



product modification

040-0815-01

Type 465

DM44 - DIGITAL MULTIMETER

For TEKTRONIX® 465 Oscilloscopes*

Serial Numbers B251075 - Up**

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 0-20 Megohms. in six decade steps.
- 4) A precision temperature probe with a range of -55°C to +150°C.
- 5) A 1/time function for convenience in making frequency measurements with an accuracy of 2% or better.

All of the above features are included in a unit that mounts on top of the instrument, inside a new wraparound cover.

*The 465 DM44 operates on 115-230 VAC ONLY and CANNOT be used with Option 7.

**465's with serial numbers B052300 to B250000 use 040-0814-XX.

PARTS INCLUDED IN MODIFICATION KIT:

Ckt. No.	Quantity	Part Number	Description
-----	1 ea		DELAY TIME POSITION Assembly, ccnsisting of:
R1110	1 ea	311-1709-00	Resistor, var, 20k Ω 10-turn
	1 ea	198-3519-00	Cable, 3-wire ribbon, w/connector
	1 ea	003-0120-00*	Test Leads
	1 ea	016-6598-00	Pouch, Accessory
	1 ea	070-2036-01	Manual, DM44 Service
	1 ea	070-2038-00	Manual, 465 DM44 Operators
	1 ea	198-3161-00	Wire kit
	1 ea	200-1722-00	Cover, DM44 top
	1 ea	200-1723-00	Cover, Front 465 DM44
	1 ea	210-0012-00 ¹	Washer, 0.375 ID
	1 ea	210-0590-00 ¹	Nut, 0.375-32 x 0.438
	2 ea	210-0803-00 ²	Washer, flat #6L
	3 ea	210-0938-00 ³	Washer, flat, 0.250 OD, 0.109 ID
	1 ea	210-0978-00 ¹	Washer, flat, 0.500 OD, 0.375 ID
	3 ea	211-0008-00 ³	Screw, 4-40 x 0.250
	2 ea	212-0130-01	Screw, 8-32 x 0.500, Pan head
	2 ea	213-0146-00 ²	Screw, thread-forming, #6
R360,R1318	2 ea	315-0203-00	Resistor, cmpsn, 20k Ω 5% 0.25W
R363	1 ea	315-0473-00	Resistor, cmpsn, 47k Ω 5% 0.25W
R1113	1 ea	321-0154-00	Resistor, film, 392 Ω 1% 0.125W
R1143,R1144	2 ea	321-0928-07	Resistor, film, 250 Ω 0.1% 0.125W
R1142	1 ea	321-0612-07	Resistor, film, 500 Ω 0.1% 0.125W
R1112	1 ea	321-0252-00	Resistor, film, 4.12k Ω 1% 0.125W
R1111	1 ea	321-0265-00	Resistor, film, 5.62k Ω 1% 0.125W
	1 ea	348-0063-00	Grommet, plastic, 0.5 OD
	1 ea	366-1563-00	Knob
	1 ea	437-0174-02	Cabinet, wraparound
	1 ea	672-0453-00	Circuit board, DMM Power Supply
	1 ea	672-0591-10	Circuit board, DM44 w/010-6430-00 probe

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

- ¹Mounting hardware for R1110.
- ²DM44 Assembly mounting hardware.
- ³Power Supply Assembly mounting hardware.

INSTRUCTIONS:

WARNING

DISCONNECT THE INSTRUMENT FROM ITS POWER SOURCE.

- 1. Unwrap the power cord from the instrument feet.
- 2. Remove the four rear feet and two ring-assembly mounting screws, and remove the ring assembly.
- 3. Slide the wraparound cover to the rear to remove it.

A. TO REPLACE DELAY TIME POSITION POTENTIOMETER, R1110:

- 1. Disconnect the three-wire ribbon cable w/black holder from J1110 on the Timing circuit board.
- 2. Remove the DELAY TIME POSITION ten-turn counting dial and the potentiometer mounting hardware.
- 3. Replace R1110, a 2k Ω 10-turn potentiometer, with the 20k Ω 10-turn potentiometer from the kit, using the hardware indicated in Note 1 in the Parts List.
- 4. Install the charcoal knob from the kit in place of the ten-turn-counting dial removed in Step 2, and connect the three-wire ribbon cable w/black holder to J1110 on the Timing circuit board. Match the arrow on the holder with the arrow on the circuit board.

B. TO INSTALL DM44 POWER SUPPLY:

- 1. Install the 0.5-inch rubber grommet, from the kit, in the hole in the bulkhead behind the power transformer.

The DM44 Power Supply mounts on the CRT side of the bulkhead next to the power transformer.

Position the DM44 Power Supply with Q2634 and Q2638 toward the top of the instrument.

- 2. Thread the five-wire ribbon cable without connectors through the grommet in the bulkhead, and dress the wires to the outside edge of the power transformer.
- 3. Fasten the power supply to the bulkhead using the hardware indicated in Note 3 in the Parts List:
 - a. Install the two top screws from the CRT side.
 - b. Install the third power-supply mounting screw from the power transformer side, into the pem nut on the lower back edge of the power supply.
 - c. Install the bottom screw with a long magnetic screwdriver.

() 4. Solder the Power Supply 5-wire ribbon cable to T1501 terminals as shown in Fig. 1:

- () a. White-green wire to terminal 12.
- () b. White-yellow wire to terminal 12A.
- () c. White-orange wire to terminal 11.
- () d. White-red wire to terminal 10A.
- () e. White-brown wire to terminal 10.

The other end of the five-wire ribbon cable (with connectors and holder) will be connected in a later step.

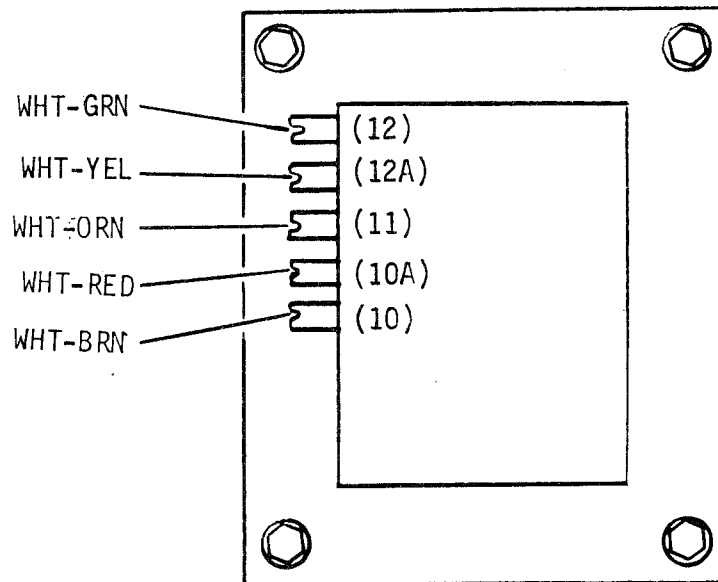


Fig. 1. Power Transformer

C. TO MODIFY TIMING CIRCUIT BOARD:

Make the following changes on the Timing circuit board as shown in Fig. 2:

- () 1. Replace R1111, a 562Ω 0.125W resistor, with the $5.62k\Omega$ 0.125W resistor from the kit.
- () 2. Install R1142, a 500Ω 0.125W resistor from the kit.
- () 3. Install R1143 and R1144, two 250Ω 0.125W resistors from the kit.
- () 4. Replace R1113, a 196Ω 0.125W resistor, with the 392Ω 0.125W resistor from the kit.
- () 5. Replace and relocate R1112, a 49.9Ω 0.125W resistor, with the $4.12k\Omega$ 0.125W resistor from the kit.

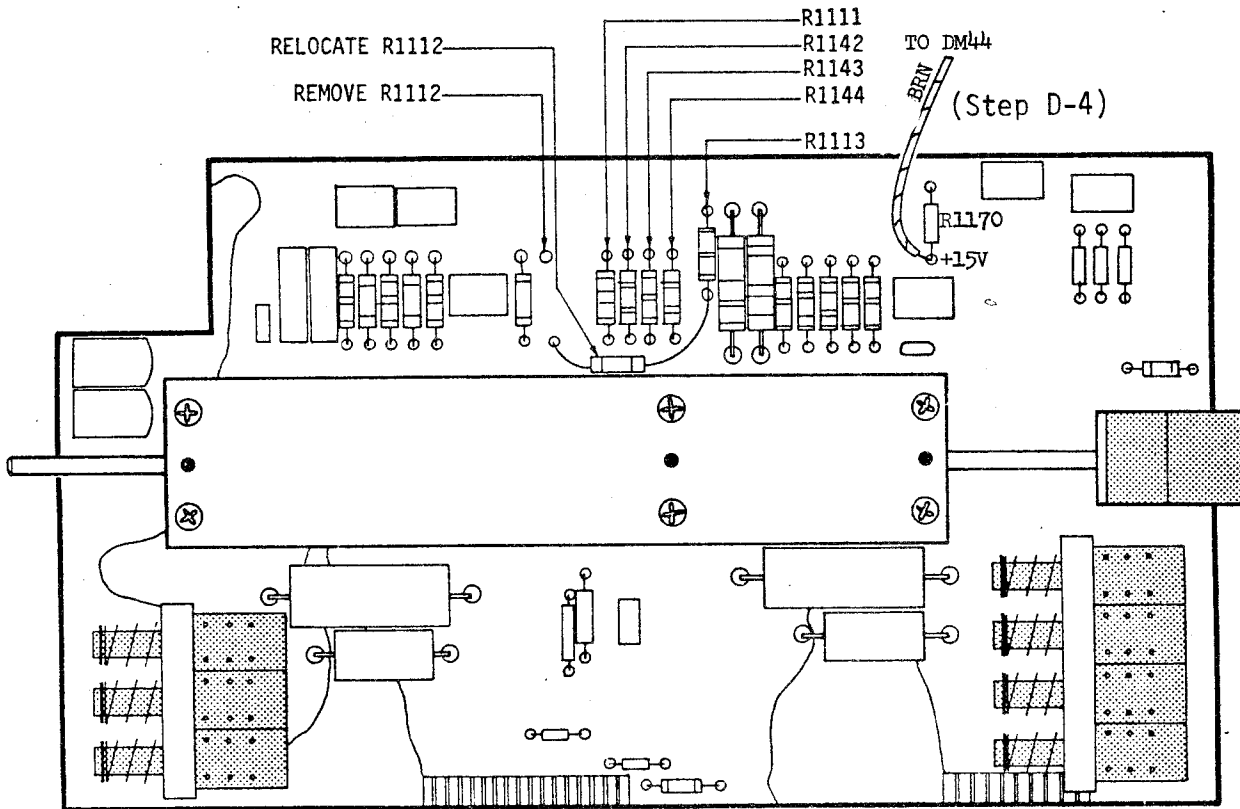
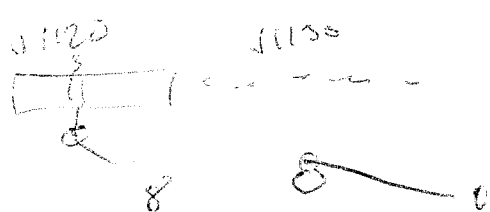


Fig. 2. Timing Circuit Board.



D. TO MODIFY A-8 TRIG. GEN. & SWP LOGIC CIRCUIT BOARD,
SEE FIGS. 3 & 4:

- () 1. Cut off both leads of R1318, the 20k Ω composition resistor from the kit, to about 3/8-inch long.
- () 2. Solder one lead of R1318 to the junction of CR1316 and the emitter of Q1314, as shown in Fig. 3.
- () 3. Solder the white-orange wire from the three-wire ribbon cable (from the kit) to the other lead of R1318 above the circuit board as shown in Fig. 3.
- () 4. Solder the brown wire of the two-wire ribbon cable (from the kit) to +15 Volts at R1170 on the Timing circuit board (see Fig. 2).
- () 5. Solder the red wire of the same ribbon cable to +5 Volts on the Trigger Generator circuit board at R864. See Fig. 4.
- () 6. If present, remove C1044, a 2.2 μ F capacitor located near P1040 on the back of the Trigger Generator and Sweep Logic circuit board.

Fig. 3. Partial Trigger Generator and Sweep Logic Circuit Board.

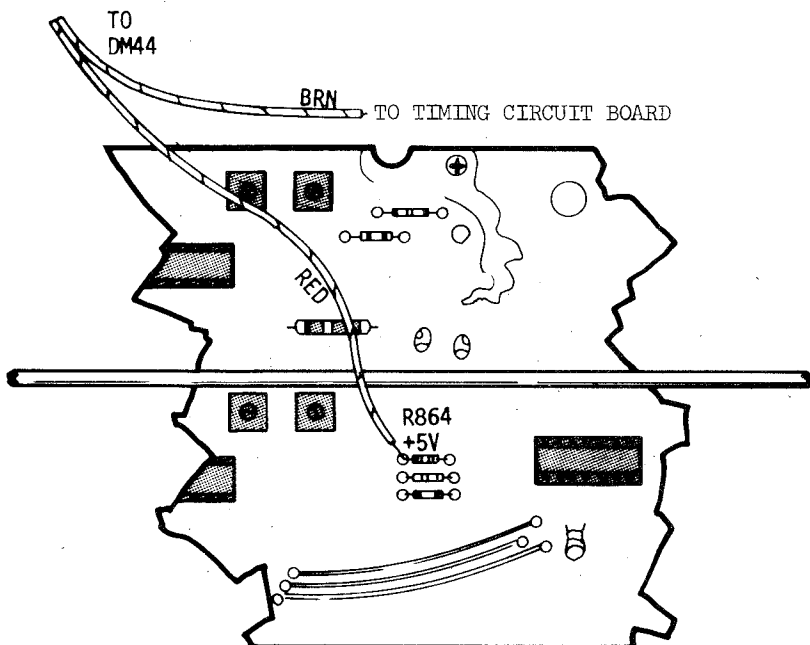
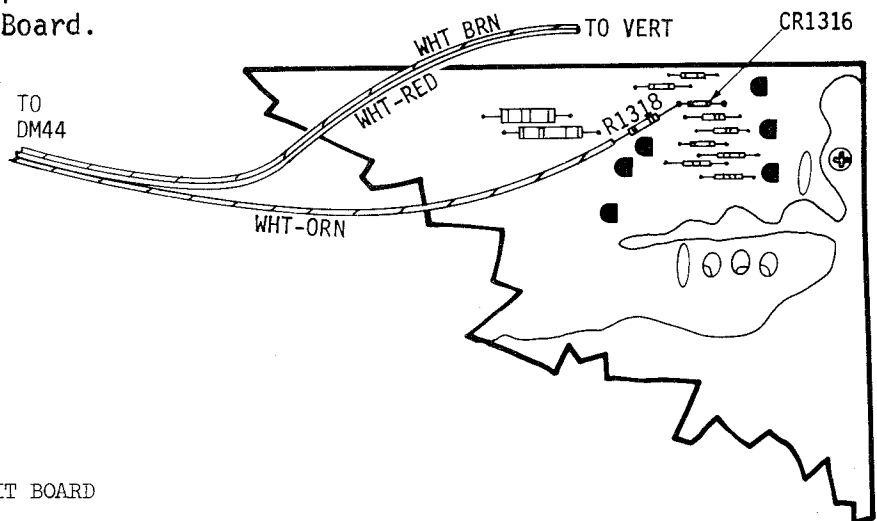


Fig. 4. Partial Trigger Generator and Sweep Logic Circuit Board.

E. TO MODIFY A-4 VERTICAL MODE SWITCH CIRCUIT BOARD, SEE Fig. 5:

- () 1. Dress the stripped ends of the white-red and the white-brown wires of the three-wire ribbon cable through the plastic grommet in the bulkhead just forward of the SM44 Power Supply, across the CRT, and through the grommet in the bulkhead behind the Vertical Preamp circuit board. (The white-orange wire was connected in Step D-3.)
- 2. Remove the Vertical Preamp circuit board to gain access to the Vertical Mode Switch circuit board as follows:
 - () a. Remove the knobs from the VOLTS/DIV switches and from the Input Coupling switches. The knobs on the VOLTS/DIV switches must have a set screw in each one loosened (use a 1/16" Allen wrench) before they can be removed, while the knobs on the Input Coupling switches are held on by spring clips and can be pulled off.
 - () b. Disconnect the Vertical POSITION control shaft couplers from the Vertical POSITION potentiometers (0.50" Allen wrench required).
 - () c. Remove the two UNCAL light lenses. Pry them away from the front panel with a fingernail and pull them straight out.
 - () d. Disconnect the following cables and wires:
 - () Nine coaxial cables (5 on the front and 4 on the back). Make note of cable color-codes to insure proper installation during reassembly.
 - () A 6-wire ribbon cable connected to P300 on the Interface circuit board.
 - () Delay-line from the rear of the Preamplifier circuit board.
 - () An eight-wire ribbon cable connected to P390 on the Vertical Mode Switch circuit board.
 - () Ground braid from the front of the Preamplifier circuit board to the Interface circuit board near the BEAM FINDER switch shaft.
 - () e. Remove the covers from the attenuators.
 - () f. Unsolder the leads to 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 front casting (1/4" nutdriver required).
 - () 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 Channel 1 POSITION potentiometer).

- () i. Remove the two circuit board hold-down screws near the rear of the circuit board and the 3/16-inch post below the Channel 2 POSITION potentiometer.
- () j. Remove the Vertical Preamp, cam switch assembly, and Vertical Mode Switch Circuit board as a unit. Pull the rear of the Vertical Preamp circuit board outward about 1 or 2 inches; then slide the whole assembly to the rear until the front-panel control shafts clear the front casting.
- () 3. Solder the white-brown wire, from the three-conductor ribbon cable installed in step E-1, to the Vertical Mode Switch circuit board as shown in Fig. 5.
- () 4. Reinstall the Vertical Preamp circuit board by performing Step E-2 in reverse.

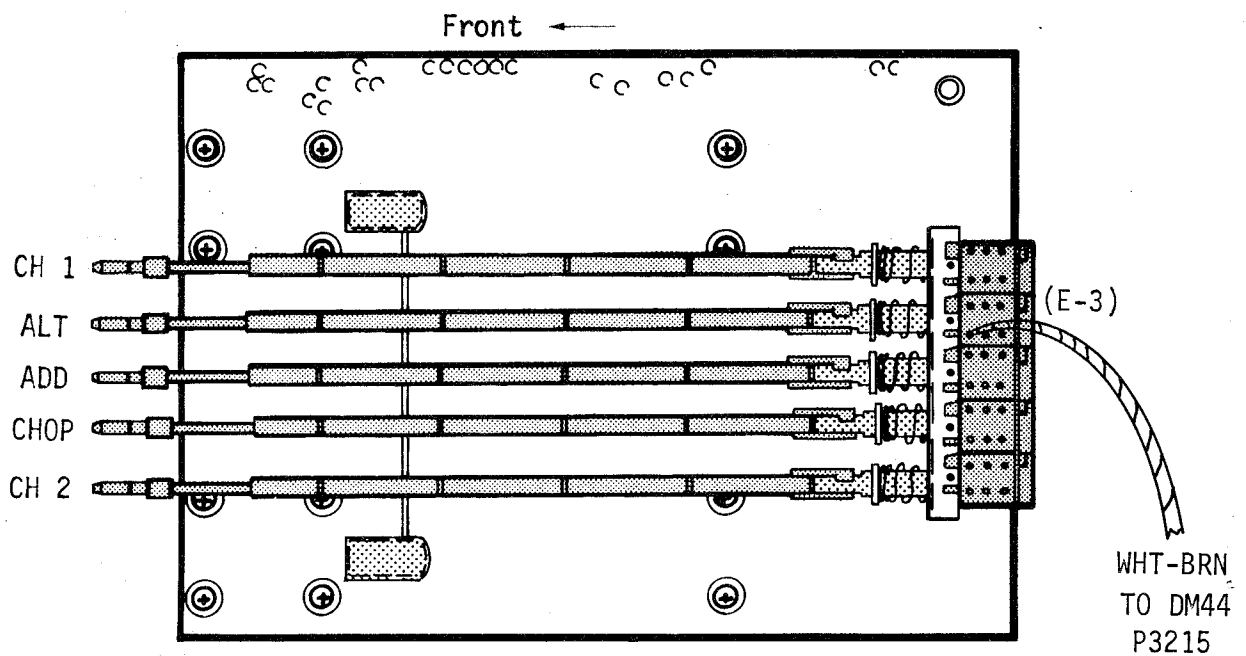


Fig. 5. Vertical Mode Switch Circuit Board.

F. TO MODIFY A-3 VERTICAL PREAMP CIRCUIT BOARD; SEE FIG. 6:

- () 1. Cut the leads of R363, the 47k Ω resistor, and R360, the 20k Ω resistor from the kit, to about 1/2" in length.
- () 2. Solder one end of R363 to R375, a 2.37k Ω resistor on the Vertical Preamp circuit board.
- () 3. Solder one lead of R360 to R364, a 1.58k Ω resistor on the Vertical Preamp circuit board.
- () 4. Solder the white-red wire, from the three-wire ribbon cable installed in step E-1, to the junction of R363 and R360, tepee-fashion above the circuit board.

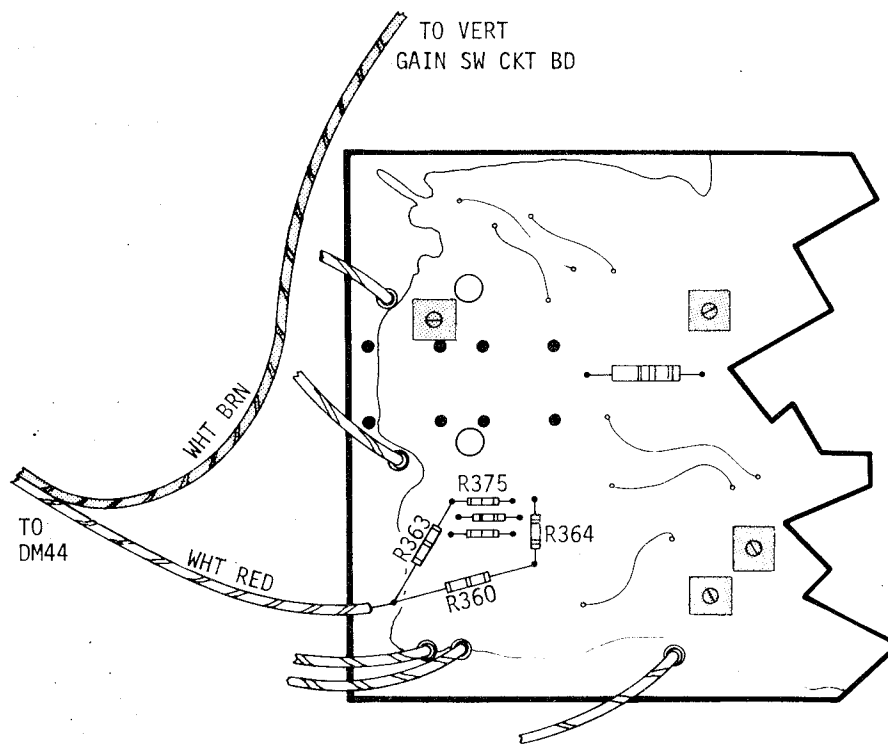


Fig. 6. Partial Vertical Preamp Circuit Board.

G. TO INSTALL DM44 ASSEMBLY:

- () 1. Dress the five-wire ribbon cable from the Power Supply through the plastic grommet in the rear mounting plate of the DM44 assembly.
- () 2. Fit the front end of the DM44 assembly in the slot in the edge of the front casting.
- () 3. Fasten the rear end of the DM44 assembly to the edge of the bulk-heads using the hardware indicated by Note 2 in the Parts List.

REFER TO FIG. 7 ON PAGE 11 WHILE PERFORMING STEPS G-4 THRU G-7.

- () 4. Connect the power supply cable to P3476 on the DM44 Main circuit board. Match the arrow on the holder with the arrow on the circuit board.
- () 5. Connect the two wires (in a two-conductor harmonica) of the three-wire ribbon cable to P3201.
- () 6. Connect the remaining wire of the 3-wire ribbon cable to P3215.
- () 7. Connect the two-wire ribbon cable to pins 9 and 10 of P3306.
- () 8. Install the eight-wire ribbon cable (from the kit) between J1130 on the Timing circuit board and P3306 on the DM44 assembly.
- () 9. Install the seven-wire ribbon cable (from the kit) between J1120 on the Timing circuit board and P3255 on the DM44 assembly.

Refer to the DM44 Service Manual and check Calibration and adjust as necessary.

H. TO INSTALL NEW WRAPAROUND COVER.

- () 1. Slide the wraparound cover over the instrument, being careful not to bump any components. Seat the front edge of the cabinet in the groove in the front casting.
- () 2. Reinstall the cabinet retaining ring and the hardware removed in Step 1.
- () 3. Install the plastic cover on top of the instrument over the Digital Multimeter, using the 8-32 x 0.500-inch screws.

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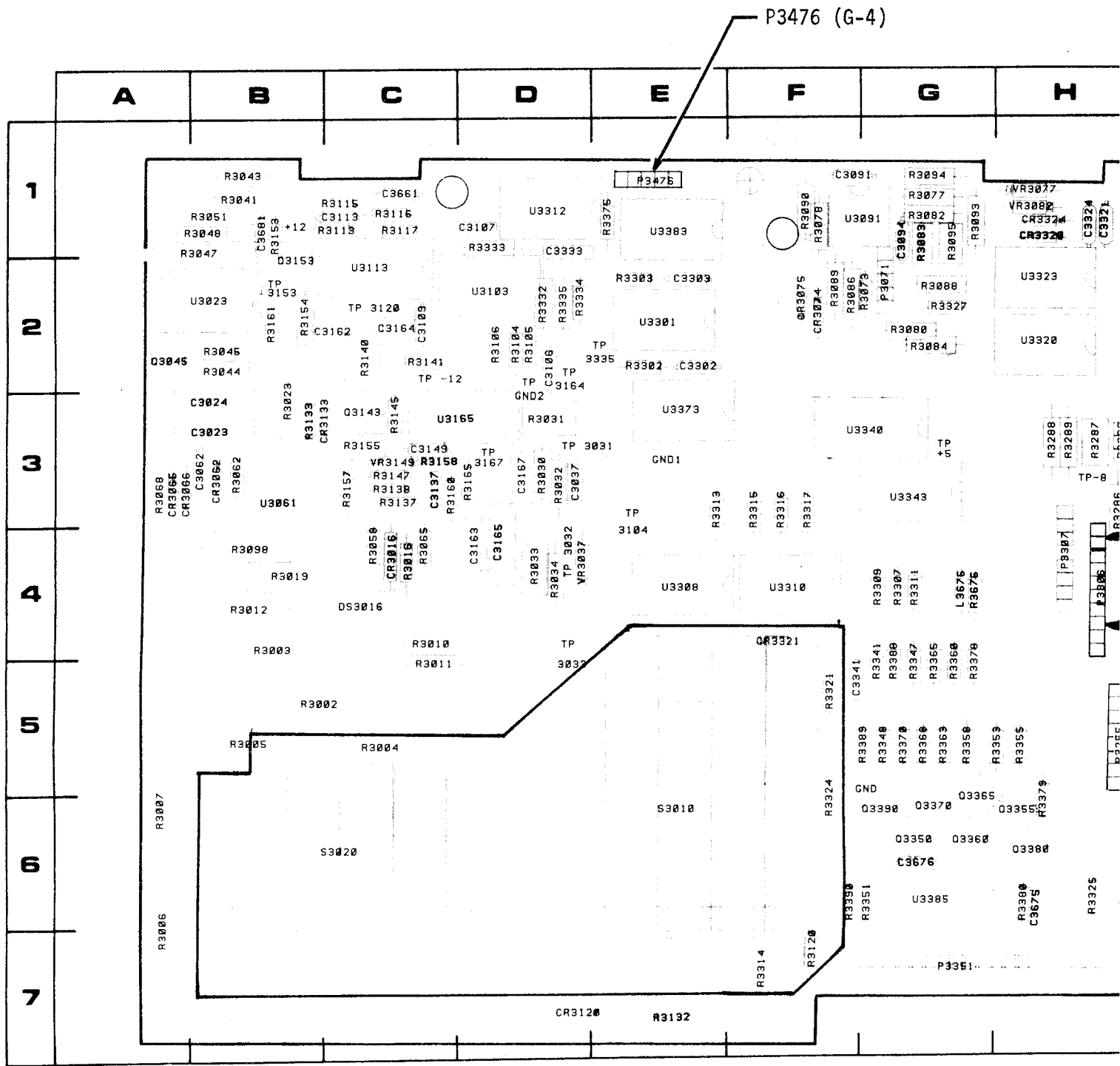
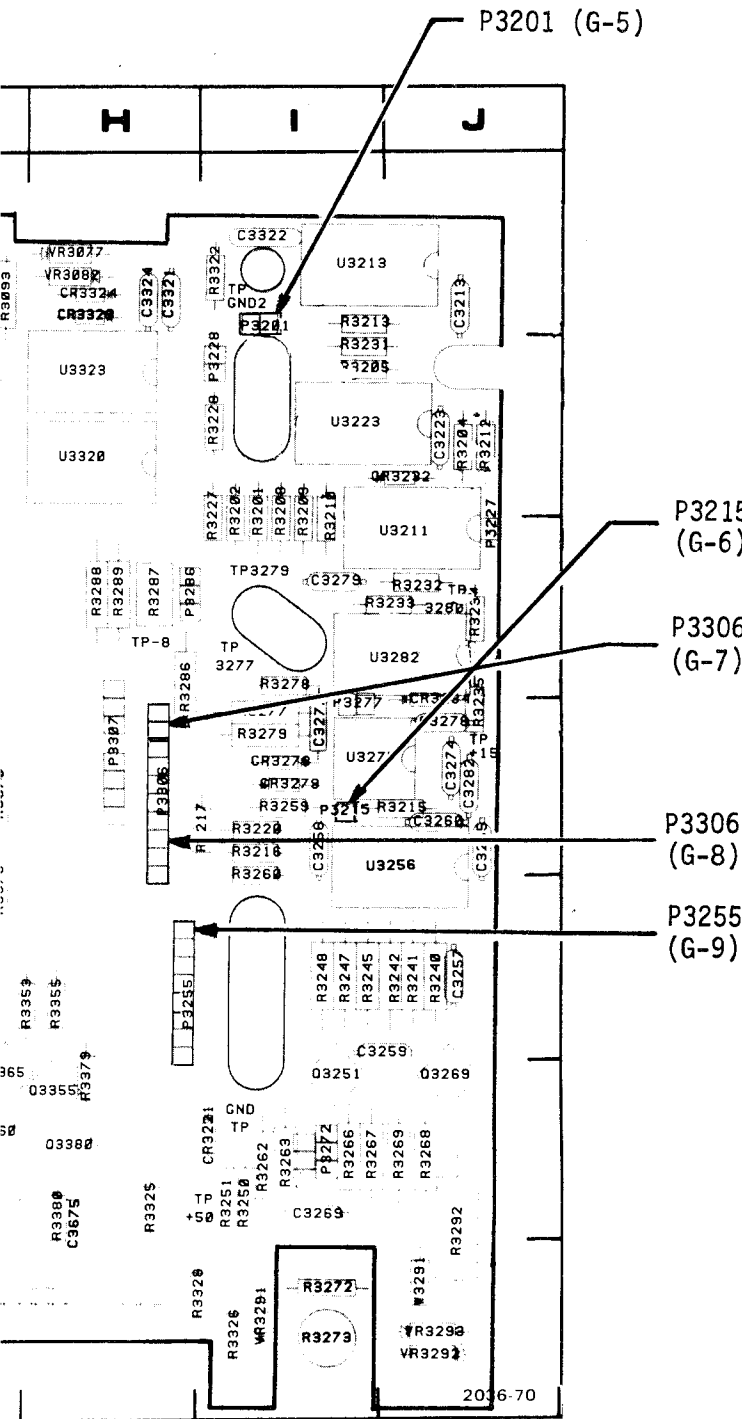


Fig. 7. DM44 Main Circuit Board.



CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C3023	3B	DS3016	4C	R3062	3B	R3233	3J	R3365	5G
C3024	3B	L3675	4G	R3065	4C	R3234	3J	R3368	5G
C3037	3D			R3068	3A	R3235	4J	R3370	5G
C3062	3B	P3071	2G	R3073	2G	R3240	5J	R3375	1E
C3091	1F	P3201	1I	R3077	1G	R3241	5J	R3378	5G
C3094	1G	P3215	4I	R3078	1F	R3242	5J	R3379	6H
C3106	2D	P3227	3J	R3080	2G	R3245	5I	R3380	6H
C3107	1D	P3228	2I	R3082	1G	R3247	5I	R3388	5G
C3109	2C	P3255	5H	R3083	1G	R3248	5I	R3389	5F
C3113	1C	P3272	6I	R3084	2G	R3250	6I	R3390	6F
C3137	3C	P3277	4I	R3086	2F	R3251	6I	R3675	4G
C3149	3C	P3286	3H	R3088	2G	R3259	4I	S3010	6E
C3162	2B	P3306	4H	R3089	2F	R3260	4I	S3020	6C
C3163	4D	P3307	4H	R3090	1F	R3262	6I		
C3164	2C	P3351	7G	R3093	1G	R3263	6I		
C3165	4D	P3476	1E	R3094	1G	R3266	6I	TP3031	3D
C3167	3D			R3095	1G	R3267	6I	TP3032	4D
C3213	1J	Q2632	1C	R3098	4B	R3268	6J	TP3033	4D
C3223	2J	Q2634	2D	R3104	2D	R3269	6J	TP3104	3E
C3255	4J	Q2636	1D	R3105	2D	R3272	7I	TP3120	2C
C3256	4I	Q2638	2D	R3106	2D	R3273	7I	TP3153	2B
C3257	5J	Q3045	2A	R3113	1C	R3277	4I	TP3164	2D
C3259	5I	Q3143	3C	R3115	1C	R3278	3I	TP3167	3D
C3260	4J	Q3153	1B	R3116	1C	R3279	4I	TP3277	3I
C3269	6I	Q3251	6I	R3117	1C	R3286	3H	TP3279	3I
C3274	4J	Q3269	6J	R3120	7F	R3287	3H	TP3280	3J
C3277	4I	Q3350	6G	R3132	7E	R3288	3H	TP3292	6H
C3278	4J	Q3355	6H	R3133	3B	R3289	3H	TP3335	2E
C3279	3I	Q3360	6G	R3137	3C	R3292	6J		
C3282	4J	Q3365	6G	R3138	3C	R3302	2E	U3023	2B
C3302	2E	Q3370	6G	R3140	2C	R3303	2E	U3061	3B
C3303	2E	Q3380	6H	R3141	2C	R3307	4G	U3091	1F
C3321	1H	Q3390	6G	R3145	3C	R3309	4G	U3103	2D
C3322	1I			R3147	3C	R3311	4G	U3113	2C
C3324	1H	R3002	5B	R3153	1B	R3313	3E	U3165	3C
C3333	1D	R3003	4B	R3154	2B	R3314	7F	U3211	3J
C3341	5F	R3004	5C	R3155	3C	R3315	3F	U3213	1I
C3661	1C	R3005	5B	R3157	3C	R3316	3F	U3223	2I
C3675	6H	R3006	6A	R3158	3C	R3317	3F	U3256	4J
C3676	6G	R3007	6A	R3160	3C	R3321	5F	U3275	4I
C3681	1B	R3010	4C	R3161	2B	R3322	1I	U3282	3J
		R3011	5C	R3165	3D	R3324	6F	U3301	2E
CR3016	4C	R3012	4B	R3201	2I	R3325	6H	U3308	4E
CR3062	3B	R3016	4C	R3202	2I	R3326	7I	U3310	4F
CR3065	3A	R3019	4B	R3204	2J	R3327	2G	U3312	1D
CR3066	3A	R3023	3B	R3205	2I	R3328	7I	U3320	2H
CR3074	2F	R3030	3D	R3208	2I	R3332	2D	U3323	2H
CR3075	2F	R3031	3D	R3209	2I	R3333	1D	U3340	3G
CR3120	7D	R3032	3D	R3210	2I	R3334	2D	U3343	3G
CR3133	3B	R3033	4D	R3212	2J	R3335	2D	U3373	3E
CR3221	6I	R3034	4D	R3213	1I	R3341	5G	U3383	1E
CR3232	2J	R3041	1B	R3215	4J	R3347	5G	U3385	6G
CR3234	3J	R3043	1B	R3216	4I	R3348	5G		
CR3278	4I	R3044	2B	R3217	4H	R3351	6G	VR3037	4D
CR3279	4I	R3045	2B	R3220	4I	R3353	5G	VR3077	1H
CR3320	1H	R3047	1B	R3227	2I	R3355	5H	VR3082	1H
CR3321	4F	R3048	1B	R3228	2I	R3358	5G	VR3149	3C
CR3324	1H	R3051	1B	R3231	2I	R3360	5G	VR3291	7I
		R3058	4C	R3232	3J	R3363	5G	VR3292	7J
								VR3293	7J
								W3291	7J