the 465. Fit the front edge of the assembly into the slot on the front edge of the 465 front casting and mark the location of the holes for the rear mounting screws on the chassis.
 - () b. Remove the assembly and drill two 0.125-diameter holes as marked. Take precautions to ensure that no metal chips fall into the instrument.
- () 2. Dress the 5-wire ribbon cable from the DM44 Power Supply through the plastic grommet in the rear mounting plate of the DM44 Main Assembly.
- () 3. Fit the front edge of the DM44 Main Assembly into the slot in the edge of the 465 front casting.

- () 4. Fasten the rear of the DM44 Main Assembly to the bulkhead using the self-tapping 6-20 x 0.312 screws and 0.375 flat washers from the kit.
- 5. Connect the cables and wires between the DM44 and the 465 as follows (see Fig. 9 for location). Be sure to match the arrows (pin 1) on the connectors with the arrows on the circuit board.
 - () a. Connect the 5-wire DM44 Power Supply ribbon cable to P3476 on the DM44 Main circuit board.
 - () b. Connect the two wires in a 2-hole connector on one end of the 3-wire ribbon cable to P3201.
 - () c. Connect the remaining wire of the above-mentioned cable to P3215.
 - () d. Connect the 2-wire ribbon cable to pins 9 and 10 of P3306.
 - () e. Install the 8-wire ribbon cable (from the kit) between J1130 on the 465 Timing circuit board and pins 1 - 8 of P3306 on the DM44 Main circuit board.
 - () f. Install the 7-wire ribbon cable (from the kit) between J1120 on the 465 Timing circuit board and P3255 on the DM44 Main Circuit board.

L. TO CHECK OPERATION AND INSTALL NEW INSTRUMENT COVERS:

- () 1. To ensure proper operation, the instrument should be completely recalibrated. Refer to the 465 and DM44 Service Manuals for instructions.
- () 2. Install the new front-panel cover from the kit, and set the instrument face-down on a flat surface.
- () 3. Slide the new wrap-around cover over the instrument (being careful not to damage any components) and seat the front edge of the cover in the groove in the front casting.
- () 4. Reinstall the rear retaining ring and the hardware removed in step A-3.
- () 5. Install the DM44 cover and accessory pouch, using the 8-32 x 0.625 screws from the kit.
- () Install the Instruction Manual Modification Insert into your 465 Service Manual.

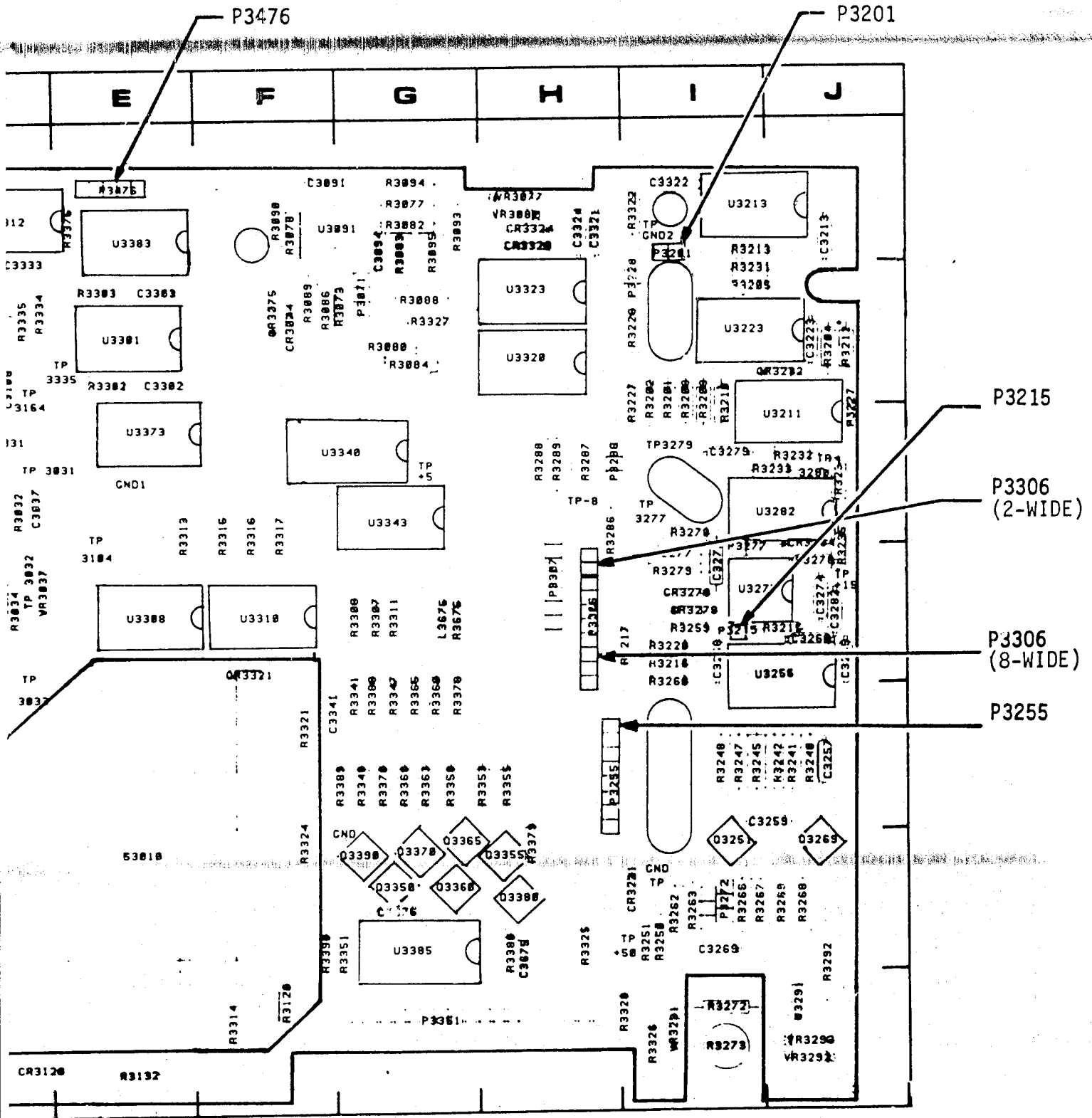


Fig. 9. DM44 Main Circuit Board