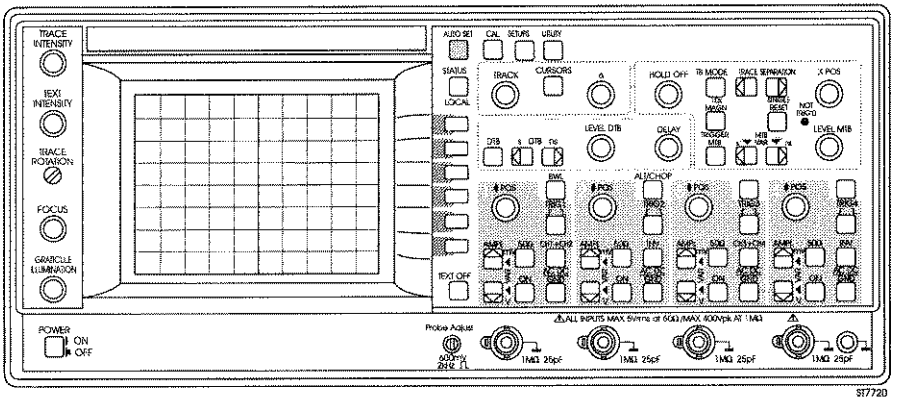
Analog Oscilloscope

PM3082-PM3084-PM3092-PM3094

Reference Manual *961129*



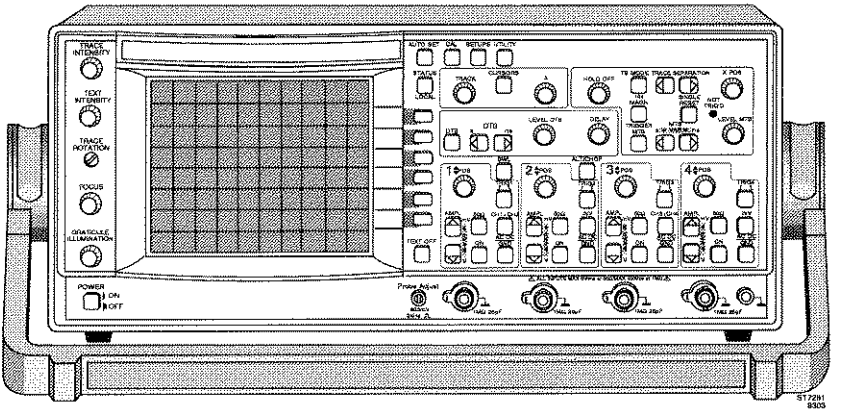
FLUKE

IMPORTANT

In correspondence concerning this instrument please give the model number and serial number as located on the type plate on the rear of the instrument.

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 provided in this manual.

Printed in the Netherlands



Thank you for purchasing this FLUKE oscilloscope. It has been designed and manufactured to the highest quality standards to give you many years of trouble free and accurate measurements.

The powerful measuring functions listed below have been combined with an easy and logical operation to let you use the full power of this instrument each and every day.

If you have any comments on how this product could be improved, please contact your local FLUKE organization. FLUKE addresses are listed in the back of this REFERENCE MANUAL.

There is an OPERATION GUIDE available containing:

- OPERATOR'S SAFETY
- INSTALLATION INSTRUCTIONS
- OPERATING INSTRUCTIONS
- HOW TO USE THE INSTRUMENT
- FUNCTION REFERENCE

MAIN FEATURES

- 200 MHz bandwidth for many advanced applications for PM3092 and PM3094. 100 MHz for PM3082 and PM3084.
- Four channels with four full attenuators for a wide range of input sensitivities up to 2 mV/div. Channels 3 and 4 in PM3092 and PM3082 offer the most commonly used input sensitivities (0.1 and 0.5 V/div).
- 1% voltage and timing accuracy. The autocal function makes automatic fine adjustments to assure this accuracy even in extreme environmental conditions.
- Autoset function provides automatic setup of an optimized display of the input signals. Works on all channels. Adjusts triggering, time, and amplitude.
- On-screen displays include ground and trigger level indicators.
- Cursors give an extensive set of measurement possibilities including fully automated voltmeter functions.
- Delayed Time Base.
- Wide range of trigger possibilities including HDTV triggering.
- RS-232 interface offers a full remote control possibility (CPL protocol). An IEEE 488.2 interface is offered as an option (SCPI protocol).

	PM3092	PM3094	PM3082	PM3084
Bandwidth	200 MHz	200 MHz	100 MHz	100 MHz
Number of channels	4 CH	true 4 CH	4 CH	true 4 CH
Input impedance	1 MΩ/50 Ω	1 MΩ/50 Ω	1MΩ	1 MΩ

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FLUKE®

DECLARATION OF CONFORMITY
for

FLUKE
Analog Oscilloscopes
PM3082, PM3084, PM3092, PM3094

Manufacturer
Fluke Industrial B.V.
Lelyweg 1
7602 EA Almelo
The Netherlands

Statement of Conformity
Based on test results using appropriate standards, the product is in conformity with
Electromagnetic Compatibility Directive 89/336/EEC
Low Voltage Directive 73/23/EEC

Sample tests
Standards used:

IEC 348 (1978)
Safety Requirements for Electronic Measuring Apparatus

EN 50081-1 (1992)
Electromagnetic Compatibility. Generic Emission Standard:
EN55022 and EN60555-2

EN 50082-1 (1992)
Electromagnetic Compatibility. Generic Immunity Standard:
IEC801 -2, -3, -4, -5

The tests have been performed in a typical configuration.

This Conformity is indicated by the symbol CE, i.e. "Conformité européenne".

1 CHARACTERISTICS

A. Performance Characteristics

- Properties expressed in numerical values with tolerances, ranges or limits stated, are guaranteed by the manufacturer.
- Properties expressed in numerical values without tolerances, ranges or limits stated, represent the characteristics of an average instrument.
- This specification is valid if the temperature has not changed more than + or -5 °C since the last AUTO CAL and the probe is of the same 10:1 model as delivered with the instrument.
- For definitions of terms, reference is made to IEC Publication 351-1, 359.

B. Safety Characteristics

This instrument has been designed and tested in accordance with IEC Publication 348, Safety requirements for Electronic Measuring Apparatus and has been supplied in a safe condition. This manual contains information and warnings which must be followed by the user to ensure safe operation and to keep the instrument in safe condition. The instrument has been designed for indoor use. It may occasionally be subjected to temperatures between + 5 °C and 10 °C without degradation of its safety.

C. Initial Characteristics

- Overall dimensions:
  - Height (without feet) : 139 mm 5.5"
  - Width (without handle) : 341 mm 13.5"
  - Length (without handle and front cover) : 481 mm 19"

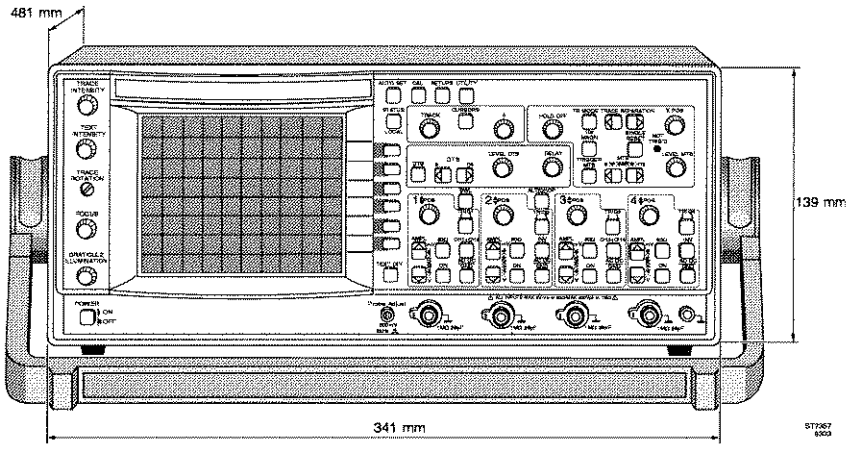


Figure 1.1 Dimensions

- Mass : 8.5 kg 17.6 lb.

- Operating positions:
  a) Horizontally on bottom feet
  b) Vertically on rear feet
  c) On the carrying handle in three sloping positions

1.1 VERTICAL

1.1.1 Channels

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
CHANNELS	CH1; CH2;	Form a channelset
	CH3; CH4	Form a channelset

1.1.2 Deflection modes

MODES	CH1, CH2, CH3, CH4	CH2 and CH4 can be inverted to allow -CH2 or -CH4
	CH1 + CH2	CH2 can be inverted to allow CH1 - CH2
	CH3 + CH4	CH4 can be inverted to allow CH3 - CH4
	Alternate/Chopped	
Chopped mode:		
Chop. freq.	1 MHz	

1.1.3 Bandwidth

FREQUENCY RESPONSE		At BNC
Lower transition point of BW input coupling in AC pos.	<10 Hz	
Upper transition point of BW:		
PM3094	CH1 ... CH4	in 50Ω position
PM3092	CH1, CH2	in 50Ω position
	CH3, CH4	at probe tip
(Ambient 5...40 °C)	>200 MHz	
(Ambient 0...50 °C)	>175 MHz	
PM3084	CH1 ... CH4	with ext. 50Ω
PM3082	CH1, CH2	with ext. 50Ω
	CH3, CH4	with ext. 50Ω
(Ambient 5...40 °C)	>100 MHz	
(Ambient 0...50 °C)	>90 MHz	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
BANDWIDTH LIMITER		
Upper transition point of BW	20 MHz	

1.1.4 Attenuator

CH1 and CH2 (PM3092, PM3082)		
Steps	2 mV/div ... 5 V/div	In a 1-2-5 sequence
CH3 and CH4 (PM3092, PM3082)		
Steps	0.1V/div, 0.5V/div	
CH1 to CH4 (PM3094, PM3084)		
Steps	2mV/div...5V/div	in a 1-2-5- sequence
Variable gain mode	2mV/div...12.5V/div	Continuously variable

1.1.5 Input characteristics

INPUT CONNECTOR	BNC	See note 1
INPUT IMPEDANCE (in 1 MΩ pos.)		Measured at freq. <1MHz
R parallel:		
- value	1 MΩ	
- tolerance	±1 %	
C parallel:		
- value	25 pF	
- tolerance	±2 pF	
INPUT IMPEDANCE (in 50 Ω pos.)		PM3092 only CH1 and CH2. PM3094 all channels
R parallel:		
- value	50 Ω	
- tolerance	±1 %	
VSWR (typical)	1.5 : 1	See note 2

Note 1: BNC with Probe Read Out Pin which causes the instrument to change V/div indication, input impedance and attenuator setting according to probe (when fitted with a probe indicator).

Note 2: Measured up to 200 MHz input frequency; in d.c. and a.c. coupling of input.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.1.6 Coupling

COUPLING	d.c.; a.c.; ground	See note 1

Note 1: In GND position: channel disconnected from input, and connected to ground, BNC open (when not in 50 Ω position). The GND coupling is not available for CH3 and CH4 in PM3092 and PM3082.

1.1.7 Dynamic range

DYNAMIC RANGE		
Up to 50 MHz	±12 div	Symmetrical
Up to 200 MHz	±4 div	Symmetrical

1.1.8 Position range

POSITION RANGE	± ≥8 div	Symmetrical

1.1.9 Trace separation

TRACE SEPARATION		MTB and DTB
Min. range	>± 4 div	MTB fixed, DTB shifts

1.1.10 Input voltage limits

INPUT VOLTAGE LIMITS		See note 1
In high Z position (d.c. + a.c. peak)	±400 V	See note 2
In 50 Ω position		
d.c.	±5 V	
a.c. r.m.s.	5 V	See note 3
a.c. peak	±50 V	See note 3

Note 1: Apparatus should be properly grounded through the protective ground conductor of the power cord.

Note 2: Up to 10 kHz; >10 kHz see figure 1.1

Note 3: Maximum of 50 mJ during any 100 ms interval.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

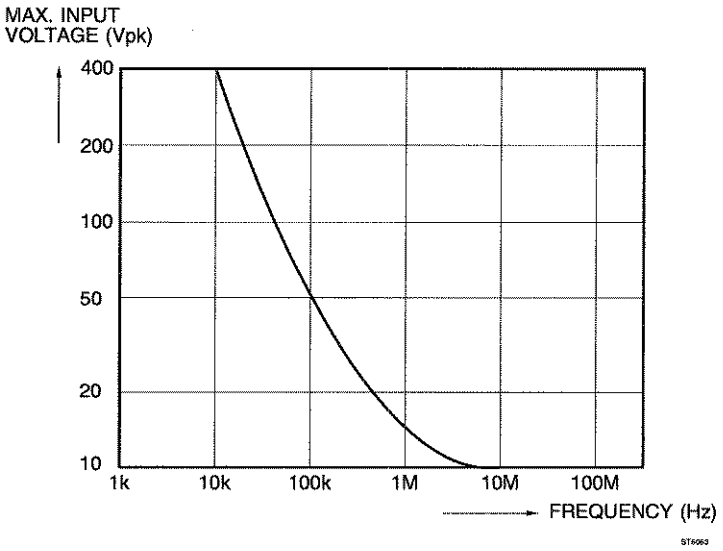


Figure 1.1 Max input voltage versus frequency

1.1.11 Step response

STEP RESPONSE	Is calculated from the formula: Risetime = 0.35 / Bandwidth and is measured over central 5 divisions (vertical)	

1.1.12 Signal delay

VISUAL SIGNAL DELAY	≥15 ns ≥13 ns	PM3092, PM3094 PM3082, PM3084
DELAY BETWEEN CHANNELS		
CH1 and CH2	<250 ps	
CH3 and CH4	<250 ps	
CH1...CH4	<250 ps	4 channel instruments
Any two channels	<500 ps	2+2 channel instruments

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
1.1.13 Vertical accuracies		
ACCURACY deflection factor		
Gain error (d.c.)	±1.3 %	Over central 6 div. See note 1
Non linearity	≤2 %	See note 2
MAX. BASELINE INSTABILITY		
Jump (all between steps, VAR and N/I)	0.2 div or 1 mV	Whichever is greater (after autocal)
Drift	0.1 div/h	
Temperature coefficient	0.03div/K	
CHANNEL ISOLATION		
Of deselected channels at 10 MHz	100 : 1	See note 3
Of deselected channels at upper transition point	50 : 1	See note 4
Between selected channels	50 : 1	See note 5
CMRR		See note 6
at 1 MHz	100 : 1	
at 50 MHz	25 : 1	

Note 1: add 1.5 % for variable gain mode

Note 2: 2 div centerscreen signal with a frequency of 50 kHz, shifted within central 6 div.

Note 3: At 10 MHz; input to deselected channel equivalent to 8 div. or less.

Note 4: PM3092/94: at 200 MHz; input to deselected channels equivalent to 8 div. or less.
PM3082/84: at 100 MHz; input to deselected channels equivalent to 8 div. or less.

Note 5: PM3092/94: at 200 MHz; channels with equal V/div. settings; input to either channel.
PM3082/84: at 100 MHz; channels with equal V/div. settings; input to either channel.

Note 6: Between any two input channels at same attenuator setting; VAR of V/div setting adjusted for best CMRR; measured with max. 8 div input at each channel (center screen).

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.2 TIMEBASE

1.2.1 Timebase modes

TIMEBASE MODES	MTB only	MTB = Main Time Base
	MTB and DTB	alternating
	DTB only	DTB = Delayed Time Base
MTB trigger modes	AUTO	free run after 100ms
	TRIGGERED	
	SINGLE	
DTB trigger modes	DTB starts	starts after adjusted DELAY time
	DTB triggered	starts on first trigger after DELAY time

1.2.2 Timebase settings

MTB		
Settings	0.5 s/div ... 20 ns/div	Note 1
Variable Time/Div range	1.25 s/div ... 20 ns/div	MTB only; continuously variable
DTB		
Settings	0.5 ms/div ... 20 ns/div	Note 1 Note 4
MTB		
Settings	0.5 s/div ... 50 ns/div	Note 2
Variable Time/Div range	1.25 s/div ... 50 ns/div	MTB only; continuously variable
DTB		
Settings	0.5 ms/div ... 50 ns/div	Note 2 Note 4
TIMEBASE MAGNIFICATION	10x	Note 3

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

Note 1: PM3092/94: in a 1-2-5 sequence. By means of the timebase magnifier (x10) the range is extended to 2 ns/div.

Note 2: PM3082/84: in a 1-2-5 sequence. By means of the timebase magnifier (x10) the range is extended to 5 ns/div.

Note 3: Expands the normal time/div. by 10 times (MTB and DTB)

Note 4: The DTB sweepspeed is higher or equal to MTB time/div. setting.

1.2.3 DTB delay

DELAY TIME	2 ns ... 4.9 s
Position range	0.1 ... 9.9 div
Resolution	1 : 40000

1.2.4 Timebase accuracies, Delaytime accuracy, DTB jitter

TIMEBASE ACCURACY		
Unmagnified:	± (1.3% of reading + 0.5% of central 8 div)	Note 1
Magnified:	± (1.3% of reading + 1.0% of central 8 div)	Note 2 Note 1
up to 10 ns/div		
in 5ns/div and 2ns/div	± (1.8% of reading + 1.5% of central 8 div)	Note 1

Note 1: add 1% of reading in variable mode

Note 2: valid over central unmagnified 8 div

DELAYTIME ACCURACY	±(0.8% of reading + 0.3% of central 8 div + 4ns)	Note 1 PM3092/94
	±(0.8% of reading + 0.3% of central 8 div + 5ns)	Note 1 PM3082/84

Note 1: add 1% of reading in variable mode.

DTB jitter in starts 1 part of 25000

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
1.2.5 External horizontal deflection		
DEFLECTION SOURCES	Line and CH1...CH4	
LINE DEFLECTION Deflection amplitude	6 ±1.7 div	Between 49 and 61 Hz at 220 V
CHANNEL DEFLECTION		Refer to VERTICAL
Error limit	±5%	Over central 6.div.
Linearity error limit	±2%	Note 1
Dynamic range up to100kHz up to 2MHz	 20 div 10 div	
POSITION RANGE	±5 div	
FREQUENCY RESPONSE Upper transition point	2 MHz	
MAX. PHASE DIFFERENCE Between horizontal and vertical	3 °	Up to 100 kHz

1.3 TRIGGERING

1.3.1 Source

SOURCE(S) MTB-triggering	CH1...CH4, Line; Composite	Note 1
SOURCE(S) DTB-triggering	CH1...CH4, TV-line	Note 2

Note 1: Each displayed channel provides its own triggering. This feature is available in the alternated mode.

Note 2: Only available when MTB-mode is switched in TV

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.3.2 Modes

MODES MTB-triggering	EDGE TV	
MODES DTB-triggering	EDGE	

1.3.3 TV systems

TV systems	TV HDTV	Note 1 Note 1

Note 1: Field1, Field2 and TVline selection possible.

1.3.4 Coupling

BANDWIDTH EDGE TRIGGER MTB		vertical coupling in DC
Lower transition point of BW		BW = Bandwidth
Trigger coupling: DC AC LF-reject HF-reject	 d.c. 10 Hz 30 kHz d.c.	
Upper transition point of BW		
Trigger coupling: DC AC LF-reject HF-reject	 See sensitivity See sensitivity See sensitivity 30 kHz	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
BANDWIDTH EDGE TRIGGER DTB		vertical coupling in DC
Lower transition point of BW		BW = Bandwidth
Trigger coupling:		
DC	d.c.	
AC	10 Hz	
LF-reject	30 kHz	
HF-reject	d.c.	
Upper transition point of BW		
Trigger coupling:		
DC	See sensitivity	
AC	See sensitivity	
LF-reject	See sensitivity	
HF-reject	30 kHz	

1.3.5 Sensitivity

EDGE TRIGGER SENSITIVITY MTB/DTB PM3092/94:		See note 1 & 3
d.c. to 100 MHz	0.5 div	
d.c. to 200 MHz	1.0 div	
d.c. to 300 MHz	2.0 div	See note 2
EDGE TRIGGER SENSITIVITY MTB/DTB PM3082/84:		See note 1 & 3
d.c. to 50 MHz	0.5 div	
d.c. to 100 MHz	1.0 div	
d.c. to 200 MHz	2.0 div	See note 2
TV TRIGGER SENSITIVITY amplitude of sync pulse	0.7 div	See note 1

Note 1: All figures are valid for an ambient temperature range of 5 ... 40 °C, add 20 % for ambient 0 ... 50 °C.

Note 2: Measured with a 2 div centerscreen signal.

Note 3: In noise trigger multiply stated value by 2.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
1.3.6 Slope		
Slope selection edge	+ or -	MTB and DTB. See note1

Note 1: In TV-triggering pos/neg video.

1.3.7 Level

LEVEL CONTROL RANGE MTB EDGE	± 8 div	
Unless in Level-p(eak)p(eak)	Note 1	
TV	Fixed	
LEVEL CONTROL RANGE DTB EDGE	± 8 div	
TRIGGERLEVEL Accuracy	≤0.2 div	at 1 MHz input signal triggercoupling DC.
Triggergap	0.4 div	at 1 MHz input signal; in noise triggering multiply by 2.

Note 1: The control range of the trigger level is related to the peak-peak value and duty cycle of the trigger signal.

1.3.8 Hold Off

HOLDOFF SETTING Minimum	2 us or 5 div. of MTB setting	Whichever is greater
Maximum	2 s or 20 div. of MTB setting	Whichever is smaller

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.4 CURSORS

1.4.1 Cursor Control

NUMBER OF CURSORS	4	
CURSOR MODES		See note 1
Manual	Amplitude	ΔV, V1&V2 to GND, ratio
	Time	ΔT, 1/ΔT, Ratio, Phase
	Both	See note 2 and 3
Measure	Vpp	ΔVpp, Vp+&Vp- to GND, Vdc to GND Risetime 10%-90% 20%-80% See note 4

Note 1: In the "MTB + DTB" and "DTB" timebasemode, all waveform operations are performed on DTB traces.

Note 2: The ratio range is 0% ... 999% where 100% corresponds to the value in the cursor read out at the moment that the "ΔT=100%"- or "ΔV=100%"-button is pushed.

Note 3: The phase range is 0° ... 999° where 360° corresponds to the value in the cursor read out at the moment that the "ΔT=360°"-button is pushed.

Note 4: Amplitude cursors track the min. and max. value of the signal; not possible with DTB on.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.4.2 Cursor Accuracies

VOLTAGE MEASUREMENT		Note 1
Manual	±1% of FULL SCALE	
Vpp mode:	±3% of FULL SCALE + 800 μV	Note 2
TIME MEASUREMENTS		Note 3
Unmagnified time base	±1% of FULL SCALE	
Magnified time base up to 10ns/div:	±1.4% of FULL SCALE	
Magnified time base in 5ns/div. and 2ns/div	±2.2% of FULL SCALE	

Note 1: Measured with 1kHz square wave within central 6 div.

Note 2: For signals >1 div.
Vpp mode follows the trigger system frequency response curve.

Note 3: Within central 8 div.

1.5 FRONT PANEL MEMORY

Memory size	10 fronts	

1.6 BLANKING OR Z-AXIS

Input connector	BNC	
Input impedance	10 kΩ	
Input coupling	dc	
Max. input voltage	±10V	
Input voltage unblanked	0.5V or less	See note 1
Input voltage blanked	+ 2.4 V or more	See note 1
Response time	80ns	Risetime 2 ns

Note 1: Half tones are possible at input voltages between +0.8V and +2.4V.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.7 DISPLAY

CRT		
Deflection	Electrostatic	Vector
Dimensions (h x v)	80 mm x 100 mm	8 x 10 divisions
Phosphor:		
Standard	Green GH (P31)	
GRATICULE	Fixed	
Y-AXIS		
ORTHOGONALITY	90° +/- 0.5°	
ACCELERATING VOLTAGE	16.5 kV	
Writing speed	>1.8 cm/ns	
TRACE ROTATION		Screw driver adjustment
Min range	10°	External field <0.1 mT
Min overrange	2°	
TRACE DISTORTION		Deviation from straight line inside 6x8 div
At center of screen	<0.3 mm	
Else	<1.0 mm	

1.8 EXTERNAL INTERFACES

1.8.1 Calibrator

WAVEFORM	
Shape	square-wave
INTERNAL IMPEDANCE	
Value	1200 Ω

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
OUTPUT VOLTAGE		
Peak - peak value	600 mV	See note 1
Tolerance	1%	
OUTPUT CURRENT		
Peak - peak value	0.5 mA	See note 2
FREQUENCY		
Value	2 kHz	
Tolerance	±20 %	

Note 1: Positive going with respect to ground: open voltage (halves when terminated with 1200 Ω).

Note 2: When output short circuited (halves when terminated with 1200 Ω).

1.8.2 Standard external interfaces

TYPE OF INTERFACE	RS 232 -C		CPL (Compact Programming Language) See operating guide
PINNING			
PIN	I/O	NAME	
1	-	-	Not connected
2	I	RXD	Received data
3	O	TXD	Transmitted data
4	O	DTR	Data terminal ready
5	-	GND	Signal ground
6	I	DSR	Data set ready
7	O	RTS	Request to send
8	I	CTS	Clear to send
9	-	-	Not connected
TRANSMISSION MODES	Asynchronous Full duplex		
HANDSHAKE			
Hardware	RTS/CTS and DSR/ DTR		Default: not active Note 1
Software	XON/XOFF		Default: not active Note 1

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
BAUDRATE	75, 110, 150, 300, 600,1200, 2000, 2400, 4800, 9600, 19200, 38400	Receiving and transmitting Default: 1200 Note 1
NUMBER OF STOP BITS	1	
PARITY	odd, even or no	Default: no parity See note 1
CHARACTER LENGTH	7 or 8	Default: 8, See note 1
ERROR RESPONSE	See operating guide	
ELECTRICAL		
TXD and RXD Spacing "0" Marking "1"	 ≥+3V ≤-3V	
RTS, CTS, DSR and DTR ON OFF	 ≥+3V ≤-3V	
Current output	≤10mA	
Impedance Output Impedance Input	300Ω ± 10% ≥3kΩ ≤7kΩ	
Voltage Output Voltage Input	≥-12V ≤+12V ≥-25V ≤+25V	
Connector	Shielded	9 pole RAP male connector according MIL-C-24308

Note 1: Selectable via UTILITY-menu and CPL.
When battery installed, same as last power-off value.

1.8.3 Optional external interfaces

IEEE	ANSI/IEEE 488.2	SCPI, See 1.17

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.9 AUTOSET & CALIBRATION

1.9.1 AUTO SET

Vertical deflection,	2 ... 5 div	Note 1
Horizontal deflection	Max. 6 periods on CRT	Note 1
	At input signal 10 mV ... 25V 40 Hz ... 30 MHz	

Note 1: AUTO SET selects the proper channel, sets vertical deflection, timebase speed, intensity and triggering for easy to read display of input signals or user programmable AUTO SET items.

1.9.2 Calibration

CALIBRATION FACILITIES	Auto CAL	See note 1

Note 1: Calibrates vertical offset and gain, horizontal offset, gain and sweeptime, trigger offset and gain.

1.10 POWER SUPPLY & BATTERY BACKUP

1.10.1 Power supply

LINE VOLTAGE		
a.c. (r.m.s.)		
Operation	100 V ...240V	
Tolerance	(± 10%)	
LINE FREQUENCY		
Nominal	50 Hz...400 Hz	
Limits of operation	45 Hz...440 Hz	
LINE WAVEFORM CHARACTERISTICS		At nominal source voltage
Max. waveform deviation factor	10 %	
Crest factor	1.27...1.56	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
ALLOWABLE POWER INTERRUPTION	20 ms	See note 1
POWER CONSUMPTION		
Without options	60 W	
Max. power consumption	80 W	
POWER CORD		
Length	2.1 m (82.7")	
Power plug	Nat. version	

Note 1: At lowest allowable source voltage. After this time the oscilloscope data is saved before the instrument goes down and an automatic power-on sequence starts after restoration of the power source voltage.

1.10.2 Battery backup

DATA & SETTINGS RETENTION	See note 1	
Retention time	2 years	
Batteries:		
Recommended type	LR 6	See note 2
Quantity	2	
Temperature range	0...+ 70 °C	See note 3

Note 1: When instrument is switched off or during mains failure.

Note 2: According to IEC 285 (= Alkaline Manganese Penlight Battery), e.g. LR6.

Note 3: At -40...0 °C settings retention is uncertain. It is advised to remove batteries from instrument when it is stored during longer periods (> 24h) below -30°C or above 60 °C. UNDER NO CIRCUMSTANCES BATTERIES SHOULD BE LEFT IN THE INSTRUMENT AT TEMPERATURES BEYOND THE RATED RANGE OF THE BATTERY SPECIFICATION.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.11 MECHANICS

PORTABLE VERSION		
Dimensions:		Handle excluded
Length	481 mm	Add 5 mm for cover Add 65 mm for handle
Width	341 mm	Add 50 mm for handle
Height	139 mm	Add 8 mm for feet
Mass: Instrument	8.5 kg	
COOLING	Forced air, Regulated	No air filter

1.12 ENVIRONMETAL

1.12.1 General

The characteristics are valid only if instrument is checked in accordance with the official checking procedure. Warming-up and recovery time are in accordance with MIL-T-28800D par. 3.7.1.1.
The instrument meets the environmental requirements of MIL-T-28800D Type III Class 3, Style D, Color R, unless specified otherwise.

1.12.2 Environmental

TEMPERATURE		See note 1
Operating:		
min. low temperature	0 °C	
max. high temperature	+ 50 °C	
Non operating (storage):		
min. low temperature	- 40 °C	
max. high temperature	+70 °C	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
MAX. HUMIDITY		See note 1
Operating and Non operating (storage)	95 %	Relative humidity non condensing

Note 1: In accordance with MIL-T-28800D par. 3.7.2.1.1. (FIGURE 2).

MAX. ALTITUDE		
Operating	4.6 km	See note 4
Non operating (storage)	12 km	See note 5
VIBRATION (OPERATING)		See note 6
Freq. ranges:		g level at max. freq.:
	5 Hz ... 15 Hz	0.7 at 15 Hz
	16 Hz ... 25 Hz	1.3 at 25 Hz
	26 Hz ... 55Hz	3 at 55 Hz
At each frequency range:		
Cycling time	15 min	
Resonance search	5 min	
Resonance dwell	10 min	See note 7

Note 4: In accordance with MIL-T-28800D par 3.7.3.
Note 5: Maximum operating temperature derated 3 °C for each km above sea level.
Note 6: In accordance with MIL-T-28800D par. 3.7.4.1.
Note 7: At each resonance frequency (or at 33 Hz if no resonance was found).

SHOCK (OPERATING)		See note 8
Amount of shocks		
total	18	
each axis	6	3 in each direction
Shock waveform	half sinewave	
Duration	6-9 ms	
Peak acceleration	400 m/s^2	
BENCH HANDLING		See note 9
Meets requirements of	MIL-ST-810, method 516 procedure V	
TRANSPORTATION	Drop height 0.76 m	See note 11

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
SALT ATMOSPHERE		
Structural parts	See note 10	

Note 8: In accordance with MIL-T-28800D par. 3.7.5.1.
Note 9: In accordance with MIL-T-28800D par. 3.7.5.3.
Note 10: In accordance with MIL-T-28800D par. 3.7.8.1.
Note 11: Drop in shipping container on 8 corners, 12 edges, 6 surfaces.

1.13 EMI

1.13.1 General aspects and Susceptibility

1.13.1.1 General

Meets MIL-T-28800D, Type III, Class 3 (Navy requirement, unless specified otherwise).

Meets MIL-STD-461C as follows:

-	Conducted Emissions	Part 2	CE01 (Narrow band)
		Part 4	CE03
-	Conducted Susceptibility	Part 2	CS01
		Part 5	CS06 (Limited to 300V)
-	Radiated Emissions	Part 5 and 6	RE01
		Part 2	RE02 (1 GHz max)

1.13.1.2 Susceptibility

Meets harmonized product requirements of 89/336EEC, EN50081.1 and EN50082.1 with addition of the tables 1 to 8.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

The PM3082 and PM3084, including standard accessories, conform with the EEC Directive 89/336 for EMI immunity, as defined by IEC 801-3, with the addition of the following tables.

Table 1.

	Susceptibility: no visible disturbance		
Frequency range: 10 kHz .. 25 MHz	E = < 0.1V/m	E = 1 V/m	E = 3 V/m
Stand alone	2 mV/div ... 5 V/div	2 mV/div ... 5 V/div	2 mV/div ... 5 V/div
With PM9010/091	2 mV/div ... 5 V/div	10 mV/div ... 5 V/div	20 mV/div ... 5 V/div

Table 2.

	Susceptibility: no visible disturbance		
Frequency range: 25 MHz ... 1 GHz	E = < 0.1V/m	E = 1 V/m	E = 3 V/m
Stand alone	2 mV/div ... 5 V/div	5 mV/div ... 5 V/div	10 mV/div ... 5 V/div
With PM9010/091	2 mV/div ... 5 V/div	50 mV/div ... 5 V/div	200 mV/div ... 5 V/div

Table 3.

	Susceptibility: disturbance less than 10 % of full scale		
Frequency range: 10 kHz .. 25 MHz	E = < 0.1V/m	E = 1V/m	E = 3 V/m
Stand alone	N/A	N/A	N/A
With PM9010/091	N/A	2 mV/div ... 5 mV/div	5 mV/div ... 10 mV/div

Table 4.

	Susceptibility: disturbance less than 10 % of full scale		
Frequency range: 25 MHz ... 1 GHz	E = < 0.1V/m	E = 1V/m	E = 3 V/m
Stand alone	N/A	2 mV/div	2 mV/div ... 5 mV/div
With PM9010/091	N/A	10 mV/div ... 20 mV/div	50 mV/div .... 100 mV/div

For conditions not specified in tables 1 - 4, a susceptibility effect of more than 10 % is possible.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

The PM3094 and PM3092, including standard accessories, conform with the EEC Directive 89/336 for EMI immunity, as defined by IEC 801-3, with the addition of the following tables.

Table 5.

	Susceptibility: no visible disturbance		
Frequency range: 10 kHz .. 25 MHz	E = < 0.1V/m	E = 1 V/m	E = 3 V/m
Stand alone	2 mV/div ... 5 V/div	2 mV/div ... 5 V/div	2 mV/div ... 5 V/div
With PM9020/091	2 mV/div ... 5 V/div	10 mV/div ... 5 V/div	20 mV/div ... 5 V/div

Table 6.

	Susceptibility: no visible disturbance		
Frequency range: 25 MHz ... 1 GHz	E = < 0.1V/m	E = 1 V/m	E = 3 V/m
Stand alone	2 mV/div ... 5 V/div	2 mV/div ... 5 V/div	10 mV/div ... 5 V/div
With PM9020/091	2 mV/div ... 5 V/div	200 mV/div ... 5 V/div	500 mV/div ... 5 V/div

Table 7.

	Susceptibility: disturbance less than 10 % of full scale		
Frequency range: 10 kHz.. 25 MHz	E = < 0.1V/m	E = 1V/m	E = 3 V/m
Stand alone	N/A	N/A	N/A
With PM9020/091	N/A	2 mV/div ... 5 mV/div	5 mV/div ... 10 mV/div

Table 8.

	Susceptibility: disturbance less than 10 % of full scale		
Frequency range: 25 MHz ... 1 GHz	E = < 0.1V/m	E = 1V/m	E = 3 V/m
Stand alone	N/A	N/A	2 mV/div ... 5 mV/div
With PM9020/091	N/A	50 mV/div ... 100 mV/div	100 mV/div ... 200 mV/div

For conditions not specified in tables 5-8, a susceptibility effect of more than 10 % is possible.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.13.2 VDE requirements

The instrument meets the requirements of VDE 0871, Grenzwertklasse B.

1.13.3 Additional EMI requirements

The instrument is tested in accordance with IEC 351-1 par 5.1.3.1. The maximum deflection factor is 7 mm/mT (0.7 mm/gauss). This value measured with the instrument in a homogeneous field (in any direction with respect to the instrument) with a flux intensity (peak to peak value) of 1.42 mT (14.2 gauss) and of symmetrical sine wave form with frequency of 45 Hz ... 66 Hz.

1.14 SAFETY

MEETS REQUIREMENTS OF	IEC 348 Class I	See note 1
	UL 1244	See note 2
	CSA C22.2 No231	See note 2
	VDE 0411	See note 1
APPROVALS (applied for)	CSA C22.2 No231	
MAX. X-RADIATION	MIL-T-28800D par. 3.9.3.4.a	

Note 1: Except for power cord, unless shipped with universal European power plug.

Note 2: Except for power cord, unless shipped with North American power plug.

1.15 ACCESSORIES

PACKED WITH INSTRUMENT	
Signal input (passive)	2 x 10 MΩ, 10:1 probe with readout (1.5 m)
Contrast filter	Blue
Front cover	Can be locked on instrument
Operation Guide	
Reference Manual	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

1.16 OPTIONS & OPTIONAL VERSIONS

1.16.1 Line Cord

LINE CORD	Universal European	in accordance with VDE
	North American	in accordance with CSA, UL
	United Kingdom	in accordance with BSI
	Australian	in accordance with SAA
	Swiss	in accordance with SAV

1.16.2 Options versions

EXTERNAL INTERFACES		
	Y-out, MTB-gate, DTB-gate, EXT triggering	Factory installed only
	IEEE	Factory installed only

1.16.3 Optional outputs

Y SIGNAL OUT	BNC	
Source	CH1	
Coupling	as CH1	
Voltage: into 1 MΩ	20 mV/div	
with a tolerance of	±10 %	
into 50 Ω	10 mV/div	
with a tolerance of	±10 %	
Freq. response	dc ... 200 MHz (PM3092/94) dc ... 100 MHz (PM3082/94)	Terminated with 50Ω
Dynamic range	±10div	At 50 MHz
MTB/DTB GATE OUT		
Connector	BNC	
Output impedance	1 kΩ	
Voltage:		
Timebase not running	0.2 ± 0.2 V	
Timebase running	3.7 ± 1.3 V	

1.16.4 Optional external MTB trigger input

SOURCE(S) MTB-triggering		CH1 ... CH4 External Composite	No line triggering
INPUT CONNECTOR		BNC	At rear of instrument
INPUT IMPEDANCE			Measured at freq.<1MHz
R parallel	- value	1 M Ω	
	- tolerance	± 1 %	
C parallel	- value	25 pF	
	- tolerance	± 5 pF	
DYNAMIC RANGE			
Up to 10 MHz		± 2.5 V	Symmetrical
INPUT VOLTAGE LIMITS			See note 1
	(d.c. + a.c. peak)	± 400 V	See note 2

Note 1: Apparatus should be properly grounded through the protective ground conductor of the power cord.

Note 2: Up to 10 kHz; > 10kHz see figure 1.1.

EDGE TRIGGER SENSITIVITY		See note 3
d.c. to 5 MHz	100 mV	
d.c. to 10 MHz	200 mV	

Note 3: In noise-trigger multiply stated value by 2.

TRIGGERLEVEL		
Range	± 1.45 V	See note 4
Accuracy	≤ 0.45 V	at 1 kHz inputsignal triggercoupling DC

Note 4: With Level-pp on the range is restricted to the peak-peak value of the trigger signal.

1.17 SPECIFICATION OF IEEE-OPTION

TYPE OF INTERFACE	ANSI/IEEE 488.2	SCPI (see SCPI operating manual) Note 1
INTERFACE REPERTORY		
Source handshake	SH1	Complete capability
Acceptor handshake	AH1	Complete capability
Talker	T5	Basic talker: yes Serial poll: yes Talk only: yes Unaddress if MLA: yes
Listener	L3	Basic listener: yes Listener only: yes Unaddress if MTA: yes
Service request	SR1	Complete capability
Remote local	RL1	Complete capability
Parallel poll	PP0	No capability
Device clear	DC1	Complete capability
Device trigger	DT1	Complete capability
Controller	C0	No capability
ELECTRICAL INTERFACE		
Busdrivers	E2	Three state (true=0 ... 0.8V; false=2 ... 5V)
Connector	Shielded	Amphenol type 57FE-20240-20SD35
Pin 1 ... 4	DIO1 ... DIO4	
Pin 13 ... 16	DIO5 ... DIO8	
Pin 18 ... 23	GND	
Pin 24	Logic GND	
Pin 5	EOI	
Pin 6	DAV	
Pin 7	NRFD	
Pin 8	NDAC	
Pin 9	IFC	
Pin 10	SRQ	
Pin 11	ATN	
Pin 12	Shield	
Pin 17	REN	

FUNCTION SELECTION	Via UTILITY-MENU	Busaddress Default: 8 Note 2
INTERFACE STATUS INDICATOR	On screen	

Note 1: Talker/listener.

Note2: When battery installed, same as last power-off value.

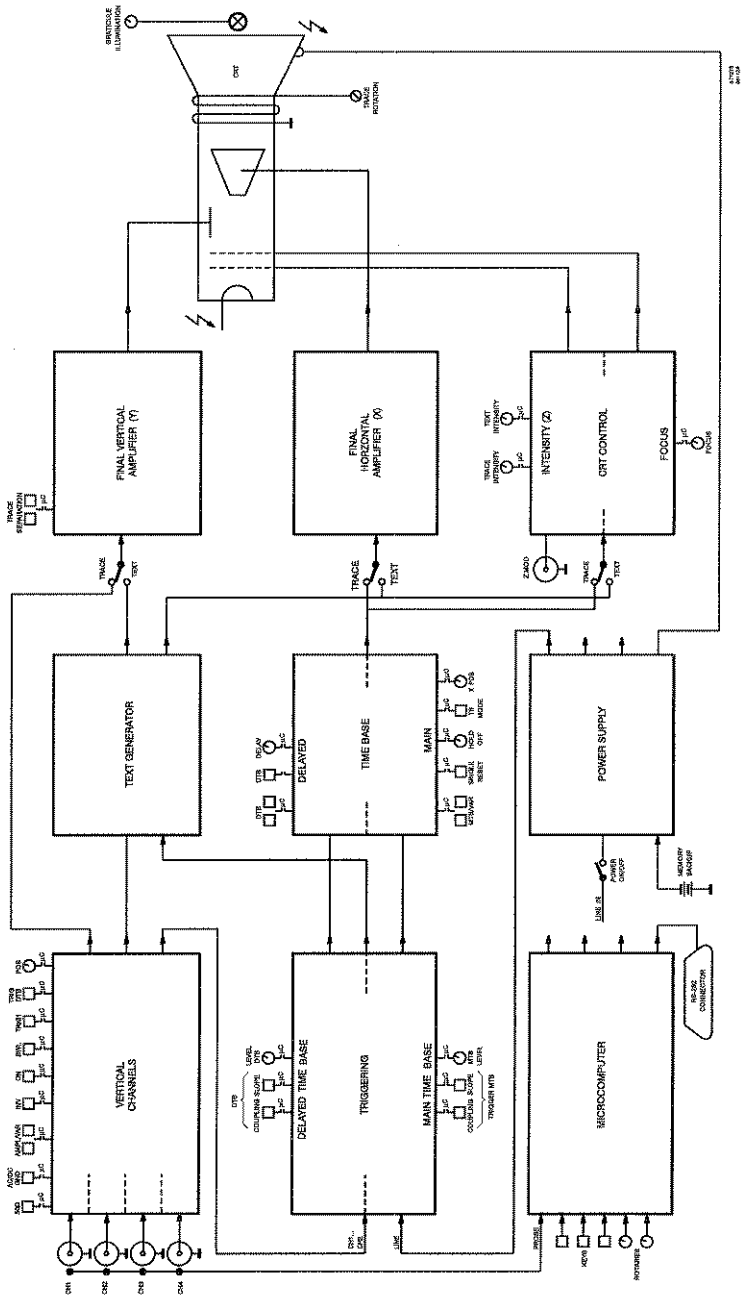


Figure 2.1 Blockdiagram

2 PRINCIPLE OF OPERATION

2.1 INTRODUCTION

This chapter describes the principle of operation and should be read in combination with the block diagram in figure 2.1.

The block diagram shows the user in which sections of the oscilloscope circuitry the controls and keys are operating, and how signals are routed. For a detailed description of each function, refer to chapter 5 'Function Reference' in the Operating Guide.

Lines between controls/keys and the block they are operating are interrupted. The text 'µC' at the interruption indicates that the control operates the block via the microComputer.

2.2 CONTROL SECTION

The heart of the control section is formed by a MICROCOMPUTER with an incorporated RS-232 interface. The MICROCOMPUTER reads all the keys (except POWER ON/OFF) and rotary controls. It sends control signals to the oscilloscope circuits to put them in the desired mode. Control of the oscilloscope functions can also be done by an external computer connected to the RS-232 CONNECTOR.

2.3 VERTICAL DEFLECTION

This section consists of the blocks VERTICAL CHANNELS and FINAL VERTICAL AMPLIFIER. There are four vertical channels. Small differences between the channels depend on instrument versions. The inputs CH1 ... CH4 are applied to the block VERTICAL CHANNELS. In this block the following functions are made:

- Input coupling can be switched between AC, DC and GND. As an extra 50 Ω input impedance can be selected in the 200 MHz models.
- The AMPL/VAR key pair determines the input sensitivity of each channel. Some channels may have a switch to toggle between the two most commonly used input sensitivities.
- Each channel can be switched on/off with the ON key and bandwidth can be limited to 20 MHz via the BWL key.
- Trigger source selection for MTB and DTB is done via the keys TRIG1 ... TRIG4 and the menu under the DTB key.
- The vertical signal position of each channel can be adjusted with a POS control.

The FINAL VERTICAL AMPLIFIER drives the vertical deflection system of the Cathode Ray Tube (CRT). The TRACE SEPARATION key pair adjusts the vertical distance between MTB and DTB display, when in Alternate Timebase Mode.

2.4 HORIZONTAL DEFLECTION

The horizontal deflection consists of the blocks TRIGGERING, TIMEBASE and FINAL VERTICAL AMPLIFIER. TRIGGERING and TIMEBASE are both split up in sections for MTB and DTB; these sections are almost identical.

Triggering can be done via CH1 ... CH4 or a signal derived from the line voltage. The following controls adjust the triggering:

- COUPLING permits selection between ac, dc, lf-reject, hf-reject and noise suppression.
- SLOPE permits triggering on positive- or negative-going signal edges.
- LEVEL adjusts the signal level where the timebase is started.

The output of the TRIGGERING generates a pulse that starts the TIMEBASE.

The TIMEBASE generates a so-called sawtooth signal that gives a time linear horizontal display on the CRT. The following controls influence the timebase:

- MTB/VAR and DTB adjust the horizontal time scale of MTB and DTB.
- The TB MODE key permits selection between auto (free run), trig(gered) and single (shot) mode of MTB. The SINGLE RESET key resets the MTB when in single shot mode.
- The DTB key permits selection of the operating modes of the DTB.
- The HOLD OFF control adjusts the period of time that the MTB does not start upon receipt of a trigger.
- The DELAY control adjusts the time delay between start of MTB and DTB.
- X POS controls the horizontal position of the signal display.

2.5 CRT DISPLAY SECTION

This section determines the intensity and focusing of the signal on the screen. The intensity of trace and text/cursors can be adjusted separately with the controls TRACE INTENSITY and TEXT INTENSITY. The FOCUS control determines the sharpness of text and traces. Moreover focusing is controlled such that changes in intensity do not affect display sharpness.

2.6 POWER SUPPLY

This POWER SUPPLY converts a wide range of line input voltages into stable supply voltages that feed the circuits in the oscilloscope. Also the very high voltages for the CRT are made by the power supply. Another output signal is used to trigger the MTB if 'line' is selected as trigger source. Memories in the oscilloscope are supplied by a MEMORY BACKUP battery if line voltage is switched off.

2.7 TEXT GENERATOR

The generation of text and cursors is done in the block TEXT GENERATOR.

For display on the CRT, the digital text information is converted into analog and applied to the final amplifiers for VERTICAL and HORIZONTAL deflection. The FOCUS and INTENSITY parts are controlled in a similar way. Switching between TRACE MODE and TEXT MODE is done via switches that are operated by the TEXT GENERATOR. The switches are incorporated in the inputs of the output stages of Final Y, Final X, Intensity and Focusing.

3 BRIEF CHECKING PROCEDURE

3.1 General information

This procedure is intended to verify the instrument's functions with a minimum of test steps and actions required.
It is assumed that the operator doing this test is familiar with this kind of instruments and their characteristics.

WARNING: Before turning on the instrument, ensure that it has been installed in accordance with the instructions mentioned in Chapter 2 of the Operation Guide.

NOTE: The procedure does not verify 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. Removing the instrument covers is not necessary to perform this procedure. All checks are made from the outside of the instrument.

If this test is started a few minutes after turning on the instrument, test steps may be out of specification, due to insufficient warm-up time. Be sure to allow the full warm-up time of 30 minutes (under average conditions).

The check is set up in a logical sequence. For a complete check of every facet of the instrument's calibration, refer to the 'PERFORMANCE TEST' section in Chapter 4 of this Reference Manual (for qualified persons only).

The check can be used for different instrument types. Where differences exist, they are indicated (e.g., in the vertical channels). Those test steps can be skipped.

3.2 Preliminary settings of the controls

For ease of reading the following abbreviations are used:

CW = Clockwise (rotation direction of a control)
CCW = Counter Clockwise (rotation direction of a rotary control)
CRT = Cathode Ray Tube (the oscilloscope's viewing area)
MTB = Main Timebase, MAIN TB
DTB = Delayed Timebase, DELAY TB

Trace alignment:
- Turn the oscilloscope on with the POWER ON OFF key.
- Press the STATUS and TEXT OFF keys simultaneously. This assures that the oscilloscope is in the default mode. The default mode is the basis of this brief checking procedure.
- Press the AUTOSET key.
- Turn the TRACE INTENSITY control so that a clearly visible horizontal line appears on the CRT.
- Press the TEXT OFF key when no text is present on the CRT. Turn the TEXT INTENSITY control so that clearly visible text appears on the CRT.
- Turn the FOCUS control to make the line and text look as sharp as possible across the CRT area.
- Turn the GRATICULE ILLUMINATION control so that the desired illumination of the measuring graticule is obtained.
- Verify that the trace on the CRT is exactly parallel to the horizontal lines of the measuring raster; if not, correct this with a small screwdriver on the TRACE ROTATION control.

Instrument calibration.
Press the CAL key for two seconds: this starts the AUTOCALibration procedure. Wait until the normal display appears again. The oscilloscope calibration is now optimized.

Probe adjustment:
- Connect a 10 : 1 probe to the CH1 input.
- Connect the probe tip to the Probe Adjust output socket.
- Press the green AUTOSET key.
- Verify that a square-wave signal is displayed on the CRT.
- Verify that top and bottom of the square wave are straight: if not, this must be corrected by adjusting the probe. The correction is done with a small screwdriver. This adjustment is made in the box at the oscilloscope input side of the probe.

Note :
- The POS CH1, POS CH2, POS CH3, POS CH4 and X POS controls need occasional readjustment during this procedure to align the waveform with the measuring raster.
- Small readjustments of the TRACE INTENSITY, TEXT INTENSITY and FOCUS controls may also be necessary.
- Information about active instrument settings is indicated on the viewing area as shown in Fig. 3.1.

Repeatedly pressing the TEXT OFF key allows you to select the amount of information on the display.

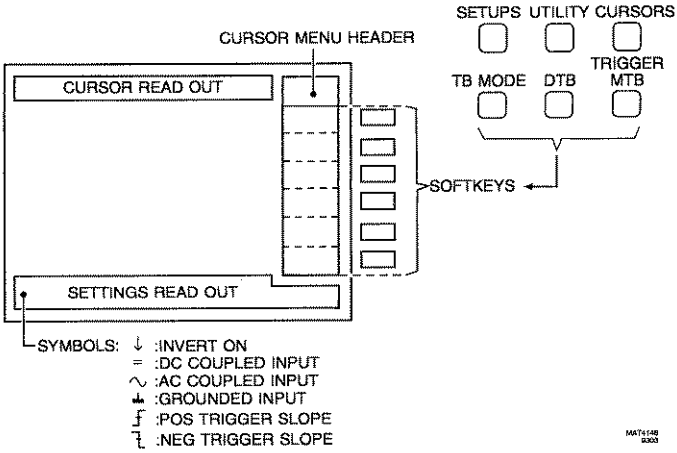


Figure 3.2 CRT viewing area, menukeys and softkeys.

3.3 Vertical section

The vertical section consists of four channels CH1, CH2, CH3 and CH4. These are almost identical. The procedure is described for CH1. Steps for CH2, CH3 and CH4 are shown in parenthesies. To check all four channels the procedure must be done four times.

In some instrument versions, CH3 and CH4 have a limited range of input sensitivities. Differences in the keys for AC/DC input coupling, grounded trace (GND) and 50Ω input impedance may exist as well. This is indicated in the text. These test steps may be skipped.

Proceed as follows:

Preparation:
- Connect a probe to the CH1 (CH2, CH3, CH4) input.
- Connect the probe tip to the Probe Adjust output socket.
- Press the AUTOSET key.
- Adjust the AMPL key pair to an input sensitivity of 100mV/div; in case of an AMPL toggle key on CH3/CH4 the sensitivity must be 1.00 V.

- Adjust the MTB key pair to 0.1 ms/div.
- Verify that a square wave as indicated in Fig. 3.2 is displayed; in case of an AMPL toggle key on CH3/CH4, the vertical amplitude is 0.6 divisions instead of 6 divisions. The corresponding display is shown in Fig. 3.3.

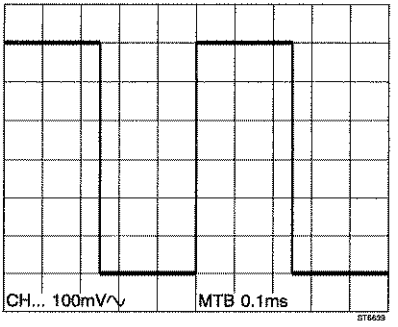


Figure 3.3

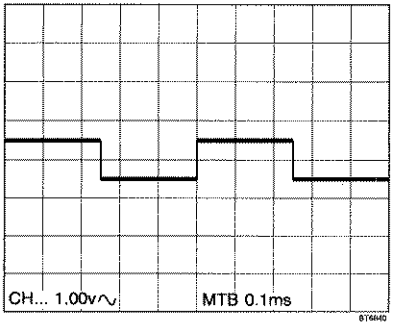


Figure 3.3

Input coupling and POS control:

- Press the AC/DC/GND or AC/DC key so that dc input coupling (=) is obtained.
- Verify that this results in an upward signal shift. Fig. 3.4 shows this for channels with 100mV input sensitivity: the shift is 3 divisions. Fig. 3.5 shows this for channels with 1.00 V input sensitivity: the shift is 0.3 divisions..

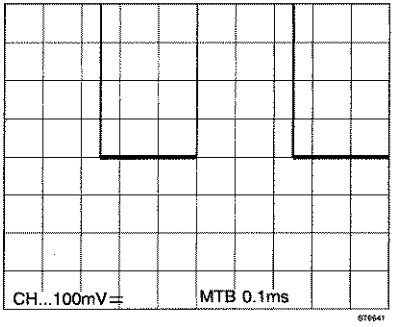


Figure 3.4

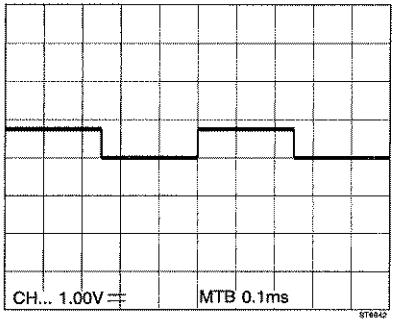


Figure 3.5

- Turn the POS control CCW until the display of Fig. 3.2 or Fig. 3.3 is obtained again.
- Press the AC/DC/GND or GND key so that GND input coupling (⊥) is obtained.
- Verify that this results in a horizontal line in the lower part of the CRT.
- Turn the POS control CW until the line is in the middle of the screen.
- Press the AC/DC/GND key so that ac input coupling (∿) is obtained. In case of separate GND and AC/DC keys, they both must be pressed to obtain an ac coupled input. The waveform as indicated in Fig. 3.2 or Fig. 3.3 is displayed again.

AMPL and VAR functions (this test is skipped for channels where AMPL is a toggle key):

- Press the lower AMPL key and verify that the signal amplitude is 3 divisions. The input sensitivity is 200mV/div.
- Press the upper AMPL key twice and verify that the amplitude is bigger than the screen height of 8 divisions. Use the POS control to shift the top and bottom of the signal into the screen area.
- Press both AMPL keys; this activates the VAR function. Now input sensitivity can be adjusted in fine steps.
- Press the lower AMPL key until a readout of 150 mV is reached.
- Turn the POS control to position the waveform in the middle of the screen.
- Check for a display as indicated in Fig. 3.6..

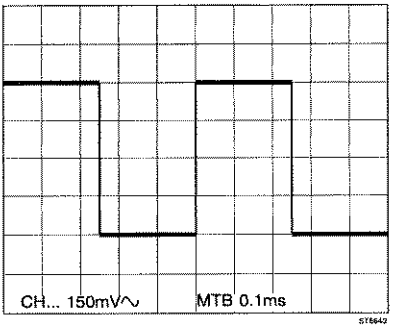


Figure 3.6

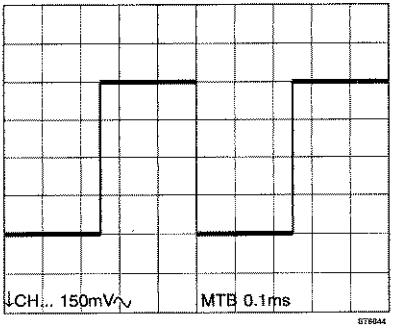


Figure 3.7

INV function:

- The following check is only required for CH2 and CH4.
- Press the INV key and check for a display as shown in Fig. 3.7.

3.4 Horizontal section, Main and Delayed Time Base.

Preparation:
- Connect a probe to the CH1 input.
- Connect the probe tip to the Probe Adjust output socket.
- Press the AUTOSET key.
- Adjust the AMPL key pair to an input sensitivity of 100mV/div.
- Adjust the MTB key pair to 0.1 ms/div.
- Verify that a square-wave as shown in Fig. 3.2 is displayed.

MTB trigger slope:
- Press the TRIG 1 key and verify that the displayed square-wave starts with a negative-going signal.
- Press the TRIG 1 key again and verify that the displayed square-wave starts with a positive-going slope as indicated in Fig. 3.2.

Time coefficients MTB and VAR mode:
- Press the left of the MTB key pair and verify that the number of signal periods increases.
- Select 0.5 ms/div and verify that one signal period is displayed per division.
- Press both of the MTB keys; this activates the VAR mode and the readout in the viewing area changes from 0.5 ms into 500 µs.
- Press the right of the MTB key pair until a readout of 250 µs is reached.
- Verify that one signal period occupies 2 divisions.
- Press the left of the MTB key pair until a readout of 500 µs is reached.
- Verify that one signal period occupies 1 division.
- Press both of the MTB keys; the VAR mode is switched off and the readout in the viewing area changes from 500 µs to 0.5 ms.
- Press the right of the MTB key pair and verify that the number of signal periods decreases.
- Select 0.1 ms/div with the MTB key pair and verify that the square wave is displayed as shown in Fig. 3.2.

MTB and DTB functions:
- Press the lower CH1 AMPL key so that an input sensitivity of 200 mV/div is obtained for channel 1.
- Use the CH1 POS control to position the signal in the upper half of the screen.
- Press menukey DTB: the DELAYED TIME BASE menu appears at the CRT softkeys.
- Select DEL'D TB 'on' and MAIN TB 'on' in this menu.
- Select 20 us/div with the 'DTB s ns' keys.
- Adjust the DELAY control to 400.0 us so that the display of Fig. 3.8 is obtained. For this the TRACE SEPARATION keys (or TRACK rotary) must be adjusted such that MAIN TB is above the DELAY TB display.

- Press the left of the 'DTB s ns' keys and verify that number of displayed signal periods increases. The lowest TIME/DIV range is 0.1 ms/div.
- Press the right of the 'DTB s ns' keys and verify that the number of displayed periods decreases. Proceed until the time scale of 50 us/div is reached.
- Select 'trig'd' in the DELAYED TIME BASE menu.
- Adjust the trigger level of DELAYED TIME BASE with the LEVEL DTB control for a triggered display (signal on DELAY TB time scale visible).
- Press the front panel key TRIG1 and check that the DELAYED TIME BASE is triggered on the negative going slope of the square-wave.

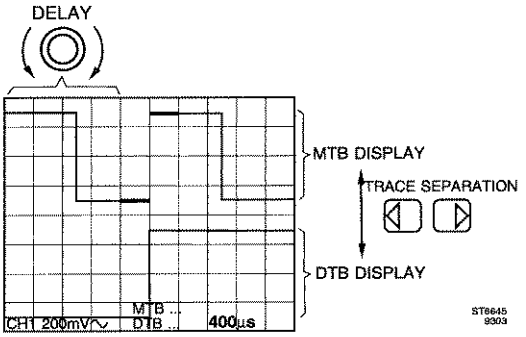


Figure 3.8

3.5 Horizontal section, X-deflection.

Preparation:
- Connect a probe to the CH1 input.
- Connect the probe tip to the Probe Adjust output socket.
- Press the AUTOSET key.
- Press the AMPL key pair to adjust to an input sensitivity of 100mV/div.
- Press the MTB key pair to adjust to 0.1 ms/div.
- Verify that a square wave as shown in fig. 3.2 is displayed.

X-defection check:
- Press the CH2 ON key to turn CH2 on.
- Press the CH1 ON key to turn CH1 off.
- Press the TB MODE menu key: theTB MODE menu appears at the CRT softkeys.
- Press the CRT softkeys to select X-DEFL 'on' and verify that two points with a horizontal distance of approximately 6 divisions are displayed.

3.6 Cursors

Preparation:
- Connect a probe to the CH1 input.
- Connect the probe tip to the Probe Adjust output socket.
- Press the AUTOSET key.
- Adjust the CH1 AMPL key pair to obtain an input sensitivity of 200mV/div.
- Adjust the MTB to 0.1 ms/div.
- Verify that a square wave with an amplitude of 3 divisions is displayed.

VOLT cursors check:
- Press the CURSORS menu key; the CURSORS menu appears at the CRT softkeys.
- Using softkeys, select 'Vpp'. T_{rise} must be 'off'.
- Select readout 'Vpp' in the CURSORS menu.
- Verify that a dashed and a dotted horizontal line (the volt cursors) appear on the screen.
- Verify that the lines are located at the top and bottom levels of the signal. Verify that the cursors follow the signal extremes when the CH1 AMPL key pair is adjusted to 100mV/div. The corresponding display is shown in Fig. 3.9. The readout should be approximately Vpp = 600 mV..

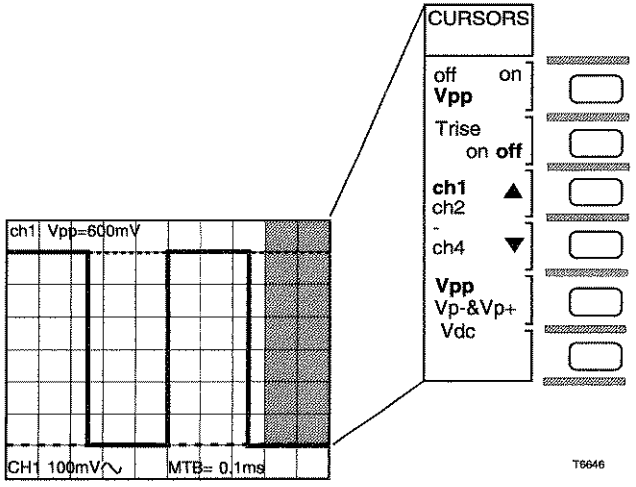


Figure 3.9

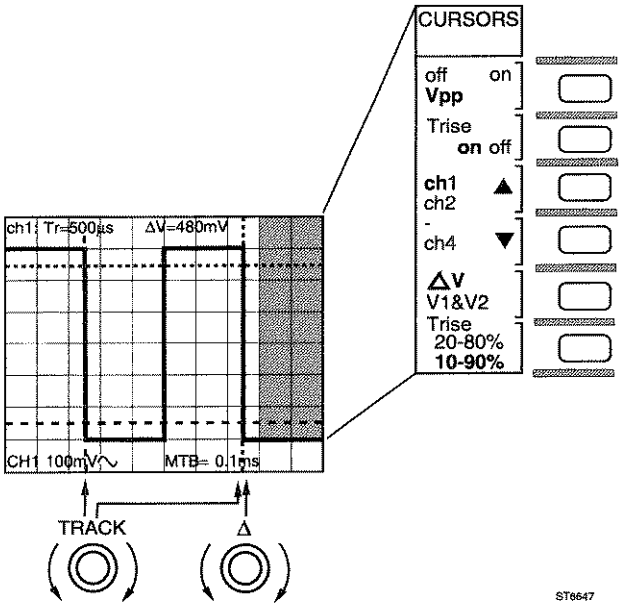


Figure 3.10

TIME cursors check:

- Select 'T_{rise} on' and 'T_{rise} 10-90%'. Verify that a set of vertical lines (the time cursors) is displayed on the screen.
- Turn the 'Δ' control so that the dotted line is approximately 2 divisions to the right of the dashed line.
- Turn the TRACK control so that the dashed line coincides with the first negative edge of the signal.
- Turn the 'Δ' control so that the dotted line coincides with the second negative edge of the signal.
- Verify that the display appears as shown in Fig. 3.10 and that the cursor readout shows approximately T_r = 500 µs.

3.7 TEXT OFF key:

- Press the TEXT OFF key and verify that the CRT softkey text disappears.
- Press the TEXT OFF key again and verify that only the signal, the cursors, and the cursor readout value are displayed.
- Press the TEXT OFF key to obtain full information again in the viewing area.

4 PERFORMANCE TEST

4.1 GENERAL INFORMATION

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

This procedure is intended to:

- Check the instrument's 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 instrument's calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instrument covers is not necessary to perform this procedure. All tests are made from the outside of the instrument.

If the test is started shortly after turning on the instrument, steps may be out of specification, due to insufficient warm up time. Be sure to allow the full warm up time of 30 minutes (under average conditions).

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

IMPORTANT NOTES

- The input voltage must be supplied to the CH1 input, unless otherwise stated. Set the MTB/VAR key pair to a suitable position, unless otherwise stated.
- Tolerances given are for the instrument under test and do not include test equipment error. Bear in mind that the test equipment and connecting cables are properly terminated.
  In case of high-frequency signals this termination must be 50 Ω. This is achieved with a 50 Ω termination at the end of the cable. Such termination is not necessary for the PM 3094 (all channels), or CH1, CH2 of the PM 3092; these oscilloscopes feature switchable internal 50 Ω input impedance.
- In some tests vertical channels CH2, CH3, CH4 appear in parentheses after CH1, e.g., CH1 (CH2, CH3, CH4). This indicates that the CH1 test should be performed first, followed by the tests for CH2, CH3 and CH4.
- Some of the tests are not necessary for all four oscilloscope types. This is indicated as necessary. The test step may then be skipped.

4.2 RECOMMENDED TEST EQUIPMENT

Note: the digital multimeter is not required for this test. The oscilloscope is necassary to test optional outputs.

Note: the FLUKE 5500A Multiproduct calibrator is always used in scope mode. The output signal must be taken from the BNC output 'SCOPE'.

Note: for each test an alternative generator type is listed. Although not sold anymore, these generator types may be available in cal labs.

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq: 10 Hz...100 kHz Sine wave/square-wave Ampl: 0...20 V (pp) DC offset -5...+5 V Rise time ≤ 30 ns Duty cycle 50 %	Fluke 5500A mode: wavegen
Constant amplitude sine wave generator	Freq: 50 kHz...300 MHz Constant pp. amplitude of 10 mV to 5.5 Vpp	Fluke 5500A mode: levsine
Square-wave calibration generator	For ampl. calibration: Freq: 1 kHz Ampl: 10 mV... 50 Vpp	Fluke 5500A mode: volt
	For rise time measurements: Freq: 10 kHz...1 MHz Ampl: 10 mV... 2.75 Vpp Rise time: ≤ 1 ns	Fluke 5500A mode: edge
Time marker generator	Repetition rate: 0.5 s...2 ns	Fluke 5500A mode: marker
Digital multimeter	Wide voltage and current ranges.	Fluke 29/79 with AC, DC and resistance ranges. High voltage probe. Required: 1 % accuracy, model 80K-40

Variable voltage transformer (VARIAC)	Well insulated output voltage 90...264 V (ac)	
TV pattern generator with video output		Fluke PM 5418
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Fluke PM 3394B
BNC/Probe tip adapter	For bandwidth check of PM3092	Ord. nr. 5322 263 50022
50 Ω cables, 75 Ω cable, 50 Ω terminations, 75 Ω termination, 10:1 attenuator, T-piece, power splitter 2:1 attenuator	Fluke or e.g. Tektronix BNC types for fast rise time square-wave and high-frequency sinewave applications	Fluke PM 9074 Fluke PM 9075 Fluke PM 9581 TEK 011-0055-01 TEK 011-0059-02 Fluke PM 9067 Fluke PM 9584/02 TEK 011-0069-02

4.3 TEST PROCEDURE

4.3.1 Preliminary settings

Test equipment:

None

Settings/procedure and requirements (the steps 4...8 are not required for PM 3082/84):

1 - If not present install 2 penlight (LR6) back up batteries in the holder at the rear panel of the oscilloscope.
2 - Turn on the oscilloscope under test.
3 - Press the STATUS and TEXT OFF keys simultaneously. This assures that the oscilloscope follows the default reaction when the green AUTOSET key is pressed.
4 - Press the UTILITY menu key to display the UTILITY menu.
5 - Press softkey AUTOSET to display the UTILITY AUTOSET menu.
6 - Press the relevant softkey to select 'userprog'.
7 - Press softkey VERT.
8 - Select with softkey '1MΩ / 50Ω / unaffect' the 'unaffect' position.
9 - Check for the instrument settings in the lower part of the viewing area: when not available press TEXT OFF until the maximum amount of information is displayed.

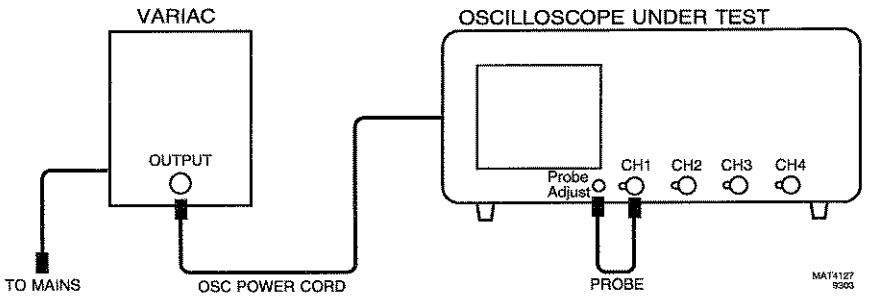
4.3.2 Power supply

This test checks the proper operation of the power supply at all possible line voltages.

Test equipment:

Variable voltage transformer (VARIAC)

Test set-up:



Settings/procedure:

1 - Adjust the input line voltage to the oscilloscope (output from VARIAC) to a desired value between 100 and 240 V (rms), frequency 50...400 Hz.
2 - Press POWER ON on the oscilloscope.
3 - Apply the Probe Adjust signal from the front panel of the oscilloscope to input CH1 , e.g., by means of a 10:1 probe.
4 - Press the green AUTOSET key.

Requirements:

1 - Verify that the oscilloscope starts at any input voltage between 100 and 240 V; in particular the line voltages 100, 120, 220 and 240 V must be checked.
2 - Verify that the instrument's performance does not change over the indicated voltage range; and that the displayed Probe Adjust signal is distortion-free and has equal intensity.

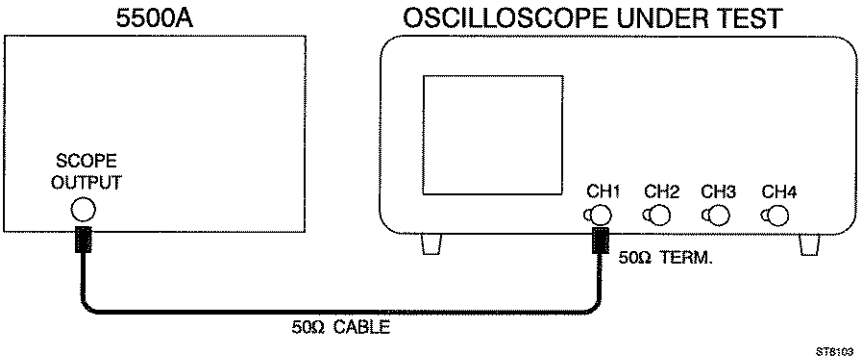
4.3.3 Auto set

This test checks the correct working of the AUTOSET function.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set-up:



Settings/procedure:

1 - Apply a 10 MHz sine wave signal of 600 mV (pp into 50 Ω) to input CH1;.
2 - Press the green AUTOSET key. Use a 50 Ω termination at the end of the coax cable. For instruments with switchable 50 Ω input impedance it is recommended to use the internal termination (when active, the text 'LZ' appears in the lower part of the viewing area). For instruments without internal termination, an external termination should be used.

Requirements:

Verify that the displayed waveform is stable and properly triggered. Amplitude should be within the screen area. Horizontally a number of signal periods should be displayed.

Repeat the same settings and procedure for CH2, CH3 and CH4.

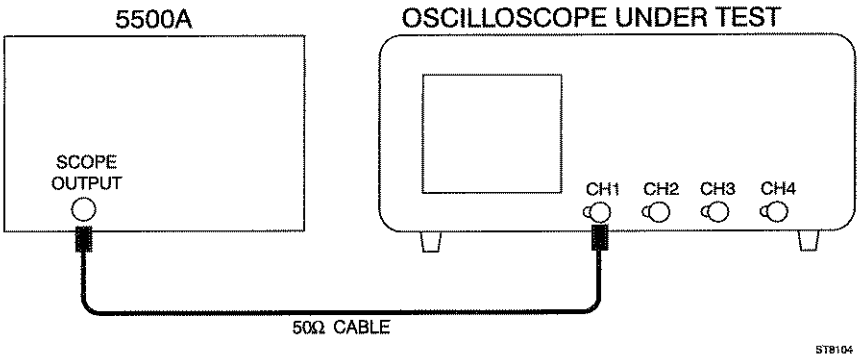
4.3.4 Orthogonality

This test checks the angle between the horizontal and vertical deflection plates (orthogonality).

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator PM5136)

Test set up:



Settings/procedure:

1 - Press the CAL key for a few seconds to start the autocal procedure. This takes approximately one minute. When ready, the oscilloscope is fine tuned to optimal accuracy.
2 - Apply a 50 Hz sine wave signal of 8 V (pp) to input CH1;
3 - Press the AUTOSET key and adjust the input signal to a trace- height of 8 div.
4 - Activate the GND function and verify that the straight line is exactly parallel to the horizontal graticule lines. If not, readjust the TRACE ROTATION.
5 - Switch the GND function off and verify that a signal of 8 divisions is displayed.
6 - Press the TB MODE menu key to display the TB MODE menu.
7 - Select X-DEFL 'on' in this menu; the text 'on' must be intensified. The name of the displayed menu now changes into : TB MODE X-DEFL.
8 - Select 'ch2' in the TB MODE X-DEFL menu.
9 - Use the X POS control to shift the vertical line to the center of the screen.

Requirements:

1 - Verify that the vertical line is parallel to the vertical graticule line in the center of the screen.
2 - Verify that the angle with respect to the horizontal graticule lines is 90° ± 0.5° as indicated in the figure.

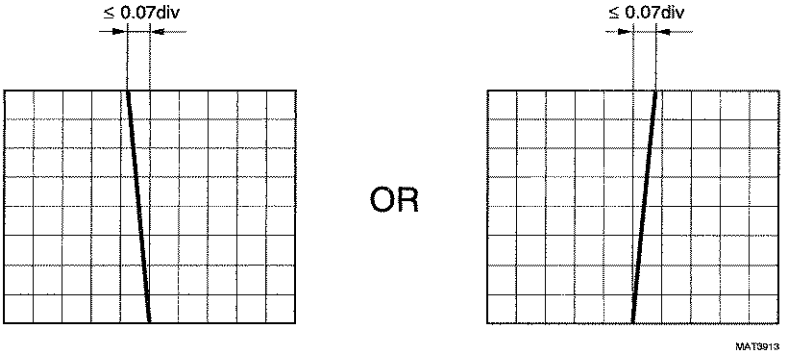


Figure 4.1 Orthogonality

4.3.5 Trace distortion

This test checks the distortion of a horizontal line in the central 6 x 8 divisions of the screen.

Test equipment:

None

Settings/procedure:

1 - Press the AUTOSET key with no input signal applied to the scope.
2 - Use the CH1 POS control to shift the timebase line vertically across the center 6 divisions of the screen.

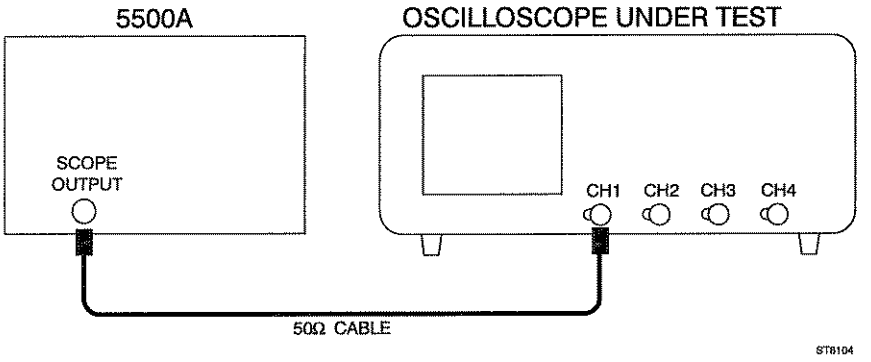
Requirements:

Verify that the deviation from the ideal straight line does not exceed 0.03 divisions in the center of screen and 0.1 divisions elsewhere.

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator PM5136)

Test set-up:



Settings/procedure:

1 - Apply a 50 Hz sine wave signal of 8 V (pp into 50 Ω) to input CH1;
2 - Press the AUTOSET key and adjust the input signal to an amplitude of 8 divisions.
3 - Using the CH1 POS control, adjust the display around the center of the screen.
4 - Press the TB MODE menu key to display the TB MODE menu.
5 - Select X-DEFL 'on' in this menu; the text 'on' must be intensified. The name of the menu now changes into TB MODE X-DEFL.
6 - Select 'ch2' in the TB MODE X-DEFL menu.
7 - Using the X POS control, shift the vertical line across the center 8 divisions of the screen.

Requirements:

Verify that the deviation from the ideal straight line does not exceed 0.03 divisions in the center of screen and 0.1 divisions elsewhere.

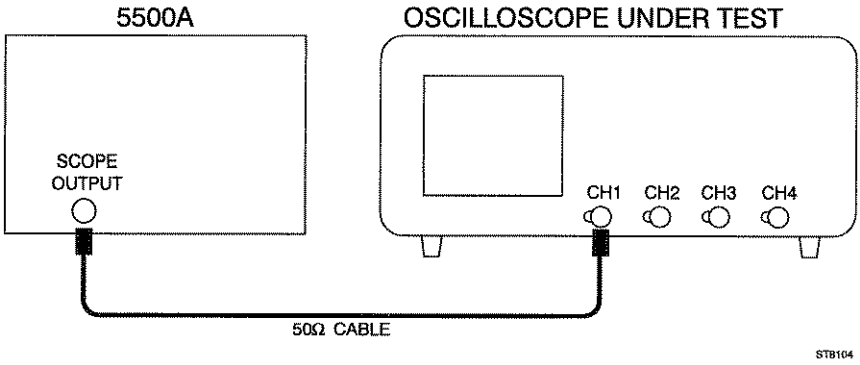
4.3.6 Vertical deflection; deflection coefficients

The vertical deflection coefficients of channels CH1, CH2, CH3, and CH4 are checked by means of a calibrated signal.

Test equipment:

Fluke 5500A mode: volt (Alternative: square-wave calibration generator PG 506)

Test set up:



Settings/procedure:

1 - Apply a 1 kHz square-wave signal of 20 mV to input CH1. Set the generator in position STD AMPL. The generator must not be terminated with 50 Ω (the text 'LZ' must not be visible in the lower part of the viewing area).
2 - Press the green AUTOSET key.
3 - Set CH1 to 5 mV/div and to DC input coupling. The waveform must be in the vertical middle of the screen.
4 - Press the BWL key to activate the bandwidth limiter.
5 - Press menukey TRIGGER MTB and activate softkey 'noise on' and 'hf rej'.
6 - Change the input voltage and the setting of CH1 according to table I and verify that the amplitude of the signal agrees with this table. The signal should remain positioned in vertical center of the screen.

Note: only the input sensitivities essential for instrument accuracy are checked.

Requirements:

table I.

Input voltage (pp)	Setting	Requirements
20 mV	5 mV	3.94...4.06 div (+/- 1.3%)
50 mV	10 mV	4.93...5.07 div (+/- 1.3%)
1 V	0.2 V	4.93...5.07 div (+/- 1.3%)
5 V	1 V	4.93...5.07 div (+/- 1.3%)

Repeat the settings/procedure in table I for CH2, CH3 and CH4. Use table II for CH3 and CH4 in PM 3092 and PM 3082.

table II.

Input voltage (pp)	Setting	Requirements
0.5 V	0.1 V	4.93...5.07 div (+/- 1.3%)
2 V	0.5 V	3.94...4.06 div (+/- 1.3%)

4.3.7 Vertical deflection; variable gain control range (continuation of 4.3.6)

This test checks the vertical VARiable gain control.

Settings/procedure:

1 - Apply a square-wave signal of 0.2 V to input CH1 and press AUTOSET.
2 - Set CH1 to 50 mV/div and input coupling to DC. Using the CH1 POS control, center the waveform in the screen.
3 - Select the VARiable mode by simultaneously pressing both AMPL keys. The readout changes into 50.0 mV/div.
4 - Press the mV key to adjust an input sensitivity of 40.0 mV/div.

Requirements:

Verify that the displayed amplitude is between 4.86 and 5.14 divisions (+/- 2.8 %).

Repeat the settings and procedure for CH2. For the PM 3094 and PM 3084 repeat the same steps for CH3 and CH4.

4.3.8 Vertical deflection; input coupling (continuation of 4.3.7)

This test verifies the operation of the AC input coupling. Also, the operation of the ground (GND) function is checked.

Settings/procedure:

1 - Switch the CH1 VARiable mode off by simultaneously pressing both AMPL/VAR keys. The readout changes to 50 mV.
2 - CH1 sensitivity is 50 mV/div; the vertical deflection is now 4 divisions.

Requirements:

1 - Activate the CH1 GND function and verify that a horizontal line is displayed.
2 - Select the AC input coupling and verify that a 4 divisions square-wave signal is displayed. Center this signal in the middle of the screen.
3 - Select the DC input coupling and verify that the 4 divisions square-wave signal moves up. This shift is caused by the signal's positive dc component: this component is not blocked in DC coupled mode.

Repeat the settings and procedure for CH2, CH3, and CH4. In the PM 3092 and PM3082, the test of the GND function is skipped for CH3 and CH4.

4.3.9 Vertical cursor accuracy (continuation of 4.3.8.)

This test verifies the accuracy of the voltage cursors

Settings/procedure:

1 - Change the generator output voltage to 0.1 V.
2 - Apply this voltage to CH1.
3 - Switch CH1 to ON and switch the other channels off.
4 - Select DC coupled input and 20 mV/div for CH1.
5 - Select CH1 as trigger source (TRIG 1).
6 - Use POS to center the 5 div square-wave (on the dotted horizontal lines of the graticule).
7 - Press the CURSORS menukey.
8 - Select 'on' and volt cursors (=) in the CURSORS menu.
9 - Select Δ V in the READOUT menu.

Requirements:

- Use the TRACK and Δ controls to position both cursor lines exactly on top and bottom of the signal. Check for a cursor readout between 98.4 and 101.6 mV.

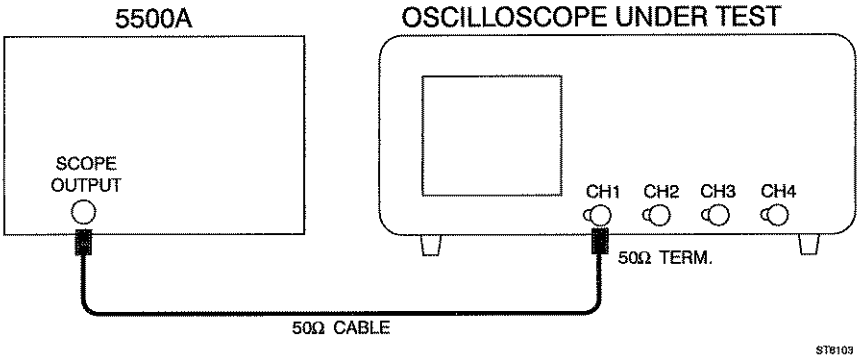
4.3.10 Vertical deflection, high-frequency response

This test verifies the upper transition point of the vertical bandwidth.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set-up:



Settings/procedure:

1 - Apply a 50 kHz sine wave signal of 600 mV (pp into 50 Ω) to input CH1, and press the AUTOSET key.
2 - Use an external 50 Ω termination. Use the internal termination of the oscilloscope, when available (if active, the text 'LZ' is visible in the lower part of the viewing area).
3 - Set CH1 to 0.1 V/div.
4 - Adjust the input signal to an amplitude of exactly 6 divisions.
5 - Slowly increase the frequency to 200 MHz (PM 3092/94) or 100 MHz (PM3082/84) and verify that the displayed amplitude does not drop below 4.2 divisions.
6 - Switch the frequency of the sine wave signal to 50 kHz.
7 - Use the BWL key to activate the vertical bandwidth limiter. The text BWL appears in the display area.
8 - Slowly increase the frequency to 20 MHz and verify that the vertical deflection has decreased to 4.2 div approximately at 20 MHz.
9 - Switch the bandwidth limiter (BWL) off.

Requirements:

The vertical deflection must be 4.2 divisions or more. For the bandwidth limiter the requirement is 4.2 div approximately at 20 MHz.

Repeat the above settings and procedure for CH2, CH3 and CH4. The procedure for CH3 and CH4 in PM3092 must be done via the 10:1 probe instead of the 50 Ω cable. Oscilloscope in 1V/div and generator voltage 5 Vpp into 50 Ω. Termination resistor directly at generator output. Use the BNC to probe tip adapter between termination resistor and probe tip. Adjust the amplitude at 50 kHz to 5 divisions. Check that the amplitude at higher frequencies does not drop below 3.5 div.

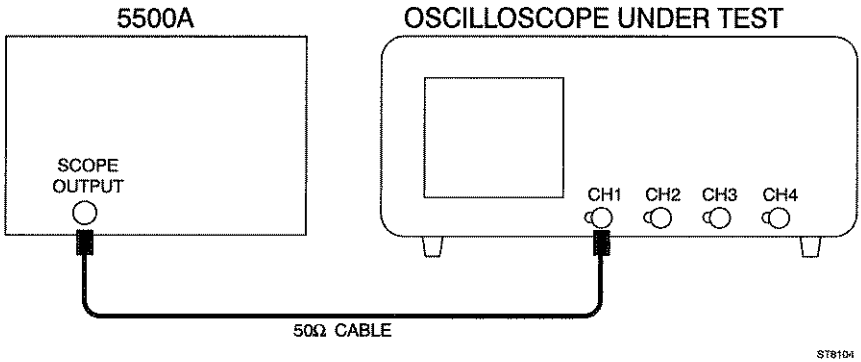
4.3.11 Vertical deflection, low-frequency response

This test verifies the lower transition point of the vertical bandwidth.

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator PM5136)

Test set up:



Settings/procedure:

1 - Apply a 5 kHz sine wave signal of 600 mV (pp) to input CH1, and press the AUTOSET key.
2 - Set CH1 to 0.1 V/div.
3 - Adjust the input signal to an amplitude of exactly 6 divisions.
4 - Lower the frequency to 10 Hz and verify that the displayed amplitude does not drop below 4.2 divisions.

Requirements:

The vertical deflection must be 4.2 divisions or more.

Repeat the above settings and procedure for CH2, CH3, and CH4.

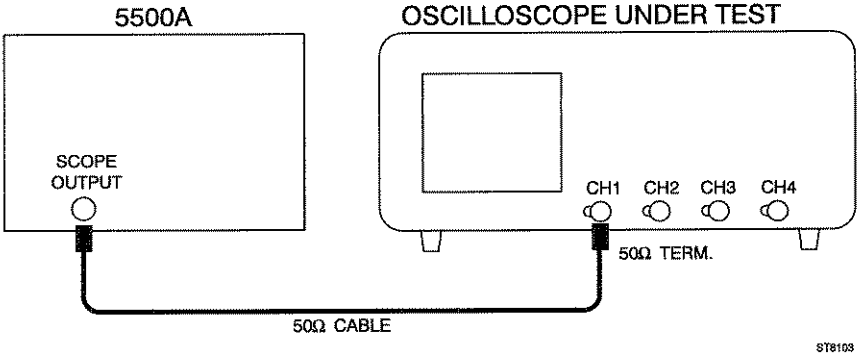
4.3.12 Vertical deflection; dynamic range at 50/25 MHz

The oscilloscope must be capable of displaying signal amplitudes that are larger than the screen. In practice, a low frequency signal with an amplitude equivalent to 24 divisions must be displayed with no distortion.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set up:



Settings/procedure:

1 - Apply a 50 MHz (PM 3092/94) or 25 MHz (PM 3082/84) sine wave signal of 2.4 V (pp into 50Ω) to input CH1 and press the AUTOSET key.
2 - Use a 50 Ω termination. Use the internal termination when available.
3 - Set CH1 to 0.1 V/div.
4 - Using the CH1 POS control, shift the sine wave vertically over the screen.

Requirements:

Verify that top and bottom of the sine-wave signal of 24 divisions in amplitude can be displayed with no distortion.

Repeat the above settings and procedure for CH2, CH3, and CH4.

4.3.13 Vertical deflection; dynamic range at 200/100 MHz (continuation of 4.3.12)

In this test, the dynamic range of the amplifier is checked at a high frequency.

Settings/procedure:

1 - Apply a 200 MHz (PM 3092/94) or 100 MHz (PM 3082/84) sine-wave signal of 0.8 V (pp into 50 Ω) to input CH1.
2 - Press the AUTOSET key, and set CH1 to 0.1 V/div.
3 - Use a 50 Ω termination. Use the internal termination when available.
4 - Set the amplitude to exactly 8 divisions.

Requirements:

Verify that the sine wave of 8 divisions in amplitude is displayed with no distortion.

Repeat the above settings and procedure for CH2, CH3, and CH4.

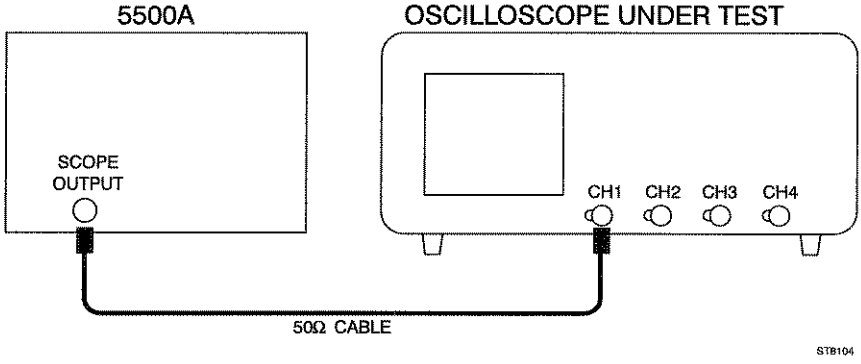
4.3.14 Vertical deflection; position range

The range of the vertical shift is checked with a sine-wave signal of 8 divisions in amplitude.

Test equipment

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator PM5136)

Test set up:



Settings/procedure:

1 - Apply a 1 kHz sine wave signal with an amplitude of 0.8 V (pp) to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.1 V/div.

Requirements

Turn the CH1 POS control fully clockwise and counterclockwise and verify that top and bottom of the 8 divisions signal can be positioned outside the graticule.

Repeat the above settings and procedure for CH2, CH3, and CH4.

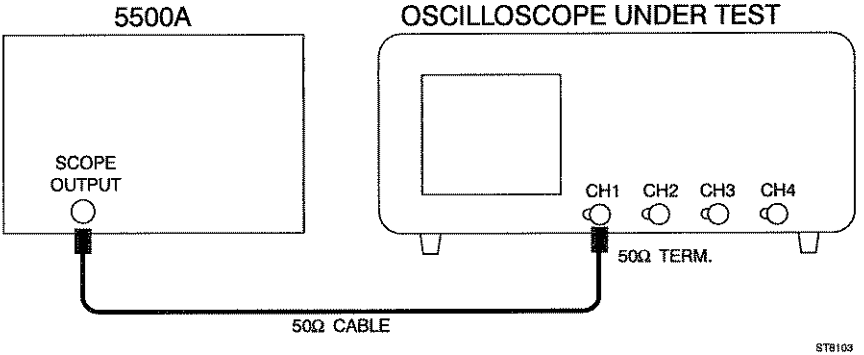
4.3.15 Vertical deflection; crosstalk between channels at 200/100 MHz

At higher frequencies there exists some crosstalk between any two channels. In the following test, crosstalk is verified at a high frequency.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set up:



Settings/procedure:

1 - Apply a 200 MHz (PM 3092/94) or 100 MHz (PM 3082/84) sine-wave signal of 4 V (pp into 50 Ω) to input CH1.
2 - Press the AUTOSET key.
3 - Use a 50 Ω termination. Use the internal termination when available.
4 - Switch all channels ON.
5 - Set all channels to 0.5 V/div.
6 - Adjust the generator to a signal amplitude of 8 div.
7 - Activate the GND function of CH2, CH3, and CH4 (if present on the oscilloscope).

Requirements:

Verify that the displayed amplitude the channels with no input signal applied is less than 0.16 divisions, (better than 1 : 50).

Repeat the above settings and procedure:
- Input signal applied to CH2. CH1, CH3, and CH4 input GND.
- Input signal applied to CH3. CH1, CH2, and CH4 input GND.
- Input signal applied to CH4. CH1, CH2, and CH3 input GND.

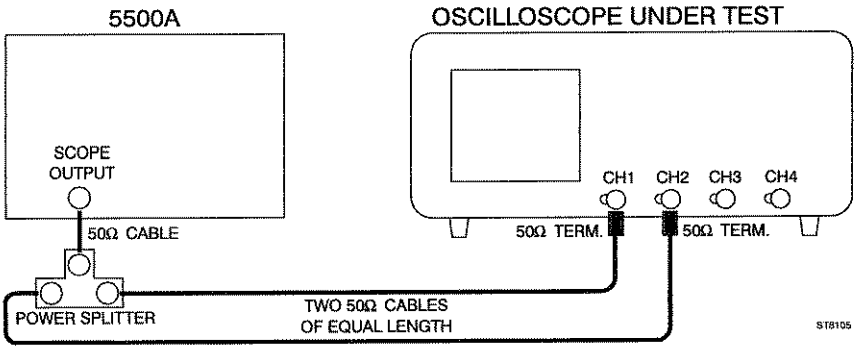
4.3.16 Vertical deflection; common mode rejection ratio at 1 MHz

The common mode rejection ratio (CMRR) is a measure of susceptibility to common mode signals. This susceptibility is verified in this test.

Test equipment:

- Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)
- Power splitter PM9584

Test set up:



Settings/procedure:

1 - Use a power splitter and two cables of equal length to CH1 and CH2. Apply a 1 MHz sine-wave signal of 0.8 V (pp into 50 Ω) to inputs CH1 and CH2.
2 - Press the AUTOSET key.
3 - Use 50 Ω terminations. Use the internal terminations when available.
4 - Set CH1 and CH2 to 0.1 V/div and adjust the generator voltage for a deflection of 8 divisions.
5 - Set CH1 and CH2 to DC input coupling.
6 - Press the CH1+CH2 key to activate the 'added' mode.
7 - Press the INV key of CH2; the result is the display of CH1-CH2.
8 - Press the ON keys of CH1 and CH2; this switches CH1 and CH2 off and only the differential signal (CH1 CH2) is now visible.
9 - Readjust the VAR function of CH1 or CH2 for minimum amplitude.

Requirements

Verify that the trace-height of the CH1-CH2 differential signal is less than 0.08 divisions.

Repeat the above settings and procedure for CH3 and CH4 (PM 3094 and PM 3084 only).

4.3.17 Vertical deflection; common mode rejection ratio at 50 MHz (continuation of 4.3.16)

The common mode rejection ratio (CMRR) indicates the susceptibility to common mode signals at higher frequencies. The susceptibility is verified in this test.

Settings/procedure:

1 - Use a power splitter and two cables of equal length to CH1 and CH2. Apply a sine-wave signal of 50 MHz with an amplitude of 0.8 V (pp into 50 Ω) to inputs CH1 and CH2.
2 - Press the AUTOSET key.
3 - Use a 50 Ω termination. Use the internal termination when available.
4 - Set CH1 and CH2 to 0.1 V/div and adjust the generator voltage for a deflection of 8 divisions.
5 - Set CH1 and CH2 to DC input coupling.
6 - Press the CH1+CH2 key; to activate the added mode.
7 - Press the INV key of CH2; the result is the display of the differential signal of CH1-CH2.
8 - Press the ON keys of CH1 and CH2; this switches CH1 and CH2 off and only the differential signal of CH1 CH2 display is now visible.
9 - Readjust the VAR function of CH1 or CH2 for minimum amplitude.

Requirements:

Verify that the amplitude of the CH1-CH2 differential signal is less than 0.32 divisions.

Repeat the above settings and procedure for CH3 and CH4 (PM 3094 and PM 3084 only).

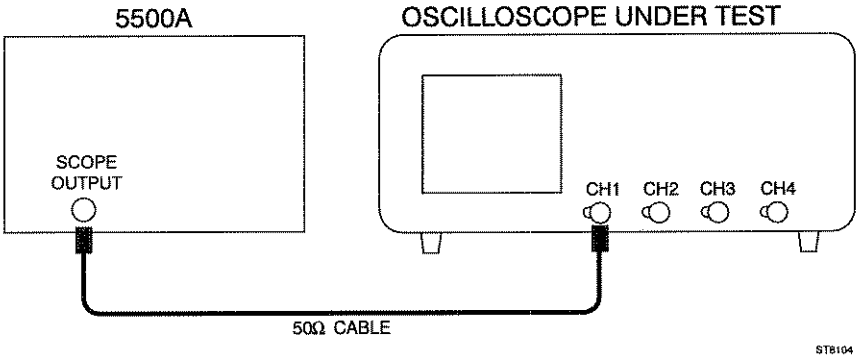
4.3.18 Vertical deflection; LF linearity

The linearity of the vertical amplifier is checked by moving a signal with a fixed amplitude vertically over the entire screen area.

Test equipment

Fluke 5500A mode: wavegen, wave square (Alternative: function generator PM5136)

Test set up:



Settings/procedure

1 - Apply a 50 kHz square-wave signal of 200 mV (pp) to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.1 V/div.
3 - Move the square-wave signal to the vertical center of the screen.
4 - Adjust the generator output so that the displayed amplitude is exactly 2 divisions.
5 - Use the CH1 POS control to shift the signal across the central 6 divisions of the screen.

Requirements

Verify that the amplitude in the two upper and lower divisions is between 1.96 ...2.04 divisions (+/- 2%).

Repeat the above settings and procedure for CH2, CH3 and CH4.

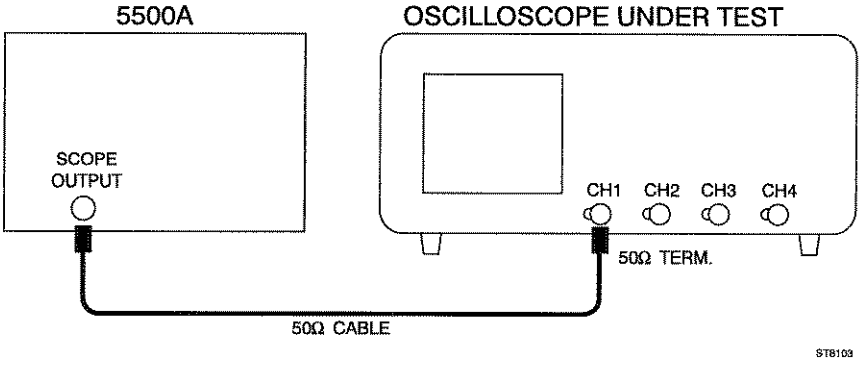
4.3.19 Vertical deflection; visual signal delay

Many applications require that the leading edge of a fast pulse triggering the oscilloscope be made visible. A fixed amount of signal delay is introduced in the vertical channels of this instrument to allow the timebase to start before the triggering leading edge causes vertical deflection to occur.
This delay is verified in the following test.

Test equipment

Fluke 5500A mode: edge (Alternative: square-wave calibration generator PG 506)

Test set-up:



Settings/procedure:

1 - Apply a signal with a fast rise time of less than 1 ns and an amplitude of 0.5 V (into 50 Ω), and a frequency of 1 MHz, to input CH1. Set the generator in the 'edge' mode.
2 - Press the AUTOSET button and set CH1 to 0.1 V/div.
3 - Use a 50 Ω termination. Use the internal termination when provided.
4 - Set the MTB to 50 ns/div.
5 - Press x10 MAGN and turn the X POS control to display the leading edge.
6 - Turn the TRACE INTENSITY control clockwise for maximum intensity.
7 - Press the TRIGGER MTB menu key to access the TRIGGER MAIN TB menu.
8 - Select level-pp 'off' mode in this menu.
9 - Select 'dc' trigger coupling in the menu.
10 - Adjust LEVEL MTB for a triggered display and maximum visible signal delay.

Requirements

Verify that the visible signal delay is at least 15 ns (3 divisions) for PM3092 and PM3094. For PM3082 and PM3084, the visible signal delay must be least 13 ns (2.6 divisions).

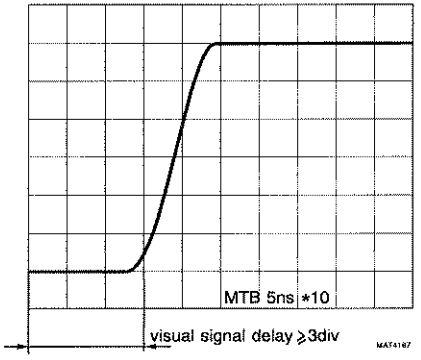


Figure 4.2 Visual signal delay (example for 15 ns)

4.3.20 Vertical deflection; base line instability

In the following test, several adjustments of balance, offset and jump, are checked.

Test equipment

None

Settings/procedure and requirements:

1 - Press the AUTOSET key (no input signal) and set CH1 to 5 V/div.
2 - Use the CH1 POS control to position the trace in the vertical middle of the screen.
3 - Press both CH1 AMPL keys simultaneously to select the VARiable mode. The readout changes to 5.00 V. The input sensitivity can be adjusted now in very fine steps between 2 mV and 12.5 V/div.
4 - Press the 'V' key and verify that the base line jump is not more than 0.2 divisions between 5.00 V to 12.5 V/div.
5 - Press the 'mV' key and verify that the base line jump is not morethan 0.2 divisions between 12.5 V/div to 5 mV/div.
6 - Press the ON keys of CH2 and CH1; CH2 is now on and CH1 is off.

7 - Using the CH2 POS control, position the trace in the vertical middle of the screen.
8 - Press both CH2 AMPL keys simultaneously to select the VARiable mode. The readout changes to 5.00 V. The input sensitivity can be adjusted now in very fine steps between 2 mV and 12.5 V/div.
9 - Press the 'V' key and verify that the base line jump is not more than 0.2 divisions between 5.00 V to 12.5 V/div.
10 - Press the 'mV' key and verify that the base line jump does not 0.2 divisions between 12.5 V/div to 5 mV/div.
11 - Press the INV key repeatedly and verify that the base line jump is not more than 0.2 divisions.

For the PM 3094 and PM3084 repeat the above procedure for CH3 and CH4. The CH3 settings are equal to those of CH1; the CH4 settings are equal to CH2.

For the PM 3092 and PM3082 the following steps are required to check CH3 and CH4:

1 - Press the ON keys of CH3 and CH2; CH3 is now on and CH2 is off.
2 - Use the CH3 POS control to position the trace in the vertical center of the screen.
3 - Press the CH3 AMPL key repeatedly and verify that the base line jump does not exceed 0.2 divisions.
4 - Press the ON keys of CH4 and CH3; CH4 is now on and CH3 is off.
5 - Using the CH4 POS control, position the trace in the vertical center of the screen.
6 - Press the CH4 AMPL key repeatedly and verify that the base line jump does not exceed 0.2 divisions.
7 - Press the INV key repeatedly and verify that the base line jump does not exceed 0.2 divisions.

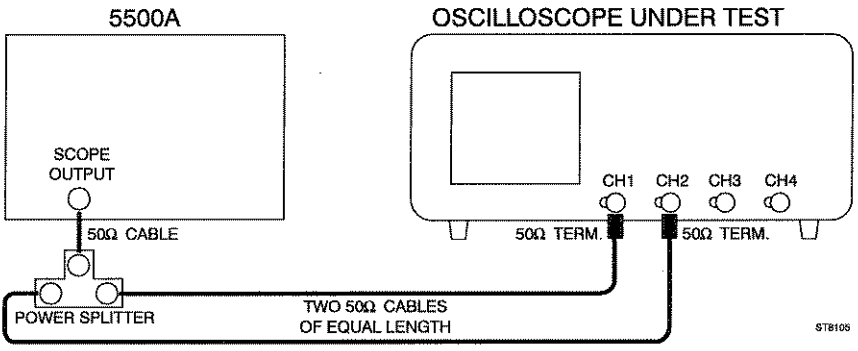
4.3.21 Delay difference between vertical channels in PM 3092, PM 3094

The delay difference between CH1, CH2, CH3, and CH4 is checked here.

Test equipment:

- Fluke 5500A mode: edge (Alternative: square wave calibration generator PG 506)
- Power splitter PM9584

Test set up:



Settings/procedure:

1 - Apply a square-wave signal with a fast rise time of less than 1 ns, and an amplitude of 1 V (into 50 Ω), with a frequency of 1 MHz, to inputs CH1 and CH2. The generator must be set in the 'edge' mode.
Use a power splitter and two cables of equal length to CH1 and CH2.
2 - Press the AUTOSET key.
3 - Use 50 Ω terminations. Use the internal terminations when available.
4 - Set CH1 and CH2 to 0.1 V/div and input coupling to DC.
5 - Press the 10x MAGN key and set the MTB to 2 ns/div.
6 - Press menukey TRIGGER MTB.
7 - Select level-pp 'off' and 'dc' trigger coupling in the related menu.
8 - Press menukey TB MODE.
9 - Select 'trig' in the related menu.
10 - Adjust LEVEL MTB for a triggered display of the leading edge.
11 - Using the X POS and LEVEL MTB control, position the leading edges of the signals in the horizontal center of the screen.
12 - Using both CH1 and CH2 POS controls, adjust the vertical position of each trace between the dotted 0 % and 100 % lines. The signals appear to be superimposed.

Requirements

Verify that the delay difference between the two displayed signals is less than 0.25 ns.

This equals 0.13 divisions in PM 3092 and PM 3094.

Repeat the above settings and procedure for CH3 and CH4 in PM 3094.

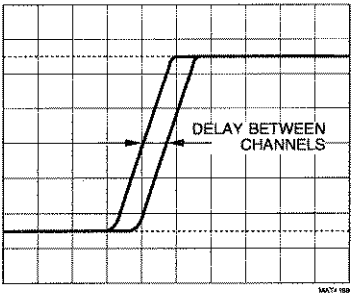


Figure 4.3 Delay difference ≤ 0.13 div

Settings/procedure PM 3092:

1 - Apply a fast rise time (≤ 1 ns) signal of 1 V (into 50 Ω), frequency 1 MHz, to inputs CH1 and CH3. Generator in 'edge' mode.
Use a power splitter and two cables of equal length to CH1 and CH3.
2 - Press the AUTOSET key.
3 - Use 50 Ω terminations.
4 - Set CH1 and CH3 to 0.1 V/div and input coupling to DC.
5 - Press 10x MAGN key and set MTB to 2 ns.
6 - Position the rising edges of the signals in the horizontal center of the screen, by means of the X POS control.
7 - Adjust the two traces between the dotted lines 0 % and 100 % by means of the CH1 and CH3 POS controls so that both signals cover each other.

Requirements:

Verify that the delay difference between the two displayed signals is less than 0.5 ns: this equals 0.25 divisions in PM 3092.

Repeat settings/procedure for CH1 and CH4.

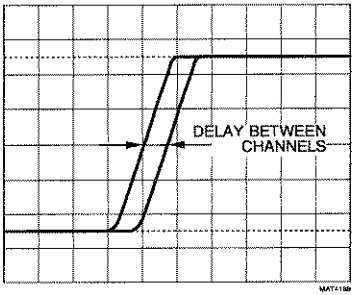


Figure 4.4 Delay difference ≤ 0.25 div

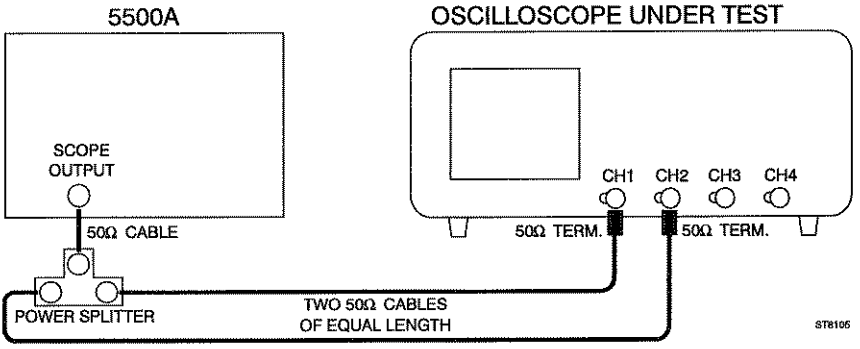
4.3.22 Delay difference between vertical channels in PM 3082, PM 3084.

The delay difference between CH1, CH2, CH3, and CH4 is checked here.

Test equipment:

- Fluke 5500A mode: edge (Alternative: square wave calibration generator PG 506)
- Power splitter PM9584

Test set-up:



Settings/procedure:

1 - Apply a square-wave signal with a fast rise time of less than 1 ns, and an amplitude of 1 V (into 50 Ω), with a frequency of 1 MHz, to inputs CH1 and CH2. The generator must be set in the 'edge' mode.
Use a power splitter and two cables of equal length to CH1 and CH2.
2 - Press the AUTOSET key.
3 - Use 50 Ω terminations.
4 - Set CH1 and CH2 to 0.1 V/div and input coupling to DC.
5 - Press the 10x MAGN key and set the MTB to 5 ns/div.
6 - Press menukey TRIGGER MTB.
7 - Select level-pp 'off' and 'dc' trigger coupling in the related menu.
8 - Press menukey TB MODE.
9 - Select 'trig' in the related menu.
10 - Adjust LEVEL MTB for a triggered display of the leading edge.
11 - Using the X POS and LEVEL MTB control, position the leading edges of the signals in the horizontal center of the screen.
12 - Using both CH1 and CH2 POS controls, adjust the vertical position of each trace between the dotted 0 % and 100 % lines. The signals appear to be superimposed.

Requirements

Verify that the delay difference between the two displayed signals is less than 0.25 ns.

This equals 0.05 divisions in PM 3082 and PM 3084.

Repeat the above settings and procedure for CH3 and CH4 in PM 3084.

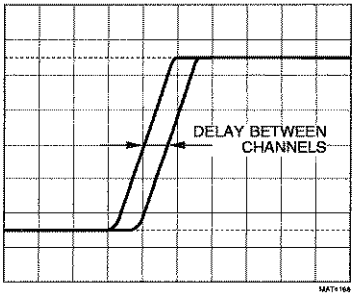


Figure 4.5 Delay difference ≤ 0.05 div

Settings/procedure PM3082:

1 - Apply a fast rise time (≤ 1 ns) signal of 1 V (into 50 Ω), frequency 1 MHz, to inputs CH1 and CH3. Generator in 'edge' mode.
Use a power splitter and two cables of equal length to CH1 and CH3.
2 - Press the AUTOSET key.
3 - Use 50 Ω terminations.
4 - Set CH1 and CH3 to 0.1 V/div and input coupling to DC.
5 - Press 10x MAGN key and set MTB to 5 ns.
6 - Position the rising edges of the signals in the horizontal center of the screen, by means of the X POS control.
7 - Adjust the two traces between the dotted lines 0 % and 100 % by means of the CH1 and CH3 POS controls so that both signals cover each other.

Requirements:

Verify that the delay difference between the two displayed signals is less than 0.5 ns: this equals 0.1 divisions in PM 3082.

Repeat settings/procedure for CH1 and CH4.

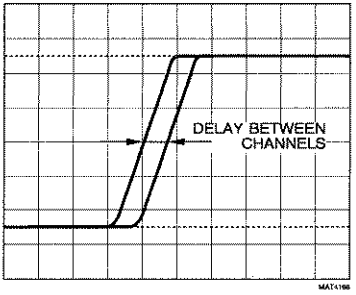


Figure 4.6 Delay difference ≤ 0.1 div

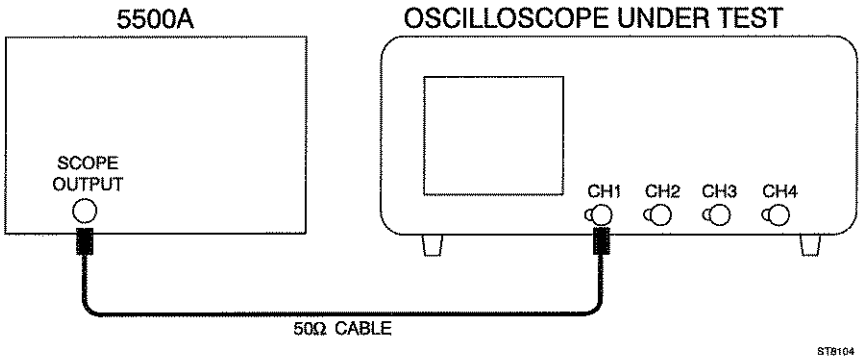
4.3.23 Horizontal deflection; display modes and trace separation

The correct working of main timebase (MTB), delayed timebase (DTB) and the TRACE SEPARATION is checked.

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator, PM5136)

Test set-up:



Settings/procedure and requirements:

1 - Apply a 2 kHz sine-wave signal of 400 mV (pp) to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.1 V/div.
3 - Adjust the generator signal to a trace height of 4 divisions.
4 - Set MTB to 0.5 ms.
5 - Press menukey DTB.
6 - Set DEL'D TB to 'on' in the DELAYED TIMEBASE menu.
7 - Set MAIN TB to 'on' in the DELAYED TIMEBASE menu.
8 - Set the DELAYED TIME BASE to 50 us.
9 - Operate the DELAY control and verify that the intensified part can be shifted horizontally along the MAIN TB display.
10 - Operate the TRACE SEPARATION keys (or the TRACK control) and check that the DEL'D TB and MAIN TB display can be shifted so that they do not cover each other.

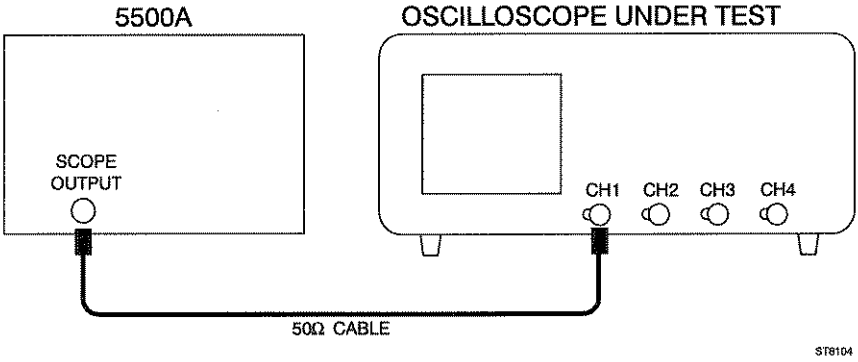
4.3.24 Horizontal deflection; X deflection

The correct working of the X Y mode (X-DEFL 'on') is tested.

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator, PM5136)

Test set-up:



Settings/procedure:

1 - Apply a 2 kHz sine-wave signal of 800 mV (pp) to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.1 V/div.
3 - Adjust the generator signal to a trace height of 8 divisions.
4 - Select X DEFL 'on' in the TB MODE menu (present under the TB MODE menu key).
5 - Select 'ch1' as X-deflection source in the TB MODE X-DEFL menu.
6 - Use the CH1 POS and X POS controls to obtain the display in the figure below.

Requirements:

Verify that a line with an angle of 45° is displayed.

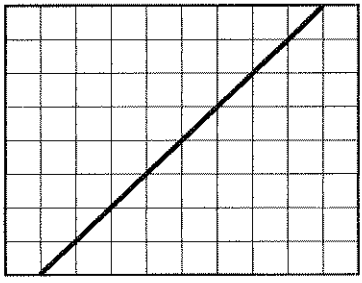


Figure 4.7 X deflection

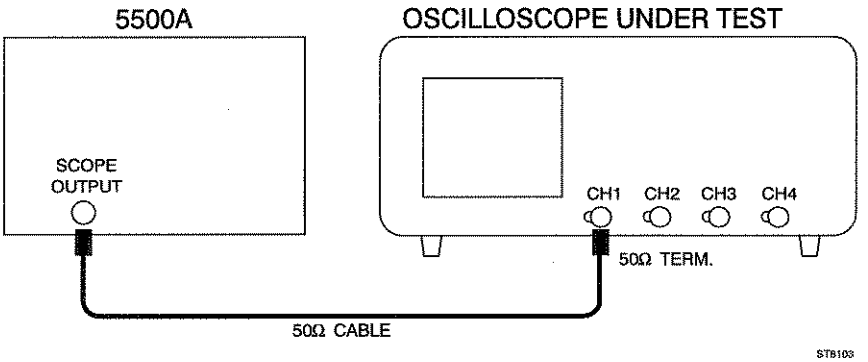
4.3.25 Horizontal deflection; main time-base deflection coefficients

The deflection coefficients of the main timebase generator (MTB) are verified by means of a calibration signal.

Test equipment:

Fluke 5500A mode; marker (Alternative: time marker generator TG 501)

Test set-up:



Settings/procedure:

1 - Apply a 0.1 µs time marker signal to input CH1.
2 - Press the AUTOSET key.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Press menukey TRIGGER MTB.
5 - Select level-pp 'off' and 'dc' in the TRIGGER MAIN TB menu.
6 - Press menukey TB MODE.
7 - Select 'trig' in the TB MODE menu.
8 - Adjust the LEVEL MTB rotary for a correctly triggered display.
9 - Verify the deflection coefficients of MTB with 10x MAGN off and 10x MAGN on (MGN in display) according to the requirements in the tables. Make use of the deflection error readout of the calibrator.

Note:
- *Error limits must be measured between the 2nd and the 10th graticule line (there are 11 graticule lines). These are the central 8 divisions.*
- *With 10x MAGN on (MGN), the central 10 divisions of the expanded 100 divisions of MTB are measured.*
- *Only the time base positions essential for instrument accuracy are checked.*

Requirements analog mode 10x MAGN off:

MTB setting	Marker pulse	Max. error	
20 ns	20 ns	1.8 %	(PM 3092, PM 3094)
0.1 us	0.1 us	1.8 %	
0.5 us	0.5 us	1.8 %	
1 us	1 us	1.8 %	
5 us	5 us	1.8 %	
20 us	20 us	1.8 %	
0.5 ms	0.5 ms	1.8 %	
1 ms	1 ms	1.8 %	
10 ms	10 ms	1.8 %	

Requirements analog mode 10x MAGN on (MGN):

MTB setting	Marker pulse	Max. error	
2 ns	2 ns	3.3 %	(PM 3092, PM 3094)
5 ns	5 ns	3.3 %	
10 ns	10 ns	2.3 %	
0.1 us	0.1 us	2.3 %	

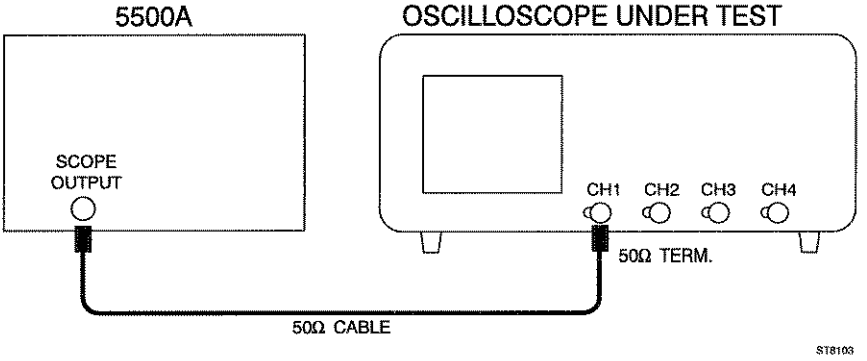
4.3.26 Horizontal deflection; VARiable mode accuracy MTB.

The horizontal MTB deflection coefficients can be varied in steps such as done in 4.3.25. A range of much finer steps can also be selected. Here, the accuracy of this range is checked.

Test equipment:

Fluke 5500A mode: marker (Alternative: time marker generator TG 501)

Test set-up:



Settings/procedure:

1 - Apply a 5 us time marker signal to input CH1.
2 - Press the AUTOSET key.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Select in the TRIGGER MTB menu level-pp 'off' and 'dc' trigger coupling.
5 - Adjust LEVEL MTB for a correctly triggered display.
6 - Set the MTB to 5 us.
7 - Select the MTB VARiable mode by pressing both MTB keys at a time: the readout changes into 5.00 us.
8 - Press the 'ns' key and adjust the readout to 2.50 us.

Requirements:

Verify that the horizontal distance between the time markers equals 2 divisions. Use the X POS control to align the marker pulses with the graticule. Now check (across the central 8 divisions) if the timebase accuracy is ± 2.8%: make use of the deflection error readout of the calibrator to check this.

4.3.27 Time cursor accuracy (continuation of 4.3.26)

This test verifies the accuracy of the time cursors.

Settings/procedure:

1 - Switch the MTB VARiable mode off by pressing both MTB TIME/DIV keys at a time: the readout changes to 2 us.
2 - Select 5 us/div for the MTB.
3 - Switch off the deflection error facility of the time marker generator.
4 - Press the CURSORS menukey.
5 - Select 'on' and time cursors (//) from the CURSORS menu.
6 - Select Δ T in the READOUT menu.

Requirements:

Position one cursor line exactly on the 2nd time marker on the screen and the other cursor on the 10th time marker. The distance between both cursors is now 8 time marker intervals. Check for a cursor readout between 39.5 and 40.5 us.

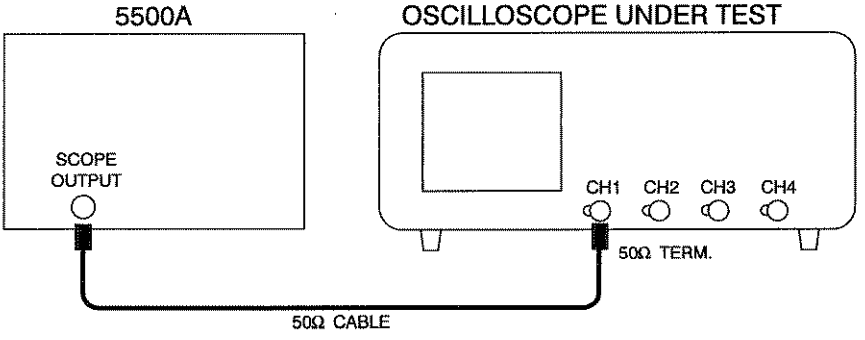
4.3.28 Horizontal deflection; delayed time-base deflection coefficients

The deflection coefficients of the delayed timebase generator (DTB) are verified by means of a calibration signal.

Test equipment:

Fluke 5500A mode: marker (Alternative: time marker generator TG 501)

Test set-up:



Settings/procedure:

1 - Apply a 0.5 ms time marker signal to input CH1.
2 - Press the AUTOSET key.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Select in the TRIGGER MTB menu level-pp'off' and 'dc' trigger coupling.
5 - Press the TB MODE menu key: select in the related menu 'trig' mode.
6 - Adjust LEVEL MTB for a correctly triggered display.
7 - Set the trace height to about 4 divisions.
8 - Press menukey DTB and select in the related menu DEL'D TB 'on' and MAIN TB 'on'.
9 - Set MTB to 1 ms and DTB to 0.5 ms.
10 - Set the delay time to about 0 sec. using the DELAY control.
11 - Adjust the vertical position of the MTB display with the CH1 POS control in the top half of the viewing area.
12 - Adjust the vertical position of the DTB display with the TRACE SEPARATION keys (or the TRACK control).
13 - Verify the DTB deflection coefficients with 10x MAGN off and 10x MAGN on (MGN in display) according to the requirements in the tables. Make use of the deflection error readout of the calibrator.

Note:
- *Error limits must be measured between the 2nd and the 10th graticule line (there are 11 graticule lines). These are the central 8 divisions.*
- *With 10x MAGN on (MGN), the central 10 divisions of the expanded 100 divisions of DTB are measured.*
- *Only the time base positions essential for instrument accuracy are checked.*
- *DTB TIME/DIV is electrically coupled with MTB TIME/DIV; to check the settings in the table only the key pair MTB TIME/DIV VAR must be pressed.*

Requirements analog mode 10x MAGN off:

DTB setting	MTB setting	Marker pulse	Max. error
0.5 ms	0.5 ms	0.5 ms	1.8 %
20 us	20 us	20 us	1.8 %
5 us	5 us	5 us	1.8 %
1 us	1 us	1 us	1.8 %
0.5 us	0.5 us	0.5 us	1.8 %
0.1 us	0.1 us	0.1 us	1.8 %
50 ns	50 ns	50 ns	1.8 %
20 ns	20 ns	20 ns	1.8 % (PM 3092/94)

Requirements analog mode 10x MAGN on (MGN):

DTB setting	MTB setting	Marker pulse	Max. error
0.1 us	0.1 us	0.1 us	2.3 %
10 ns	10 ns	10 ns	2.3 %
5 ns	5 ns	5 ns	3.3 %
2 ns	2 ns	2 ns	3.3 % (PM 3092/94)

4.3.29 Horizontal deflection; delay time multiplier

In this test the minimum and maximum delay time is checked.

Test equipment:

None

Settings/procedure and requirements:

1 - Press the AUTOSET key.
2 - Press the DTB menu key: select in the related menu DEL'D TB 'on' and MAIN TB 'off'.
3 - Set MTB to 0.5 µs.
4 - Set DTB to 50 ns.
5 - Adjust the vertical position of the MTB display with the CH1 POS control in the top half of the viewing area.
6 - Adjust the vertical position of the DTB display with the TRACE SEPARATION keys (or the TRACK control).
7 - Adjust the delay time to 500.0 ns by means of the DELAY control.
8 - Adjust the start of the MTB display exactly on the first graticule line by means of X POS.
9 - Verify that the difference between start of MTB and start of intensified part is between 0.9...1.1 divisions.
10 - Adjust the delay time to 5.000 us with the DELAY control.
11 - Verify that the difference between start of MTB and start of the intensified part is between 9.9 to 10.1 divisions.

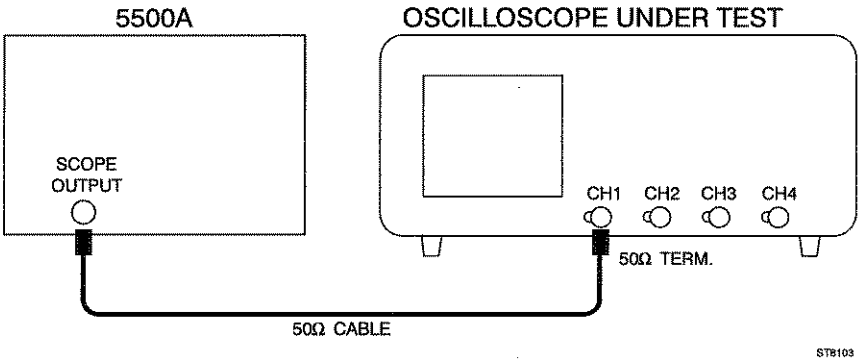
4.3.30 Horizontal deflection; delayed timebase jitter

There is a certain instability in the starting point, the so called jitter, of the DTB. The maximum allowed jitter is checked in this test.

Test equipment:

Fluke 5500A mode: levsine (Alternative: function generator PM5136)

Test set-up:



Settings/procedure:

1 - Apply a 1 MHz sine-wave signal of 120 mV (pp into 50 Ω) to input CH1.
2 - Press the AUTOSET key and set for a trace-height of 6 divisions.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Press menukey DTB and select in the belonging menu DEL'D TB 'on' and MAIN TB 'on'.
5 - Set MTB to 0.5 ms.
6 - Set DTB to 0.5 us.
7 - Adjust the delay time to 5.000 ms by means of the DELAY control.
8 - Switch the MAIN TB display to 'off' in the DELAYED TIME BASE menu: only the DELAY TB is displayed now.

Requirements:

Verify that the jitter of the DTB is not more than 0.4 divisions. (1 part per 25000)

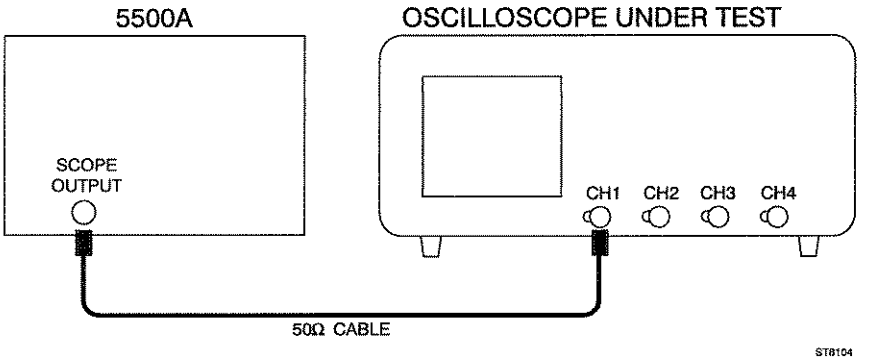
4.3.31 Horizontal deflection; X deflection coefficient via CH1

The amplification of the horizontal amplifier via the vertical input amplifier is checked.

Test equipment:

Fluke 5500A mode: volt (Alternative: square-wave calibration generator PG 506)

Test set-up:



Settings/procedure:

1 - Apply a 1 kHz square-wave signal of 0.1 V to input CH1. Generator in 'volt' mode and output not terminated into 50 Ω ('LZ' must not appear in lower part of viewing area).
2 - Press the AUTOSET key.
3 - Set CH1 to 20 mV and DC coupled input.
4 - Select X-DEFL 'on' and 'ch1' in the TB MODE menu.
5 - Press the CH2 ON key and then the CH1 ON key; the result is that CH2 is on and CH1 off.

Requirements:

Verify that two dots with a horizontal distance of 4.7 ... 5.3 divisions are displayed.

4.3.32 Horizontal deflection; X deflection coefficient via 'line'

The amplification of the horizontal amplifier via the line trigger signal is checked. Do this test only when 220 V line voltage is available.

Test equipment:

None

Settings/procedure:

1 - Press the AUTOSET key.
2 - Select X-DEFL 'on' in the TB MODE menu.
3 - Select 'line' in the TB MODE menu.

Requirements:

Verify that a horizontal line of 4.3 to 7.7 divisions is displayed when the line voltage is 220 V (rms).

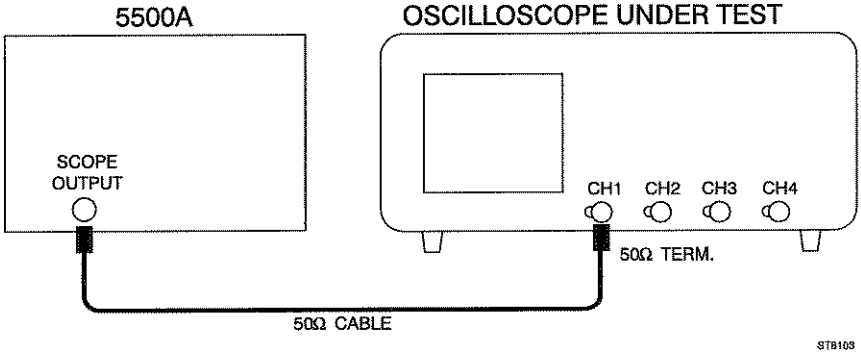
4.3.33 Horizontal deflection; high frequency response

In this test, the bandwidth of the horizontal amplifier is checked.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503).

Test set-up:



Settings/procedure:

1 - Apply a 50 kHz sine-wave signal of 30 mV (pp into 50 Ω) to input CH1.
2 - Press the AUTOSET key and set CH1 to 5 mV.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature ('LZ' must be visible in lower part of viewing area).
4 - Select X-DEFL 'on' in the TB MODE menu.
5 - Select 'ch1' in the TB MODE X-DEFL menu.
6 - Press the CH2 ON key and then the CH1 ON key: the result is that CH2 is on and CH1 off.
7 - Adjust the input voltage for exactly 6 divisions horizontal deflection.
8 - Increase the input frequency up to 2 MHz.

Requirements:

Verify that the trace width is at least 4.2 divisions over the complete bandwidth range.

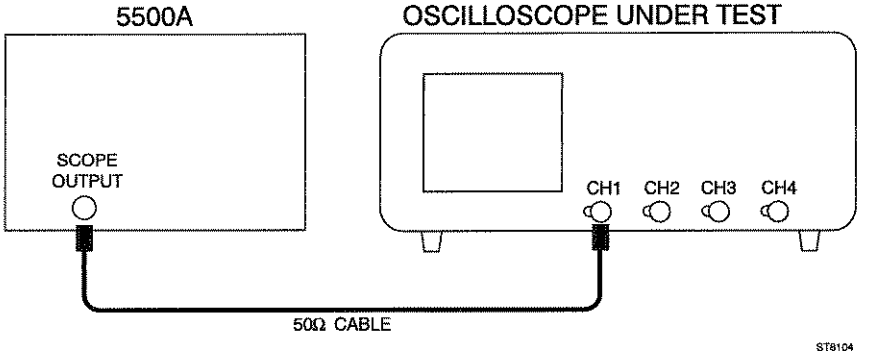
4.3.34 Maximum phase shift between horizontal and vertical deflection

There will be a certain phase shift between the horizontal and vertical amplifier. The value of this shift is measured here.

Test equipment:

Fluke 5500A mode: wavegen, wave sine (Alternative: function generator, PM5136)

Test set-up:



Settings/procedure:

1 - Apply a 2 kHz sine-wave signal of 1.2 V (pp into 50 Ω) to CH1.
2 - Press the AUTOSET key.
3 - Adjust the generator to a trace height of exactly 6 divisions.
4 - Select X-DEFL 'on' in the TB MODE menu.
5 - Select 'ch1' in the TB MODE X-DEFL menu.
6 - Increase the input frequency to 100 kHz.

Requirements:

Verify that the phase shift is less than 3°, ≤ 0.32 div, see figure).

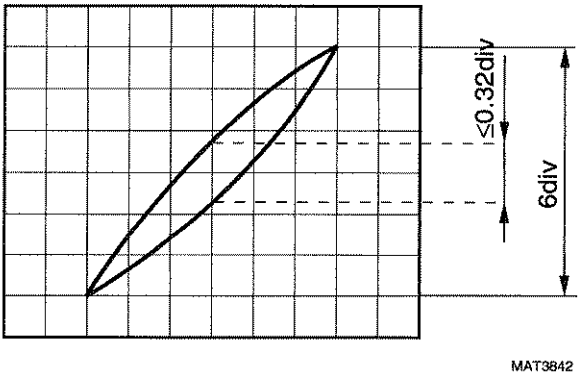


Figure 4.8 Phase shift between horizontal and vertical channel

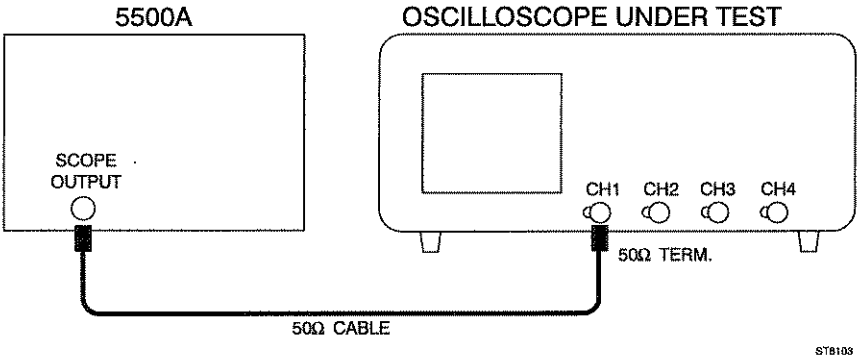
4.3.35 MTB triggering PM 3092/3094; trigger sensitivity via CH1, CH2, CH3 and CH4

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the main timebase trigger sensitivity via the CH1, CH2, CH3 and CH4 inputs is checked.

Test equipment:

Fluke 5500A mode; levsine (Alternative: constant amplitude sine wave generators SG 503 + SG 504)

Test set-up:



Settings/procedure and requirements:

1 - Apply a 100 MHz sine-wave signal of 1 V (pp into 50 Ω) from the calibrator to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.5 V/div.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Set the input coupling of CH1 to DC and POSition the signal in the vertical center of screen.
5 - Select 'trig' in the TB MODE menu.
6 - Press the TRIGGER MTB menu key and select level-pp 'off' and 'dc' trigger coupling in the belonging menu.
7 - Turn LEVEL MTB control for a well-triggered signal.
8 - Decrease the amplitude of the input signal.
9 - Verify that the signal is well-triggered at amplitudes of 0.5 divisions and more.
10 - Decrease the input frequency to 50 kHz.
11 - Verify that the signal stays well-triggered at amplitudes of 0.5 divisions and more.
12 - Increase the input frequency to 200 MHz.
13 - Increase the input voltage to 1 division.
14 - Turn LEVEL MTB.
15 - Verify that the signal is well-triggered at amplitudes of 1 division and more.
16 - Apply a 300 MHz sine-wave signal of 2 V (pp into 50 Ω) from the calibrator toinput CH1.
17 - Adjust the input voltage to 2 divisions.
18 - Verify that the signal is well-triggered at amplitudes of 2 divisions and more; adjust LEVEL MTB when necessary.

Repeat the procedure for CH2, CH3 and CH4 for the frequencies 50 kHz (0.5 div input signal) and 300 MHz (2 div input signal)

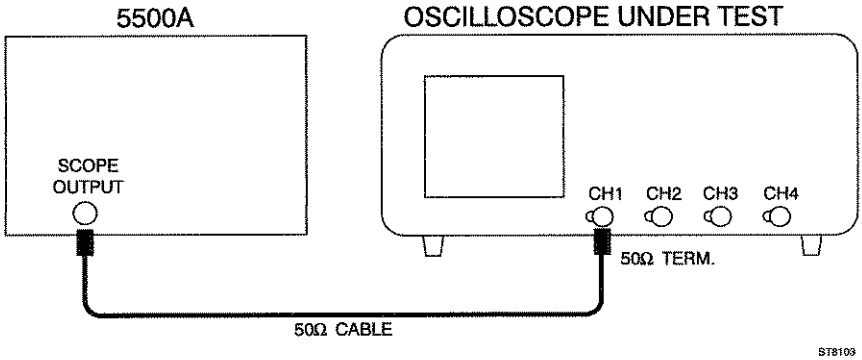
4.3.36 MTB triggering PM 3082/3084; trigger sensitivity via CH1, CH2, CH3 and CH4

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the main timebase trigger sensitivity via the CH1, CH2, CH3 and CH4 inputs is checked.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set-up:



Settings/procedure and requirements:

1 - Apply a 50 MHz sine-wave signal of 1 V (pp into 50 Ω) to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.5 V/div.
3 - Use a 50 Ω termination.
4 - Set the input coupling of CH1 to DC and POSition the signal in the vertical center of screen.
5 - Select 'trig' in the TB MODE menu.
6 - Press the TRIGGER MTB menu key and select level-pp 'off' and 'dc' trigger coupling in the belonging menu.
7 - Turn LEVEL MTB control for a well-triggered signal.
8 - Decrease the amplitude of the input signal.
9 - Verify that the signal is well-triggered at amplitudes of 0.5 divisions and more.
10 - Decrease the input frequency to 50 kHz.
11 - Verify that the signal stays well-triggered at amplitudes of 0.5 divisions and more.
12 - Increase the input frequency to 100 MHz.

13 - Increase the input voltage to 1 division.
14 - Turn LEVEL MTB.
15 - Verify that the signal is well-triggered at amplitudes of 1 division and more.
16 - Increase the input frequency to 200 MHz.
17 - Adjust the input voltage to 2 divisions.
18 - Verify that the signal is well-triggered at amplitudes of 2 divisions and more; adjust LEVEL MTB when necessary.

Repeat the procedure for CH2, CH3 and CH4 for the frequencies 50 kHz (0.5 div input signal) and 200 MHz (2 div input signal)

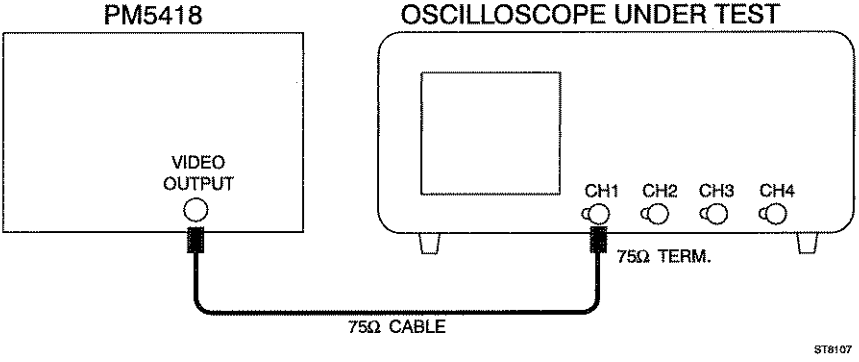
4.3.37 MTB/DTB triggering; trigger sensitivity TVL-TVF

This test checks the trigger sensitivity for television line- and field synchronization pulses.

Test equipment:

TV pattern generator with video output (PM5418)

Test set-up:



Settings/procedure:

1 - Apply a video signal to input CH1 with an amplitude of about 1 V synchronization pulse amplitude; use a 75 Ω termination.
2 - Press the AUTOSET key.
3 - Select 'tv' twice in the TRIGGER MTB menu.
4 - Select 'pos' or 'neg' (depends on employed generator) in the TRIGGER MAIN TB menu. The generator must be in 'pal' system mode.
5 - Select in the TRIGGER MAIN TB menu field 1, field 2 or lines.

Requirements:

Decrease the amplitude of the input signal and verify that the signal is well-triggered on the narrow TV line and the wide TV field pulse, at sync pulse amplitudes of 0.7 divisions and more.

Repeat settings/procedure with the generator in 'ntsc' mode.

Settings/procedure:

6 - Select field 1 or field 2 in the TRIGGER MAIN TB menu. The generator must be in 'pal' system mode.
7 - Press menu key DTB and select in the belonging menu DEL'D TB 'on', MAIN TB 'on', and 'tvline' (third softkey).
8 - Adjust the vertical position of the MTB display with the CH1 POS control in the top half of the viewing area.
9 - Adjust the vertical position of the DTB display with the TRACE SEPARATION keys (or the TRACK control).

Requirements:

Decrease the amplitude of the input signal and verify that the signal is well-triggered on the narrow TV line pulse, at sync pulse amplitudes of 0.7 divisions and more.

Repeat settings/procedure with the generator in 'ntsc' mode.

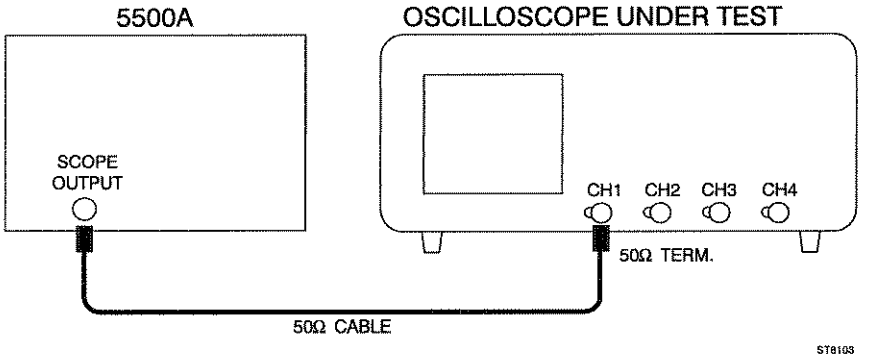
4.3.38 DTB triggering PM 3092/3094; trigger sensitivity via CH1, CH2, CH3 and CH4

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the main timebase trigger sensitivity via the CH1, CH2, CH3 and CH4 inputs is checked.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generators SG 503 + SG 504)

Test set-up:



Settings/procedure and requirements:

1 - Apply a 100 MHz sine-wave signal of 1 V (pp into 50 Ω) from the calibrator to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.5 V/div.
3 - Use a 50 Ω termination. For instruments with switchable 50 Ω input impedance it is recommended to make use of this feature.
4 - Set the input coupling of CH1 to DC and POSition the signal in the vertical center of screen.
5 - Select 'trig' in the menu under menukey TB MODE.
6 - Press menukey TRIGGER MTB and select in the TRIGGER MAIN TB menu level-pp 'off' and 'dc' trigger coupling.
7 - Adjust LEVEL MTB for a correctly triggered display.
8 - Press menukey DTB and select DEL'D TB 'on' and MAIN TB 'on' in the belonging menu.
9 - Set MTB to 0.2 us/div and DTB to 20 ns/div.
10 - Adjust the DELAY control to a delay time of 1.000 us.

11 - Select 'trig'd' and 'dc' coupling in the DELAYED TIME BASE menu and press the front panel key TRIG1. Or TRIG2 (CH2 on), TRIG3 (CH3 on), TRIG4 (CH4 on).
12 - Adjust the LEVEL DTB control for a well-triggered signal (intensified part must be visible).
13 - Operate the TRACE SEPARATION keys (or TRACK control) to separate MTB and DTB for well visible displays.
14 - Decrease the amplitude of the input signal.
15 - Verify that the DTB is well triggered at signal amplitudes of 0.5 divisions and more.
16 - Decrease the input frequency to 50 kHz. Set MTB to 50 us/div and DTB to 20 us/div.
17 - Verify that the DTB stays well triggered at signal amplitudes of 0.5 divisions and more.
18 - Increase the input frequency to 200 MHz.
19 - Increase the input voltage to 1 division.
20 - Operate the LEVEL DTB control.
21 - Verify that the DTB is well triggered at all amplitudes of 1 division or more.
22 - Apply a 300 MHz sine-wave signal of 2 V (pp into 50 ohm) from the calibrator to input CH1.
23 - Adjust the input voltage to 2 divisions.
24 - Verify that the DTB is well-triggered at signal amplitudes of 2 divisions and more: adjust the LEVEL DTB control if necessary.

Repeat the procedure for CH2, CH3 and CH4 for the frequencies 50 kHz (0.5 div input signal) and 300 MHz (2 div input signal)

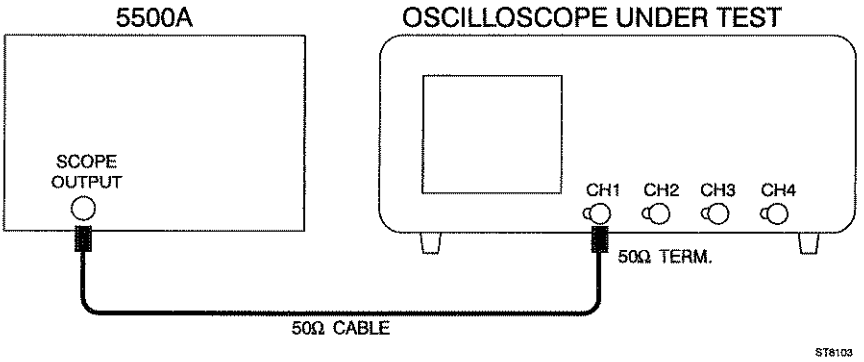
4.3.39 DTB triggering PM 3082/3084; trigger sensitivity via CH1, CH2, CH3 and CH4

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the main timebase trigger sensitivity via the CH1, CH2, CH3 and CH4 inputs is checked.

Test equipment:

Fluke 5500A mode: levsine (Alternative: constant amplitude sine wave generator SG 503)

Test set-up:



Settings/procedure and requirements:

1 - Apply a 50 MHz sine-wave signal of 1 V (pp into 50 Ω) from the calibrator to input CH1.
2 - Press the AUTOSET key and set CH1 to 0.5 V/div.
3 - Use a 50 Ω termination.
4 - Set the input coupling of CH1 to DC and POSition the signal in the vertical center of screen.
5 - Select 'trig' in the menu under menukey TB MODE.
6 - Press menukey TRIGGER MTB and select in the TRIGGER MAIN TB menu level-pp 'off' and 'dc' trigger coupling.
7 - Adjust LEVEL MTB for a correctly triggered display.
8 - Press menukey DTB and select DEL'D TB 'on' and MAIN TB 'on' in the belonging menu.
9 - Set MTB to 0.2 us/div and DTB to 50 ns/div.
10 - Adjust the DELAY control to a delay time of 1.000 us.

11 - Select 'trig'd' and 'dc' coupling in the DELAYED TIME BASE menu and press the front panel key TRIG1. Or TRIG2 (CH2 on), TRIG3 (CH3 on), TRIG4 (CH4 on).
12 - Adjust the LEVEL DTB control for a well-triggered signal (intensified part must be visible).
13 - Operate the TRACE SEPARATION keys (or TRACK control) to separate MTB and DTB for well visible displays.
14 - Decrease the amplitude of the input signal.
15 - Verify that the DTB is well triggered at signal amplitudes of 0.5 divisions and more.
16 - Decrease the input frequency to 50 kHz. Set MTB to 50 us/div and DTB to 20 us/div.
17 - Verify that the DTB stays well triggered at signal amplitudes of 0.5 divisions and more.
18 - Increase the input frequency to 100 MHz.
19 - Increase the input voltage to 1 division.
20 - Operate the LEVEL DTB control.
21 - Verify that the DTB is well triggered at all amplitudes of 1 division or more.
22 - Increase the input frequency to 200 MHz.
23 - Adjust the input voltage to 2 divisions.
24 - Verify that the DTB is well-triggered at signal amplitudes of 2 divisions and more: adjust the LEVEL DTB control if necessary.

Repeat the procedure for CH2, CH3 and CH4 for the frequencies 50 kHz (0.5 div input signal) and 200 MHz (2 div input signal)

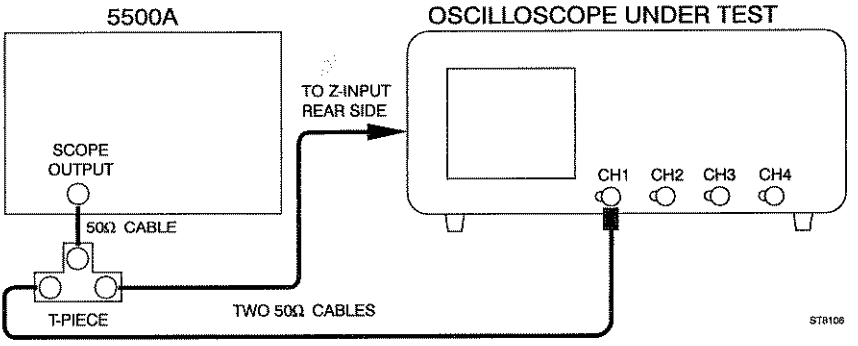
4.3.40 Z-MOD sensitivity

This test checks the sensitivity of the Z modulation input.

Test equipment:

- Fluke 5500A mode: wavegen, wave square (alternative: function generator PM5136)
- T-piece PM9067

Test set-up:



Settings/procedure and requirements:

1 - Apply a 1 kHz square-wave signal, duty cycle 50 %, amplitude between 0 to +2.5 V, to input CH1. Adjust the calibrator to an output signal of 2.5 Vpp with an offset of 1.25V.
2 - Press the AUTOSET key.
3 - Set MTB to 0.5 ms/div.
4 - Set the trace of CH1 in mid position with the CH1 POS control.
5 - Apply the same signal by means of the T-piece to the Z input (rear side).
6 - Adjust TRACE INTENSITY so that only the bottom half of the square-wave is displayed; the top half must be just invisible (0.5 ms light on; 0.5 ms light off).
7 - Decrease the input signal to 0.5 Vpp with an offset of 0.25V.
8 - Set CH1 to 0.5 V/div.
9 - Verify that the top half of the square-wave is visible at full intensity.

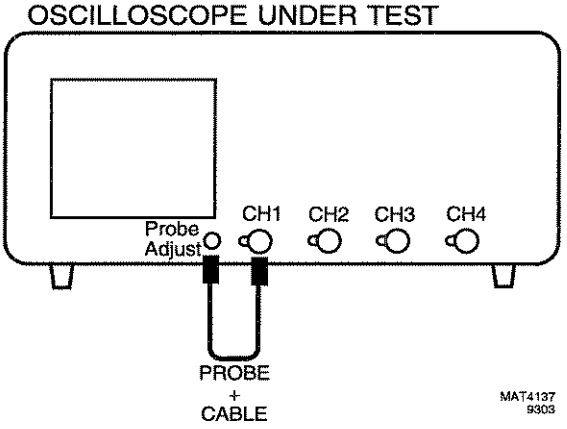
4.3.41 Probe Adjust signal; frequency and output voltage

The Probe Adjust signal is a calibration signal with fixed frequency and voltage. In this test, the values of frequency and voltage are checked.

Test equipment:

None

Test set-up:



Settings/procedure:

1 - Connect the Probe Adjust signal to input CH1 and press the AUTOSET key.
2 - Select GND of CH1.
3 - Set the trace in the center of the screen.
4 - Switches GND of CH1 off.
5 - Select DC input coupling for CH1.

Requirements:

1 - Verify that a positive going square-wave signal of 0.6 V (pp) is displayed, i.e. 3 divisions vertical at 0.2 V.
2 - Verify that the frequency of the displayed signal is about 2 kHz, i.e. a period time between 4.0...6.0 divisions horizontal at MTB 0.1 ms.

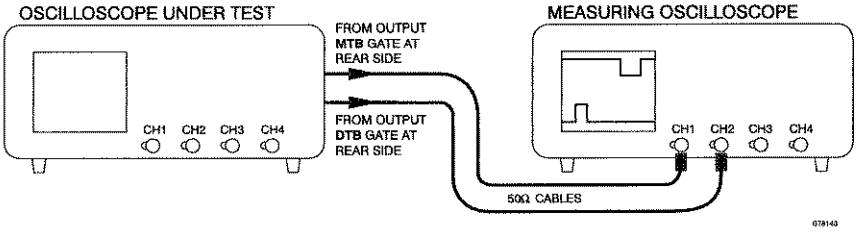
4.3.42 Testing the optional auxiliary outputs

MTB-GATE and DTB-GATE outputs

Test equipment:

measuring oscilloscope.

Test set up:



Settings/procedure:

Oscilloscope under test:
- Take care that no input signal is applied to the oscilloscope inputs.
- Press the STATUS and TEXT OFF keys simultaneously. This assures that the oscilloscope occupies its default position.
- Press the DTB menu key to display the DELAYED TIME BASE menu. Select the 'on' position of the DEL'D TB softkey. The result is that MTB is in 1.00 ms/div and that DTB is in 100 µs/div and that both time bases are on.
- Apply a 50Ω coaxial cable to rear panel output 'MTB-GATE'.
- Apply another 50Ω coaxial cable to rear panel output 'DTB-GATE'.

Measuring oscilloscope:
- Apply the coaxial cable from signal 'MTB GATE' of the oscilloscope under test to input CH1 of the measuring oscilloscope.
- Apply the coaxial cable from signal 'DTB GATE' of the oscilloscope under test to input CH2 of the measuring oscilloscope.
- Press the green AUTOSET key.
- Adjust CH1 and CH2 to DC input coupling; if the ocilloscope is in 50Ω ('LZ') position, select an input impedance of 1MΩ.
- Adjust CH1 and CH2 to 2 V/div.
- Select 2 ms/div for MTB.

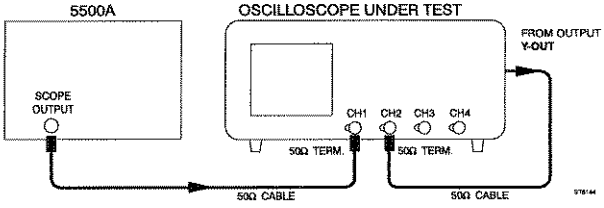
Requirements:

- Verify that two square-wave signals are displayed via CH1 and CH2 of the measuring oscilloscope.
- Verify that the 'low' level of both square-waves is between 0 .. 0.4 V.
- Verify that the 'high' level of both square-waves is between 2.4 .. 5 V.
- Verify that the 'MTB GATE' signal (is displayed via CH1) is high during 10 ms or more.
- Verify that the 'DTB GATE' signal (is displayed via CH2) is high during 1 ms or more.

Y-OUTput signal

Test equipment: Fluke 5500A mode: levsine (Alternative: constant amplitude sine-wave generator SG503).

Test set up:



Settings/procedure:

- Apply a 50 kHz sine-wave signal of 600 mV (pp into 50Ω) to input CH1 and press the green AUTOSET key.
- Use external 50Ω termination at the CH1 input. Use the internal termination of the oscilloscope, when available (if active, the text 'LZ' is visible in the lower part of the viewing area).
- Set CH1 to 0.1 V/div.
- Adjust the generator signal to an amplitude of exactly 6 divisions.
- Connect the rear side output Y-OUT via a coaxial cable with the CH2 input. Use external 50Ω termination at the CH2 input. Use the internal termination of the oscilloscope, when available (if active, the text 'LZ' is visible in the lower part of the viewing area).
- Switch CH2 to on and CH1 to off.
- Put CH2 in 10 mV/div.

Requirement:

Check for a vertical amplitude of the 50 kHz sine-wave signal between 5.3 .. 6.7 divisions.

Settings/procedure:

- Adjust the 50 kHz sine-wave signal to an amplitude of exactly 6 divisions.
- Slowly increase the frequency of the generator to 100 MHz (PM3082/84) or 200 MHz (PM3092/94).

Requirement:

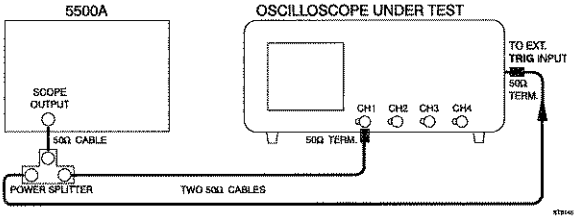
Verify that the displayed sine-wave does not drop below an amplitude of 3 divisions across the frequency range 50 kHz .. full bandwidth. The observed bandwidth curve is that of CH1 and CH2 in cascade.

EXT TRIGger input

Test equipment:

- Fluke 5500A mode: levsine (Alternative: constant amplitude sine-wave generator SG503).
- Power splitter.

Test set up:



Settings/procedure:

- Use a power splitter and two coaxial 50Ω cables to apply the generator output signal to input CH1 and the rear panel input 'EXT TRIG'.
- Use an external 50Ω termination at the end of each cable. When available, use the internal termination of input CH1 (if active, the text 'LZ' is visible in the lower part of the viewing area).
- Adjust the generator output signal for a 50 kHz sine-wave of 200 mV (pp output amplitude into 50Ω).
- Press the green AUTOSET key.
- Press the TRIGGER menu key to display the TRIGGER MAIN TB menu. Select with softkey 'ch1, extern, line' the 'extern' trigger source.
- Put CH1 in 50 mV/div and adjust the generator output voltage to a vertical display of 2 divisions.
- Slowly increase the frequency of the generator signal from 50 kHz to 5 MHz.

Requirement:

Check that the signal diplayed via CH1 stays well triggered across the indicated frequency range (the 'ARM'D LED must stay dimmed).

Settings/procedure:

- Adjust the generator output voltage to a vertical display of 4 divisions.
- Slowly increase the frequency of the generator signal from 5 MHz to 10 MHz.

Requirements:

Check that the signal diplayed via CH1 stays well triggered across the indicated frequency range (the 'ARM'D LED must stay dimmed).

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 THE CONTRAST FILTER

The bezel can be removed by pulling the upper rim away from the front panel. This makes the contrast filter accessible for e.g. cleaning. The filter has open spaces at the edges that allow to lift it from the screen with a small screwdriver.

When cleaning the filter, ensure that a soft cloth is used. The cloth must be free from dust and abrasive particles in order to prevent scratches.

When installing the filter take care that the side facing the screen is the one that has a small distance from the screen.

When installing the bezel take care that the grooves for text/softkey alignment are on the right hand side.

5.3 RECALIBRATION

From experience, it is expected that the instrument operates within its specifications for a period of at least 2,000 hours, or for one year if used infrequently. Recalibration must be carried out by qualified personnel only.