100 MHz Dual-Channel Oscilloscope
PM 3267

Operating Manual/Gebrauchsanleitung/Notice d'emploi

9499 440 22801
8211

MAT1196

PHILIPS

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: *The design of this instrument is subject to continuous development and improvement. Therefore the instrument may not exactly comply with the information in the manual.*

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

IMPORTANT

Dans votre correspondance se rapportant à cet appareil, veuillez indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

REMARQUES: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

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1. GENERAL INFORMATION

1.1. INTRODUCTION

The portable oscilloscope PM3267 combines dual channel and dual time-base facilities with an extensive bandwidth of 100MHz.
It enables signals with a sensitivity of 2mV/DIV to be measured.
A wide choice of display modes is available, for example:
single channel, two channels alternately or chopped, and two channels added.
Both channels can be displayed with 'normal' polarity or 'inverted'.
An additional feature of the instrument is a third channel, namely, TRIG VIEW, which enables a display of the main time-base trigger signal.

In addition to the main time-base, the instrument also has a delayed time-base facility.
With the alternate time-base mode selected, a simultaneous display of the vertical input signal is possible on the main and delayed time-base scales.

The instrument operates on a.c. supply voltages of 110V, 220V and 240V, and battery voltages of 20V ... 32V.

The features listed make the PM3267 suitable for a wide range of measuring applications such as laboratory use, field service, service-workshops and in education.

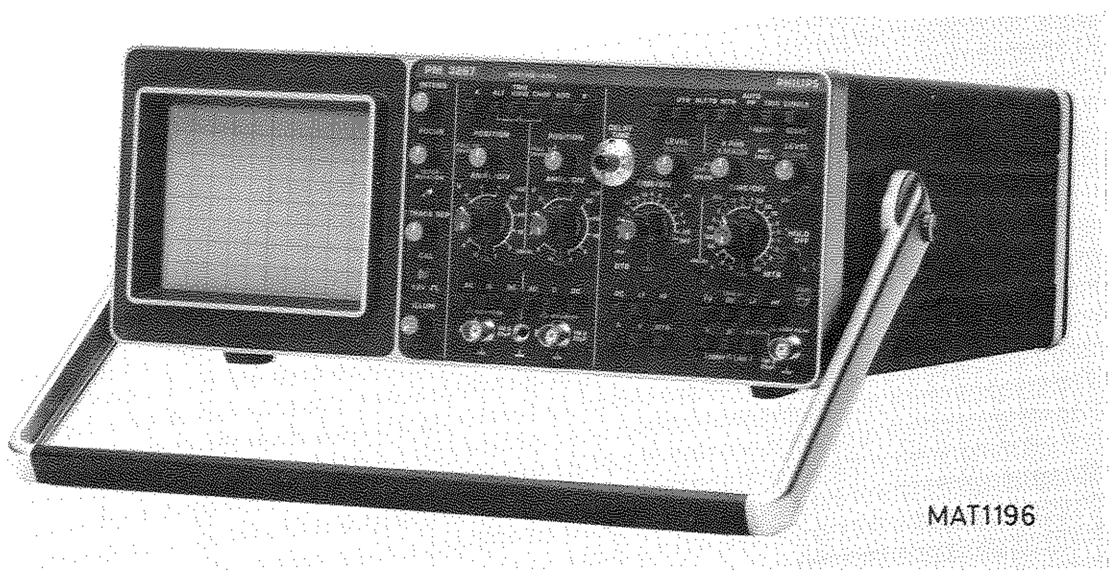

Fig. 1.1. Portable dual-channel oscilloscope PM3267.

1.2. CHARACTERISTICS

This instrument has been designed and tested in accordance with IEC Publication 348 for Class II instruments and has been supplied in a safe condition. The present Operating Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

- This specification is valid after the instrument has warmed up for 15 minutes (reference temperature 23^{o}C).
- Properties expressed in numerical values with tolerance stated, are guaranteeed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.
- Inaccuracies (absolute or in %) relate to the indicated reference value.

1.2.1. Cathode ray tube

Measuring area	8 cm. x 10cm.
Screen type	P31 phosphor (GH). Phosphors optionally available: P7 (GM), long persistence. P11 (BE), blue, high photographic writing speed.
Acceleration voltage	10kV.
Display resolution	20 lines/div. in vertical and horizontal direction.
Orthogenality	Angle between X and Y trace 90^{o} ± 1^{o}.
Engravings	cm. divisions with 2mm. subdivisions along central axes and 3rd. and 7th. horizontal graticule lines. Dotted lines at 1.5 and 6.5 div. from top of display area.
Trace rotation	Provides adjustment of a horizontal trace in parallel with graticule lines. Screwdriver-operated adjustment at front panel. Minimum overrange 4^{o}.

1.2.2. Vertical or Y-axis

Display modes	– Channel A only – Channel B only – Trigger view only – Channels A and B chopped – Channels A and B alternated – Channels A and B and trigger view chopped – Channels A and B and trigger view alternated – Channel A and B added
Polarity inversion	Channel A and B can be inverted
Chopped mode:	
display time per channel	900ns
blanking time per channel	100ns
Frequency response (Ch. A and B)	
DC coupled	DC .. 100MHz (–3dB)
AC coupled	2Hz ... 100MHz (–3dB)
Rise-time (Ch. A and B)	⩽ 3.5ns (see fig. 1.2.)
Derated bandwidth in 2.5 and 10mV/div	DC ... 80MHz (–3dB)
Derated rise-time in 2.5 and 10mV/div	⩽ 4.4ns (see fig. 1.2.)
Pulse aberrations (Ch. A and B)	⩽ 3% (⩽ 4% p.p.)
Pulse aberrations in 2.5 and 10mV/div	⩽ 4% (⩽ 5% p.p.) Outside the centre 6 div additional pulse aberrations of 1%. In added and invert mode additional pulse aberrations of 1%.

Deflection coefficients	2mV/div ... 10V/div in 1-2-5 sequence. Uncalibrated continuous control between the steps. Operation indicated by uncal LED.
Error limit	3%
Input impedance	1mΩ (± 1%) in parallel with 25pF (± 2.5pF). Difference in input cap. of vertical and trigger input ⩽ 2pF.
Max. input voltage	42V (DC + AC peak). According to IEC348.
Test voltage	500V (rms)
Dynamic range	24 div up to 40MHz. 8 div up to 100MHz.
Shift range	+ and – 8 div from screen centre.
Linearity error	⩽ 3% Non linearity of CRT included. Measured at a frequency of 50kHz.
Visible signal delay	30ns approx. at max. intensity and well-focused display.
Base line instability	⩽ 0.2 div between AMPL/DIV steps. Additional 0.2 div when switching between 20mV/div 10mV/div, 5mV/div and 2mV/div. ⩽ 1 div when operating the invert switch. ⩽ 2 div: 10mV ... 2mV/div. ⩽ 0.6 div when switching to or from added mode. ⩽ 0.3 div when rotating the continuous AMPL/DIV control.
Base line drift	⩽ 0.5 div/h. measured in 2mV/div
Base line temp. coefficient	⩽ 0.025 div/K measured in 2mV/div.
Decoupling factor	⩾ 40dB at 50MHz ⩾ 35dB at 100MHz input signal at one channel (up to full screen) shall not give a display via the other channel, more than the stated value, according to IEC351.
Common mode rejection ratio (CMRR)	⩾ 100 at 2MHz ⩾ 20 at 50MHz ⩾ 10 at 100MHz All measured at 8 div common mode signal, after adjustment of continuous AMPL/DIV for max. CMRR and in equal AMPL/DIV settings.

1.2.3. Trigger view

Trigger view	Display of internal or external main time-base trigger signal.
Frequency response	internal: DC ... 60MHz external: DC ... 70MHz Both in DC trigger coupling.
Rise-time	internal: ⩽ 5.8ns external: ⩽ 5ns Both in DC trigger coupling.
Pulse aberrations	internal: (⩽ 10% p.p.) MTB of S22 depressed external: ⩽ 6% (⩽ 8% p.p.)
Deflection coefficients	internal: see Ch. A or B deflection coefficients. external: 200mV/div.

Error limit	internal: ⩽ 10% external: ⩽ 3%
Trigger point	In screen centre ± 0.3 div.
Time delay between trig. view via external trigger input and vertical channels	6ns
Dynamic range	+ and – 8 div up to 40MHHz

1.2.4. Horizontal or X-deflection

Display modes	MTB (main time-base) MTB intensified DTB (delayed time-base) MTB and DTB in alternate time-base mode EXT X delfection via MTB trigger source
Trace separation	Symmetrical vertical separation between MTB and DTB of 5 div.

Main time-base

MTB modes	Auto pp, Auto, Trig, Single In Auto pp and Auto modes a bright base line is displayed if no trigger signal is present. In Auto pp the trigger level is adjustable between the max and min value of the trigger signal. In Auto mode the trigger level range is independent on the trigger signal. In SINGLE the NOT TRIG LED is on after reset of the time-base and extinguishes after the start of the time-base.
Position range	+ and – 5 div from screen centre
Horizontal drift	⩽ 0.5 div/h. measured in 2mV/div
Horizontal temp. coefficient	⩽ 0.025 div/K. measured in 2mV/div..
MTB time coefficients	50ns/div ... 0.5 s/div in 1-2-5- sequence. Uncalibrated continuous control between the steps. Operation indicated by uncal LED.
Error Limit	± 3%. Measured over centre 8 div of screen.
Expansion (X MAGN pulled)	X10
Additional error in X MAGN mode	± 2%. Excluded are the first and last 50ns of which additional error is ± 5%. Measured over centre 8 div of screen.
Expansion balance	1 div, O-jump between expanded and unexpanded sweep should not deviate from centre graticule more than the specified value.
Linearity	5%. Excluded are the first and last 50ns. Deviation of first and last div with respect to centre 8 div.
Hold off	Continuously adjustable up to 10x minimum value.

Delayed time-base

DTB modes	Started after delay time. Triggered upon first trigger after delay time.

Position range	see main time-base
Horizontal drift	
Horizontal temp. coefficient	
Error limit	
Expansion (X MAGN pulled)	
Additional error in X MAGN mode	
Expansion balance	
Linearity	
DTB time coefficients	50ns/div ... 1ms/div in 1-2-5- sequence. Uncalibrated continuous control between the steps. Operation indicated by uncal LED.
Delay time	Variable between 5s and 500ns.
Delay time error limit	± 3% + 60ns.
Incremental delay error limit	0.5%
Delay time jitter	1 : ⩾ 20.000. Regardless of sweep speed.

External X deflection

Frequency response	DC ... 100kHz (–0.5dB). MTB trigger coupling in DC. For frequency response in non DC coupling refer to MTB trigger coupling.
Deflection coefficients	internal: see Ch. A and B deflection coefficients. external X input: 200mV/div.
Error limit	10%. Via Ch. A, Ch. B or external X input.
Expansion	X10
Additional error limit	2%
Input impedance	1MΩ (± 1%) in parallel with 25pF (± 2.5pF). Input impedance such that a 10 : 1 attenuator probe after being adjusted on Ch. A or B can be applied to the ext. trig. input without readjustment.
Max. input voltage	42V (DC + AC peak). According to IEC 348.
Test voltage	500V (rms)
Dynamic range	⩾ 20 div
Position range	+ or – 5 div from screen centre
Linearity error	⩽ 5%
Compression	⩽ 1%
Phase shift between X and Y deflection	⩽ 3° at 100kHz
Horizontal drift	⩽ 0.5 div/h. measured in 2mV/div.
Horizontal temp. coefficient	⩽ 0.025 div/K. measured in 2mV/div.
X-deflection via line	8 div (± 10%) at line frequency.

1.2.5. Triggering

Triggering of main time-base

Source	Ch. A, Ch. B, composite, external line.
Trigger coupling	DC, LF, HF. Bandpass: DC: DC ... full bandwidth LF: 2Hz ... 25kHz (via external trigger input: 7Hz ... 25kHz). HF: 25kHz ... full bandwidth Lower frequency limit 10Hz in auto and auto pp mode.
Slope	Positive or negative
Level range: trig, auto, single	internal: + and – 8 div external: + and – 1.6V.
auto pp	Within pp value of trigger signal.
TV	Fixed level.
Sensitivity (in DC mode)	internal: 0.5 div up to 40MHz 1.5 div up to 100MHz external: 100mV up to 40MHz 300mV up to 100MHz
TV triggering	Positive and negative video selection via slope switch. TV frame triggering at MTB TIME/DIV 0.5 s/div ... 50μs/div. TV line triggering at MTB TIME/DIV 20μs/div ... 50ns/div.
TV trigger sensitivity	internal: 0.7 div synch. pulse. external: 150mV synch. pulse.
NOT TRIG'D LED	LED is on in absence of trigger signal.

Triggering of delayed time-base

Source	Ch. A, Ch. B, MTB. In MTB mode the DTB starts immediately after the delay time.
Trigger coupling Slope Level range Sensitivity	See main time-base triggering.

1.2.6. Additional characteristics

Calibration voltage generator

Output	1.2V rectangular. Starting from zero level negative going.
Error limit	± 1%.
Frequency	2kHz approx.

Additional input

External Z-modulation	DC coupled TTL compatible "1" is normal intensity "0" blanks display
Min. required pulse width	10ns

Power supply

AC ranges	90 ... 132V 195 ... 245V 210 ... 270V
Power consumption	45W
AC frequency	46 ... 440Hz
DC voltage range	20 ... 32V
DC current	1.45A at 24V

1.2.7. Options

TTL triggering

Internal — The correct TTL level is obtained with the AMPL/DIV in position 2V/div.

External — The correct TTL level is obtained via a 10 : 1 attenuator probe.

ECL triggering

Internal — The correct ECL level is obtained with the AMPL/DIV in position 0.5V/div.

NOTE: Instead of TV triggering, you can modify the instrument for TTL or ECL triggering. If modified the main time-base triggering is automatically set for TTL or ECL triggering. The level control is not operative then.

Sweep out MTB

Output voltage — From – 1.8V to + 3.8V. Output short-circuit protected.

Gate out MTB

Output voltage — At TTL level: "high" during MTB sweep. Output short-circuit protected.

Gate out DTB

Output voltage — At TTL level: "high" during DTB sweep. Output short-circuit protected.

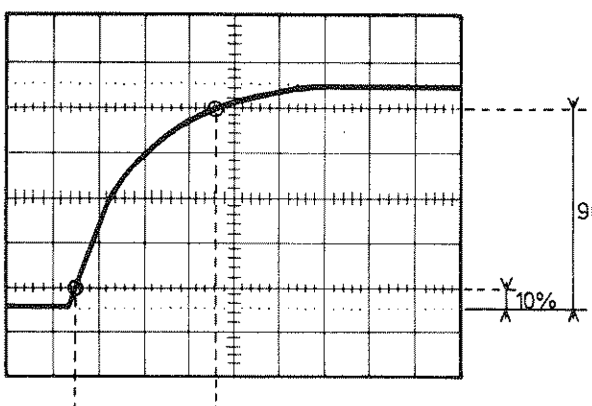

Fig. 1.2. Rise time measurement $t_R = t_2\ (90\%) - t_1\ (10\%)$ (general formula)

$$\text{Rise-time of oscilloscope} = \frac{0.35}{\text{bandwidth (Hz) of the instrument}}$$

NOTE: Bear in mind that inaccuracies of CRT and time-base and rise-time of generator (measured with an input pulse with a rise-time $\leqslant$ 1ns) influence this measurement.

Rise-time measurement of a signal applied to the vertical inputs:

Bear in mind that the rise-time measured on the oscilloscope screen is influenced by the rise-time of the oscilloscope according to the formula:

$$T_R\ (\text{measured}) = \sqrt{(T_R\ (\text{signal})^2 + (T_R\ (\text{oscilloscope})^2}$$

The measuring fault $\leqslant 3\%$, if the rise-time of the input pulse is $\geqslant 4$ times the rise-time of the oscilloscope.

1.2.8. Mechanical data

Dimensions:

Depth	445mm.	Handle and controls excluded
Width	335mm.	Handle excluded
Height	137mm.	Feet excluded
Mass	10.6 kg. (23,3 lb)	

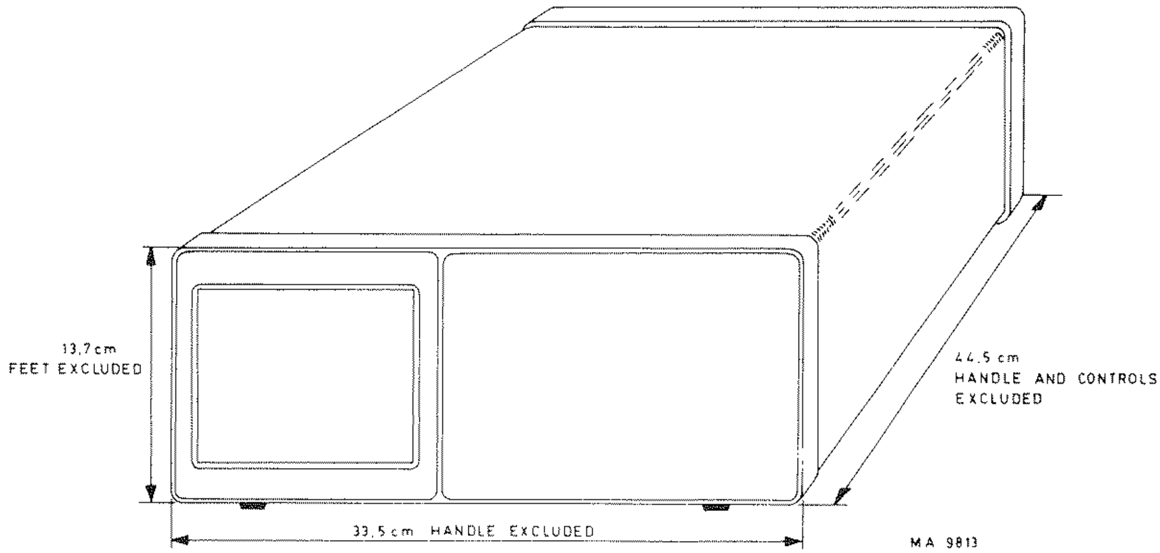

Fig. 1.3. Dimensions of instrument

1.2.9. Environmental Characteristics

NOTE: The characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS-organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.

Ambient temperature	
Rated range of use	0^oC ... $+40^oC$
Limit range of operation	-10^oC ... $+55^oC$
Storage conditions	-40^oC ... $+70^oC$
Humidity	According to IEC68 dB
Bump	$300m/s^2$ half sine 11ms duration, 3 shocks per direction with a total of 18
Vibration	20 minutes in each of 3 directions, 5 ... 55Hz 1mm (PP) and $40m/s^2$ max. acceleration
Altitude	Limit range of operation: 5000m (15000 feet)
	Limit range of transport: 15000m (50000 feet)
Recovery time	30 min. if ambient temperature is raised from -10^oC to $+20^oC$ at 60% relative humidity.
Electromagnetic interference	Meets VDE 0871 and VDE 0875 Grenzwertklasse B.

1.3. ACCESSORIES

1.3.1. Accessories supplied with the instrument.

- Two 10 : 1 attenuator probes PM8927A
- A front cover
- A BNC-banana 4mm. adaptor; see fig. 1.4.
- An operating manual
- A callapsible viewing hood

1.3.2. Optional accessories:

- A service manual (see ordering card)
- A plug for 24Volt DC supply according to 130/10 IEC-02, ordering number 4822 266 20014.
- Plug and cable (length 40cm) for 24Volt DC supply according to 130/10 IEC-02, ordering number 4822 321 20125.

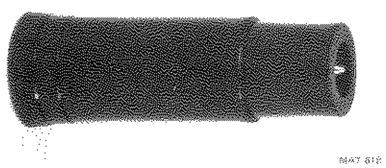

Fig. 1.4. BNC-Banana 4mm adaptor

1.4. ACCESSORY INFORMATION

10 : 1 Passive probe PM8297A.

The PM8927A is a probe with an attenuation factor of 10, designed for real-time oscilloscopes up to 100MHz, with BNC input jack and 14 ... 40pF input capacitance in parallel with 1MΩ. The cable length of this probe is 1.5 metres.

Characteristics

Electrical

Attenuation	10x ± 2% (Oscilloscope input 1MΩ)
Input resistance d.c.	10MΩ ± 2% (Oscilloscope input 1MΩ)
a.c.	See curve Fig. 1.5.
Input capacitance d.c. and l.f.	11pF ± 1pF (Oscilloscope input 1MΩ ± 5% paralleled by 25pF ± 5pF)
Input reactance h.f.	See curve Fig. 1.5.
Useful bandwidth	100MHz see curve Fig. 1.7.
Max. input voltage	500V d.c. + a.c. peak, derating with frequency. See Fig. 1.6. Oscilloscope input 1MΩ and voltage applied between probe tip and earthed part of probe body. Test voltage $1500V_{d.c.}$ during 1s. at a temperature between 15 and $25^{o}C$, a rel. hum. of 80% at maximum and at sea level.
Check-zero button probe shell	Same function as 0 position of input coupling switch on oscilloscope.
Compensation range	14 ... 40pF.

Environmental

Probe operates within specifications over the following ranges:

Temperature	$-25^{o}C$ to $+70^{o}C$
Altitude	Up to 5000 metres (15000 feet)
Other environmental data	Same as for any PHILIPS oscilloscope the probe is used with

Mechanical

Dimensions	Probe body 103mm. x 11mm. dia (max.) Cable length 1500mm. Correction box 55 x 30 x 15mm. incl. BNC
Mass	Incl. standard accessories 140g.

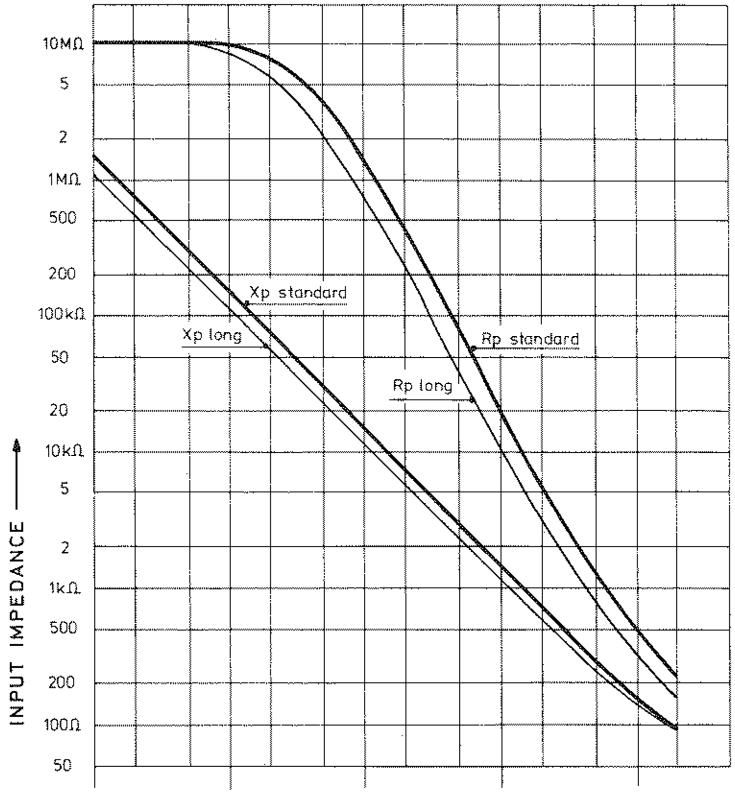

Fig. 1.5. Input impedance versus frequency

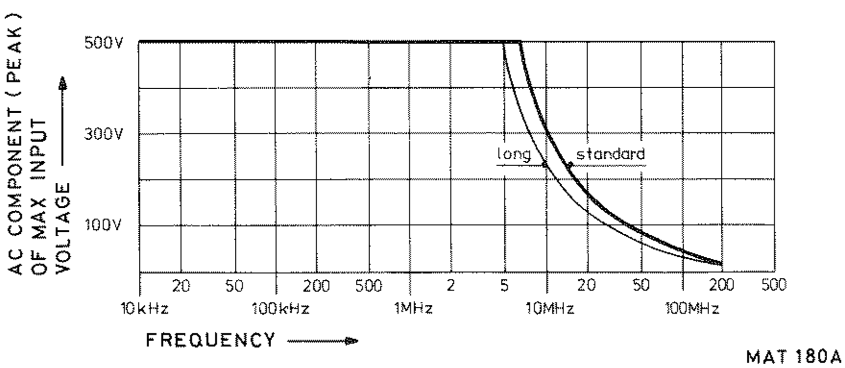

Fig. 1.6. AC-component (peak) of max. input voltage versus frequency

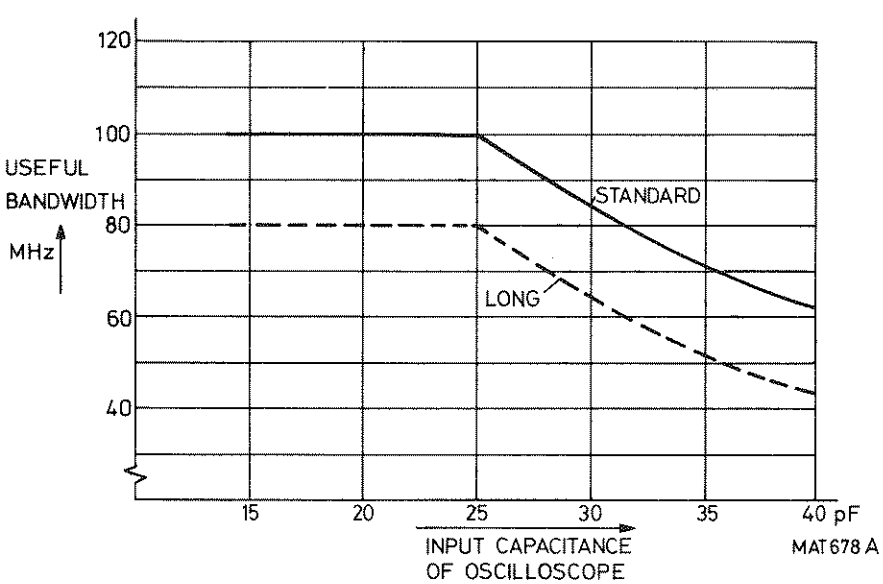

Fig. 1.7. Useful bandwidth versus input capacitance of oscilloscope

Adjustments

Matching the probe to your oscilloscope

The measuring probe has been adjusted and checked by the manufacturer. However, to match the probe to your oscilloscope, the following manipulation is necessary.
Connect the measuring pin to the CAL socket of the oscilloscope.
A trimmer C2 (Fig. 1.10.) can be adjusted through a hole in the compensation box to obtain optimum square-wave response. See Fig. 1.8a, b and c.

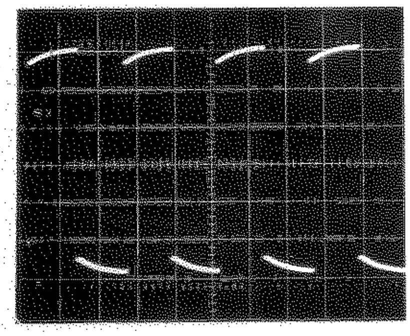

Fig. 1.8.a Overcompensation (adjustment C2)

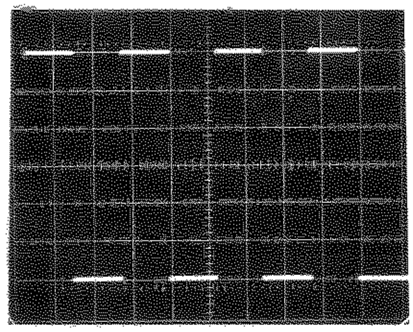

Fig. 1.8.b Correct compensation (adjustment C2)

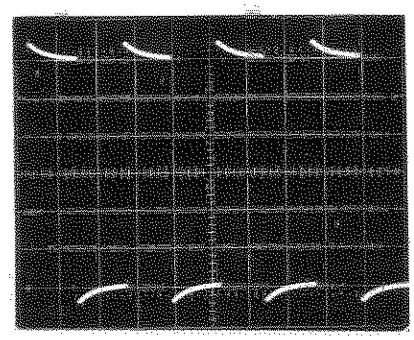

Fig. 1.8.c Under-compensation (ajdustment C2)

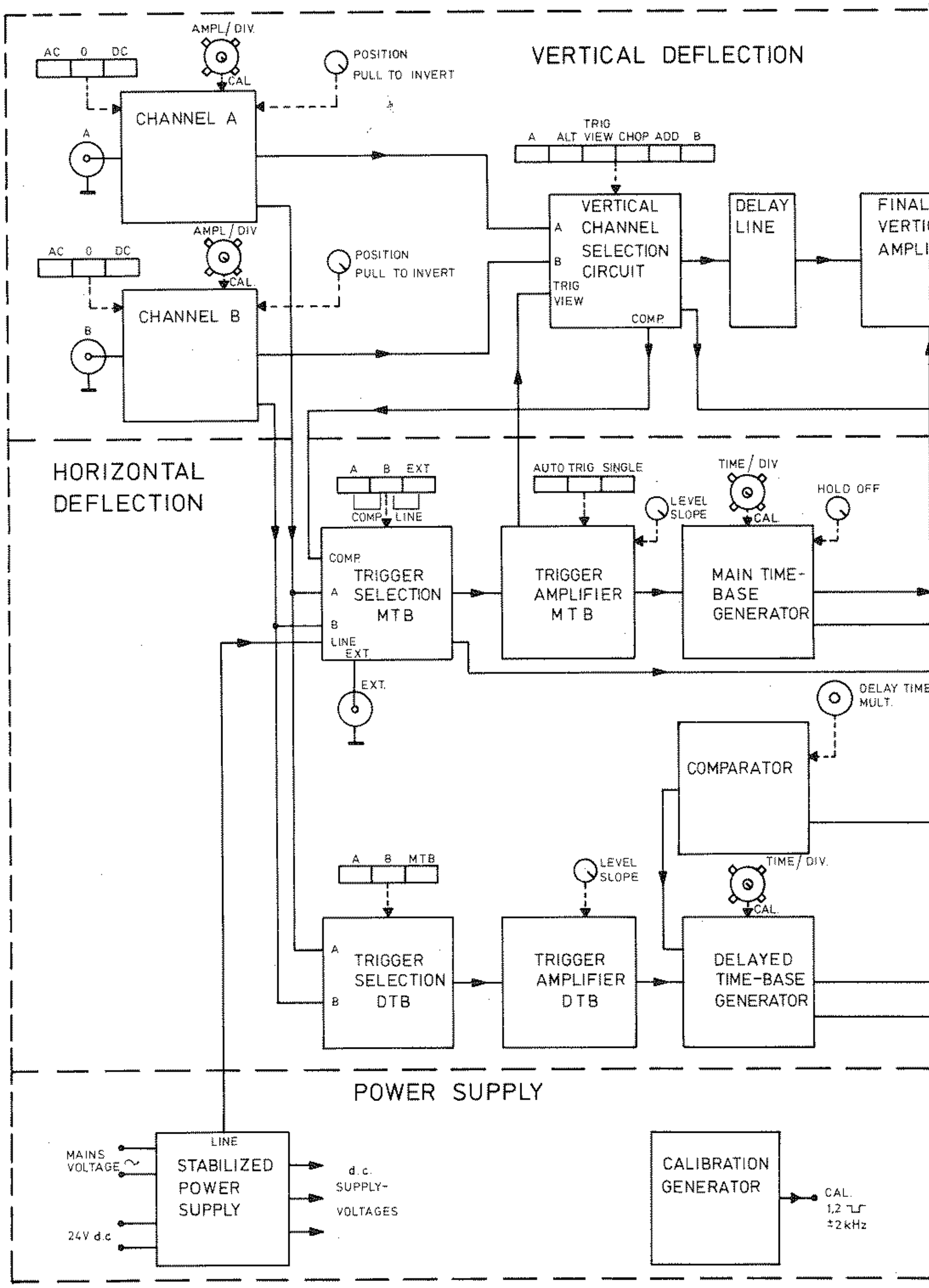

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Fig. 1.9. Block diagram
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Fig. 1.9. Schéma synoptique

Depending on the DTB trigger source switch selection, the DTB starts immediately (MTB selected) or upon receipt of the trigger pulse derived from the TRIGGER AMPLIFIER (A or B selected).

Each time-base produces a time-linear sawtooth voltage, the sweep time of which can be selected with the TIME/DIV switch.

The HORIZONTAL SELECTION circuits determine which signal is routed to the FINAL HORIZONTAL AMPLIFIER.

The signals available for selection are: MTB, DTB, ALT. TB or X DEFL.
To prevent trace overlap in the ALT. TB mode, the TRACE SEP control permits vertical shift between the MTB and DTB displays.

Horizontal shift of the time-base line is achieved with the X POS control and it can be magnified by a factor of 10 using the PULL FOR 10x switch part of this control.
The FINAL HORIZONTAL AMPLIFIER drives the horizontal deflection (X) plates of the c.r.t.

1.5.3. CRT display section

Trace intensity is controlled by the Z AMPLIFIER and adjusted by the INTENS control.
The Z AMPLIFIER blanks the flyback of the trace and also the switching intervals between traces in the CHOP and ALT modes.
For CHOP mode, the blanking signal is derived from the vertical CHANNEL SELECTION and the HORIZONTAL SELECTION circuit.

The ALT mode blanking signal is produced in the HORIZONTAL SELECTION circuit.

For the intensified portion of the delayed time-base on the main time-base waveform, a signal is produced in the DTB, which is fed to the Z AMPLIFIER.

The FOCUS control drives the focussing electrode of the c.r.t. to regulate the sharpness of the trace.
The trace should lie parallel with the horizontal graticule lines. Any deviation can be corrected with the TRACE ROTATION potentiometer.

1.5.4. Power supply

The PM3267 oscilloscope may be powered by an a.c. mains voltage (110V, 220V, 240V) or a 20 ... 32V battery supply.
For safety, the oscilloscope is provided with a double-insulated mains transformer.
After rectification, the stabilised d.c. voltages are fed to the various electronic circuits in the instrument.
When the instrument is operating from an a.c. mains voltage, a mains frequency-related signal is fed to the TRIGGER SELECTION of the MTB for LINE triggering.

The extra-high tension supplies for the c.r.t. are produced in the 1500 V CONVERTER and the H.V. MULTIPLIER (8,5 kV).

2. INSTALLATION INSTRUCTIONS

2.1. IMPORTANT SAFETY INSTRUCTIONS (IN ACCORDANCE WITH IEC 348).

Before connecting the instrument to the mains (line), visually check the cabinet, controls and connectors, etc., to ascertain whether any damage has occured in transit. If any defects are apparent, do not connect the instrument to the mains (line).

CLAIMS

In the event of obvious damage or shortages, or if the safety of the instrument is suspect, a claim should be filed with the carrier immediately. A Philips Sales or Service organisation should also be notified in order to facilitate repair of the instrument.

The instrument must be disconnected from all voltage sources and any high voltage points discharged before any maintenance or repair work is carried out.
If adjustments or maintenance of the operating instrument with covers removed is inevitable, it must be carried out only by a skilled person who is aware of the hazards involved. In normal operation the double insulated power supply obviates the need for a safety ground.

Warning: **It must be borne in mind that in all measurements the frame ground of the oscilloscope is raised to the same potential as that of the measuring ground probe connection. Neither the probe's ground lead nor the frame ground shall be connected to live potentials.**

2.2. REMOVING AND FITTING THE FRONT COVER

For ease of removal and fitting, the front cover has been designed simply as a push-fit on the front of the instrument.

2.3. POSITION OF THE INSTRUMENT

The instrument may be used in any desired position. With the handle folded down, the instrument may be used in a folded sloping position. The characteristics in accordance with para. 1.2. are guaranteed only for normal position or when the handle is folded down. (Ensure that the ventillation holes in the rear cover are free).
Do not position the instrument on any surface which procedures or radiates heat, or in direct sunlight.
The carrying handle can be rotated if the pushbuttons on its bearings are depressed.

2.4. MAINS (LINE) VOLTAGE SETTING AND FUSES

Before inserting the mains plug into the mains socket, make sure that the instrument is set to the local mains voltage.
Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse-holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced or when the instrument is to be adapted to a different mains voltage.

The instrument can be set to operate on the following mains voltages: 110V, 220v and 240V a.c.
These nominal voltages can be selected by means of the mains voltage selector, located at the rear (see Fig. 2.1.).
For mains voltage selection, proceed as follows:

- Select one of the voltage ranges, as appropriate, by turning the selector with a screwdriver.
  On delivery, the instrument is set to 220 V a.c.

A thermal fuse is fitted in the mains transformer; if replacement is necessary, it must be carried out only by a skilled person who is aware of the danger involved.

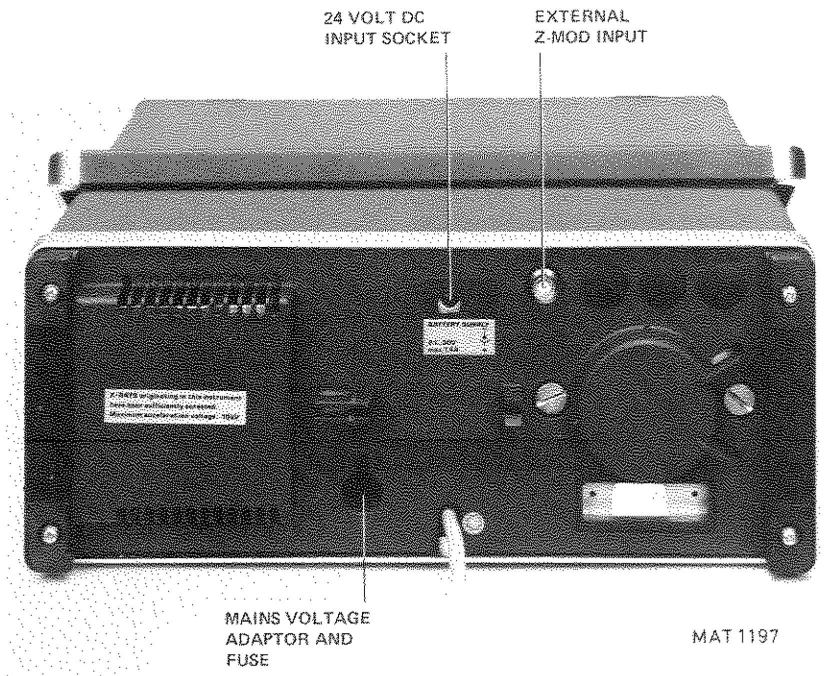


Fig. 2.1. Rear view of instrument

2.5. EXTERNAL 24V D.C. SUPPLY

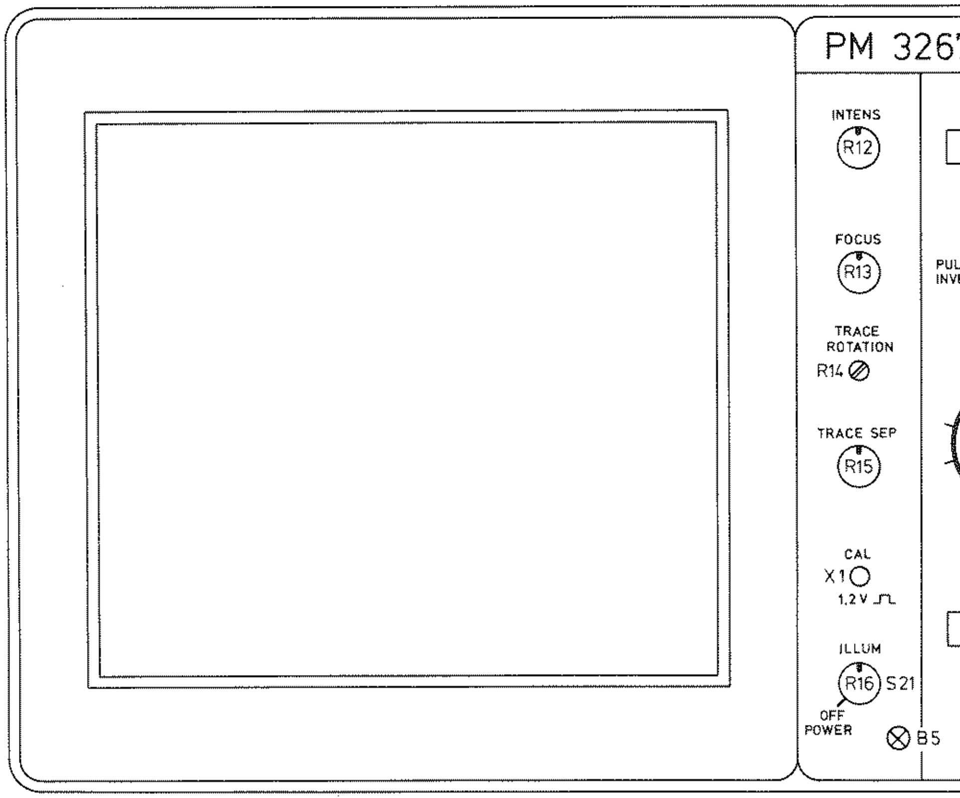
The instrument may also be powered from a battery supply of 20V ... 32V, connected to the battery input socket located on the rear of the instrument (see fig. 2.1.). The 24V input is protected against reversed polarity of the battery input source. Protection is also given by a 2A delayed-action fuse located on the printed-wiring board of the power supply. This fuse shall be replaced only by a skilled person who is aware of the danger involved.

It is recommended that the instrument is not connected to the 24 V battery supply and the mains supply at the same time.

2.6. EARTHING

This instrument has a double-insulated mains transformer; in normal operation this facility obviates the need for a safety ground.

Warning: **It must be borne in mind that in all measurements the frame ground of the oscilloscope is raised to the same potential as that of the measuring ground probe connection. Neither the probe's ground lead nor the frame ground shall be connected to live potentials.**



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WER ON led (B5).
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for at least one minute.

Fig. 3.1. *Front view showing controls and sockets*
Abb. 3.1. *Vorderansicht mit Bedienungselemente und Buchsen*
Fig. 3.1. *Vue antérieure, montrant les commandes et les douilles de connexion*

3.3. EXPLANATION OF CONTROLS AND SOCKETS (see Fig. 3.1.)

The controls and sockets are listed according to their functional sections and a brief description of each is given.

3.3.1. CRT section

INTENS (R12)	Continuously variable control of trace brilliance on the c.r.t. screen.
FOCUS (R13)	Continuously variable control of the focussing of the c.r.t. electron beam
TRACE ROTATION (R14)	Screwdriver control of trace alignment in parallel with the horizontal graticule lines.

3.3.2. Vertical section

A, ALT, TRIG VIEW, CHOP, ADD, B (S1)

Vertical display mode switches. These pushbutton switches permit eight different vertical display modes to be selected.

A	Channel A only
ALT	Channel A and B alternately. The display is switched over from one channel to the other at the end of every time-base sweep.
TRIG VIEW	Trigger view, MTB trigger signal.
CHOP	Channel A and B chopped. The display is switched over from one channel to the other at a fixed frequency.
ADD	Channel A and B added.
B	Channel B only.
ALT and TRIG VIEW	Channel A and B and the MTB trigger signal alternately displayed.
CHOP and TRIG VIEW	Channel A and B and the MTB trigger signal chopped displayed.

With no pushbuttons depressed, channel A is displayed.

POSITION (R1/R2)	Continuously variable control giving vertical shift of the trace over the screen.
PULL TO INVERT (S4/S5)	Push-pull switch combined with the POSITION control. The signal of the relevant channel is inverted if the POSITION control is pulled.
AMPL/DIV (S9/S11)	This switch permits selection of the vertical deflection coefficient of the relevant channel in twelve steps from 2 mV/DIV to 10 V/DIV in a 1-2-5 sequence.
CAL (AMPL/DIV) (R7/R8) (S10/S12)	Continuously variable control of the vertical deflection coefficients of the relevant channel. The deflection coefficients of the AMPL/DIV switches are calibrated when the continuous control is in CAL position.
UNCAL (B3)	The UNCAL led lights up if one of the continuous controls is not in the CAL position

AC-0-DC
(S17/S18)

Input signal coupling switches.
AC button depressed:
– only the a.c. component of the input signal is fed to the attenuator, via a blocking capacitor, which blocks the d.c. component.

0 button depressed:
– the input signal is interrupted and the input of the attenuator is connected to earth, providing a zero reference for the relevant channel.

DC button depressed:
– the complete input signal (a.c. + d.c. components) is connected to the attenuator.

No pushbuttons depressed:
– input signal is d.c. coupled.

A B
1 MΩ/25 pF
(X2/X4)

BNC input sockets for the A and B channels.
Rated input voltage : 42V (dc + ac peak)

(X3) ⏚

Measuring earth socket.

CAL
(X1)

Output socket of a square-wave calibration signal with an amplitude of 1,2 V_{p-p} (± 1 %) and a frequency of 2 kHz approx.

3.3.3. Horizontal section

X DEFL, DTB, ALT TB, MTB
(S2)

Horizontal display mode switches

X DEFL	The horizontal deflection is achieved by the signal selected with the MTB trigger source selector switches (S23)
DTB	The horizontal deflection signal is supplied by the delayed time-base, only if the DTB TIME/DIV switch (S13) is not in the OFF position.
ALT TB	The horizontal deflection is switched over from MTB to DTB at the end of each time-base sweep. When the DTB TIME/DIV switch (S13) is in the OFF position, neither the MTB nor the DTB is displayed.
MTB	The horizontal deflection voltage is supplied by the MTB. A part of the trace is intensified when the DTB is on.

With no push-button depressed the MTB is displayed.

TRACE SEP
(R15)

Trace separation control
Gives continuously variable control of the space between the traces of the MTB and DTB signals when ALT TB (S2) is depressed.

X POS
(R5)

This control gives horizontal shift of the trace over the screen

X MAGN
(S7)

This push-pull switch is combined with the X POS control
The horizontal deflection is increased by a factor of 10 when the X POS control is pulled.

MAGN
(B2)

The MAGN led lights up when the push-pull switch X MAGN is pulled.

3.3.4. Main time-base

AUTO PP, TRIG, SINGLE (S3)

Main time-base trigger mode selection switches.

AUTO PP	When depressed, this pushbutton enables the MTB to run automatically when no trigger pulses are available. In this mode, AUTO peak-peak level is selected for triggering the MTB signal. Consequently, the LEVEL control (R6) only influences the triggering within the level range of the peak-peak level. The trigger bandwidth is 10Hz ... 100MHz. When the DC pushbutton of S20 is depressed, the trigger signal is AC coupled. When the TTL pushbutton of S20 is depressed, the trigger signal is dc-coupled and the level is fixed for TTL signals.
TRIG	With the TRIG pushbutton depressed the MTB will not run without trigger pulses, i.e. the MTB must be normally triggered in this mode. Trigger coupling is that selected with the MTB trigger coupling switches.
SINGLE	When this pushbutton is depressed the MTB will only start once on receipt of a trigger pulse.
TRIG and AUTO PP both depressed	When both TRIG and AUTO are depressed together, the MTB will run automatically when no trigger pulses are received. In this mode there is no AUTO peak-peak level, so the MTB must be normally triggered. This mode allows presetting of LEVEL in TRIG VIEW mode without an input signal. Trigger coupling is that selected with the MTB trigger coupling switches.

With no pushbutton depressed, the SINGLE mode is selected.

LEVEL (R6)

Continuously variable control to determine the level of the trigger point on the trigger signal at which the MTB starts.

SLOPE (S8)

This push-pull switch is combined with the LEVEL control (R6)
When the SLOPE switch is depressed, the MTB is triggered on the positive-going slope, and on the negative-going slope when it is pulled.

NOT TRIG'D (B1)

This led lights up when the MTB is not triggered or waits for a single shot event (in SINGLE mode)

TIME/DIV (S15)

Time coefficient control of the MTB by means of a 22-way rotary switch in a 1-2-5 sequence.
This time coefficient setting multiplied by the DELAY TIME control (R3) setting gives the delay time of the DTB.

CAL (TIME/DIV) (R10, S16)

Continuously variable control of the time coefficient of the MTB.
In the CAL position, the time coefficients of the TIME/DIV switch are calibrated.

UNCAL (B4)

The UNCAL led lights up if the continuous controls of the MTB or DTB are not in CAL position.

HOLD OFF
(R11)

This control determines the HOLD OFF time between the MTB sweeps. During the HOLD OFF time the MTB does not respond to trigger pulses which permits certain trigger pulses to be suppressed.
For normal operation the control must be set fully clockwise to give minimum HOLD OFF time. (See also section 3.4.3.3.).

TV, DC, LF, HF
(S20)

Main time-base trigger coupling switches.

TV In this mode, the LEVEL control (R6) is inoperative.
A fixed trigger level is set. For frame and line synchronisation, a frame or line filter is selected by the MTB TIME/DIV switch (S15):

TV frame triggering is selected in the positions 0.5s ... 50μs/div.
Line triggering is selected in the positions 20μs ... 50ns/div.
Via the selected filter, the trigger signal is fed direct to the MTB.

DC The trigger signal is direct-coupled and has a bandwidth of 0 ... 100MHz.

LF The trigger signal is coupled via a low-pass filter for frequencies from 2Hz up to 25kHz.

HF The trigger signal is coupled via a high-pass filter for frequencies from 25kHz up to 100MHz.

With no pushbuttons depressed, the trigger signal is AC-coupled.

A, B, EXT, COMP, LINE
(S23)

Main time-base trigger source selector of X DEFL source selector.

A The MTB is internally triggered on a signal derived from channel A. When X DEFL (S2) is depressed, the horizontal deflection is derived from channel A.

B The MTB is internally triggered on a signal derived from channel B. When X DEFL (S2) is depressed, the horizontal deflection is derived from channel B.

EXT The MTB is externally triggered on a signal connected to the BNC socket (X5) to the right of the EXT button.

COMP With pushbuttons A and B depressed together, composite triggering of the two signals is possible.
This mode enables a stable display of two signals that have no time relation.
Composite triggering only functions correctly when the vertical display mode ALT (S1) is selected.
When COMP triggering is selected together with TRIG VIEW the MTB trigger signal derived from channel A is displayed.
In composite mode, the position of the trigger points on the input signals depends on the settings of the POSITION controls of channels A and B.
Both signals must completely overlap to obtain a steady display.

LINE Pushbuttons B and EXT depressed together.
The MTB is triggered on a signal derived from the mains voltage.
When X DEFL (S2) is depressed, the horizontal deflection is determined by a signal derived from the mains voltage.

With no pushbuttons depressed, trigger source or X DEFL source A is selected.

1MΩ/25pF (X5)	EXT. trigger input for the MTB. When X DEFL (S2) is depressed, the horizontal deflection is determined by the signal on the BNC socket 1MΩ/25pF. Rated input voltage 42V (dc + ac peak).

The MTB trigger coupling switch TV (S20) can be changed to the following functions:

TTL (optional) (20)	In this mode, the LEVEL control is inoperative. The trigger level is set to a fixed TTL-level. The TTL trigger signal is direct-coupled and the trigger sensitivity is adapted to the TTL signals. In the EXT trigger mode, the EXT trigger input sensitivity is adapted to TTL signals if a 10 : 1 attenuator probe is used.
ECL (optional) (S20)	In this mode, the LEVEL control (R6) is inoperative. The trigger level is set to a fixed ECL level. The ECL trigger signal is direct-coupled and the trigger sensitivity is adapted to ECL signals.

Instructions to modify the TV function to ECL/TTL are described in the service manual.

3.3.5. Delayed time-base

DELAY TIME (R3)	Calibrated ten-turn dial to adjust the delay time after which the DTB starts. This delay time is the product of the dial-setting and the MTB TIME/DIV coefficient.
LEVEL (R4)	Continuously variable control to determine the level of the trigger point on the trigger signal at which the DTB starts.
SLOPE (S6)	This push-pull switch is combined with the LEVEL control (R4). When this switch is depressed, the DTB signal is triggered on the positive-going slope, and on the negative-going slope of the trigger signal when it is pulled.
TIME/DIV (S13)	Time coefficient control of the DTB by means of a 14-way rotary switch in a 1-2-5- sequence. In the OFF position the DTB is switched off.
CAL (TIME/DIV) (R9, S14)	Continuously variable control of the DTB time coefficient. In the CAL position the time coeffcients of the DTB TIME/DIV switch are calibrated.
DC, LF, HF (S19)	The delayed time-base trigger coupling switches. DC — The trigger signal is direct-coupled, with a triggerbandwith of 0 ... 100MHz. LF — The trigger signal is coupled via a low-pass filter for frequencies from 2Hz up to 25kHz. HF — The trigger signal is coupled via a high-pass filter for frequencies from 25kHz up to 100MHz. The DTB trigger signal is AC-coupled with no pushbutton depressed.
A, B, MTB (S22)	The delayed time-base trigger source selector. A — After the selected delay time, the DTB is triggered on the trigger signal derived from channel A. B — After the selected delay time, the DTB is triggered on the trigger signal derived from channel B. MTB — The DTB start immediately after the selected delay time.

3.3.6. Rear-panel sockets

Z MOD (X6)	Input socket for Z modulation of the c.r.t. trace. This input signal must be TTL compatible. The trace is blanked when this input is 'low'.

3.3.6.1. Optional outputs

SWEEP OUT MTB	Output socket of the MTB sawtooth voltage.
GATE OUT MTB	Output socket of a TTL compatible signal, which is 'high' during the MTB sweep and 'low' for other conditions.
GATE OUT DTB	Output socket of a TTL compatible signal, which is 'high' during the DTB sweep and 'low' for other conditions.

3.4. DETAILED OPERATING INFORMATION

Before switching on, ensure that the oscilloscope is installed in accordance with the instructions given in Section 2. Installation Instructions.

3.4.1. Preliminary control settings and connections

As the following settings are identical for both channels A and B, only the procedure for channel A is described.

Proceed as follows:
- Set the INTENS control (R12) and the FOCUS control (R13) to mid-position.
- Switch on the oscilloscope with the POWER ON pushbutton (S21). Check that led B5 lights up.
- Depress pushbutton A of the vertical display mode switches (S1).
- Set the POSITION control (R1) of channel A to mid-position.
- Set the channel A AMPL/DIV switch (S9) to .2V/DIV and its continuous control (R7) to CAL position.
- Depress pushbutton AC of the input signal coupling switches (S17).
- Depress pushbutton MTB of the horizontal display mode switches (S2).
- Depress pushbutton AUTO PP of the MTB trigger mode switches (S3).
- Depress pushbutton A of the MTB trigger source switches (S23).
- Set the MTB TIME/DIV switch (S15) to .2ms/DIV and its continous control (S16) to CAL position.
- Set the X POS control (R5) to mid-position.
- Set the HOLD OFF control (R11) fully clockwise.
- Depress the DC pushbutton of the MTB trigger coupling switches (S20).
- Adjust the INTENS and FOCUS controls for a visibly well-defined trace.
- Controls not mentioned may occupy any position.
- Connect the signal to be measured on input socket A (X2).
- Adapt the settings of the AMPL/DIV and TIME/DIV controls to the amplitude and frequency of the input signal.

3.4.2. Inputs A and B

To increase measuring versatility, the oscilloscope has been designed with two identical signal channels.
Each channel can be inverted by the PULL TO INVERT switch incorporated in the POSITION control.
Each channel can be used for either YT measurements in combination with one or both time-base generators, or for XY measurements in combination with horizontal deflection, controlled by either an internal (channel A or B) or an external source.

3.4.2.1. YT measurements

The vertical deflection can be selected by depressing one of the vertical display mode switches.
The sweep time is determined by the settings of the MTB and DTB TIME/DIV switches.
Simultaneous display of two different signals is achieved by selecting either the ALT or the CHOP pushbutton.

Choice of display mode depends on the frequency of the signals to be displayed.

Displaying h.f. and l.f. signals - select ALT mode

In the ALT mode, the display is switched over from one channel to the other during the flyback period of the trace.
Although the ALT mode can be used at all sweep speeds, at long sweep times (l.f.) display quality may be impaired as the trace alternations becomes visible.

Displaying l.f. signals - select CHOP mode

In the CHOP mode, the display is switched over from one channel to the other at a fixed frequency of $\approx$ 500 kHz.

The CHOP mode gives a better display quality for long sweep times (l.f.).
However, it is unsuitable for h.f. signals as the switching period from channel to channel becomes visible at high frequencies.

The signals of both channels can be inverted by the polarity switches, PULL TO INVERT, incorporated in the POSITION controls. For addition of the channel A and B signals, the pushbutton ADD must be depressed.
When one of the signals is inverted, the display will show, in ADD mode, the difference of both input signals.

The ADD mode also enables differential measurements:

Common mode rejection (see Fig. 3.2.).
When the polarity switches of the two channels are in opposite positions, the common-mode portions (the sine-wave signal) are almost suppressed, and the differential mode portions (the square-wave) are added.

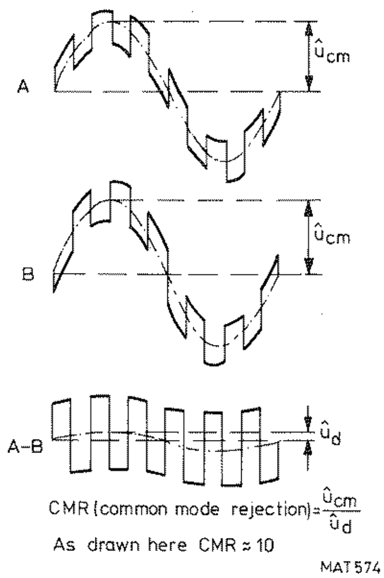

Fig. 3.2. Suppression of common mode signals.

3.4.2.2. XY measurements

The horizontal deflection can be selected by the horizontal display mode switches.
When the pushbuttons DTB, ALT TB or MTB are depressed, the horizontal deflection is determined by the delayed time-base, both time-bases or the main time-base respectively.

With pushbutton X DEFL depressed, the time-base generators are switched off. Horizontal deflection is then controlled by the signal selected by the X DEFL source switches A, B, EXT or LINE:

A — signal from channel A used for X deflection. In this mode, the AC/0/DC function, AMPL/DIV, X POS, X MAGN are operative.

B — signal from channel B used for X deflection. (Functions as for channel A are operative).

EXT — signal from BNC socket at right-hand side of EXT pushbutton used for X deflection.

B + EXT — signal derived from the mains voltage (LINE) used for X deflection.

The selected X DEFL signal can be DC, LF or HF coupled, using the MTB trigger coupling switches, which now function as X DEFL coupling switches.

3.4.2.3. Input coupling switches AC/0/DC

In the DC position of the coupling switch the full bandwidth of the instrument is available, and d.c. components are displayed as trace shifts.

This may be inconvenient if small a.c. components of interest are superimposed on high d.c. voltages. Any attenuation of the signal will result in an attenuation of the small a.c. components. The solution is to use the AC position of the coupling switch. In this position the d.c. component of the signal is inhibited by a blocking capacitor. Note that this capacitor also suppresses low frequencies, which means that some pulse droop will occur when low frequency square-wave signals are displayed.

In the 0 position of the coupling switch, the input signal is interrupted and the amplifier input is earthed, enabling the 0 V reference of a trace to be readily determined.

3.4.3. Triggering

To obtain a stable display of an input signal, the time-base must always be started on one fixed point of the signal waveform.
Therefore, the time-base generator is started by narrow trigger pulses, formed in the trigger unit and controlled by a signal derived from the vertical input channels, from the mains, or from an external source.

3.4.3.1. Trigger coupling

The MTB trigger coupling can be selected by the trigger coupling switches TV, DC, LF and HF.
In the AUTO PP mode, the MTB trigger signal is a.c.-coupled, except when X DEFL is selected.
In TV mode the MTB trigger signal is d.c.-coupled.
In the TRIG mode and AUTO mode the trigger coupling is determined by the selection of the trigger coupling switches TV, DC, LF and HF (S20).
The HF position inserts a high-pass filter for frequencies of 25kHz and higher, this pushbutton selection being used to reduce l.f.-interference e.g. hum.
The LF pushbutton inserts a band-pass filter for frequencies from 2Hz to 25kHz, reducing h.f.-interference (e.g. noise) and d.c.
When the DC pushbutton is selected, the trigger signal is direct-coupled and triggering can be obtained from signals from 0Hz and higher.
When TV is selected, the MTB LEVEL control is inoperative; the trigger level is fixed. The trigger signal is d.c.-coupled and the sensitivity is adapted to TV signals.

MTB TRIGGER MODE (S3)	MTB TRIGGER COUPLING SWITCH SELECTION (S20)			
	TV	DC	LF	HF
AUTO PP	DC	AC	LF	HF
AUTO	DC	DC	LF	HF
	LEVEL control inoperative	Trigger bandwidth DC: 0 ... 100MHz AC: 2Hz ... 100MHz LF: 2Hz ... 25kHz HF: 25kHz ... 100MHz		

3.4.3.2. Trigger source selector, level control and auto peak-peak level.

The main time-base trigger source can be selected with the MTB trigger source selector pushbuttons, A, B, EXT, COMP and LINE.

When A is selected, the MTB trigger signal is derived from channel A (and B selected, from channel B). Composite triggering (A + B depressed) is selected for displaying two signals that are not time-related.
In this mode, the MTB is triggered on the signal in turn to be displayed.
Composite triggering (COMP) only functions well in the ALT mode, as the triggering switches over from one trigger source to the other at the end of every time-base sweep.
For COMP triggering, use the POSITION controls of channels A and B to set the signals being displayed so that they completely overlap each other. Overlapping is necessary as they must occupy the same trigger range for a stable, well-triggered display.

The POSITION controls influence the triggering in the COMP mode, since the COMP trigger signals are picked-off after the vertical POSITION controls and the NORMAL/INVERT circuits.
When COMP triggering is selected together with TRIG VIEW, the MTB trigger signal derived from channel A is displayed.

LINE triggering is selected when the B and EXT pushbuttons are selected simultaneously. In this mode, the trigger signal is derived from the mains voltage; i.e. related to the mains frequency.
When the EXT pushbutton is depressed, the MTB is triggered on an external signal applied to the BNC socket to the right of the EXT pushbutton.

In the AUTO PP mode, the level range is determined by the input signal amplitude. This level is related to the signal peak-peak level, so triggering will always occur within this peak-peak level range.
The trigger point can only be shifted within this range by the LEVEL control.

In the TRIG mode, there is no AUTO peak-peak level; therefore, the LEVEL control must be adjusted to obtain a well-triggered display.

When the AUTO PP and TRIG pushbuttons are depressed together, there is only auto free-run of the main time-base but no AUTO peak-peak level.

The circuit functions as follows:
The trigger signal is fed to the input of a differential amplifier. The voltage on the other input of this amplifier is determined by the position of the LEVEL control. If the trigger signal has reached the voltage level of the LEVEL potentiometer, a trigger pulse is generated and the time-base starts. (See also Fig. 3.3.).

In this way, the time-base is started at a fixed point of the trigger signal, which means that using the LEVEL control, it is possible to scan the shape of the waveform.

The LEVEL potentiometer also incorporates a push-pull switch +/– SLOPE, which permits selection of the trigger slope. If the switch is depressed, the time-base starts on the positive-going slope (see Fig. 3.3.). If the switch is pulled, the time-base starts on the negative-going slope of the trigger signal.

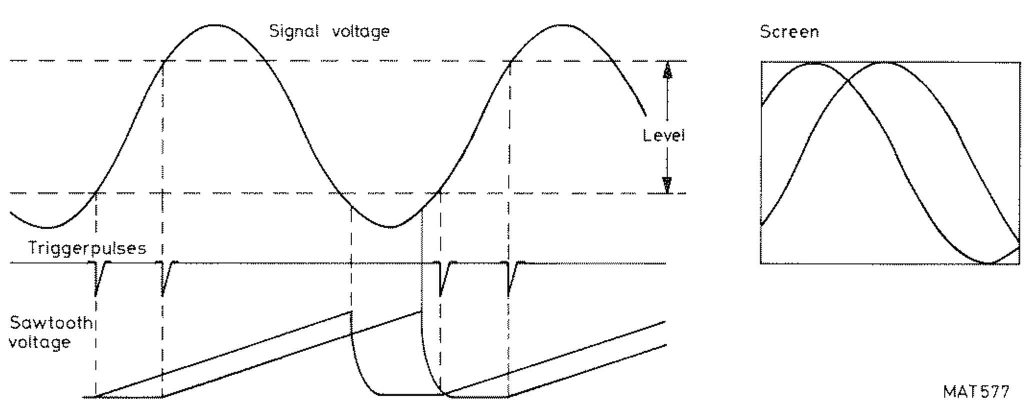

Fig. 3.3. Scanning the waveform by means of the LEVEL potentiometer

3.4.3.3. AUTO triggering and HOLD OFF

In the AUTO PP mode, the MTB starts automatically when no trigger pulses are available, by trigger pulses generated in the AUTO circuit.
Even with no signal applied to the input of the oscilloscope, a trace will be visible on the screen in the AUTO PP mode. As soon as trigger pulses are available, the free-running state of the MTB is terminated and it is triggered within the AUTO peak-peak level.
This peak-peak level is determined by the amplitude of the input signal, as described in Section 3.4.3.2.

When the AUTO PP and TRIG pushbuttons are depressed together, the time-base is triggered as in the AUTO PP mode, but without AUTO peak-peak level, as previously stated. In this mode, the trigger signal coupling is determined by the MTB trigger coupling switches.

The oscilloscope also features a variable HOLD OFF control. This performs a useful function in digital and computer applications, where complex pulse patterns need to be measured.

When a complex pulse pattern is displayed (see Fig. 3.4.) and this pattern is also used for triggering, a double or even a multiple-picture display may occur. The more complex the pattern, the greater the possibility of multiple displays.
These effects can be corrected by adjusting the HOLD OFF control to increase the hold-off time (see Fig. 3.4.)

Normally, the HOLD OFF control should be fully clockwise to maintain trace brightness at the faster sweep rates.

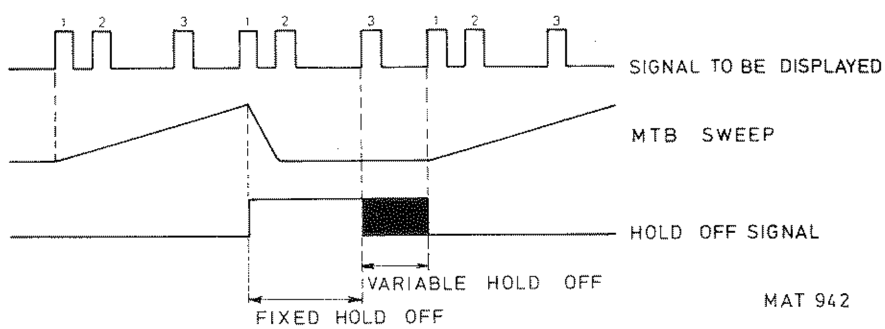

Fig. 3.4. Trigger pulse suppression with the variable HOLD OFF control

3.4.3.4. SINGLE shot triggering

When events that occur only once need to be observed, it is often desirable to ensure that only one sawtooth is generated, even though further trigger pulses occur after the phenomena of interest. To this end, the SINGLE pushbutton of the MTB trigger mode selector must be selected.

The first trigger pulse to occur, after the SINGLE pushbutton has been depressed, starts the MTB. After this, the MTB does not respond to trigger pulses until the SINGLE pushbutton is again depressed.
Adjust the LEVEL control so that the NOT TRIG'D indicator extinguishes.
The NOT TRIG'D indicator lights up when the SINGLE pushbutton is depressed and extinguishes at the end of the MTB sweep; i.e. after triggering.

3.4.4. X Magnifier

When the push-pull switch X MAGN, combined with the X POS control, is pulled, the sweep speed on the screen increases to ten times the TIME/DIV setting of the time-base.
In this position, the portion of the signal, displayed over a width of one division in the centre of the screen in the x1 position (X MAGN depressed), will occupy the full width of the screen.
Using the X POS control, any portion of the trace can be brought on to the screen for inspection.
In the x10 position, the time coefficient is determined by dividing the TIME/DIV setting by a factor of 10.

The X MAGN is also operative in all the X DEFL modes.

3.4.5. The delayed time-base (DTB)

The delayed time-base can be used for the accurate study of complex signals.
When the MTB pushbutton of the horizontal display mode switches is depressed, and the DTB TIME/DIV switch is not in the OFF position, the DTB is on.
A part of the MTB trace is now intensified if the DTB is triggered, this part indicating the time during which the DTB is on.

The ten-turn DELAY TIME control enables the intensified part to be shifted along the horizontal time axis; i.e. varying the delay before the DTB starts.

The delay time can be calculated by multiplying the setting of the ten-turn control by the setting of the MTB TIME/DIV control.
The length of the intensified part can be controlled by the DTB TIME/DIV control.

When the DTB pushbutton of the horizontal display mode switches is depressed, the intensified part occupies the full width of the screen.

In the ALT TB mode, the MTB (with intensified part) and the DTB traces are alternately displayed. This enables the user to compare the signal detail with the overall signal without having to switch between the MTB and DTB modes. In the ALT TB mode, the input of the horizontal final amplifier is switched over from one time-base to the other at the end of every sweep.

Vertical shift between these two time-base traces is controlled by the front-panel TRACE SEP control (trace of MTB upwards and DTB downwards).

The DTB trigger source switches enable selection of A, B and MTB.
When A is selected, the DTB will start after the delay time selected, on receipt of a trigger pulse from channel A.

When B is selected, the DTB will start after the delay time, on receipt of a trigger pulse from channel B.

When MTB is selected, the DTB will start immediately after the delay time.

The input signals A and B can also be displayed in ALT TB mode. To obtain a stable display, channels A and B must be triggered in COMP mode.

In these modes the displayed signals are:
- the MTB channel A signal with intensified part,
- The intensified part of channel A displayed over full width of the screen (DTB).
- the MTB channel B signal with intensified part,
- the intensified part of channel B displayed over the full width of the screen (DTB).

In the COMP mode, these four traces must fully overlap (see Section 3.4.3.2.) for a well-triggered display.

The UNCAL indicator (B4) lights up when at least one TIME/DIV switch (DTB or MTB) is not in the CAL position.

3.4.6. The trigger view channel

With the TRIG VIEW pushbutton depressed, the MTB trigger signal is displayed.
This mode enables the user to observe the level of the trigger signal at which the MTB is started.
This trigger level can be adjusted by the LEVEL/SLOPE control.

With EXT triggering of the MTB, the signal applied to the EXT socket is displayed via the trigger view channel.

The internal trigger sources can also be displayed via the trigger view channel.
Other TRIG VIEW display facilities include:

- TRIG VIEW together with channel A and B in ALT mode, by depressing ALT + TRIG VIEW simultaneously.
- TRIG VIEW together with channel A and B in CHOP mode, by depressing CHOP + TRIG VIEW, simultaneously.

Note that when channel A and B are composite triggered (COMP) and selected together with TRIG VIEW, only the MTB trigger signal derived from channel A is displayed.

The TRIG VIEW channel can also be used to predetermine the trigger level without the aid of an input signal, when SINGLE shot mode is selected.
An important requirement when the signal to be measured is a single event, not accessible in advance.

For the display of input signals that exceed a known trigger level, this level can be set in advance. Time-base sweeps will then be initiated when this preset level is exceeded.

The procedure is as follows:

- Depress the TRIG VIEW pushbutton.
- Using the LEVEL control, adjust the trace of the TRIG VIEW channel, (in relation to the central horizontal graticule line) to the desired trigger level.
  Input signals in excess of this selected level will be displayed.

4. BRIEF CHECKING PROCEDURE

4.1. GENERAL INFORMATION

This check is intended to check the oscilloscope performance with a minimum of test steps and actions required.
It is assumed that the operator doing this test is familiar with oscilloscopes and its characteristics.

WARNING: **Before switching on, ensure that the oscilloscope has been installed in accordance with the instructions mentioned in chapter 2.**

If this test is started a few minutes after switching on, bear in mind that test steps may be out of specification, due to insufficient warming up time.
To be sure that this will not happen, allow the full indicated warming up time.

4.2. PRELIMINARY SETTINGS AND CONNECTIONS

As the following settings and checks are identical for channels A and B, only the procedure for channel A is described.

- Set the INTENS control (R12) and the FOCUS control (R13) to mid-position.
- Switch-on the oscilloscope with the POWER ON pushbutton (S21). Check that the POWER ON indicator lights up.
- Depress pushbutton A of the vertical display mode switches (S1).
- Set the POSITION control R1 of channel A to mid-position.
- Set the channel A AMPL/DIV switch (S9) to 20 mV/DIV and its continuous control (R7) in the CAL position.
- Depress pushbutton AC of the input signal coupling switches (S17).
- Depress pushbutton MTB of the horizontal display mode switches (S2).
- Depress pushbutton AUTO PP of the MTB trigger mode switches (S3).
- Push the MTB and DTB SLOPE switches S6 and S8, incorporated in the LEVEL controls, for positive triggering.
- Depress pushbutton A of the MTB trigger source switches (S23).
- Set the MTB TIME/DIV switch (S15) to .2 ms/DIV and its continuous control (S16) in the CAL position.
- Set the X POS control (R5) to mid-position.
- Set the HOLD OFF control (R11) fully clockwise.
- Depress pushbutton DC of the MTB trigger coupling switches (S20).
- Adjust the INTENS and FOCUS controls for a visibly well-defined trace.

Unless otherwise stated, the controls occupy the same position as in the previous procedure.

4.2.1. Trace rotation

- Set the trace in the centre of the screen using the POSITION control (R1).
- Check that the trace lies parallel with the horizontal graticule lines; if necessary re-adjust the TRACE ROTATION (R14) preset.

4.2.2. Use of probes

The 10:1 passive probes must be properly compensated before use to avoid pulse distortion or amplitude errors at high frequencies.
For correct adjustment, connect the probe to the CAL socket and set the adjustment point in the probe compensation box for optimum square-wave response (see Section 1.4.).

4.2.3. Vertical channels

- Connect the CAL output (X1) to the channel A input socket (X2) via a 10:1 passive probe.
- If necessary, compensate the probe to obtain a well-defined square-wave signal (see Section 4.2.2.).
- Check that the amplitude of the square-wave is 6 divisions on the screen.
- Pull the POSITION control (R1) to check that the PULL TO INVERT switch S4 inverts the signal.
- Push the POSITION control to return switch S4 to its normal position.
- Depress pushbutton DC of the input coupling switches (S17).
- Check that the signal shifts upwards because of the d.c. component now displayed.
- Depress the AC pushbutton of S17.

4.2.3.1. Vertical display mode switches

- Set the controls of channel B in the same position as described for channel A in Section 4.2.
- Depress the ALT pushbutton.
- Set the MTB TIME/DIV switch to 50 ms/DIV.
- Check that channel A and B are alternately displayed.
- Depress the CHOP pushbutton.
- Check if channel A and B are simultaneously displayed.
- Set the MTB TIME/DIV switch to .2 ms/DIV.
- Apply the CAL output signal to the inputs of channels A and B via 10:1 probes.
- Set the AMPL/DIV controls of channel A and B to 50 mV/DIV.
- Set the signals from channels A and B in the vertical centre of the screen so that they completely overlap each other.
- Depress the ADD pushbutton.
- Check that the trace height is 4.8 divisions (A and B channels added).
- Check that the POSITION controls of channels A and B also influence the position of the added signal.
- Remove the input signal from channel B.
- Depress the TRIG VIEW pushbutton.
- Check that the signal on which the MTB is triggered is displayed.
- Operate the LF and HF pushbuttons of the MTB trigger coupling switches and check that the influence of the coupling filters is visible on the trace.
- Check that the trigger view signal is shifted vertically by the MTB LEVEL control.

4.2.4. Time-bases and triggering

- Set the controls as indicated in Section 4.2.
- Depress the DC pushbutton of the DTB trigger coupling switches.
- Depress the MTB pushbutton of the DTB trigger source switches.
- Connect the CAL signal to the input of channel A.
- Pull the SLOPE switch of the MTB and check that the MTB is triggered on the negative-going slope of the input signal.
- Depress the SLOPE switch of the MTB to return to positive triggering.
- Set the MTB TIME/DIV switch to .5 ms /div.
- Pull the X MAGN switch combined with the X POS control and check that the horizontal deflection is magnified by a factor of 10.
- Depress the X MAGN switch to its normal position.
- Set the MTB TIME/DIV switch to .2 ms/div.
- Set the channel A AMPL/DIV switch to 50 mV/DIV.
- Set the DTB TIME/DIV switch to 50 µs/DIV and its continuous control to the CAL position.
- Set the DELAY TIME control to 0.
- Check that the intensified part starts at the beginning of the MTB trace.
- Check that the intensified part can be shifted over the MTB trace using the DELAY TIME control
- Set the DELAY TIME control to 5.0 and check that the intensified part starts in the centre of the screen.
- Depress pushbutton A of the DTB trigger source switches.
- Check that the DTB (intensified part) is triggered on the signal derived from channel A; i.e. the DTB LEVEL control should be adjusted for a well-triggered intensified part.
- Pull the DTB SLOPE switch; the DTB should be triggered on the negative-going slope of the channel A signal.
- Depress the SLOPE switch of the DTB to return to positive triggering.
- Depress the MTB pushbutton of the DTB trigger source switches.
- Depress the DTB pushbutton of the horizontal display mode switches.
- Check that the intensified part now occupies the entire screen width.
- Depress the ALT TB pushbutton and check that both the MTB signal + intensified part and the full-width DTB signal are displayed.
- Adjust the vertical shift between the displays with the TRACE SEP control.
- Depress pushbutton X DEFL. Check that horizontal deflection is determined by the channel A signal, and is 2,4 divisions.
- Depress the MTB pushbutton again.
- Depress the SINGLE pushbutton.
- Set the MTB LEVEL control so that the NOT TRIG'D indicator is off.
- Depress the SINGLE pushbutton and check that the input signal is displayed once only.
- Depress the AUTO PP pushbutton.
- Turn the HOLD OFF control anti-clockwise and check that the intensity of the displayed signal decreases (maximum hold-off time).
- Turn the HOLD OFF control clockwise for normal display.

5. PREVENTIVE MAINTENANCE

5.1. GENERAL INFORMATION

This instrument generally requires no maintenance, as it contains no components that are subject to wear. However, to ensure reliable and troublefree operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.

5.2. CLEANING THE NEXTEL SUEDE COATING

Warning: **The Nextel suede coating is ethanol-resistant, but is susceptible to methylated spirit, which will attack the surface (due to one of its denaturing substances).**

The bright appearance of the cabinet, lacquered with Nextel suede coating, will deteriorate after some time as the surface becomes soiled. Cleaning with a cloth soaked in water, ethanol or a common household cleansing agent does not always restore this lustre or remove all dirt from the holes and pores.
The 3M Company have developed a cleansing pad (White Cleansing Pad, Catalogue No. 8440) which when soaked in water, ethanol or a common household cleansing agent will also penetrate holes and pores.

This method is similar to the action of abrasive cleaning pads but is not abrasive. Abrasive cleaning pads should not be used, otherwise surface scratches will result.

5.3. REMOVING THE BEZEL AND CONTRAST PLATE (TO CLEAN THE CONTRAST FILTER)

- Grip the lower corners of the bezel and gently ease it away from the front panel (Fig. 5.1.).
- Press the contrast filter gently to remove it from the bezel.
- When cleaning the filter, ensure that a soft cloth is used, free from dust and abrasive particles, to prevent scratches.

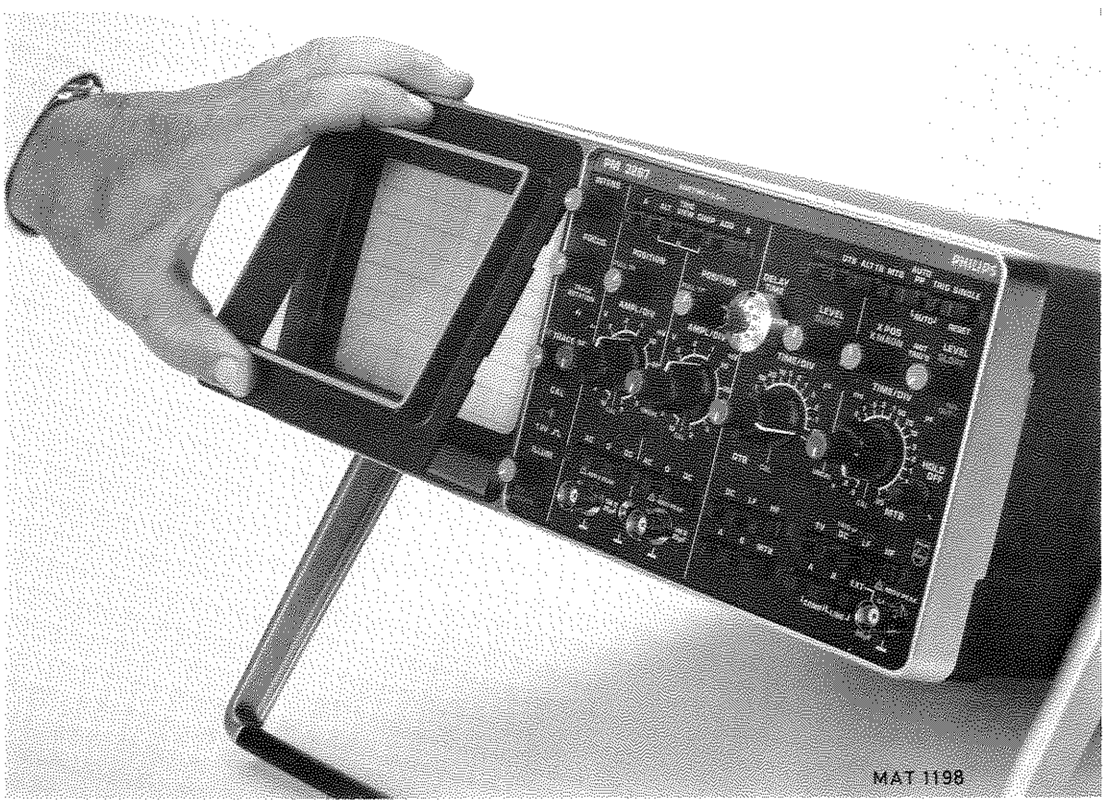

Fig. 5.1. Removing the bezel and contrast plate

5.4. RECALIBRATION

From experience it is expected that the oscilloscope operates within its specification for a period of at least 1000 hours or for six months if used infrequently.
In addition, replacement of components may necessitate recalibration of the affected circuits. The brief checking procedure can also be helpful in localising certain troubles in the instrument.
In some cases, minor troubles may be revealed and/or corrected by recalibration. Complete checking & adjusting instructions are given in the Checking & Adjusting Section of the Service Manual.