

PHILIPS

Operating manual

Plug-in units PM 3417 + PM 3418

IMPORTANT:

In correspondence concerning these instruments, please quote the type number and the serial number as given on the type plate on the rear of the instruments.

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General part

Introduction



Plug-in unit PM 3417 is a time-base generator intended for the horizontal channel of basic oscilloscope PM 3410. In combination with drift-free amplifier plug-in unit PM 3418 an oscilloscope is obtained with a sensitivity of 0.5 mV/cm in the frequency range from DC – 15 Mc/s.

The time-base generator supplies a sawtooth voltage for horizontal deflection, which can be delayed continuously and in steps by means of a delay generator.

The possibility to intensify the display facilitates

selection of the signal to be delayed. All trigger modes are applicable to both the time-base generator and the delay generator.

The time-base unit should be plugged into the upper and the amplifier unit into the lower opening of the basic instrument.

The general information and the directions for use are given in this operating manual, while the information for service purposes will be given, for each unit separately, in the service manuals PM 3417 and PM 3418.

Technical data

Properties expressed in numerical values with statement of tolerances are guaranteed by the factory. Numerical values without tolerances are intended for information purposes only and refer to the pro-

erties of an average instrument. The numerical values apply to nominal mains voltages unless otherwise stated.

A. Time-base unit PM 3417

1. ELECTRICAL

a. Display modes

NORM	Normal time base only
SINGLE	Normal time base, single-sweep operation
INTENSIFIED	Time base of delay generator intensified by the normal time base
DELAYED	Normal time base delayed by the delay generator
X-INPUT	Horizontal deflection by an external voltage

b. Normal time base

Time coefficients	0.1 $\mu\text{sec/cm}$... 10 sec/cm Adjustable in 25 steps in a ratio of 1–2–5. Continuous control between the steps (non-calibrated)
Tolerance of time coefficients (continuous control in position CAL)	With the expansion control in position $\times 1$: 3% With the expansion control in position $\times 5$: 5% (In position 10 sec/cm the deviation may be 2% greater).
Shift	At maximum expansion ($\times 5$), the time base ends can be made visible by means of the shift control.
Output voltages	
1. Sawtooth voltage (see Fig. 1)	Positive-going sawtooth voltage Amplitude 10 V_{p-p} . The output is short-circuit proof. $R_i = 6 \text{ k}\Omega$
2. Gate pulse (see Fig. 1)	Negative-going gate pulse Amplitude 12 V_{p-p} . The output is short-circuit proof. $R_i = 6 \text{ k}\Omega$

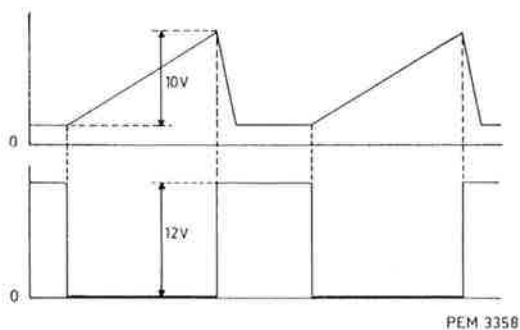


Fig. 1. Output voltages

c. Delay generator

Delay	Continuously adjustable from 2 μ sec. . . 100 msec by means of a 12-position switch and a helical potentiometer. Tolerance of the step control: 3%. Tolerance of the helical potentiometer: 0.2% of the end-of-scale value. The delay is equal to the product of the two settings.
Instability of the delay	$< 10^{-3}$ of the setting of the step control.
Signal jitter eliminator	When the knob is not in position CAL DELAY, the triggering of the time base is postponed until the next vertical input signal variation. The trigger point can be adjusted by means of a potentiometer.
Output voltage	Positive-going delayed trigger pulse. Amplitude $> 5 V_{p-p}$ The output is short-circuit proof. $R_i = 10 k\Omega$. The delay is independent of the position of the signal jitter eliminator.

d. Triggering

In the positions "SINGLE" and "NORM" of the mode selector the time base is directly triggered. In positions "INTENSIFIED" and "DELAYED" the delay generator is triggered. This generator starts the time base after the selected delay time.

Trigger source	Internal, 50 Hz or external
Trigger polarity	Triggering can take place on the positive or negative-going edge of the input signal.
Trigger mode	HF (LF rejected), LF, DC, AUT, TV-LINE or TV-FRAME (see chapter VI. B-4)
Trigger sensitivity	
1. Internal	5 mm image height up to 1 MHz 10 mm image height up to 10 MHz
2. External	500 mV _{p-p} up to 10 MHz Maximum permissible input voltage: 300 V _{p-p} Input impedance: 1 M Ω // 25 pF
Maximum trigger frequency when the signal jitter eliminator is used	1 MHz, internal trigger signal
Trigger level	Continuously adjustable over a trace height of 8 cm

e. Horizontal amplifier (position X-INPUT)

Sensitivity	1 V/cm in position $\times 1$ of the expansion control 200 mVc/m in position $\times 5$ of the expansion control
Bandwidth	0-5 MHz (-3 dB)
Input impedance (BU5-X INPUT)	1 M Ω // 15 pF

f. Power consumption of the unit 20 W

2. MECHANICAL

a. Dimensions length: 330 mm
width: 185 mm
height: 103 mm

b. Weight 2.8 kg

B. Amplifier unit PM 3418

1. ELECTRICAL

Amplifier D.C. coupled

Input circuit:

a. Input Asymmetrical, provided with selector switch AC-0-DC.
In position AC a blocking capacitor is switched in; in position 0 the amplifier input is connected to earth.

b. Maximum permissible d.c. voltage in position AC 400 V

c. Input impedance 1 M Ω // 30 pF

Deflection coefficient 14 calibrated steps of 0.5 mV/cm . . . 10 V/cm in a ratio of 1-2-5
Accuracy: \pm 3%
Continuous control between the steps (non-calibrated)

Frequency response DC: 0-15 MHz ($-$ 3 dB)
AC: 3 Hz-15 MHz ($-$ 3 dB)

Rise time 23 ns

Overshoot \leq 1% for pulses with a rise time of $>$ 10 ns

Sag \leq 1.5%

Deflection 8 cm from 0-15 MHz

Expansion Up to 10 times the useful screen height (8 cm) for frequencies in the centre of the frequency response curve. The peaks of an image expanded 3 \times can be made visible with the SHIFT control without distortion.

Drift related to input \leq 2 mm per week

Delay Delay line: 200 ns
Effective: 40 ns

Power consumption of the unit 9 W

2. MECHANICAL

a. Dimensions length: 330 mm
width: 185 mm
height: 103 mm

b. Weight 2.5 kg



Accessories

— Manual for PM 3417 and PM 3418, delivered with the PM 3417 instrument

Optional accessories

A. 1 : 10 MEASURING PROBE PM 9326

This measuring probe consists of the following parts, see Fig. 2.

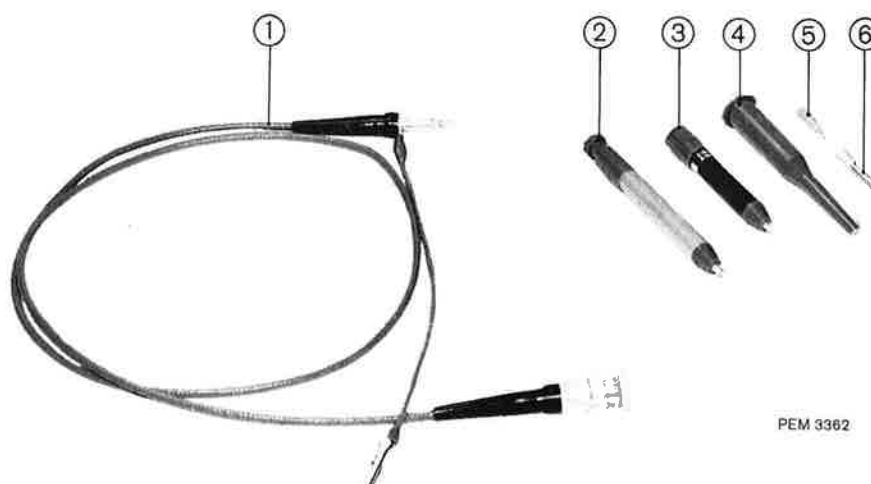
1. Probe cable and earth lead
2. 1 : 10 measuring head
3. 1 : 1 measuring head
4. Measuring clip
5. Measuring hook
6. 4 mm plug pin

Technical data

Attenuation	$10 \times \pm 3\%$
Input impedance	$10 \text{ M}\Omega // 8 \text{ pF}$
Maximum permissible input voltage	1000 V_p (max. d.c. component when the blocking capacitor in the oscilloscope is switched in: 400 V)
Length of measuring cable	1 meter
Connector	type BNC

B. 1 : 10 MEASURING PROBE PM 9327

As A. but cable length 2 m.



PEM 3362

Fig. 2. Measuring probes PM 9325 and PM 9326A/10

C. BNC TO 4 mm PLUG ADAPTER PM 9051
(See Fig. 3)



Fig. 3. Adapter PM 9051

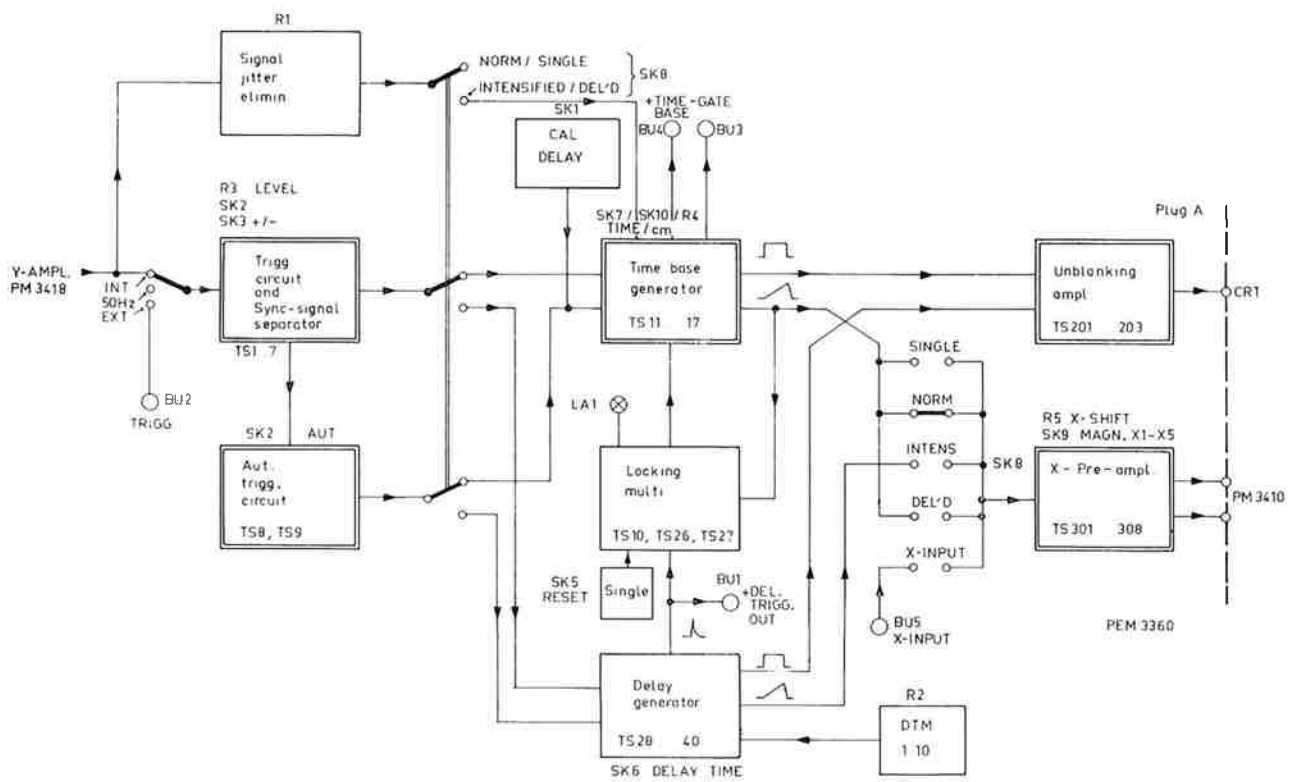


Fig. 4. Block diagram PM 3417

Description of block diagrams

A. Time-base generator PM 3417

(see Fig. 4)

1. NON-DELAYED TIME BASE

In the block diagram the blocks relating the non-delayed time base mode are surrounded by a double line.

The trigger source is selected with switch SK4: internal, 50 Hz, or external. (The polarity of the trigger signal can be reversed with SK3.)

With trigger mode selector SK2, included in the trigger circuit, the following trigger modes are selected:

TV FRAME, TV LINE, DC, LF, HF, or AUT.

In positions TV FRAME and TV LINE the signal is fed via the sync. signal separator.

With SK2 in position AUT, the automatic trigger circuit ensures a free-running time base, as long as no trigger signal is available, by applying a d.c. voltage.

From the time base generator an unblanking pulse is fed to the C.R.T. via the unblanking amplifier during the forward sweep.

The sawtooth voltage from the time base generator is applied to the horizontal pre-amplifier; the latter also includes shift control R5 and expansion control SK9 ($\times 1$ — $\times 5$).

The symmetrical output of the pre-amplifier is connected to the horizontal output amplifier in basic instrument PM 3410.

2. DELAYED TIME BASE

For operation as time-base generator with trigger delay the trigger signals from the trigger circuit are fed to the delay generator.

The trigger modes for the delay generator are equal to those already described under 1.

The output voltage of the delay generator is a sawtooth voltage from which a delayed trigger pulse is obtained by comparison with a variable d.c. voltage (DELAY TIME MULTIPLIER 1 : 10).

This trigger pulse, which is also available on BU1 (+ DEL. TRIGG. OUT), switches over the locking multivibrator so that the time-base generator is no longer blocked.

In position CAL DELAY of SK1, the time-base generator is set to free run because a pre-set voltage is applied, so that the time-base generator is immediately started as soon as the locking multivibrator is switched over.

If, however, SK1 is not in position CAL DELAY (Jitter free), the time-base generator will only be

started, after change-over of the locking multivibrator, by the next trigger signal applied via the signal-jitter eliminator. In this case there is no choice of trigger source or trigger mode. The trigger signal is AC coupled and is independent of polarity; the trigger source is internal only, the maximum trigger frequency is 1 MHz.

With SK8 in position INTENSIFIED the horizontal pre-amplifier is connected to the output of the delay generator. Via the unblanking amplifier an unblanking pulse from this generator is fed to the C.R.T. During the forward sweep of the electron beam the C.R.T. is unblanked by this pulse. After the selected delay time an unblanking pulse from the time-base generator gives the C.R.T. an extra brightness during the sweep time of the time-base generator.

With SK8 in position DEL'D the output of the time-base generator is connected to the horizontal pre-amplifier and the C.R.T. is unblanked by the pulse from this generator only.

3. SINGLE SWEEP MODE

With mode selector SK8 in position SINGLE the circuit is as described under 1, except that in this case the locking multivibrator is switched in too. If switch SK5 RESET is depressed, the locking multivibrator changes over so that the time-base generator can be started. Pilot lamp LA1 now lights up. If trigger mode selector SK2 is in position AUT, the time-base generator will start immediately after change-over of the locking multivibrator. In all other positions of SK2 the time base generator will only be started by the next trigger pulse from the trigger circuit.

After the image has been written once, the time base generator switches over the locking multivibrator again so that LA1 extinguishes.

4. HORIZONTAL PRE-AMPLIFIER

In the extreme right position of mode selector SK8 socket BU5, X INPUT, is connected to the horizontal pre-amplifier via a cathode follower. The time-base generator and the delay generator are now switched off and the electron beam is located in the centre of the screen while the C.R.T. is normally unblanked.

The pre-amplifier contains expansion control SK9 $\times 1$ — $\times 5$, with which the gain of the pre-amplifier can be increased by a factor 5, i.e. the sweep time can be made five times as short. Moreover the pre-amplifier includes shift potentiometer R5 by means of which the image can be shifted horizontally.

B. Vertical amplifier PM 3418

(see fig. 5)

The input signal on BU1 is fed directly to the input attenuator or via a blocking capacitor.

With the input attenuator nine different deflection coefficients can be selected in the range from 10V/cm... 20 mV/cm. The remaining five deflection coefficients in the range of 10 mV/cm up to 0.5 mV/cm are obtained by step-control of the pre-amplifier gain.

The d.c. voltage drift of the pre-amplifier is minimised by means of a control circuit. Moreover, in position AC of SK2 negative feedback of the leak voltage of the blocking capacitor takes place.

The drift-stabilized signal is fed to the delay line

driver. This driver also includes a limiter circuit to avoid overdriving of the stage and of the vertical output amplifier in the basic oscilloscope. The delay line is proportioned so that in all cases the trigger edge of the vertical input signal can be displayed on the screen.

Subsequently the delayed signal is symmetrically fed to the output amplifier in the basic instrument PM 3410 via the vertical amplifier.

The trigger signal is picked off before the delay line and fed to time base plug-in unit PM 3417 via the trigger pre-amplifier.

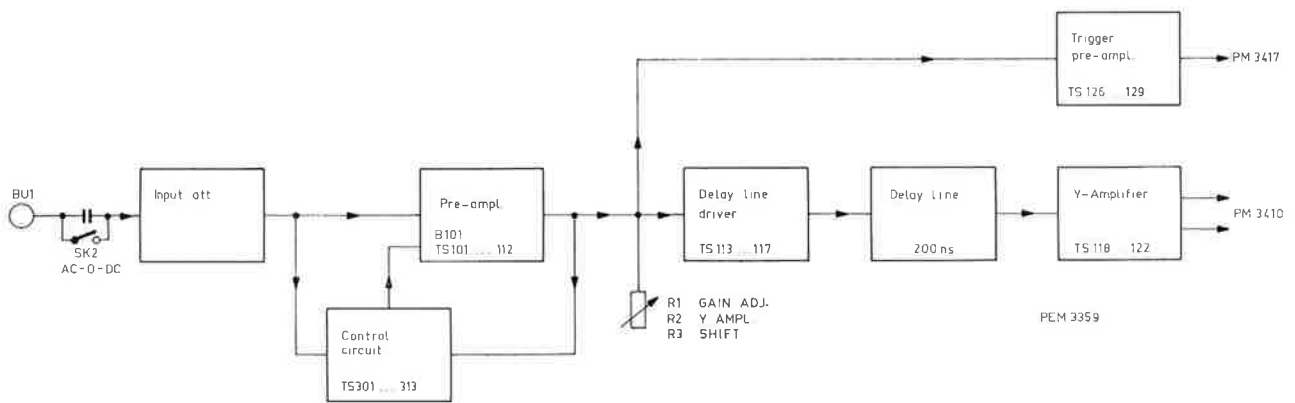


Fig. 5. Blockdiagram PM 3418

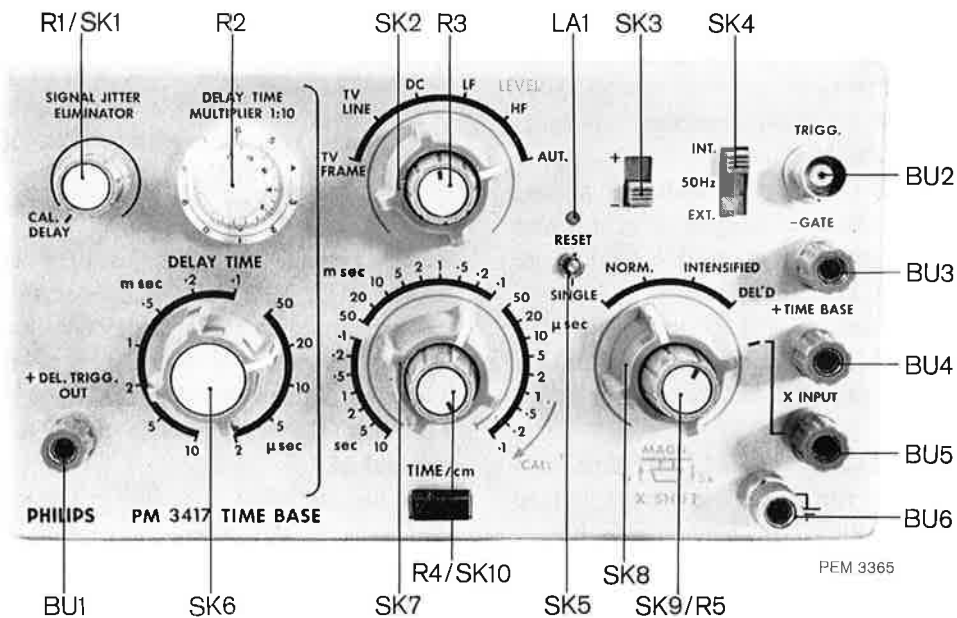


Fig. 6. Front view PM 3417

Directions for use

Survey of controls, input and output connectors



A. Time-base unit PM 3417 (see fig. 6)

TIME/cm, SK7, R4, SK10	Time coefficient selector; 25 calibrated steps and non-calibrated continuous control
Mode selector, SK8	In position SINGLE of the mode selector, single sweep operation is possible after depressing button RESET, SK5. In position NORM, operation with non-delayed time base takes place. In position INTENSIFIED the part of the waveform to be expanded can be selected. When switched to position DEL'D the intensified part of the signal will be extended over the full screen width. In the fully clockwise position of the selector, horizontal deflection is effected by external voltages applied to BU5.
MAGN.-X-SHIFT, SK9, R5	Pulling this knob gives a horizontal expansion of five times. Turning the knob effects horizontal positioning.
RESET, SK5, LA1	Reset button for single sweep operation with "ready" indication.
Triggermode selector, SK2	With this switch, a selection can be made from 6 trigger modes: TV-FRAME, TV-LINE, DC, LF, HF and AUT.
LEVEL, R3	Trigger level control.
+ or —, SK3	Selector for triggering on positive or negative-going edges of the trigger-signal.
INT - 50 Hz - EXT., SK4	Selector for triggering from internal or external sources, or with mains frequency.
TRIGG., BU2	Input socket for external triggering.
— GATE, BU3	Output socket with negative-going pulse during forward sweep of time-base.
+ TIME BASE, BU4	Output socket for sawtooth voltage.
X-INPUT, BU5	Input socket for horizontal deflection from an external source.
⊥ BU6	Earthing socket.
DELAY TIME, SK6 and DELAY TIME	Selectors for setting the delay between the arrival of a trigger pulse and the start of the time base generator.
MULTIPLIER, R2	The delay time is given by the product of the two settings, provided the SIGNAL JITTER ELIMINATOR is in position CAL. DELAY.
SIGNAL JITTER ELIMINATOR, R1, SK1	Jitter phenomena can be eliminated when the knob is not in position CAL. DELAY.
+ DEL. TRIGG. OUT, BU1	Output socket on which a positive pulse appears after the selected delay time.

B. Amplifier unit PM 3418 (see fig. 7)1 M Ω – 30 pF, BU1

AC–0–DC, SK2

Y-AMPL., SK1, R2

SHIFT, R3

GAIN ADJ., R1

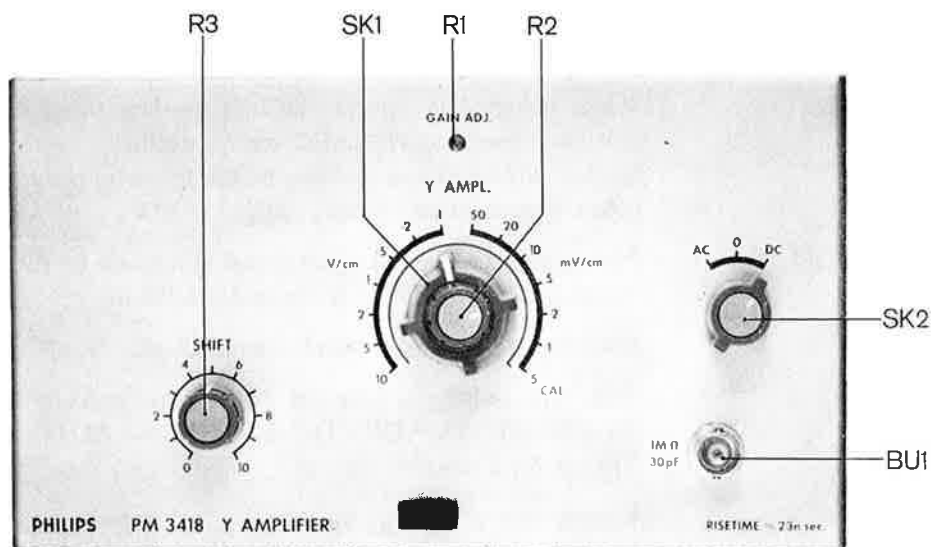
Vertical input socket.

Input selector for vertical deflection. A blocking capacitor is inserted in the input circuit when switched to position AC. The input stage of the vertical amplifier is earthed in position "0", while the input socket is disconnected.

Deflection coefficient selector; 14 calibrated steps and non-calibrated continuous control.

Vertical shift control.

Screwdriver adjustment for sensitivity correction of the vertical amplifier.



PEM 3364

Fig. 7. Front view PM 3418



Operation

A. PRELIMINARY ADJUSTMENTS

Before carrying out measurements check the sensitivity of the vertical amplifier with the aid of the calibration voltage of the basic oscilloscope. If necessary, readjust the sensitivity with R1, GAIN ADJ.

In case a 1 : 10 measuring probe PM 9326A/10 (as mentioned in chapter III A) is used, check the square wave reproduction of the calibration voltage via the probe. If necessary, readjust the probe trimmer until the square wave reproduction is satisfactory.

B. OPERATION WITH A NON-DELAYED TIME-BASE (SK8 IN POSITION "NORM").

1. Time coefficient.

The 25 different time coefficients which are selected with switch TIME/cm are only calibrated with continuous control TIME/cm in position CAL.

With control "MAGN, ×1 — ×5" in position "×5" the coefficient selected with "TIME/cm" is reduced by a factor 5. The shortest calibrated sweep time in that case is

$$\frac{0.1 \mu\text{sec/cm}}{5} = 20 \text{ nsec/cm.}$$

2. Trigger source.

INT

To obtain a steady display it is necessary to select a suitable trigger source. Trigger signals can be derived either from the waveform under test ("INT"), which is the usual method, or from an external source or a signal with mains frequency.

EXT

When triggering the sweep by means of an external waveform whose frequency is related to the signal under test, this external signal is applied to trigger input socket "TRIGG".

The advantage of external triggering is that the trigger signal remains constant and provides the possibility of observing the shaping and amplification of a signal throughout an apparatus without having to adjust the LEVEL control for each observation.

50 Hz

When studying waveforms with mains frequency or corresponding harmonics, it can be more convenient to trigger with mains frequency. In this position, LEVEL setting is also possible.

3. Trigger point.

+ and —

For the purpose of selection between triggering on the positive or negative going edge of the waveform, a + and — selector is provided in addition to the three trigger sources.

LEVEL

Turning the LEVEL control will change the trigger point on the slope of the displayed waveform and is only used in positions DC, LF and HF of mode selector SK2.

4. Trigger mode

There is a choice of 6 trigger modes: AUT, HF, LF, DC, TV-LINE and TV-FRAME.

AUT

In position AUT the time base generator is freerunning, so even without a vertical signal the sweep trace appears on the screen. After applying a signal, the time base generator switches from the freerunning to the triggered state. The frequency at which triggering can take place varies from 50 Hz—10 MHz.

HF

With this trigger mode the trigger signal is AC-coupled to the trigger circuit. Therefore, the LEVEL setting is independent of DC-components. Low frequency components, such as hum, which are superimposed on the trigger signal are attenuated, and will not cause an unstable display. The frequency at which triggering can take place varies from 2kHz—10 MHz, (RC-time: 100 μsec).

LF

This trigger mode also employs an AC-coupled trigger signal with the advantage of the LEVEL setting being independent of DC-components. The coupling capacitor is of such value that the frequency at which triggering can take place ranges from 10 Hz—10MHz (RC time: 100 msec).

DC

The DC-trigger mode allows triggering on all kinds of waveforms from DC to 10 MHz.

In case of DC-coupled triggering the LEVEL setting is affected by any variation in the d.c. level.

TV-LINE, TV-FRAME

In these positions of the triggermode selector, the trigger signal is fed via a sync. signal separator. Triggering then takes place on the line or frame pulses of the TV input signal, so that stable displays can be obtained.

5. Single sweep

Single sweep operation can be very conveniently used in case non-recurrent phenomena or continuously changing phenomena are to be photographed.

Operation is as follows: After turning the mode selector to SINGLE depress button RESET.

The time base generator is then ready for triggering. This "ready" position is indicated by the pilot lamp. As soon as a trigger pulse arrives a single scanning of the screen takes place after which the pilot lamp will be extinguished.

Note that in position AUT of the trigger mode selector the time base generator will be started even without a trigger pulse, in which case the time base is scanned across the screen as soon as button RESET is depressed.

Another sweep can only follow after button RESET has been depressed again. The LEVEL control should be adjusted empirically in order to find the correct setting.

Remark:

With the mode selector in position SINGLE, a positive pulse of about $5 V_D$ will appear on socket + DEL. TRIGG OUT every time button "RESET" is depressed.

6. Horizontal deflection with an external voltage.

With the mode selector turned fully clockwise the time base generator is switched off and horizontal deflection can take place by a voltage applied to socket X-INPUT. With switch MAGN in position " $\times 1$ " the sensitivity of this input is 1 V/cm, while in position " $\times 5$ " this becomes 200 mV/cm.

C. OPERATION WITH A DELAYED TIME-BASE

1. Introduction

The starting point of the horizontal sweep can be

delayed with respect to the arrival of a trigger pulse. The time delay is adjusted with the DELAY TIME switch and the DELAY TIME MULTIPLIER, while the normal time base generator – whose sweep time is adjusted by the TIME/cm selector – supplies a horizontal sweep, starting when the delay time has elapsed. Possible applications are, for instance, large-scale expansion and accurate time measurements.

2. Large scale expansion with calibrated delay time

If no sufficient expansion can be obtained with expansion control " $\times 1$ — $\times 5$ " large-scale expansion can be employed.

For that purpose the DELAY TIME switch is adjusted to the same value as time coefficient selector TIME/cm, after which mode selector SK8 is placed in position INTENSIFIED.

The DELAY TIME MULTIPLIER is now adjusted so that the intensified part of the trace starts at the beginning of the part to be expanded. Subsequently the TIME/cm switch is adjusted to such a value that only the part of the image to be expanded is intensified. The width of the intensified part of the trace is determined by the ratio between the time coefficient, set with switch TIME/cm, and the time set with switch DELAY TIME.

For instance:

"TIME/cm" in position $5 \mu\text{sec/cm}$.

"DELAY TIME" in position $50 \mu\text{sec}$.

The unblanked section now covers 1/10th of the total image, this is approximately 1 cm (see Fig. 8). The delay time, with the SIGNAL JITTER ELIMINATOR in position CAL DELAY, is given by the product of the delay time setting and the setting of the DELAY TIME MULTIPLIER control. After the selected delay time a positive pulse of about $5V_{D-D}$ appears on socket + DEL. TRIGG-OUT.

When switching the mode selector to DEL'D the intensified part of the waveform is expanded to full screen width (see Fig. 9 A).

3. Jitter free operation

Jitter phenomena are most pronounced with large expansions. These can be eliminated by turning the SIGNAL JITTER ELIMINATOR out of position CAL DELAY. In this case the time base is not started immediately after the adjusted delay time but only when the next signal variation arrives. The starting point is adjusted with R1 (SIGNAL JITTER ELIMINATOR). The intensified part of the image then shifts to the following edge, no matter whether this is positive or negative going. The initial point of the intensified part is no longer continuously adjustable

with the DELAY TIME MULTIPLIER, but will hop from edge to edge when the setting of the multiplier is changed.

The delay time is no longer calibrated; the positive pulse on socket + DEL TRIGG OUT does however appear after the selected delay time (see Fig. 9B).

4. Time and frequency measurements

If in the INTENSIFIED position of the mode selector a very high sweep speed is selected, the intensified part of the display will become very small or will be reduced to just a spot.

With the SIGNAL JITTER ELIMINATOR in position CAL DELAY first shift the bright spot to the beginning and then to the end of the interval to be measured. By subtracting the two settings of the

DELAY TIME MULTIPLIER and multiplying the result by the setting of the DELAY TIME selector the time interval between the two points is found. The same procedure can be applied to frequency measurement, bearing in mind, that the frequency is reciprocal to the period.

5. Delayed trigger pulse

The delayed trigger pulse appears on socket + DEL TRIGG OUT after the delay time set with the DELAY TIME selector and the DELAY TIME MULTIPLIER. This happens no matter what the position of the SIGNAL JITTER ELIMINATOR might be. The trigger pulse can be used to introduce a certain phenomenon after a known time interval has elapsed.

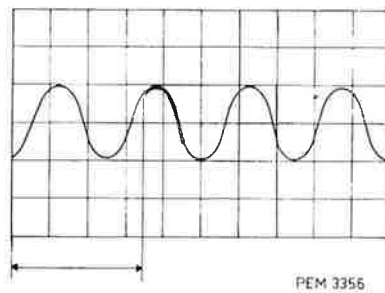


Fig. 8. Intensified display

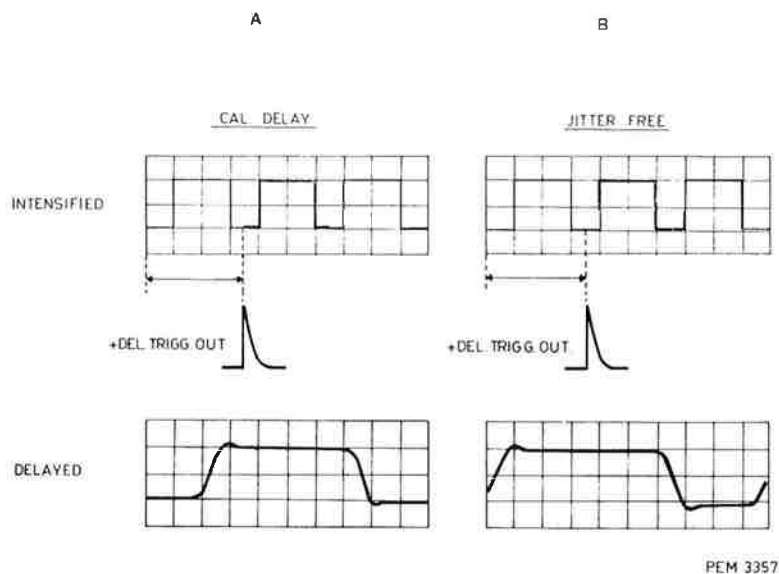


Fig. 9. Cal. delay and jitter-free operation