PHILIPS

100 MHz Digital Storage Oscilloscopes
PM3365A/67A/75/77

TEST & MEASUREMENT CUSTOMER SUPPORT

4822 872 00411
891030

Reference Manual

60 MHz Digital Storage Oscilloscopes
PM3365A/67A/75/77

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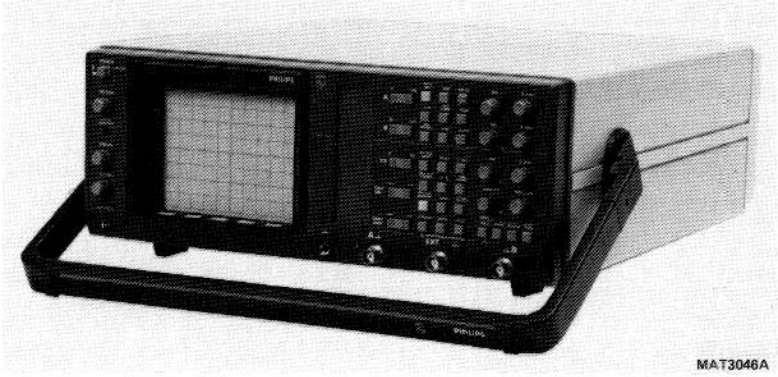

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IMPORTANT: **In correspondence concerning this instrument please quote the typenumber and serial number as given on the type plate.**

NOTE: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

PRINTED IN THE NETHERLANDS

Table of Contents

1 CHARACTERISTICS

A. Performance Characteristics

Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.
This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23 °C).
For definitions of terms, reference is made to IEC Publication 351-1.

B. Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety requirements for Electronic Measuring Apparatus, UL 1244 and CSA 556B and has been supplied in a safe condition.

C. Initial Characteristics

Overall dimensions:	
Width	
Including handle:	387 mm
Excluding handle:	350 mm
Length	
Including handle:	518,5 mm
Excluding handle, excl. knobs:	443,5 mm
Excluding handle, incl. knobs:	455,5 mm
Height	
Including feet:	146,5 mm
Excluding feet:	134,5 mm
Excl. under-cabinet:	132,5 mm

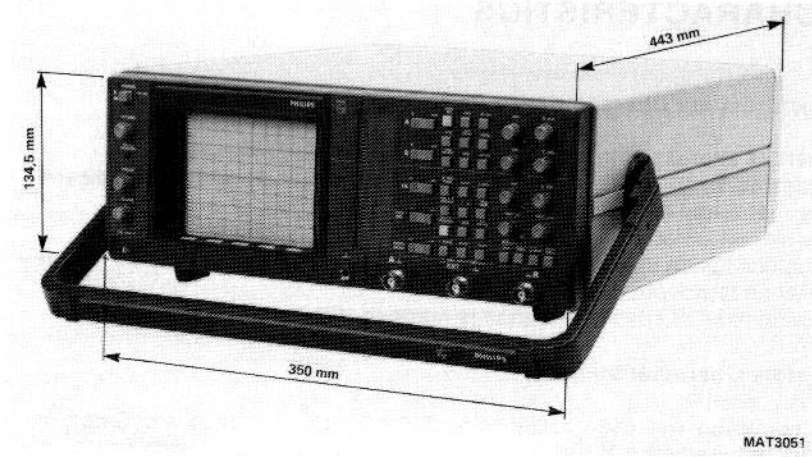


Figure 1 Dimensions of oscilloscope

Mass: 9,5 kg

Operating positions:
a. Horizontally on bottom feet
b. Vertically on rear feet
c. On the carrying handle in two sloping positions.

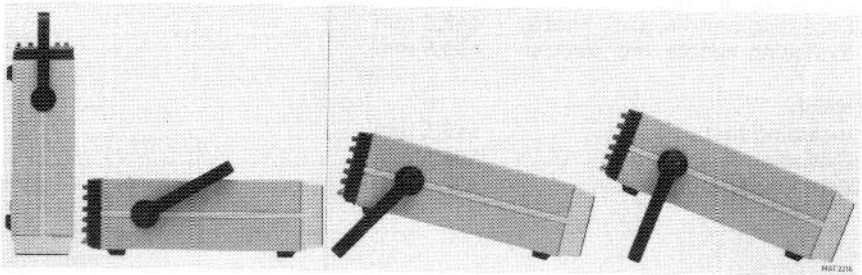


Figure 2 Operating instructions

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO

1.1 DISPLAY

* CRT		
Type number	PHILIPS D14-372	
Measuring area (h x w)	80 x 100 mm	8 x 10 div., 1 div. = 10 mm, 1 subdiv. (sd) = 2 mm
* Screen type		
Standard	GH (P31)	Standard persistence (7 ms)
Option	GM (P7)	Long persistence (30 ms)
* Total acceleration voltage	16 kV	
* Graticule:		
Engravings	Internal fixed	
Division lines	1 cm	Horizontal as well as vertical
Subdivisions	2 mm	Horizontal as well as vertical
Dotted lines	1,5 and 6,5 cm from top	Only horizontal
Percentages	0%, 10%, 90%, 100%	Left side only
* Orthogonality	90 ± 1°	Measured in zero point
* Illumination	Continuously variable	By means of potentiometer

1.2 VERTICAL DEFLECTION OR Y AXIS

* Auto set	Automatic setting according to input signal	
* Deflection modes and sources	Channel A and/or B or ADDED (A + B, A-B)	Channel B can be inverted. All combinations are possible in ALTERNATE as well as in CHOP mode

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Deflection coefficients	2 mV/div...10 V/div	In 1, 2, 5 sequence. If probe with range indicator is used, deflection coeff. is automatically calculated in display
* Variable adjustment range	1 : > 2,5	
* Error limit	± 3%	Only in calibrated position
* Input impedance	1 MΩ ± 2%	Measured below 1 MHz
Paralleled by	20 pF ± 2 pF	Measured below 1 MHz
* Max. input voltage	400 V (d.c. + a.c. peak)	Up to 125 kHz, for higher frequency see figure 3
Max. test voltage (rms)	500 V	Max. duration 60 s.

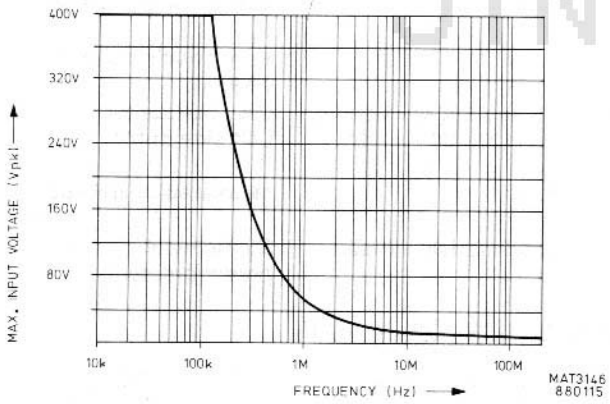


Figure 3 Maximum input voltage versus frequency

* Bandwidth		
20 mV/div...10 V/div	≥ 100 MHz	Input 6 div. sine-wave.
2 mV/div...10mV/div	≥ 75 MHz	Input 6 div. sine-wave.
* Rise-time		
20 mV/div...10 V/div	< 3,5 ns	Calculated from 0,35/ f at -3 dB
2 mV/div...10 mV/div	< 4,7 ns	Calculated from 0,35/ f at -3 dB

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Noise		
20 mV/div...10 V/div	< 0,05 div	Tangentially measured. Pick up on open BNC excluded.
2 mV/div...10 mV/div	< 0,2 div	Tangentially measured. Pick up on open BNC excluded.
* Lower -3 dB point	≤ 10 Hz	In AC position, 6 div. sine-wave
* Dynamic range d.c. ...10 MHz	> 24 div	
* Min position range	± 8 div	
* Cross talk between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave.
At 10 MHz	1 : > 100	2, 5 and 10 V are excluded.
At 100 MHz	1 : > 50	2, 5 and 10 V are excluded.
* Common Mode Rejection Ratio		Both channels same attenuator setting, vernier adjusted for best CMRR; measured with max. 8 div. (± 4 div) each channel
at 1 MHz	1 : 100	
at 50 MHz	1 : 10	
* Visible signal delay	> 13 ns	Max. intensity, measured from line start to trigger point.
* Base line jump: between attenuator steps 20 mV...10 V	< 0,2 div	
Additional jump between 10 mV...20 mV	< 0,3 div	
Normal Invert jump	< 0,2 div	Only channel B

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV...10V).
Variable jump	< 0,2 div	Max. jump between any two positions of the variable potmeter

1.3 HORIZONTAL DEFLECTION OR X AXIS

1.3.1 Time base

* Time coefficient	0,5 s/div...50 ns/div	In 1, 2, 5 sequence (magnifier off)
Error limit	± 3 %	Measured at -4... + 4 div. from screen centre.
* Horizontal position range	Start of sweep and 10th div. can be shifted at least 0,5 div over screen centre	
* Variable control ratio	1 : > 2,5	
* Time-base magnifier	Expansion x10	Not valid in X-deflection.
Error limit	± 4 %	Measured at + 4...-4 div. from screen centre. Excluding first 50 ns and last 50 ns.
* Horizontal magnifier balance	< 0,5 div	Shift start of sweep in x10 in mid-screen position, then switch to x1.
* Hold-Off Min to max hold-off time ratio	1 : > 10	Minimum hold-off time is related to time-base setting.

1.3.2 X-deflection

* Deflection coeff. Via channel A or B	2 mV/div...10 V/div	In 1, 2, 5 sequence + variable
Via EXT input	100 mV/div	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Error limit		
Via channel A or B	± 5%	
Via EXT input	± 5%	
* Bandwidth	DC... ≥ 2 MHz	DC coupled
* Phase shift between X and Y-deflection	< 3° DC...100 kHz	DC coupled
* Dynamic range	> 24 div DC...100 kHz	DC coupled
1.3.3 EXT input		
* Input impedance	1 MΩ ± 2%	Measured below 1 MHz
Paralleled by	20 pF ± 2 pF	Measured below 1 MHz
* Max. input voltage (d.c. + a.c. peak)	400 V	For derating with frequency see figure 3.
Max. test voltage (rms)	500 V	Max. duration 60 s.
* Lower -3 dB point	< 10Hz	AC coupled
1.4 TRIGGERING		
* Trig. mode		
AUTO (auto free run)	Bright line in absence of trigger signal	Auto free run starts 100 ms (typ.) after no trigger pulse. Switches automatically to free run if one of the display channels is grounded.
TRIGGERED		In multi-channel mode (alternate) each channel is armed after reset; if sweep has already started, sweep is not finished. Not applicable in peak-to-peak coupling
SINGLE		

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* TRIGGER SOURCE	A, B, Composite (A/B), EXT, Line	In line, trigger source is always the mains. Line trigger amplitude depends on line input voltage. Approx. 6 div. at 220 Vmains voltage and 50 Hz frequency.
* TRIGGER COUPLING	Peak-to-peak (p-p), DC, TVL, TVF, LF, HF	
* LEVEL range		
Peak-to-peak:	Related to peak-to-peak value	p-p coupling is DC rejected
DC internal	> ± 8 div.	
DC external	> ± 800 mV	
TVL/TVF	Fixed level	
HF	50 kHz ... 100 MHz	
LF	DC ... 50 kHz	
* Trigger slope	+/-	Slope sign in LCD. For TVL/TVF + or - is used to indicate positive or negative video
* TRIGGER SENSITIVITY		
Internal		
DC...10 MHz	> 0,5 div.	Trig. coupling DC.
At 100 MHz	> 1,2 div.	Trig. coupling DC.
At 150 MHz	> 2,0 div.	Trig. coupling DC.
External		
DC...10 MHz	> 50 mV	Trig. coupling DC.
At 100 MHz	> 150 mV	Trig. coupling DC.
At 150 MHz	> 500 mV	Trig. coupling DC.
TVL/TVF internal	> 0,7 div.	Sync. pulse
TVL/TVF external	> 70 mV	Sync. pulse

1.5 SIGNAL ACQUISITION

* Sampling type		
at 50 s/div...0,5 µs/div.	Real time	For PM3365A/67A
at 0,2 µs/div...20 ns/div.	Equivalent time (Sequential sampling)	For PM3365A/67A
at 50 s/div...0,2 µs/div.	Real time	For PM3375A/77A
at 0,1 µs/div...20 ns/div.	Equivalent time (Sequential sampling)	For PM3375A/77A

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Maximum sample rate:		Sample rate depends on time/div setting
Real time	100 megasamples/s 250 megasamples/s	For PM3365/67 For PM3375/77
Equivalent time	2,5 gigasamples/s	
* Vertical (voltage) resolution	8 bits	0,4% of full range of 10 divisions.
* Horizontal (time) resolution:		
in single channel acquisition		
at 50 s/div...5 ms/div	4096 samples/acquisition	1 Sample = 0,025% of full record.
at 2 ms/div...20 ns/div	512 samples/acquisition	1 Sample = 0,2% of full record.
in dual channel acquisition		
at 50 s/div...5 ms/div	2048 samples/acquisition	1 Sample = 0,05% of full record.
at 2 ms/div...20 ns/div	512 samples/acquisition	1 Sample = 0,2 % of full record.
* Record length	10,2 x time/div	Display in unmagnified position.
* Acquisition time:		
real time	10,2 x time/div	
at 5 ms/div...0,5 μs/div	+30 ms...50 ms	exclusive delay time
at 0,5 s/div...5 ms/div	+50 ms...70 ms	exclusive delay time
equivalent time	1024 x 20 μs +30 ms...50 ms	Depending on trigger frequency
* Sources	Channel A, Channel B	Channel B can be inverted before acquisition.
* Acquisiton modes	1 Channel only	Full memory available for 1 channel
	2 Channels	Simultaneously sampled; 2 channels share memory.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO

1.6 CHANNELS A AND B

* Frequency response:		Z source = 25 Ω
Lower transition point of BW		
Input coupling in DC position	d.c.	
Input coupling in AC position	≤ 10 Hz	
Upper transition point of BW (amb 15...35°C)		
20 mV/div...10 V/div	≥ 100 MHz (-3 dB)	Deviation max. 3 MHz for ambient 0...40°C.
2 mV/div...10 mV/div	≥ 75 MHz (-3 dB)	Deviation max. 3 MHz for ambient 0...40°C.
* Max. base line instability:		
Jump (Ambient: 15...35°C):		Add 25% for ambient 0...40°C.
when switching to memory mode:	≤ 0,3 div	Add 0,5 div for 0,5 μs/div and 1 μs/div
when actuating INVertor switchd	≤ 0,3 div	
between any time/div positions	≤ 0,5 div	
Drift	≤ 0,1 div/h	Measured in 20 mV/div position
Temperature coef.	≤ 0,05 div/K	Measured in 20 mV/div position

1.7 TIME BASE

* Modes	Recurrent	
	Single shot	
	Multiple shot	Up to 2 shots
	Roll	Will be stopped by trigger
	Zoom	The part of the trace between the cursors will be magnified by doing a new acquisition with adopted trigger delay and time/div

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Time coefficients:		
In recurrent	0,5 s/div...20 ns/div	
In single shot and	50 s/div...0,5 μs/div	For PM3365A/67A
multiple shot	50 s/div...0,2 μs/div	For PM3375/77
Error limit (Ambient: 15...35°C)		
In real time mode	± 1 %	Add 0,5 % for ambient 0...40°C
up to memory	± 0,1%	
In equivalent time mode	± 3%	

1.8 TRIGGER

* Trigger delay range:		
In real time		Selectable in divisions
	-10... + 2500 div	For PM3365A/67A
	-10... + 5000 div	For PM3375/77
In equivalent time	0... + 20 div	Selectable in divisions.
Accuracy	± 0,3 div	
Fixed trigger delay in sampling mode	100 ns ± 10 ns	
* Trigger level view		Indication in LCD
Inaccuracy	≤ 0,5 div	

1.9 MEMORY

* Memory size:		
Registers	4	
Register depth:		
acquisition	4096 words	
register	4096 words	
Wordlength	8 bits	
* Functions	Clear	
	Load	Contents of acquisition are saved in register
	Lock	Memory system is locked. If lock is not active the signal is written into the acquisition memory.
* Front setting memory size	64 front settings	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO

1.10 DISPLAY

* Sources	Channel A, Channel B, Reference register , R1 or R2 or R3	In any combination
* Display expansion horizontal	1x...32x	Value of trigger delay setting in LCD is based on unmagnified display
* Display manipulations	dot join	Including digital interpollation at 20 ns/div...2 ms/div
* Display part range horizontal	full memory	The displayed part of the magnified memory can be chosen

1.11 CALCULATION FACILITIES

* Functions	Frequency, Period, Pulse width, Rise or fall time, Peak-to-peak value, Root mean square value, Mean value, dV, dt Average Envelope	Between cursors indicated by markers

1.12 AUTO SETTING

* Settling time	3 s (typical)	Auto set is done in analog mode.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO

1.13 CURSORS

* Horizontal resolution:		
in single channel mode	1 : 4096	
in dual channel mode	1 : 2048	
at 2 ms/div...20 ns/div	1 : 512	display in dots
	1 : 1024	display in dot-join
* Vertical resolution	1 : 256	over 10 div
* Read out resolution	3 Digits	
* Voltage cursors:		
Error limit amb. 15...35°C	±3 %	Referred to input at BNC, error of probes etc. excluded. Add 3% for ambient 0...40°C.
Cursor range	Displayed part of memory	Cursors can not pass each other. (X-position is ignored).

1.14 POWER SUPPLY

* Line input voltage a.c.:		One range
Nominal	100 V...240 V	
Limits of operation	90 V...250 V	
* Line frequency:		
Nominal	50 Hz...400 Hz	
Limits of operation	43 Hz...445 Hz	

* Safety requirements within specification of:
IEC 348 CLASS I
UL 1244
VDE 0411
CSA 556 B

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Power consumption (AC source)		At nominal source voltage
Nominal	75 W	For PM3365A/67A
	85 W	For PM3375/77

1.15 SUNDRIES

* Z-MODulation		TTL-compatible
ViH	≥ 2,0 V	Blanks display.
ViL	≤ 0,8 V	Max. intensity.
Minimum pulse width for blanking	25 ns	Analog control between ViH and ViL is possible.
* CAL output		To calibrate drop or tilt of probes. The output may be short-circuited to ground.
Output voltage	1,2 V ± 1%	Rectangular output voltage.
Frequency	2 kHz	
* Data and settings retention:		When instrument is switched off or during mains failure. The oscilloscope settings and traces are saved.
Memory back-up voltage	2...3,5 V	
Memory back-up current drain	Typical 25 μA	At 25°C
Recommended batteries		According to IEC285 (= Alkaline Manganese Penlight Battery)
type	LR 6	e.g. PHILIPS LR 6.
quantity	2 pcs	Delivered with the instrument.
temperature rise of batteries	20 K	After warming-up period of instrument.
Retention time	typical 5 years	At 25°C, with recommended (fresh) batteries.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Temperature range	0... +70°C	At -40...0°C settings retention is uncertain. It is advised to remove batteries from the instrument when it is stored during longer (24h) period below -30°C or above 60°C. WARNING: UNDER NO CIRCUMSTANCES BATTERIES SHOULD BE LEFT IN INSTRUMENT AT TEMPERATURES BEYOND THE RATED RANGE OF THE BATTERY. SPECIFICATIONS!
* Analog plot output		
Connector	DIN plug 9 pin female	
Functions	Memory dump	Register selectable
Sensitivity	1 V/full memory ±3%	Horizontal and vertical
Pen lift	TTL compatible	Pen-up is software selectable (0 or 1). Open collector output; max. 12 V.
Plot time per dot	20 ms...2000 ms	Software selectable
Plot sequence	Channel A first	In dual channel operation; with more registers starting with the lowest number.

1.16 ENVIRONMENTAL CHARACTERISTICS

The environmental data mentioned in this manual are based on the results of the manufacturer's checking procedures. Details on these procedures and failure criteria are supplied on request by the PHILIPS/FLUKE organisation in your country, or by PHILIPS, INDUSTRIAL AND ELECTRO-ACOUSTIC SYSTEMS DIVISION, EINDHOVEN, THE NETHERLANDS.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Meets environmental requirements of:	MIL-T-28800 C, type III, CLASS 5 Style D	Except for front cover.
* Temperature: operating temp. range within specification	10°C...40°C	MIL-T-28800 C par. 3.9.2.3. tested cf. par. 4.5.5.1.1.
Limits of operating temperature range	0°C...40°C	MIL-T-28800 C par. 3.9.3.3. tested cf. par. 4.5.5.1.1.
Non-operating (storage):	-40°C... +75°C	Cf. MIL-T-28800 C par. 3.9.2.3. tested cf. par. 4.5.5.1.1.
* Max. humidity operating/non-operating 95% RH		10...30°C
* Max. altitude:		MIL-T-28800 C par. 3.9.3. tested, par. 4.5.5.2.
Operating	4,5 km (15 000 feet)	Maximum (Operating temperature derated 3°C for each km, for each 3000 feet, above sea level).
Non-operating (storage)	12 km (40 000 feet)	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* Vibration (operating)		MIL-T-28800 C par. 3.9.4.1. tested, par. 4.5.5.3.1.
Freq. 5...15 Hz		
Sweep time	7 min.	
Excursion (p-p)	1,5 mm	
Max acceleration	7 m/s^2 (0,7 x g)	at 15 Hz
Freq. 15...25 Hz		
Sweep time	3 min.	
Excursion (p-p)	1 mm	
Max acceleration	13 m/s^2 (1,3 x g)	at 25 Hz
Freq. 25...55 Hz		
Sweep time	5 min.	
Excursion (p-p)	0,5 mm	
Max acceleration	30 m/s^2 (3 x g)	at 55 Hz
Resonance dwell	10 min.	at each resonance freq. (or at 33 Hz if no resonance was found). Excursion, 9.7.1. to 9.7.2.
* Shock (operating)		MIL-T-28800 C par. 3.9.5.1. tested, par. 4.5.5.4.1.
Amount of shocks		
total	18	
each axis	6	3 in each direction
Shock wave-form	Half sine-wave	
Duration	11 ms	
Peak acceleration	300 m/s^2 (30 x g)	
* Bench handling		MIL-T-28800 C par. 3.9.5.3. tested, cf. par. 4.5.5.4.3.
Meets requirements of	MIL-STD-810 method 516, proced. V	
* Salt atmosphere		MIL-T-28800 C par. 3.9.8.1. tested, par. 4.5.6.2.1.
Structural parts meet requirements of	MIL-STD-810 method 509, proced. I salt solution 20%	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFO
* EMI (Electronic Magnetic Interference) meets requirements of	MIL-STD-461 CLASS B	Applicable requirements of part 7
	CE03, CE07 RE02 CS01, CS02, CS06 RS02, RS03	No malfunction Fieldstrength 10 V/m (10 kHz...30 MHz), 5 V/m (30 kHz...1 GHz)
* Magnetic radiated susceptibility Maximum deflection factor	2 mm/Gs	Tested conforming IEC 351-1 par 5.1.3.1 Measured with instrument in a homogeneous magnetic field (in any direction with respect to instrument) with a flux intensity (p-p value) of 1,42 mT (14,2 gauss) and of symmetrical sine-wave form with a frequency of 45 Hz...66 Hz

1.17 SAFETY

* Meets requirements of	IEC 348 CLASS I	
	VDE 0411	Except for power cord, unless shipped with Universal European power plug.
	UL 1244	Except for power cord, unless shipped with North American power plug
	CSA 556 B	

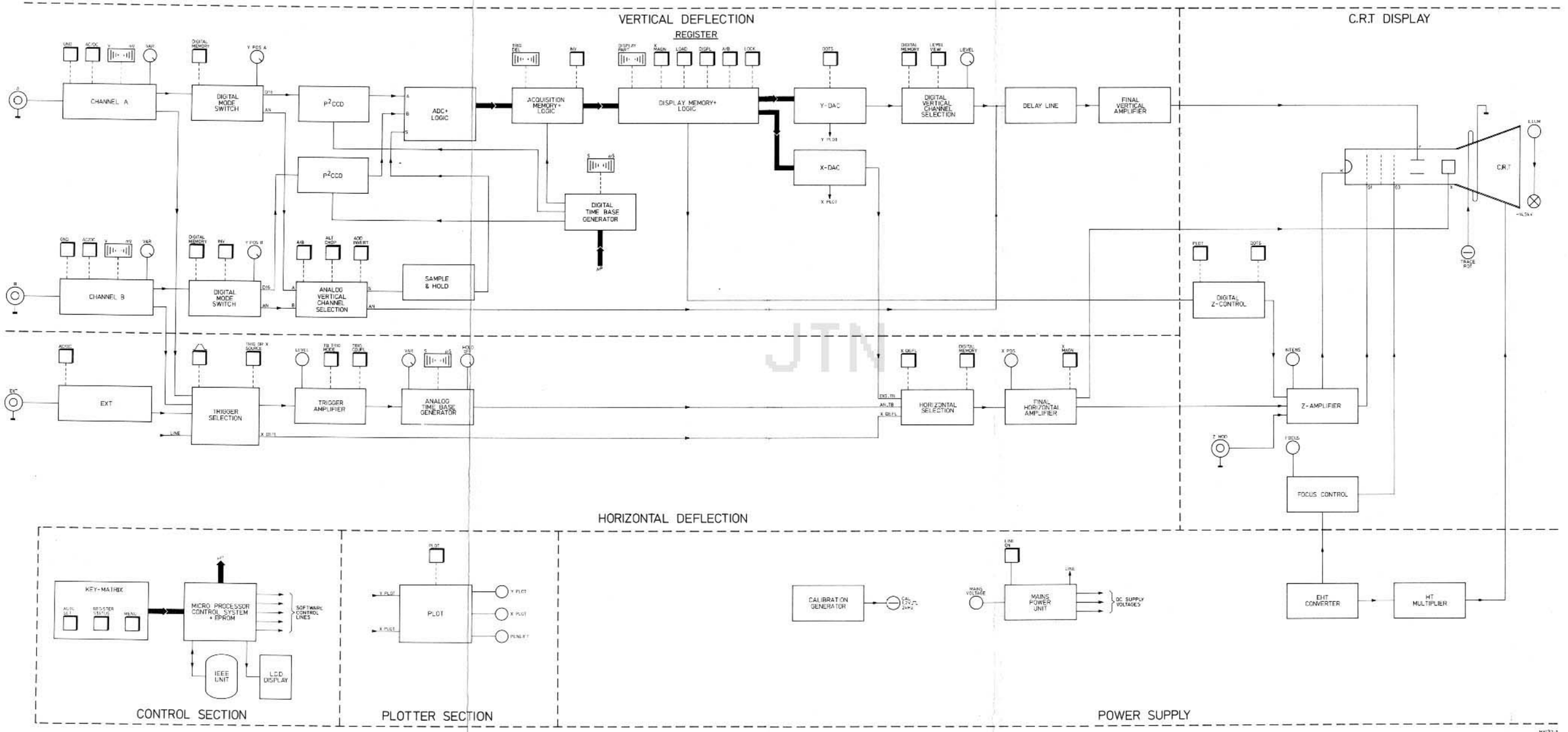


Figure 4 Blockdiagram

2 PRINCIPLE OF OPERATION

This section describes the principle of operation and should be read in conjunction with the block diagram (see Figure 4).

The instrument can be used as an analog real time oscillosope and as a digital storage oscilloscope. This selection can be made by means of the DIGITAL MEMORY key, which selects an analog and a digital signal path. At the same time, selection is made between an analog time-base circuit and a digital time base circuit.

The oscilloscope circuit consists of six functional main sections:

- Control section (see Section 2.1.)
- Vertical deflection (see Section 2.2.)
- Horizontal deflection (see Section 2.3.)
- CRT display section (see Section 2.4.)
- Plotter section (see Section 2.5.)
- Power supply section (see Section 2.6.)

2.1. CONTROL SECTION

The knobs in the key-matrix on the front panel drive the various circuits via the software control lines. These lines are controlled by the microprocessor, which also drives the LCD (Liquid Crystal Display) for the control setting indication.

AUTO SET enables vertical and horizontal functions to be set depending on the value of the input signal.

MENU permits checking of all possible knob setting in the LCD.

The rotary controls and the knob LINE ON are directly connected to their control circuits.

2.2 VERTICAL DEFLECTION

As the vertical channels A and B are identical, only one is described. The input signals of channels A and B are fed via the ATTENUATORS to the DIGITAL MODE SWITCH.

The following ATTENUATOR functions are controlled by the front panel keys via the microprocessor.

GND	Disconnects the input and ground the attenuator
AC/DC	Input signal coupling
V-mV	Vertical deflection coefficient
VAR	Continuously-variable attenuation control UNCAL indicated in LCD

The DIGITAL MODE SWITCH has the following functions:

DIGITAL MEMORY	Selection for real time mode or digital memory mode.
INV (ch. B only)	Input signal and polarity inversion in digital memory mode.

Vertical shifting of the displayed signal is achieved by the Y POS rotary knob.

Real-time mode:

In real-time mode the signal is fed directly to the ANALOG VERTICAL CHANNEL SELECTION.

The ANALOG VERTICAL CHANNEL SELECTION selects the input signals A and/or B, depending on which function is activated via the keys.

The following vertical display modes can be selected:

A	channel A only
B	channel B only
A and B	channels A and B displayed simultanously. ALT or CHOP mode is selected by its key.
ADD/ INV (ch. B only)	channel A added to channel B is displayed. input signal inversion in real time mode.

Digital memory mode:

In digital memory mode, the signal is applied to the P^2CCD (Peristaltic Profiled Charge Coupling Device), or to the SAMPLE & HOLD depending on the time base mode.

The P^2CCD is active in time base modes Roll, Direct and P^2CCD, and serves as a delay-line (for Roll or Direct mode) or a time converter (for P^2CCD mode). This is controlled by the DIGITAL TIME-BASE GENERATOR. The output is connected to the ADC circuit.

The SAMPLE & HOLD is active in the time base mode Sequential sampling. This is controlled by the DIGITAL TIME-BASE GENERATOR. The output is connected to the ADC circuit.

The resulting signal is multiplexed and then digitized in a ANALOG-TO-DIGITAL CONVERTER (ADC). The timing of the ADC conversion is determined by the DIGITAL TIME-BASE GENERATOR.

After digitizing, the binary code is processed by the display processor containing the ACQUISITION MEMORY and the DISPLAY MEMORY. The TRIG DEL and DISPLAY PART UP-DOWN keys serve for manipulation of the digital signal in the ACQUISITION circuit.

The DISPLAY LOGIC allows selection of several digital vertical display modes of ch. A, ch. B, REG A and REG B by means of the A/B, REGISTER LOAD and REGISTER DISPL. keys. LOCK serves for locking the contents of the DISPLAY MEMORY.

The digital output information of the DISPLAY MEMORY is converted again to an analog signal in the VERTICAL or HORIZONTAL DIGITAL-TO-ANALOG CONVERTER (Y-DAC and X-DAC). The DOTS key permits selection for a dot-joined display on the CRT screen.

The output of the Y-DAC is applied to the DIGITAL VERTICAL CHANNEL SELECTION.
The DIGITAL MEMORY key enables the digital memory to be displayed on the screen.
LEVEL VIEW permits displaying of the trigger level. This trigger level can be adjusted by means of the TRIG LEVEL rotary knob.

Another output of the Y-DAC is applied to the PLOT circuit.

In analog mode, the DELAY LINE permits the viewing of leading edges of fast input signals.

The selected signal derived from the analog path or digital path is fed, via the DELAY LINE and the FINAL VERTICAL AMPLIFIER to the vertical deflection plates (Y) of the CRT.

2.3 HORIZONTAL DEFLECTION

The analog time-base is triggered on the signal selected in the TRIGGER SELECTION stage.
Trigger selection can be made by the TRIG SOURCE or X key for:

A	signal derived from channel A
B	signal derived from channel B
COMP	composite triggering of both channels A and B
EXT	external input via BNC socket
LINE	signal derived from mains (line) voltage

Positive or negative triggering is selected by the SLOPE key.

After selection of the source, selection of the TB trigger mode or coupling can be made in the TRIGGER AMPLIFIER. The TB TRIG MODE key allows selection of:

AUTO	Automatic free-run in the absence of trigger signals
TRIG	Normal triggering
MULTIPLE	TB sweep runs twice for REGISTER and DISPLAY MEMORY
SINGLE	TB sweep started once

The TRIG COUPL softkey allows selection of:

P-P	Peak-to-peak triggering
DC	Normal triggering
TVF	Triggering on TV FIELD synchronisation pulses
TVL	Triggering on TV LINE synchronisation pulses
LF	Triggering on HF REJECTED signal
HF	Triggering on LF REJECTED signal

The level at which the TB starts is determined by adjustment of the TRIG LEVEL rotary knob. This level is displayed by means of the LEVEL VIEW key.

The ANALOG TIME-BASE GENERATOR determines the horizontal deflection coefficient in the real time mode via the TB s-μs UP-DOWN key and the VAR rotary knob.
The LCD displays the correct deflection simultaneously.

The DIGITAL TIME-BASE GENERATOR is under control of the MICROPROCESSOR CONTROL SYSTEM.

The DIGITAL TIME-BASE GENERATOR determines the horizontal deflection coefficient in the digital memory mode via the s-μs UP-DOWN control. The output of this block controls the P^2CCD or ACQUISITION logic.

The X-DAC receives its digital information from the DISPLAY MEMORY and converts it into the analog horizontal deflection signal. The output of the X-DAC is applied to the HORIZONTAL DEFLECTION.

The HORIZONTAL SELECTION stage selects the horizontal deflection source by the DIGITAL MEMORY key or the X DEFL key.
The following deflection sources are possible:

ANALOG TIME BASE
DIGITAL TIME BASE
X DEFLECTION

The X MAGN key enables the analog horizontal deflection coefficient to be magnified by a factor of 10 (factor 2, 4, 8, 16 and 32 in digital mode). Horizontal shift of the trace is achieved by the X POS rotary knob. The FINAL HORIZONTAL AMPLIFIER drives the horizontal deflection plates (X) of the CRT.

2.4 CRT DISPLAY

The trace intensity on the CRT is controlled by the Z AMPLIFIER.
The Z AMPLIFIER blanks the flyback on the trace and also the switching intervals between the traces. For the vertical switching modes in real-time mode, ALT and CHOP, the Z AMPLIFIER is driven by a Z-blanking signal from the ANALOG VERTICAL CHANNEL SELECTION (CHOP) or the HORIZONTAL SELECTION (ALT).
In the digital mode the blanking pulse is derived from the DISPLAY Logic. DOTS serves for a dot-joined display and PLOT serves for a more intensified dot on the CRT screen during the PLOT action.
External trace blanking is obtained via an applied signal to the Z MOD BNC-input.

The FOCUS rotary knob drives the focus electrodes of the CRT via the FOCUS control unit, to give trace sharpness.

Trace alignment is achieved by the TRACE ROT rotary knob, which drives the trace rotation coil.

The ILLUM rotary knob provides illumination of the graticule by means of two lamps.

2.5 ANALOG PLOT SECTION

The Y-DAC and X-DAC supply the plot signals to the PLOT circuit.
When the PLOT key is depressed this circuit generates the correct signal to the ANALOG PLOT socket at the rear of the instrument.

2.6 POWER SUPPLY SECTION

The oscilloscope may be powered by any a.c. voltage between 100 V and 240 V.
When switched off, the LINE ON switch interrupts the primary circuit. This switch is the only front-panel pushbutton that is not controlled by the microprocessor.

After rectification, the relevant d.c. supply voltages feed the various circuits in the instrument.

When the instrument is operating from an a.c. mains voltage, a related signal at mains frequency is fed to the TB TRIGGER SELECTION for LINE triggering.

The EHT CONVERTER produces 14,5 kV via the HT MULTIPLIER for the accelerator anode of the CRT and -2,1 kV for the FOCUS CONTROL.

The calibration square-wave signal is generated in the CALIBRATION GENERATOR and fed to the CAL socket.

3 BRIEF CHECKING PROCEDURE

3.1 GENERAL INFORMATION

This procedure 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 their characteristics.

WARNING: Before switching-on, ensure that the oscilloscope has been installed in accordance with the instructions.

NOTE: The procedure does not check every facet of the instrument's calibration; rather, it is concerned primarily with those parts of the instrument that are essential to measurement accuracy and correct operation.
It is not necessary to remove the instrument covers to perform this procedure. All checks are made from the outside of the instrument.

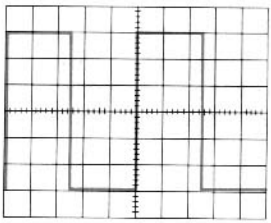
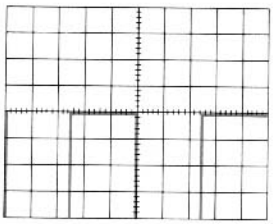
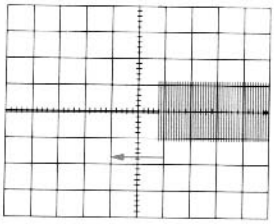
If this test is started a few minutes after switching-on, bear in mind that test steps may be out of specification, due to insufficient warm- up time.
Therefore, to ensure accuracy, allow the full indicated warm- up time.
The following abbreviations are used: CW = Clockwise
CCW = Counter clockwise

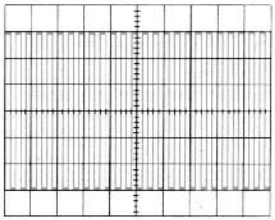
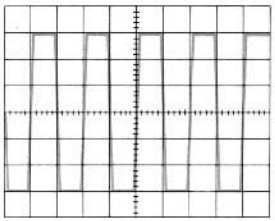
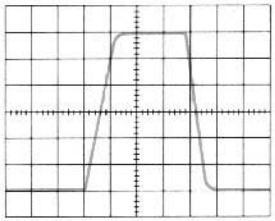
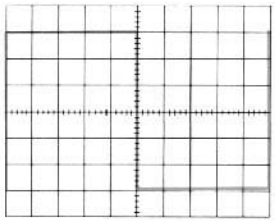
The brief checking procedure is set up in such a way that in a fixed sequence of thirteen steps the most important functions, including front panel rotary knobs, are shown and checked. At the end of each step the rotary knobs must be reset to the previous setting. As stated, the procedure can be performed without removing the instrument covers.
For a complete check of every facet of the instruments calibration, refer to Chapter 4 (Performance check).

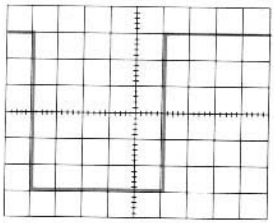
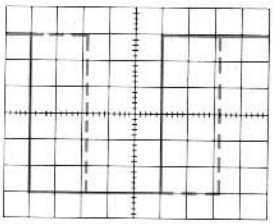
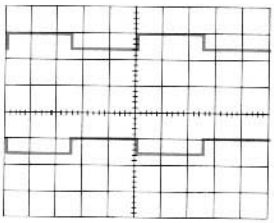
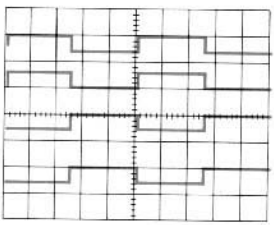
3.2 ENTERING THE BRIEF CHECKING PROCEDURE

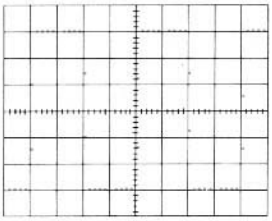
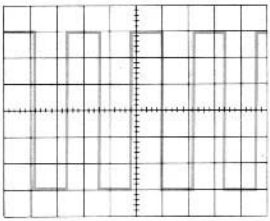
To enter the procedure, proceed as follows:
- Press MENU and keep it pressed.
- Press also AUTO SET.
- Now the Service menu has been entered, the LCD should indicate "*".
- Press "CHECK", which is one of the CRT softkeys.
- The CRT should indicate: "BRIEF CHECKING" on the upper side of the screen.
- Check that the trace lies parallel with the horizontal graticule lines; if necessary readjust the TRACE ROTATION control
- Connect the CAL output to the channel A and B input sockets via 10:1 passive probes.
- Each step can now be selected by pressing the DOWN or UP softkey under the CRT screen.

- For leaving the brief checking procedure, press RETURN.

Measurements	Rotary knobs	Requirements
DC input coupling		
		Square-wave of 6 DIV p-p (compensate both probes)
	Y POS A or B:CCW	Check that the signals shift downwards.
	Y POS A or B:CW	Check that the signals shift upwards.
	LEVEL: CW or CCW	Check that the trace triggers in the most extreme positions of the LEVEL rotary knob.
AC input coupling		
		Check that the signals shift downwards since the attenuator input are AC-coupled.
		Check that the signals trigger on the falling edge.
	VAR A or B: CCW	Check that the amplitude decreases.
	LEVEL: CW or CCW	Check that the traces do not trigger in the most extreme positions of the LEVEL rotary knob.
Roll Mode		
		Check that the trace grows from right to left.

Measurements	Rotary knobs	Requirements
Display part x1		
	X POS: CW or CCW	Check that a 6 div square-wave with a high number of signal periods is visible. Check that the trace shifts horizontally over the screen.
Display part x8		
		Check that the number of signal periods is decreased by eight.
Display part x32		
		Check that the number of signal periods is again decreased by four.
Trigger delay 0 div		
		Check that a 6 div square-wave is visible. Trigger moment is at 0 div.

Measurements	Rotary knobs	Requirements
Pre-trigger 6 div 		Check that the rising edge is on the 6th vertical graticule line.
Delay trigger 94 div 		Check that the rising edge is on the 6th vertical graticule line approx.
Multi display A + B 		Check that the signals are displayed simultaneously.
Register display 	Y POS A or B: CW	Check that four signals are displayed on the screen. Note that first the Y POS A or Y POS B rotary knob must be turned before you can see the ch. A or ch. B signal.

Measurements	Rotary knobs	Requirements
Dotted display		
		Check that the signal is displayed in only dots.
Locked display		
		Check that a 6 div square-wave is displayed.
	VAR A or B: CW or CCW	Check that the VAR rotary knob is not active.
	Y POS A or B: CW or CCW	Check that the Y POS rotary knob is not active.
	X POS: CW or CCW	Check that the trace shifts horizontally over the screen.

NOTE: You can leave the service menu by pressing the AUTO SET key.

4 PERFORMANCE TEST

4.1 GENERAL INFORMATION

WARNING: Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions, outlined in Section 2 of the Operation Guide.

This procedure is intended to:

- Check the instruments' specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instruments.
- Check the necessity of recalibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instruments calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the outside of the instrument.

If the test is started within a short period after switching-on, bear in mind that steps may be out of specification, due to insufficient warming-up time. Warming-up time under average conditions is 30 minutes.

The checks are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the intensity and trigger-level controls as needed.

IMPORTANT NOTES

- At the start of every check, the controls always occupy the AUTO SET position, unless otherwise stated.

- The input voltage has to be supplied to the A-input; unless otherwise stated. Set the TIME/DIV switch to a suitable position; unless otherwise stated.

- Tolerances given are for the instrument under test and do not include test equipment error.

In this chapter in some checks channel B is mentioned between brackets behind channel A. It is advised to perform channel A checks first. After that the checks for channel B can be done.

4.2 RECOMMENDED TEST EQUIPMENT

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq: 1 MHz...10 MHz Sine-wave/square-wave Ampl: 0...20 V (pp) DC offset -5... +5 V Rise-time ≤30 ns Duty cycle 50 %	Philips PM5134
Constant amplitude sine-wave generator	Freq: 100 kHz...50 MHz Constant pp. amplitude of 120 mV and 3 V	Tektronix SG 503
Square-wave calibration generator	For ampl. calibration: Freq: 1 kHz Ampl: 10 mV...50 V For rise-time measurements: Freq: 1 MHz Ampl: 10...500 mV Rise-time: ≤1ns	Tektronix PG 506
Time-marker generator	Repetition rate: 0,5 s...50 ns	Tektronix TG 501
Variable mains transformer	Well insulated output voltage 90...264 V (ac)	Philips order. number 2422 529 00005
Moving iron meter		
Dummy probe 2:1	1 M Ω± 1 % // 20 pF	
Cables, T-piece, 10:1 attenuator, terminations for the generator	General Radio types for fast rise-time, square-wave and high freq. sine-wave BNC types for other applications	

4.3 TEST PROCEDURE

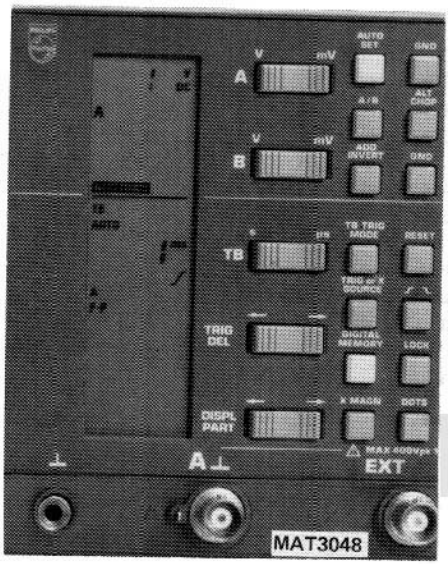


Figure 4.1 SOFTSTART condition

4.3.1 Preliminary settings

TEST EQUIPMENT No

TEST RESULTS

SETTINGS/
PROCEDURE

1- Switch-on the instrument.
2- Check if all LCD segments are on for approx. 1 second.
3- Press MENU and AUTO SET in sequence.
4- Check if the front controls are set in the softstart condition as indicated in figure 4.1.
5- At the start of every check **only** AUTO SET must be pressed (after the input signal is applied).

REQUIREMENTS See procedure 2 and 4.

4.3.2 Power supply

TEST EQUIPMENT Variable mains transformer

TEST RESULTS

SETTINGS/
PROCEDURE

1- Adjust mains voltage between 100 and 240 V (a.c.-r.m.s.), frequency 50...400 Hz.
2- Press POWER ON.
3- Apply the CAL signal provided on the front panel of the oscilloscope to input A , e.g. by means of a probe.
4- Press AUTO SET.

REQUIREMENTS

1- Starts at any mains voltage between 100 and 240 V.
2- Instruments performance does not change over indicated mains voltage range; displayed CAL signal distortion-free and with equal intensity.

4.3.3 Power consumption

TEST EQUIPMENT -Variable mains transformer
-Watt meter

TEST RESULTS

SETTINGS/
PROCEDURE
1- Adjust mains voltage at 220 V (r.m.s.).
2- Press POWER ON.

REQUIREMENTS Power consumption is maximum :
- 75 W for PM3365A/PM3367A
- 85 W for PM3375/PM3377

4.3.4 Vertical deflection; deflection coefficients

TEST EQUIPMENT Square-wave calibration generator (PG506)

TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 1 kHz square-wave signal of 10 mV to input A (B).
2- Press AUTO SET.
3- Set A (B) at 2 mV/div.
4- Check if the amplitude of the signal agrees with the table specified in requirements.

REQUIREMENTS

Input voltage (pp)	A(B) setting	Requirements
10 mV	2 mV	4,85...5,15 div
20 mV	5 mV	3,88...4,12 div
50 mV	10 mV	4,85...5,15 div
0,1 V	20 mV	4,85...5,15 div
0,2 V	50 mV	3,88...4,12 div
0,5 V	0,1 V	4,85...5,15 div
1 V	0,2 V	4,85...5,15 div
2 V	0,5 V	3,88...4,12 div
5 V	1 V	4,85...5,15 div
10 V	2 V	4,85...5,15 div
20 V	5 V	3,88...4,12 div
50 V	10 V	4,85...5,15 div

4.3.5 Vertical deflection; variable gain control range
(continuation of 4.3.4)

TEST RESULTS

SETTINGS/
PROCEDURE Turn VAR control fully anti-clockwise.

REQUIREMENTS Check if displayed amplitude is not more than 2 div (1:2,5).

4.3.6 Vertical deflection; input coupling
(continuation of 4.3.5)

TEST RESULTS

SETTINGS/
PROCEDURE Turn VAR control fully clockwise.

REQUIREMENTS
1- Press GND and check if input signal is interrupted.
2- Press GND again, then AC/DC and check if in DC position the signal shifts upwards.

4.3.7 Vertical deflection, frequency response

TEST EQUIPMENT Constant amplitude sine-wave generator (SG503) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a constant amplitude sine-wave signal of 120 mV to input A(B).
2- Set A(B) at 20 mV/div
3- Set the frequency at 50 kHz and adjust the trace-height at exactly 6 div.
4- Increase the frequency up to 100 MHz (slowly) and check if the vertical deflection is 4,2 div or more over the complete bandwidth range.
5- Reduce the amplitude of the input signal to 12 mV and the frequency to 50 kHz.
6- Set A(B) at 2 mV and adjust the trace-height at exactly 6 div.

7- Increase the frequency up to 75 MHz (slowly) and check if the vertical deflection is 4,2 div or more over the complete bandwidth range.

REQUIREMENTS The vertical deflection must be 4,2 div or more.

4.3.8 Vertical deflection; rise-time

TEST EQUIPMENT Fast-rise square-wave generator (PG506)

TEST RESULTS

SETTINGS/ PROCEDURE

1- Set A(B) at 50 mV/div.
2- Press X MAGN.
3- Set TB at 5 ns/div.
4- Adjust the trace height exactly between the dotted lines 0 % and 100 % (5 div).

REQUIREMENTS Important:

$$t_r \text{ (measured)} = \sqrt{t_r \text{ (input signal)}^2 + t_r \text{ (osc.)}^2}$$

1- Check the rise-time measured between the 10 % and 90 % lines (4 div).
2- The rise-time must be 3,5 ns or less.

4.3.9 Vertical deflection; noise

TEST EQUIPMENT LF square-wave generator

TEST RESULTS

SETTINGS/ PROCEDURE

1- Apply a 10 Hz square-wave signal to input A, terminated with a 20 dB attenuator and a 50 Ω terminator.
2- Set channel A(B) to 2 mV/div.
3- Set coupling to DC
4- Set TB at 20 μs/div
5- Set TRIG SOURCE to B(A).

6- While the oscilloscope is not triggered, the input signal is visible as two traces, separated by the peak to peak voltage of the signal.
7- Decrease the input voltage in that way, that the two traces just meet each other without intensity variation.
8- Remove the 20 dB attenuator and measure the pp value of the square-wave voltage.
9- This value is equal to 10 times the noise of the trace. Divide this value by 10 to know the noise value of the trace.

REQUIREMENTS Ensure that the noise is less than 0,4 mV.

4.3.10 Vertical deflection; dynamic range at 10 MHz

TEST EQUIPMENT Constant amplitude sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 2,4 V (pp), frequency 10 MHz, to input A(B).
2- Set A(B) at 0,1 V/div.
3- Shift with the Y POS control the sine-wave vertical over the screen.

REQUIREMENTS Check if top and bottom of the sine-wave signal can be displayed distortion-free at the trace-height of 24 div.

4.3.11 Vertical deflection; dynamic range at 100 MHz
(continuation of 4.3.9)

TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 1,6 V (pp), frequency 100 MHz, to input A(B).
2- Set A(B) at 0,2 V/div.
3- Set the trace-height at exactly 8 div.

REQUIREMENTS Check if the sine-wave of 8 div is displayed distortion-free.

4.3.12 Vertical deflection; position range

TEST EQUIPMENT LF sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 8 V (pp), frequency 1 kHz, to input A(B).
2- Set A(B) to 0,5 V/div.

REQUIREMENTS Rotate the channel A(B) Y POS control fully clockwise and anti clockwise and check if the top and bottom of the signal can be positioned on the vertical centre of the screen.

4.3.13 Vertical deflection; cross talk between A and B at 10 MHz

TEST EQUIPMENT Sine-wave calibration generator (SG503) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 4 V (pp), frequency 10 MHz, to input A(B).
2- Press A/B (both channels displayed).
3- Set channel A and B to 0,5 V/div.
4- Press A/B, only the channel without input signal displayed.

REQUIREMENTS Check if the trace-height of the channel without input signal is less than 0,08 div, (better than 1:100).

4.3.14 Vertical deflection; cross talk between A and B at 100 MHz

TEST EQUIPMENT Sine-wave calibration generator (SG503) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 4 V (pp), frequency 100 MHz, to input A(B).
2- Press A/B (both channels displayed).
3- Set channel A and B to 0,5 V/div.

4- Press A/B, only the channel without input signal displayed.

REQUIREMENTS Check if the trace-height of the channel without input signal is less than 0,16 div, (better than 1:50).

4.3.15 Vertical deflection; common mode rejection ratio

TEST EQUIPMENT HF constant amplitude sine-wave generator (SG503)

TEST RESULTS

SETTINGS/
PROCEDURE

1- Apply a signal of 4 V (pp), frequency 1 MHz, to inputs A and B.
2- Set A and B to 0,5 V/div.
3- Set input coupling of A and B to DC.
4- Press ADD/INVERT three times, (ADD and INVERT on)
5- Adjust the VAR controls for minimum trace-height difference between channels A and B.

REQUIREMENTS Check if the trace-height of the A-B signal is less than 0,08 div.

4.3.16 Vertical deflection; LF linearity

TEST EQUIPMENT LF square-wave generator

TEST RESULTS

SETTINGS/
PROCEDURE

1- Apply a signal of 200 mV, frequency 50 kHz, to input A(B).
2- Set A(B) at 0,1 V/div.
3- Adjust the square-wave signal at the vertical centre of the screen.
4- Adjust the signal-height to exactly 2 div.
5- Shift the signal by means of the Y POS control to the two upper and lower divisions of the screen.

REQUIREMENTS Check if the trace-height in the two upper and lower divisions is 1,94...2,06 div.

4.3.17 Vertical deflection; visual signal delay

TEST EQUIPMENT Square-wave calibration generator (PG506) TEST RESULTS

SETTINGS/ PROCEDURE

1- Apply a fast rise-time (≤ 1 ns) signal of 0,5 V, frequency 1 MHz, to input A.
2- Press AUTO SET.
3- Set A at 0,1 V/div.
4- Set TB at 50 ns/div.
5- Press TB MAGN and turn X POS to display the rising edge.
6- Set INTENSITY fully clockwise.
7- Set trigger coupling to DC.
8- Adjust TRIG LEVEL for maximum visual signal delay.

REQUIREMENTS Check if visual signal delay is at least 15 ns.

4.3.18 Vertical deflection; base line jump

TEST EQUIPMENT No TEST RESULTS

SETTINGS/ PROCEDURE AND REQUIREMENTS Attenuator balance:

This check must be done in the service menu OFFS-A. To enter this menu proceed as follows:
Press MENU and keep it pressed, then press AUTO SET, the LCD shows an asterisk (*).

1- Select OFFS-A of CRT function controls.
2- Check LCD display; "3.0" flashing.
3- The attenuator is switched between the 1-2-5 positions.

4- Check if both spots do not jump more than 0,2 div (1 subdiv).

VAR balance:

1- Press mV of channel A UP-DOWN control.
2- Check LCD display: "3.1" flashing.
3- Rotate VAR control of channel A(B).
4- Check if the spot does not shift more than 0,2 div (1 subdiv).

x1/x10 attenuator offset:

1- Press mV of channel A UP-DOWN control
2- Check LCD display: "3.2" flashing.
3- Check if both spots do not jump more than 0,3 div (1,5 subdiv).

NORMAL-INVERT jump:

1- Press mV of channel A UP-DOWN control 4 times.
2- Check LCD display: "3.6" flashing.
3- Check if the displayed spot does not jump more than 0,2 div (1 subdiv).
4- Press AUTO SET 2 times to leave the SERVICE MENU.

4.3.19 Horizontal deflection; offset of trigger point

TEST EQUIPMENT No

TEST RESULTS

SETTINGS/ PROCEDURE AND REQUIREMENTS

This check must be done in the service menu OFFS-A. To enter this menu proceed as follows:
Press MENU and keep it pressed, then press AUTO SET, the LCD shows an asterisk (*).

1- Select OFFS-A of CRT function controls.
2- Press mV of channel A UP-DOWN control 3 times.
3- Check LCD display: "3.3" flashing.
4- Turn Y POS of channel B and set the spot in the vertical centre of the screen.
5- Check if the displayed spot does not jump more than 0,3 div (1,5 subdiv) horizontally.
6- Press mV of channel A UP-DOWN control.
7- Check LCD display: "3.4" flashing.
8- Turn Y POS of channel A and set the spot in the vertical centre.
9- Check if the displayed spot does not jump more than 0,3 div (1,5 subdiv) horizontally.
10- Press mV of channel A UP-DOWN control.
11- Check LCD display: "3.5" flashing.
12- Turn Y POS of channel B and set the spot in the vertical centre.
13- Check if the displayed spot does not jump more than 0,3 div (1,5 subdiv).
14- Press AUTO SET 2 times to leave the SERVICE MENU.

4.3.20 Horizontal deflection; X deflection

TEST EQUIPMENT LF sine-wave generator

TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 2 kHz to input A.
2- Press AUTO SET.
3- Set the trace height at 3 div.
4- Press X DEFL, and check if only the X DEFL is on.

REQUIREMENTS Check if a line with an angle of 45° is displayed.

4.3.21 Horizontal deflection; time-base deflection coefficients.

TEST EQUIPMENT Time marker generator (TG501)

TEST RESULTS

SETTINGS/
PROCEDURE

1- Apply a time marker signal of 50 ns to input A.
2- Press AUTO SET.
3- Check the deflection coefficients in TB x1 and TB x10 according to the table in requirements.

REQUIREMENTS

Time marker pulse	TB setting	Max. error at: TB x1	TB x10
50 ns	50 ns	±3 %	±4 %
0,1 µs	0,1 µs	±3 %	±4 %
0,2 µs	0,2 µs	±3 %	±4 %
0,5 µs	0,5 µs	±3 %	±4 %
1 µs	1 µs	±3 %	±4 %
2 µs	2 µs	±3 %	±4 %
5 µs	5 µs	±3 %	±4 %
10 µs	10 µs	±3 %	±4 %
20 µs	20 µs	±3 %	±4 %
50 µs	50 µs	±3 %	±4 %
0,1 ms	0,1 ms	±3 %	±4 %
0,2 ms	0,2 ms	±3 %	±4 %
0,5 ms	0,5 ms	±3 %	±4 %
1 ms	1 ms	±3 %	±4 %
2 ms	2 ms	±3 %	±4 %
5 ms	5 ms	±3 %	±4 %
10 ms	10 ms	±3 %	±4 %
20 ms	20 ms	±3 %	±4 %
50 ms	50 ms	±3 %	±4 %
0,1 s	0,1 s	±3 %	±4 %
0,2 s	0,2 s	±3 %	±4 %
0,5 s	0,5 s	±3 %	±4 %

4.3.22 Horizontal deflection; variable control ratio (VAR TB)

TEST EQUIPMENT Time marker generator (TG501) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 1 μs time marker signal to input A.
2- Set TB to 0,2 μs/div; time marker on the first and sixth graticule line.
3- Set the TB VAR fully anti-clockwise.

REQUIREMENTS Check if the second marker is placed between the second and third graticule line. This means that the VAR control overlaps the timebase steps 0,2 to 0,5 μs (2,5:1).

4.3.23 Horizontal deflection; TB magnifier balance

TEST EQUIPMENT Time marker generator (TG501) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 1 μs time marker signal to input A.
2- Set TB to 0,2 μs/div; time marker on the first and sixth graticule line.
3- Set the TB VAR fully clockwise.
4- Set X MAGN on.
5- Set the top of the second marker pulse exactly at the vertical centre of the graticule.
6- Set X MAGN to off.

REQUIREMENTS Check if the top of the second marker pulse is not shifted more than 0,5 div.

4.3.24 Horizontal deflection; X deflection coefficient via A

TEST EQUIPMENT Sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 2 kHz to channel A and set for a trace-height of 4 div.
2- Press X DEFL.

3- Press A/B twice for only channel B display.

REQUIREMENTS Check if a horizontal line of 3,8...4,2 div is displayed.

4.3.25 Horizontal deflection; X deflection coefficient via EXT

TEST EQUIPMENT Sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 1 V (pp), frequency 2 kHz to input EXT.
2- Select EXT with TRIG or X SOURCE.
3- Press X DEFL.

REQUIREMENTS Check if a horizontal line of 9,5...10,5 div is displayed.

4.3.26 Horizontal deflection; X deflection coefficient via LINE

TEST EQUIPMENT No TEST RESULTS

SETTINGS/
PROCEDURE
1- Select LINE with TRIG or X SOURCE.
2- Press X DEFL.

REQUIREMENTS Check if a horizontal line is displayed of approximately 8 div (at 220 V mains voltage).

4.3.27 Horizontal deflection; frequency response 1

TEST EQUIPMENT Constant amplitude sine-wave generator (SG 503). TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 50 kHz signal of 30 mV to input A.
2- Set A to 5 mV/div.
3- Press X DEFL.
4- Press A/B twice for channel B as vertical deflection.

5- Adjust the input voltage for exactly 6 div horizontal deflection.
6- Increase the input frequency up to 2 MHz.

REQUIREMENTS Check if the trace width is at least 4,2 div over the complete bandwidth range.

4.3.28 Horizontal deflection; frequency response 2

TEST EQUIPMENT LF sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 10 Hz signal to input A.
2- Set the vertical deflection of A to exactly 6 div.
3- Select X DEFL.
4- Press A/B twice for channel B as vertical deflection.

REQUIREMENTS Ensure that the trace width is at least 4,2 div.

4.3.29 Maximum phase shift between horizontal and vertical deflection

TEST EQUIPMENT LF sine-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a signal of 2 kHz to channel A and set for a trace-heigth of exactly 6 div.
2- Press X DEFL.
3- Increase the input frequency up to 100 kHz.

REQUIREMENTS Check if the phase shift is less than 3°, (see figure 4.2).

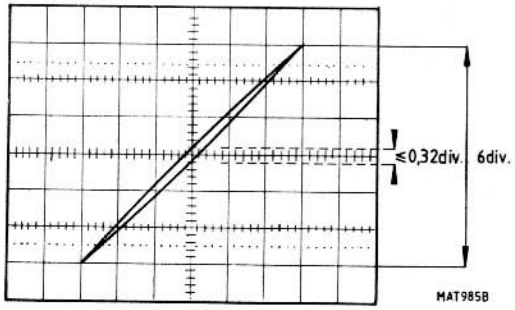


Figure 4.2 Phase shift

4.3.30 Triggering; sources and coupling

TEST EQUIPMENT Square-wave generator

TEST RESULTS

SETTINGS/
PROCEDURE
AND
REQUIREMENTS

1- Apply a signal of 2 kHz to channel A.
2- Set the trace-height to 4 div.
3- Press TRIG COUPL and select DC.
4- Adjust TRIG LEVEL for a triggered signal.
5- Check if a square-wave signal of 4 div is displayed.
6- Press TRIG COUPL and select p-p.
7- Turn TRIG LEVEL and check if the signal is triggered over the complete level range.
8- Connect the CAL signal to input B.
9- Press A/B to display both channels
10- Set channel B to 0,2 V/div.
11- Select B as trigger source with TRIG or X SOURCE, (A is not triggered).
12- Check if a square-wave of 6 div is displayed.
13- Increase the input frequency at input A up to 20 kHz (CAL signal to B).
14- Press TRIG or X SOURCE 4 times, (A and B selected).

15- Check if 2 well triggered traces are displayed.
16- Remove the input signals.

4.3.31 Triggering; slope selection and level control range

TEST EQUIPMENT LF sine-wave generator

TEST RESULTS

SETTINGS/ PROCEDURE AND REQUIREMENTS

1- Apply a signal of 800 mV, frequency 2 kHz, to input A(B)(EXT).
2- Set A (B) to 0,1 V/div at DC input coupling.
3- Press TRIG COUPL for p-p triggering.
4- Turn TRIG LEVEL fully clockwise and fully anti-clockwise.
5- Check if the signal is well triggered over the complete TRIG LEVEL range.
6- Set the TRIG LEVEL control in its mid-position.
7- The start of the signal display must be in the vertical centre.
8- Press TB TRIG MODE.
9- Press SLOPE. (⎍ ⎏)
10- Check if the sine-wave signal is inverted and if it is triggered at the negative slope.
11- Press SLOPE once again.
12- Press TRIG COUPL for DC coupling.

13- Set A(B) to 50 mV/div (16 div trace-height).
14- Turn the TRIG LEVEL.
15- Check if the range is more than ±8 div and if the signal is triggered on the positive slope
16- Remove the input signal.

4.3.32 Triggering; trigger sensitivity

TEST EQUIPMENT Sine-wave generator (SG503)

TEST RESULTS

SETTINGS/
PROCEDURE
AND
REQUIREMENTS

1- Apply a signal of 250 mV (pp), frequency 10 MHz, to input A(B)(EXT).
2- Set AC/DC coupling of A(B) to DC.
3- Press TB TRIG MODE for TRIG mode.
4- Press TRIG COUPL for DC trigger coupling.
5- Set A(B) to 0,2 V/div.
6- Decrease the amplitude of the input signal.
7- Turn TRIG LEVEL.
8- Check if the signal is well-triggered at amplitudes of 0,5 div and more.
9- Decrease the input frequency to 50 kHz.
10- Check if the signal stays well-triggered at amplitudes of 0,5 div and more.
11- Increase the input frequency to 100 MHz.
12- Increase the input voltage to 1,2 div.
13- Turn TRIG LEVEL.
14- Check if the signal is well-triggered at amplitudes of 1,2 div and more.
15- Increase the input frequency to 150 MHz.
16- Increase the input voltage to 2 div.
17- Check if the signal is well-triggered at amplitudes of 2 div and more.
18- Remove the input signal.

4.3.33 Triggering; trigger sensitivity TVL-TVF

TEST EQUIPMENT TV pattern generator with video output (PM5518) TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a video signal to input A(B) with an amplitude of 0,7 div sync. pulse amplitude.
2- Press TB TRIG mode for TRIG mode.
3- Press AC/DC for DC input coupling.
4- Press TRIG COUPL for TVL and TVF.

REQUIREMENTS Check for a stable triggering on TVL and TVF at sync. amplitudes of 0,7 V.

4.3.34 Cursors; voltage cursor accuracy

TEST EQUIPMENT Square-wave generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a square-wave voltage of 1 V (pp) to the channel A input.
2- Set A to 0,2 V/div.
3- Press DIGITAL MEMORY.
4- Press LOCK
5- Select CURSORS of CRT function controls.
6- Position the 1st cursor in the horizontal mid of the top of the waveform.
7- Position the 2nd cursor in the horizontal mid of the bottom of the waveform.

REQUIREMENTS Check for a voltage cursor read-out at the top of the screen of 0,97...1,03 V.

4.3.35 Cursors; time cursor accuracy

TEST EQUIPMENT Time marker generator TEST RESULTS

SETTINGS/
PROCEDURE
1- Apply a 1 ms time marker signal to channel A.

2- Press DIGITAL MEMORY.
3- Set TB to 1 ms/div.
4- Press LOCK.
5- Select CURSORS of CRT function controls.
6- Position the 1st and 2nd cursor in that way, that they cover a distance of 8 time marker intervals.

REQUIREMENTS Check for a time cursor read-out of 7,99...8,00 ms.

4.3.36 Z-MOD sensitivity

TEST EQUIPMENT Square-wave generator

TEST RESULTS

SETTINGS/
PROCEDURE
AND
REQUIREMENTS

1- Apply a signal of 1 kHz, duty cycle 50 %, amplitude 2,5 V (pp) to input A.
2- Set TB to 0,5 ms/div.
3- Set the trace of channel A in mid position.
4- Apply the same signal to the Z input (rear side).
5- Check if only the bottom half of the square-wave signal is displayed (500 μs blanking and 500 μs unblanking.
6- Remove the Z input.
7- Decrease the input signal to 2 V (pp).
8- Reconnect the Z input.
9- Set A to 0,5 V/div.
10- Check if the top half of the square-wave signal is visible with a lower intensity.
11- Check if the top half of the signal is completely unblanked at an input signal less than 0,8 V.

4.3.37 CAL signal; frequency and output voltage

TEST EQUIPMENT No

TEST RESULTS

SETTINGS/
PROCEDURE

1- Connect the CAL signal to input A.
2- Press GND of channel A.
3- Set the trace in the centre of the screen.
4- Press GND of channel A.
5- Select DC of A input coupling.

REQUIREMENTS Check if a positive going square-wave signal of 1,2 V (pp), frequency 2 kHz, is displayed.

5 PREVENTIVE MAINTENANCE

5.1 GENERAL INFORMATION

This instrument normally requires no maintenance, since none of its components is subject to wear. However, to ensure reliable and trouble-free operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.

5.2 REMOVING THE BEZEL AND CONTRAST FILTER (to clean the contrast filter)

- Insert a screwdriver in the slot on the upperside of the bezel and gently loosen the bezel.
- Ease the bezel away from the front panel.
- Press the contrast filter from the bezel.
- To prevent scratches, when cleaning the filter, always use a clean soft cloth, free from dust and abrasive particles.

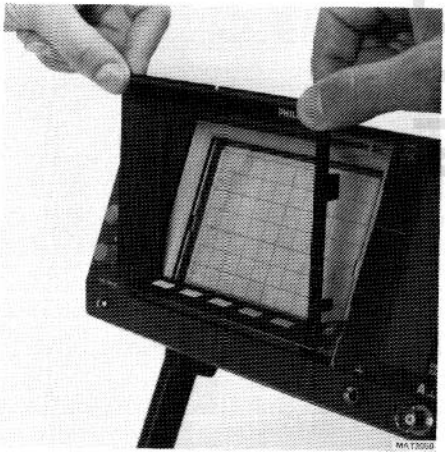


Figure 6 Removing the bezel and the contrast filter.

5.3 RECALIBRATION

To ensure accurate measurements, check the calibration of the instrument after specified recalibration intervals. Recalibration must be carried out by qualified personnel only.