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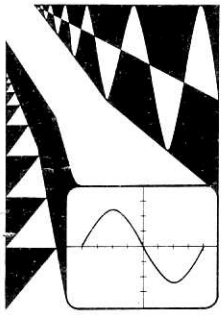

Portable dual-trace multiplier oscilloscope

PM 3265

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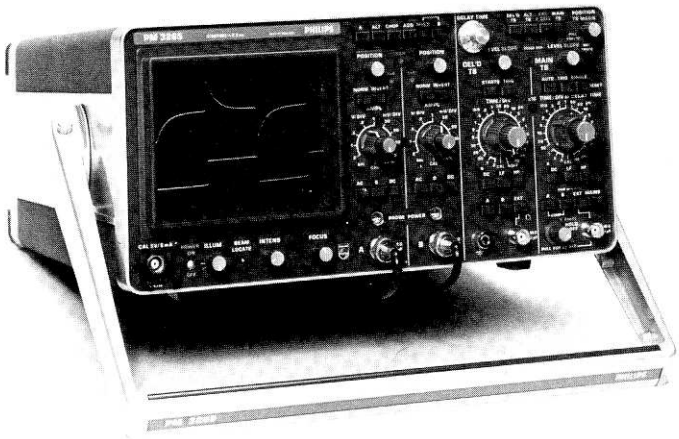

Instruction manual

Portable dual-trace multiplier oscilloscope

PM 3265

PHILIPS

PRINTED IN THE NETHERLANDS

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Contents

Operating manual

1. General information

1.1. INTRODUCTION

The PM 3265 Portable multiplier oscilloscope enables the measurement of signals at a high sensitivity (5 mV/DIV) over a large bandwidth (150 MHz). The oscilloscope is provided with many thin-film circuits which guarantee a very stable operation and reduce the number of adjusting points.

There is a wide choice of display possibilities, such as one channel, two channels alternately or chopped, two channels added or multiplied, with normal and inverted positions for both input signals, and a main and delayed time-base.

The PM 3265 oscilloscope features a tapless power supply with low dissipation. This power supply works on any a.c. voltage between 90 V and 264 V and d.c. voltages between 125 and 264 V, thus obviating the need of adjusting the instrument to the local mains voltage.

All these features make the oscilloscope suitable for a wide variety of applications.

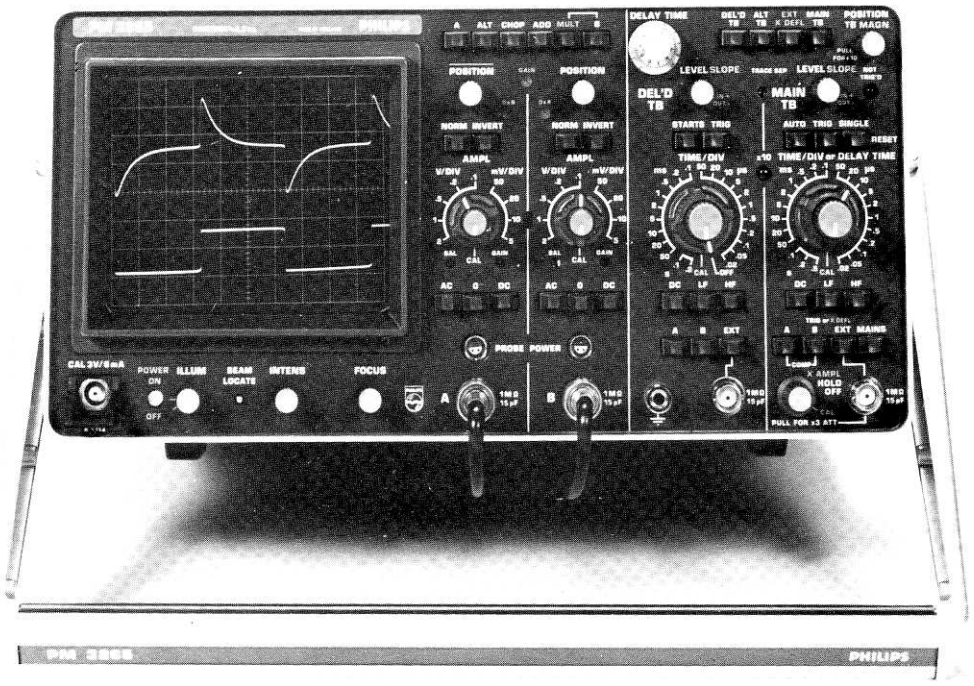

Fig. 1.1. Portable multiplier oscilloscope PM 3265

1.2. CHARACTERISTICS

This instrument has been designed and tested according to IEC Publication 348 for Class I instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings which 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 30 minutes. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

Designation		Specification	Additional information
1.2.1.	C.R.T.		
	Type	PHILIPS D14-240	Rectangular tube face, domed mesh type, post-accelerator, metal-backed phosphor
	Measuring area	80 mm x 100 mm	
	Screen type	P31 (GH) phosphor	P7 (GM) phosphor optional
	Photographic writing speed	$>$ 1500 cm/μs	Measured with Steinheil Oscillophot M5 camera. Aperture: 1:1,2 Object to image ratio: 1:0,5 Film: Polaroid 410 (10000 ASA) No pre-fogging Phosphor type P31 (GH)
	Total acceleration voltage	19 kV	
	Graticule	Internal	Continuously variable illumination
	Engravings	Centimetre divisions with sub-divisions of 2 mm along the central axis. Dotted lines indicate 10 % and 90 % of measuring lattice for measurement of rise time	
1.2.2.	VERTICAL OR Y AXIS		
1.2.2.1.	*Response*		
	Frequency range	d.c. ... 150 MHz 10 Hz ... 150 MHz	−3 dB bandwidth d.c. coupled −3 dB bandwidth a.c. coupled
	Rise time	$\approx$ 2,3 ns	
	Pulse aberrations	±3 %	
1.2.2.2.	*Deflection coefficients*	5 mV/DIV ... 2 V/DIV	Nine calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : $\geqslant$ 2,5
1.2.2.3.	*Error limit*	±3 %	
1.2.2.4.	*Max. permissible input voltage*	±400 V 800 $V_{p\text{-}p}$ a.c.	d.c. + a.c. peak. Up to 20 mV position of input attenuator derating at frequencies over 500 kHz. See Fig. 1.2

Designation	Specification	Additional information
1.2.2.5. Instability of the spot position		
Trace jump	< 0,3 Div	When switching between any of the attenuator positions.
Trace jump	< 0,3 Div	When switching the NORM/INVERT switch
Trace shift	< 0,3 Div	When rotating the continuous attenuatc
Trace shift	< 1 Div	When switching to the ADDED position
Temperature drift	< 20 µV/°C	Typical value
1.2.2.6. Maximum deflection	24 divisions	
Shift range	16 divisions	8 divisions each in topward and downward direction reckoned from the central horizontal graticule line
1.2.2.7. Input impedance	1 MOhm//15 pF	
1.2.2.8. Input RC time	⩾ 17 ms	Coupling switch to AC
1.2.2.9. Visible signal delay	Approximately 16 ns	
1.2.2.10. Display modes	Channel ± A only Channel ± B only Channels ±A and ±B chopped Channels ±A and ±B alternate Channels ±A and ±B added Channels ±A and ±B multiplied Channels ±A and ±B multiplied with channel B chopped or alternate	
1.2.2.11. Chopper frequency	≈ 1 MHz	
1.2.2.12. Cross-talk between channels	1 : 500	2 divisions of signal amplitude at 50 MHz on one channel set to 2 V/ DIV. Cross-talk is measured on other channe set to 20 mV/DIV
1.2.2.13. Common-mode rejection factor	100 at 100 kHz 100 at 2 MHz 20 at 50 MHz	Measured with +A and −B added; max. common mode signal 8 divisions
1.2.2.14. Y out	50 mV/Div into 50 Ω ±2 % 100 mV/Div into ⩾ 10 kΩ ±2 %	BNC at rear panel
Frequency range	DC ... 150 MHz	Dynamic range 8 Div
Pulse aberations	5 %	
Output level	zero	Adjustable at rear panel
Output drift	⩽ 1,5 mV/°C into 50 Ω ⩽ 3 mV/°C into ⩾ 10 kΩ	
1.2.2.15. Multiplier display modes	Product (signal ±A x Signal ±B) only Product (signal ±A x signal ±B) and signal ±B chopped or alternate For XY modes; refer to chapter 1.2.6.	Chopped ⩽ 5 mS MTB setting Alternate > 5 mS MTB setting
1.2.2.16. Multiplier bandwidth	100 MHz (−3 dB)	Measured with a sine wave to one channel and a DC signal to the other

Designation	Specification	Additional information
1.2.2.17. Multiplier rise time	≈ 3,5 ns	
1.2.2.18. Scale factor	1 ±2 %	The product of a signal giving A div. display via input Ya and a signal giving B div. display via input Yb, will produce A x B div.display within 2 %. (Adjustable at front panel) Temperature coefficient 0,1 %/°C
1.2.2.19. Non-linearity	Max. 4 % of full screen deflection (±0,16 Div)	Non-linearity is the peak deviation of (A x B) = f(B) from an ideal straight line measured at 1000 Hz.
1.2.2.20. Multiplier dynamic range	Signal A max. 8 Div p-p (±4 Div from screen centre) Signal B max. 8 Div p-p (±4 Div from screen centre) Product A x B max. 8 Div p-p (±4 Div from screen centre)	
1.2.2.21. Feed through	⩽ 0,3 div. up to 25 MHz 0 x A ⩽ 0,5 div. up to 100 MHz 0 x B ⩽ 1 div. up to 100 MHz	Spurious product of one signal zero, other signal a sine wave of 8 div./signal referenced to the 50 kHz voltage of a constant voltage generator.
1.2.2.22. Product offset	⩽ 0,3 Div.	Shift of the base line when switching from the Alt or Chop mode to the mult mode or mult and Channel B mode.
1.2.2.23. Product offset drift	⩽ 0,03 Div/°C	
1.2.2.24. Propagation delay	≈ 6 ns	Delay between the product and one of its factors.
1.2.2.25. Noise at full bandwidth	⩽ 0,3 Div.	Measured tangentially Reduced noise at limited bandwidth (internal setting)
1.2.2.26. Y Out in Multiplier AxB mode		
Bandwidth	0-100 MHz	(−3 dB)
Scale factor	50 mV ±2 % into 50 Ω for each div. of the display product 100 mV ±2 % into ⩾ 10 kΩ for each div. of the displayed product	
Output level	zero	Adjustable at rear panel
Output drift	⩽ 1,5 mV/°C into 50 Ω ⩽ 3 mV/°C into ⩽ 10 kΩ	
1.2.3. HORIZONTAL OR X AXIS		
1.2.3.1. Display modes	– Main time base – Main time base intensified by delayed time base – Delayed time base – Main time base and Delayed time base alternated – XY Operation	X deflection by: – Channel A signal – Channel B signal – Composite A and B signal – Signal applied to EXT connector of main time base – Mains frequency

Designation	Specification	Additional information
1.2.4. MAIN TIME BASE		
1.2.4.1. Operation	Triggered Automatic Single shot	Possibility of automatic free-running in the absence of triggering signals
1.2.4.2. Time coefficients	0,5 s/Div ... 20 ns/Div	Twenty-three calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : ⩾ 2.5 between the steps
1.2.4.3. Coefficient error	±2 % ±3 %	+20 °C ... +30 °C +5 °C ... +40 °C Sweep accuracy over any two divisions of 10 div sweep is ±5 %. Exclude the first and last div at the 2 ns, 5 ns and 10 ns magnified sweep rates.
1.2.4.4. Expansion		
Magnification	10x	Switched, calibrated
Additional error	±1 %	First and last 50 ns of 2 ns, 5 ns, 10 ns and 20 ns magnified sweep rates excluded.
Fastest sweep rate	2 ns/Div	
1.2.4.5. Variable hold-off time	The sweep hold-off time can be increased by approximately a factor of 10	Not operable at .02, .05, .1 and . 2 µs/Div.
1.2.5. DELAYED TIME BASE		
1.2.5.1. Operation	Delayed time base starts either immediately after the delay time, or upon arrival of the first trigger pulse after the delay time	
1.2.5.2. Time coefficient	0,2 s/div ... 20 ns/div	Twenty-two calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : ⩾ 2,5 between the steps.
1.2.5.3. Coefficient error	±2 % ±3 %	+20 °C ... +30 °C +5 °C ... +40 °C Sweep accuracy over any two divisions of 10 div sweep is ±5 %. Exclude the first and last div at the 2 ns, 5 ns and 10 ns magnified sweep rates.
1.2.5.4. Delay time	Continuously variable between 0x and 10x the time coefficient of the main time base	Calibrated. Range delay-time multiplier 0,00 - 9,99. Incremental accuracy 0,5 %; typical 0,2 %.
1.2.5.5. Delay-time jitter	⩽ 1 : 20 000	Typical value 1 : 50 000
1.2.5.6. Alternate Time Base	Main time base and Delayed time base alternated. Max. vertical separation ⩾ 4 div.	Continuously adjustable on front panel
1.2.6. X DEFLECTION		
X Deflection via channel Y_A		
1.2.6.1. Deflection coefficient	5 mV/div. ... 2 V/div	Uncalibrated continuous control 3:1 via X AMPL potentiometer

Designation	Specification	Additional information
1.2.6.2. Coefficient error	±5 %	
1.2.6.3. Bandwidth	DC ... 3 MHz	−3 dB bandwidth over 8 div.
1.2.6.4. Input impedance	1 MOhm//15 pF	
1.2.6.5. Phase difference	$\leqslant 3^{o}$ at 2 MHz	

X Deflection coefficient via channel Y_B or composite

Same as for X deflection via Y_A channel, but with a possible coefficient error of ±20 %.

External X deflection via EXT input

1.2.6.6. Deflection coefficient	300 mV/DIV approx. 900 mV/DIV at 3x Attenuated	In calibrated position In calibrated position
1.2.6.7. Bandwidth	DC ... 3 MHz	−3 dB bandwidth over 8 div continuous control $\geqslant$ 3:1
1.2.6.8. Input characteristics	Identical to Y channels	
1.2.6.9. Phase difference	$\leqslant 3^{o}$ at 100 kHz	

X Deflection with internal voltage at mains frequency

The deflection depends on the mains voltage and has been factory-adjusted to 8 div at a mains voltage of 220 V.

1.2.7. TRIGGERING OF THE MAIN TIME BASE

1.2.7.1. Source	Internal from channel A Internal from channel B Internal composite signal from both channel A and channel B Internal from mains External source	
1.2.7.2. Mode	Automatic	Automatic free-run of the time-base generator approx. 50 ms after disappearance of the trigger signal.
	Manual level Single sweep	
1.2.7.3. Slope	+ or −	
1.2.7.4. Sensitivity	Internal 0,5 DIV up to 100 MHz 1 DIV up to 150 MHz External 150 mV	
1.2.7.5. Filter bandwidth	DC: 0 - 150 MHz LF internal: 0 - 30 kHz approx. −3 dB LF external: 10 Hz - 30 kHz approx. −3 dB HF: 30 kHz - 150 MHz approx.	Both internal and external −3 dB, both internal and external
1.2.7.6. Level range	24 DIV −3,6 V to +3,6 V −11 V to +11 V	at internal trigg. at external trigg. at external trigg., 3xAttenuated
1.2.7.7. Input characteristics	Identical to Y channels	

Designation	Specification	Additional information
1.2.8. TRIGGERING OF THE DELAYED TIME BASE		
1.2.8.1. Source	Internal from channel A Internal from channel B External	
Other characteristics are identical to TRIGGERING OF THE MAIN TIME BASE.		
1.2.8.2. Mode	Starts	Triggered by main sweep immediately after delay
	Trig	Triggerable after Delay Interval
1.2.9. CALIBRATION UNIT		
1.2.9.1. Output voltage	3 V_{p-p}	
1.2.9.2. Output current	6 mA	
1.2.9.3. Error limit	±1 %	Both voltage and current
1.2.9.4. Frequency	2 kHz < 2 %	
1.2.9.5. Protection	The output is protected against continuous short-circuits	
1.2.10. ADDITIONAL INPUT AND OUTPUTS		
1.2.10.1. Z Input		
Connector	BNC	At rear panel
Input impedance	1 MΩ/15 p	
Max. permissible input voltage	as Y inputs	
Freq. range	DC ... 10 MHz	
Input voltages	0 V total unblanked −10 V total blanked	For PM 3265 S/N D01 601-D01 800
	+5 V total unblanked 0 V partly blanked −5 V total blanked	For PM 3265 from S/N D02-801 onwards
1.2.10.2. Main Time Base		
Connector	BNC	At rear panel
Output voltage	0 ... +5 V_{p-p}	
Output impedance	5 kΩ	
Protection	The output is protected against continuous short-circuits	
1.2.10.3. Delayed Gate		
Connector	BNC	At rear panel
Output voltage	0 ... +6 V_{p-p}	0 V during delayed sweep
Output impedance	3 kΩ	
Protection	The output is protected against continuous short-circuits	

Designation	Specification	Additional information
1.2.11. POWER SUPPLY		
1.2.11.1 Mains voltages	AC: between 100 and 240V, ±10 % DC: between 130 and 350V, ±10 %	Between +5 and 40 °C. 90 VAC at limited mains voltage distortion; peak value/r.m.s. value = $\sqrt{2} \pm 2$ %, B ≤ 0,05 (IEC 359).
1.2.11.2 Mains frequency	46 to 440 Hz	
1.2.11.3 Probe power	+ and − 24V	Max. 100 mA between +5 and + 40 °C
1.2.11.4 Power consumption	55W	Probe power included.

1.2.12. ENVIRONMENTAL CHARACTERISTICS

The environmental data 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 Instruments Dept.
EINDHOVEN - HOLLAND

1.2.12.1. Ambient temperature	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Rated range of use Limit range of operation Storage and transport conditions } according to IEC68 Ab and Bb
1.2.12.2. Altitude	5 000 m 15 000 m	Operating Not operating
1.2.12.3. Humidity	Type Test according to IEC 68 Db	*
1.2.12.4. Shock	Type Test according to IEC 68 Eb	*
1.2.12.5. Vibration	Type Test according to IEC 68 Fc	*
1.2.12.6. Recovery time	15 minutes for normal operation	Coming from −10 °C and going to +20 °C at 60 % relative humidity **Warning:** When an instrument is brought from the cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.

1.2.13. MECHANICAL DATA

1.2.13.1. Dimensions	Length 410 mm (16 1/4") Width 316 mm (12 1/4") Height 154 mm (6 1/8")	Excl. controls, cover and feet
1.2.13.2. Weight	approx. 10 kg (22 lbs)	

*For IEC references see also Philips Data Sheet:
Quality Assurance Program Oscilloscopes No. 17.7200.32.0556.11.

1.2.14. ACCESSORIES

1.2.14.1. Accessories delivered with the instrument

Two contrast filters (one installed)
Front cover with storage space for probes
Collapsible viewing hood PM 9366
Banana - BNC adapter PM 9051
CAL terminal - BNC adapter
Manual

1.2.14.2. Optional accessories

PM 9335 (L)	Passive 1:1 probe
PM 9351 (L)	Passive 10:1 probe
PM 9358	Passive 100:1 high-voltage probe
PM 9347	Active t.v. probe
PM 9352	Active microminiature probe
PM 9353	Active F.E.T. probe
PM 9355	Current probe with amplifier
PM 8960	Rack-mounting adapter
PM 8971	Camera flange
PM 9380	Oscilloscope camera
M3, M4, M5	Oscilloscope camera range Steinheil Oscillosphot
PM 8991	Oscilloscope trolley
PM 8980	Long viewing hood

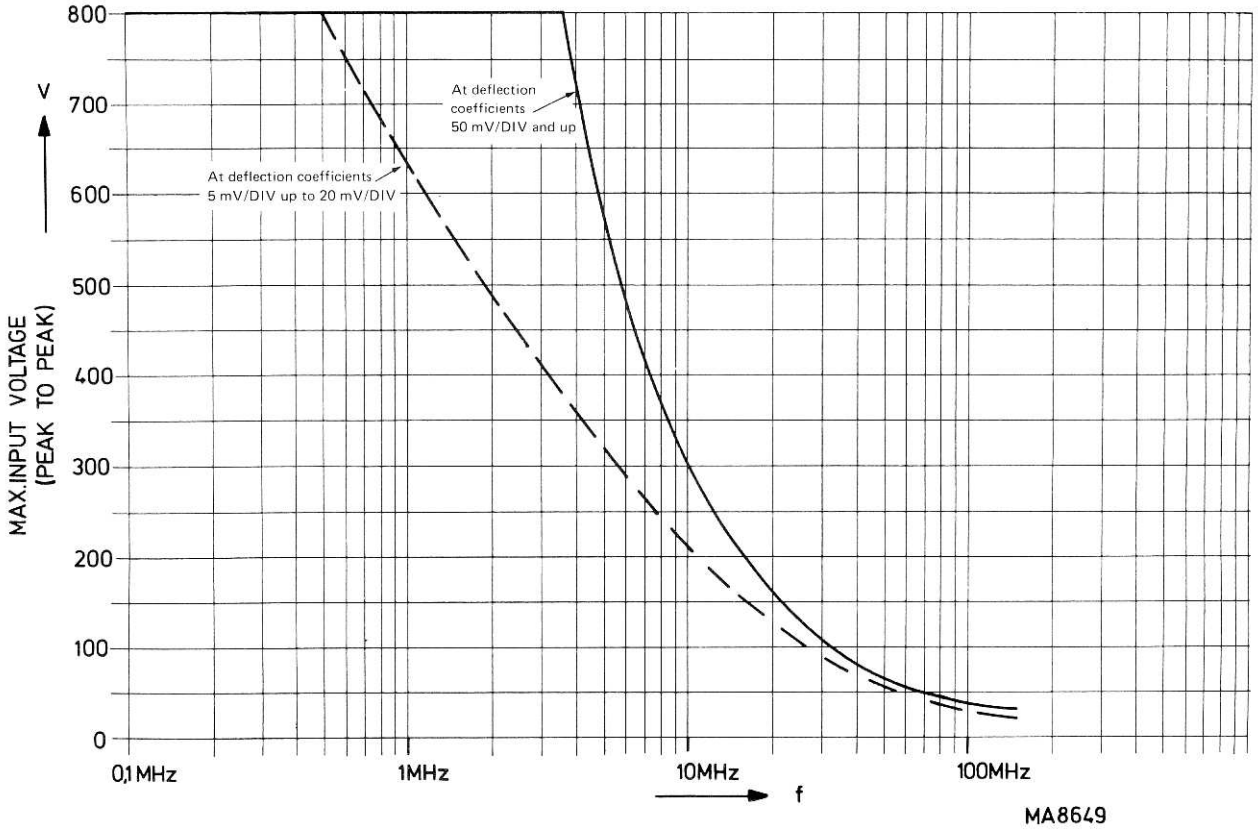

Fig. 1.2. Derating of the maximum permissible input voltage as a function of frequency

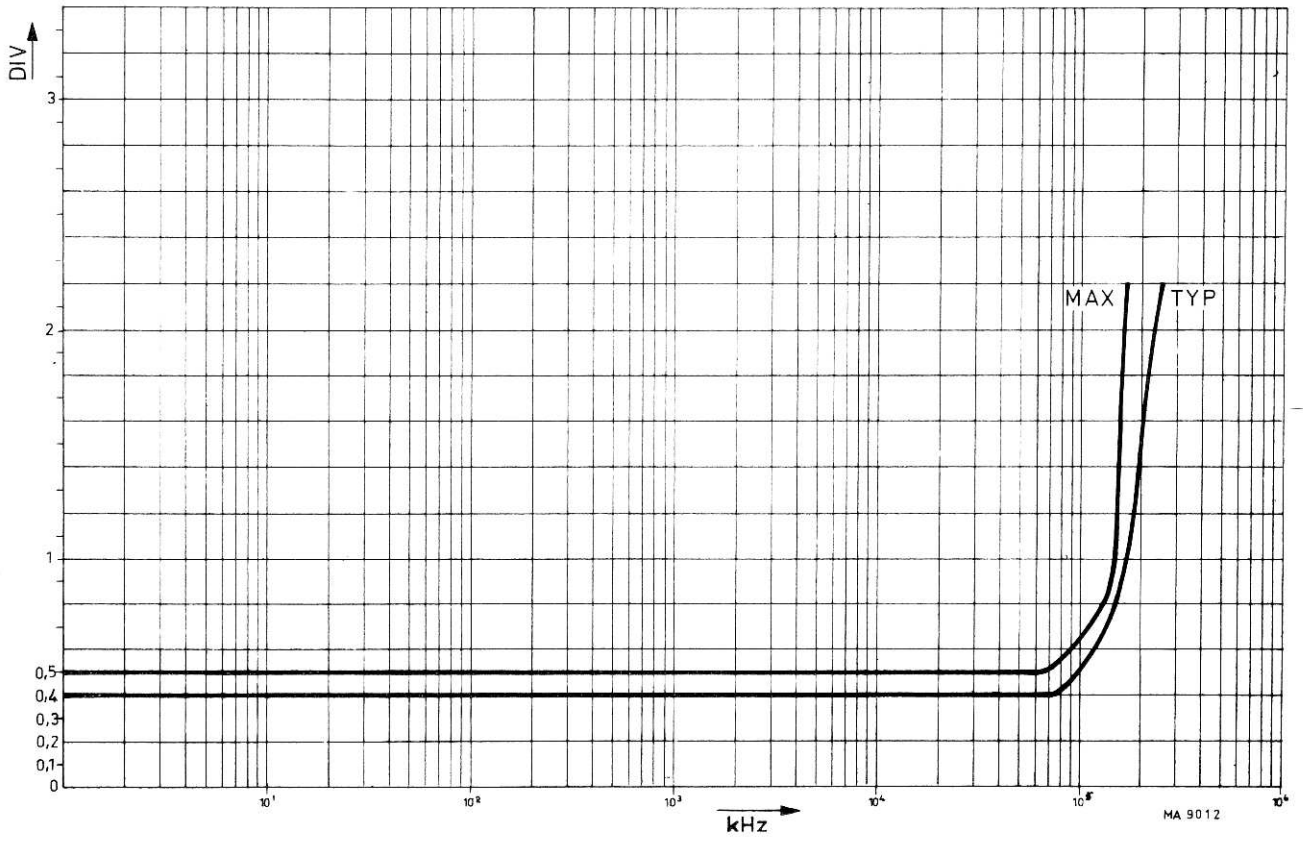

Fig. 1.3. Trigger sensivity as a function of frequency

1.3. GLOSSARY OF MULTIPLIER TERMS

1.3.1. Analogue multiplier

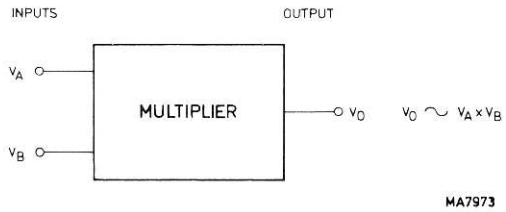

Fig. 1.4. Analogue multiplier

An analogue multiplier is a non-linear device which produces an output voltage that is proportional to the algebraic product of two input voltages

1.3.2. Multiplier bandwidth

The multiplier bandwidth is the frequency range between DC and the frequency at which the multiplier output is 3 dB down with respect to the output at a given low frequency.
This bandwidth is specified by a constant amplitude sine-wave with variable frequency applied to one input and a DC voltage to the other.

1.3.3. Multiplier rise-time

The multiplier rise-time is the response time of the output swing when a step voltage is applied to one input and a DC voltage to the other.
This time is measured between the 10 % and 90 % points of the step response.

1.3.4. Four quadrant operation

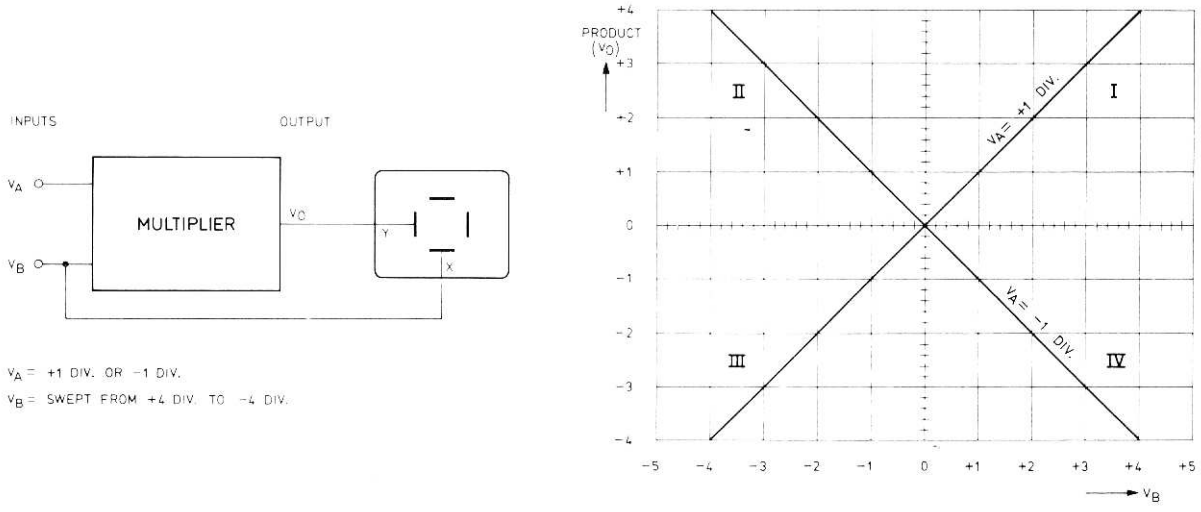

Fig. 1.5. Four quadrant operation

A four-quadrant multiplier can produce an output signal in any of the four quadrants (marked I to IV) of the Cartesian co-ordinate system.

1.3.5. Input off-set

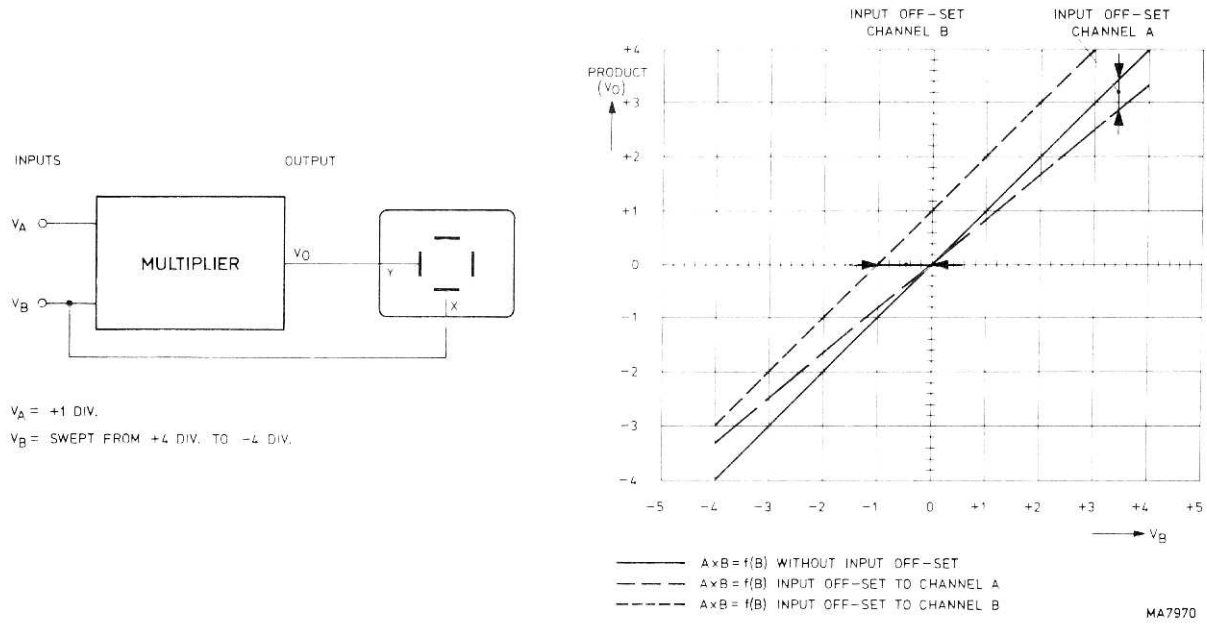

Fig. 1.6. Input off-set

The input off-set is the virtual voltage at the multiplier input when no input signal is applied. This off-set can be minimized by applying a DC balance voltage.

1.3.6. Output off-set

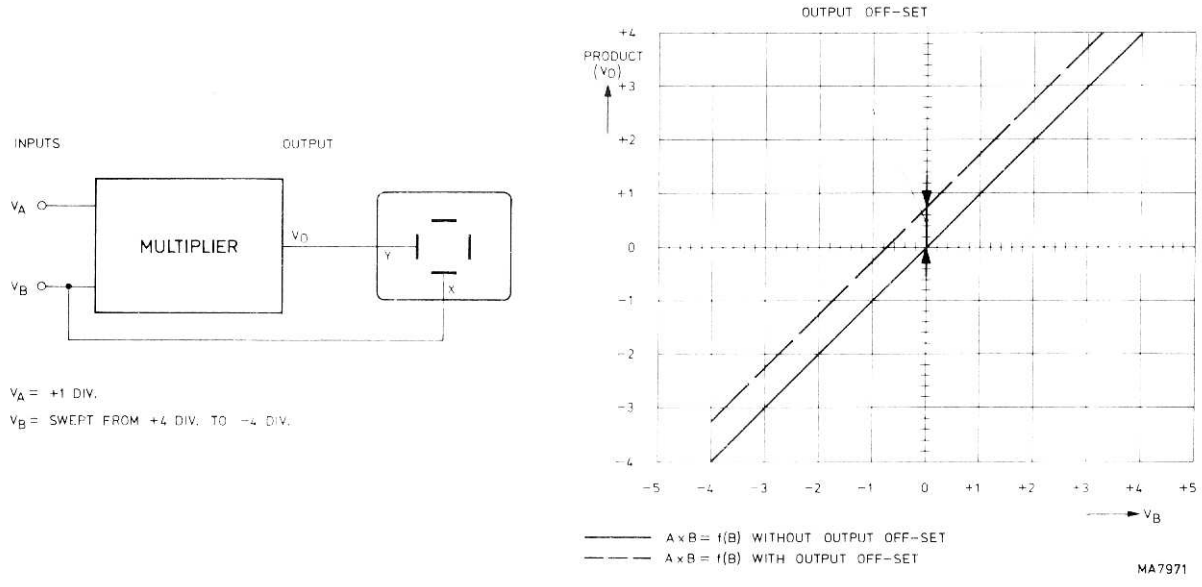

Fig. 1.7. Output off-set

Output off-set is the unwanted voltage at the multiplier output when both input signals are zero. This output off-set is visible as a vertical shift of the displayed product.

1.3.7. Scale factor

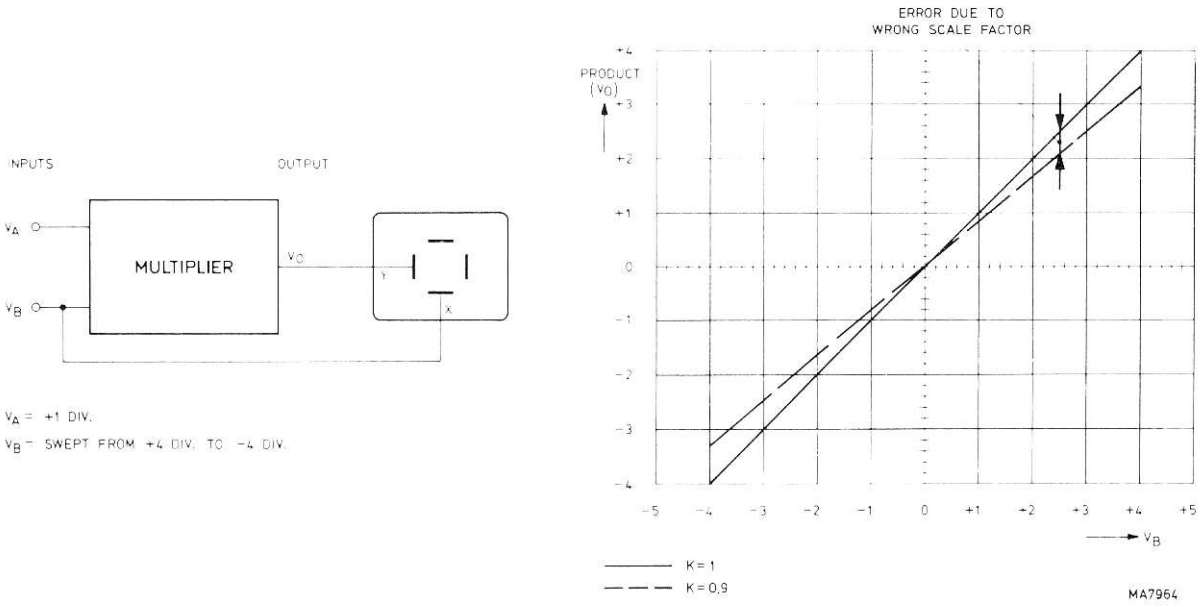

Fig. 1.8. Scale factor

The scale factor K is the constant of proportionality that relates the C.R.T. deflection to the inputs A and B in the MULT. mode.

1.3.8. Non-linearity

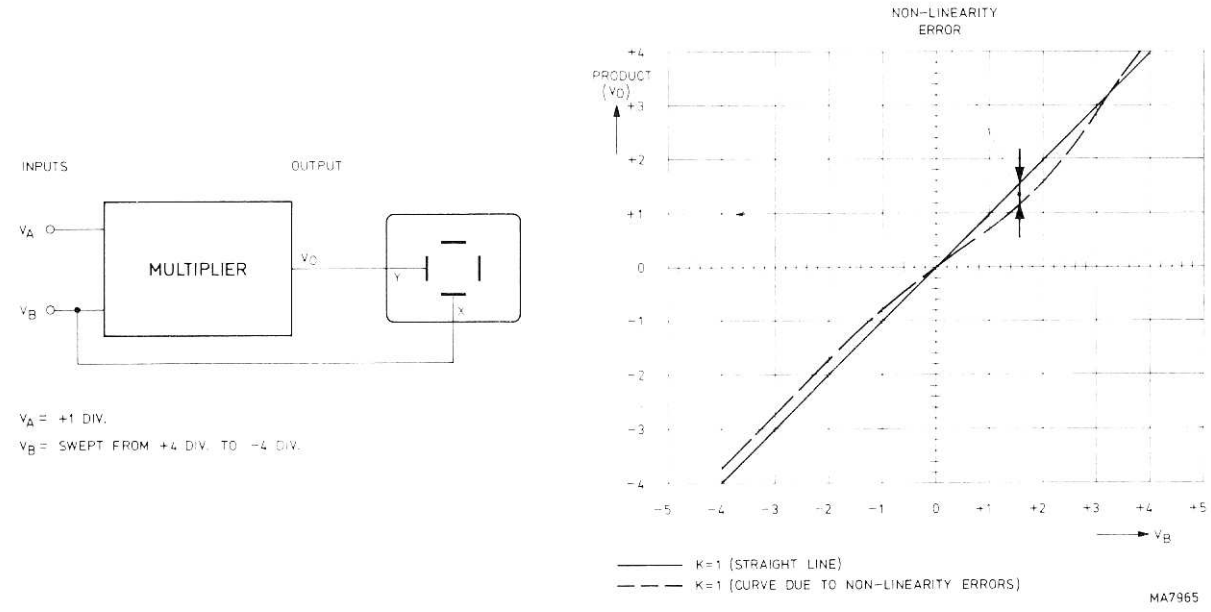

Fig. 1.9. Non-linearity

Non-linearity is the peak deviation of (AxB) = f (B) from the best straight line. It is expressed as a percentage of full screen deflection.

1.3.9. Feed-through

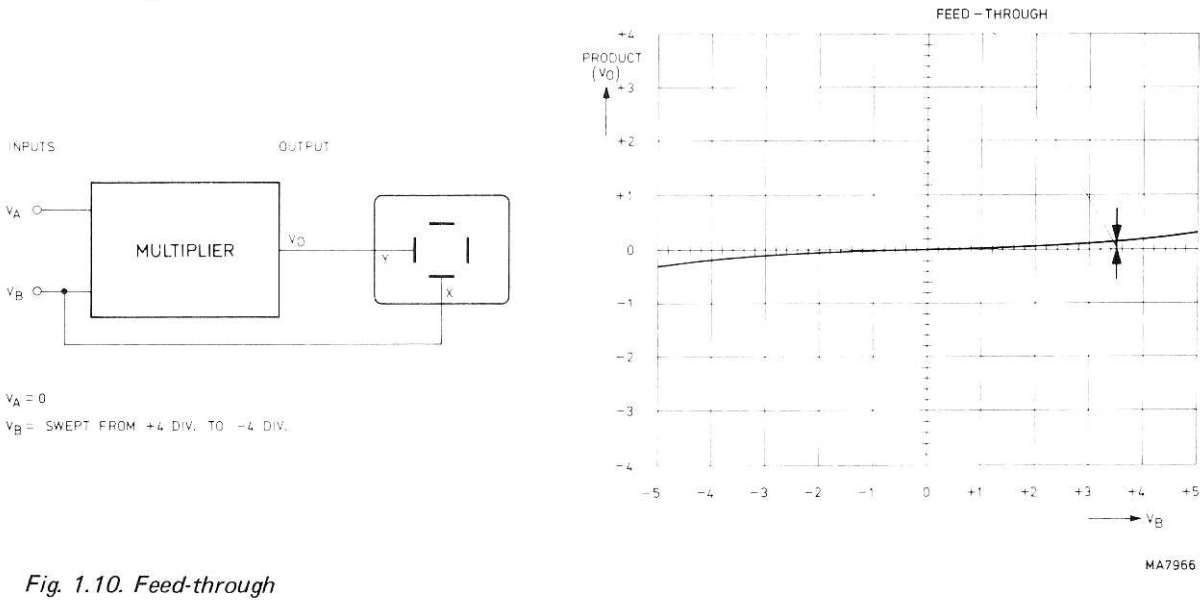

Fig. 1.10. Feed-through

Feed-through is the AC voltage at the multiplier output when after input off-set balancing, one input is held at zero and a maximum signal is applied to the other.

1.3.10. Propagation delay

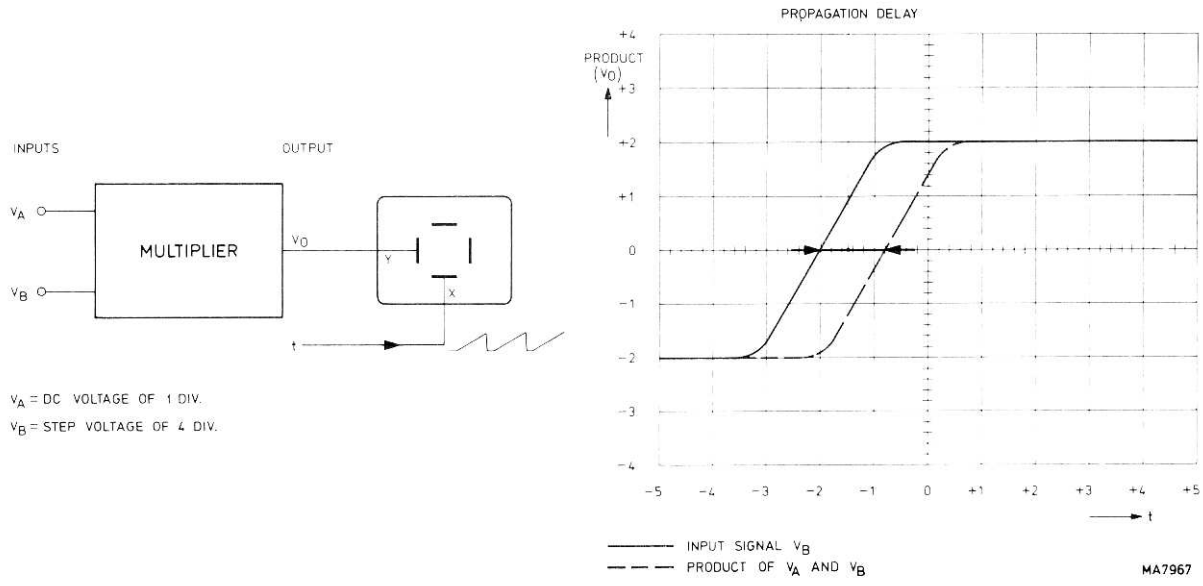

Fig. 1.11. Propagation delay

The propagation delay is the delay between input and output signals caused by the multiplier in processing the input signals.

1.3.11. Noise

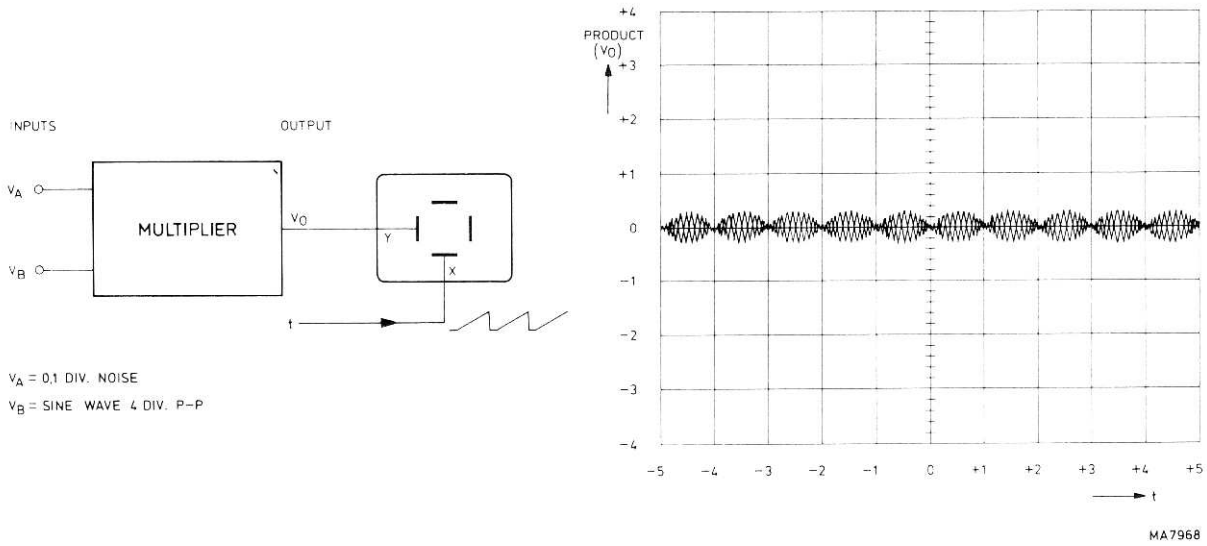

Fig. 1.12. Noise

The multiplier circuit produces no appreciable noise. However, an input voltage of A divisions at one channel will multiply the noise present at the other channel.
This can cause modulation and thus a corrugated base line.

1.3.12. Input dynamic range

The maximum signal which can be applied to inputs A and B without impairing linearity.

1.3.13. Output dynamic range

The maximum signal which can occur at the output without impairing linearity.

Fig. 2.1. Removing front cover

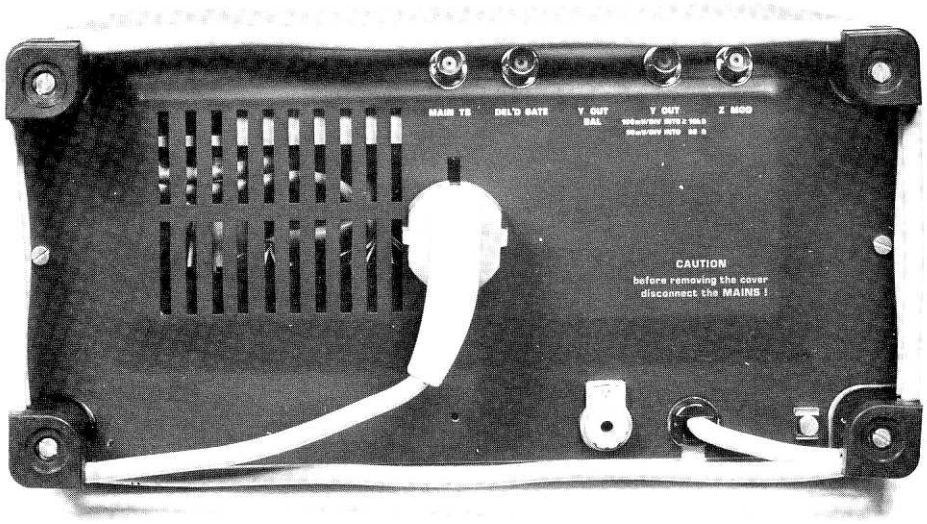

Fig. 2.2. Rear view of the instrument

2. Directions for use

2.1. INSTALLATION

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section EARTHING).

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 be a skilled person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged if the instrument has been separated from all voltage sources.

2.1.1. Removing and fitting the front cover

Removing: – Turn the knob in the centre of the cover a quarter of a turn anti-clockwise to position UNLOCKED.
– Take the cover off.

Fitting: – Turn the knob to the UNLOCKED position.
– Fit the cover over the front of the oscilloscope.
– Press the knob and turn it a quarter of a turn clockwise to the LOCKED position.

Remark: The handle can be rotated if the push-buttons on its bearings are depressed.

2.1.2. Mains adjustment and fuse

The ability of the instrument to operate at any mains voltage between 90 and 264 Va.c., obviates the need of adaptation to the local mains voltage.
The fuse holder which is mounted on the rear panel carries a 2 A delayed action fuse. 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.

2.1.3. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:
– via the protective earth terminal (at the rear, intentified by the symbol ⏚);
– via the three-core mains cable.

The mains plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor. Replacing the mains plug is at the users own risk. After replacing a mains plug, a high-voltage test in accordance with IEC Publication 348 is strongly recommended.

Warning: Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

When an instrument is brought from the cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.

2.1.4. Switching on

The POWER switch is incorporated in the graticule ILLUMination control on the front panel, immediately below the screen bezel. The oscilloscope must never be switched on whilst any circuit board or block has been removed.
Never remove a circuit board or block until at least one minute after the oscilloscope has been switched off.

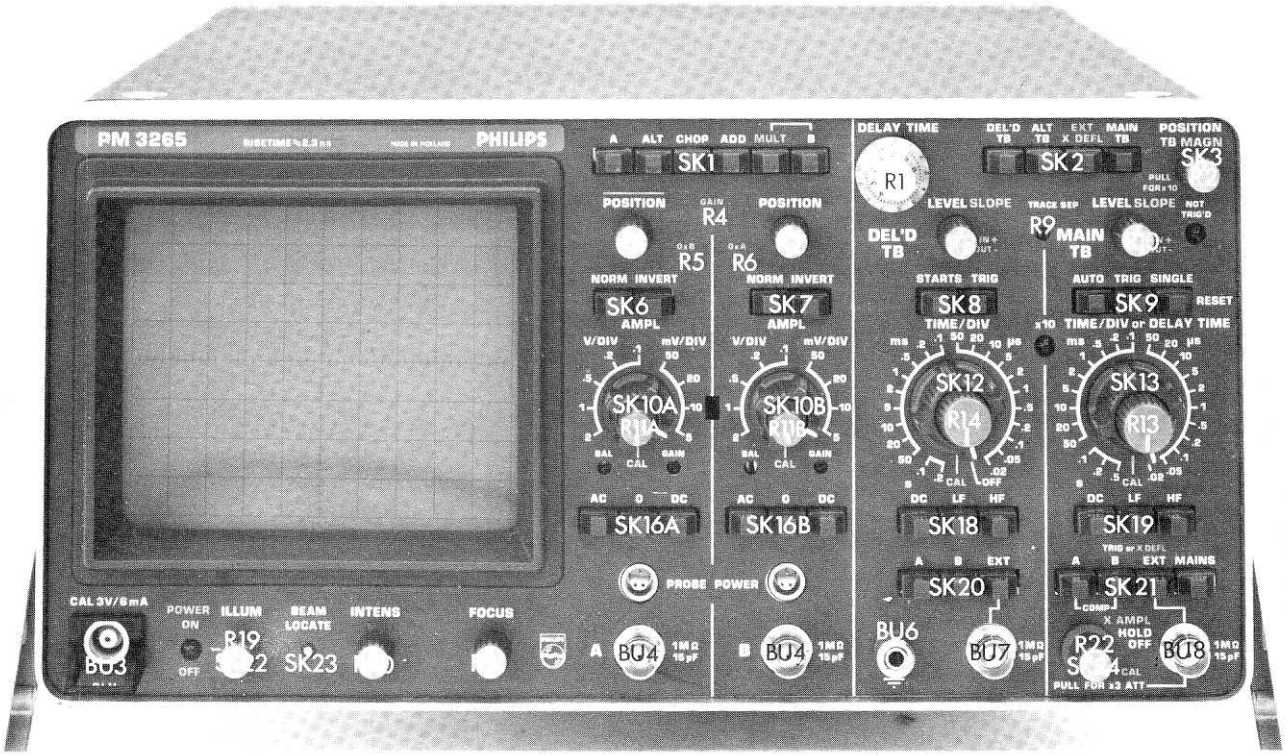

Fig. 2.3. Front view of the instrument

2.2. OPERATING INSTRUCTIONS

Before switching on, ensure that the oscilloscope has been correctly installed in accordance with section 2.1. INSTALLATION and that the precautions outlined have been observed.

2.2.1. Controls and sockets (Fig. 2.3.)

2.2.1.1. Vertical channels

A/ALT/CHOP/ADD/MULT/B	Display-mode controls; 6-way push-button switch.
A depressed	Vertical deflection is achieved by the signal connected to the input of channel A.
ALT depressed	The display is switched over from one vertical channel to the other at the end of every cycle of the time-base signal.
CHOP depressed	The display is switched over from one vertical channel to the other at a fixed frequency.
ADD depressed	Vertical deflection is achieved by the sum signal of channels A and B.
MULT depressed	Vertical deflection is achieved by the product signal of channels A and B.
B depressed	Vertical deflection is achieved by the signal connected to the input of channel B. If no push-button is depressed, the instrument operates in the ALT mode.
MULT and B depresses simultaneously	The display is switched between MULT and B in the chop or alt mode depending on Time/div. setting
POSITION	Continuously variable control giving vertical shift of the display.
NORM/INVERT	2-Way push-button switch for the inversion of the signal polarity. No push-button depressed has the same effect as the NORM button depressed.
AMPL.	Step control of the vertical deflection coefficients; 9-way switch.
AMPL./CAL. (blue)	Continuously variable control of the vertical deflection coefficients. In the CAL. position the deflection coefficient is calibrated.
BAL (screw-driver operated)	Continuously variable control of the direct voltage balance of the vertical amplifiers.
GAIN (screw-driver operated)	Continuously variable control of the overall gain of the vertical channels.
AC/0/DC	Signal coupling; 3-way push-button switch.
AC depressed	Coupling via a blocking capacitor
0 depressed	Connection between input circuit and input socket is interrupted and the amplifier input is earthed
DC depressed	Direct coupling No button depressed has the same effect as the AC button depressed.
A 1 MOhm - 15 pF	BNC input socket for channel A
B 1 MOhm - 15 pF	BNC input socket for channel B
GAIN (screw-driver operated)	Continuously variable control of the vertical gain in the MULTIPLIER mode
ZERO A (screw-driver operated)	Continuously variable control of the off-set voltage correction in channel A (multiplier)
ZERO B (screw-driver operated)	Continuously variable control of the off-set voltage correction in channel B (multiplier)

2.2.1.2. Horizontal channel

DEL'D TB - ALT. TB - EXT. X DEFL - MAIN TB	Horizontal-deflection controls; 4-way push-button switch
DEL'D TB depressed	The horizontal deflection voltage is supplied by the delayed time-base generator.
ALT. TB	The horizontal display is switched over from the main time base to the delayed time base at the end of every cycle of the main time base generator.
EXT. X DEFL depressed	Horizontal deflection is achieved by an external signal applied to the input socket of the horizontal amplifier, by the channel A signal, by the channel B signal, the composite signal or by a mains-frequency signal.
MAIN TB depressed	The horizontal deflection voltage is supplied by the main time-base generator. A part of the trace is intensified (except in position OFF of the TIME/DIV switch of the delayed time-base generator). No button depressed has the same effect as the MAIN TB button depressed.
POSITION TB MAGN	Continuously variable control giving horizontal shift of the display; incorporates a push-pull switch which increases the horizontal deflection coefficient by a factor 10. A pilot lamp labelled x 10 lights up when the magnifier is in operation.
X AMPL/HOLD OFF	Continuously variable control of the horizontal deflection coefficients in case of external X deflection. In case of X deflection by the main time base, this control can be used to increase the sweep hold-off time.
TRACE SEP. (screw-driver operated)	Continuously variable control of the vertical space between the two time-base displays in the ALT. TB mode.

2.2.1.3. Main time-base generator

LEVEL SLOPE	Continuously variable control to select the level of the triggering signal at which the time-base generator starts. This control incorporates a push-pull switch which enables choice of triggering on the positive- or negative-going edge of the triggering signal.
NOT TRIG'D	Pilot lamp which lights up when the time-base generator is in waiting position.
AUTO - TRIG - SINGLE	Trigger-mode controls; 3-way push-button switch.
AUTO depressed	The main time-base generator is free-running in the absence of triggering signals.
TRIG depressed	The time-base generator is normally triggered.
SINGLE depressed	After operating the SINGLE button, the time-base generator runs only once upon receipt of a trigger pulse. If no button is depressed, the instrument operates in the SINGLE mode.

TIME / DIV or DELAY TIME	Time-coefficient control of the main time-base; 23-way rotary switch.
TIME/DIV - CAL (blue)	Continuously variable control of the time coefficient of the main time-base. In the CAL position the time coefficient is calibrated.
DC - LF - HF	Trigger coupling; 3-way push-button switch.
DC	Triggering signals are direct-coupled.
LF	Coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz - 30 kHz).
HF	Coupling via a high-pass filter for frequencies higher than 30 kHz. No push-button depressed has the same effect as button DC depressed.
TRIG or X DEFL	Trigger source or external X deflection selector; 4-way push-button switch.
A	Internal triggering or X deflection signal derived from channel A.
B	Internal triggering or X deflection signal derived from channel B.
COMP (A and B depressed simultaneously)	Internal triggering or X deflection signal derived from channel A and B.
EXT	Triggering on external signal connected to the adjacent 1 MOhm-15 pF socket. When the EXT X DEFL button of the horizontal deflection controls is depreseed, this socket is connected to the input of the horizontal amplifier.
MAINS	Triggering or X deflection signal derived from an internal voltage with the mains frequency. No push-button depressed has the same effect as button A depressed.
1 MOhm - 15 pF	BNC socket for external triggering or horizontal deflection.

2.2.1.4. Delayed time-base generator

DELAY TIME	Continuously variable control of the delay time, operating together with the TIME/DIV controls of the main time-base generator.
LEVEL SLOPE	Continuously variable control to select the level of the triggering signal at which the delayed time-base generator starts. This control incorporates a push-pull switch which enables choice of triggering on the positive- or negative-going edge of the triggering signal.
STARTS - TRIG	Choice of the starting point of the delayed time-base generator after the delay time; 2-way push-button switch.
STARTS	The delayed time-base generator is started immediately after the delay time.
TRIG	The delayed time-base generator starts after the delay time upon receipt of a trigger pulse. No push-button depressed has the same effect as the STARTS button depressed.
TIME/DIV	Time-coefficient control of the delayed time-base; 23-way rotary switch. Incorporates an OFF position in which the delayed time-base generator is switched off.
TIME/DIV - CAL (blue)	Continuously variable control of the time coefficient of the delayed time-base generator. In the CAL position the time coefficient is calibrated.

DC - LF - HF	Trigger coupling; 3-way push-button switch.
DC	Triggering signals are direct-coupled.
LF	Coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz to 30 kHz).
HF	Coupling via a high-pass filter for frequencies higher than 30 kHz. No button depressed has the same effect as the DC button depressed.
A - B - EXT	Trigger source control; 3-way push-button switch.
A	Internal triggering signal derived from channel A.
B	Internal triggering signal derived from channel B.
EXT	Triggering on an external signal connected to the adjacent 1 MOhm - 15 pF socket.
	No button depressed has the same effect as the A button depressed.
1 MOhm - 15 pF	BNC input socket for external triggering signal.

2.2.1.5. Cathode-ray tube

ILLUM POWER	Continuously variable control of the graticule illumination; incorporates mains switch. Pilot lamp indicates the ON state.
INTENS	Continuously variable control of the trace brilliance.
FOCUS	Continuously variable control of the electron-beam focusing.

2.2.1.6. Miscellaneous

CAL	Output socket on which a square-wave voltage of 3 V_{p-p} and a current of 6 mA at a frequency of 2 kHz are available. Amplitude accuracy: ± 1 %. Frequency accuracy: ± 2 %. The output is protected against continuous short-circuits.
BEAM LOCATE	Push-button to enable a trace to be readily located on the screen by reducing the deflection coefficients.
PROBE POWER	Power socket for active accessories; supplies +24 V and −24 V.
⏚	Measuring-earth socket.
Rear sockets	
MAIN TB	Output socket on which the sweep is available at 0...+5 V_{p-p}.
DEL'D GATE	Output socket on which a square wave voltage of 6 V_{p-p} pos. is available during the delayed sweep.
Y Out	Output socket which gives Y out at 50 mV/div at 50 Ω or 100 mV/div at ⩾ 10 kΩ.
Y OUT BAL	Controls the DC level of Y OUT.
Z Mode.	Blanking or unblanking of the trace, visible modulation up to 10 MHz.

2.2.2. Preliminary settings

As the following settings are identical for both vertical channels, only the procedure for channel A has been indicated.

2.2.2.1. Adjusting the d.c. balance

- Operate push-button A of the display-mode controls.
- Operate push-button AUTO of the trigger-mode controls.
- Operate push-button MAIN TB of the horizontal deflection controls.
- Set the AMPLitude switch to 5 mV and the continuous control to CALibrated.
- Centre the trace with the POSITION controls.
- Set the INTENSity and FOCUS controls for a sharp, well-defined trace.
  The controls not mentioned may occupy any position.
- Check that the trace does not jump when the input coupling switch is switched between the DC and O positions.
  If necessary, readjust the BALance control on the front panel immediately below the AMPLitude control.

2.2.2.2. Adjusting the gain

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

- Set the AC-0-DC switch to DC.
- Set the AMPLitude switch to .5 V and the continuous control to CALibrated.
- Connect the CALibration socket to the A input socket.
- Check that the trace height is exactly 6 divisions.
  If necessary, readjust the GAIN control on the front panel, immediately below the AMPLitude switch.

2.2.3. Inputs A and B and their possibilities

The oscilloscope has been provided with two identical channels, each of which can be used for either Y/T measurements in combination with one or both time-base generators, or XY measurements in combination with the external horizontal channel.

2.2.3.1. Y/T Measurements

To display one signal, either of the two vertical channels can be selected by operating either push-button A or push-button B of the display-mode controls.
When push-button ALT or CHOP is depressed, two different signals can be displayed simultaneously. The Y deflection coefficient and the polarity can be selected for each channel individually. When the ALT button is operated, the display is switched over from one channel to the other at the flyback of the time-base signal. Although the ALTERNATE mode can be used at all sweep speeds of the time-base generator, the CHOPPED mode will give a better display quality for long sweep times, because during these long sweep times the alternate display of the two input signals is clearly visible to the eye.

In the CHOPPED mode, the display is switched over from one channel to the other at a fixed frequency.
If push-button ADDED of the display-mode switch is operated, the signal voltages of both vertical channels are added. Depending on the positions of the polarity switches, either the sum or the difference of the input signals is displayed. The ADDED mode also enables differential measurements. With these measurements advantage is taken from the common mode rejection in the ADDED position. When the polarity switches of both channels are set to opposite positions, the common mode parts of the signals on sockets A and B will undergo a very slight amplification only, with respect to the differential mode parts.

2.2.3.2. XY Measurements

If push-button EXT X DEFL of the horizontal-deflection controls is operated, the time-base generators are switched off. Push-button A of the TRIG OR X DEFL controls enables a signal applied to the A channel to be used for horizontal deflection. The AC/0/DC switch and the step attenuator of channel A remain operative.
Continuous control of the deflection coefficients is possible with the X DEFL/HOLD OFF control and horizontal trace shift with the X POSITION control.

Vertical channel B may also be used for X deflection.
To this end, the B botton of the TRIG OR X DEFL controls is depressed.
The composite signal of A and B may also be used for X deflections by depressing the A and B button simultaneously.

It is also possible to use an internal voltage at the mains frequency or a signal applied to the EXT socket at the bottom right-hand side of the front panel for X deflection, after depressing the relevant push-button of the TRIG OR X DEFL controls. In these modes the trace width can be controlled with the X DEFL/HOLD OFF potentiometer.
With this potentiometer in its CAL position, the deflection coefficient for external signals is 300 mV/DIV.
The external signal can be either d.c or a.c. coupled (lower frequency limit 10 Hz) by depressing either the DC or the LF/HF push-button of the trigger coupling controls of the main time-base.

2.2.3.3. AC/0/DC switch

The signal under observation is applied to input socket(s) A (B) and the AC/0/DC switch is set to either AC or DC. As the vertical amplifier is d.c. coupled, the full band-width of the instrument is available and d.c. components are displayed as trace shifts in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. level.
Some pulse droop will occur when l.f. square-wave signals are displayed.

The 0 position interrupts the signal and earth the amplifier input for quickly determining the zero level.

2.2.4. Using the multiplier

The signals to be multiplied must be applied to input sockets A and B.

2.2.4.1. Dynamic range

Both multiplicants A and B must be within the dynamic range of the multiplier and preamplifier circuits. As an overload condition for these circuits might not be noticed in the displayed product, care must be taken to keep each of the input signals within the specified dynamic range, allowing for a maximum amplitude of 8 $div_{p\text{-}p}$.

For the displayed product again a maximum amplitude of 8 $div_{p\text{-}p}$ is specified. If the output maximum is exceeded, one of the input signals must be reduced in amplitude.

2.2.4.2. Multiplier balance

When either A or B is multiplied by 0 (zero), the product must be zero. Offset voltages at the multiplier inputs may still cause some deflection on the screen. These offset voltages must be reduced to a minimum by using the following procedure:

- Allow a warm-up period of at least 15 minutes, preferably 30 minutes.
- Apply an a.c. signal with an amplitude within the specified dynamic range to both input A and input B.
- Depress push-button MULT of the display-mode controls.
- Depress push-button 0 of the channel A signal coupling controls.
- Depress push-button AC of the channel B signal coupling controls.
- Minimize the deflection by means of the 0xB potentiometer without changing the attenuator setting.
- Depress push-button AC of the channel A signal coupling controls.
- Depress push-button 0 of the channel B signal coupling controls.
- Minimize the deflection by means of the 0xA potentiometer without changing the attenuator setting.

2.2.4.3. Multiplier gain

- Set both AMPL switches to 10 mV/DIV and the vernier controls to CAL.
- Depress the DC push-button of the signal coupling controls of both channels.
- Apply a sine wave signal of 40 $mV_{p\text{-}p}$, frequency 50 kHz, to the channel A input socket.
- Apply a d.c. voltage of 10 mV to the channel B input socket.
- Adjust the MULTIPLIER GAIN control on the front panel for a trace height of 4 div.

2.2.4.4. Multiplier output level

The multiplier output signal is displayed via the A channel. The displayed product will normally have a d.c. component, also if both input signals consist of a.c. components. Therefore, it is important to know the zero level of the displayed product. The d.c. zero line can be shifted to the most convenient place on the screen by means of the channel A POSITION control, if the 0 push-button of the signal-coupling controls has been depressed.

2.2.4.5. Multiplier output connector

The multiplier output signal is available at a BNC connector labelled Y OUT at the rear of the instrument. The output signal (being the instantaneous value of the displayed product) is calibrated in terms of screen deflection: one division provides 100 mV into a high-ohmic load ($\geqslant$ 10 kOhm) or 50 mV into 50 Ohm.

2.2.5. Triggering

If a signal must be displayed, the horizontal deflection must always be started on one fixed point of the signal in order to obtain a stationary display. The time-base generator is, therefore, started by narrow trigger pulses formed in the trigger unit and controlled by a signal originating from the vertical input signals, an internal voltage at mains frequency or an external source.

2.2.5.1. Trigger coupling

Three different trigger-coupling methods can be chosen with the DC/LF/HF switch. In the HF and LF positions, the transfer characteristic is limited.
In position DC the trigger signal is passed unchanged.
In position LF, a 0 Hz (10 Hz for external triggering) to 30 kHz band-pass filter is inserted. This position can be used to reduce interference from noise.
In position HF, a 30 kHz high-pass filter is inserted.
This position can be used to reduce interference from e.g. hum.

2.2.5.2. Selecting the trigger source and setting the trigger level

The trigger signal is obtained from channel A (button A depressed), channel B (button B depressed), the COMPosite A and B signal (buttons A and B simultaneously depressed), an external source (button EXT depressed) or from an internal voltage at mains frequency (button MAINS depressed).
The trigger signal is not affected by the continuous AMPLitude control. Depending on the LEVEL setting the trigger start point is selected. (see fig. 2.4)
This means that, with the aid of the LEVEL control, it is possible to scan the shape of the trigger signal.
The LEVEL potentiometer is combined with a push-pull switch which allows selection of the trigger SLOPE.

2.2.5.3. Automatic triggering

When the AUTOmatic button of the AUTO-TRIG-SINGLE switch is operated, and if there are no trigger pulses available, the time-base generator is automatically free-running.
The trace is, therefore, always visible. The AUTOmatic mode can be used in all cases where also the TRIG mode is usable, except with signal frequencies lower that 20 Hz or pulse trains with an off time exceeding 50 ms.
As soon as trigger pulses are available, the free-running state of the time-base generator is automatically terminated and the time-base generator is triggered again as described in sections 2.2.5.1. and 2.2.5.2.
When the TRIGgered or SINGLE button is operated, the auto-circuit is switched off. The LEVEL setting can also be used in the AUTOmatic mode.

2.2.5.4. SINGLE sweep triggering

When effects which occur only once have th be observed (usually photographed), it is often desirable to ensure that only one sawtooth is generated, even though several trigger pulses might be produced after the phenomenon of interest. Of course, the single sawtooth in question must be triggered by a trigger pulse. To this end, the SINGLE button must be pressed. The first trigger pulse that appears after the button has been released will start the time-base generator.
The time-base generator is then blocked until the SINGLE button is pressed again. The NOT TRIG'D lamp will light up as soon as the SINGLE button has been released, until the trigger pulse arrives.

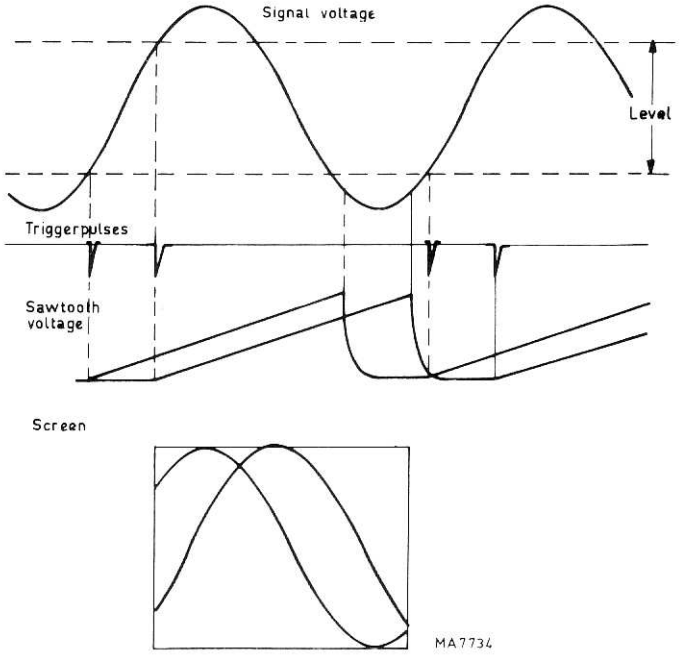

Fig. 2.4. Scanning the waveform by means of the LEVEL potentiometer

2.2.6. Time-base MAGNifier

The time-base magnifier is operated by a push-pull switch incorporated in the horizontal-POSITION control. If this switch is pulled to position x10, the sweep speeds of the main time-base generator are increased by a factor of 10. Thus, the portion of the signal displayed over one division in the x1 position (T B MAGNifier depressed), will occupy the full width of the screen in the x10 position.
Any portion of the trace can be brought on to the screen by the horizontal-POSITION control for scrutinisation. In the x10 position, the time coefficient is determined by dividing the indicated TIME/DIV value by 10.

2.2.7. Use of the delayed time-base

The delayed time-base can be used for the accurate study of complex signals. When push-button STARTS of the STARTS/TRIG controls is operated immediately after the delay-time, the delayed-time base starts (TIME/DIV switch not at OFF), and the delayed signal is intensified in the MAIN TB position of the horizontal deflection controls. The DELAY TIME control enables this intensified portion to be shifted along the time axis. The duration of the intensified portion, its length, can be controlled in steps and continuously by means of the TIME/DIV controls of the delayed time-base generator. When push-button DEL'D TB of the horizontal deflection controls is operated, the intensified portion occupies the full width of the screen. In the DEL'D TB position, the delay time, (i.e. the interval between the starting point of the main time-base and the starting point of the delayed time-base) is determined by the settings of the main TIME/DIV controls and the DELAY TIME control.

If the TRIG button of the STARTS/TRIG controls is operated, the delayed time-base is started by the first trigger pulse that occurs after the selected delay time. This trigger pulse is supplied by the trigger unit of the delayed time-base generator. This position is used when time jitter would otherwise give a blurred image of the detail under observation. This time jitter could be part of the signal being investigated or, at extreme magnifications, originate in the time-base circuits.

2.2.8. Use of the ALTernate TB

The PM 3265 is equipped with display switching. This offers the instrument user a simultaneous display of the signal on the two time scales provided by the main time-base and by the delayed time-base.
Detailed examination of a certain portion of the main time-base display is enabled by expanding the time interval of interest by means of the delayed time-base. Expansion is achieved by selecting a correspondingly faster sweep for the delayed time-base TIME/div. control. Positioning of the time interval is set by the DELAY TIME potentiometer.

The part of the signal under detailed observation by the delayed time-base remains as an intensified portion of the main time-base display. This not only facilitates the location of the required detail during dialling but also serves as a visual indication of which portion of the overall trace is being examined. One can immediately correlate the detail with the overall signal, which may be extremely complex, without the necessity of switching between MAIN TB and DEL'D TB.

Vertical shift between the two time-base displays is continuously variable with the TRACE SEParation control.