TMC SPECIFICATION NO. S503

TITLE: PRODUCTION TESTING OF TMC MODEL DVM-2

JOB

I. Introduction

A. The DVM is a Diversity Visual Monitor. For test purposes, it may be divided into four sections:

1. Power Supply
2. Scope Circuit
3. Sweep Circuit
4. Marker and IF Section

B. The Power Supply

The positive voltage supply is conventional, supplying 250 volts unregulated and 105 volts regulated.

The negative high voltage supply utilizes three selenium rectifiers as a voltage tripler and produces - 1500 volts.

C. The Scope Circuit

The scope circuit can be subdivided into the basic scope control circuit and two DC amplifiers which provide the necessary deflection voltages.

The basic scope circuit consists of voltage dividers which provide the necessary bias and operating voltages for focus, intensity (brightness) control and astigmatism (spot shape). Provision is made through a differentiating network, for blanking (visual extinction of the trace during the interval that the sawtooth, or time base generator is recycling).

In the horizontal DC amplifier (V107(12AT7)), dual triodes are used in which push-pull operation is accomplished by a voltage divider arrangement which causes the plate voltage of one triode to drive the grid of the other triode, thereby tending to drive the second plate negative as the first goes positive. The voltages on these plates are then applied to the CRT deflection plates, causing deflection of the spot. This feature is taken advantage of in the positioning control which varies the bias on one triode causing the potential of the plates to change, relative to each other and thereby positioning the trace on the screen.

The vertical DC Amplifier (V105(12AT7)) is similar to the horizontal.

D. The Sweep Circuit

The Sweep Circuit may be subdivided into the sawtooth generator, and the sweep oscillator.

The sawtooth generator, (V104(884)) is a gas triode, operating as a free running relaxation oscillator. This oscillator generates a voltage which varies linearly with time, producing a time reference which is applied to the horizontal scope axis, and to the sweep generator. The rate or frequency of this time base is determined by the time constants, R124,R123 and C115, and is variable by R124, (Sweep Speed).

The sweep oscillator (V108B(1/2 6U8A) is a Hartley Circuit, frequency modulated by a reactance tube (V108A(1/2 6U8A). The reactance tube is operated in such a way that it is equivalent to an inductance which varies linearly with grid voltage. An appropriate fraction of the time - base voltage is applied to the grid, to cause the oscillator to sweep ±5 or ±1 kilocycle about its center frequency, in this case, 600 kc. This 600 kc is then applied to a mixer. The time base is synchronized so that the oscillator is at its center frequency (600 kc) at the same time that the trace has traversed half the width of the CRT screen. Since the trace is now synchronized with the sweep, a horizontal displacement on the scope corresponds to a frequency and the scope may be calibrated as such.

E. Marker and IF Section

The input signal (500 kc) is applied to V101 (6BE6) and is Heterodyned with the sweep oscillator frequency of 600 kc. This produces a frequency modulated voltage difference of 100 kc in the plate circuit of V101. This 100 kc voltage difference is then applied to a crystal filter, FL-100, whose high-Q characteristic permits passage of a small band of frequencies (100 kc region), attenuating all other frequencies. V102(6AG5) then amplifies the filtered frequency to the detector circuit V103A(1/2-12AX7) where resultant rectified positive portion of applied voltage or positive pulse is fed to the pulse amplifier, V103B(1/2-12AX7). The AVC network CR105(1N39B) and CR104(1N482A)acts as a peak envelope detector which functions to detect modulation and ringing, converting this to an AVC gate which is applied to the detector, effectively limiting the intermodulation.

The output pulse of V103B is coupled to the vertical amplifier, V105(12AT7) and applied to the vertical deflection plates of the CRT. The Diode Circuit, CR-100(1N-39B) acts as a DC restorer. The net result is that a vertical signal pulse appears on the monitor scope screen when a 100 kc signal difference is obtained at the output of the DVM mixer circuit.

Since the screen is calibrated in frequency, the position of this vertical pulse corresponds to the input frequency. At 500 kc, the pulse should be in the exact center position, or zero reference point. An input signal of 502 kc mixing with 602 kc will cause a 2 kc displacement of the pulse to the right of zero reference. This displacement to the right is due to the fact that the 602 kc sweep oscillator frequency is generated at a later time than 600 kc. Similarly, the vertical pulse position will be somewhere to the left of zero point for an input signal less than 500 kc.

In order to insure correct calibration, a 500 kc calibration oscillator or marker is incorporated in the DVM as a reference standard. For calibration, the incoming signals are removed from the monitor scope screen by S100 (calibrate), while V100 (6AG5) is activated. V100 is a crystal controlled oscillator (500 kc). Zero reference on the screen can now be established by adjusting R163 (Cal-Zero set). This control adjusts the sweep oscillator V108 center frequency to 600 kc. The magnitude of the reference signal can be adjusted by C100.

The DVM-2 provides three inputs for 500 kc IF from diversity receivers (minimum signal input 0.1 volt), two of which can be fed out again to an IF converter unit, a diversity combining unit, etc.

II. Test Equipment Required

A. AC VTVM (H.P. Model 410)

B. RF Voltmeter (Ballantine Laboratories Model 314 or Equivalent)

C. RF Signal Generator (Measurements Model 82 or Equivalent)

D. Oscilloscope (DuMont Model 304 or Equivalent)

E. Crystals - 499.000 Kc   501.000 Kc *
495.000 Kc   505.000 Kc

NOTE: Unless otherwise specified, all readings ±10%.

III. Preliminary

1. Inspect unit for mechanical imperfections and for proper placement of components.

2. Inspect for obvious wiring errors.

3. Check for B+ shorts with ohmmeter.

IV. Test of Power Supply

1. Check output Voltages

a) B+, C135 pin 5, +255 v.
b) V110, Pin 5, +105 volts
c) C133, - minus 1500 volts
d) vary R152 and R137, voltage "b" above should remain constant at +105 volts.

* NOTE: An RF Signal Generator may be used in conjunction with a frequency meter or counter (Berkeley model 5558 or equivalent) instead of the crystals (E)

V. Test of Scope Circuit

1. Check scope system, lock scope in place so that trace is horizontal.

2. Vary R147*, Pin 4, CRT varies from -810 to -960 volts.
Vary R140, Pin 8, CRT varies from 0 to +255 volts.
Set both for sharpest trace, with least distortion on ends.

3. Vary R152, Pin 3, V107 varies from 3 to 4.6 volts
Vary R137, Pin 3, V105 varies from 4 to 6.3 volts
Set R131 and R156 to zero, center spot on baseline with R152 and R137, set R131 approximately 35% maximum and R156 approximately 50%.

4. Vary R145, voltage at wiper varies from -1390 to -1340 volts.

5. Check waveform at Pin 3, CRT, observe pulses, also observe for blanking on CRT screen. 

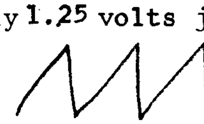
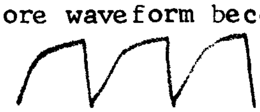
VI. Test of Sweep Circuit

1. Sawtooth Oscillator (all voltage and frequency readings on scope)

Output should be 12 volts of the waveform shown:

(output from C114)

Frequency should vary from about 35 to 50 cycles per second as R124 is varied.

Voltage at pin 7 of V107, should be of the same waveform and vary from 0 to 14 volts as R156 is varied. Set to approximately 1.25 volts just before waveform becomes nonlinear, that is, changes from  to  .

Voltage at wiper of R160 should vary from ½ to 1.7 volts, as R160 is varied. Set for about 1.2 volts (Waveform: ).

* Front Panel Controls

R147 - Focus	R131 - V Gain
R140 - Astig	R156 - H Gain
R152 - H. Pos	R163 - Center Freq.
R137 - V. Pos	

Voltage at wiper of R161 should vary from 0 to 1/2 as R161 is varied. Set for about 1/4 volt (Waveform: ).

2. Sweep Oscillator

1. Check DC voltage on pin 7, V108, it should vary approximately 0.6 volts as R163 is varied (From 3.3 to 3.9V)

2. Output (Pin 1, V101) of sweep generator should be a 1.8 volt sine wave (approximately).

3. Alignment

a) Set S102 to ±1 kc, R163 to "Center", with 500.000 kc crystal in XY100 & W/S100 depressed, center marker with T102. Bottom - broad tuning Top - vernier.

b) By adjusting T102, and switching between the ±1 and ±5 kc ranges, find the point (off center) where the marker remains in the same position for both ranges. Lock T102 at this point and center marker with R152

c) Set S102 to ±1 kc with 499.000 kc crystal in XY100. Adjust R161 until marker lines up with left 1 inch graduation on screen. Check with 501.000 kc crystal on right side.

d) Set S102 to ±5 kc with 495.000 kc xtal in XY100. Adjust R160 until marker lines up with left 1 inch graduation. Check on right with 505.000 kc xtal on right. (On high end check marker; should fall less than 10% short).

e) Lock R160 & R161.

NOTE: Steps C & D above may be accomplished by means of an accurately calibrated signal source, fed into any input.

VII. Test and Alignment of Marker and IF Section (IF = 100 kc)

1. Marker - check output (R107) (S100 in) should vary from .0075 to .025 volts RF as C100 is varied (use non-metallic tool). Leave C100 at minimum.

2. Feed in a 500 kc 0.1 volt unmodulated signal. Check inputs 1,2,3 (J101 and 104, J102 and 105, J103) against S101 position.

3. Align T100 for maximum gain, (as indicated by vertical height on screen). Note, there are two slugs to adjust, above and below chassis.

4. Set R106 to maximum. Adjust R131 for full height on screen (±1 kc range). Adjust C100 (non-metallic tool) so that marker attains full height on screen.

5. Trace signal. Voltages should read approximately as per Chart 1, (±10%)

6. Check AVC system. Measure voltage at C140 (black terminal of T100). Compare with input voltage. Results should be similar to Chart 2, as pictured in Figure 1. Reject if voltage measurements are consistantly lower than those of chart 2.

CHART 1

SIGNAL VOLTAGES (RF)

(Ref: Ballantine Labs Model 314, RF Voltmeter or Equivalent)

POINT	VOLTAGE	
	±1 KC	±5 KC
Input	0.10	0.10
V101 Pin 7	0.01	0.01
V101 Pin 5	0.90	1.30
V102 Pin 1	0.03	0.03
V102 Pin 5	0.45	0.20
V103 Pin 6	0.64	0.26
V103 Pin 8	0.21	0.14
V103 Pin 2	0.20	0.13
V103 Pin 1	15.0	10.0
CR100	5.0	3.0
V105 Pin 7	0.55	0.35

CHART 2

AVC VOLTAGE (DC)

(Ref: Heathkit Model AV2, AC VTVM or Equivalent)
See also Figure 1

Input Volts	AVC Volts
0	-.56
0.014	-.56
0.1	-.84
0.12	-.96
0.14	-1.14
0.16	-1.26
0.18	-1.42
0.20	-1.6
0.25	-2.0
0.30	-2.5
0.40	-3.5
0.50	-4.54

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VIII. Chart #4, D.C. Voltages

INPUT: 0.1 Volt Unmodulated Signal

VOLTAGE: Maintained Constant at 115 Volts AC. (important)

INSTRUMENTS: VTVM - Heath V-7A, with RF Probe or equivalent

Oscilloscope - Any scope which can be accurately calibrated to read peak-to-peak voltages.

NOTE: Unless otherwise specified, a tolerance of ± 10% should be allowed on all readings.

TUBE	PIN	VOLTAGE	REMARKS
V100	1	-9.5	Push S100 Voltage depends on activity of XTAL Will change if XTAL changed
6AG5	2	0	
Marker	3	6.3 VAC	
Osc.	4	0	
	5	64	"
	6	44	"
	7	0	
V101	1	-5	
6BE6	2	+1.2	
Mixer	3	6.3AC	
	4	0	
	5	200	
	6	62	
	7	0	
V102	1	0	
6AG5	2	N.C	Internally connected to 7
1.F.	3	6.3AC	
	4	0	
	5	210	
	6	130	
	7	1.20	
V103	1	135 (117→90)*	Disable AVC. (See note 1)
12AX7	2	.1(0.7→1.3)*	Voltage varies with change
Detector	3	1.1 (1.3→1.5)*	in input voltage, from
Amplifier	4,5	6.3	0 to 0.1 volts.
	6	-½ to 5V, as input varies	
	7	0, with AVC Disabled	
	8	.1 (0.7-1.3)	
	9	0	

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V104 884 Sawtooth Oscilator	1	NC	
	2	0	
	3	33	Peak-to-peak value (sawtooth)
	4	NC	
	5	0,VDC.6VAC	Spike, (3 volts in magnitude as seen on oscilloscope.
	6	NC	
	7	6.3AC	
	8	5	DC Bias level, (plus (½ volt spike, visible on scope)
V105 12AT7 Vertical AMP	1	150 (110-160)**	Vary V-POS (See note 2)
	2	1.9 (1.7-2.2)**	Vary V-Gain
	3	4.9 (40-5.8)**	Vary V-POS
	4,5	6,3AC	
	6	110	
	7	-0.33 (0to-4.3)**	Vary V-Gain
	8	+0,2	
	9	0	
V106 CRT	1-12	6.3 VAC Between 1 and 12 (Floating to Ground)	
	2	-1150 (1150-1290)*	Vary intensity
	3	-1250	
	4	-840 (760-900)**	Vary focus
	5	NC	
	6	+96	
	7	+148	
	8	+95 (0 to 250)**	Vary Astigmatism
	9	+100	
	10	+96	
	11	NC	
V107 12AT7 Horizontal AMP	1	96 (87-117)**	Vary H-POS
	2	2,5(2.3-2.7)**	Vary H-POS
	3	4.0(3.0-4.5)**	Vary H-POS
	4,5	6.3AC	
	6	99	
	7	2.5(0to 3.3)p/p**	Vary H-Gain peak-to-peak value of an AC [redacted] sawtooth
	8	1.6	
	9	0	
V108 6U8-A Reactance Oscillator	1	99	Slightly less thanV110(regulated)
	2	0	
	3	100	"
	4	6.3AC	
	5	0	
	6	98	Slightly less than Pin 3(regulated)
	7	3(2.7 to 3.4)**	Varies with Calibration-zero set Control
	8	0	
	9	7(-6.8 to-7.8)**	"

V109	1,3,5,7	NC	
5Y3-G	2	267	
Rectifier	4	340 AC	Does not vary if line is kept constant at 115
	6	340 AC	
	8	267	
V110	1,5	105	Stays constant within ± 1%
OB2	2,4,7	0	
Voltage Reg.	3,6	NC	(Firing voltage varies with individual tube)

*Given value is the operational level, with 0.1 volts input to DVM. Values in parentheses indicate variations in level with varied input signal (0 to 0.1V) and with AVC disabled (ground)

**Value given is for reference only, may vary from unit to unit. The range of value given in parentheses indicates the values which should be observed as the indicated control is varied.

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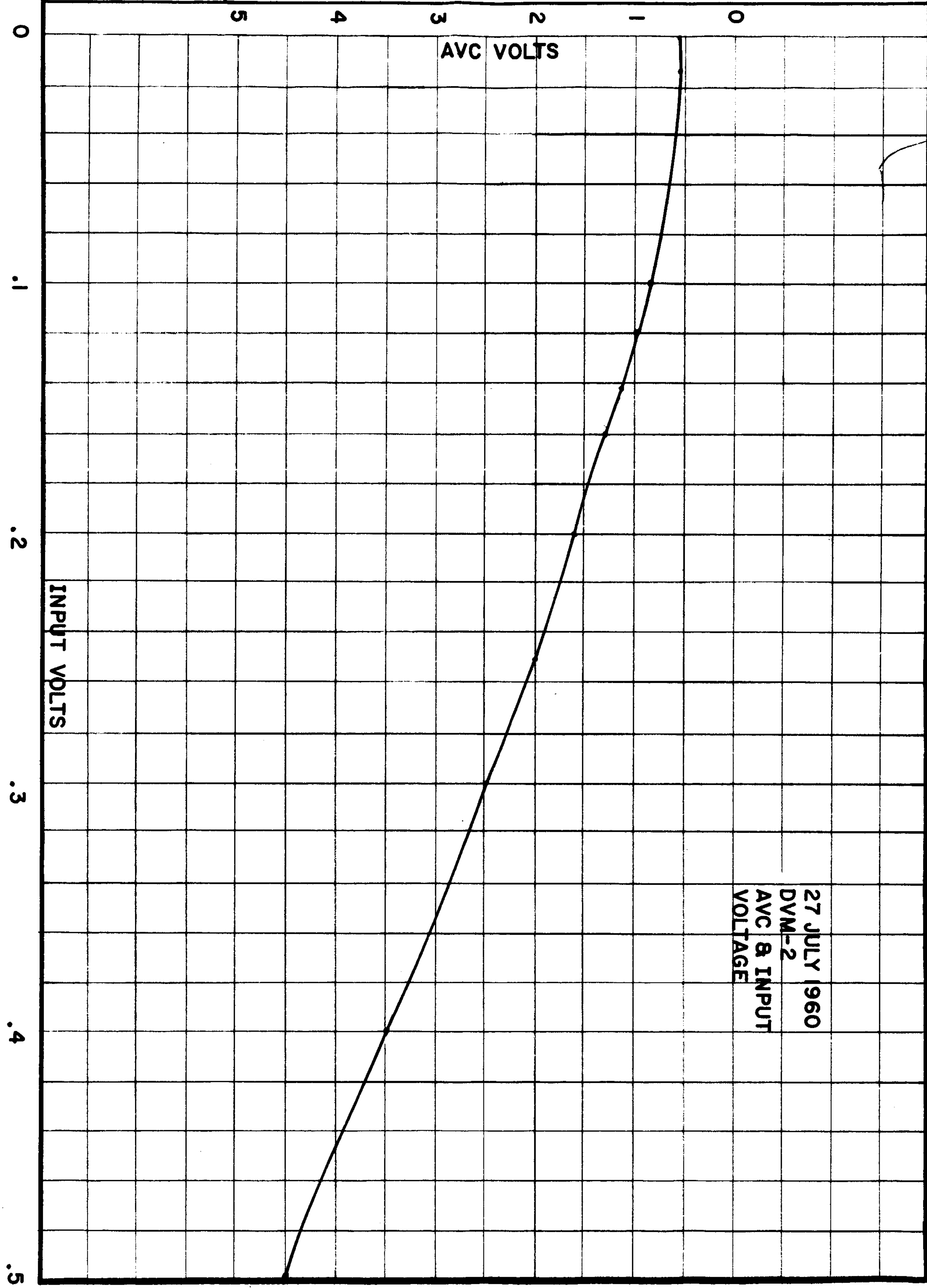

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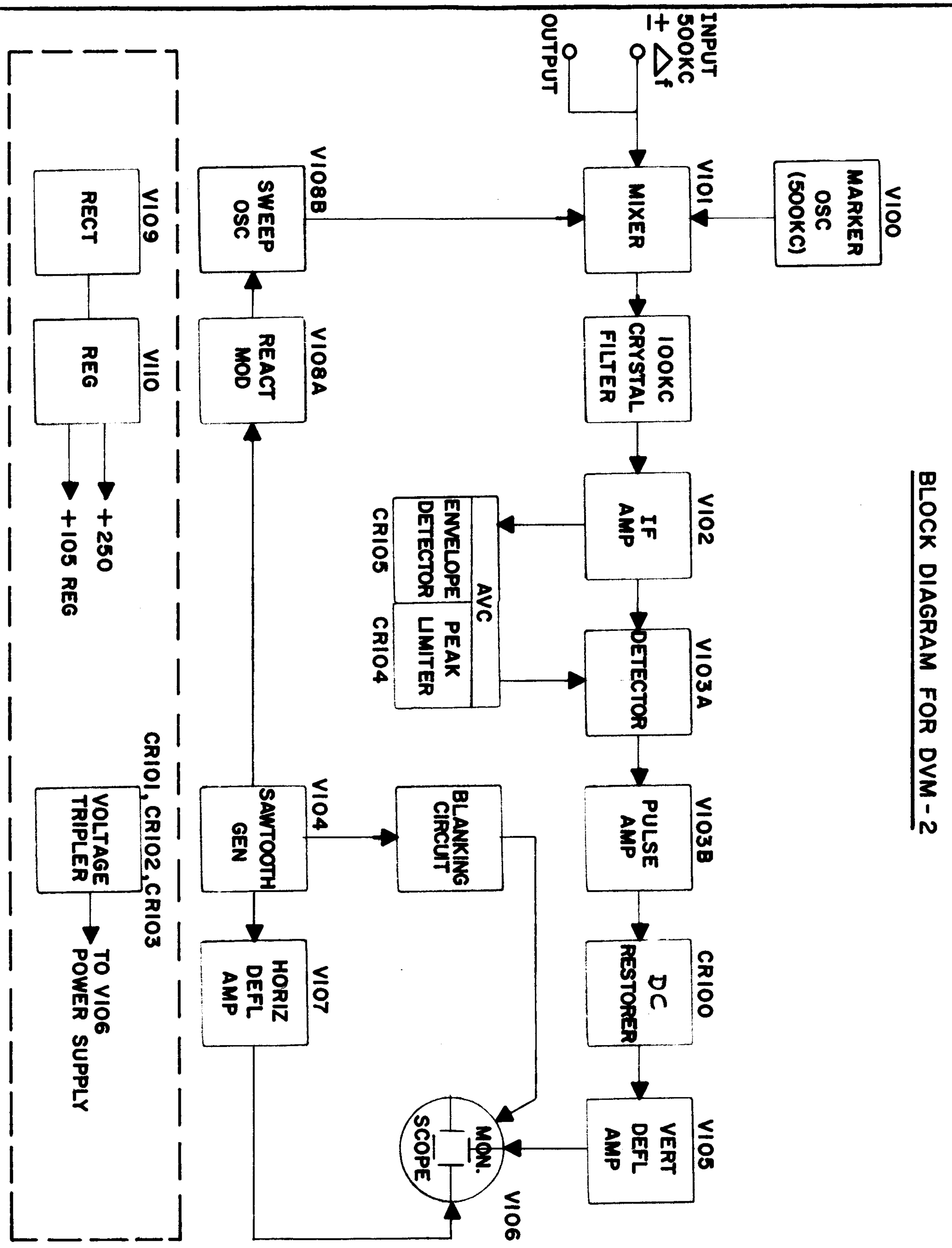

REVISION SHEET THE TECHNICAL MATERIEL CORP. MAMARONECK NEW YORK

DVM-2

MODEL ______ PROJECT NO ______

DATE	REV.	PAGE	EMN#	DESCRIPTION	CHK.	APP.
9-26-60		1		In paragraph I, item B, chg. 1400 volts to 1500 volts.		
9-26-60		2		In paragraph I, item E, chg. (1/2-12AU7) to (1/2-12AX7)		
9-26-60		3		In paragraph II, item A, chg. AC VTVM (Heathkit Model		
				AV2 or Equivalent) to AC VTVM (H.P. Model 410)		
9-26-60		3		In paragraph IV, in (c) chg. 1400 volts to 1500 volts.		
9-26-60		4		In paragraph VI, item 1, chg. 35 volts to 12 volts.		
9-26-60		4		In paragraph VI, item 1, chg. 4 volts to 1.4 volts.		
9-26-60		4		In paragraph VI, item 1, chg. 3.0 volts to 1.25 volts.		
9-26-60		4		In paragraph VI, item 1, chg. 2 to 5.5 volts to 1/2 to 1.7 volts.		
				Change 3.8 volts to 1.2 volts.		
9-26-60		4		Added "Front Panel Controls", to bottom of page.		
9-26-60		5		Retyped With The Following Changes:		
				chg. "0 to 2" to "0 to 1/2." chg. 1 volt to 1/4 volt.		
				In paragraph 2, item 1, Revised		
				In paragraph 3, item (a), add, "Bottom - Broad Tuning,		
				Top - Vernier"		
				In paragraph 3, item (d), Revised		
				Added section (e) "Lock R160 & R161"		
9-26-60		6		Added to #6, Reject if voltage measurements are consistantly		
				lower than those of chart 2.		
9-26-60		7		In chart 1, chg. V107 to V101, chg. V105 to V101		
11-28-60		8,9,10		New sheets . Renumbered pages.		

TMC FORM 154-A

FILE W/S503

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MODEL DVM-2

SERIAL NO. ____________

I. PRELIMINARY ____________

A. B+ Short ____________

II. POWER SUPPLY

A. B+ (255V) Output ____________ Volts

B. B+ (Reg) (105V) Output ____________ Volts

Regulation ____________

C. High Voltage (-1500V) Output ____________ Volts

III. SCOPE

A. Visual - Align Baseline ____________

B. Position

1. Horizontal ____________

2. Vertical ____________

C. H. Gain

D. Picture

1. Focus ____________

2. Astigmatism ____________

3. Intensity ____________

4. Blanking ____________

IV. SWEEP

1. Waveform ____________

2. Horizontal Gain (0-1.4V) ____________ Volts

3. Calibration - Zero Set (Swing = 0.6V) ______________ Volts

4. V108 Output

A. Shape ______________

B. Volts (1.8V) ______________ Volts

V. ALIGNMENT

1. 500 KC Center ______________

2. ±1 KC ______________

3. ±5 KC ______________

4. Lock ______________

5. 100 KC I.F.

A. Peak ______________

VI. INPUTS

J101 _______ Position 1 ______________

J102 _______ Position 2 ______________

J103 _______ Position 3 ______________

VII. VERTICAL

1. Gain ______________

2. Align Height ______________

3. Marker ______________

A. Align Height ______________

DATE ____________________ TESTED BY ____________________