



## ADJUSTING PROCEDURE

### CONTENTS

9.0 Adjusting procedure.....	9-1
9.1 General information.....	9-1
9.2 Recommended test and calibration equipment.....	9-2
9.3 Adjusting procedure.....	9-7

## 9.0 ADJUSTING PROCEDURE

### 9.1 GENERAL INFORMATION

The following information provides the complete adjusting procedure for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary.

The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.

Before any adjustment, the instrument must attain its normal operating temperature.

- Warming-up time under average conditions is 30 minutes.
- Where possible, the instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument specifications unless they are also published in chapter 3.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused low intensity display.
- All controls which are mentioned without item numbers are located on the outside of the instrument.

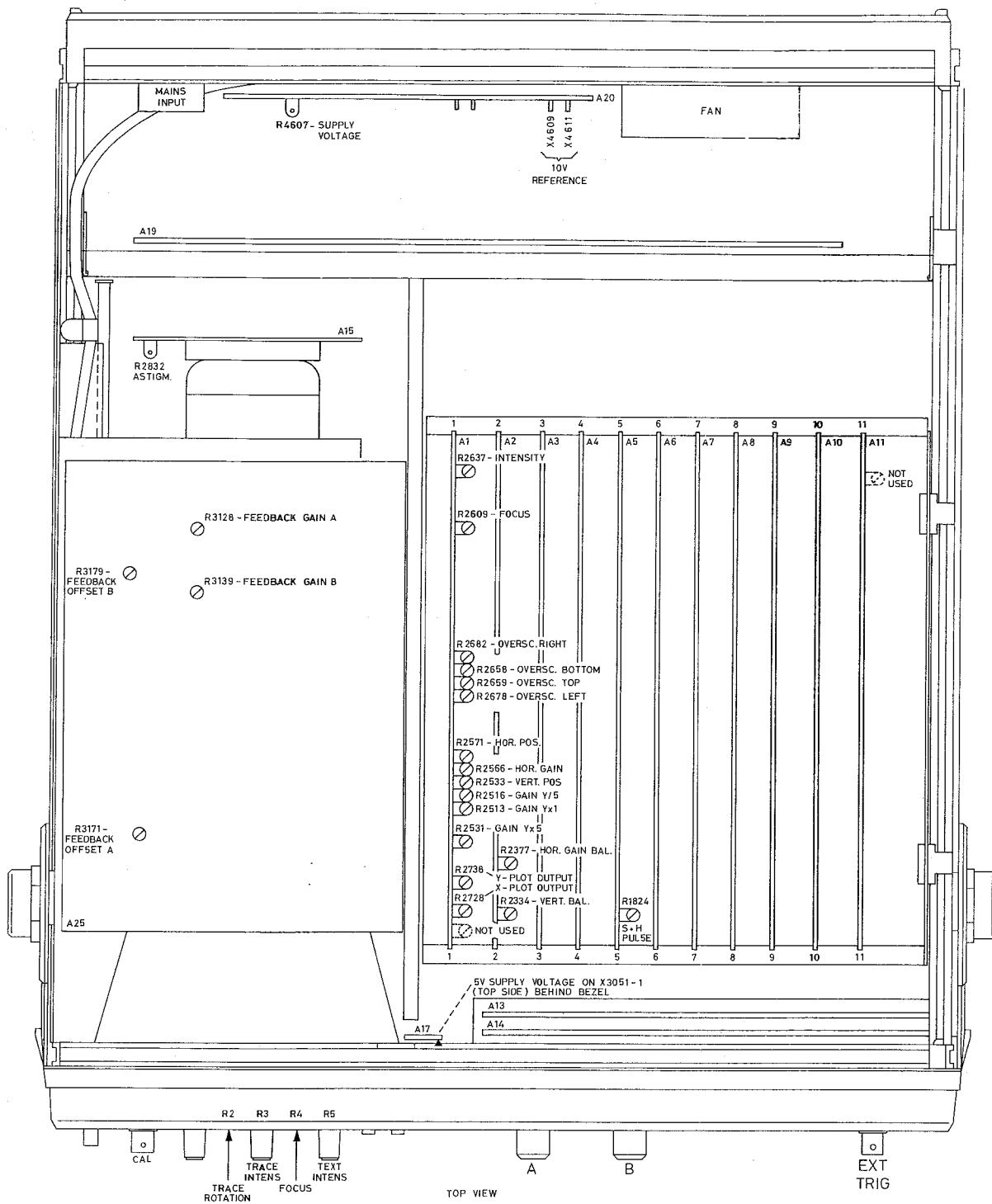
WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live. The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved.

Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

## 9.2 RECOMMENDED TEST AND CALIBRATION EQUIPMENT

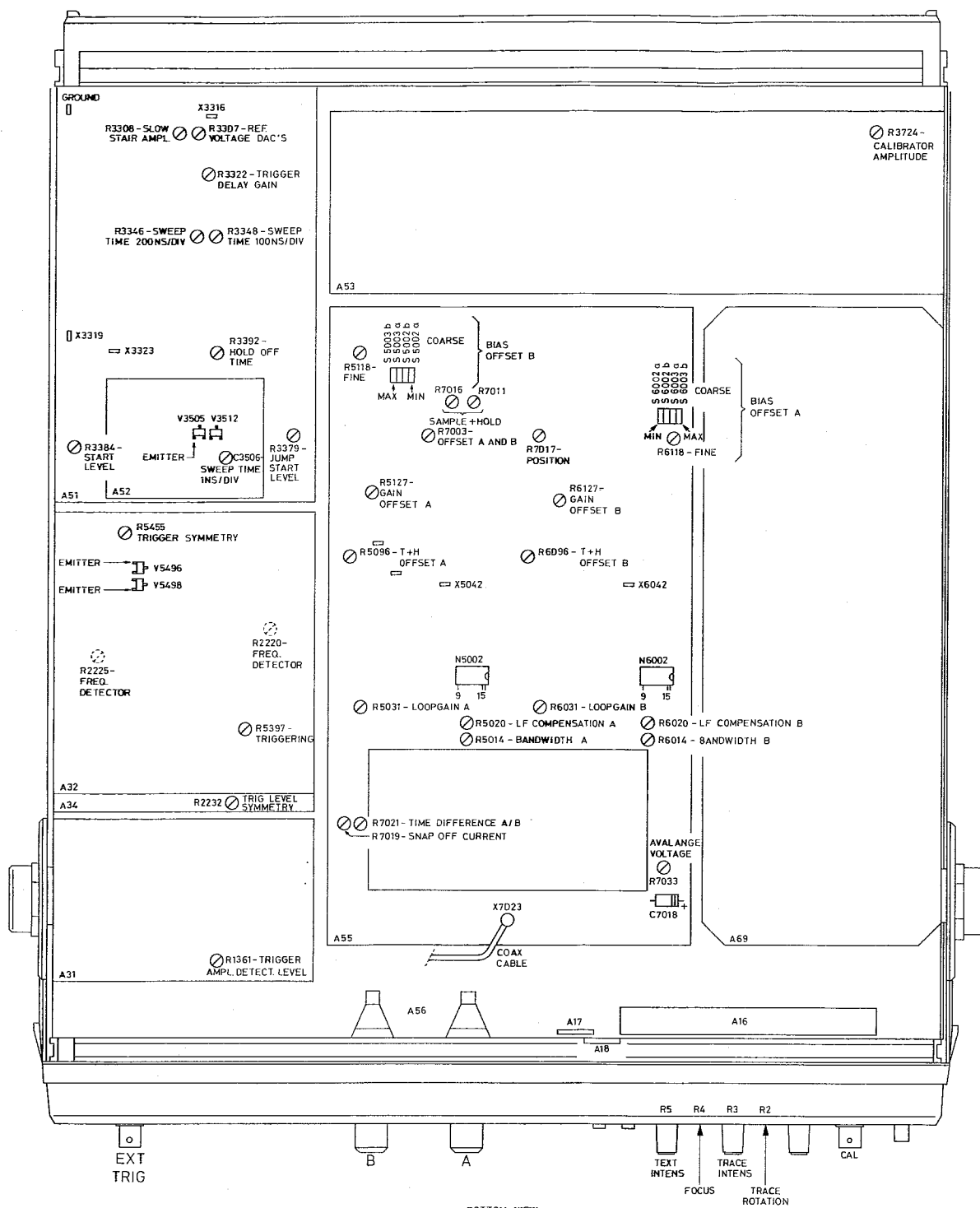
Type of instrument	Specification	Used for	Example of required instruments
1. Constant amplitude sine-wave generator.	Freq. 50kHz.. 1000MHz Voltage 10mV.. 5Volt	Bandwidth check of vertical channels and triggering	Tektronix SG503 + SG504
2. Frequency doubler	Input voltage 2 ... 5V. Input freq. 100 ... 1000 MHz	Checking bandwidth and trigger sensitivity	HP 11721 A
3. Time marker generator	Repetition rate 20us ... 1ns	Checking and adjusting of time base	Tektronix TG501.
4. Square-wave calibration generator	Output voltage into 1 M.ohm 10mV ... 2V. Halves into 50 ohm. Duty cycle 50%	Checking and adjusting of vertical sensitivity.	Tektronix PG506
5. Fast-rise square-wave generator	Output voltage 200mV/rise time 70 ps or less. Frequency 50kHz	Checking the sq. wave response.	Tektronix 284
6. BNC coax cables, attenuators (6, 14, 20 and 26 dB), adaptors between N, GR and BNC	Good quality types that are applicable up to 2GHz	Checking the sq. wave response and trigger bandwidth	

Type of instrument	Specification	Used for	Example of required instruments
7. LF sine-wave /sq.-wave generator	Sine-wave Freq.: 1Hz... 1MHz Voltage: 0... 5 volt  Square-wave Freq.: 1Hz... 1MHz Voltage: 0... 5 volt	Checking various specification points	Philips PM5131
8. Trimming tool kit	--	Adjustments	Philips SBC317 (ord. number 4822 310 50095)
9. Variable mains transformer.	Well-insulated Output voltage 90...264VAC	Checking influence of mains voltage variations and adjustment of power supply.	Philips ord. number 2422 529 00005
10. Oscilloscope	The bandwidth must be 100 MHz or more	Checking the instrument under test	Philips PM3267
11. Digital multimeter	Wide voltage, current and resistance ranges. Required accuracy 0,1%	Checking and adjusting of the instrument	Philips PM2718
12. Power splitter+ 2 equal coax cables	Equal output voltages. Bandwidth 2GHz or more	Checking and adjusting of time difference and common mode rejection ratio.	
13. 3 miniature coax cables	Length > 20cm. Type such as used internally in this oscilloscope	Adjustment of frequency detector	For ordering numbers refer to chapter 15.3



MAT3083  
880212

Figure 9.1 Adjustment points, top view.



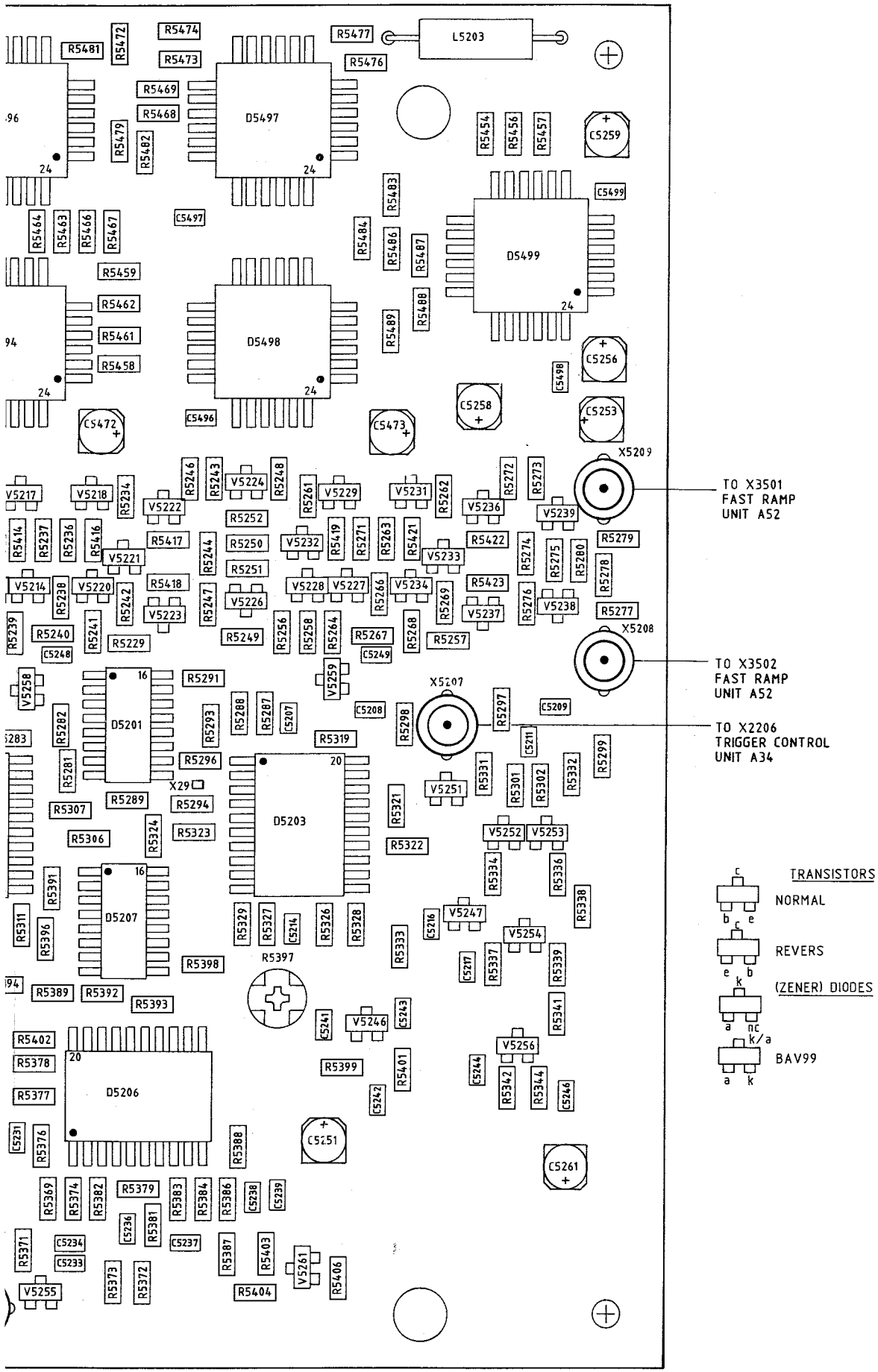
BOTTOM VIEW

MAT3082  
880212

Figure 9.2 Adjustment points, bottom view.







MAT 3256

Figure 9.3 Measuring points on three-stage trigger unit (unit A32).

### 9.3 ADJUSTING PROCEDURE

#### 9.3.1 Preparation and list of abbreviations.

Some of the adjustments are done with the use of the service menu. This menu can be switched-on by depressing the top and bottom softkeys together at the same moment. After this action you must select CHECK & ADJ. You are now in the part of the service menu that must be used during certain adjustments. Now you can for instance select the part that helps to adjust the display section.

This part is called DISPLAY. By means of the softkeys NEXT and PREVIOUS you are able to scroll downwards or upwards through the steps of the DISPLAY menu. These steps are DISPLAY 1, DISPLAY 2, .... and so on. During the adjustment procedure it is assumed that the operator knows how to select a certain part of the service menu.

The following abbreviations are used in the adjustment procedure:

bal. = balance  
 cal.sq.wave = calibrated square wave  
 div = division of the measuring graticule  
 DVM = digital voltmeter  
 hor. = horizontal  
 SM = service menu (followed by the step that must be selected)  
 M.OSC = measuring oscilloscope; measurements via 10:1 probe, given scope sensitivity does not incorporate probe attenuation factor  
 sq.wave = square wave

Note: generator output voltages are peak-to-peak values.

Important: Use always an isolated adjustment tool.

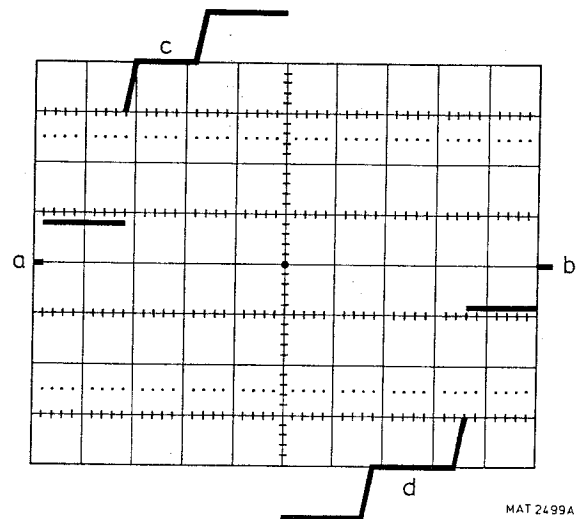
#### 9.3.2 POWER SUPPLY + CAL VOLTAGE

Adjustment	Adj. point/ unit	Settings + requirement
-Supply voltage	R4607/A20	10.00 V (+/- 0,1V) between X4609 and X4611 with d.c. voltage range of DVM.
-Calibrator amplitude	R3724/A53	Terminate CAL output with BNC into banana adaptor. Connect the DVM (dc-voltage range) with the adaptor outputs. Adjust R3724 to 1000 mV (+/- 2mV) read-out on DVM.

#### 9.3.3 DISPLAY SECTION

-Intensity	R2637/A1 R3/front R5/front	SM: DISPLAY 0, R3 and R5 (INTENS) 90° from counter clockwise stop. Adjust R2637 for test pattern + text just visible
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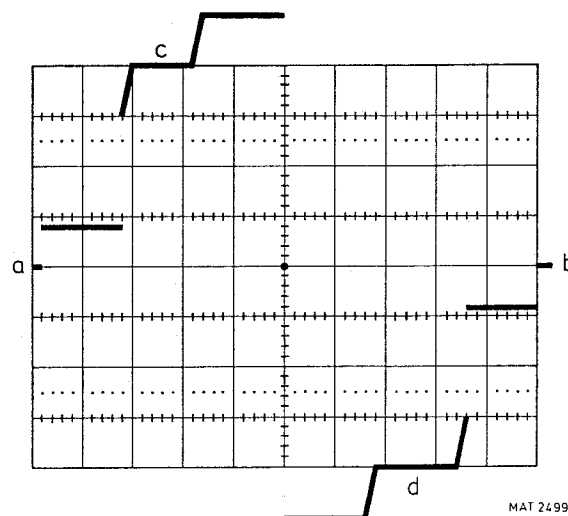
Adjustment	Adj. point/ unit	Settings + requirement
-Focus + astigmatism	R2609/A1 R2832/A15	SM: DISPLAY 0, R3/R5/R4 (FOCUS) at front panel in mid position. Text + test pattern must be equally sharp across screen, also if intensity is changed.
-Trace rotation	R2/front	SM: DISPLAY 0. Horizontal line must be in parallel with graticule.
-Presets necessary in case that oscilloscope is totally misadjusted	R2682/A1 R2658/A1 R2659/A1 R2678/A1  R2513/A1 R2533/A1 R2566/A1 R2571/A1	}All adjustments fully counter }clockwise } }  }Adjust roughly for a correct }position of the text on the }screen }
-Vertical balance	R2334/A2	SM: DISPLAY 1 (see figure below).



Adjust for minimal vertical jump of  
the lines a and b.

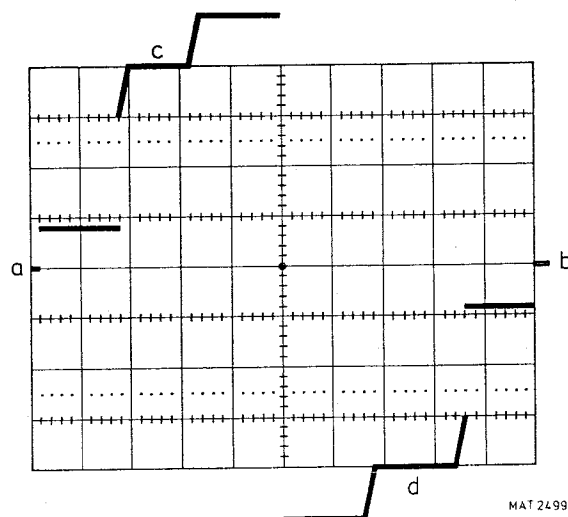
-Hor. gain balance	R2377/A2	SM: DISPLAY 2. Adjust for minimal jump of dot in screen centre.
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Adjustment	Adj. point/ unit	Settings + requirement
-Hor. position + Vert. position	R2571/A1 R2533/A1	SM: DISPLAY 3. Position the dot in the graticule centre. Allowed deviation $\pm 0,1$ div in hor. and vert. direction. Can be used to compensate for small shifts of the centre dot under SM DISPLAY 4, 5 and 6 so that the gain adjustments become more accurate.
-Gain Yx5	R2531/A1	SM: DISPLAY 4. Adjust for 8 div vertical distance between the two horizontal lines.
-Gain Yx1	R2513/A1	SM: DISPLAY 5 (see fig. above). Adjust for 8 div vertical distance between the lines c and d.



9

-Hor. gain	R2566/A1	SM: DISPLAY 5 (see fig. below)
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## Adjustment

Adj. point/  
unit

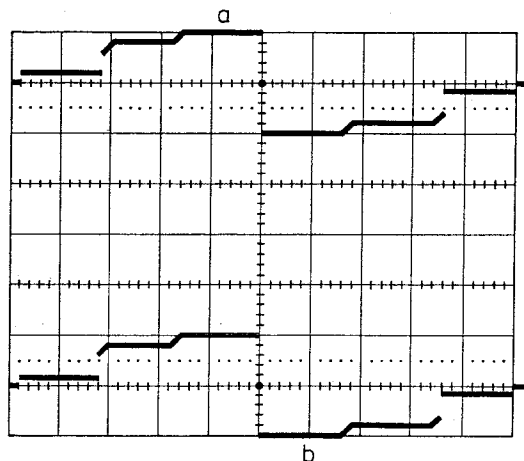
Settings + requirement

Adjust to 10 div vertical distance  
between starting point of the small  
lines a and b.

-Gain Y/5

R2516/A1

SM: DISPLAY 6 (see fig. below)



MAT 2500A

Adjust for 8 div vertical distance  
between the lines a and b.

-Overscan  
suppression

R2678/A1

SM: DISPLAY 7 (see fig. below)

Turn R2678 in clockwise direction  
until left-hand test pattern does  
not become longer anymore.

R2682/A1

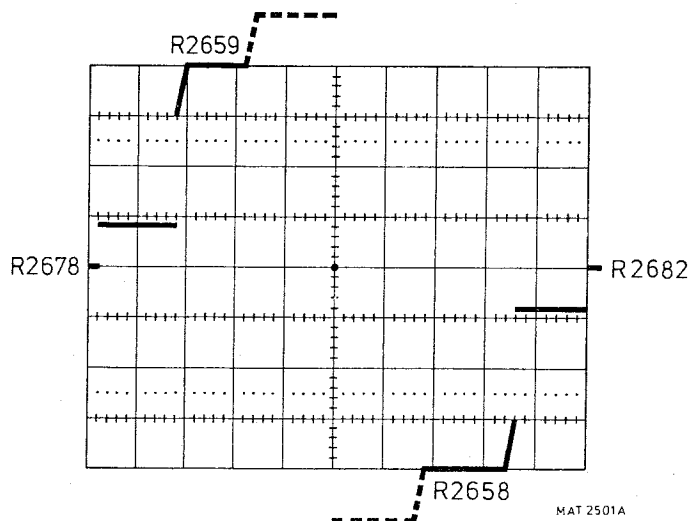
Turn R2682 in clockwise direction  
until right-hand test pattern does  
not become longer anymore.

R2658/A1

Bottom test pattern 0,1 div outside  
graticule.

R2659/A1

Top test pattern 0,1 div outside  
graticule.



MAT 2501A

### 9.3.4 HORIZONTAL SECTION

Adjustment	Adj. point/ unit	Settings + requirement
-Reference voltage DAC's	R3307/A51 X3316/A51	Adjust for 8,92V (+/- 90 mV) between X3316 and mass. Voltage measured with DVM.
-Slow stair amplitude	R3308/A51 X3319/A51	Trig.MODE: SYNC'ED Time/div: 1 ns Trig. DELAY: Ø Adjust the signal amplitude at X3319 to 4 V peak-to-peak. Measured with oscilloscope (M.OSC).
-Hold off time	R3392/A51 X3323/A51	A input: no signal Time/div: 20 ns Trig. MODE: SYNC'ED Trig. DELAY: Ø HOLD OFF: MINimal Hor. resolution: 512 samples Connect M.OSC with X3323. Adjust the duration of the hold-off sawtooth on the screen of the M.OSC to 45us (+/- 2us). Select a horizontal resolution of 64 (via softkey ACQ MODE). Check for a duration of the hold-off sawtooth of approximately 150 us.
-Start level	R3384/A51	Ch. A input: CAL voltage. Turn R3384 fully clockwise. Press AUTO SET. TIME/DIV: 500ns. Adjust X POSITION so that start of trace is within screen. Adjust R3384 so that signal slope is 0,06 div (+/- 0,04 div) from start of trace.
-Jump start level	R3379/A51 V3505E/A52 X3316/A51	SM: FAULT FIND, DAC TEST, FAST RAMP. Ch. A input: CAL voltage. M.OSC: Ch. A (50mV/div., DC coupl.) to V3505/emitter; Ch. B (50mV, DC coupl, INVERT, ADD) to X3316, position top level of the signal within the screen area of the M.OSC Adjust R3379 for minimal jump of this sawtooth. The jump is well visible if the M.OSC is not triggered. Remove the probes and press AUTO SET to leave the SM. Note: check the start level again. If necessary, readjust R3384 slightly.

Adjustment	Adj. point/ unit	Settings + requirement
-Sweep time 200 ns/div	R3346/A51	A input: 0,2 us time markers. Vertical: Ch. A, 200 mV/div, Time/div: 200 ns. Trigger mode: TRIG. Trig. DELAY: Ø Adjust the time markers on the screen.
-Sweep time 10 ns/div	C3506/A52	A input: 10 ns time markers Time/div: 10 ns. Trig mode: COUNT DOWN. Adjust the time markers on the screen
-Sweep time 100 ns/div	R3348/A51	A input: 0,1 us time markers Time/div: 100 ns/div. Trig. mode: TRIGGER. Adjust the time markers on the screen.
-Trig. delay gain	R3322/A51	Ch. A: 1 us time markers. Trig. mode: TRIGGER. TIME/DIV: 100ns. Trigger delay: Ø. Align signal slopes with 1th and 11th graticule line with X POSITION. New trigger delay: 10 div. Adjust R3322 to pre- vious signal slope position.

### 9.3.5 VERTICAL SECTION

-Bandwidth A(B)	R5014/A55 N5002/9,15 (R6014/A55 N6002/9,15)	Unplug coax cable X7023 on A55 and remove 2 screening boxes from A55. Adjust voltage between pin 9 and 15 of N5002 (N6002) to 4V (+/- 10 mV) measured with a DVM. Reinstall the coax cable again.
-Avalanche voltage & snap-off current	R7033/A55 R7019/A55 C7018/A55	Put R7019 in mid position. Ch. A: CAL voltage. Press AUTO. TIME/DIV: 1 us. Position signal inside grati- cule with OFFSET. Adjust R7033 to 21V (+/- 0,5V) across C7018.

Adjustment	Adj. point/ unit	Settings + requirement
-Time difference Ch. A, B	R7021/A55	Ch. A and B input: HF sq.wave 200mV /50kHz/rise-time <70ps via power splitter and 2 identical coax cables. Press AUTO. TIME/DIV: 1 us. Adjust LEVEL so that display starts at leading edge of signal. TIME/DIV 1 ns. Select via MAGN/DELAY menu TB sweep speed 100 ps/div and keep leading edge in graticule center by adjusting the DELAY value. Select DISPLAY MAGNIFY to *2. Adjust R7021 to a time difference of <0,1 div between A and B trace. If necessary correct vertical shift with OFFSET and make amplitudes equal with VARIABLE control.
-Sample + hold pulse A(B)	R7011/A55 (R7016/A55)	Ch. A(B) input: sq.wave 100kHz/300 mV. Ch. A(B) on, 50mV/div, EYE PATTERN. TIME/DIV: 1 us. Adjust R7011 (R7016) to maximum signal amplitude on the screen.
-Feedback gain A(B)	R3128/A25 (R3139/A25)	A(B) input: calibrated d.c. voltage 0,2V into 1 M.ohm (halves into 50 ohm. Generator adjusted to d.c. mode via switch in left-hand side panel. EYE PATtern: off. Ch. A(B): 20 mV/div. Position time base line on lower graticule line without input signal. Connect generator and check for vertical shift of time base line of 5 div. If necessary readjust R3128 (R3139). Note: this adjustment influences the vertical offset of the signal so that the optimal calibration is obtained after repeatedly performing the adjustment.
-Feedback offset A(B)	R3171/A25 (R3179/A25) X5042/A55 (X6042/A55)	A(B) input: no signal Vertical: EYE PAT A(B) Adjust voltage at X5042 (X6042) on unit A55 to 0 V (+/-50mV) with DVM. Note: reinstall the screening boxes on unit A55 again.
-LF compensation A(B)	R5020/A55 (R6020/A55)	A(B) input: CAL voltage. Vert. mode: EYE PAT, ch. A(B) on, 100 mV/div. TIME/DIV: 2 us. Adjust for a straight pulse top.



Adjustment	Adj. point/ unit	Settings + requirement
-Loop gain A(B)	R5031/A55 (R6031/A55)	<p>A(B) input: calibrated d.c. voltage 0,5V into 1 M.ohm (halves into 50 ohm). Generator adjusted to d.c. mode via switch in left-hand side panel. EYE PATtern: on. Ch. A(B): 50 mV/div. Position time base line on lower graticule line without input signal. Connect generator and check for vertical shift of time base line of 5 div. If necessary readjust R5031 (R6031).</p> <p>Note: this adjustment influences the vertical offset of the signal so that the optimal calibration is obtained after repeatedly performing the adjustment.</p> <p>Note: switch the generator back from d.c. to 1 kHz sq.wave mode.</p>
-T&H offset A(B) & channel switch	R5096/A55 (R6096/A55) X7023/A55  R7017/A55  R7003/A55	<p>A(B) input: no signal Vert. mode: EYE PAT, A AND B, 200 mV/div Time/div: 200 ns Trig. mode: SYNC'ED. Unplug the coax cable from X7023. Put the Y-POSITION in CALIBRATE via the DISPLAY menu. Adjust R5096 (R6096) for minimal trace jump when operating VARIABLE control A(B) between min and max. Position both lines upon each other with R7017. Position both lines in vertical mid of screen. Reinstall X7023 again.</p>
-Gain offset A(B)	R5127/A55 (R6127/A55)	<p>Ch. A(B): on, 50mV/div, no input signal. TIME/DIV: 200ns. Trig. mode: SYNCHRONIZE. Via OFFSET menu A(B): ADJUST, then ZERO and then DIV. Adjust R5127 (R6127) to a trace shift of 1 div when operating UP/DOWN.</p>

Adjustment	Adj. point/ unit	Settings + requirement
-Bias offset A(B)	R5118/A55 (R6118/A55)	Adjust Offset to ZERO via the OFFSET menu. Adjust R5118 (R6118) so that trace is as close as possible to vertical mid of screen. Check this for increasing input sensitivity (AMPL/DIV).
	S5002a,b/A55 S5003a,b/A55 (S6002a,b/A55) (S6003a,b/A55)	If this cannot be adjusted, put R5118 (R6118) in mid position. AMPL/DIV: 200mV. Adjust the 4 switches S5002a (smallest effect) ... S5003b (biggest effect) so that the channel A line is as close as possible to vertical mid of screen. Do this successively for increasing input sensitivity (AMPL/DIV). Do finally the fine adjustment with R5118. Do the same for ch. B with the 4 switches S6002a (smallest effect) .. S6003b (biggest effect). Do the fine adjustment with R6118.

### 9.3.6 TRIGGERING

-Trig.level symmetry	R2232/A34 X29/X30/A32	A,B input: no signal Press AUTO SET. Select trig. MODE SYNC'ED (functions as LEVEL reset) and then TRIG. Adjust the voltage between X29 and X30 to 0V (+/-1mV) with a DVM.
-Trigger symmetry	R5397/A32 R5455/A32	Ch. A input: sine-wave 100MHz/8mV Ch. A: on and at 5mV/div. Trig mode : TRIGGER and HIGH SENSE. Source: A TIME/DIV: 5ns. Turn R5397 clockwise. Then turn it counterclockwise until signal is triggered and just free from distortion. This is well visible at high intensity. Trig. mode: SYNCHRONIZE. Remove the input signal. Adjust R5455 to 0V (+/- 5mV) between the emitters of V5496 and V5498 with a DVM.

Adjustment	Adj. point/ unit	Settings + requirement
-Trigg. amplifier detection level	R1361/A31	<p>Trig mode: TRIGGER. Ch. A input: sine-wave 150 kHz/11,3 mV (= 8 mV + 3 dB). TIME/DIV: 5 us. Check if signal is correctly triggered (adjust LEVEL if necessary). Check if signal is free from distortion (turn intensity high): if not, turn R5397 slightly counterclockwise.</p> <p>Do the above check with a sine-wave 150 kHz/113 mV (=80 mV + 3 dB) with trigger mode LOW SENS and AMPL/DIV 50 mV. If necessary, readjust R5397 slightly in counterclockwise direction.</p>
		<p>A input: sine wave, 1GHz, 40 mV. Vert.mode: A, 10 mV/div. Trig.mode: COUNT DOWN, HIGH SENSE. Signal must be triggered. Switch to AUTO SELECT. Turn R1361 fully counterclockwise. Turn R1361 clockwise to the point that signal is just not triggered. Turn R1361 slightly counterclockw. Push COUNT DOWN and then AUTOSELECT and check for a triggered display: if not, turn R1361 again slightly counter-clockwise. Check for correct triggering between COUNT DOWN and AUTO SELECT across the bandwidth range 0,2 .. 2GHz while keeping the signal amplitude at 4 div on screen. If this is not good, turn R1361 again slightly counter-clockwise.</p>

Adjustment	Adj. point/ unit	Settings + requirement
-Switching of frequency detector	R2220/A34 R2225/A34	<p>Ch. A input: sine-wave 120MHz/500 mV. Vertical: ch. A on and at 200 mV/div. Trig. source: A. Trig. mode AUTO SELECT. TIME/DIV: 5ns.</p> <p>Increase generator frequency and check that triggering switches from TRIGGER to COUNTDOWN at 160MHz. Decrease generator frequency and check that triggering switches from COUNTDOWN to TRIGGER at 150MHz. If the above figures are not met: detach unit A32 so that R2220 and R2225 can be reached. Three coaxial cables must be replaced by types longer than 20 cm in order to make enough space between the units A32 and A34. Turn R2220 fully clockwise, R2225 fully counterclockwise. Select signal frequency of 160MHz. Adjust R2220 towards the position that trigger switches from TRIGGER to COUNTDOWN. Select signal frequency of 150MHz. Adjust R2225 towards the position that triggering switches from COUNTDOWN to TRIGGER. Install A32 again.</p>
-Triggering	R5397/A32	<p>Ch. A input: sq.wave 120mV/100Hz .. 1MHz. Vertical: ch. A on and 20 mV/div. Trig. source: A. Trig mode: TRIGGER, HIGH SENSE. TIME/DIV: adjust for good signal display. Check that the displayed sq.wave is free from noise/distortion across given frequency range. If not, turn R5397 slightly clockwise. Repeat the above procedure with a sq.wave 1,2V/100Hz .. 1MHz and trig. mode: LOW SENS.</p>

### 9.3.7 PLOT OUTPUTS

Adjustment	Adj. point/ unit	Settings + requirement
-Plot output voltage	R2738/A1 R2728/A1	<p>Plug plot cable into DIN socket at rear panel. Banana plugs: red: Y-output, blue: X-output, black: mass. A and B input: sq.wave, 10 kHz, 1,2 V.</p> <p>Press AUTO. Position the two square wave signals in the vertical mid of the screen. Ch. A,B AMPL/DIV: 100 mV so that signal amplitude is higher then the 10 div vertical input range. TIME/DIV: 10 us. Select A VERSUS B via DISPLAY mode and switch register R0 on. Select 20 ms/DT via menus SAVE/PLOT SELECT and ANALOG. Connect a DVM with the plot Y-output and press SAVE/PLOT and then softkey ANALOG. The plot function is active as long as a dot moves from left to right on bottom graticule line. The plot action can be stopped inbetween with softkey STOP.</p> <p>Adjust R2738 for a max. DVM reading of 1.000 V. Connect DVM with the plot X-output and press softkey ANALOG. Adjust R2728 for a max. DVM-reading of 1.000 V.</p>