

2 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

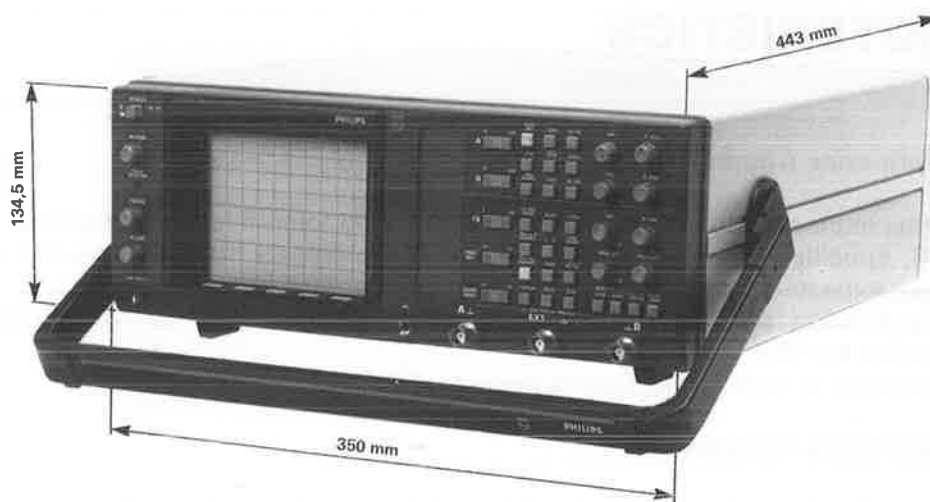
Including handle:	387 mm
Excluding handle:	350 mm

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



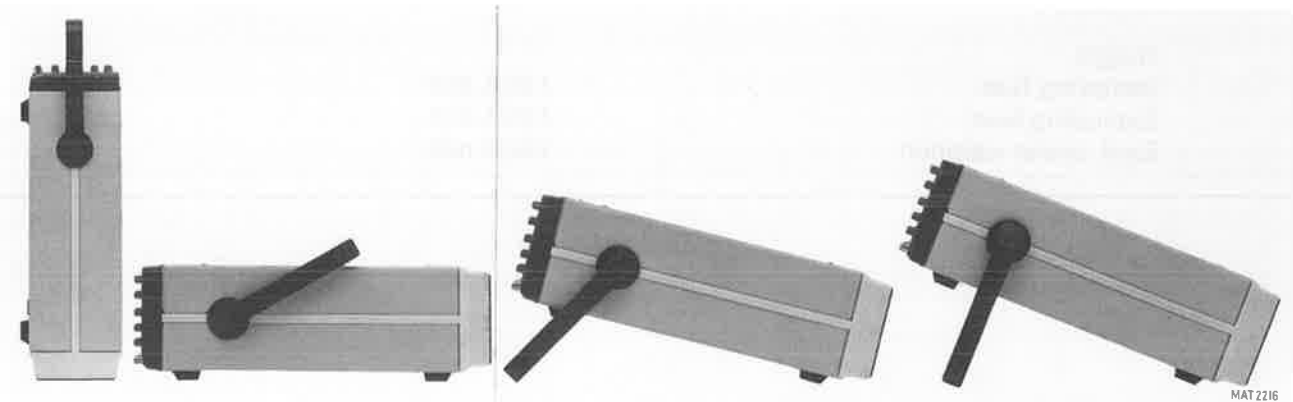
MAT3051

Figure 2.1 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



MAT 2216

Figure 2.2 Operating positions

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.1 DISPLAY		
* CRT Type number Measuring area (h x w)	PHILIPS D14-372 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 Division lines	Internal fixed 1 cm	Horizontal as well as vertical
Subdivisions	2 mm	Horizontal as well as vertical
Dotted lines Percentages	1,5 and 6,5 cm from top 0%, 10%, 90%, 100%	Only horizontal Left side only
* Orthogonality	$90 \pm 1^\circ$	Measured in zero point
* Illumination	Continuously variable	By means of potentiometer
2.2 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
* 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	$\pm 3\%$	Only in calibrated position
* Input impedance Paralleled by	1 M Ω $\pm 2\%$ 20 pF ± 2 pF	Measured below 1 MHz Measured below 1 MHz

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Max. input voltage Max. test voltage (rms)	400 V (d.c. + a.c. peak) 500 V	Max. duration 60 s.
* Bandwidth 20 mV/div...10 V/div 2 mV/div...10 mV/div	≥ 60 MHz ≥ 35 MHz	Input 6 div. sine-wave. Input 6 div. sine-wave.
* Rise-time 20 mV/div. ... 10 V/div 2 mV/div. ... 10 mV/div	< 5,8 ns < 10 ns	Calculated from 0,35/ f at -3 dB Calculated from 0,35/ f at -3 dB
*Pulse aberration: Overshoot, ringing and rounding	< 1,5 sd peak to peak	Input pulse 5 div. + or-2,5 div. from screen centre, positive as well as negative pulse.
Duration of ringing	20ns	Ringing has ended when amplitude is 1/3 of starting amplitude.
Hole or bump Drop or tilt	< 0,7 sd (peak) < 0,7 sd (peak)	
* Noise 20 mV/div. ... 10 V/div 2 mV/div. ... 10 mV/div	< 0,1 div < 0,25 div	Visually measured. Pick up on open BNC excluded. Visually 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 10 MHz...60 MHz	> 24 div > 8 div	Vernier in CAL position Vernier in CAL position
* Min position range	± 8 div	Vernier in CAL position
* Cross talk between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave. 2, 5 and 10 V are excluded. 2, 5 and 10 V are excluded.
At 10 MHz At 60 MHz	1 : > 100 1 : > 50	
* 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	
* Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Base line jump: between attenuator steps 20 mV...10 V	< 0,2 div	Only channel B When A and B are positioned in screen centre (20 mV...10V).
Additional jump between 10 mV and 20 mV	< 0,3 div	
Normal Invert jump	< 0,2 div	
ADD jump	< 0,6 div.	
Variable jump	< 0,2 div	Max. jump between any two positions of the variable potmeter

2.3 HORIZONTAL DEFLECTION OR X AXIS

2.3.1 Time-base

* Time coefficient	0,5 s/div...50 ns/div	In 1, 2, 5 sequence (magn. off) Measured at -4... +4 div. from screen centre.
Error limit	< $\pm 3\%$	
* 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 Error limit	Expansion x10 < $\pm 4\%$	Not valid in X-deflection. 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.

2.3.2 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	
* Error limit Via channel A or B Via EXT input	< $\pm 5\%$ < $\pm 5\%$	
* Bandwidth	DC... ≥ 2 MHz	DC coupled

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Phase shift between X and Y-deflection	< 3° DC...100 kHz	DC coupled
* Dynamic range	> ± 12 div DC...100 kHz	DC coupled
2.3.3 EXT Input		
* Input impedance Paralleled by	1 MΩ ± 2% 20 pF ± 2 pF	Measured below 1 MHz Measured below 1 MHz
* Max. Input voltage (d.c. + a.c. peak) Max. test voltage (rms)	400 V 500 V	Max. duration 60 s.
* Lower -3 dB point	< 10 Hz	AC coupled

2.4 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.
TRIGGERED		Switches automatically to free run if one of the display channels is grounded.
SINGLE		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
* 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 V mains 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	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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 50 MHz	> 1,0 div.	Trig. coupling DC.
At 100 MHz	> 3,0 div.	Trig. coupling DC.
External		
DC...10 MHz	> 50 mV	Trig. coupling DC.
At 50 MHz	> 150 mV	Trig. coupling DC.
At 100 MHz	> 500 mV	Trig. coupling DC.
TVL/TVF internal	> 0,7 div.	Sync. pulse
TVL/TVF external	> 70 mV	Sync. pulse

2.5 SIGNAL ACQUISITION

* Sampling type		
at 50 s/div. ...0,5 μ s/div.	Real time	For PM3350A/52A
at 50 s/div ... 0,2 μ s/div.	Real time	For PM3355/57
* Maximum sample rate:		Sample rate depends on time/div setting
Real time	100 megasamples/s 250 megasamples/s	For PM3350A/52A For PM3355/57
* 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 2ms/div...0,5 μ s/div	512 samples/acquisition	For PM3350A/52A 1 Sample = 0,2% of full record.
at 2 ms/div...0,2 μ s/div	512 samples/aquisition	For PM3355/57 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...0,5 μ s/div	512 samples/acquisition	For PM3350A/52A 1 Sample = 0,2 % of full record.
at 2 ms/div...0,2 μ s/div	512 samples/aquisition	For PM3355/57 1 Sample = 0,2% of full record

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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 μ s/div	+ 30 ms...50 ms	For PM3350A/52A exclusive delay time
at 2 ms/div...0,2 μ s/div	+ 30 ms...50 ms	For PM3355/57 exclusive delay time
at 0,5 s/div...5 ms/div	+ 50 ms...70ms	exclusive delay time
* Sources	Channel A, Channel B	Channel B can be inverted before acquisition
* Acquisition modes	1 Channel only	Full memory available for 1 channel
	2 Channels	Simultaneously sampled; 2 channels share memory.

2.6 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)		Deviation max. 3 MHz for ambient 0...40°C.
10 V ... 2 mV	≥ 20 MHz (-3 dB)	For PM3350A/52A
10 V ... 20 mV	≥ 35 MHz (-3 dB)	For 3355/57
10 mV ... 2 mV	≥ 20 MHz (-3 dB)	For 3355/57
*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 μ s/div and 1 μ s/div
when actuating INVertor switch	0,3 div	
between any time/div positions	0,5 div	
Drift	0,1 div/K	Measured in 20 mV/div position
Temperature coef.	$\pm 0,05$ div/K	Measured in 20 mV/div position

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.7 TIME BASE		
* Modes	Recurrent Single shot Multiple shot Roll Zoom	Up to 2 shots Will be stopped by trigger The part of the trace between the cursors will be magnified by doing a new acquisition with adopted trigger delay and time/div
* Time coefficients:		
In recurrent	0,5 s/div...0,2 μ s/div	For PM3350A/52A
In single shot and multiple shot	0,5 s/div...0,2 μ s/div 50 s/div...0,5 μ s/div 50 s/div...0,2 μ s/div	For PM3355/57 For PM3350A/52A For PM3355/57
Error limit (Ambient: 15...35°C)		
In real time mode	$\pm 1 \%$	Add 0,5 % for ambient: 0...40°C
up to memory	$\pm 0,1\%$	To be measured via remote control only

2.8 TRIGGER

* Trigger delay range:		
In real time	-10... + 2500 div -10... + 5000 div	Selectable in divisions. For PM3350A/52A For 3355/57
In equivalent time	0... + 20 div	Selectable in divisions.
Accuracy	$\pm 0,3$ div	
* Trigger level view		Indication in LCD
Inaccuracy	$\leq 0,5$ div	

2.9 MEMORY

* Memory size:		
Registers	4	
Register depth:		
acquisition	4096 words	
register	4096 words	
Wordlength	8 bits	
* Functions	Clear Load Lock	Contents of acquisition are saved in register 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 INFORMATION
2.10 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 interpolation at 0,5 μ s/div...2 ms/div for PM3350A/52A or 0,2 μ s/div...2ms/div for PM3355/57.
* Display part range horizontal	full memory	The displayed part of the magnified memory can be chosen

2.11 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.
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2.12 AUTO SETTING

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

2.13 CURSORS

* Horizontal resolution: in single channel mode in dual channel mode	1 : 4096 1 : 2048	
at 2 ms/div...0,5 μ s/div	1 : 512 1 : 1024	For PM3350A/52A display in dots display in dot-join
at 2 ms/div...0,2 μ s/div	1 : 512 1 : 1024	For PM3355/57 display in dots display in dot-join

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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).

2.14 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		
* Power consumption (AC source)		At nominal source voltage
Nominal	70 W 80 W	For PM3350A/52A For PM3355/57

2.15 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.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
Memory back-up voltage	2...3,5 V	
Memory back-up current drain	Typical 25 μ A	At 25°C
Recommended batteries		According to IEC285 (= Alkaline Manganese Penlight Battery) e.g. PHILIPS LR 6. Delivered with the instrument.
type	LR 6	
quantity	2 pcs	After warming-up period of instrument.
temperature rise of batteries	20 K	At 25°C, with recommended (fresh) batteries.
Retention time	typical 5 years	
* 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 \pm 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 lowest number.

2.16 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.

* Meets environmental requirements of:

MIL-T-28800 C, type III,
CLASS 5 Style D

Except for front cover.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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 parr. 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 (15000 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)	
* 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	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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%	
* EMI (Electronic Magnetic Interference) meets requirements of	MIL-STD-461 CLASS B CE03, CE07 CS01, CS02, CS06 RS02, RS03	Applicable requirements of part 7 No malfunction
* 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

2.17 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	