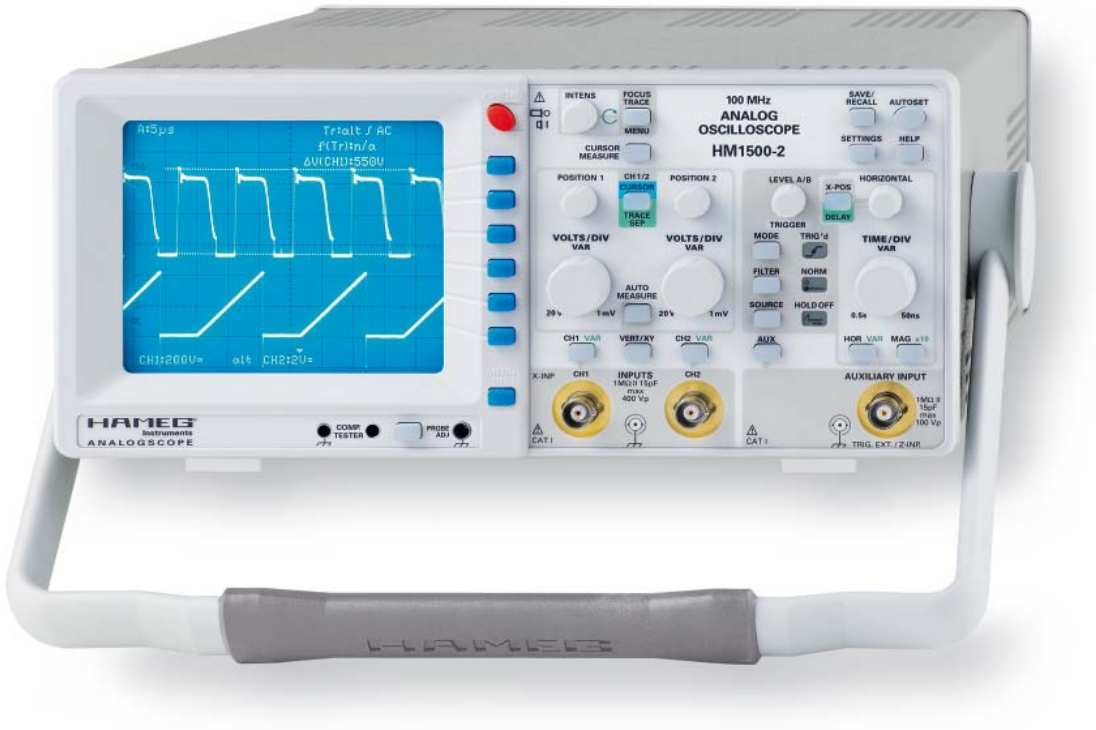
HAMEG Instruments
A Rohde&Schwarz Company

150 MHz Analog oscilloscope® HM1500-2

Servicemanual

English



Release: July, 2008

CE

Hersteller / Manufacturer / Fabricant: HAMEG Instruments GmbH, Industriestraße 6, D-63533 Mainhausen

KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE

HAMEG Instruments

Die HAMEG Instruments GmbH bescheinigt die Konformität für das Produkt
The HAMEG Instruments GmbH herewith declares conformity of the product
HAMEG Instruments GmbH déclare la conformite du produit

Bezeichnung / Product name / Designation: Oszilloskop / Oscilloscope / Oscilloscope

Typ / Type / Type: HM1500-2

mit / with / avec: –

Optionen / Options / Options: –

mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes

EMV Richtlinie 89/336/EWG ergänzt durch 91/263/EWG, 92/31/EWG
EMC Directive 89/336/EEC amended by 91/263/EWG, 92/31/EEC
Directive EMC 89/336/CEE amendée par 91/263/EWG, 92/31/CEE

Niederspannungsrichtlinie 73/23/EWG ergänzt durch 93/68/EWG
Low-Voltage Equipment Directive 73/23/EEC amended by 93/68/EEC
Directive des equipements basse tension 73/23/CEE amendée par 93/68/CEE

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées:

Sicherheit / Safety / Sécurité: EN 61010-1:2001 (IEC 61010-1:2001)
Überspannungskategorie / Overvoltage category / Catégorie de surtension: II
Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2

Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique

EN 61326-1/A1 Störaussendung / Radiation / Emission:
Tabelle / table / tableau 4; Klasse / Class / Classe B.

Störfestigkeit / Immunity / Imunitée: Tabelle / table / tableau A1.

EN 61000-3-2/A14 Oberschwingungsströme / Harmonic current emissions / Émissions de courant harmonique:
Klasse / Class / Classe D.

EN 61000-3-3 Spannungsschwankungen u. Flicker / Voltage fluctuations and flicker / Fluctuations de tension et du flicker.

Datum /Date /Date
01. 04. 2007

Unterschrift / Signature / Signatur

Holger Asmussen
Manager

General information regarding the CE marking

HAMEG instruments fulfill the regulations of the EMC directive. The conformity test made by HAMEG is based on the actual generic- and product standards. In cases where different limit values are applicable, HAMEG applies the severer standard. For emission the limits for residential, commercial and light industry are applied. Regarding the immunity (susceptibility) the limits for industrial environment have been used.

The measuring- and data lines of the instrument have much influence on emission and immunity and therefore on meeting the acceptance limits. For different applications the lines and/or cables used may be different. For measurement operation the following hints and conditions regarding emission and immunity should be observed:

1. Data cables

For the connection between instrument interfaces and external devices, (computer, printer etc.) sufficiently screened cables must be used. Without a special instruction in the manual for a reduced cable length, the maximum cable length of a dataline must be less than 3 meters and not be used outside buildings. If an interface has several connectors only one connector must have a connection to a cable.

Basically interconnections must have a double screening. For IEEE-bus purposes the double screened cable HZ72 from HAMEG is suitable.

2. Signal cables

Basically test leads for signal interconnection between test point and instrument should be as short as possible. Without instruction in the manual for a shorter length, signal lines must be less than 3 meters and not be used outside buildings.

Signal lines must screened (coaxial cable - RG58/U). A proper ground connection is required. In combination with signal generators double screened cables (RG223/U, RG214/U) must be used.

3. Influence on measuring instruments

Under the presence of strong high frequency electric or magnetic fields, even with careful setup of the measuring equipment, influence of such signals is unavoidable.

This will not cause damage or put the instrument out of operation. Small deviations of the measuring value (reading) exceeding the instruments specifications may result from such conditions in individual cases.

4. RF immunity of oscilloscopes.

4.1 Electromagnetic RF field

The influence of electric and magnetic RF fields may become visible (e.g. RF superimposed), if the field intensity is high. In most cases the coupling into the oscilloscope takes place via the device under test, mains/line supply, test leads, control cables and/or radiation. The device under test as well as the oscilloscope may be effected by such fields.

Although the interior of the oscilloscope is screened by the cabinet, direct radiation can occur via the CRT gap. As the bandwidth of each amplifier stage is higher than the total –3dB bandwidth of the oscilloscope, the influence of RF fields of even higher frequencies may be noticeable.

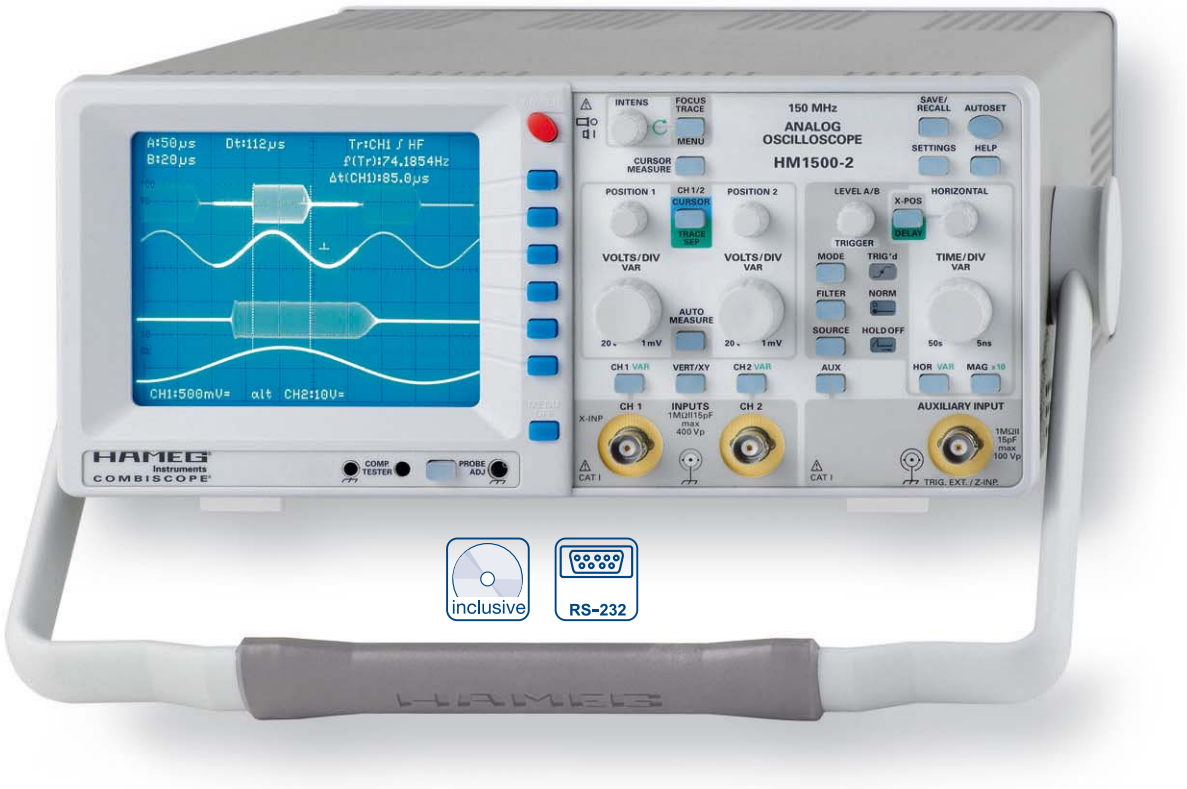
4.2 Electrical fast transients / electrostatic discharge

Electrical fast transient signals (burst) may be coupled into the oscilloscope directly via the mains/line supply, or indirectly via test leads and/or control cables. Due to the high trigger and input sensitivity of the oscilloscopes, such normally high signals may effect the trigger unit and/or may become visible on the CRT, which is unavoidable. These effects can also be caused by direct or indirect electrostatic discharge.

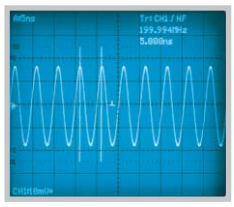
HAMEG Instruments GmbH

Contents

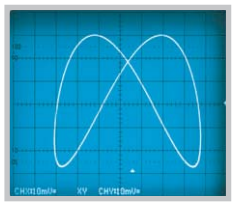
150 MHz Analog Oscilloscope
HM1500-2



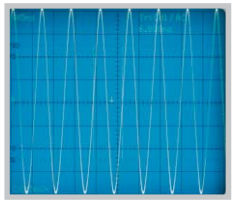
199.994 MHz Sine Wave Signal, measured with internal frequency counter



Lissajous Figure (XY Mode)



Excellent dynamic range characteristics demonstrated with a 150 MHz signal



- 2 Channels with deflection coefficients of 1 mV/cm – 20 V/cm
- 2 Time Bases: 0.5 s/cm – 5 ns/cm and 20 ms – 5 ns/cm
- Low Noise Measuring Amplifiers with high pulse fidelity
- Videotrigger: Odd and even frames, Line Selection (525/60 and 625/50 standard)
- 200 MHz 6-Digit Frequency Counter, Cursor and Automatic Measurement
- 14 kV high writing speed CRT, Readout, Autoset, Delay Line, no Fan
- Save/Recall Memories for Instrument Settings
- Help Function, Multilingual Menu
- RS-232 Interface (for parameter queries and control only)

150 MHz Analog Oszilloscope HM1500-2

Valid at 23 °C after a 30 minute warm-up period

Vertical Deflection	
Channels:	2
Operating Modes:	CH 1 or CH 2 separate, DUAL (CH 1 and CH 2 alternate or chopped), Addition
XY-Mode:	CH 1
Invert:	CH 1, CH 2
Bandwidth (-3dB):	2 x 0 – 150 MHz
Rise time:	‹ 2.3 ns
Bandwith limiting (selectable):	about 20 MHz (5 mV/cm – 20 V/cm)
Deflection Coefficients(CH 1, 2):	14 calibrated steps
1 mV – 2 mV/cm:	± 5 % (0 – 10 MHz (-3 dB))
5 mV – 20 V/cm:	± 3 % (1-2-5 sequence)
variable (uncalibrated)	› 2.5 :1 to › 50 V/cm
Inputs CH 1, 2:	
Input Impedance:	1 MΩ II 15 pF
Coupling:	DC, AC, GND (ground)
Max. Input Voltage:	400 V (DC + peak AC)
Y Delay Line:	70 ns
Measuring Circuits:	Measuring Category I
Auxiliary input:	
Function (selectable):	Extern Trigger, Z (unblank)
Coupling:	AC, DC
Max. input voltage:	100 V (DC + peak AC)

Triggering	
Automatic (Peak to Peak):	
Min. signal height:	5 mm
Frequency range:	10 Hz – 250 MHz
Level control range:	from Peak- to Peak+
Normal (without peak)	
Min. signal height:	5 mm
Frequency range:	0 – 250 MHz
Level control range:	-10 cm to +10 cm
Operating modes:	Slope/Video
Slope:	positive, negative, both
Sources:	CH 1, CH 2, alt. CH 1/2 (≥ 8 mm), Line, Ext.
Coupling:	**AC:** 10 Hz – 250 MHz **DC:** 0 – 250 MHz **HF:** 30 kHz – 250 MHz **LF:** 0 – 5 kHz Noise Rej. switchable
Video:	pos./neg. Sync. Impulse
Standards:	525 Line/60 Hz Systems 625 Line/50 Hz Systems
Field:	even/odd/both
Line:	all/line number selectable
Source:	CH 1, CH 2, Ext.
Indicator for trigger action:	LED
External Trigger via:	Auxiliary Input (0.3 V_{pp}, 150 MHz)
Coupling:	AC, DC
Max. input voltage:	100 V (DC + peak AC)
2nd Trigger	
Min. signal height:	5 mm
Frequency range:	0 – 250 MHz
Coupling:	DC
Level control range:	-10 cm to +10 cm

Horizontal Deflection	
Operating modes:	A, ALT (alternating A/B), B
Time base A:	0.5 s/cm – 50 ns/cm (1-2-5 sequence)
Time base B:	20 ms/cm – 50 ns/cm (1-2-5 sequence)
Accuracy A and B:	± 3 %
X Magnification x10:	to 5 ns/cm
Accuracy X x10:	± 5 %
Variable time base A/B:	cont. 1:2.5
Hold Off time:	var. 1:10 LED-Indication
Bandwidth X-Amplifier:	0 – 3 MHz (-3 dB)
XY phase shift ‹ 3°:	‹ 220 kHz

Operation/Measuring/Interfaces	
Operation:	Autoset, Menu and help functions (multilingual)
Save/Recall (instrument parameter settings):	9
Signal display:	max. 4 traces CH 1, 2 (Time Base A) in combination with CH 1, 2 (Time Base B)
Frequency counter:	
6 digit resolution:	›1 MHz – 250 MHz
5 digit resolution:	0.5 Hz – 1 MHz
Accuracy	50 ppm
Auto Measurements:	Frequency, Period, V_{dc}, V_{pp}, V_{p+}, V_{p-}
Cursor Measurements:	Δt, 1/Δt (f), t_r, ΔV, V to GND, ratio X, ratio Y
Resolution Readout/Cursor:	1000 x 2000 Pts
Interfaces (plug-in):	RS-232 (HO710),
Optional:	Dual-Interface USB/RS232, IEEE-488 (GBIP) Dual-Interface Ethernet/USB

Display	
CRT:	D14-375GH
Display area (with graticule):	8 cm x 10 cm
Acceleration voltage:	ca. 14 kV

General Information	
Component tester:	
Test voltage:	approx. 7 V_{rms} (open circuit), approx. 50 Hz
Test current:	max. 7 mA_{rms} (short circuit)
Reference Potential:	Ground (safety earth)
Probe ADJ Output:	1 kHz/1 MHz square wave signal 0.2 V_{pp} (tr ‹ 4 ns)
Trace rotation:	electronic
Line voltage:	105 – 253 V, 50/60 Hz ± 10 %, CAT II
Power consumption:	37 Watt at 230 V, 50 Hz
Protective system:	Safety class I (EN61010-1)
Weight:	5.6 kg
Cabinet (W x H x D):	285 x 125 x 380 mm
Ambient temperature:	0 °C ...+40 °C

Accessories supplied: Line cord, Operating manual, 2 Probes 10:1 with attenuation ID

Optional accessories:

HO720 Dual-Interface RS-232/USB
HO730 Dual-Interface Ethernet/USB
HO740 Interface IEEE-488 (GPIB)
HZ70 Opto-Interface (with optical fiber cable)

Front Panel Elements – Brief Description

1 **POWER** (pushbutton)
Turns scope on and off.

2 **INTENS** (knob)
Intensity for trace and readout brightness, focus, trace rotation and other control functions.

3 **FOCUS, TRACE, MENU** (pushbutton)
Calls the "Int. Knob" menu to be displayed and enables the change of different settings using the INTENS knob. See item 2.

4 **CURSOR MEASURE** (pushbutton)
Opens menu for Cursor Measurement selection and activation

5 **SAVE/RECALL** (pushbutton)
Offers access to the instrument settings memory.

6 **SETTINGS** (pushbutton)
Opens menu for language and miscellaneous function.

7 **AUTOSET** (pushbutton)
Enables appropriate, signal related, automatic instrument settings.

8 **HELP** (pushbutton)
Switches help texts regarding controls and menus on and off.

9 **POSITION 1** (knob)
Controls position of actual present functions 11: Signal, Cursor and Trace Separation (time base B).

10 **POSITION 2** (knob)
Controls position of actual present functions 11: Signal, Cursor and Trace Separation (time base B).

11 **CH1/2-CURSOR-TRACE SEP** (pushbutton)
Calls the menu and indicates the current function of POSITION 1 and 2 controls (CH1/2 not lit).

12 **VOLTS/DIV-VAR** (knob)
Channel 1 Y deflection coefficient and variabel setting.

13 **VOLTS/DIV-VAR** (knob)
Channel 2 Y deflection coefficient and variabel setting.

14 **AUTO MEASURE** (pushbutton)
Calls menu for automatic measurement selection and deactivation.

15 **LEVEL A/B** (knob)
Trigger level control for time base A and B.

16 **MODE** (pushbutton)
Calls selectable trigger modes.

17 **FILTER** (pushbutton)
Calls selectable trigger filter (coupling), noise reject and trigger slope menu.

18 **SOURCE** (pushbutton)
Calls trigger source menu (e.g. CH1, CH2, Alt. 1/2, External, AC Line).

19 **TRIG'd** (LED)
Lit on condition that trigger signals meets trigger conditions.

20 **NORM** (LED)
Lit on condition that NORMAL triggering is present.

21 **HOLD OFF** (LED)
Lit if a hold off time > 0% is chosen in time base menu (HOR VAR pushbutton 26).

22 **X-POS / DELAY** (pushbutton)
Calls and indicates the actual function of the HORIZONTAL knob 23, (X-POS = dark).

23 **HORIZONTAL** (knob)
Controls horizontal position of trace and delay time of time base B.

24 **TIME/DIV - VAR** (knob)
Time base A and B deflection coefficient and time base variable control.

25 **MAG x10** (pushbutton)
10 fold expansion in X direction in Yt mode, with simultaneous change of the deflection coefficient display in the readout.

26 **HOR VAR** (pushbutton)
Calls time base A and B mode setting, time base variable and hold off control.

27 **CH1 VAR** (pushbutton)
Calls channel 1 menu with input coupling (AC, DC, GND) and termination (1 MΩ, 50Ω), inverting, probe and Y variable control.

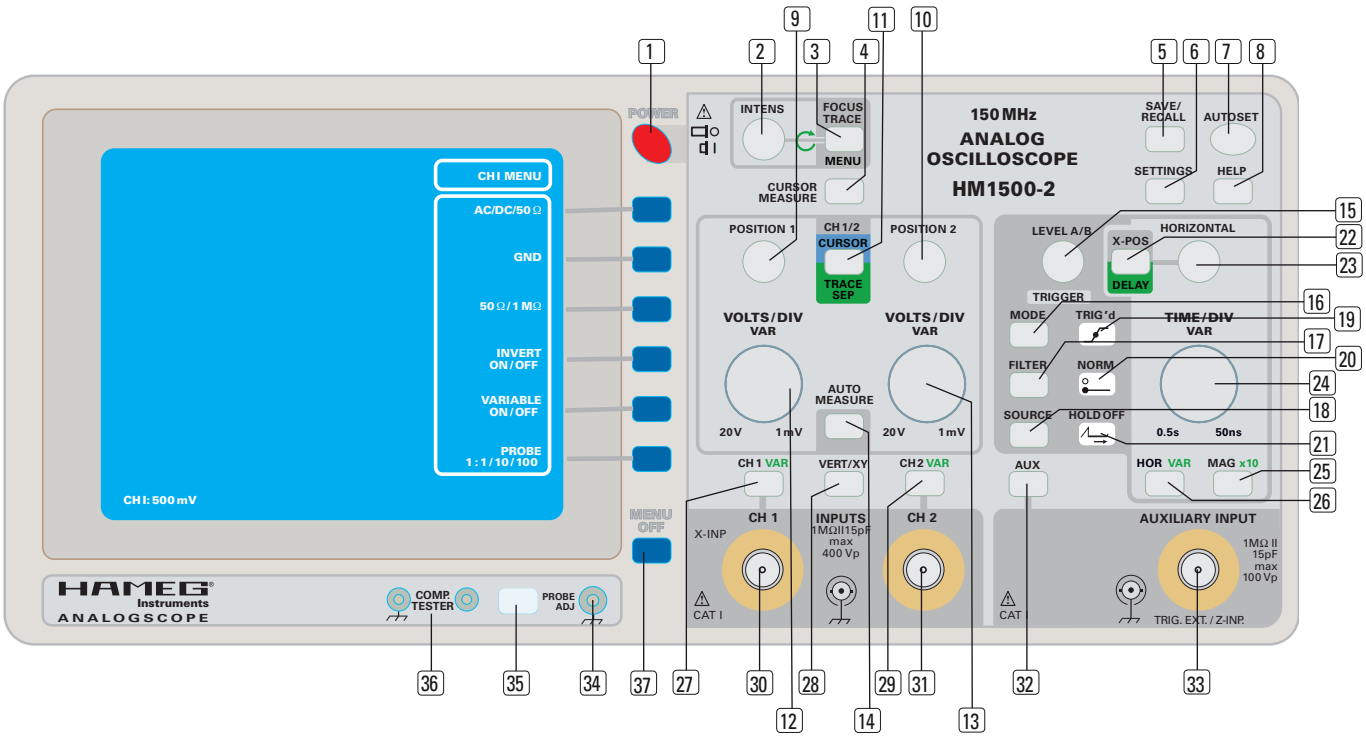
28 **VERT/XY** (pushbutton)
Calls vertical mode selection, addition, XY mode and bandwidth limiter.

29 **CH2 VAR** (pushbutton)
Calls channel 2 menu with input coupling (AC, DC, GND) and termination (1 MΩ, 50Ω), inverting, probe and Y variable control.

30 **CH1** (BNC-socket)
Channel 1 signal input and input for horizontal deflection in XY mode.

31 **CH2** (BNC-socket)
Channel 2 signal input and vertical deflection input in XY mode.

32 **AUX** (pushbutton)
If external triggering is not chosen, activation/deactivation of AUXILIARY INPUT (33) for intensity modulation (Z) and input coupling selection.



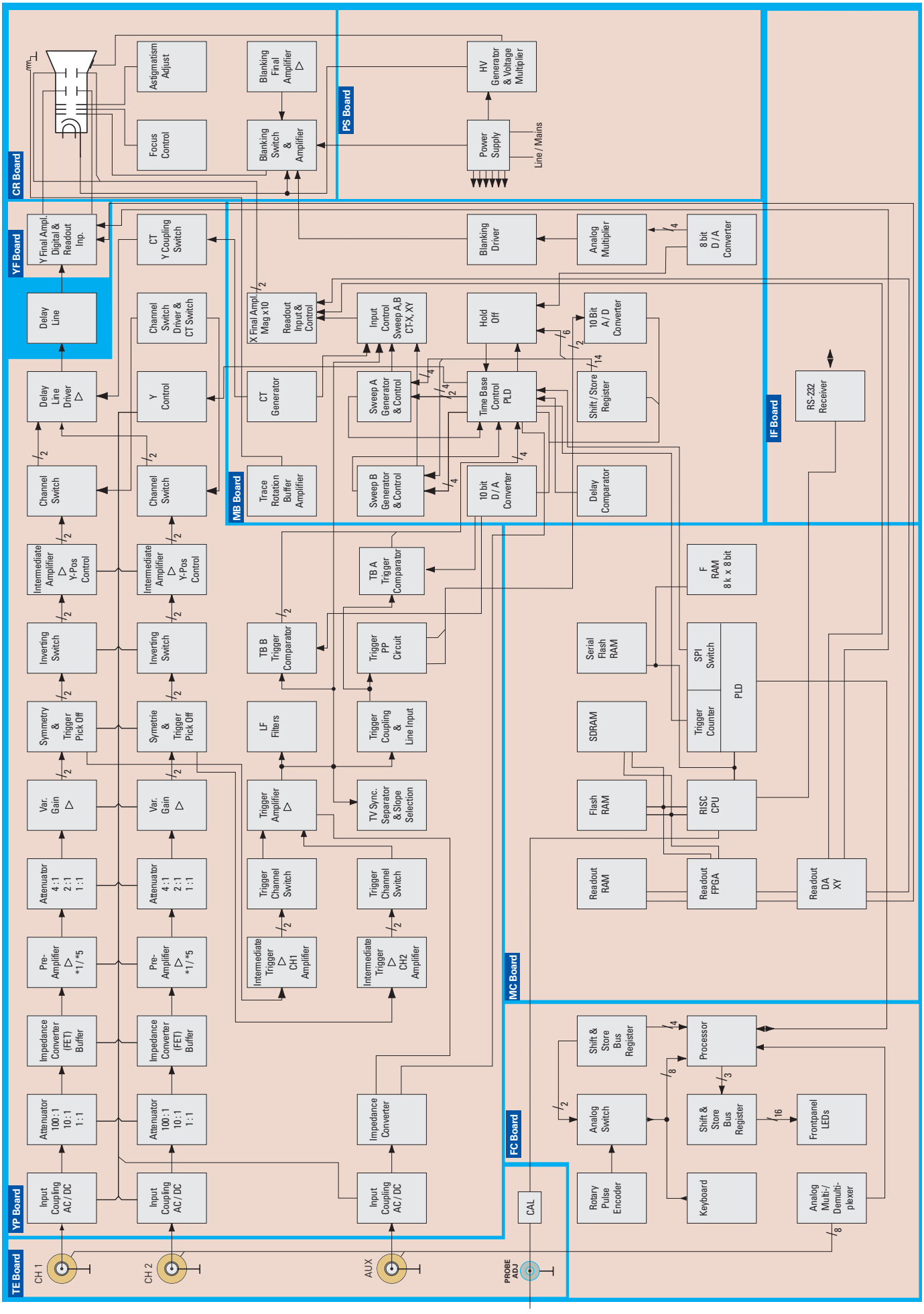
33 **AUXILIARY INPUT** (BNC-socket)
Input for external trigger or intensity (Z) modulation signal.

34 **PROBE ADJ** (socket)
Square wave signal output for frequency compensation of x10 probes.

35 **PROBE COMPONENT TESTER** (pushbutton)
Calls menu for COMPONENT TESTER on/off, frequency selection of PROBE ADJ signal, information of instrument hardware, software and interface if installed.

36 **COMPONENT TESTER** (2 sockets with 4 mm Ø)
Connectors for test leads of the Component Tester. Left socket is galvanically connected with protective earth.

37 **MENU OFF** (pushbutton)
Switches the menu display off or one step back in the menu hierarchy.


CR Board
PS Board
YF Board
MB Board
IF Board
MC Board
FC Board
YP Board
TE Board
Astigmatism Adjust
Focus Control
Blanking Final Amplifier
Blanking Switch & Amplifier
HV Generator & Voltage Multiplier
Power Supply
Line / Mains
Y Final Ampl. Digital & Readout Inp.
CT Y Coupling Switch
Blanking Driver
Analog Multiplier
8 bit D/A Converter
Delay Line
Channel Switch Driver & CT Switch
X Final Ampl. Mag x10
Readout Input & Control
Input Control Sweep A,B CT-X, XY
Hold Off
10 Bit A/D Converter
Delay Line Driver
Y Control
CT Generator
Sweep A Generator & Control
Time Base Control PLD
Shift / Store Register
RS-232 Receiver
Channel Switch
Trace Rotation Buffer Amplifier
Sweep B Generator & Control
10 bit D/A Converter
Delay Comparator
Intermediate Amplifier Y-Pos Control
TB A Trigger Comparator
F RAM 8 k x 8 bit
Inverting Switch
TB B Trigger Comparator
Trigger PP Circuit
Serial Flash RAM
SPI Switch
PLD
Symmetry & Trigger Pick Off
Symetrie & Trigger Pick Off
LF Filters
Trigger Coupling & Line Input
SDRAM
Trigger Counter
Var. Gain
Trigger Amplifier
TV Sync. Separator & Slope Selection
Flash RAM
RISC CPU
Attenuator 4:1 2:1 1:1
Trigger Channel Switch
Readout RAM
Readout FPGA
Readout DA XY
Pre-Amplifier *1/*5
Intermediate Trigger CH1 Amplifier
Intermediate Trigger CH2 Amplifier
Impedance Converter (FET) Buffer
Attenuator 100:1 10:1 1:1
Impedance Converter
Shift & Store Bus Register
Processor
Analog Switch
Frontpanel LEDs
Input Coupling AC/DC
CAL
Rotary Pulse Encoder
Keyboard
Analog Multi-/ Demulti-plexer
CH 1
CH 2
AUX
PROBE ADJ

Short Description of HM1500-2 Boards

Preliminary note:
This short description refers to the HM1500-2 block diagram. It contains the most important functions, but not all.

1. TE Board

(1) Probe identification
The contact area around the BNC sockets (CH1, CH2 and AUXILIARY INPUT) is for probe identification contact recognition. The information from the probe`s internal identification resistor is input in the processor system and automatically changes parameters regarding the probe`s divider ratio.

(2) Calibrator Signal
The calibrator signal originates from the MC board, controls the output amplifier and is available at the PROBE ADJ socket.

2. YP Board

(1) CH1 and CH2
The measuring signal at the input is galvanically connected to a switchable, high impedance attenuator (DC coupling) or via an input capacitor (AC coupling) which controls the input FET (impedance converter). The following measuring amplifier stages are DC coupled.

The next stage is the Pre-Amplifier where, in the case of 1 mV/cm and 2 mV/cm an additional amplification by 5 is made.

The following low impedance attenuator enables the selection of all Y deflection coefficients from 1 mV/cm to 20 V/cm in conjunction with the high impedance attenuator and the Pre Amplifier.

The fixed Y deflection coefficient can also be set to uncalibrated intermediate values in the VAR Gain stage. Additionally, the signal is converted from an unsymmetrical signal into 2 symmetrical signals with a phase difference of 180°. The following stages up to the Delay Line Driver are designed as two identical amplifiers.

The Symmetry and Trigger Pick Off stage is used to correct asymmetries and thereafter pick off the measurement signal to be used for internal triggering.

If activated, the Inverting Switch interchanges the 2 (180° different) measuring signals to be amplified in the following stages. The result is a 180° turned (inverted) signal display.

In the Intermediate Amplifier the DC current of both identical amplifiers is controlled in such a way, that if the current in one amplifier is reduced it increases in the other amplifier by the same amount. This causes a shift in trace position (Y position).

Thereafter the measuring signals of CH1 and CH2 are input in the Channel Switch. The channel switch selects which signal is output and drives the Delay Line Driver. The channel switch is controlled by the Channel Switch, Driver & CT Switch stage.

The Delay Line stage converts the signal to the impedance matching stage of the delay line.

(2) AUXILIARY INPUT
The signal applied to this input is connected to an FET (impedance converter) galvanically (DC coupling) or via an input capacitor (AC coupling). It can be used for external triggering or intensity modulation.

(3) Trigger Section
The CH1 and CH2 measuring signals originating from the measuring amplifier Trigger Pick Off are amplified in the Intermediate Trigger Amplifier CH1 and CH2.

These signals later used for internal triggering are input in the Trigger Channel Switch stage. The signal to be used for internal triggering can pass the switch.

This signal enters the Trigger Amplifier stage for additional amplification and for external trigger signal input.

The output signal is connected with the LF Filter, TV Sync. Separator & Slope Selection and Trigger Coupling & Line Input stage. The selected stage serves as the source for the TB A (time base A) Trigger Comparator and the Trigger PP Circuit.

The Trigger Amplifier output signal is also the DC coupled source of the TB B Trigger Comparator (time base B). The Trigger PP Circuit generates a signal height dependent voltage that can be used for trigger level setting at the time base A trigger comparator.

Both time base A and B reference voltages are generated by the 10 bit D/A Converter on MB board. The time base A and B trigger comparator output signals are connected with the Time Base Control PLD on MB board for time base triggering.

(4) Y Control
This stage symbolises all control functions for attenuator, variable, position, inverting and other Y amplifier related functions.

(5) Channel Switch, Driver and CT Switch
This stage symbolises all control functions regarding the channel switches, switches in the driver section and the component tester (CT) switch over.

(6) CT Y Coupling Switch
Switches off the measuring signal in the Delay Line Driver stage and inputs the vertical component of the component tester (CT) signal.

3. Delay Line

The delay line causes a delay of the measuring signal, so that switching and other delays in the trigger and time base section are compensated and the trigger slope becomes visible.

4. YF Board

(1) The measuring signal is amplified and controls the Y plates of the cathode ray tube (CRT).

(2) The Y component of the readout is input here for Y deflection. It originates from data in the Readout FPGA (MC board) which has been converted by the Readout DAC (MC board) into analogue signals.

5. MB Board

The main function is to generate sweep (sawtooth) signals for time base A and B in the Sweep A Generator & Control stage and in the Sweep B Generator & Control stage.

The sweep start of both time bases is controlled by the Time Base Control PLD in connection with the Hold Off stage and the trigger signals coming from the time base A and B trigger comparators located on YP board.

The sweep deflection time (coefficient) depends on the Shift/ Store Register data controlling both sweep generators and the Hold Off stage.

The Delay Comparator controls the time base B delay time comparing the A sweep voltage height with a reference voltage.

The Input Control - Sweep A, B, CT-X and XY stage selects between time base sweep A and B, the X deflection component of the component tester (CT) and the signal to be used for X deflection in XY mode.

The signals mentioned before are output to the X Final Amplifier, Mag x10, Readout Input & Control stage. Additionally this stage receives the X deflection signal and the X deflection component of the readout. The latter originates from data in the Readout FPGA (MC board) which has been converted by the Readout DAC (MC board) into analogue signals. The X final amplifier controls the X plates of the cathode ray tube (CRT).

The unblank and intensity information comes from the time base control. It is converted to analogue via an 8 bit D/A Converter and controls the Blanking Switch & Amplifier (CR board) via an Analogue Multiplexer and the Blanking Driver stage.

The CT generator generates the X and Y signal components of the component tester (CT).

The Trace Rotation Buffer Amplifier feeds the trace rotation coil on the cathode ray tube (CRT) with a current for the compensation of CRT production tolerances as well as the influence of external magnetic fields on the sweep.

6. FC Board

This board enables the user to control the instrument via keyboard and rotary pulse encoders. Probes with identifications contacts are recognised and their probe factors are taken into account. Additionally the user gets information about the instruments state via front panel LEDs and readout information by aid of the Readout FPGA (MC board).

7. MC Board

The main function of this board is to generate readout data (Readout RAM), output these data converted to analogue for controlling the X and Y final amplifiers, so that the readout can be displayed by the cathode ray tube (CRT).

The control function for these processes originate from the PLD stage and control the affected stages via the SPI-Control-Bus.

Parameter data can also be sent via the Interface (IF board) to external devices. It is also possible to receive data for instrument control, firmware update etc.

8. IF Board

This board enables RS-232 interface to be input for bi-directional data transfer.

9. PS Board

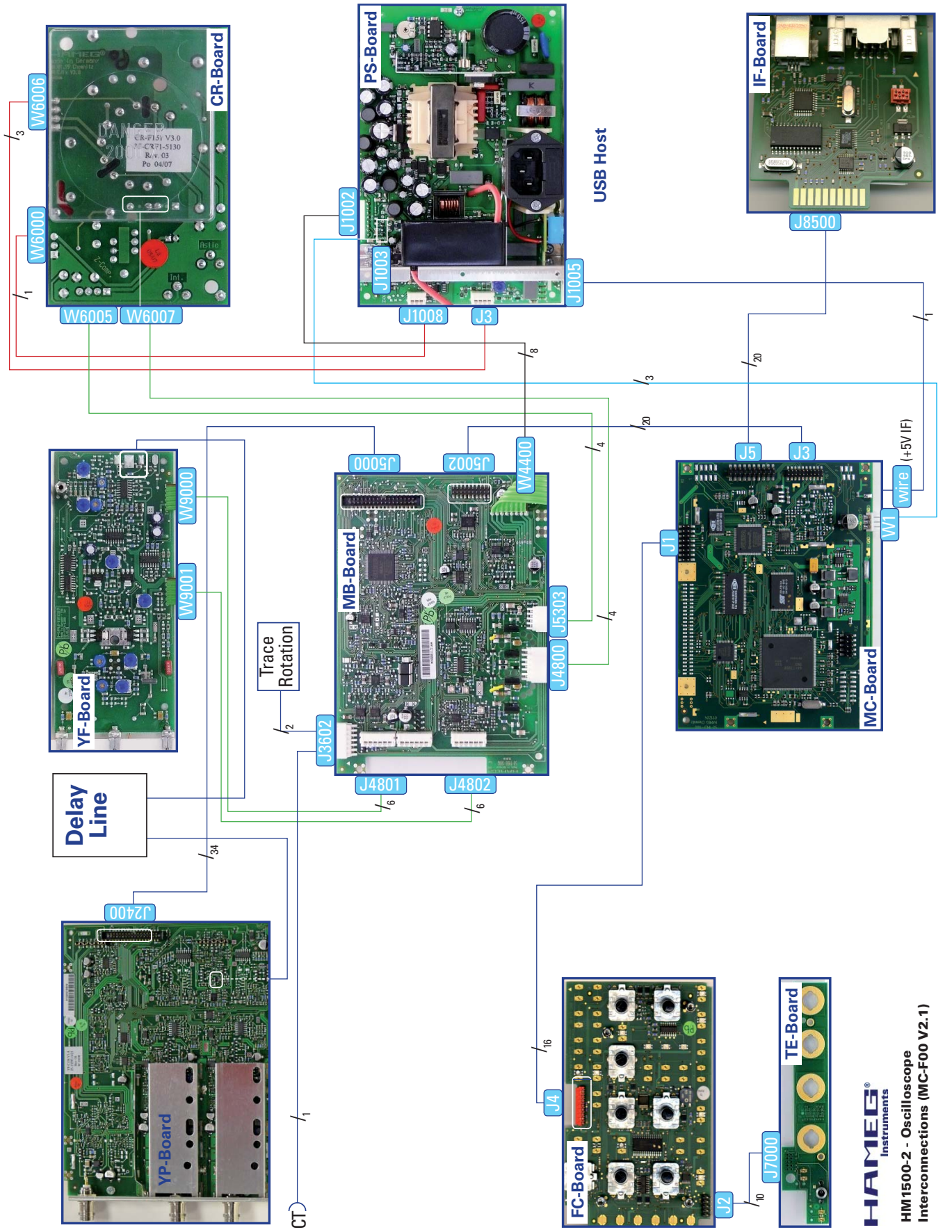
This board contains a switch mode power supply with different supply voltages for the instrument.

It also contains –2 kV high voltage generator, the voltage multiplier for 12 kV generation and the heater voltage. All voltages are required for cathode ray tube (CRT) operation.

10. CR Board

The CR board contains the Blanking Final Amplifier, the Blanking Switch & Amplifier, the Focus Control and the Astigmatism Adjust. stage.

PCB Interconnections



PCB Interconnections

Remark: Due to technical reasons the state "Low Active" is indicated on some circuit diagrams by a bar above the signal name and in other cases by an asterisk (*). In this listing all lines with "low active" state are marked with the * symbol even if the circuit diagram shows the bar above the signal name. Inverted signals are marked in the same way.

In cases where signal names or pin numbers are divergent both name are mentioned (the bracket position refers to the headline). Example:

YP Board (J2400) and MB Board (J5000)

Direction	Pin	Name
	(6) 1	X (Y)

Pin number (6) refers to the YP- and 1 to the MB Board. X represents the name on the YP- and (Y) the name on the MB Board.

YP Board (J2400) and MB Board (J5000)

Direction	Pin	Name
<---	1	SYS_REF
<---	2	Y2_POS
<---	3	Y1_POS
--->	4	( ), YP_CODE
<---	5	SDO_YP
<---	6	SCLK_YP
<---	7	CS_YP, CS_YP
	8	5V
<---	9	CT_Y
<---	10	ALT-TB
	11	-6V
<---	12	Y2_TRG
<---	13	Y1_TRG
	14	12V
<---	15	Y1
<---	16	Y2
<---	17	VOUT_TRG
<---	18	AUX1-LEV
--->	19	PP-
--->	20	PP+
<---	21	TRB-LEV
<---	22	TRA-LEV
--->	23	TRGMP
--->	24	X/Y
<---	25	LINE-TR
--->	26	TV-LINE
	27	PP-DIS
	28	Reference Potential
--->	29	TRB (low active), ( )
--->	30	TRB, ( )
--->	31	TRA (low active), ( )
--->	32	TRA, ( )
	33	Reference Potential
--->	34	Z

FC Board (J2) and TE Board (J7000)

Direction	Pin	Name
--->	1	SW_OUT, CT_KEY
	2	CT_KEY, SW_OUT
--->	3	VCC_CALI, ( )
	4	EXT_KEY2, VCC_CALI
	5	Reference Potential, ( )
--->	6	REM_LED, ( )
<---	7	PROBE_1, PROBE_4
<---	8	PROBE_4, PROBE_1
<---	9	PROBE_2, PROBE_3
<---	10	PROBE_3, PROBE_2

FC Board (J4) and MC Board (J1)

Direction	Pin	Name
	1	VCC_CAL I
<---	2	SW_OUT
	3	+5V, +5V_PS
	4	VCC_CPU, +3.3V
	5	Reference Potential
<---	6	DBG, (DEB_KEY)
<---	7	SPEAKER, ¯CPU_RES¯ (low active)
--->	8	¯DRQ_KEY¯ (low active)
--->	9	SDI, SDI_KEY
--->	10	SCLK, SCLK_KEY
<---	11	¯CS_KEY¯, ¯CPU_CS_ SPI_KEY¯
<---	12	SDO, SDO_KEY
	13	nc
	14	nc
	15	nc
	16	nc

YF Board (W9000) and MB Board (J4801)

Direction	Pin	Name
<---	1	¯D_ANA¯, DIG/¯ANA¯
	2	nc, CT_ON
--->	3	Y-ROUT, RO_Y_POS
--->	4	¯Y_ROUT¯, RO_Y
	5	5V, 5V
	6	+12V, 12V

YF Board (W9001) and MB Board (J4802)

Direction	Pin	Name
	1	-6V
--->	2	Y-DV2
--->	3	Y-DV1
--->	4	( ), YF-CODE
	5	( ), Reference Potential
	6	YDV

MB Board (J3602) and CT/TR

Direction	Pin	Name
<---	1	CTIN
	2	nc
	3	nc
	4	nc
--->	5	TRC-ROT
	6	Reference Potential

MB Board (J5002) and MC Board (J3)

Direction	Pin	Name
	1	3.3V, +3.3V
	2	TRGCNTG, TRIG_CNT_GATE
	3	¯TRIGGER¯
	4	TRG/X
--->	5	VCC_CALI
<---	6	2.5V, +2.5V
<---	7	RO_Y
<---	8	RO_Y_POS
--->	9	TRIG_MB
<---	10	RO_X
<---	11	RO_X_POS
--->	12	RO_WAIT
	13	DIG/¯ANA¯ (DIGital = high, ANAlogue = low)
	14	RO_DARK
	15	D_INT_B, DIG_INT_B
<---	16	ANA_INT
	17	SDI_MB
	18	SCLK_MB
	19	SDO_MB
	20	CS_MB, CS_SPI_MB

MB Board (W4400) and PS Board (J1002)

Direction	Pin	Name
<---	1	XDV, +115V
<---	2	YDV, +65V
	3	Reference Potential
<---	4	5V, +5V_ANA
<---	5	LINE_TR
	6	12V, +12V
<---	7	-CT_V, CT_V
	8	-6V

MB Board (J4800) and CR Board (W6007)

Direction	Pin	Name
--->	1	( ), X_2
	2	nc
--->	3	XDV, YDV
--->	4	YDV, XDV
	5	nc
--->	6	( ), X_1

MB Board (J5303) and CR Board (W6005)

Direction	Pin	Name
--->	1	( ), FOC_CTRL
--->	2	Reference Potential
	3	BLANK
	4	( ), 12V

MC Board (W1) and PS Board (J1003)

Direction	Pin	Name
	1	GND
<---	2	+5V_PS, (+5V_DIG)
	3	GND

MC Board (wire) and PS Board (J1005)

Direction	Pin	Name
		+5V IF

MC Board (J5) and IF-C00 Board (X1)

Direction	Pin	Name
	1	+5V IF, 5V_IF
	2	Reference Potential
--→	3	RTS, IF_CTS
←--	4	CTS, IF_RTS
	5	Reference Potential
←--	6	RxD, IF_TXD
	7	Reference Potential
--→	8	TxD, IF_RXD
	9	Reference Potential
--→	10	¯EXT_IF_EN¯, ( )
	11	Reference Potential
--→	12	nc
←--	13	EXT_IF_ID0, ID0
←--	14	EXT_IF_ID1, ID1
←--	15	EXT_IF_ID2, ID2
--→	16	EXT_IF_DATA/¯CONFIG¯, nc
--→	17	¯CPU_RDY_RES_PLD¯, nc
	18	nc
	19	nc
	20	nc

PS Board (J3) and CR Board (W6006)

Direction	Pin	Name
--→	1	HT_2
--→	2	HT_1
--→	3	-2000V (-2kV)
--→	4	FOCUS

PS Board (J1008) and CR Board (W6000)

Direction	Pin	Name
	1	
--→	2	PUMP_VOL
	3	

YP Board and YF Board (via delay line)

Direction	Pin	Name
--→		Y signal via delay line

HM1500-2 Troubleshooting

Security advice!
The following procedures assume that the instrument is connected to mains/line via a safety class II transformer. Only qualified personnel (technicians and engineers) who are aware of the danger of electricity should execute the following procedures.

If cables or connectors have to be disconnected, the instrument must be switched off before removing them.

For measurement at high voltage (-1.5 kV Focus and -2 kV) use suitable probes, recommended by HAMEG.

Such measurements should be performed in the following way:
1. Switch the oscilloscope off.
2. Connect measuring instrument reference potential to chassis.
3. Connect the probe tip of the measuring instrument to the measuring point.
4. Switch the oscilloscope on.
5. Before removing the measuring instrument connections, switch the oscilloscope off again.

A: Opening the Oscilloscope

1. Place the oscilloscope upside down; set the handle to the maximum rear position, then pull both handle knobs outward and remove the handle. (Photo A1 and A2)

Photo A1

Photo A2

2. Unscrew the nuts and remove the back panel. (Photo A3, A4 and A5)

Photo A3

Photo A4

Photo A5

3. Set the front face of the oscilloscope on a soft surface and pull the cabinet off. (Photo A6 and A7)

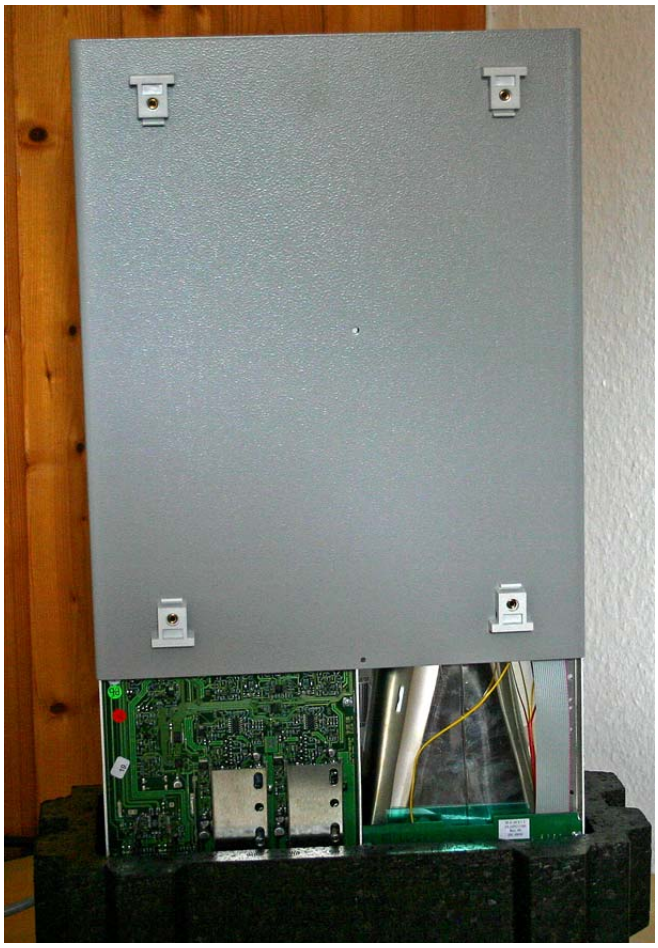


Photo A6

Photo A7

Please note:
After repair work, close the instrument in reverse order of above.

B: Preliminary Test!

The precondition for undistorted operation is correct supply voltages generated by the power supply. It is highly recommended to check the power supply output voltages before any other action.

The following steps show you what to do.

B1.1 Miscellaneous voltages

Locate and identify the 8 pole connector W4400 on MB board. See photo B1.1.

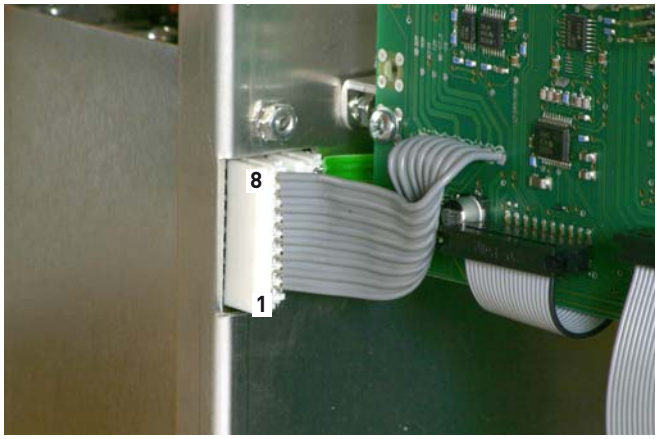


Photo B1.1

All voltages are measured with respect to ground (chassis). The following voltages must be present:

- Pin 1: approx. +115 V
- Pin 2: +65 V (± 0.5 V)
- Pin 4: approx. +5.2 V
- Pin 6: +12 V (± 50 mV)
- Pin 8: approx. -6 V

1.2 +5 V

Locate and identify the 3 pole connector W1 on the MC board (marked "+5V" on the pcb) connecting the power supply board (J1003) with the MC board. . See photo B1.2.

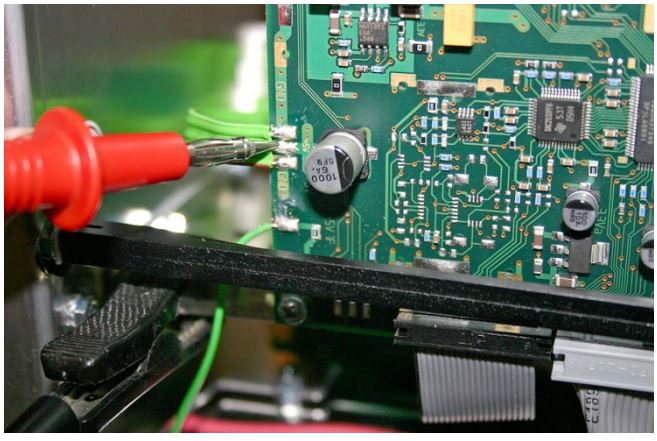


Photo B1.2

The voltage at "+5V" should be approx. +5V.

1.3 +5 V IF

Locate and identify J1005 (1 litz wire) connecting the power supply board with the MC board (marked "+5 V IF" on the pcb) on the MC board. See photo B1.3.

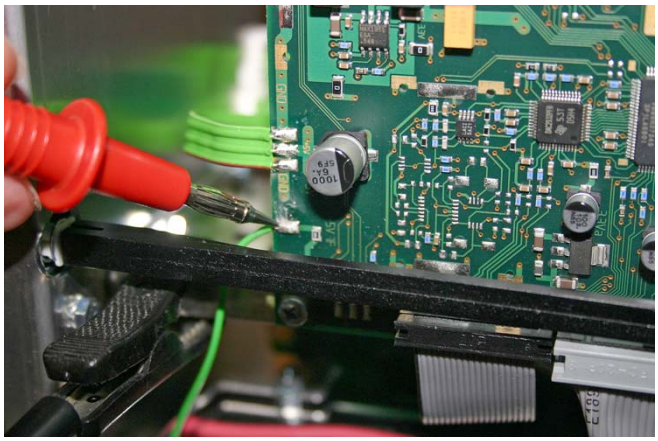


Photo B1.3

The voltage at "+5 V IF" should be approx. +5V.

1.4 "Pump Voltage"

Locate and identify connector J1008 pin 2 (1 wire) connecting the power supply with the CR board. See photo B1.4.1.

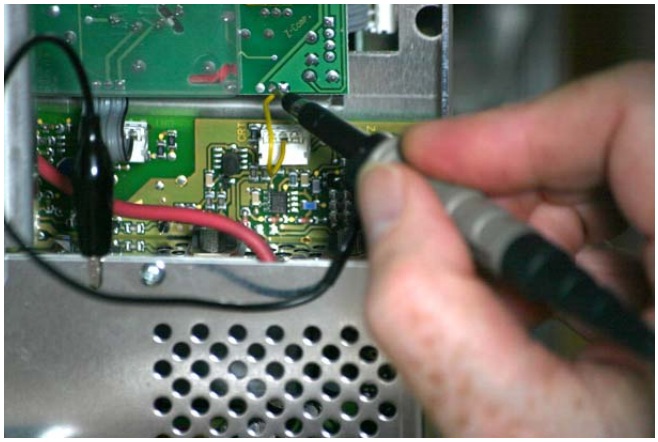


Photo B1.4.1

Measure the "Pump Voltage" using an oscilloscope. See photo B1.4.2 and B1.4.3.

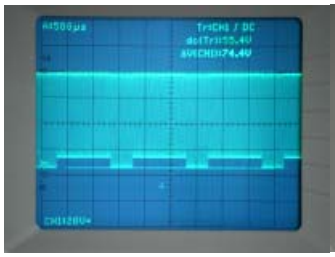


Photo B1.4.2

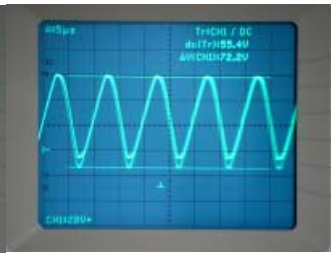


Photo B1.4.3

Note: The pump voltage indicates the switch mode power supply switching frequency.

1.5 -2 kV

Locate and identify Molex connector J1009 (4 wires) connecting the power supply board with the CR board. See photo B1.5.

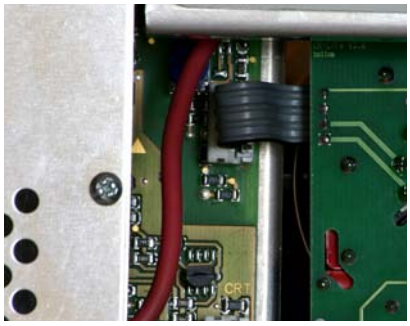


Photo B1.5

Check that the probe and the measuring instrument are suitable for measuring voltages up to 2.5 kV.
Measure approx. -2 kV at pin 3.

1.6 Focus Voltage

Locate and identify connector J3 (4 wires) connecting the power supply board with the CR board. See photo B1.6.

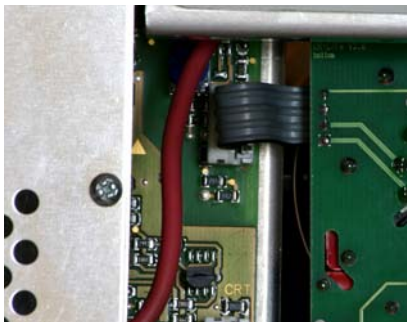


Photo B1.6

Check that the probe and the measuring instrument are suitable for measuring voltages up to 2.5 kV.
Measure approx. -1.5 kV at pin 4.

1.7 +12 kV

1.7.1 +12 kV measurement

- Switch the instrument off!
- Locate and identify the high voltage connector at the front of the crt cone.
- Be sure not to get in contact with metal parts of the high voltage connector during the following procedure!
- Set a multimeter to DC measurement and select a suitable range for high voltage measurement in combination with a high voltage probe (specified for 14 kV or more).
- Connect the reference potential connector of the high voltage probe with chassis.
- Lift the rubber of the high voltage connector and move the probe tip in the gap between crt glass and rubber to get in contact with the high voltage connector.
- Switch the oscilloscope on.

▶ **The multimeter should display approx. 12 kV.**

Note:
If no high voltage probe is available the measurement can be made in one of the following ways.

1.7.2

- Locate and identify the high voltage connector at the crt cone.
- Indicate the presence of the high voltage by aid of an oscilloscope.
- Position the tip of a *10 probe (10:1 divider probe) in approx. 5 mm distance of the high voltage connector clip. See photo B1.7.1.

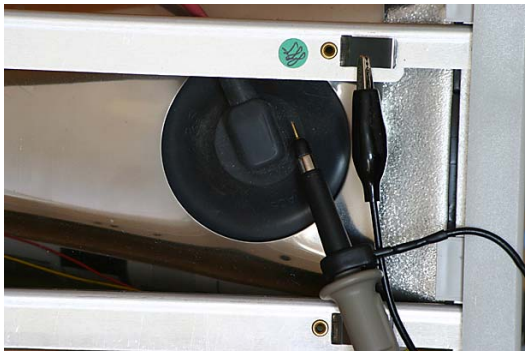


Photo B1.7.1)

▶ **A sine wave signal indicating the high voltage generator frequency (approx. 40 kHz) and the AC ripple on the high voltage should be visible. See photo B1.7.2.**

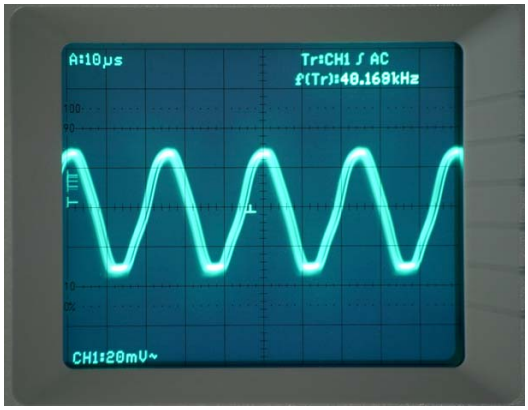


Photo B1.7.2

This indicates that the high voltage multiplier is working properly.

1.7.3

Please note that the crt and the voltage multiplier can still be charged although the instrument is switched off.

- To discharge connect a cable at one side with chassis and solder a 50 kΩ resistor on the other side. Use an isolated tool to move the resistor to the crt high voltage connector and thereafter to the high voltage connector clip to discharge both via the resistor.
- Switch the instrument off!
- Remove the high voltage connector (clip) at the crt cone and put it in position where the distance to the chassis or crt mu-metal screening is approx. 20 mm. See photo B1.7.3.

Photo B1.7.3

- Take all safety precautions to be sure that nobody can get in contact with the high voltage clip!!!
- Switch the oscilloscope on.

▶ **If a fizzing noise can be heard, the high voltage is present.**

- Switch the instrument off!
- Insert the high voltage connector into the hole in the crt shielding, press the crt clip rubber so that the clip can be inserted into the high voltage connector hole in the crt.
- Check that the high voltage clip is securely fixed.

1.8 CRT Heater

Look between the CRT mu-metal shielding and the CR board to see whether the heater (filament) glows.

Attention: The heater voltage is superimposed on -2 kV.

Note:
If all measurements and tests have been completed successfully except this item, switch the oscilloscope off.
Locate and identify connector J3 (4 wires) connecting the power supply board with the CR board. See photo B1.8.

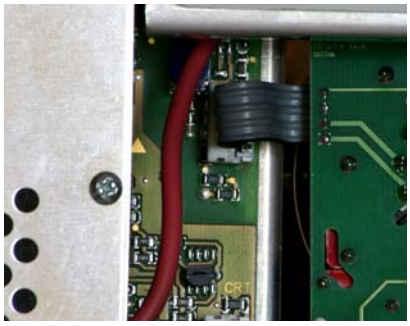


Photo B1.8

Disconnect the connector J3.

Use an Ω meter to measure approx. 15 Ω between wire 1 and 2 on the CR board leading to pin 1 and 14 (heater) of the CRT.

If the heater seems to be defective, remove the CRT socket and measure the CRT heater resistance between pin 1 and 14 to be sure that the CRT is not the reason.

B1.9 Remedy

If one of these voltages is missing or the wrong value, the following procedure is recommended:

- Disconnect the instrument from mains/line.
- Remove the interface mounting plate.
- Remove the power supply shielding.
- Unsolder the wire soldered to the protective earth (PE) connection at the inner side of the rear chassis, marked by an earth symbol.
- Remove all cables and wires connected to the power supply.
- Unfasten the power supply mounting nuts.
- Remove the power supply and replace it by a new power supply.

Proceed in reverse order to mount the new power supply.

Attention!
Special care must be taken for the protective earth connection (PE). It must be mechanically fixed and then soldered such that even accidental contact with a soldering iron wouldn`t open the connection.

Security check!
Check that after PS board replacement the protective earth connection is reestablished.

1.10 Adjustment after power supply change.

The following procedures are required after changing a power supply due to tolerances.

- Check and adjust +65 V and +12V as described under item 1 and 2 in the Adjustment Procedure.
- Press SETTINGS pushbutton, select "Self Cal" and "Start" the self calibration.
- Check time base and Y accuracy and make corrections if required (Adjustment Procedure item 8, 9, 26 - 42 and 52 - 54).

C: Error Diagnostics

The following examples will help you determine the board to be replaced or repaired. Due to each board's comprehensive functions it is not always possible to determine one board precisely. Thus it might be necessary to change more than one board.

As explained before under item B1, the power supply check has the highest priority.

The MC board has the second highest priority, as it controls most of the other boards with the exception of the power supply board. Thus if the power supply is ok, but no trace becomes visible and/or the instrument does not respond to the controls it is recommended to change the MC board first.

If the MC board was the reason for an error and is replaced, don`t forget to make a new adjustment of item 9 as described in the Adjustment Procedure and a complete Performance Check.

Attention!
It is recommended to reinstall the old board if a new board did not solve the problem.

Item	Instrument Behavior	What to do	Remark
C1.1	No front panel LED lit, no trace and no readout visible on the screen.	Pull out fuse holder and check the (external accessible) fuse. If the fuse is blown, replace it and switch the instrument on again. If the error is still present, and the (external accessible) fuse is blown again, continue with item C1.3. If the (external accessible) fuse is not blown, continue with item C1.2.	The instrument must be disconnected from mains/line before checking the fuse.
C1.2		Remove the power supply shielding as described under item B1.9 and check the (internal accessible) fuse on the PS board. If the fuse is blown, replace it and switch the instrument on again. If the error is still present, and the (internal accessible) fuse is blown again, continue with item C1.3.	The instrument must be disconnected from mains/line before checking the fuse.
C1.3		Replace the power supply by a new one as described under item B1.9 and adjust the new power supply (item B1.10).	
C1.4		Security check! Check that after PS board replacement the protective earth connection is re established.	

Item	Instrument Behavior	What to do	Remark
C2.1	No trace and no readout visible on the screen. LEDs lit during power up.	Press AUTOSET pushbutton to make the trace visible. If the error is still present continue with item C2.2.	This description assumes that the crt heater glows as described under item B1.8.
C2.2		Switch the oscilloscope off before continuing with item C2.3!	
C2.3		Remove the plastic cap and make a short between pin 2 (cathode) and pin 3 (grid 1).	See photo C2.3.
C2.4		Switch the oscilloscope on and watch if the trace becomes visible with a too high intensity. If yes continue with item C2.5. If not continue with item C2.8.	No potential difference between cathode and grid causes maximum beam current in the crt and should only be permitted for a few seconds.
C2.5		Locate and identify pin 2 at connector J5303 on MB board and continue with item C2.6.	See photo C2.5.
C2.6		Measure the "BLANK" signal using an oscilloscope with a *10 probe. If the signal is present exchange the CR board and continue with item C2.7. If the signal is not present continue with item C2.11 (replacement of MB board).	See photos C2.6.1 (DC coupling) and C2.6.2 (AC coupling)
C2.7		If trace and readout are visible thereafter, a readjustment of item 4 (CRT minimum intensity), 5 (Focus symmetry) and 6 (Astigmatism correction) is required as described in the Adjustment Procedure. Thereafter the time base and Y accuracy must be checked and if necessary corrected as described under item 8, 9, 26 - 42 and 52 - 54 in the Adjustment Procedure.	
C2.8		Locate and identify pin 1 and 6 at connector J4800 on MB board and continue with item C2.9.	See photos C2.8.1 and C2.8.2.

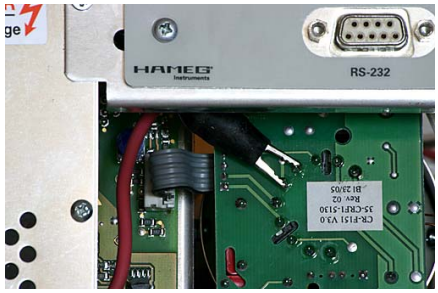


photo C2.3


photo C2.5

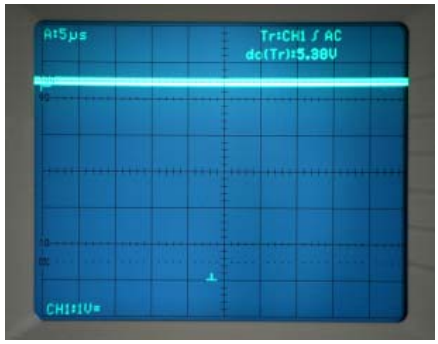


photo C2.6.1

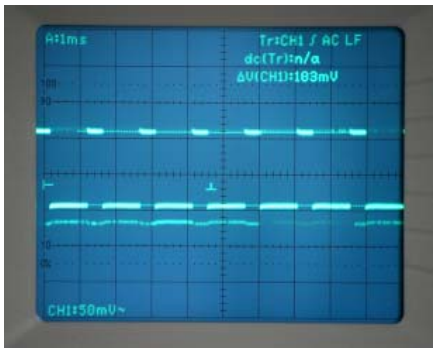


photo C2.6.2

Item	Instrument Behavior	What to do	Remark
C2.9		Measure the sawtooth signal using an oscilloscope with a *10 probe or alternatively the method described under item C2.10. If the signals are not present, the X deflection (MB board) is the reason for the error and the MB board must be changed. Continue with item C2.11. Otherwise continue with item C2.12.	See photos C2.9.1 and C2.9.2. !
C2.10		Connect pin 1 and 6 at J4800 on MB board by a short. Now a bright spot should become visible in the screen centre. If this is case the MB board must be changed. Continue with item C2.11.	See photo C2.10. If due to the short, both X deflection plates have the same potential, the beam is undeflected and should be in the screen center.
C2.11		Replace the MB board to see if trace and readout are present. If this is the case the following adjustments must be made as described in the Adjustment Procedure under item 8, 9, 38 – 47 and 49 – 56.	
C2.12		Locate and identify the Y final stage transistors mounted on the rear chassis. Connect both collectors by a wire (short). The collectors are the centre leads of the transistors. If the trace becomes visible continue with item C2.13. If the trace does not become visible continue with item C2.15.	See photo C2.12.

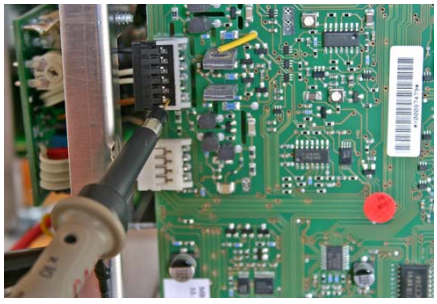


photo C2.8.1

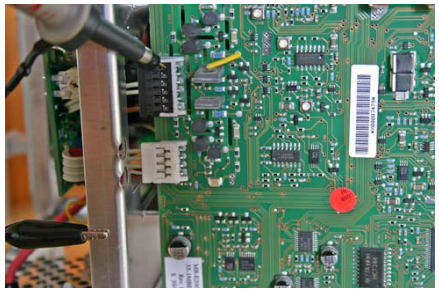


photo C2.8.2

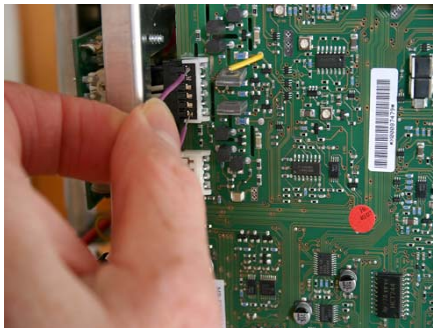


photo C2.10

photo C2.9.1

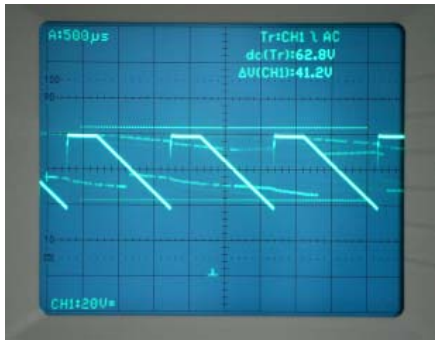


photo C2.9.2

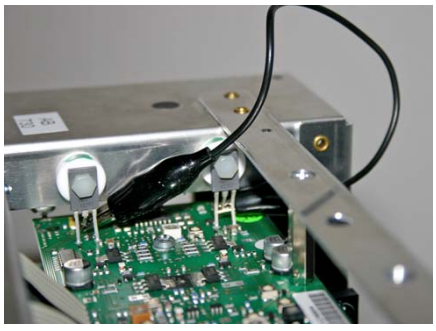


photo C2.12

Item	Instrument Behavior	What to do	Remark
C2.13		Locate and identify delay line cable on YF board and make a short across the delay line. If the trace does not become visible, exchange the YF board. Thereafter adjust item 8, 9, 26 – 28 and 42 as described in the **Adjustment Procedure**. If the trace becomes visible at the screen centre, the YF board has no error. Continue with item C2.14.	See photo C2.13.
C2.14		Exchange the YP board and make a complete oscilloscope adjustment as described in the **Adjustment Procedure**.	
C2.15		Replace the CRT and make a complete oscilloscope adjustment as described in the **Adjustment Procedure**.	If the power supply is not defective, the crt heater glows, the X plates are short circuited and the Y plates are short circuited, the beam must be visible as a spot in the screen centre. If not the crt cathode has no emission.

photo C2.13

Item	Instrument Behavior	What to do
3.1	Trace(s) not focused (approx. 2 cm height) and readout not readable	Replace the CR board to see if the trace can be focused. If this is the case a readjustment of item 4 (CRT minimum intensity), 5 (Astigmatism correction) and 6 (Focus symmetry) are required as described in the Adjustment Procedure.

Item	Instrument Behavior	What to do	Remark
C4.1	HAMEG logo has a bright spot in the top right position of the letter G, increasingly unfocused and a Zoom effect.	Use an oscilloscope and measure the PUMP_VOL(tage) via a 10:1 probe at pin 2 of connector J1008 after the wire to CR board has been disconnected. The voltage should be similar to a sine wave and should have a height of approx. 106 Vpp, symmetrical about the reference potential (chassis). If the voltage is too low, continue with item C4.2 or item C4.3.	See photos C4.1.1 and C4.1.2. Without disconnecting the wire and if generator (PS board) and load (CR board) have no error, there should be approx. 74 Vpp superimposed on approx. 50 V dc.

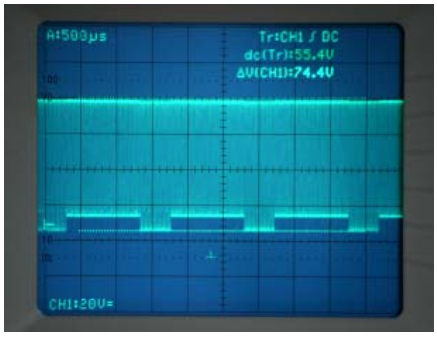


photo C4.1.1

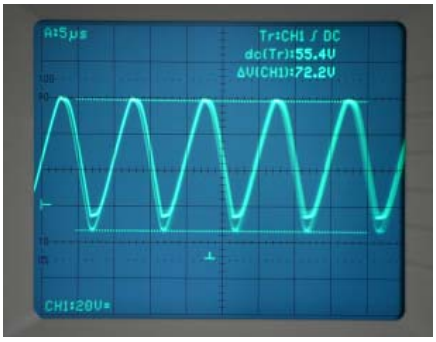


photo C4.1.2

C4.2		Replace the PS (power supply) board after disconnecting the instrument from mains/line. After successful replacement: 1. Check and adjust +65 V= and +12V= as described under item 1 and 2 in the Adjustment Procedure. 2. Press SETTINGS pushbutton, select "Self Cal" and "Start" the self calibration. 3. Check time base and Y accuracy.	
C4.3		Replace the CR board and readjust the following items as described in the Adjustment Procedure: 1. Item 4 (CRT minimum intensity) 2. Item 5 (Astigmatism correction) 3. Item 6 (Focus symmetry)	

Item	Instrument Behavior	What to do	Remark
C5.1	No trace visible in dual and single channel mode; readout displayed.	Press AUTOSET pushbutton. If no trace is displayed continue with item C5.2.	
C5.2		Connect the inner lead and the shielding of the delay line by a wire (short) or tool. If the trace is displayed near the vertical screen centre position, change the YP board and as described in the Adjustment Procedure, make a complete new adjustment of the instrument. If not, continue with item C5.3.	See photo C5.2.
C5.4		Use an oscilloscope and measure the control voltage D_ANA at pin 1 of connector J4801 (located on MB board) connecting MB and YF board. If the voltage is constantly > 2.5 V= the YF amplifier is constantly set to readout display mode and the MB board generates the wrong level. Continue with item C5.5. Note The following conditions should appear: 0 V constantly = Readout is switched off. Pulses from 0 V (signal display) to > 2.5 V (readout insert) with readout on.	See photo C5.4.1. See photo C5.4.2.
C5.5		Change the MB board and adjust item 38 – 47 and 49 – 56 as described in the **Adjustment Procedure.**	

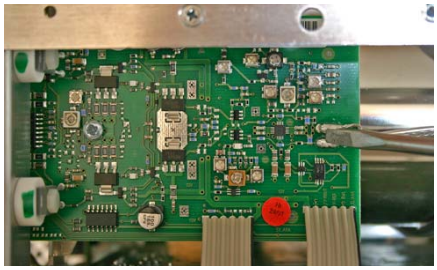


photo C5.2

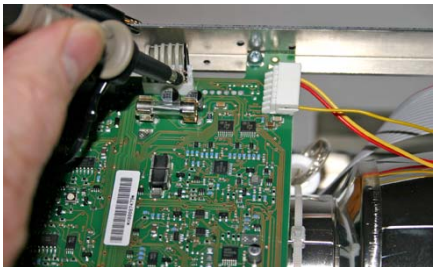


photo C5.4.1

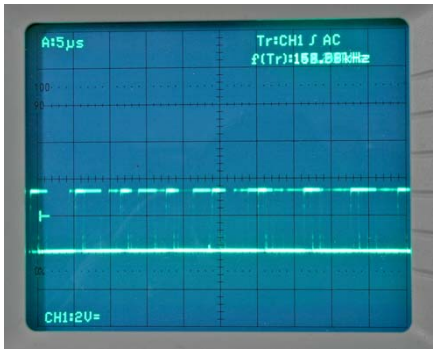


photo C5.4.2

Item	Instrument Behavior	What to do	Remark
C6.1	No X deflection or distorted X deflection in all modes	Press AUTOSET pushbutton. If there is still no X deflection, continue with item C6.2.	
C6.2		Change the MB board and adjust item 8, 9, 38 – 47 and 49 – 56 as described in the Adjustment Procedure.	

Item	Instrument Behavior	What to do	Remark
C7.1	Vertical trace position shift during vertical deflection coefficient switch over, invert switching and variable control	Press "SETTINGS" pushbutton and select "Self Cal". Press "Start" function key. If afterwards the error (> 2mm position change) is still present, continue with item C7.2.	Error condition: No signal applied and Trace position change > 2 mm.
C7.2		Change the YP board and make a complete new adjustment as described in the Adjustment Procedure.	

Item	Instrument Behavior	What to do	Remark
C8.1	No triggering	Apply suitable 50 kHz sine wave signal of 1 Vpp height to input CH 1. Press "VERT/XY" pushbutton and select "CH1" Press "AUTOSET" pushbutton. If triggering is still not possible, continue with item C8.2.	
C8.2		Change the YP board and check if triggering is possible. If yes continue with item C8.3. If not continue with item C8.4.	
C8.3		Change the YP board and make a complete new adjustment as described in the Adjustment Procedure.	
C8.4		Change the MB board and adjust item 8, 9, 38 – 47 and 49 – 56 as described in the Adjustment Procedure.	

Item	Instrument Behavior	What to do	Remark
C9.1	No or only little reaction on turning front panel knob(s)	Change the MC board and check the front panel knob(s) function. If there is still no reaction, continue with item C9.2.	
C9.2		Change the FC board.	

Performance Check HM1500-2

Table of Content

A Test Instruments required

1) Hameg Test Generator HZ620, HF and HM2xxx LF Box.
2) Constant amplitude sine wave generator, 20 Hz – 250 MHz, output 5 mV – 5 V into 50Ω preferably with 20dB attenuation (e.g. HM 813x).
3) 2 BNC-cables, 50Ω, e.g. HZ34.
4) BNC-T-connector.
5) Oscilloscope probe 10:1, with exactly 9MΩ series resistance and compensated for test oscilloscope.
6) Oscilloscope 200 MHz, 5 mV/div to 5 V/div, e.g. HM2005.
7) All insulated trimming/adjusting tools.
8) Variable output, safety insulation transformer.
9) Video signal generator with positive and negative signal output.
10) Digital Multimeter, e.g. HM8011.
11) 50Ω 2:1 splitter.

B Performance Check

This procedure covers the most important - but not all - performance checks.

Basic Settings

Do not check the instrument until the normal operating temperature is reached, after a minimum warmup time of 30 minutes.

Before starting each adjustment procedure, set the oscilloscope to the following settings:

1. Do not apply a signal to an input.
2. Press VERT/XY pushbutton and select CH 1.
3. Press AUTOSET pushbutton.
4. Press MODE pushbutton in the TRIGGER section of the front panel.
5. Press FILTER pushbutton in the TRIGGER section of the front panel.
6. Check that <Trig. Filter> AC, <LF> Off, <Noise Reject> Off and <SLOPE> Rising are selected.
7. Press SOURCE pushbutton in the TRIGGER section of the front panel.
8. Press CH 1 pushbutton.
9. Check that <CH1>DC, Ground (GND) Off, Invert Off, Variable Off and Probe *1 are selected. For channel 2 performance checks, please note the following deviations:
10. Press CH 2 pushbutton.
11. Check that <CH 2> DC, Ground (GND) Off, Invert Off, Variable Off and Probe *1 are selected. If different settings are required, they are mentioned particularly for each subject.

C Software Adjustment Menu

Attention:
To avoid misuse and misalignment, do not publicise how to enter the Software Adjustment Menu.

Some checks require the presence of software adjustment menus. To enter these menus:

1. Press the PROBE ADJ pushbutton below the CRT to display the Utilities menu.
2. Switch COMP. TESTER On.
3. Press the AUTO MEASURE pushbutton and the SETTINGS pushbutton at exactly the same time to activate the Settings Adjust menu.

D Checks

1. Trace Rotation Check

- Set baseline with POSITION 1 to the horizontal centre line of the graticule.
- Press FOCUS TRACE MENU pushbutton on the front panel to open the "Int. Knob" menu.
- Select "Trace Rot.".
- Turn INTENS knob to adjust baseline exactly parallel to the horizontal centre line of the graticule.

2. Readout Adjustment Check

- Con Press "PROBE ADJ." pushbutton, "COMP. TESTER On" function key and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously to enter the "Settings Adjust" menu.
- Press "Adjust 1" function key.
- Press "RO Adjust" function key to enter the "Adjust 1 RO Adjust" submenu.
- Press "Trace Rot." function key.
- Check that the Service Rectangle is exactly parallel to the horizontal lines of the graticule.
- Check that the Service Rectangle cross symbol is congruent with the graticule center.
- Check that the Service Rectangle has exactly 6 division height and 8 division width.

3. CH1: 5 mV/div 100 Hz Square Wave Check

- Press "CH 1 VAR" pushbutton to call the "CH1" menu.
- Select "Page 1" in this menu.
- Select "1MΩ" input impedance.
- Check that DC input coupling is selected.
- Connect a HZ620 25 mV_{pp}, 100 Hz square wave signal via 50Ω cable to input CH 1.
- Set time base to 2 ms/div.
- Check that 5 mV/div is active.
- Press (Trigger) "FILTER" pushbutton and select Slope: Both.
- Check that two straight lines are displayed.

4. CH2: 5 mV/div 100 Hz Square Wave Check

- Press "VERT/XY" pushbutton to call the Vertical menu.
- Press "CH 2" function key to select CH 2 mode.
- Press "CH 2 VAR" pushbutton to call the "CH2" menu.
- Select "Page 1" in this menu.
- Select "1MΩ" input impedance.
- Check that DC input coupling is selected.
- Connect a 25 mV_{pp} / 100 Hz square wave signal via 50Ω cable.
- Check that DC input coupling is selected.
- Set time base to 2 ms/div.
- Check that 5 mV/div is active.
- Press TRIGGER FILTER pushbutton and select Slope: Both.
- Check that two straight lines are displayed.

5. CH1: Input Capacitance

- Connect the "HM2xxx LF Box" Ethernet plug with the HZ620 Box I Ethernet socket.
- Use HZ620 "SIGNAL" pushbutton(s) and select FREQ: 5 kHz and AMP:50mV (": Sqr 50Ω" is displayed one line below).
- Connect HZ620 output with the "HM2xxx LF Box" square wave (marked) input via a 50Ω BNC cable.
- Connect the "HM2xxx LF Box" with both inputs (CH 1 and CH 2).
- Check that HZ620 output is switched on.
- Press HZ620 "SUB FUNCTION" pushbutton to activate "ATT 2:1".

Note:
This activates two independent 2:1 dividers in the "HM2xxx LF Box". Each divider consists of a 1MΩ resistor and a 13 pF capacitor connected in parallel with the resistor. The HZ620 signal is fed via the 2:1 dividers to each oscilloscope input, which must be set to 1MΩ input impedance to achieve the 2:1 attenuation.

- Press "VERT/XY" pushbutton to call the Vertical menu.
- Press "CH 1" function key to select CH 1 mode.
- Press "CH 1 VAR" pushbutton and select "1MΩ" input impedance.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Set time base to 100 µs/div.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Check for 5 divisions signal height.
- Check that 2 parallel, straight lines are displayed.
- Do not change the HZ620 settings until item 6 has been finished.
- Continue with item 6.

6. CH1: 20:1 Attenuator Compensation

Continue the performance check under the last conditions of item 5.

- Set attenuator CH 1 to 100 mV/div.
- Check that the time base is set to 100 µs/div.
- Increase HZ620 output voltage for 5 division signal height.
- Check that 2 parallel, straight lines are displayed.
- Continue with item 7.

7. CH2: Input Capacitance

Continue the adjustment under the last conditions of item 6.

- Turn HZ620 "AMPLITUDE" knob and select "AMP:50mV".
- Press "VERT/XY" pushbutton to call the Vertical menu.
- Press "CH 2" function key to select CH 2 mode.
- Press "CH 2 VAR" pushbutton and select "1MΩ" input impedance.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Check that the time base is set to 100 µs/div.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Check for 5 divisions signal height.
- Check that 2 parallel, straight lines are displayed.
- Continue with item 8.

8. CH2: 20:1 Attenuator Compensation

Continue the performance check under the last conditions of item 7.

- Set attenuator CH 2 to 100 mV/div.
- Check that the time base is set to 100 µs/div.
- Increase HZ620 output voltage for 5 division signal height.
- Check that 2 parallel, straight lines are displayed.

9. CH1: Y Accuracy

The accuracy reading should always be performed in the following way:

- Set the square wave bottom on a horizontal graticule line and read the height in the top position in the screen centre.
- Calculate the deviation in respect to the specifications. 3% error of 5 div. (50 mm) height means that the acceptance range is from 48.5 mm to 51.5 mm.

9.1 CH1 – 1 mV/div (3% accuracy)

- Set time base to 500 µs/div.
- Set attenuator CH 1 to 1 mV/div.
- Press "CH 1 VAR" pushbutton and select 50Ω input impedance.

Note:
The oscilloscope 50Ω input impedance is required only for 1mV/div. check, as the minimum output voltage at HZ620 is 10 mV_{pp}. As the HZ620 source impedance is 50Ω in this setting, the input signal is 5 mV_{pp}.

- Set HZ620 to "10 mV", 1 kHz square wave signal.
- Connect HZ620 output via 50Ω cable to input CH 1.
- For 0% error the signal height is 5 div.
- Continue with item 9.2.

9.2 CH1 – 2 mV/div (3% accuracy)
- Set attenuator CH 1 to 2 mV/div.
- Press "CH 1 VAR" pushbutton and select "1MΩ" input impedance.
- Do not change the HZ620 setting (10 mV_{pp}, 1 kHz square wave signal).
- For 0% error the signal height is 5 div.
- Continue with item 9.3.

9.3 CH1 – 5 mV/div (3% accuracy)
- Set attenuator CH 1 to 5 mV/div.
- Set HZ620 to "25mV".
- For 0% error the signal height is 5 div.
- Continue with item 9.4.

9.4 CH1 – 10 mV/div (3% accuracy)
- Set attenuator CH 1 to 10 mV/div.
- Set HZ620 to "50mV".
- For 0% error the signal height is 5 div.
- Continue with item 9.5.

9.5 CH1 – 20 mV/div (3% accuracy)
- Set attenuator CH 1 to 20 mV/div.
- Set HZ620 to "100mV".
- For 0% error the signal height is 5 div.
- Continue with item 9.6.

9.6 CH1 – 50 mV/div (3% accuracy)
- Set attenuator CH 1 to 50 mV/div.
- Set HZ620 to "250mV".
- For 0% error the signal height is 5 div.
- Continue with item 9.7.

9.7 CH1 – 100 mV/div (3% accuracy)
- Set attenuator CH 1 to 100 mV/div.
- Set HZ620 to "500mV".
- For 0% error the signal height is 5 div.
- Continue with item 9.8.

9.8 CH1 – 200 mV/div (3% accuracy)
- Set attenuator CH 1 to 200 mV/div.
- Set HZ620 to "1V".
- For 0% error the signal height is 5 div.
- Continue with item 9.9.

9.9 CH1 – 500 mV/div (3% accuracy)
- Set attenuator CH 1 to 500 mV/div.
- Set HZ620 to "2.5V".
- For 0% error the signal height is 5 div.
- Continue with item 9.10.

9.10 CH1 – 1 V/div (3% accuracy)
- Set attenuator CH 1 to 1 V/div.
- Set HZ620 to "5V".
- For 0% error the signal height is 5 div.
- Continue with item 9.11.

9.11 CH1 – 2 V/div (3% accuracy)
- Set attenuator CH 1 to 2 V/div.
- Set HZ620 to "10V".
- For 0% error the signal height is 5 div.
- Continue with item 9.12.

9.12 CH1 – 5 V/div (3% accuracy)
- Set attenuator CH 1 to 5 V/div.
- Set HZ620 to "25V".
- For 0% error the signal height is 5 div.
- Continue with item 10.

10. CH2: Y Accuracy
The accuracy reading should always be performed in the following way:
- Set the square wave bottom on a horizontal graticule line and read the height in the top position in the screen centre.
- Calculate the deviation in respect to the specifications. 3% error of 5 div. (50 mm) height means that the acceptance range is from 48.5 mm to 51.5 mm.

10.1 CH2 – 1 mV/div (3% accuracy)
- Check that time base is set to 500 µs/div.
- Set attenuator CH 2 to 1 mV/div.
- Press "CH 2 VAR" pushbutton and select 50Ω input impedance.

Note:
The oscilloscope 50Ω input impedance is required only for 1mV/div. check, as the minimum output voltage at HZ620 is 10 mV_{pp}. As the HZ620 source impedance is 50Ω in this setting, the input signal is 5 mV_{pp}.

- Set HZ620 to "10 mV", 1 kHz square wave signal.
- Connect HZ620 output via 50Ω cable to input CH 2.
- For 0% error the signal height is 5 div.
- Continue with item 10.2.

10.2 CH2 – 2 mV/div (3% accuracy)
- Set attenuator CH 2 to 2 mV/div.
- Press "CH 2 VAR" pushbutton and select "1MΩ" input impedance.
- Do not change the HZ620 setting (10 mV_{pp}, 1 kHz square wave signal).
- For 0% error the signal height is 5 div.
- Continue with item 10.3.

10.3 CH2 – 5 mV/div (3% accuracy)
- Set attenuator CH 2 to 5 mV/div.
- Set HZ620 to "25mV".
- For 0% error the signal height is 5 div.
- Continue with item 10.4.

10.4 CH2 – 10 mV/div (3% accuracy)
- Set attenuator CH 2 to 10 mV/div.
- Set HZ620 to "50mV".
- For 0% error the signal height is 5 div.
- Continue with item 10.5.

10.5 CH2 – 20 mV/div (3% accuracy)
- Set attenuator CH 2 to 20 mV/div.
- Set HZ620 to "100mV".
- For 0% error the signal height is 5 div.
- Continue with item 10.6.

10.6 CH2 – 50 mV/div (3% accuracy)
- Set attenuator CH 2 to 50 mV/div.
- Set HZ620 to "250mV".

- For 0% error the signal height is 5 div.
- Continue with item 10.7.

10.7 CH2 – 200 mV/div (3% accuracy)
- Set attenuator CH 2 to 100 mV/div.
- Set HZ620 to "500mV".
- For 0% error the signal height is 5 div.
- Continue with item 10.8.

10.8 CH2 – 200 mV/div (3% accuracy)
- Set attenuator CH 1 to 200 mV/div.
- Set HZ620 to "2V".
- For 0% error the signal height is 5 div.
- Continue with item 10.9.

10.9 CH2 – 500 mV/div (3% accuracy)
- Set attenuator CH 2 to 500 mV/div.
- Set HZ620 to "2.5V".
- For 0% error the signal height is 5 div.
- Continue with item 10.10.

10.10 CH2 – 1 V/div (3% accuracy)
- Set attenuator CH 2 to 1 V/div.
- Set HZ620 to "5V".
- For 0% error the signal height is 5 div.
- Continue with item 10.11.

10.11 CH2 – 2 V/div (3% accuracy)
- Set attenuator CH 2 to 2 V/div.
- Set HZ620 to "10V".
- For 0% error the signal height is 5 div.
- Continue with item 10.12.

10.12 CH2 – 5 V/div (3% accuracy)
- Set attenuator CH 2 to 5 V/div.
- Set HZ620 to "25V".
- For 0% error the signal height is 5 div.

11. ADD Accuracy

The accuracy reading should always be performed in the following way:
- Set the square wave bottom on a horizontal graticule line and read the height in the top position in the screen centre.
- Calculate the deviation in respect to the specifications. 3% error of 5 div. (50 mm) height means that the acceptance range is from 48.5 mm to 51.5 mm.

Continue as follows:
- Connect a BNC T adapter with the output of HZ620.
- Set HZ620 to "FREQ: 5kHz", "AMP:25mV" and "Sqr 600 Ω".
- Connect a 50Ω BNC-BNC cable with each BNC T adapter socket.
- Connect one BNC cable with "CH 1" input and the other with "CH 2" input.
- Press "VERT/XY" pushbutton and select "ADD" mode in Vertical menu.
- Press "CH 2 VAR" pushbutton and select "1MΩ" input impedance.
- Press "CH 1 VAR" pushbutton and select "1MΩ" input impedance.
- Set both attenuators to 10mV/div.
- Check that (Trigger) "SOURCE" is set to CH1.
- Check that the signal is displayed with 5 div. height (0% error).

12. CH1: Y-Amplifier Overshoot
- Press "VERT/XY" pushbutton to call the "Vertical" menu.
- Press "Bandwidth" function key to select "Bandwidth Full".
- Press "CH1 VAR" pushbutton to call "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "MENU OFF" pushbutton.
- Set time base to 20 ns/div.
- Set "VOLTS/DIV" CH 1 to 5 mV/div.
- Connect the "BOX II" BNC plug with the input of CH 1.
- Set HZ620 to "1MHz".
- Check that the signal overshoot and ringing is similar to photo 44.1 in the Adjustment Procedure and not significantly higher.
- Continue with item 13.

13. CH1: 5mV/div Y-Amplifier Bandwidth Check

Continue the adjustment under the last conditions of item 12.
- Check that CH 1 mode is present.
- Check that 50Ω input impedance is present.
- Check that "VOLTS/DIV" CH 1 is set to 5 mV/div.
- Set time base to 500 ns/div.
- Connect a 40 mV_{pp} / 4 MHz sine wave signal from a constant amplitude generator via a 50Ω cable to the input of CH 1.
- Press "SOURCE" pushbutton to call the Trig. Source menu.
- Press "External" function key.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).
- If the -3dB bandwidth is 215 MHz or higher in analogue mode, switch to digital mode and check the bandwidth again.
- If the -3dB bandwidth conditions are met continue with item 14.

14. CH1: 1mV/div Y-Amplifier Bandwidth Check

Continue the adjustment under the last conditions of item 13.
- Check that CH 1 mode is present.
- Check that 50Ω input impedance is present.
- Check that time base is set to 500 ns/div.
- Set "VOLTS/DIV" CH 1 to 1 mV/div.
- Connect an 8 mV_{pp} / 4 MHz sine wave signal from a constant amplitude generator via a 50Ω cable to the input of CH 1.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).
- If the -3dB bandwidth is 100 MHz or higher in analogue mode, switch to digital mode and check the bandwidth again.

15. CH2: Y-Amplifier Overshoot
- Press "VERT/XY" pushbutton to call the "Vertical" menu.
- Press "Bandwidth" function key to select "Bandwidth Full".
- Press "CH2 VAR" pushbutton to call "CH2" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "MENU OFF" pushbutton.
- Check that time base is set to 20 ns/div.
- Set "VOLTS/DIV" CH 2 to 5 mV/div.
- Connect the "BOX II" BNC plug with the input of CH 2.
- Set HZ620 to "1MHz".
- Check that the signal overshoot and ringing is similar to

photo 45.1 in the Adjustment Procedure and not significantly higher.
- Continue with item 16.

16. CH2: 5mV/div Y-Amplifier Bandwidth Check

Continue the adjustment under the last conditions of item 15.
- Check that CH 2 mode is present.
- Check that 50Ω input impedance is present.
- Check that "VOLTS/DIV" CH 1 is set to 5 mV/div.
- Set time base to 500 ns/div.
- Connect a 40 mV_{pp} / 4 MHz sine wave signal from a constant amplitude generator via a 50Ω cable to the input of CH 2.
- Press "SOURCE" pushbutton to call the Trig. Source menu.
- Press "External" function key.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).
- If the -3dB bandwidth is 215 MHz or higher in analogue mode, switch to digital mode and check the bandwidth again.
- If the -3dB bandwidth conditions are met continue with item 17.

17. CH2: 1mV/div Y-Amplifier Bandwidth Check

Continue the adjustment under the last conditions of item 16.
- Check that analogue mode is present.
- Check that CH 2 mode is present.
- Check that 50Ω input impedance is present.
- Check that time base is set to 500 ns/div.
- Set "VOLTS/DIV" CH 2 to 1 mV/div.
- Connect an 8 mV_{pp} / 4 MHz sine wave signal from a constant amplitude generator via a 50Ω cable to the input of CH 1.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).
- If the -3dB bandwidth is 100 MHz or higher in analogue mode, switch to digital mode and check the bandwidth again.

18. CH 1: 5 mV/div XY mode X Accuracy

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "1MΩ" input impedance.
- Press "VERT/XY" pushbutton.
- Press "XY" function key to call the "Vertical XY" menu.
- Press "X Channel" "CH1" function key.
- Press "MENU OFF" pushbutton.
- Set HZ620 to "25 mV", 1 kHz square wave signal.
- Connect HZ620 output via 50Ω cable to input CH 1.
- Check that 2 dots are visible with a distance of 5 div. (0% error) in X direction. (3% accuracy range 48.5 mm to 51.5 mm).
- Continue with item 19.

19. CH 1: 5 mV/div XY mode X Bandwidth

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "1MΩ" input impedance.
- Press "VERT/XY" pushbutton.
- Press "XY" function key to call the "Vertical XY" menu.
- Press "X Channel" "CH1" function key.
- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "VERT/XY" pushbutton.
- Press "XY" function key to call the "Vertical XY" menu.
- Press "X Channel" "CH1" function key.
- Press "MENU OFF" pushbutton.
- Check that the attenuator is set to 5 mV/div.
- Connect a 40 mVpp, 50 kHz sine wave signal from a constant amplitude generator via a 50Ω cable the input of "CH 1".
- Adjust the generator amplitude for 8 div. display width on the screen.
- Increase the generator frequency until the signal width is 5.6 div. (-3dB).
- Under these conditions the generator frequency must be higher then 3 MHz.

20. CH 1 Time Base A: Trigger Sensitivity (internal triggering)

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note:
AC coupling should be used to prevent dc signal components influencing the required trigger level setting.

- Press "VERT/XY" pushbutton to call the "Vertical" menu.
- Press "CH1" function key to call CH 1 mode.
- Press "MENU OFF" pushbutton.
- Connect a 25 mV_{pp}, 50 kHz sine wave signal from a constant amplitude generator via a 50Ω cable to the input of CH 1.
- Check that time base A is selected and set to 20 µs/div.
- Check that attenuator CH 1 (VOLTS/DIV) is set to 5 mV/div.
- Check that trigger source CH 1 is chosen.
- Adjust the generator amplitude for 5 div. (50 mm) display height on the screen.
- Set attenuator to 50 mV/div, so that the signal height is 5 mm.
- Check that the signal can trigger the time base in AUTOMATIC and NORMAL trigger mode in combination with AC- and DC-trigger coupling and both slope settings.
- Continue with item 21 without changing the signal parameters.

21. CH 1 Time Base B: Trigger Sensitivity (internal triggering)

Operate oscilloscope as described under item 20.
- Check that the signal is displayed with 5 mm height.
- Set time base A 200 µs/div.
- Press "HOR VAR" pushbutton to call "Timebase" menu.
- Press an "A only – Search – B only" function key to select "B only".

Note:
In "Search" mode A and B time base alternate, but B time base is not triggered although in most cases has stable display.

- Set time base B to 20 µs/div
- Press a "B Trigger" function key to select "/ Edge" (/ = symbol for rising).

Note:
"B Trigger" mode means NORMAL trigger mode for the B time base.
If the signal is not displayed, turn (Trigger) LEVEL A/B knob to set the trigger symbol to the same vertical position as the ground symbol.

Note:
Check that the signal is displayed in combination with both edge settings.

Note:
In "B Trigger" mode DC trigger coupling is automatically selected.

22. CH 1: Trigger Bandwidth (internal triggering)

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note:
AC coupling should be used to prevent dc signal components to influence the required trigger level setting.

- Press "VERT/XY" pushbutton to call the "Vertical" menu.
- Press "CH1" function key to call CH 1 mode.
- Press "MENU OFF" pushbutton.
- Connect a 5 mV_{pp}, 50 kHz sine wave signal from a constant amplitude generator via a 50 cable of CH 1.
- Check that attenuator CH 1 (VOLTS/DIV) is set to 5 mV/div.
- Check that trigger source CH 1 is chosen.
- Set the generator frequency to 250 MHz.
- Adjust constant amplitude generator output for 5 mm (0.5 div.) display height on the screen.
- Check that the signal can trigger the time base in AUTOMATIC and NORMAL trigger mode in combination with AC, DC and HF trigger coupling.

23. CH 2: Trigger Bandwidth (internal triggering)

- Press "CH 2 VAR" to call the "CH2" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note:
AC coupling should be used to prevent dc signal components from influencing the required trigger level setting.

- Press "VERT/XY" pushbutton.
- Press "CH2" function key to call CH 2 mode.
- Press "MENU OFF" pushbutton.
- Connect a 5 mVpp, 50 kHz sine wave signal from a constant amplitude generator via a 50 cable of CH 2.
- Check that attenuator CH 2 (VOLTS/DIV) is set to 5 mV/div.
- Check that trigger source CH 2 is chosen.
- Set the generator frequency to 250 MHz.
- Adjust constant amplitude generator output for 5 mm (0.5 div.) display height on the screen.
- Check that the signal can trigger the time base in AUTOMATIC and NORMAL trigger mode in combination with AC, DC and HF trigger coupling.

24. Video Trigger Check

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note: AC coupling should be used to prevent dc signal components from influencing the required trigger level setting.

- Press "VERT/XY" pushbutton.
- Press "CH1" function key to call CH 1 mode.
- Press "MENU OFF" pushbutton.
- Connect a Composite Video Signal with positive polarity (line and frame content above the sync pulses) to input CH 1.
- Set A time base to 100 µs/div.
- Press (Trigger) MODE pushbutton to call "Trigger" menu.
- Press "Video" function key to activate Video triggering.
- Press (Trigger) FILTER pushbutton to call "Video" menu.
- Press "Frame Line" function key to select Frame triggering.
- Press "All" function key to accept all frame sync pulses for triggering.
- Check that "Polarity Positive" is selected.
- Check that the "Norm ...." setting (625/50 or 525/60) is in accordance with the Video Signal applied.
- Reduce the signal height so that the sync pulses height is 5 mm.
- Check that the Video Signal is a (triggered) stable display.

25. Trigger Filter Check

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note:
AC coupling should be used to prevent dc signal components from influencing the required trigger level setting.

- Press "VERT/XY" pushbutton.
- Press "CH1" function key to call CH 1 mode.
- Press "MENU OFF" pushbutton.
- Set time base to 500 µs/div.
- Set attenuator CH 1 to 5 mV/div.
- Connect a 1kHz sine wave signal of 25 mVpp amplitude to input CH 1 and check for 5 div. Y deflection.
- Set attenuator CH 1 to 50 mV/div and check for 5mm display height.
- Select trigger coupling AC, DC, HF, Noise Reject and LF.
- With the exception of HF, the signal must always trigger the oscilloscope. As in DC trigger coupling mode the peak value triggering is switched off, turn the LEVEL A/B knob until stable triggering is achieved.
- Set time base to 20 µs/div.
- Set sine wave generator to 50 kHz and 25 mVpp output amplitude and check for 5 div. Y deflection.
- Set attenuator CH 1 to 50 mV/div and check for 5mm display height.
- Select trigger coupling AC, DC, HF, Noise Reject and LF.
- Select trigger coupling from AC, DC, HF, NR and LF.
- Except in LF trigger coupling condition, the signal must always trigger the oscilloscope. As in DC trigger coupling mode the peak value triggering is switched off, turn the LEVEL A/B knob until stable triggering is achieved.

26. Time Base A: Extern Trigger Sensitivity

- Press "CH 1 VAR" to call the "CH1" menu.
- Press "50Ω 1MΩ" function key to select "50Ω" input impedance.
- Press "AC DC" function key to select "AC" input coupling.

Note:
AC coupling should be used to prevent dc signal components from influencing the required trigger level setting.

- Press "VERT/XY" pushbutton.
- Press "CH1" function key to call CH 1 mode.
- Connect a 600 mV_{pp}, 50 kHz sine wave signal from a constant amplitude generator via one of the 50Ω 2:1 signal splitter outputs and via 50Ω cable to input of "CH 1".
- Connect the second 2:1 splitter output via a 50Ω cable to the "AUXILIARY INPUT".
- Set attenuator CH 1 (VOLTS/DIV) to 200 mV/div.
- Check that trigger source CH1 is chosen.
- Check that the signal is displayed with 3 div. height on the screen.

Note:
The display of the signal via CH 1 later enables the observation of the external triggered signal.

- Press (Trigger) "SOURCE" pushbutton to call the "Trig. Source" menu.
- Press "External" function key to select external triggering via the "AUXILIARY INPUT".
- Press "MENU OFF" pushbutton.
- Check that the signal can trigger the time base in AUTOMATIC and NORMAL trigger mode in combination with AC- and DC-trigger coupling.
- Continue with item 27 without changing the signal parameters.

27. Time Base A: Extern Trigger Bandwidth

Operate oscilloscope as described under item 26.
- Set the generator frequency to 200 MHz.
- Set attenuator CH 1 (VOLTS/DIV) for approx. 2 to 6 div. signal display height.

Note:
The display of the signal via CH 1 enables the observation of the external triggered signal.

- Check that the signal can trigger the time base in AUTOMATIC and NORMAL trigger mode in combination with AC, DC and HF trigger coupling.

28. Time Base A: Accuracy

Preparations:
- Press the "PROBE ADJ" pushbutton below the CRT to display the Utilities menu.
- Switch "Comp. Tester" On.
- Press the "AUTO MEASURE" pushbutton and the "SETTINGS" pushbutton at exactly the same time to activate the "Settings Adjust" menu.
- Press "Adjust 2" function key to open "Adjust 2" menu.
- Press "Timebase" function key to open "Adjust 2 Timebase" menu.
- Press "A Timebase" function key to open "Timebase A Timebase" menu.

Note:
The actual time base setting and the required signal frequency are displayed on the screen.

- Set time mark generator for 100µs spike pulses (alternatively 10 kHz sine wave signal); signal frequency accuracy 0.1 ppm or better.
- Check that the current time base setting is 100 µs/div.
- Connect signal to input "CH 1".
- Turn CH 1 "VOLTS/DIV" knob for a signal height of approximately 5 divisions.
- Turn (Trigger) "LEVEL A/B" knob for stable triggering.

Accuracy reading:
- The accuracy reading should always be performed in the following way:
- Set "POSITION 1" knob on the front panel for reading of the pulse peak or sine wave zero crossing at the horizontal centre line of the graticule.
- Move trace with "HORIZONTAL" knob (front panel) so that the first pulse peak or sine wave zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Check that 1 pulse or signal period per division is displayed and the rightmost pulse peak or zero crossing coincides with the vertical graticule line as on the left side = 0% error.
- The maximum acceptable deviation at the 10th or 11th pulse or zero crossing is ±3 mm (3%).

Performance Check:
- Set TIME/DIV knob for "TB: 20ns" display.
- Connect a 20ns time mark signal or a 50 MHz sine wave signal (accuracy 0.1 ppm or better) to the input of CH 1.
- Turn CH 1 "VOLTS/DIV" knob for a signal height of approximately 5 divisions.
- Set (Trigger) "LEVEL A/B" knob on the front panel for stable triggering.
- Check the accuracy at this setting.
- Turn "TIME/DIV" knob one step counter clockwise and note the time base and signal frequency information displayed by the readout.
- Repeat this procedure until the 500 ms time base setting has been checked.
- Press "MENU OFF" key to return to "Adjust 2 Timebase" menu.
- Continue with item 29.

29. Time Base B: Accuracy

Operate oscilloscope as described under item 28.
- Check that "Adjust 2 Timebase" menu is displayed.
- Press "B Timebase" function key "Timebase B Timebase" menu.
- Set time mark generator for 50µs spike pulses (alternatively 20 kHz sine wave signal); signal frequency accuracy 0.1 ppm or better.
- Check that the current time base setting is 50 µs/div.
- Connect signal to input "CH 1".
- Turn CH 1 "VOLTS/DIV" knob for a signal height of approximately 5 divisions.
- Turn (Trigger) "LEVEL A/B" knob for stable triggering.

Accuracy reading:
- The accuracy reading should always be performed in the following way:
- Set "POSITION 1" knob on the front panel for reading of the pulse peak or sine wave zero crossing at the horizontal centre line of the graticule.
- Move trace with "HORIZONTAL" knob (front panel) so that the first pulse peak or sine wave zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Check that 1 pulse or signal period per division is displayed and the rightmost pulse peak or zero crossing coincides with the vertical graticule line as on the left side = 0% error.
- The maximum acceptable deviation at the 10th or 11th pulse or zero crossing is ±3 mm (3%).

Performance Check:
- Set TIME/DIV knob for "TB: 20ns" display.

- Connect a 50ns time mark signal or a 50 MHz sine wave signal (accuracy 0.1 ppm or better) to the input of "CH 1".
- Turn CH 1 "VOLTS/DIV" knob for a signal height of approximately 5 divisions.
- Set (Trigger) "LEVEL A/B" knob on the front panel for stable triggering.
- Check the accuracy at this setting.
- Turn "TIME/DIV" knob one step counter clockwise and note the time base and signal frequency information displayed by the readout.
- Repeat this procedure until the 20 ms time base setting has been checked.
- Press "MENU OFF" key until a menu is no longer displayed, COMP. TESTER mode is switched off and Yt mode is present.
- Continue with item 30.

30. Time Base A: Magnification x10

- Set "TIME/DIV" knob for "TB: 50µs" display.
- Press "MAG x10" pushbutton so that it lights.
- Check that the readout displays "A:5µs".
- Connect a 5µs spike pulse or 200 kHz sine wave signal (accuracy 0.1 ppm or better) to the input of "CH 1".
- Turn CH 1 "VOLTS/DIV" knob and sine wave generator output level for approx. 5 divisions signal height.
- Set (Trigger) "LEVEL A/B" knob on the front panel for stable triggering.

Accuracy reading:

- Set "POSITION 1" knob on the front panel for reading of the pulse peak or sine wave zero crossing at the horizontal centre line of the graticule.
- Move trace with "HORIZONTAL" knob (front panel) so that the first pulse peak or sine wave zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Check that 1 pulse or signal period per division is displayed and the rightmost pulse peak or zero crossing coincides with the vertical graticule line as on the left side = 0% error.
- The maximum acceptable deviation at the 10th or 11th pulse or zero crossing is ±5 mm (5%).

31. Z Input

- Check that "External" triggering is not active.
- Press "AUX" pushbutton to call the "Z Input" menu (impossible when "External" trigger mode is chosen).
- Press "Z Input On Off" function key to activate the Z Input function (On).
- Set time base to 20 µs/div.
- Connect a 2.5 Vpp, 1 Hz square wave signal (switching between 0 V and 2.5 V and vice versa) with the "AUXILIARY INPUT".
- Check that the trace is continuously switching between unblank and blank.

32. COMP. Tester Function

- Press button below the CRT to open the "Utilities" menu.
- Press "Comp. Tester" function key to switch over to "On".
- Check that a horizontal trace of approximately 9 div. length is displayed.
- Connect both "COMP. TESTER" sockets by a short piece of wire.
- Check that the trace is displayed in vertical direction with approximately 8 div. height.

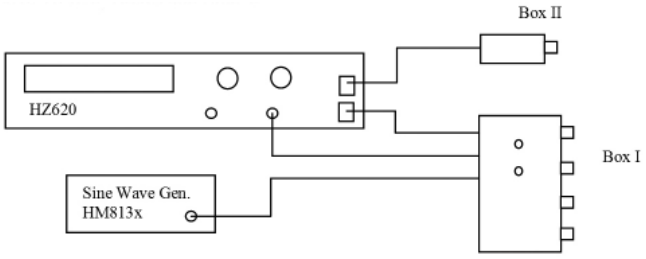
Spare-Part List HM1500-2

Spare Part	Spare Part Number
CRT Board F151	29-1000-0021
CRT Board	29-1000-0120
CRT Modul (Tube)	29-1000-0024
FC Board	29-1000-0110
IF Board	29-1000-0022
MB Board V1.0	29-1000-0019
MB Board V1.1	29-1000-0123
MC Board	29-1000-0017
PS Board V1	29-1000-0015
PS Board V2	29-1000-0119
TE Board	29-1000-0060
Delay Line	29-1000-0023
YF Board F151	29-1000-0032
YF Board F152	29-1000-0122
YP Board	29-1000-0020
Front Cover	29-1000-0126
Rear Cover	29-1000-0025
Casing	29-1000-0064
Handle	29-1000-0068
Knob Set	29-1000-0029
Screenfilterpane	29-1000-0027
Keymat	29-1000-0067

HZ620 System description

The HZ620 Test Generator is designed for testing/adjusting oscilloscopes. The following is a concise description of the HZ620 including the accessories and the signals. Basic knowledge of an oscilloscope's architecture and adjustment procedure is assumed.

HZ620 can be used as a 'stand-alone' instrument or in conjunction with a relay-box for signal routing.



Scheme of HZ620, Boxes and Sine-wave generator

The boxes are connected to the front panel of HZ620 with RJ45 connectors (CAT5 STP cable) for control, Box I additionally with BNC-SMA coaxial-cables to HZ620 and sine wave generator HM813x. Inside Box I are 2:1 Attenuators, relays for signal routing and 50Ω termination resistors.

Several types of Box I will be available for connecting to 2-Ch or 4-Ch HAMEG-oscilloscopes. Box I is also named HM1x0xLF-Box. Note that some functions of Box I are only accessible via Interface commands.

Box II contains a square-wave generator with fast rising edges.(also called HM1x0xHF-Box)

Signals of HZ620

It provides either a positive dc voltage or a square wave ranging from 0.5Hz to 100kHz.(rise/fall time ~100ns) Output voltages from +10mV to +40V (in 1/2.5/5 sequence, except 40V) with an amplitude accuracy of 0.1% are available. In the 10mV to 50mV range the source resistance is 50Ω, in the 0.1V to 40V range the source resistance is 600 Ω This signal is used for adjusting the scope's input capacitance, attenuator compensation networks, other low frequency compensation elements or the gain of the amplifier chain.

A fast rising square wave is delivered by the external box (Box II). The rise/fall time is about 0.8ns. The amplitude is approx. +25mV/50Ω (not calibrated). The frequency is 0.5Hz to 2MHz in 1-2-5 steps.
In order to ensure best waveform fidelity, the box should be connected via a 50Ω termination resistor to the oscilloscope input without a cable. The fast rising square wave is necessary for adjusting the high frequency compensation networks of the scope's amplifiers.

Time mark pulses for testing/adjusting the time-base. The frequency of the time mark pulses ranges from 0.5Hz to 100MHz which corresponds to 2s/div to 10ns/div of the oscilloscope's time-base. The amplitude is constant +0.25V peak at 50Ω. The duty cycle is about 0.05, increasing to 0.5 in the 10MHz to 100Mhz range.

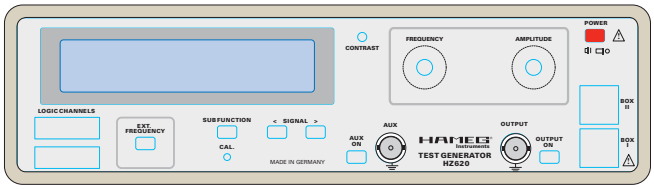
For testing the logic channels of HM2008, four LVDS-signals are delivered at the 16-pin connector with frequencies from 200kHz to 1MHz or 20MHz on all four channels. The logic outputs should be connected via a flat cable directly to the logic inputs of the scope without a logic-probe.

For checking/adjusting the threshold of the logic inputs, a dc voltage from –2V to +3V with 1mV resolution is provided by HZ620. The max. current is 5mA. It is also useful for testing the DC-gain linearity of the Y-amplifier.

By means of an external video source (CVBS-Video signal), connected at the rear side of HZ620, the scope's Videotrigger circuit can be tested in both polarities.

Operating the HZ620

The initial setting is always 'Square wave, 5kHz, 25mV, Output Off'.



Selecting Signals and Sub Functions

The '< SIGNAL >'-buttons selects the various signals successively in both directions.
The 'Sub Function' button activates an additional function, depending on the selected signal.
The following table shows the sequence of the signals and the related sub-function:

Signal	Sub Function
-Sqr 0.5Hz-100kHz, 10mV-40V	ATT 2:1 activates the 2:1 Attenuator in Box I
-Pulse, 0.5Hz-100MHz, 0.25V@50Ω	no sub function
-Logic-Probe Channels	20MHz at all four channels
-DC voltage –2V to +3V, 10mA	no sub function
-Ext. Video, fed through from an external source to the output connector of HZ620	Video invert
-HF-Box II, fast rising square wave of Box II, 0.5Hz-2MHz, approx. +25mV@50Ω	no sub function
-Sin > Box I switches to sine-wave generator input.	no sub function

When changing the signal, the activated sub-function is cancelled. The Frequency/Amplitude Encoders are enabled or disabled according to the selected signal.

The 'Ext.Frequency'-button selects an external clock source for the square wave- or pulse- signal. (Min.0.5 V_{pp}@50Ω)

The Auxiliary output is internally connected to the main output. It is intended for providing signals to high impedance inputs like Ext. Trigger. The Aux output is switched off when changing the signal type.

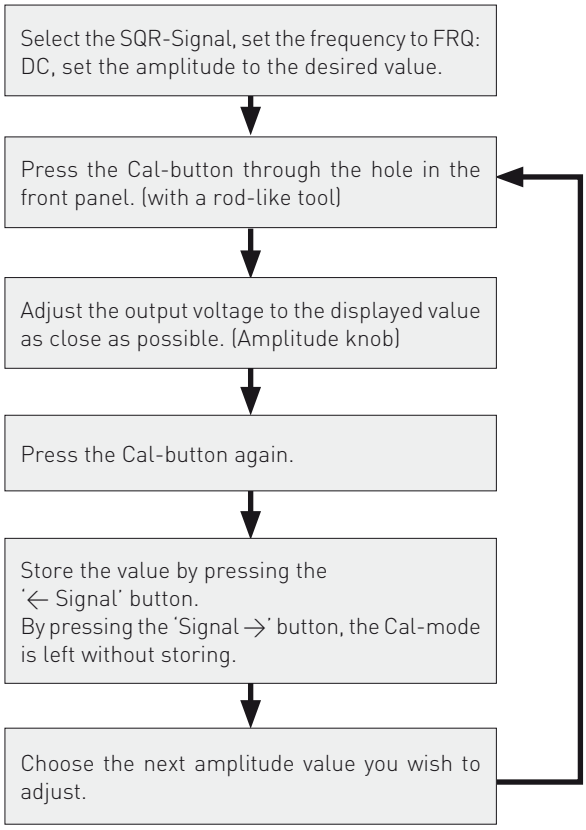
In the 25V and 40V amplitude range, a protection circuit is monitoring the output current. The output is switched off in case of an overload condition. (e.g. connecting a 50Ω termination resistor to the output). The overload condition can only be cleared by pressing the 'Output-On'-button.(Or Power On/Off)

Calibration of the Square-wave amplitude

To achieve best amplitude accuracy, each amplitude step from 10mV to 40V must be calibrated. For adjusting the amplitudes, a high precision digital multimeter is required.(5 ½ digits at least). To prevent long term de-gradation, the accuracy of the square-wave amplitudes should be checked in a 6 month interval.

Start the Cal-procedure after 30 min. warm-up period in an ambient temperature of 23°C.

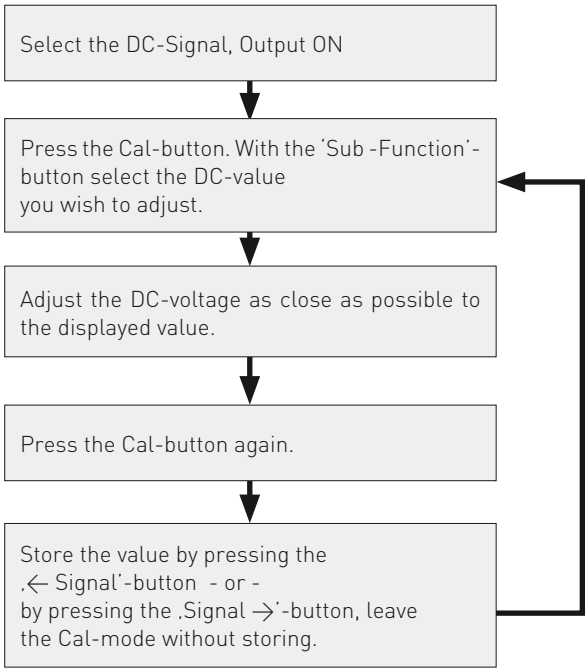
Connect the DMM to the output connector of HZ620 and follow the steps according to the diagram:



Calibrating the DC-voltage from –2V to +3V

The DC-voltage range is adjusted from –1.8V to +2.8V in steps of 200mV.

Connect a high precision DMM to the output connector of HZ620 and follow the steps of the diagram below.



For adjusting the whole DC-range, this procedure must be performed 24 times in steps of 200mV.

After calibration, the dc-voltage must not deviate more the +/-1mV from the displayed value except in the ranges beyond <1.9V and >2.9V.

The DC-range accuracy should be checked every 6 month.

Commands of the serial RS-232 interface

Interface settings: Baudrate 9600, 8 databits, no Parity, 1 stopbit, no handshake RS-232 modem cable is required.

Commands consist of 3 characters. Commands with parameters consist of 3 characters, space, Parameter. The commands and parameters are case sensitive. The commands must written in capital letters.
Termination character is always 0dh or decimal 13 (CR).

Commands for signal selection

HSQ Square wave 10mV-40V, DC-100kHz, 600 Ω

FSQ Fast rise square wave gen. of Box II (HM1x0xHF-Box), DC-2MHz, approx. 25mV @ 50Ω

PUL Time mark pulses, 0.5Hz-100MHz, 0.25V@50Ω
VID x Ext.Video signal is switched to the output connector of HZ620, x = 0 >not inverted, 1 > inverted

DIG x x = 0 >Logic Channels are switched on,
x = 1 > 20MHz on LC0 to LC3

DCV x.xxx DC-voltage from –1.999 to 2.999V, max.5mA, at least one digit after the dot must be assigned.

CHY x If Box I (HM1x0xLF-Box) is connected to HZ620, the CHY command selects a particular channel.
x = 0 > HZ620 signal is switched to all outputs of the box.
x = 1 > signal is switched to CH1 output.
x = 2 > signal is switched to CH2 output.
x = 3 > signal is switched to CH3 + CH4

Note that the CHY selection remains valid even the signal type is changed! Pulse- and Videosignal is routed to channel 1 of the box by default. It can be changed by the CHY-command.

SIN x Box I switches to sine-wave input. x = 0 > sine wave is switched to all outputs of the box
x = 1 > sine wave is switched to Channel 1 output of the box.
x = 2 > sine wave at Channel 2
x = 3 > sine wave at Channel 3+4

Signal dependent commands:
ATT x x = 0 > 2:1 Attenuator in Box I is switched off,
x = 1 > Attenuator is active
IMP x x = 0 > 50Ω termination in Box I is off,
x = 1 > 50Ω termination on,
x = 2 > toggle 50Ω
The 50Ω termination resistor of the Box is turned on/off automatically depending on the selected signal Only with the Sqr-signal (HSQ) in the amplitude range from 10mV to 50mV the 50Ω termination can be switched on/off with the IMP command.
EXT x x = 0 | 1 >Ext.Frequency input on/off

Depending on the selected signal, these commands are executed or not. When changing the signal, any of these functions is deactivated.
Other commands:
OUT x x = 0 > Output Off,
x = 1 > Output On,
x = 2 > Aux-Output ON
RST Resets the instrument to initial setting: Sqr, 5kHz, 25mV, Output Off
ID? Returns : HZ620 Vx.x + date
SN? Returns a 3 digit serial number: SN:xxx

Frequency selection:			
FRQ x	x = DC	200Hz	200kHz
	0.5Hz	500Hz	500kHz
	1Hz	1kHz	1MHz
	2Hz	2kHz	2MHz
	5Hz	5kHz	5MHz
	10Hz	10kHz	10MHz
	20Hz	20kHz	20MHz
	50Hz	50kHz	50MHz
	100Hz	100kHz	100MHz

Amplitude selection:			
AMP x	x = 10mV	**25V**	5V
	25mV	0.5V	10V
	50mV	1V	25V
	0.1V	2.5V	40V

Note that 0.25V is without a leading zero : .25V

Commands can be arranged in a chain, separated only by comma (without space). The max. length of the chain is 63 characters, terminated by 0dh (CR). e.g. HSQ,ATT 1,OUT 1

HMXX0X Oscilloscopes Test and Adjustment

Note!
This description refers to software supported oscilloscope adjustment, quality testing and error detection. It will simplify the adjustment and save time.

Table of Contents

The following equipment is provided:

1 CD with PSH test and adjustment software
1 CD with USB driver software
1 PC with Microsoft Win98, Win2000 or XP operating system
1 Test Generator HZ620
1 HF Synthesizer HM8134-3 or HM8135
1 DVD Player (TV Trigger test signal generator)
3 RS-232 extension cables with 9 pole D-Sub connectors (no null modem cables)
or
1 USB Hub, 3 USB to Serial converters and
3 USB extension cables

1. Preliminary remark

As can be seen from the schematic "HM1X0X oscilloscopes test and adjustment configuration" drawing A1 and B1, PCs with different equipment can be used for test and adjustment purposes.

1.1 PC with 3 unused COM Ports
If you have a PC with three unused COM Ports please continue with item 2.

1.2 PC without 3 unused COM Ports
If your PC has USB connectors only or not enough COM Ports please continue with item 3.

2. Preparation for COM Port operation

This section describes how to proceed if the requirements of item 1.1 are met.
During the following procedures (2.1 to 2.3) the PC and the other devices should be switched ON.

2.1 HZ620
Connect the signal generator HZ620 (A2) RS-232 connector with an unused COM Port on the PC and keep the COM Port number in mind.

2.2 HM8134-3 or HM8135
Connect the RF (HF) generator HM8134-2 or HM8135 (A4) RS-232 connector with an unused COM Port on the PC and keep the COM Port number in mind.

2.3 HM1500-2 (device under test)
Connect the HM1500-2 RS-232 connector to an unused COM Port on the PC and keep the COM Port number in mind.

Continue with item 4.

3. Preparation for USB operation

This section describes how to proceed if the requirements of item 1.2 are met. During the following procedures the PC must be switched ON.

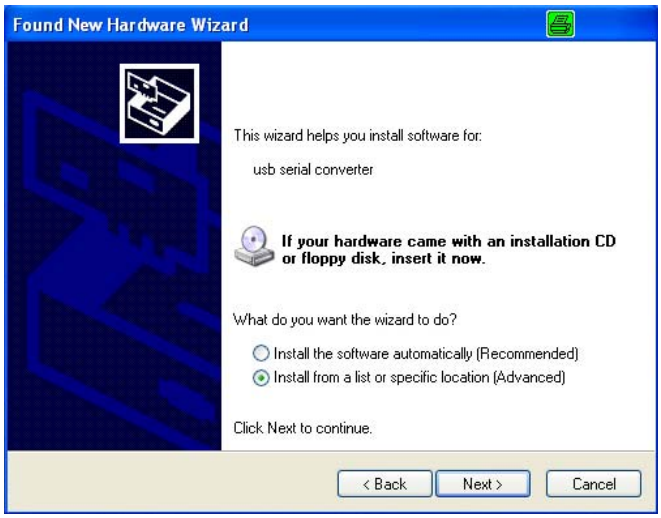
3.1 USB Hub
Connect the USB Hub to an unused USB Port on your PC. The operating system will recognise it automatically.

3.2 USB to Serial converter connection
Connect one USB to Serial converter (via extension cable) with the hub.

3.2.1 Selection
This opens the "Found New Hardware Wizard" window on the PC screen.

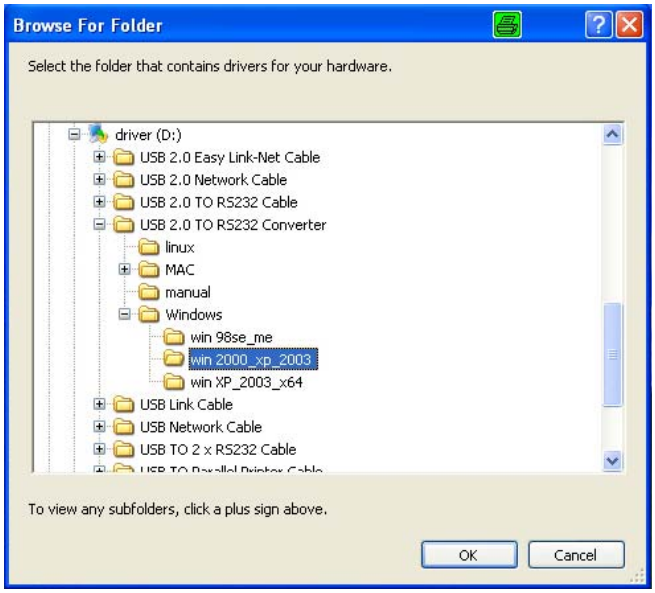
Click "No, not this time" and thereafter "Next" to continue.

3.2.2 Installation CD



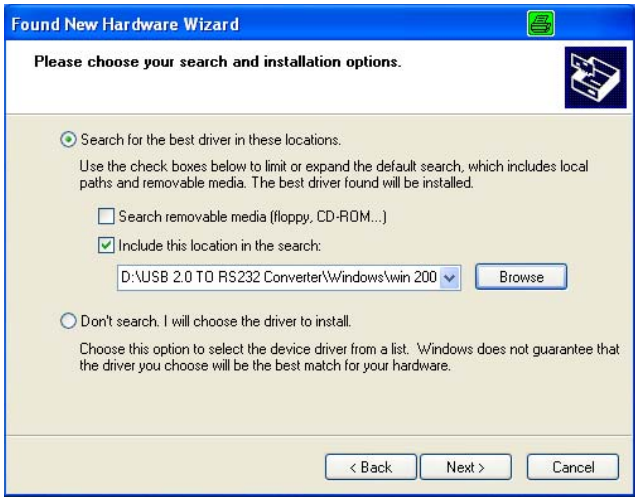
Please follow the instructions and insert the USB driver software CD. Click "Install from a list or specific location (Advanced) and thereafter "Next".

3.2.3 USB Driver selection



After opening "driver (D:)" (depends on the PC), "USB 2.0 TO RS232 Converter" and "Windows", select the folder "win 2000_xp_2003", win XP_2003_x64 or win 98se_me depending on the operating system installed, and click OK.

3.2.4 Search and installation options



Please make the settings as seen from the screen dump and continue with "Next" to start the USB driver installation.

3.2.5 Finishing the installation

After the installation has been successfully completed it is indicated by the following information.

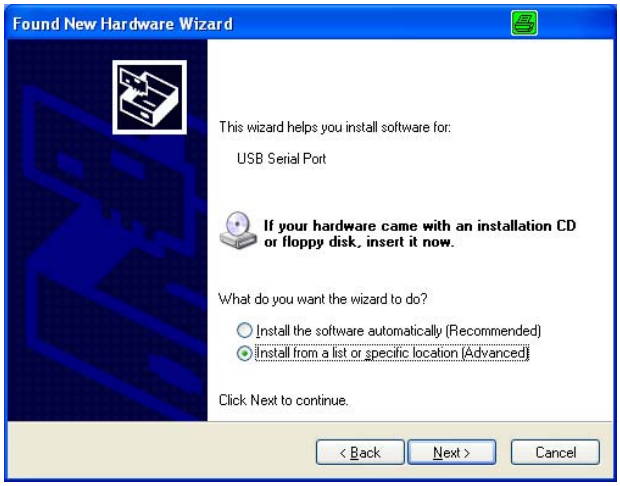
Please follow the instruction and close the Wizard by clicking „Finish". This starts a new installation dialog. Do not remove the USB driver software CD!

3.2.6 Selection

This opens the "Found New Hardware Wizard" window on the PC screen.

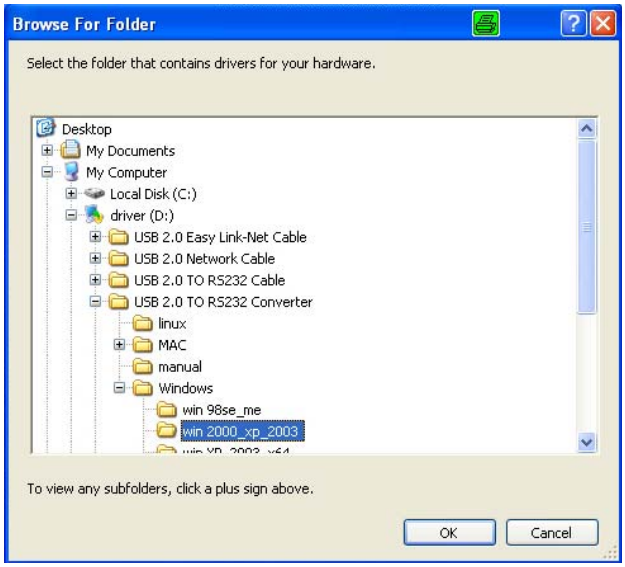
Click "No, not this time" and thereafter "Next" to continue.

3.2.7 Installation CD



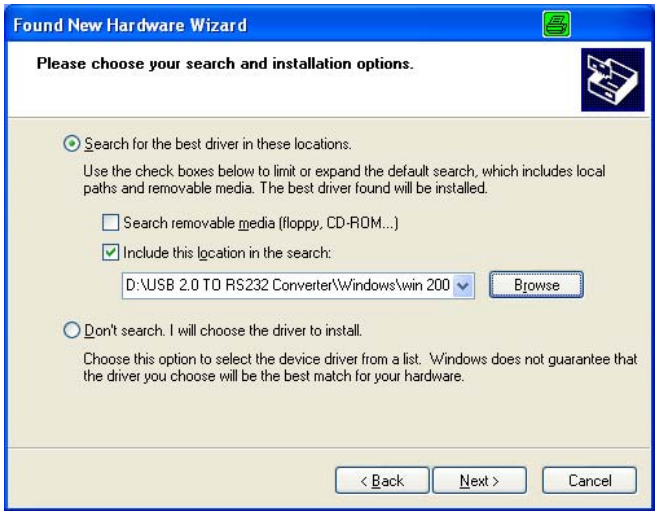
Click "Install from a list or specific location (Advanced) and thereafter "Next".

3.2.8 USB Driver selection



After opening "driver (D:)" (depends on the PC), "USB 2.0 TO RS232 Converter" and "Windows", select the folder "win 2000_xp_2003", win XP_2003_x64 or win 98se_me depending on the operating system installed, and click OK.

3.2.9 Search and installation options



Please make the settings as seen from the screen dump and continue with "Next" to start the USB driver installation.

3.2.10 Finishing the installation

After the installation has been successfully completed it is indicated by the following information.

Please follow the instruction and close the Wizard by clicking „Finish".

3.3 USB to Serial converter connection

Connect the other 2 USB to Serial converters (via extension cables) with the hub.

3.4 USB Serial Port Identification

Proceed as follows to find out the assignment of the USB Serial Ports by clicking:
Start > Control Panel > System > Hardware > Device Manager.
Open "Ports (COM&LPT).

Disconnecting and connecting one by one each USB to Serial Converter, switches the relevant COM Port off and on indicating the assigned number. Please keep the COM Port numbers in mind.

4. PSH Adjustment Software installation

Attention! The installation of the PSH 1.7x Adjustment Software assumes that Microsoft "NET Framework 1.1" is installed on the PC. If this is not the case, it must be downloaded from the Internet and installed.

4.1 Installation procedure

Insert the PSH CD and wait until the following window is displayed.

It is regarding the folder selection where PSH will be installed. If the suggestion "C:\PSH1.7x\" is not be used, click "Durchsuchen" (Browse) and select the folder of your choice.

Select whether all users (Alle Benutzer) of this PC or only the current user (Aktueller Benutzer) may have access to PSH1.7x.

Click "Abbrechen" to cancel, "Zurück" to go one step back or "Weiter" for the next step.

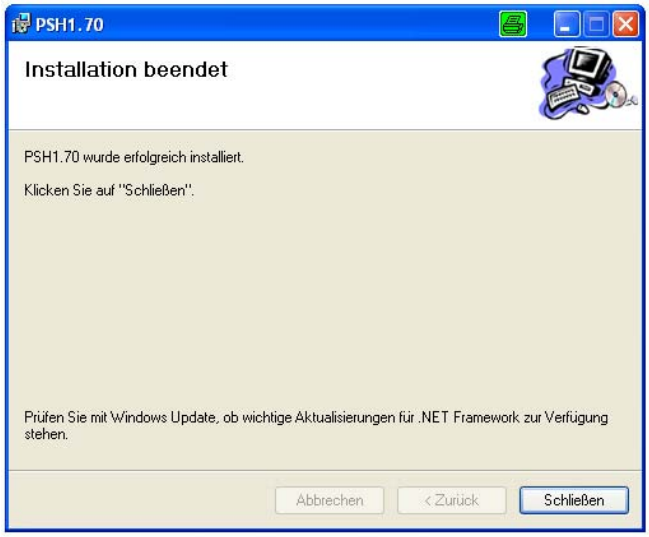
4.2 Installation confirmation

This window asks for confirmation that the installation of PSH1.7x is to be done.

Click "Weiter" (Next) to start the installation, "Abbrechen" to cancel or "Zurück" to go one step back.

4.3 Installation finished

This window informs that the PSH installation has been finished successfully.



An additional remark suggests that you use Windows Update for important NET Framework updates.Click "Schließen" (Close).

5. PSH operation

Click: start > All Programs > PSH1.7x

5.1 Update PSH

Note: This window will only be displayed if the software is started for the first time as no data base path is assigned or if the path/name was changed.

Click "OK"

5.2 Update PSH

Note: This window will only be displayed if the software is started for the first time as no picture folder is available or if the picture folder/name was changed.

Click "OK" Now the PSH screen will be displayed.

5.3 Operating mode selection

Select "service", "testing" and click "enter".

5.4 Password input

For normal adjustment/check operation a password input is not required. It must only be input if special functions such as program configuration changes are required.

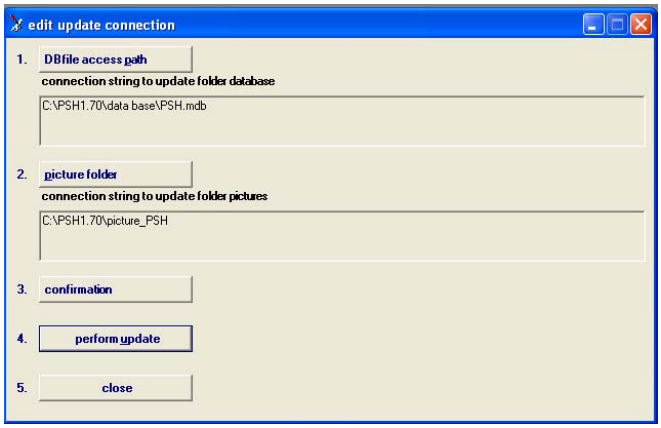
Click: edit > password input

Delete the current input (*******), input your password and click "OK".

5.5 Edit update connection

Note: The opening of this window is only required to remember the name of the path, to change it or to store a new database version downloaded from "HAMEG Service" which will be loaded with the next start of PSH.

Click: adjust > database > update internal db. This opens the "edit update connection" window.



Please proceed as follows:

Item 1. Dbfile access path

Check the name of the path that was automatically input during the installation process. If the name of the path is to be changed, click the "Dbfile access path" button and select a path name that has been input by you before under Windows Explorer.

Item 2. picture folder

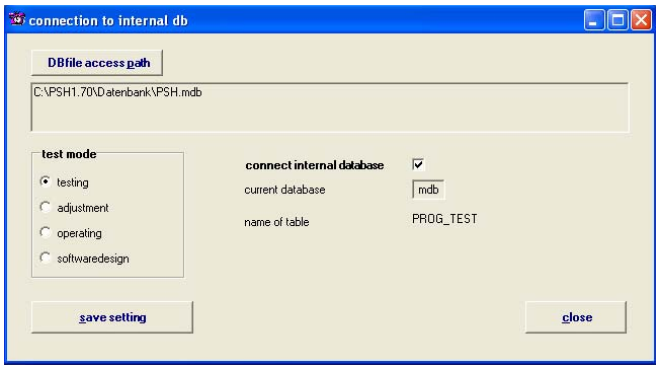
Check the name of the path that was automatically input during the installation process. If the name of the path must be changed, click the "Dbfile access path" button and select a path name that has been input by you before under Windows Explorer.

If items 1 and 2 have been checked, click "confirmation", "perform update" and "close" in this sequence.

5.6 Connection to internal db

Note: The opening of this window is only required to remember or change the name of the path, test mode and database settings.

Click: adjust > database > connect internal db. This opens the "connection to internal db" window.

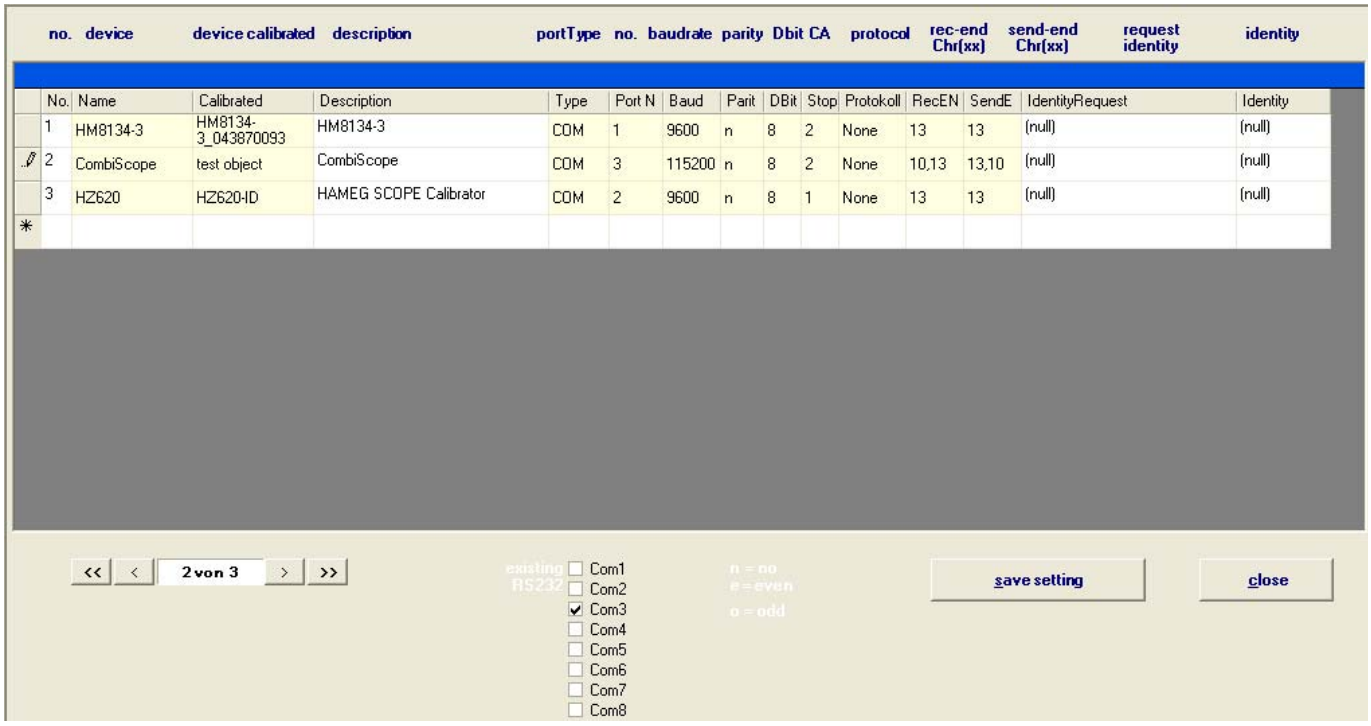


Dbfile access path

Check the name of the path that was automatically input during the installation process. If the name of the path must be changed, click the "Dbfile access path" button and select a path name that has been input by you before under Windows Explorer.

A tick at "connect internal database" describes that the database is present on your local PC. Select the "test mode", "save settings" and "close".

5.7 Device attributes



This window opens a table after "edit" > "device attributes" has been clicked. It enables the input of communications settings and additional information.

The following description refers to the table delivery status.

5.7.1 Column 1:
An arrow pointing to the right can be set to mark the complete line (e.g. to delete).

5.7.2 Column 2 ("No."):
Displays the automatically generated line number.

Note: Please do not change the actual allocation between line number and instrument as the program structure is fixed. No. 1 must be HM813x, No. 2 is for the device under test (Combiscope e.g. HM1500-2) and No. 3 must be HZ620.

5.7.3 Column 3 ("Name"):

5.7.3.1 Standard condition: Already existing device.
Select a device from the "device" list.

5.7.3.2 Special case: New device.
If a new device is to be tested/adjusted, input the device name (type). Thereafter the calibration data of this device must be input in its allocated calibration database (edit > calibrated value > device definition) respectively must be loaded into a calibration value database via "device definition".

5.7.4 Column 4 ("Calibrated"):
Can be used to input additional information such as calibration data or instrument number etc.

5.7.4.1 Edit device attributes (available in the database)
For maximum performance the generators calibration data must be used during the adjustment/check procedures. This means that if e.g. a generator is replaced by another one, the calibration data of the replacement must be taken into account by the programm.

Therefore click "edit" > "device attributes" and the instrument regarding information in column 4 (Calibrated) of e.g. HM8134-3_043870093. This opens a window in which all instruments, for which calibration data are available, are listed with their serial number or other identification attributes. Click the instrument to be used now.

5.7.4.2 Special case: Add attributes of new devices to the database. To add a new device to the database click "edit" > "calibrated values" > "device definition" to open the window "define calibrated devices". Now the tables "device name" and "device selection" are shown together with the "import preview", "end preview" and "import data" buttons.

If a new calibration of a generator has been made, it is necessary to input the new calibration data into the database.

If the calibration has been made in the HAMEG calibration lab, a text file with the calibration data will be delivered by HAMEG. These data can automatically be input in the database as described under item 5.7.4.3 and 5.7.4.4

If only a calibration protocol is available, the calibration data must be input manually as described under item 5.7.4.5 ff

5.7.4.3 "import preview", "end preview"
"import preview" opens an operating system window where a txt file can be determined and opened. It shows in all columns what could be input. To reset the columns click "end preview".

5.7.4.4 "import data"
Click "import data" to import the data automatically.

5.7.4.5 "device name"
Click the "1. select-input" button located below "device name". This activates the "Name" table, so that an already existing instrument name can be called and additionally adds a new line where the name of a new instrument can be input.
If an already existing name has been clicked, a third table with two columns opens ("nominal value" and "actual value").

5.7.4.6 "device selection"
The information in this table depends on the instrument name selected under item 5.7.4.5 "device name". It shows the instrument name and attribute(s).
Click the "2. select-input" button located under "device selection". This opens a new line in the table and enables to click at one instrument with its attribute (e.g. serial number).
The latter causes the display of the instrument specific calibration data in the "actual value" column of table 3.

5.7.4.7 "nominal value" and "actual value"
The nominal value column shows all instrument settings (frequency, level etc.) that must be present at the device under test input for adjustment/check.
The actual value column shows calibration data of the selected instrument (frequency, level etc.) of those settings used for adjustment/check. If the actual value deviates from the nominal value, the program takes it into account.
Click the "3. select-input" button in this sector to activate both columns and to introduce a new line where new settings can be input. It is also possible to edit in both columns.
"Save data" and "close" returns to the PSH desktop.

Note: The instrument number (SNR) is the reference for the instrument check (> 5.7.15 Column 15 "Identity Request").

5.7.5 Column 5 ("Description"):
Here further information can be input.

5.7.6 Column 6 ("Type"):
Here you can select between COM and USB Port.

Select COM for each instrument, as this is the standard which is in all instruments.

Note: The current PSH software version only supports COM Ports.

5.7.7 Column 7 ("Port N):
Here the port numbers can be set.

5.7.7.1 Connections via PC COM Ports.
Check COM Port number and the instrument name that is connected and to input it.

5.7.7.2 PC USB via Hub and USB/RS-232 Converter.
Input the port number as identified under item "3.4 USB Serial Port Identification". If this information is lost, proceed as described under the following item (5.7.7.2.2).

5.7.7.3 Identify and input the port number.
Disconnect all USB/RS-232 Converters from the hub, close the window "Device attributes" and open the window "Device attributes" again. Now you can see the COM settings state without USB/RS-232 Converters. It is shown below the table (Com1 .... Com8). Keep this information in mind.

Close the window "Device attributes" and connect the USB/RS-232 Converter connected with the test object (Combiscope). Open the window "Device attributes" again If e.g. Com3 now has a tick, input "3" in line 2 column 7.

Close the window "Device attributes" and connect the (second) USB/RS-232 Converter connected with the HZ620 (Test Generator). Open the window "Device attributes" again. If e.g. Com4 now has a tick, input "4" in line 3 column 7.

Close the window "Device attributes" and connect the (third) USB/RS-232 Converter connected with the HM8134-3 (Programmable Synthesizer). Open the window "Device attributes"heise.de/newsticker/ again. If e.g. Com5 now has a tick, input "5" in line 3 column 7.

5.7.8 Column 8 ("Baud"),

5.7.9 Column 9 ("Parity") and

5.7.10 Column 10 ("DBit"):

In these columns, RS-232 related settings for each device can be made. Please use the default settings:

HM8134-3 = 9600 baud, no parity, 8 data bit
Combiscope = 115200 baud, no parity, 8 data bit
HZ620 = 9600 baud, no parity, 8 data bit

Further information regarding the instruments COM Port settings can be found in the instrument manuals.

To select RS-232 default settings on the Combiscope press the "SETTINGS" pushbutton > Interface > RS232 > Parameter > Defaults.

5.7.11 Column 11 ("Stop"):

Note: The Combiscope must be set to RS232 (press "SETTINGS" pushbutton > Interface > RS232 > Parameter > Defaults).

The default setting of HM8134-3/HM8135 and HZ620 is 1 stop bit which must be input. Select "2" stop bits for the Combiscope as this is the default setting.

Further information regarding the instruments COM Port settings can be found in the instrument manual.

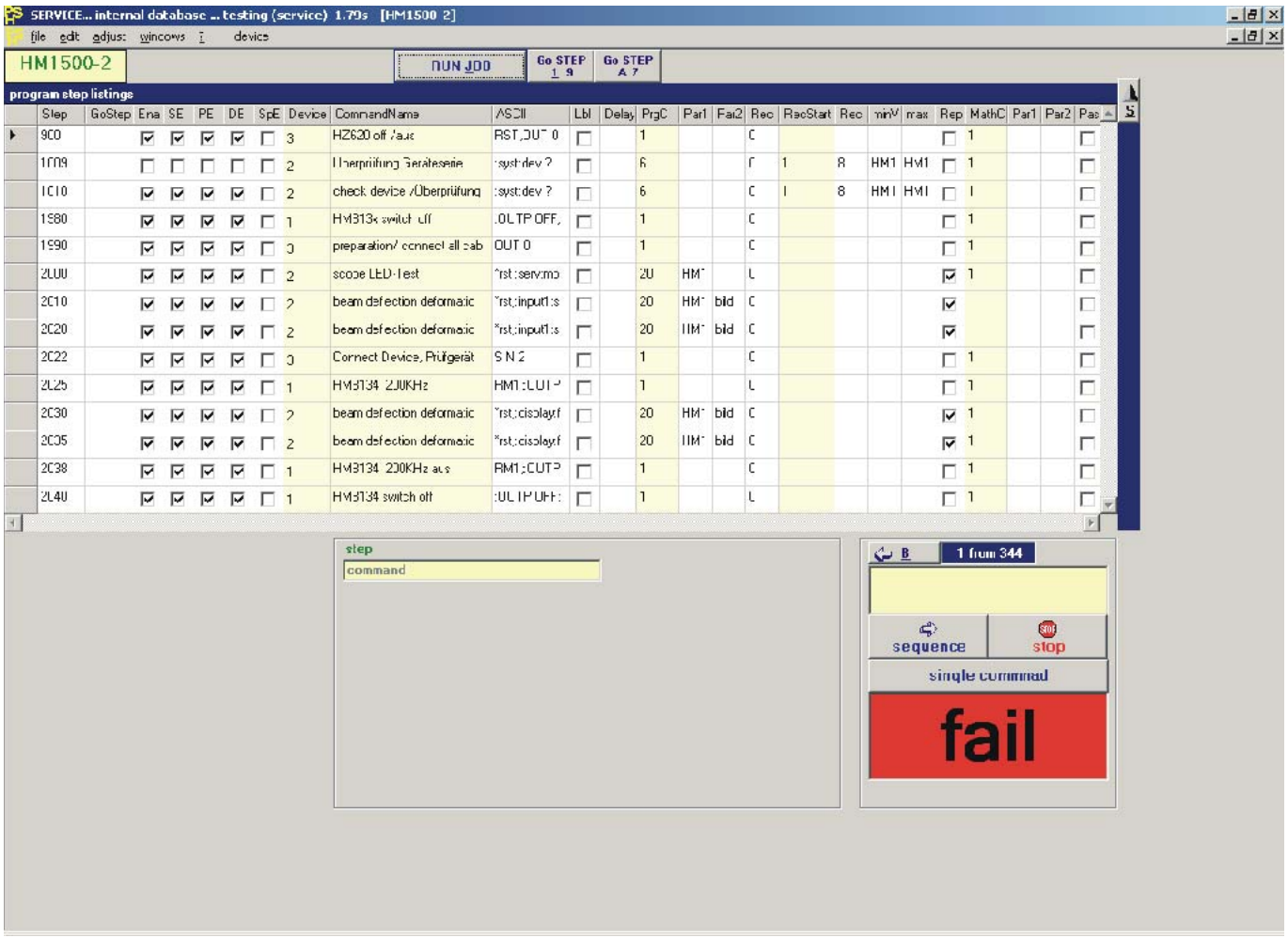
5.7.12 Column 12 ("Protocol"):
As the default setting for all three instruments is "None", please select the protocol setting "None".

Further information regarding the instruments COM Port settings can be found in the instrument manual.

5.7.13 RecEN
The current settings in this column must always be present.

5.7.14 SendEnd
The current settings in this column must always be present.

5.7.15 IdentityRequest (e.g. SNR? = Serial Number Request)
In PSH operation a query is started after clicking the "RUN JOB" or the "sequence" button. This query checks



the presence of the generators (e.g. HM813x and HZ620) and their serial numbers (to avoid the use of uncalibrated instruments with a serial number deviating from the input in column 4). If the serial number query agrees and the information in column 4 (Calibrated) coincides, the "RUN JOB" or "sequence" command will be executed. As the device under test (Combiscope) will not be queried, the input in the regarding sector will not be changed.

Note: This check will not be made at "single command" operation.

5.7.16 Identity
In this sector a check number (e.g. serial number from column 4) is automatically input, which is regarding the generators (e.g. HM813x and HZ620) and not the device under test.

5.7.17 Finishing "device attributes" input.
After you have checked or changed entries, click "save setting" and "close" to return to the PSH desktop.

5.8 Operation

Attention! The following description assumes that all devices are switched on and connected right with the PC.

5.8.1 Device selection
Click "device" to open a selection box and click the instrument type to open the "program step listings" table. It shows the program steps (step number), control buttons for program control and information about the actual step number (instrument settings, test function), result (command, fail, pass). Refer to Figure above

5.8.2 Type display
In the top left position the device type selected before (item 5.8.1) is shown.

5.8.3 "step new" (not available in the service version)
This is an editing function, generating a new step (command line) in the "program step listing" table. It will positioned one line above the currently chosen line which is indicated by an arrow. If e.g. "Step 2030" is active and the line above is "Step 2025", clicking "step new" generates a new line (e.g. the previously not existing line "Step 2028").
To delete a line, click the first column of the line to be deleted. This sets the arrow and marks the complete line blue. Then press the delete button on the PC keyboard.

5.8.4 "save data" (not available in the service version)
After changes in the table, this function saves the actual table.

5.8.5 "RUN JOB"
Clicking this button starts a complete adjustment/testing procedure from the first (Step 1014 at HM1500-2) to the last line (Step 36010 at HM1500-2) in the table, where all commands for the device under test and the signal generators are shown.
The program stops whenever a check and/or adjustment must be made. Then a window with the step number and a message window with instructions and in some cases a photo will be shown. After the adjustment or check has been made successfully, continue the program.

5.8.6 "Message" window control functions.
The "STOP" button in the message window stops the program execution sequence e.g. for repair work. The ESC key on the keyboard has the same function. If after repair work the program is to be continued, set the arrow e.g. 10 steps back (to check if the problem has been solved) and start the program by clicking "sequence".
"NEXT" continues the program. The ENTER and SPACE key on the keyboard have the same function.
If a step in the program sequence is to be repeated, click the button between NEXT and STOP. The keyboard keys "W" and "G" have the same effect.
If text and a photo are displayed, pressing the keyboard key "Z" toggles between a zoomed and normal photo display. With the keys "P" or "B" choose whether the photo or text is shown in the foreground.

5.8.7 "step label"
Opens a selection box with PSH adjustments/checks. After selecting an item (e.g. Y GAIN check CH1) the arrow is automatically set to the line where an adjustment/check must be started after changes have been made (repair or adjustment) regarding this item. Then "sequence" must be clicked to continue the adjustment/check from this item until the end of the program is reached. That makes sure that other adjustments - based on the repair or adjustment – are checked and if required corrected.

5.8.8 "DB repair" (not available in the service version)
Please follow the instruction in the window which opens.

5.8.9 "< B" (back) and "> F" (forward) buttons.
These buttons enable to select a program line.

5.8.10 "sequence"
If program parts at the beginning shall not be executed, click in the first column to determine the step number where the program is started, or use the function described under item 5.8.8. Thereafter click "sequence" to start the program at the determined line.

5.8.11 "stop" button in the "program step listings" window.
Finishes the program execution if being clicked long. This function is for interruption of automatic adjustments when due to an error an endless loop is present.

5.8.12 "single command"
Executes the activated program step.

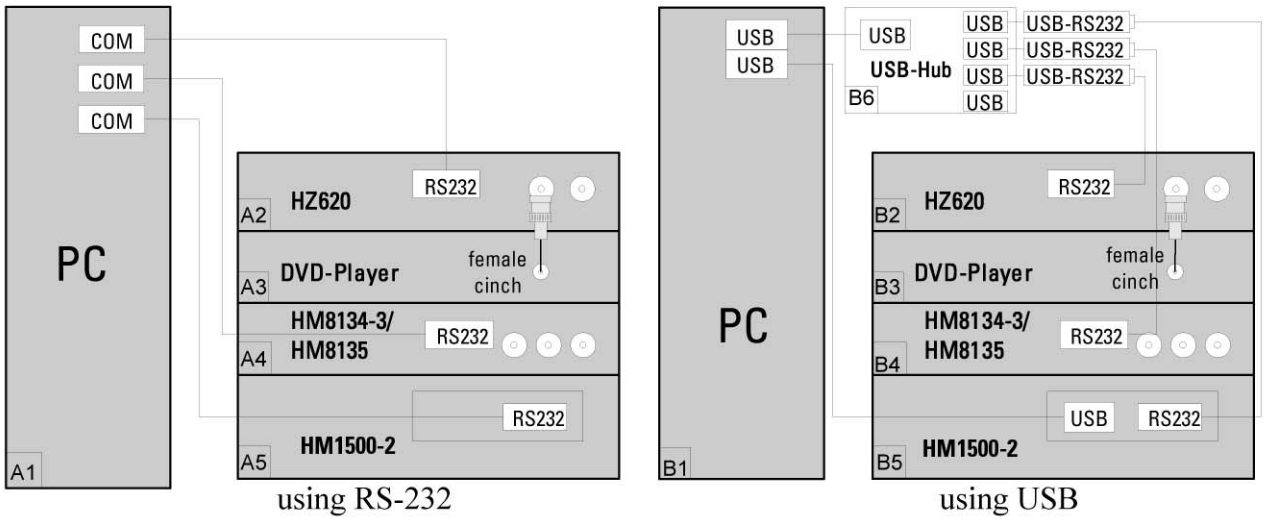
5.8.13 Fail/Pass window.
Shows the adjustment/check result.

5.8.14 "delay in ms"
Shows the execution time setting for each program line (default 300 ms). If a PC with less performance is used, it might be to mark the setting by aid of the mouse and to input a higher delay time value.

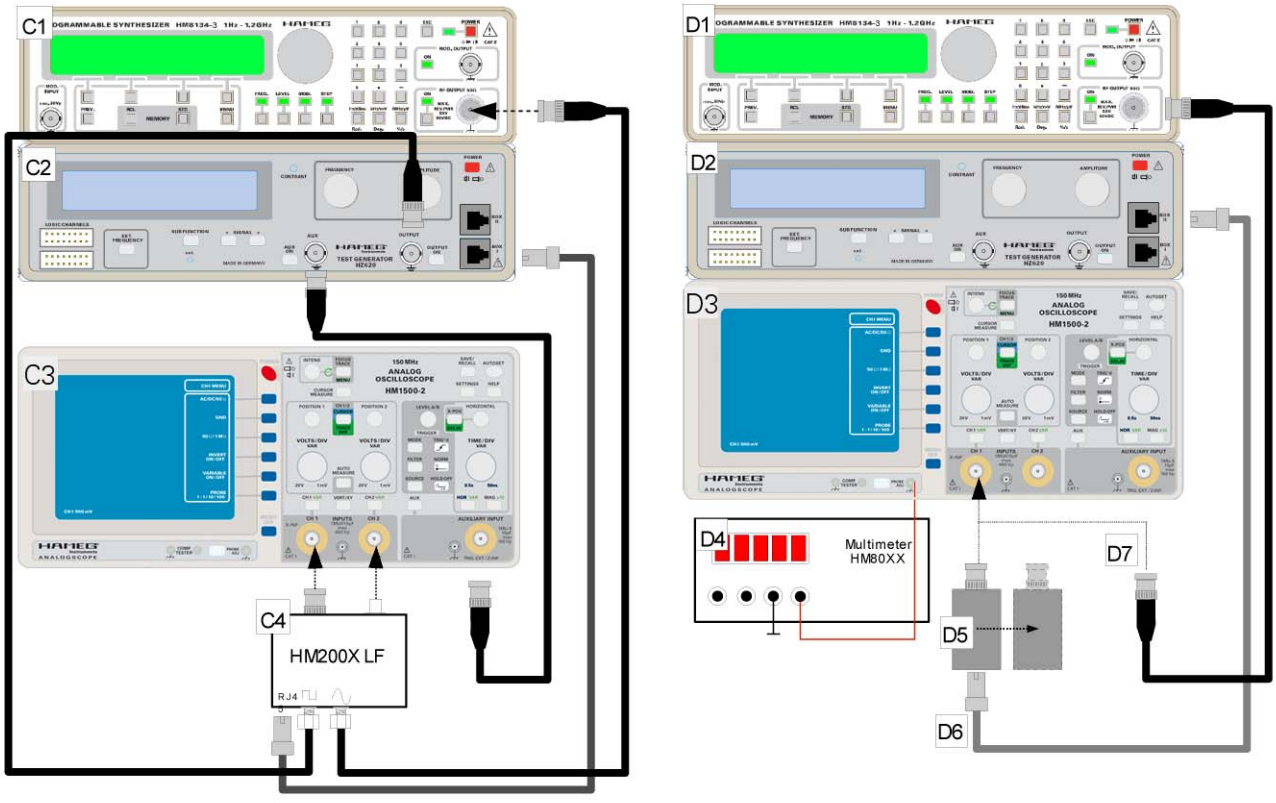
Test set up

HAMEG Instruments	**Installation the Test & Calibration equipment for HM1500-2 scopes**	To: Service	From: Development Date:18.12.07

rear connections between PC and Test & Calibration equipment



front connections between scope and Test & Calibration equipment



adjust/test LF, Y-Gain, Trigger

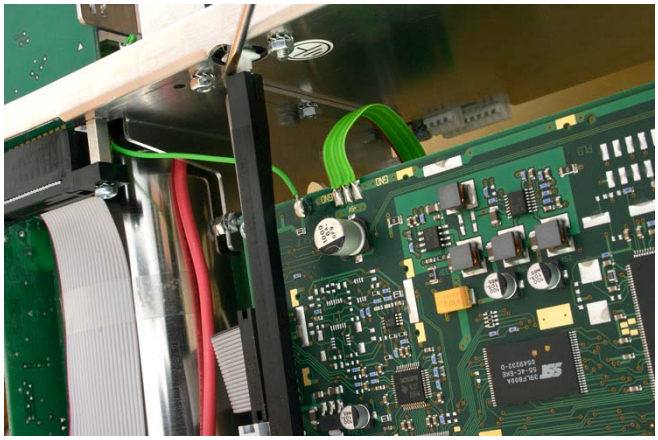
adjust/test BW, HF, PROBE-Voltage

HM1500-2 Board Replacement

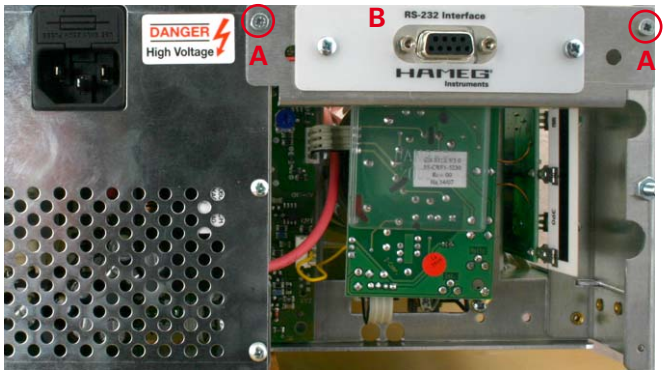
Preliminary note!
Although all PCBs have been tested by HAMEG, adjustment is required after replacement, due to unavoidable tolerances.

PS Board

1 Before removing the PS board, check that the power cable is not connected to the oscilloscope.

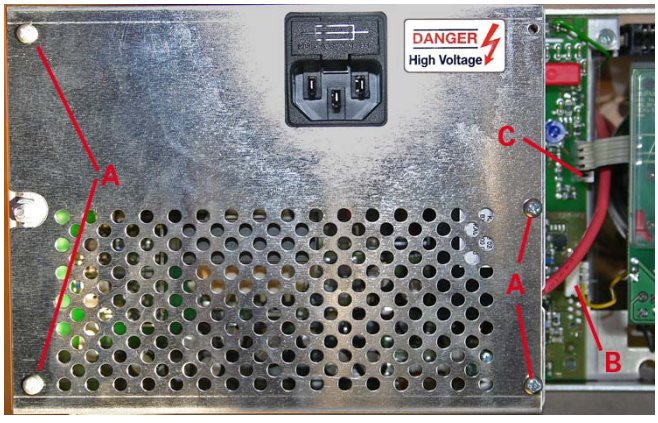


2 Remove the power rod from the power switch.



3 Locate and identify the interface at the rear.

4 Remove the 2 screws marked "A" and pull out the interface "B" together with the mounting.

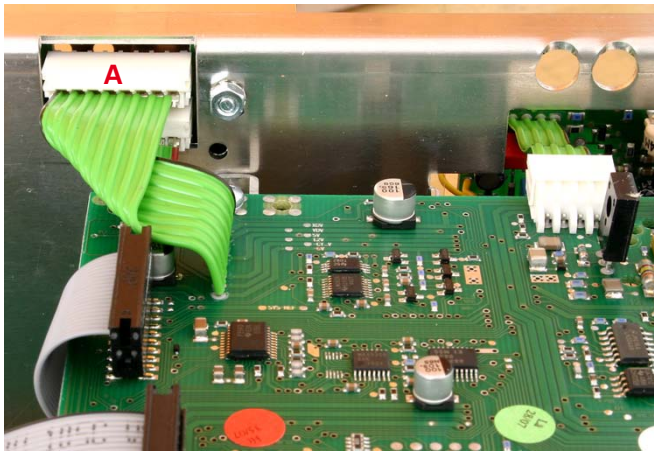


5 Locate and identify the PS board.

6 Remove the 4 screws marked "A" and remove the protection (screening) shield.

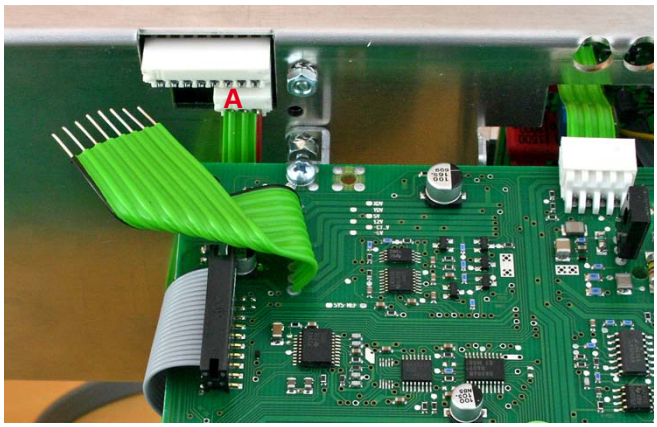
7 Press connector "B", note precisely where the wire is connected, then pull it out.

8 Pull connector "C" out.



9 Locate and identify a ribbon cable from connecting the MB board with a PS board connector at the rear chassis.

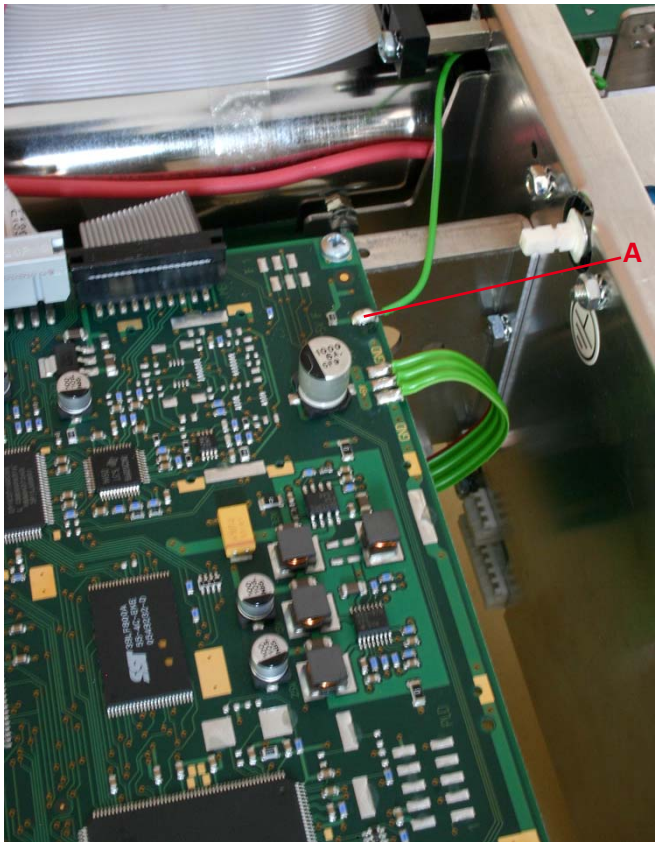
10 Press connector "A" and pull the ribbon cable (out).



11 Locate and identify a ribbon cable from connecting the MC board with a PS board connector at the rear chassis.

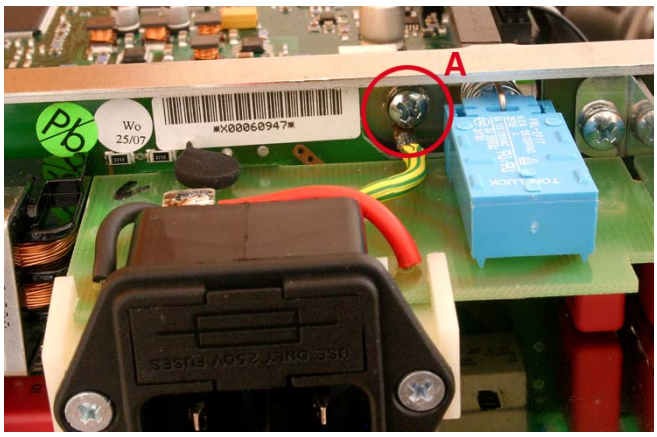
12 Press connector "A" and remove the ribbon cable..

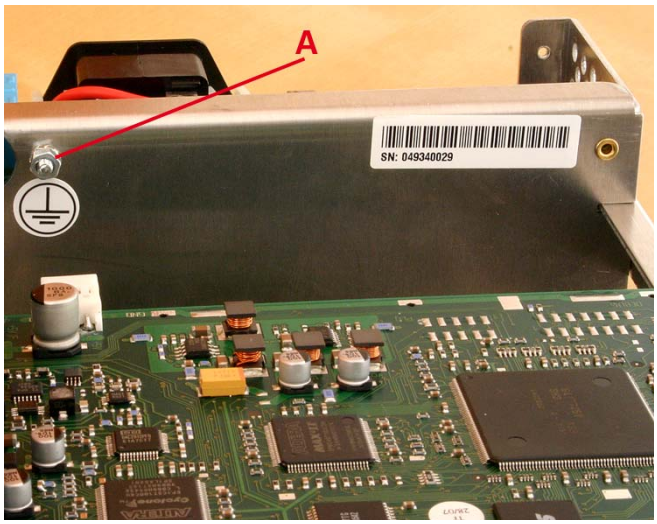
13 Remove the 3 nuts marked "A".



14 Locate and identify the MC board.

15 Unsolder the wire "A" at +5V IF pad.



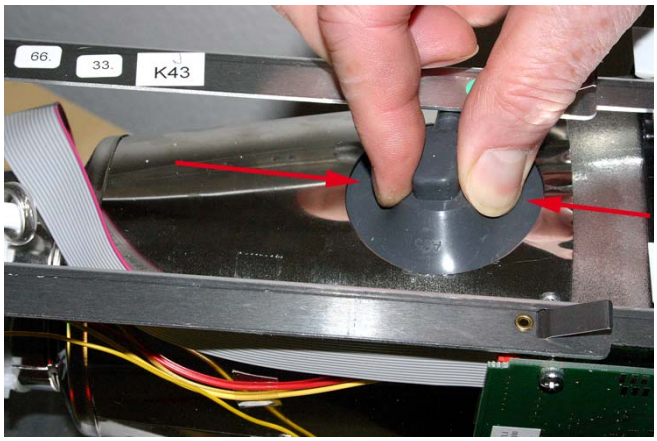


16 Locate and identify the PS board.

17 Remove screw and nut marked "A".

Attention!
This screw connects the protective ground line with the chassis.

After insertion of the new PS board, firstly this screw must be used to connect the protective ground line with the chassis. A secure connection must be made which can only broken by using a tool!



18 Locate and identify the CRT high voltage connector at the CRT cone.

19 Remove the high voltage clip by pressing the clamp under the plastic isolation.

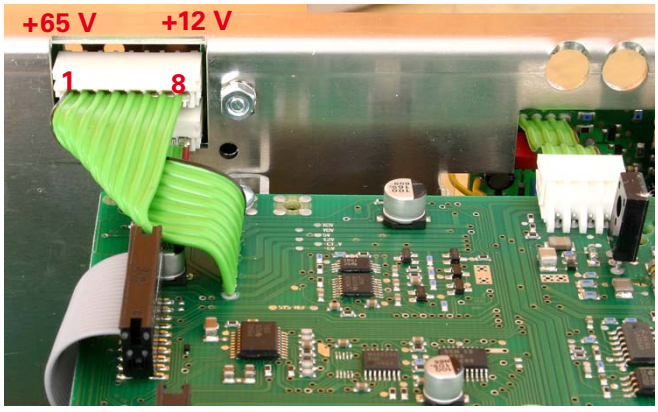
Attention!
Please note, that the crt internal capacitance may still be charged although the instrument has been switched off for a long time. During the following procedure the crt anode contact and the clamp of the high voltage clip must not be touched!

Attention!
Discharge the high voltage cable by connecting the clamp of the high voltage clip to the chassis to discharge the cable and the voltage multiplier capacitances!
Discharge the crt anode connector to chassis via a 100 Ω resistor for a some time.

20 Replace the PS board and check that the isolation plate between the PS board soldering side and the rear chassis is still present. Then follow the previous instructions in reverse order, but do not fit the protection (screening) shield.

21 Measure the resistance between the power socket centre connector marked "PE" and the rear chassis using an Ω meter. If the resistance is less than 1 Ω continue the fitting procedure. Otherwise check the protective earth circuit, and repair it until the requirement of less than 1 Ω between power socket PE and rear chassis is met.

22 Connect power cable to the oscilloscope and switch it on.

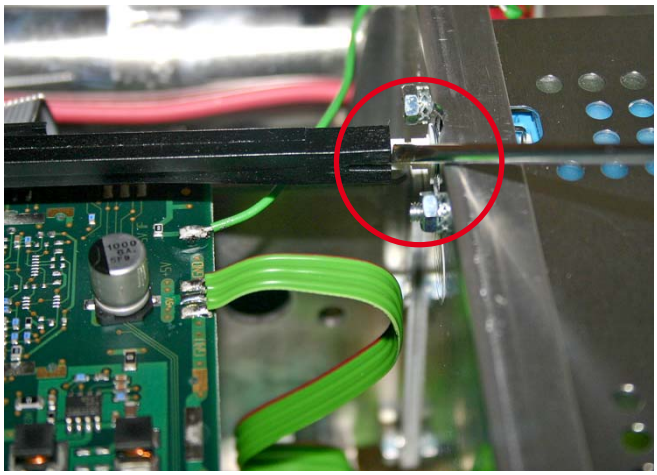


23 Follow the Adjustment Procedure HM1500-2 in the following order (item):
1) RV1001: Adjustment of +65 Volt supply
2) RV1003: Adjustment of +12 Volt supply

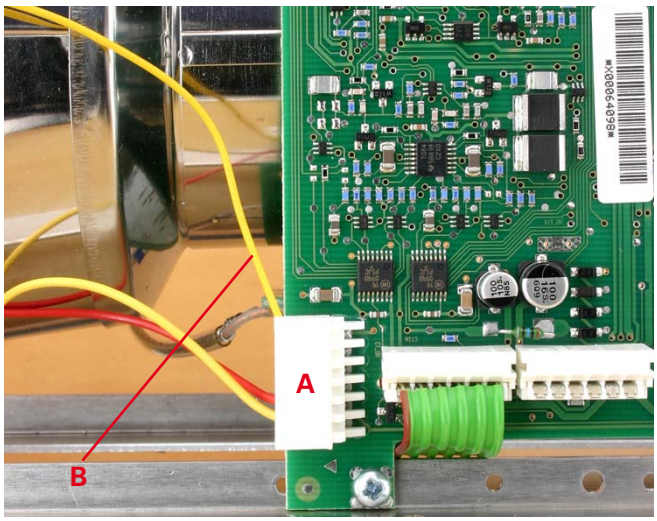
23 Due to the influence of the supply voltages on all circuitry, it is recommended to make a complete Performance Check as described in this Service Manual.

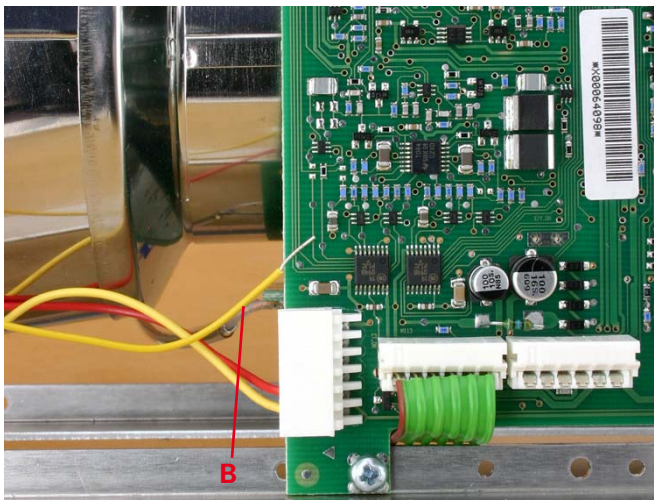
TE Board

1 Before removing the TE board, check that the power cable is not connected to the oscilloscope.



2 Remove the power rod from the power switch and pull off the red power pushbutton.

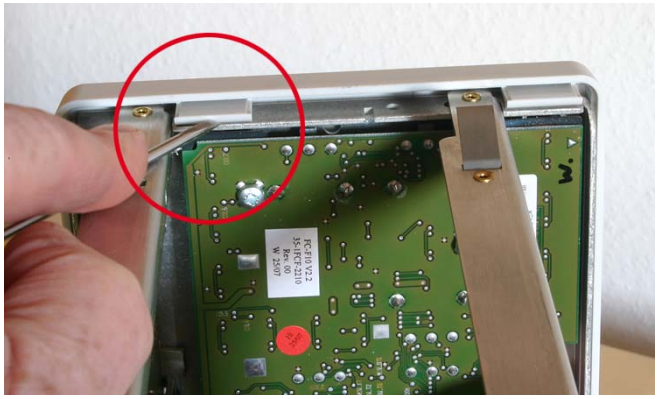


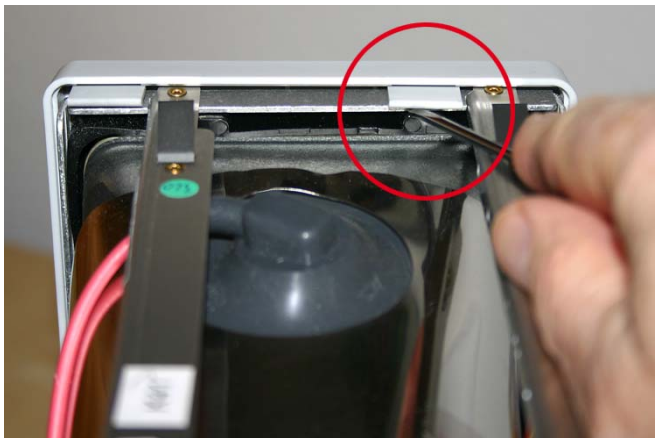


3 Locate and identify the MB board.

4 Press connector "A", note precisely where the yellow wire "B" (leading to the front panel) is connected and pull it out.

5 Remove all knobs.



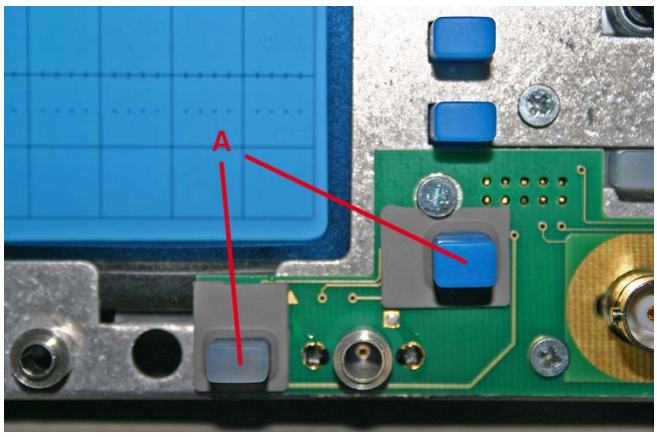


6 Locate and identify the front panel mounting points.

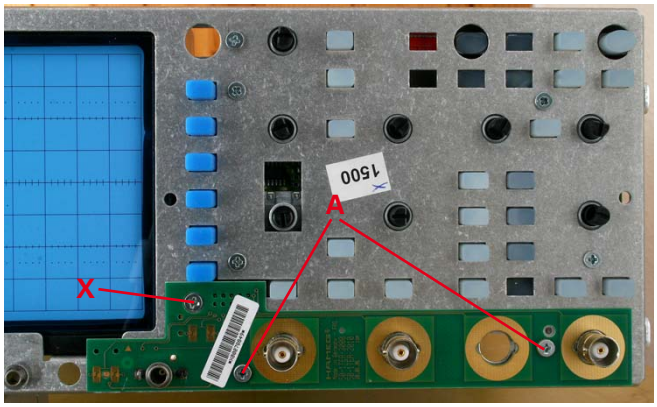
7 Release the front panel mounting points on one side, using a screwdriver as a lever.

8 Turn the oscilloscope and release the front panel mounting points on the other side.

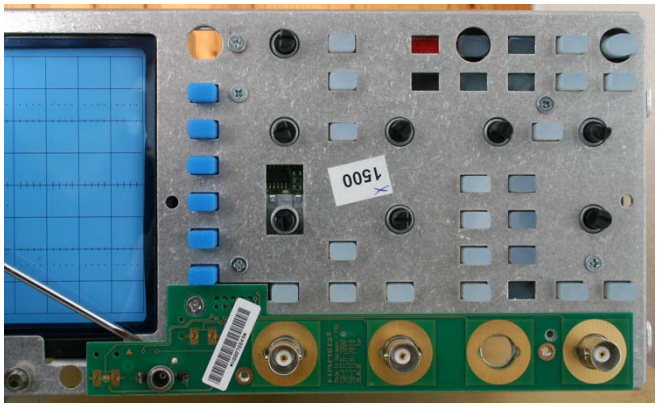
9 Carefully pull off the front panel.



10 Remove both buttons marked "A" from the TE board.



11 Remove both screws marked "A", but do not undo the screw marked "X".



12 Slide the blade of a small screwdriver on the rear of the TE board and lever the TE board away from the front chassis. Support this action by additionally moving the right side of the TE board in the same direction until the TE board is removed.

13 Replace the TE board and follow the previous instructions in reverse order.

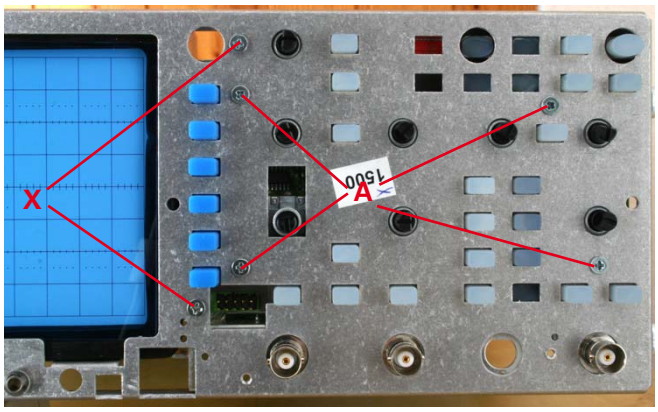
14 Connect power cable to the oscilloscope and switch it on.

15 Check the TE board functions (probe output and probe identification contact).

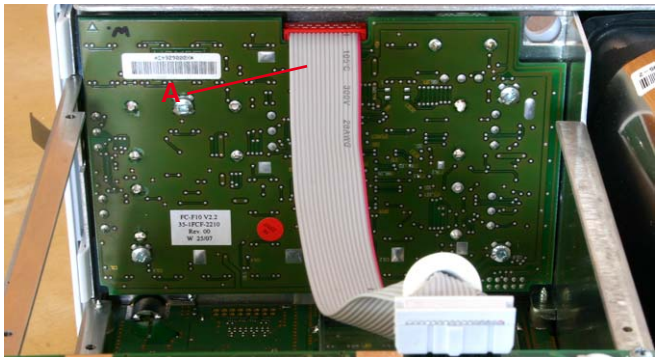
FC Board

The FC board can be replaced only, after the front panel and the TE board has been removed.

Please follow the instruction of paragraph **TE Board** from item 1 to 12. After item 12 has been finished continue with item 1 in this paragraph.



1 Remove the 4 screws marked "A", but do not undo the screws marked "X".



2 Move the FC board (together with the pushbutton rubber pad) to the rear and pull off the connector marked "A". Thereafter remove the FC board by lifting it.

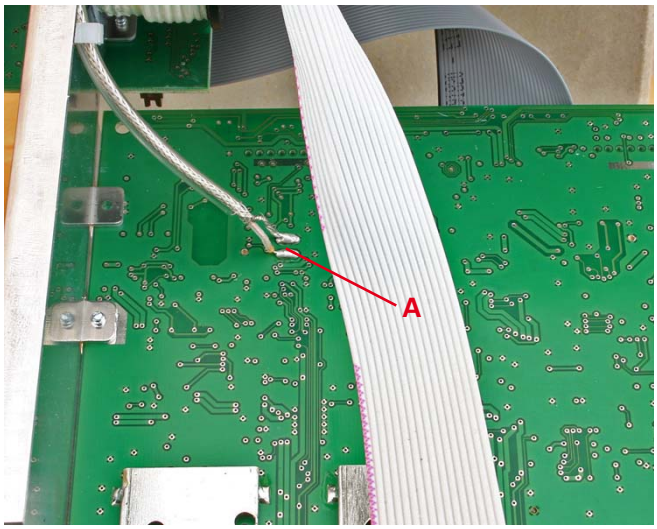
3 Replace the FC board and follow the previous instructions in reverse order.

4 Connect power cable to the oscilloscope and switch it on.

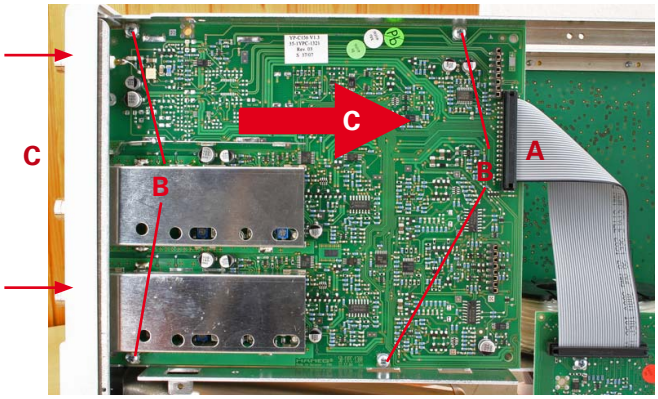
5 Check the FC board functions (pushbuttons and rotary encoders).

YP Board

1 Before removing the YP board, check that the power cable is not connected to the oscilloscope.



2 Unsolder the Y Delay Line connections marked "A".



3 Pull out the connector marked "A".

4 Remove the 4 screws marked "B".

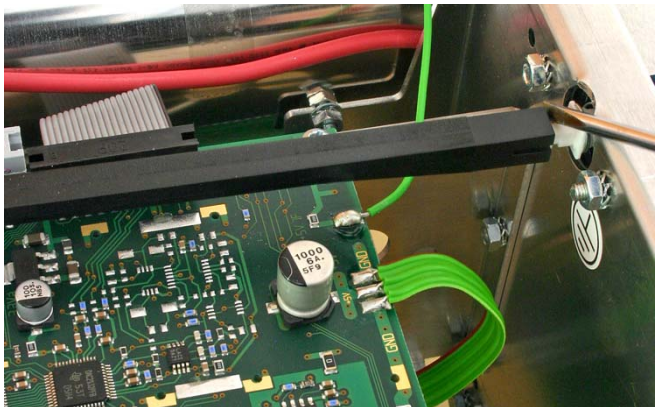
5 Carefully press the BNC sockets marked "C" and/or pull the YP board in direction "C".

6 Replace the YP board and follow the previous instructions in reverse order.

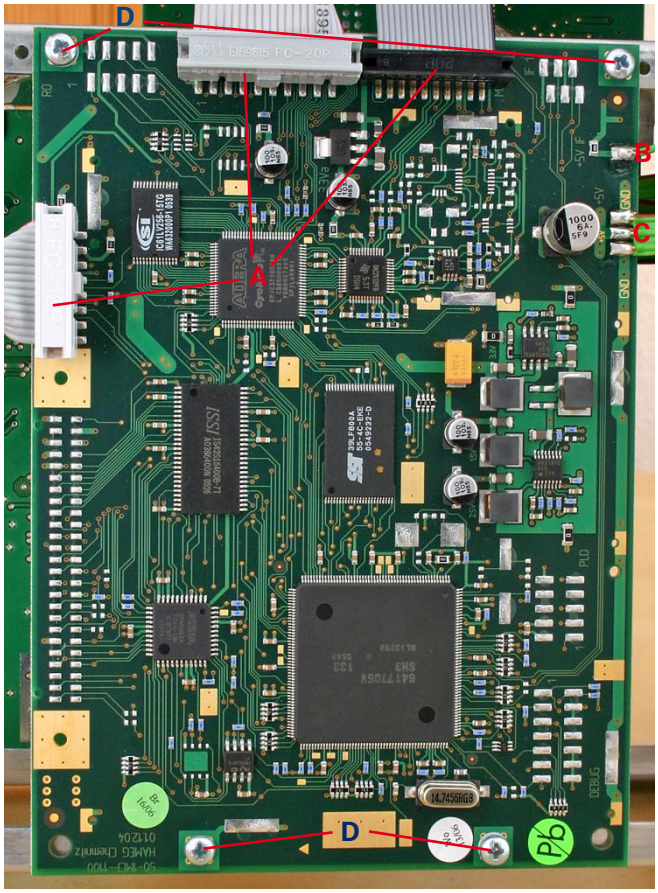
7 Make a complete adjustment as described in this Service Manual.

MC Board

1 Before removing the MC board, check that the power cable is not connected to the oscilloscope.



2 Remove the power rod from the power switch and pull off the red power pushbutton.



3 Pull out the 3 connectors marked "A".

4 Unsolder the wire marked "B" from the soldering point marked "+5V IF".

5 Unsolder the 3 wires of the ribbon cable marked "C" from the soldering point marked "+5V IF".

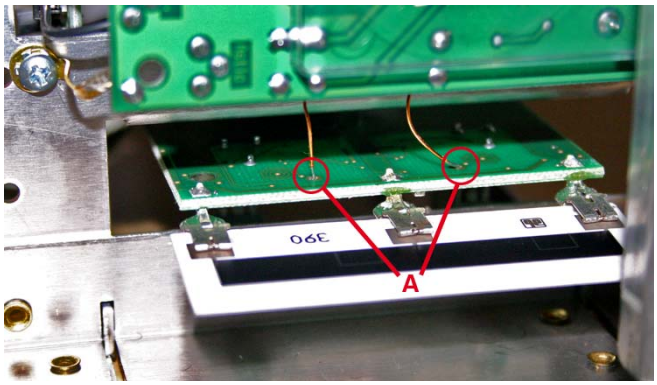
6 Remove the 4 screws marked "D".

7 Replace the MC board and follow the previous instructions in reverse order.

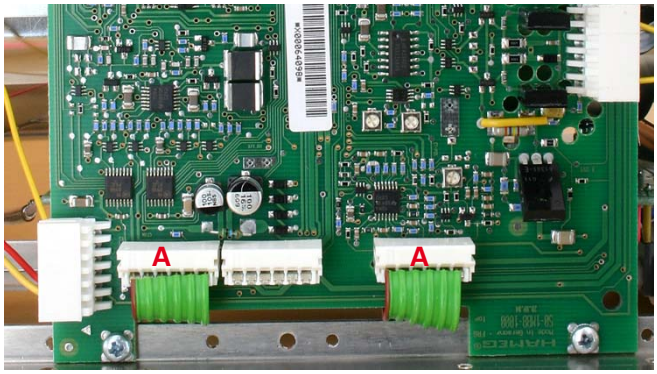
8 Make a complete Performance Check as described in this Service Manual.

YF Board

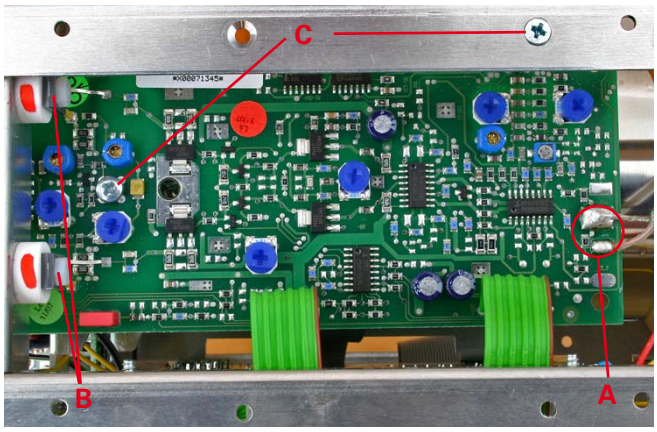
1 Before removing the YF board, check that the power cable is not connected to the oscilloscope.



2 Unsolder the wires marked "A" leading to the crt Y plates.



3 Press the 2 connectors marked "A" on MB board and remove the ribbon cables.



4 Unsolder the Y Delay Line connections marked "A".

5 Unscrew the Y final stage transistor mounting screws (nylon) marked "B", while holding the nuts on the rear side.

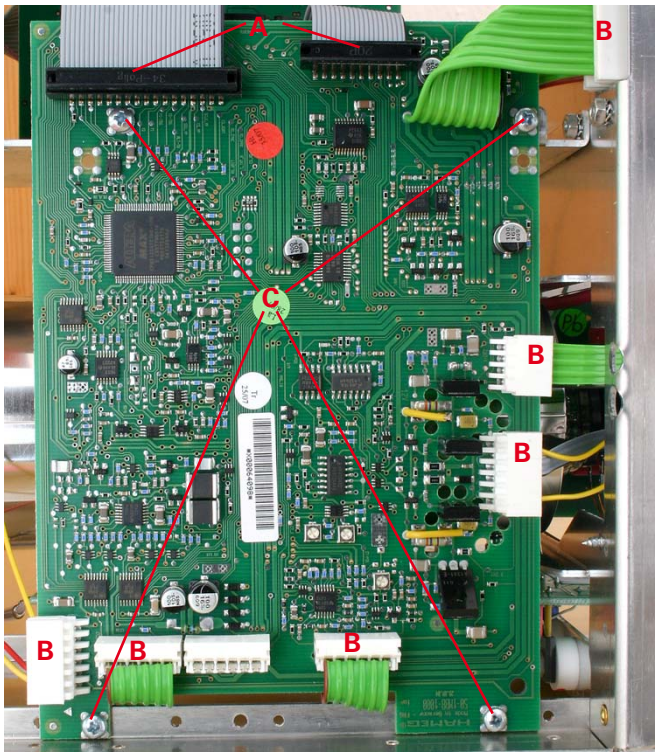
6 Remove the 2 screws marked "C".

7 Replace the YF board and follow the previous instructions in reverse order.

8 Make a complete adjustment as described in this Service Manual.

MB Board

1 Before removing the MB board, check that the power cable is not connected to the oscilloscope.



2 Locate and identify the 2 connectors marked "A" on MB board and pull them out.

3 Press the 6 connectors marked "B" and pull the ribbon cables and wires out.

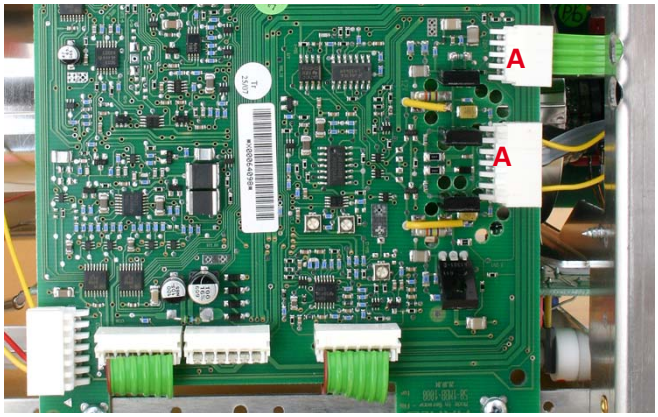
4 Remove the 4 screws marked "C".

5 Replace the MB board and follow the previous instructions in reverse order.

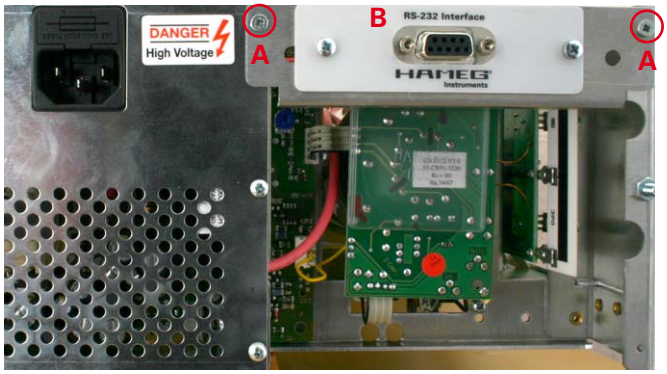
6 Make a complete adjustment as described in this Service Manual.

CR Board

1 Before removing the CR board, check that the power cable is not connected to the oscilloscope.

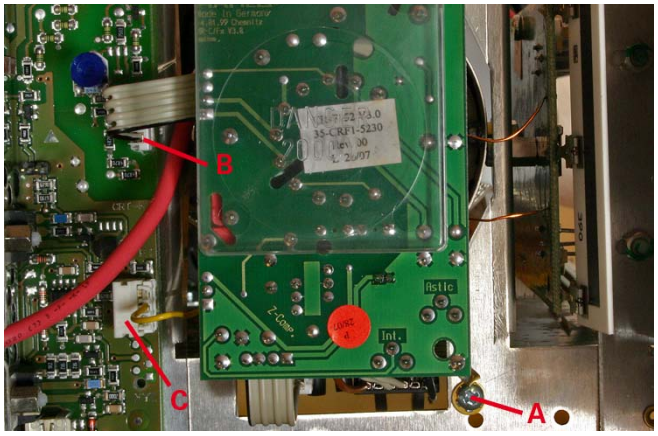


2 Locate and identify the 2 connectors marked "A" on MB board and pull them out.



3 Locate and identify the interface at the rear.

4 Remove the 2 screws marked "A" and pull out the interface "B" together with the mounting.



5 Remove the screw marked "A".

6 Pull connector "B" out.

7 Press connector "C", note precisely where the wire is connected and pull it out.

8 Replace the CR board and follow the previous instructions in reverse order.

9 Follow the Adjustment Procedure HM1500-2 in the following order (item):
- 4) R6013: CRT minimum intensity
- 5) R6024: Astigmatism correction
- 26) R9114: YF Gain (Software Supported Adjustment)
- 27) YP CH 1 Gain (Software Supported Adjustment)
- 28) YP CH 2 Gain (Software Supported Adjustment)

10 Make a complete Performance Check as described in this Service Manual.

MANUAL ADJUSTMENT PROCEDURE HM1500-2

Content

WARNING

The Instrument must be disconnected from the mains power supply whenever you open the case, repair or exchange parts.

HIGH VOLTAGE WARNING!

Hazardous High Voltage of up to 12,000 Volts is present inside this Instrument. The areas particularly affected by High Voltage are the high voltage circuit on the PS-board, the CRT anode contact and the CR-board.

SERVICE AND ADJUSTMENT

- of this instrument should only be performed in accordance and in conjunction with the operating manual and the WARNINGS contained therein.
- should only be performed by suitably qualified and experienced service personnel.

Test Instruments required:

1) Hameg Test Generator HZ620, HF and HM200 LF Box.
2) Constant amplitude sine wave generator, 20 Hz – 250 MHz, output 5 mV – 5 V into 50 Ω preferably with 20dB attenuation (e.g. HM 813x).
3) 2 BNC-cables, 50 Ω, e.g. HZ34.
4) BNC-T-connector.
5) Oscilloscope probe 10:1, with exactly 9MΩ series resistance and compensated for test oscilloscope mentioned under 6).
6) Oscilloscope 200 MHz, 5 mV/div to 5 V/div, e.g. HM2005.
7) Pre-attenuator 2:1 (1MΩ parallel with 12-25 pF C-trimmer)
8) 50 Ω BNC through termination, e.g. HZ22.
9) All insulated trimming/adjusting tools.
10) Variable output, safety insulation transformer.
11) Video signal generator with positive and negative signal output.
12) Digital Multimeter, e.g. HM8012.

Adjustment Procedure

This procedure covers all adjustments and the most important - but not all - performance checks. The correct sequence of all adjustment steps must be strictly followed.

Exact adjustment is only possible when any influence of the Earth's magnetic field has been compensated. (FOCUS TRACE MENU pushbutton opens <Int. Knob> menu with <Trace Rot.> function key for trace rotation)

All adjustments should only be performed by qualified and experienced personnel. This is particularly important for adjustments in the high voltage section of the instrument.

Before starting each adjustment procedure, set the oscilloscope to the following basic settings:

1. Do not apply a signal to an input.
2. Press "VERT/XY" pushbutton and select CH 1.
3. Press "AUTOSET" pushbutton.
4. Press "MODE" pushbutton in the TRIGGER section of the front panel.
5. Check that <Auto> and <Edge> are selected.
6. Press "FILTER" pushbutton in the TRIGGER section of the front panel.
7. Check that "Trig. Filter" "AC", "LF Off", "Noise Reject Off" and "Slope Rising" are selected.
8. Press "SOURCE" pushbutton in the TRIGGER section of the front panel.
9. Press "CH 1 VAR" pushbutton.
10. Check that for CH 1 "DC", "Ground (GND) Off", "1MΩ", "Invert Off", "Probe *1", "Full Bandwidth" and "Variable Off" are selected.
11. Press "CH 2 VAR" pushbutton.
12. Check that for CH 2 "DC", "Ground (GND) Off", "1MΩ", "Invert Off", "Probe *1", "Full Bandwidth" and "Variable Off" are selected.

If different settings are required, they are particularly mentioned for each subject.

Do not adjust the instrument until the normal operating temperature is reached, after a minimum warm up time of 20 minutes.

Software Adjustment Menu

Attention:
To avoid misuse and misalignment, do not publicise how to enter the Software Adjustment Menu.

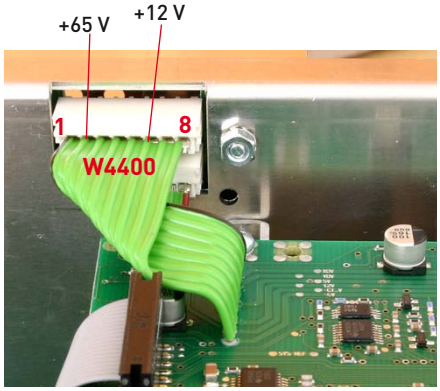
Some adjustments require the presence of service menus. These menus can only be called by pressing the "PROBE ADJ" pushbutton below the CRT to display the Utilities menu and switch "Comp. Tester On". Thereafter the "AUTO MEASURE" pushbutton and the "SETTINGS" pushbutton must be pressed at the same time to activate the "Settings Adjust" menu.

NOTE
The adjustment procedures assume that the instrument had once been properly adjusted in the factory and adjustments are required due to temperature drift or the replacement of defective components or boards.

1 RV1001: +65 Volt supply

WARNING:
To avoid damage use a fully insulated screwdriver!

- Locate and identify RV1001 PS-Board (screened section).
- Locate connector W4400 (8 pole) on MB-Board and identify pin 2.
- Adjust RV1001 for exactly +65 Volts (± 0.5 Volt) at W4400 pin 2 with respect to chassis.

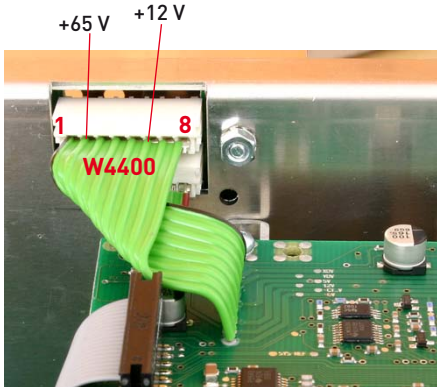


PS-Board

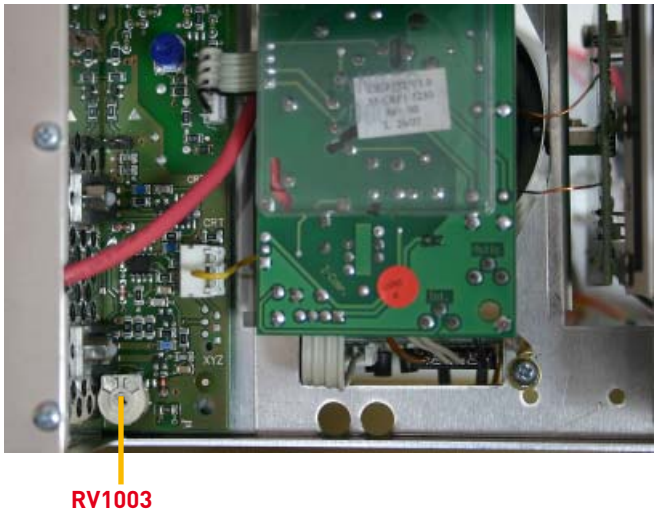
2 RV1003: +12 Volt supply

WARNING:
To avoid damage use a fully insulated screwdriver!

- Locate and identify RV1003 on PS-Board.
- Locate connector W4400 (8 pole) on MB-Board and identify pin 6.
- Adjust RV1003 for exactly +12 Volts (± 50 mV) at W4400 pin 6 with respect to chassis.



PS-Board



3 Trace Rotation Check

- Press "FOCUS TRACE MENU" pushbutton to open the "Int. Knob" menu.
- Select "Trace Rot.".
- Set baseline with "POSITION 1" to the horizontal centre line of the graticule.
- Turn INTENS knob to adjust baseline exactly parallel to the horizontal centre line of the graticule.

4 R6013: CRT minimum intensity

WARNING:
To avoid damage use a fully insulated screwdriver!

- Locate and identify R6013 on CR-Board.
- Press "CH 1" pushbutton to call "CH 1" menu.
- Press "Ground" function key to select "Ground On".
- Press "CH 2" pushbutton to call "CH 2" menu.
- Press "Ground" function key to select "Ground On".
- Press "VERT/XY" pushbutton and select "XY" mode.
- Check that "CH1" is selected as X Channel and "CH2" as Y Channel.
- Set "INTENS." control to fully left position (beep).
- Adjust R6013 so that the dot just disappears.
- Do not change the instrument settings until item 6 has been finished.

Continue with item 5.

CR Board

5 R6024: Astigmatism correction, XY Focus (Software Supported Adjustment)

WARNING:
To avoid damage use a fully insulated screwdriver!
Continue the adjustment under the last conditions of item 4.

- Locate and identify R6024 on CR-Board.
- Press "FOCUS TRACE MENU" pushbutton to call "Int. Knob" menu.
- Press "FOCUS" function key to activate the "INTENS" knob as FOCUS control.
- Turn the "INTENS" knob for optimum spot sharpness.
- Turn the "INTENS" knob continuously in both directions around the optimum spot sharpness point in both directions and watch the spot shape while simultaneously adjusting R6024 in such a way that the spot shape does not become a horizontal or vertical ellipse.
- Do not change the instrument settings until item 6 has been finished.
- Continue with item 6.

CR Board

6 RV1005: Focus symmetry

- Continue the adjustment under the last conditions of item 5.
- Locate and identify RV1005 on PS-Board.
- Turn the INTENS knob clockwise until the dot is displayed.
- Press "FOCUS TRACE MENU" pushbutton to call "Int. Knob" menu.
- Press "FOCUS" function key to activate the "INTENS" knob as FOCUS control.
- Turn the "INTENS" knob fully clockwise and counter clockwise and adjust RV1005 for equal spot size in both (cw and ccw) conditions, so that the focus point is in midrange position.

PS Board

7 XY Focus (Software Supported Adjustment)

- Call Software Adjustment Menu (press "PROBE ADJ" pushbutton, switch "Comp. Tester On" and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously).
- Press the "Adjust 1" function key.
- Press the "Focus" function key.
- Then the "Adjust 1 Focus" menu with "XY Focus" will be activated and an undeflected spot will be displayed.
- Turn the "INTENS" knob for optimum spot sharpness.
- Set "INTENS" knob for optimum spot sharpness.

- Do not change the instrument settings until item 9 has been finished.
- Continue with item 8.

8 READOUT FOCUS correction

- Continue the adjustment under the last conditions of item 7.
- Press the "RO Focus" function key.
- Turn the "INTENS" knob for optimum readout sharpness.
- Do not change the instrument settings until item 8 has been finished.

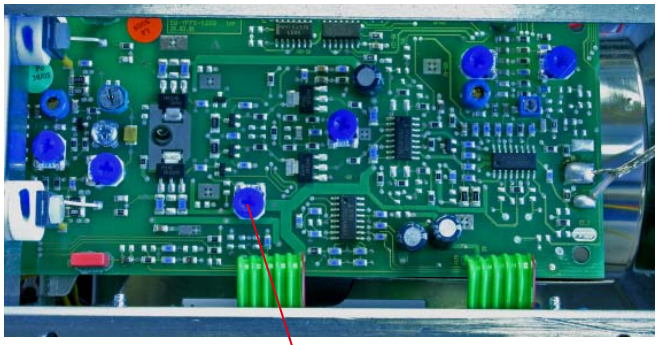
9 Overall correction and Save

- Continue the adjustment under the last conditions of item 8.
- Press the "Overall" function key.
- Turn the "INTENS" knob for optimum spot and readout sharpness.
- Press the "Save" function key to store these settings into user memory.

- Leave the Software Adjustment menu by pressing the MENU OFF pushbutton several times until the normal oscilloscope operation is present.

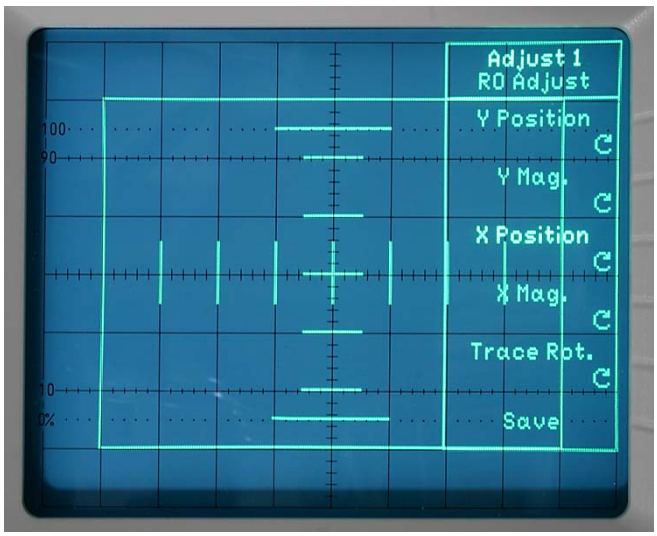
10 R9057: Readout Operating Point

- Locate and identify R9057 on YF-Board.
- Connect a 25 mVpp, 10 Hz square wave signal via 50 Ω cable and 50 Ω through terminator to input CH 1.
- Set input attenuator CH 1 to 1 mV/div.
- Set input coupling CH 1 to AC.
- Set time base to 2 ms/div.
- Adjust R9057 for minimal flickering readout display.



11 Readout Adjustment (Software Supported Adjustment)

- Press "PROBE ADJ." pushbutton, switch "COMP. TESTER On" and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously to enter the "Settings Adjust" menu.
- Press "Adjust 1" function key.
- Press "RO Adjust" function key to enter the "Adjust 1 RO Adjust" submenu.
- Turn "INTENS" knob to adjust the Service Rectangle exactly parallel to the horizontal lines of the graticule.
- Press function keys to call "Y Position", "Y Mag.", "X Position" and "X Mag." to adjust the Service Rectangle until it is adapted to the graticule lines.
- Turn "INTENS" knob in combination with Y and/or X Mag function, to adjust the rectangle for 6 division height and 8 division width.
- Turn "INTENS" knob in combination with Y and/or X Position function, so that the cross symbol in the centre of the Service Rectangle is congruent with the graticule centre.
- Press "Save" function key to store the settings into user memory.
- Leave the Software Adjustment menu by pressing the "MENU OFF" pushbutton several times until the normal oscilloscope operation is present.



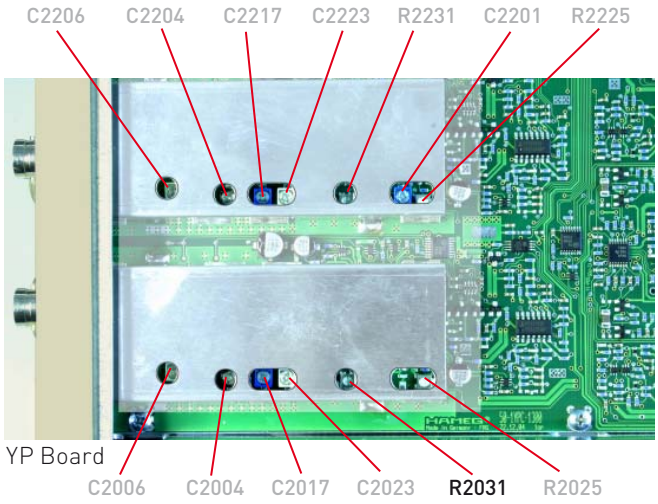
correct

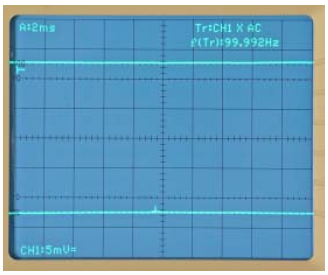
12 R2031: CH 1 100 Hz Square Wave 5 mV/div

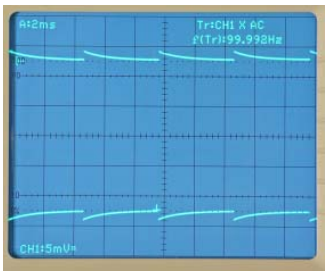
- Press "AUTOSET" pushbutton without signal applied (default setting).
- Locate and identify R2031 in the shielded CH 1 section of the YP-Board.
- Connect a 25 mVpp, 100 Hz square wave signal via 50 Ω cable and 50 Ω through terminator to input CH 1.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Set timebase to 2 ms/div.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Adjust R2031 so that two straight lines are displayed.

- Do not change the instruments settings until item 13 has been finished.

Continue with item 13.




correct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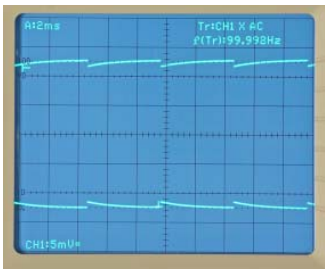
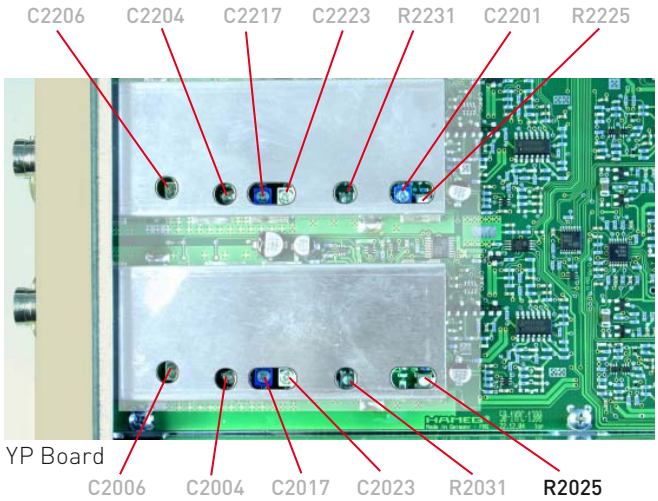
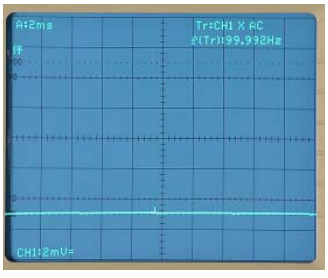

undercompensated

13 R2025: CH 1 100 Hz Square Wave 2 mV/div

Continue the adjustment under the last conditions of item 12.
- Locate and identify R2025 in CH1 section of the YP-Board.
- Set input attenuator CH1 to 2 mV/div.
- Adjust R2025 so that a straight line is displayed.

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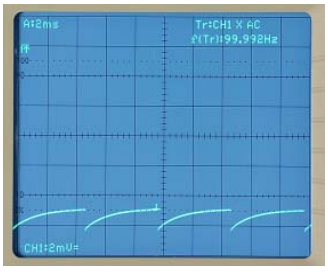
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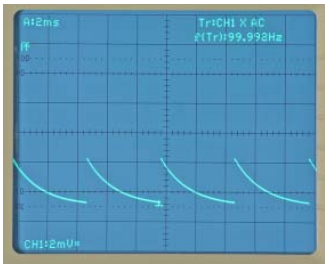
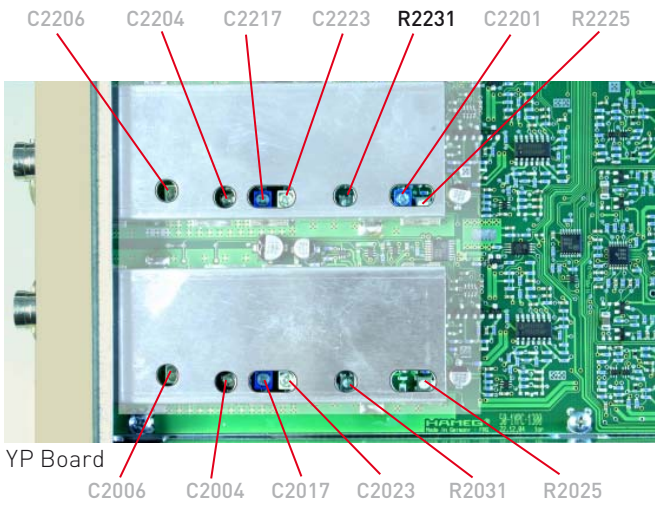

undercompensated

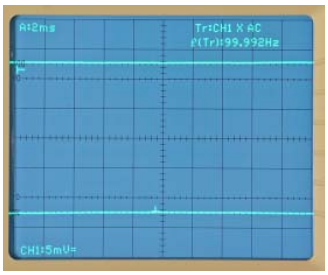
14 R2231: CH 2 100 Hz Square Wave 5 mV/div

- Press AUTOSET without signal applied (default setting).
- Locate and identify R2231 in the shielded CH 2 section of the YP-Board.
- Connect a 25 mVpp, 100 Hz square wave signal via 50 Ω cable and 50 Ω through terminator to input CH 2.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Set timebase to 2 ms/div.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Adjust R2231 so that two straight lines are displayed.

- Do not change the instruments settings until item 15 has been finished.

Continue with item 15.

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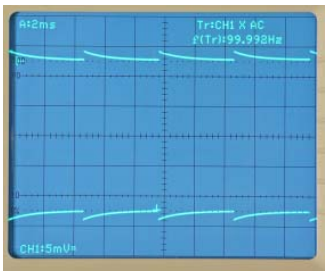
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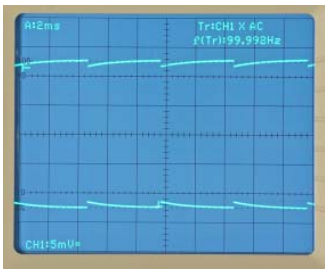
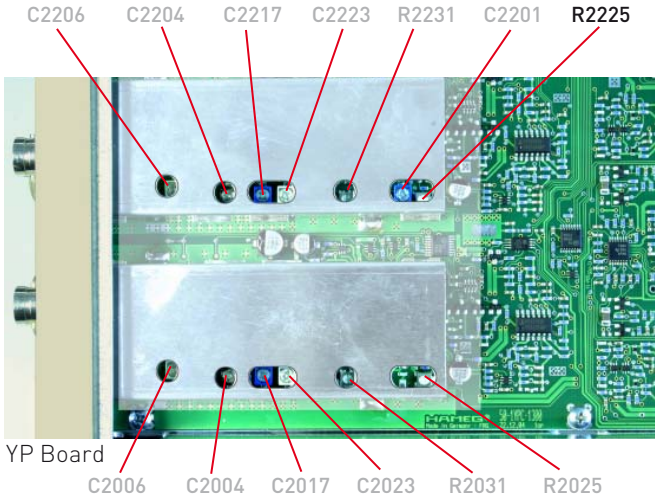
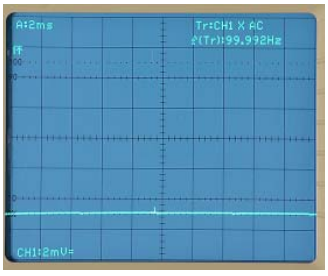

undercompensated

15 R2225: CH 2 100 Hz Square Wave 2 mV/div

Continue the adjustment under the last conditions of item 14.
- Locate and identify R2225 in CH2 section of the YP-Board.
- Set input attenuator CH2 to 2 mV/div.
- Adjust R2225 so that a straight line is displayed.

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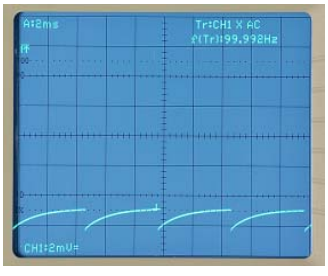
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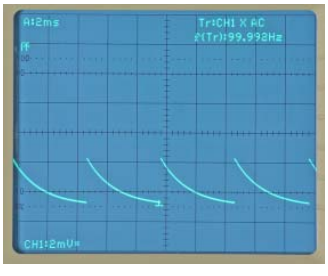
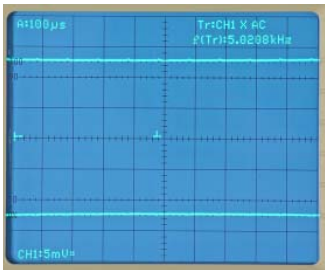

undercompensated

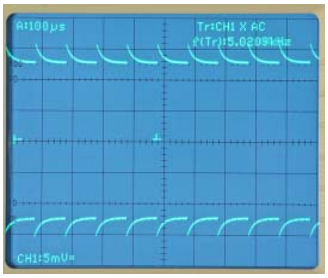
16 CH 1 Input Capacitance Adaption

- Press AUTOSET pushbutton without signal applied (default setting).
- Press VERT/XY pushbutton to call the Vertical menu.
- Press CH 1 function key to select CH 1 mode.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Set time base to 100 µs/div.
- Connect a 50 mVpp, 5 kHz square wave signal via 50 Ω cable and 2:1 pre-attenuator to input CH 1.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Adjust C-trimmer in pre-attenuator for 2 parallel, straight lines.
- Do not change the C-trimmer settings until item 20 has been finished.

Continue with item 17.



correct



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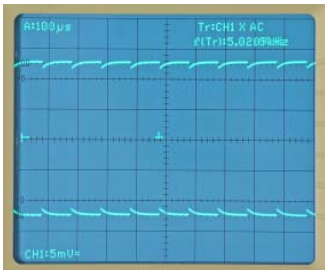


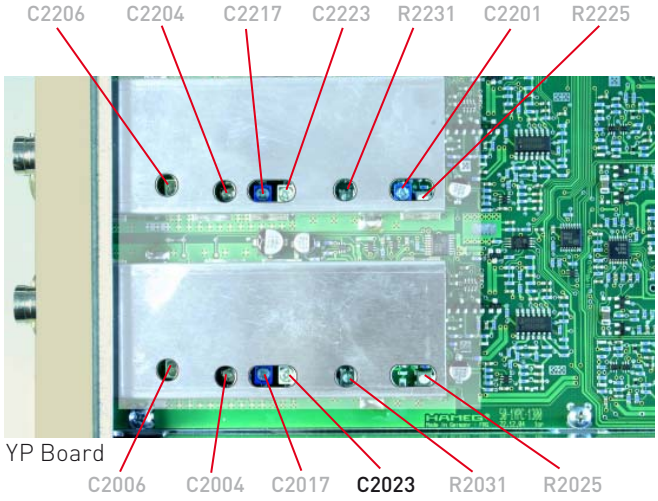
undercompensated

17 C2023: CH 1 20:1 Attenuator Compensation

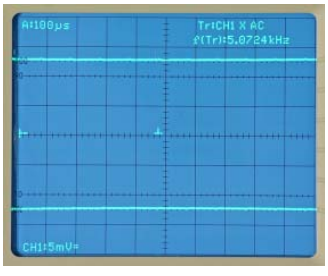
Continue the adjustment under the last conditions of item 16.

- Locate and identify C-Trimmer C2023 in the shielded CH 1 section of the YP board.
- Set attenuator CH 1 to 50 mV/div.
- Increase the calibrator output voltage for 5 division signal height.
- Adjust C2023 for 2 parallel, straight lines.

Continue with item 18.



YP Board



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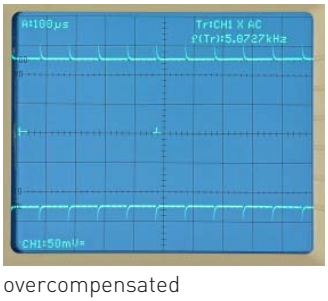

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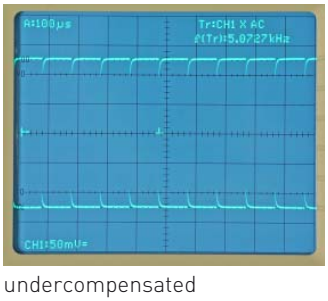
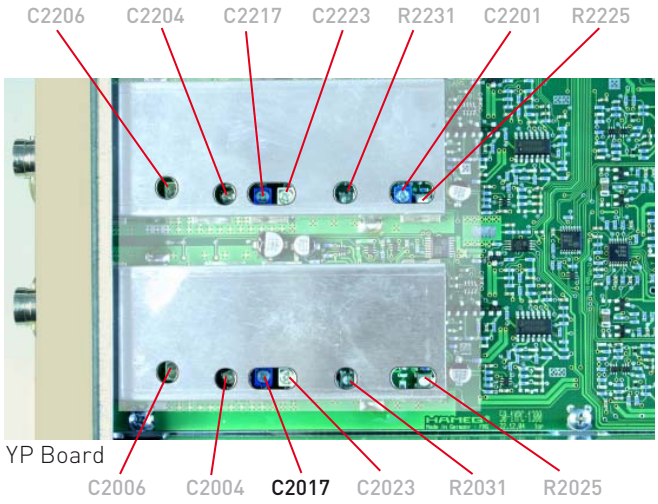


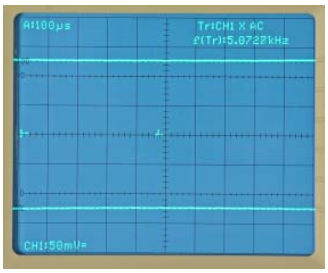
undercompensated

18 C2017: CH 1 10:1 Attenuator Input Capacitance Adaptation

Continue the adjustment under the last conditions of item 17.
- Locate and identify C-trimmer C2017 in the shielded CH 1 section of the YP board.
- Check that attenuator CH 1 is set to 50 mV/div.
- Adjust C2017 for 2 parallel, straight lines.

Continue with item 19.

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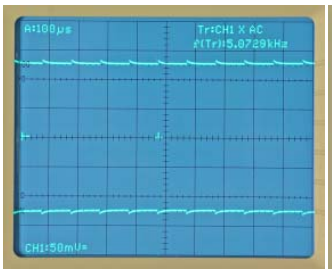
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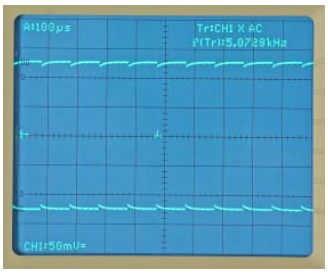
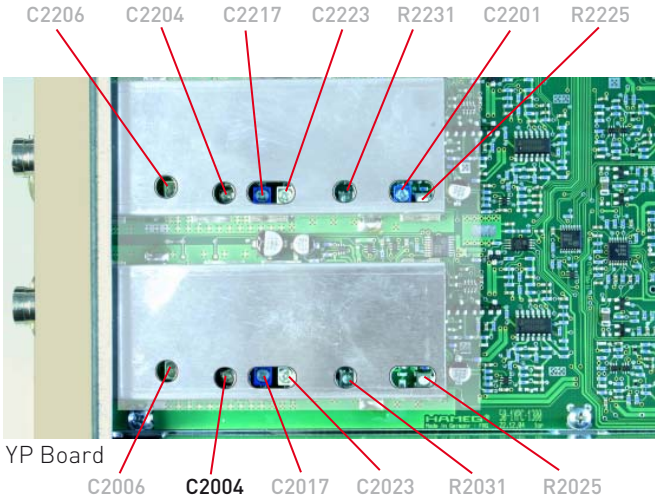
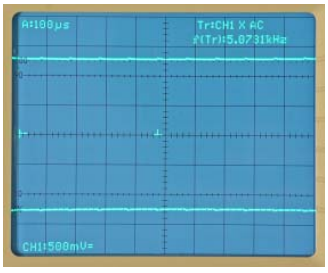

undercompensated

19 C2004: CH 2 100:1 Attenuator Compensation

Continue the adjustment under the last conditions of item 18.
- Locate and identify C-Trimmer C2004 in the shielded CH 1 section of the YP board.
- Set attenuator CH 1 to 500 mV/div.
- Increase the calibrator output voltage for 5 division signal height.
- Adjust C2004 for 2 parallel, straight lines.

Continue with item 20.

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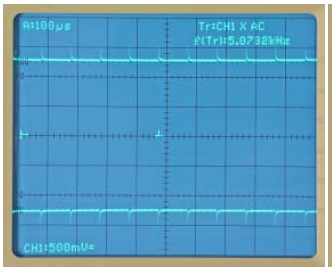
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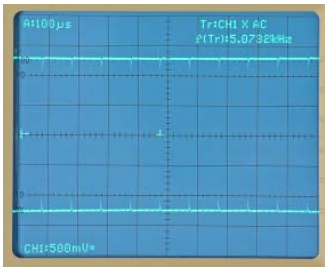
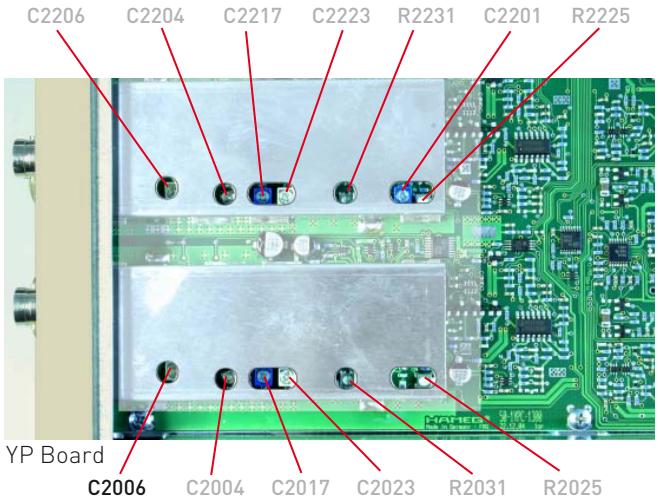
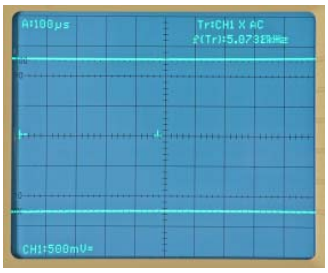

undercompensated

20 C2006: CH 1 100:1 Attenuator Input Capacitance Adaptation

Continue the adjustment under the last conditions of item 19.
- Locate and identify C-trimmer C2006 in the shielded CH 1 section of the YP board.
- Check that attenuator CH 1 is set to 500 mV/div.
- Adjust C2006 for 2 parallel, straight lines.

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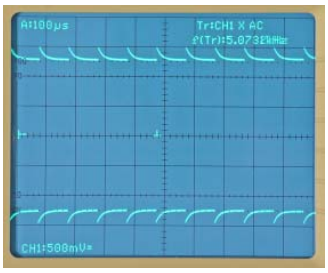
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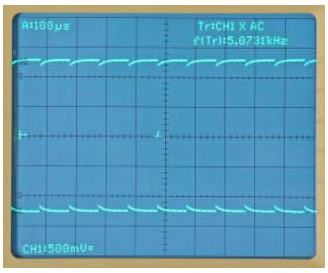
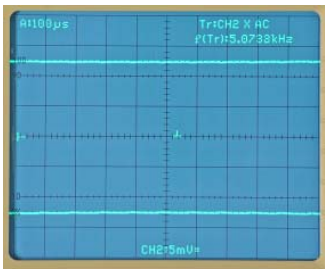
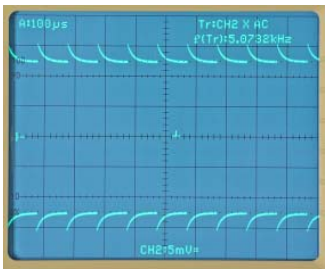

undercompensated

21 CH 2 Input Capacitance Adjustment

- Press AUTOSET pushbutton without signal applied (default setting).
- Press VERT/XY pushbutton to call the Vertical menu.
- Press CH 2 function key to select CH 2 mode.
- Press (Trigger) "FILTER" pushbutton and select "Slope Both".
- Set time base to 100 µs/div.
- Connect a 50 mV_{pp}, 5 kHz square wave signal via 50Ω cable and 2:1 pre-attenuator to input CH 2.
- Check that DC input coupling is selected.
- Check that 5mV/div is active.
- Adjust C-trimmer in pre-attenuator for 2 parallel, straight lines.

Do not change the C-trimmer settings until item 25 has been finished.
Continue with item 22.


correct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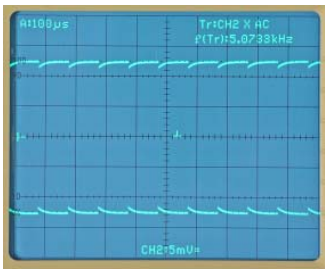
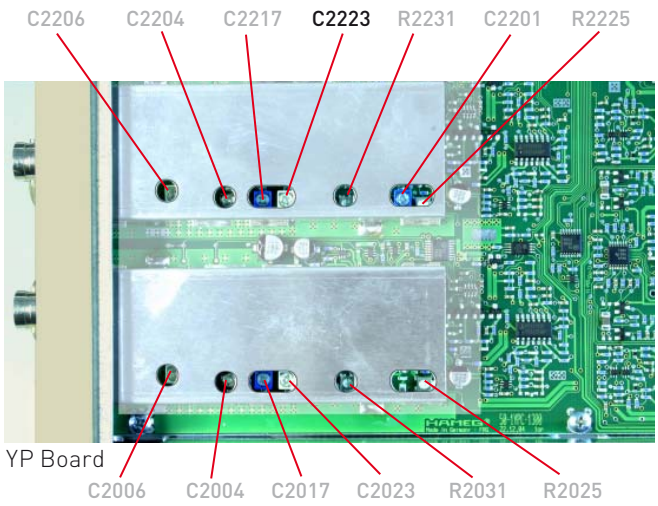
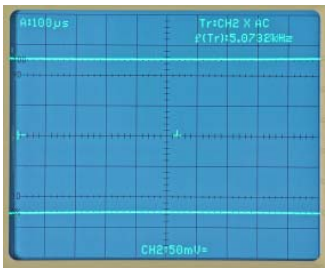

undercompensated

22 C2223: CH 2 10:1 Attenuator Compensation

Continue the adjustment under the last conditions of item 21.
- Locate and identify C-Trimmer C2223 in the shielded CH 2 section of the YP board.
- Set attenuator CH 2 to 50 mV/div.
- Increase the calibrator output voltage for 5 division signal height.
- Adjust C2223 for 2 parallel, straight lines.
- Continue with item 23.

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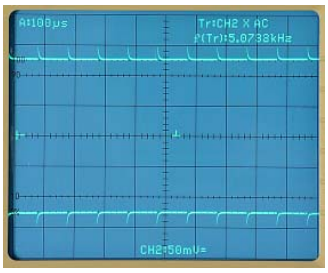
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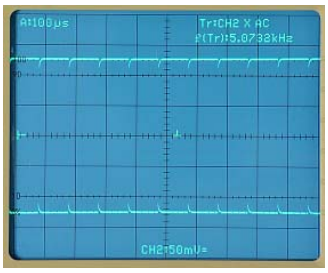
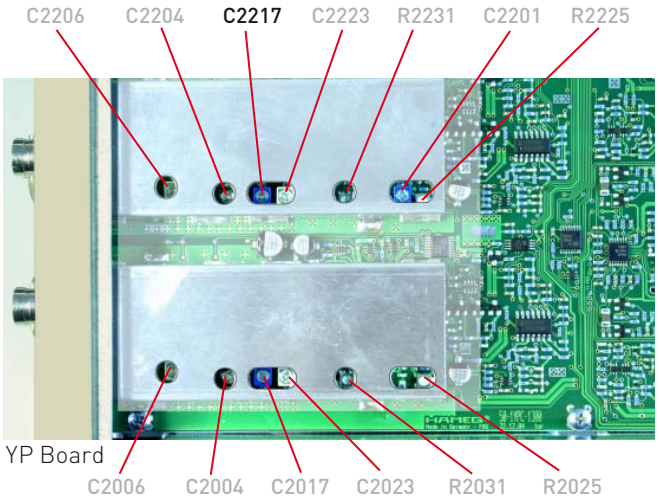
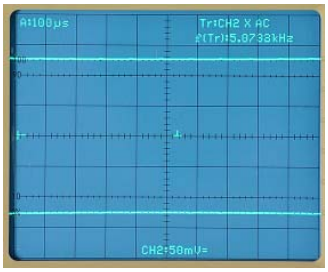

undercompensated

23 C2217: CH 2 10:1 Attenuator Input Capacitance Adaptation

Continue the adjustment under the last conditions of item 22.
- Locate and identify C-trimmer C2217 in the shielded CH 2 section of the YP board.
- Check that attenuator CH 2 is set to 50 mV/div.
- Adjust C2217 for 2 parallel, straight lines.

Continue with item 24.

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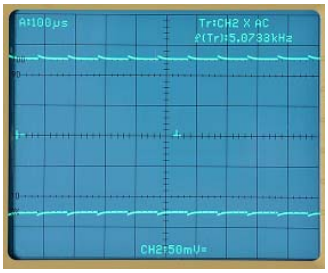
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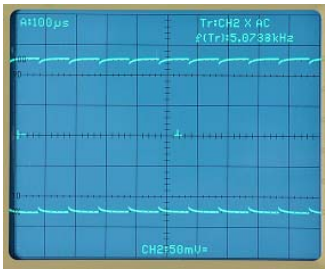
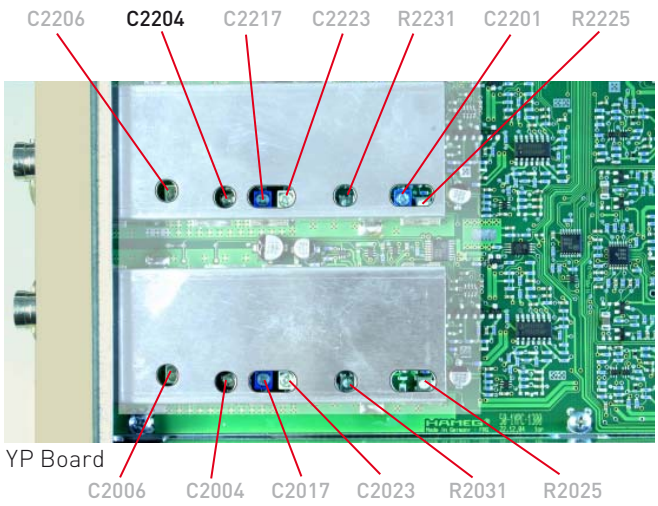
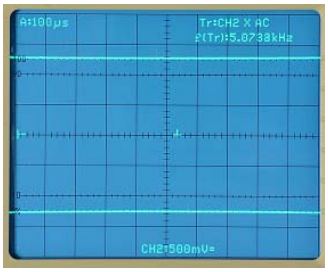

undercompensated

24 C2204: CH 2 100:1 Attenuator Compensation

Continue the adjustment under the last conditions of item 23.
- Locate and identify C-trimmer C2204 in the shielded CH 2 section of the YP board.
- Set attenuator CH 2 to 500 mV/div.
- Increase the calibrator output voltage for 5 division signal height.
- Adjust C2204 for 2 parallel, straight lines.

Continue with item 25.

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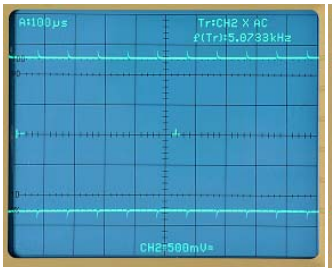
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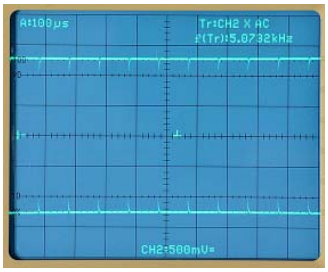
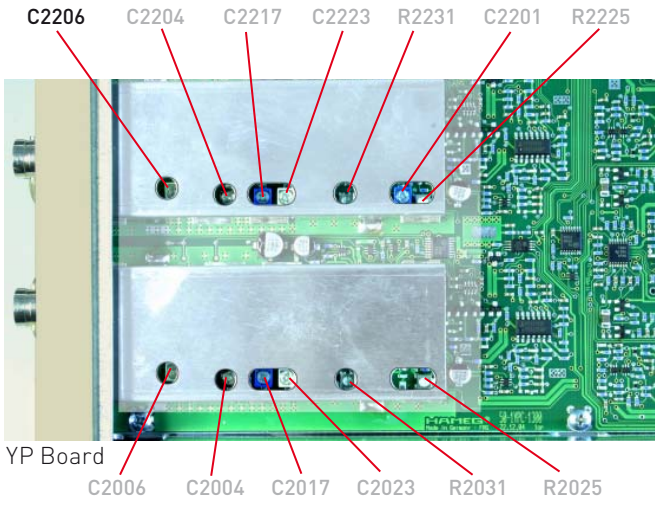
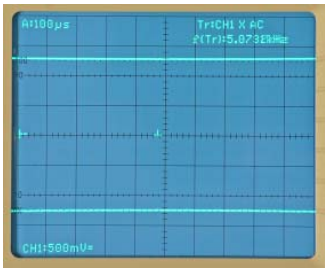
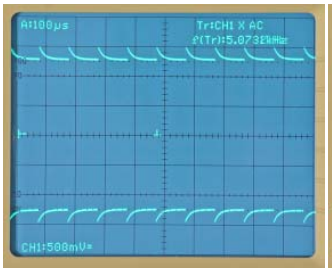

undercompensated

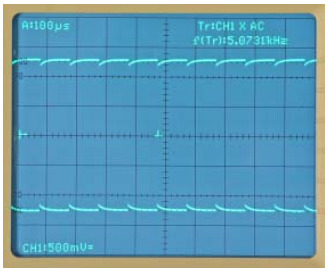
25 C2206: CH 2 100:1 Attenuator Input Capacitance Adaptation

Continue the adjustment under the last conditions of item 19.
- Locate and identify C-trimmer C2006 in the shielded CH 1 section of the YP board.
- Check that attenuator CH 1 is set to 500 mV/div.
- Adjust C2006 for 2 parallel, straight lines.




correct

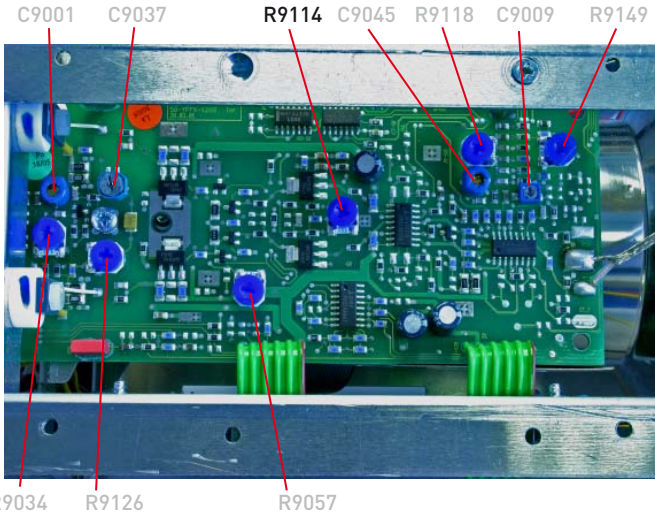

overcompensated

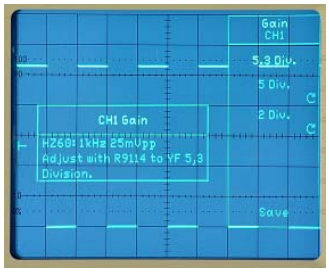

undercompensated

26 R9114: YP CH 1 Gain (Software Supported Adjustment)

- Press "PROBE ADJ." pushbutton, "COMP. TESTER On" function key and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously to enter the "Settings Adjust" menu.
- Press "Adjust 1" function key.
- Press "YP" function key to call the "Adjust 1 YP" submenu.
- Press "Gain" function key to call "YP Gain" menu.
- Press "CH 1" function key to open the "Gain CH1" submenu.
- Press "Gain 5mV" function key to open the "CH1 Gain 5mV" submenu.
- Press "5.3 Div." function key.
- Connect a 1 kHz square wave signal from HZ60 25 mVpp output or HZ620 (50 mV setting) via 50Ω cable and 50Ω through terminator to input CH 1.
- Locate and identify R9114 on YF-Board.
- Adjust R9114 for 5.3 div signal height.

Continue with item 27.





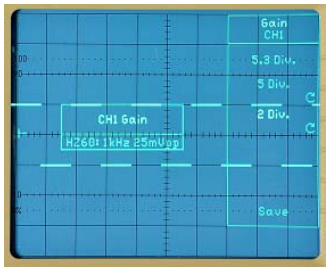
correct

27 YP CH 1 Gain (Software Adjustment)

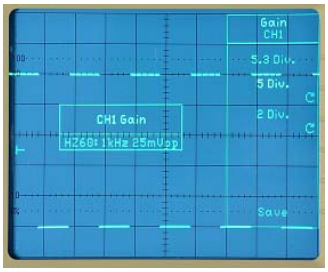
Continue the adjustment under the last conditions of item 18.

- Press "5 Div." function key.
- Turn INTENS knob for 5 div. signal height.
- Press "2 Div." function key.
- Turn INTENS knob for 2 div. signal height.
- Press "Save" function key to store the settings into user memory and return to "YP Gain" submenu.

Continue with item 28.



2 div.



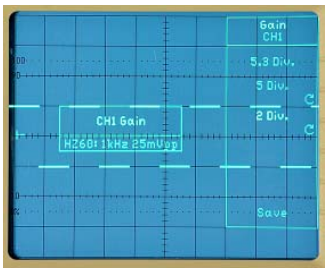
5 div.

28 YP CH 2 Gain (Software Adjustment)

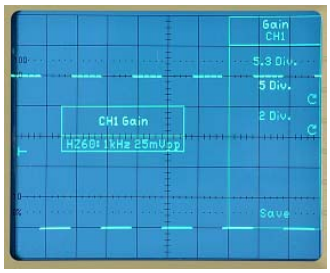
Continue the adjustment under the last conditions of item 27.

- Check that "YP Gain" submenu is present.
- Press "CH2" function key.
- Connect a 1 kHz square wave signal from HZ60 25 mVpp output or HZ620 (50 mV setting) via 50Ω cable and 50Ω through terminator to input CH 2.
- Press "5 Div." function key.
- Turn INTENS knob for 5 div. signal height.
- Press "2 Div." function key.
- Turn INTENS knob for 2 div. signal height.
- Press "Save" function key to store the settings into user memory and return to "YP Gain" submenu.

Press MENU OFF pushbutton to return to "Adjust 1 YP" menu and continue with item 29.



2 div.



5 div.

29 YP CH 1 DC Offset (Software Adjustment)

- Check that "YP Gain" submenu is present.
- Check that no signal is applied at the BNC connectors.
- Press "DC Offset" function key to call "YP DC Offset" menu.
- Press "CH 1" function key for automatic Offset adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 30.

30 YP CH 2 DC Offset (Software Adjustment)

- Check that "YP DC Offset" menu is present.
- Check that no signal is applied at the BNC connectors.
- Press "CH 2" function key for automatic Offset adjustment.
- Wait until the automatic adjustment has been finished.
- Press MENU OFF pushbutton to return to "Adjust 1 YP" menu.

Continue with item 31.

31 YP CH 1 Variable Balance (Software Adjustment)

- Check that no signal is applied at the BNC connectors.
- Press "VAR Bal." function key to call "YP VAR Bal." menu.
- Press "CH 1" function key for automatic Variable Balance adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 32.

32 YP CH 2 Variable Balance (Software Adjustment)

- Check that "YP VAR Bal." menu is present.
- Check that no signal is applied at the BNC connectors.
- Press "CH 2" function key for automatic Variable Balance adjustment.
- Wait until the automatic adjustment has been finished.
- Press MENU OFF pushbutton to return to "Adjust 1 YP" menu.

Continue with item 33.

33 YP CH 1 Invert Symmetry (Software Adjustment)

- Check that no signal is applied at the BNC connectors.
- Press "VAR Bal." function key to call "YP Inv. Sym." menu.
- Press "CH 1" function key for automatic Invert Symmetry adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 34.

34 YP CH 2 Invert Symmetry (Software Adjustment)

- Check that "YP Inv. Sym." menu is present.
- Check that no signal is applied at the BNC connectors.
- Press "CH 2" function key for automatic Invert Symmetry adjustment.
- Wait until the automatic adjustment has been finished.
- Press MENU OFF pushbutton to return to "Adjust 1 YP" menu.

Continue with item 35.

35 YP CH 1 Y Position (Software Adjustment)

- Check that no signal is applied at the BNC connectors.
- Press "Y Position" function key to call "YP Y Position" menu.
- Press "CH 1" function key for automatic Y Position adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 36.

36 YP CH 2 Y Position (Software Adjustment)

- Check that "YP Y Position" menu is present.
- Check that no signal is applied at the BNC connectors.
- Press "CH 2" function key for automatic Y Position adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 37.

37 YP ADD Position (Software Adjustment)

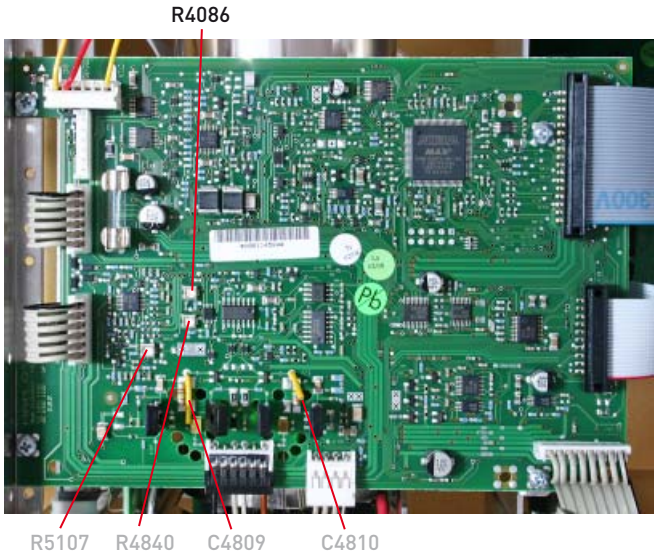
- Check that "YP Y Position" menu is present.
- Check that no signal is applied at the BNC connectors.
- Press "ADD" function key for automatic Y Position adjustment.
- Wait until the automatic adjustment has been finished.
- Press MENU OFF pushbutton to return to "Adjust 1 YP" menu.
- Press MENU OFF pushbutton to return to "Adjust Adjust 1" menu.
- Press MENU OFF pushbutton several times to return to normal operation or continue with item 38.

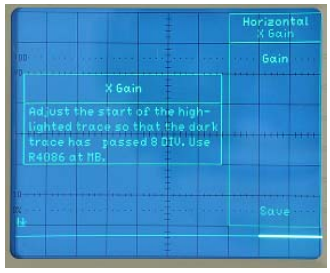
38 R4086: Horizontal X Gain (Software Supported Adjustment)

- Press "PROBE ADJ." pushbutton, "COMP. TESTER On" function key and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously to enter the "Settings Adjust" menu.
- Press "Adjust 1" function key to call the "Adjust 1 Adjust" menu.

- Press "Horizontal" function key to call the "Adjust 1 Horizontal" menu.
- Press "X Gain" function key to call "Horizontal X Gain" menu.
- Locate and identify R4086 on MB-Board.
- Set trace start position by aid of "HORIZONTAL" knob to the left vertical border line of the graticule and correct it simultaneously in combination with the following adjustment.
- Adjust R4086 so that the length of the trace with less intensity is 8 div long.
- Press "Save" function key to store the settings and to return to "Adjust 1 Horizontal" submenu.

Continue with item 39.





39 X Position (Automatic Software Adjustment)

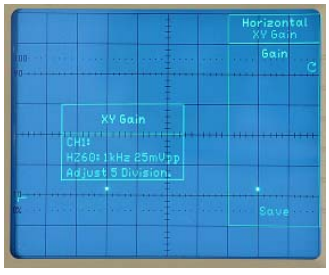
Continue the adjustment under the last conditions of item 38.
- Press "X Position" function key for automatic X Position adjustment.
- Wait until the automatic adjustment has been finished.

Continue with item 40.

40 Horizontal XY Gain (Software Supported Adjustment)

Continue the adjustment under the last conditions of item 39.
- Press "XY Gain" function key.
- Connect a 1 kHz square wave signal from HZ60 25 mVpp output or HZ620 (50 mV setting) via 50Ω cable and 50Ω through terminator to input CH 1 (X-INP).
- Turn "INTENS" for 5 div. distance in X direction between the 2 dots.
- If an X position change is required use "Position 1" knob.
- Press "Save" function key to store the settings and to leave this item.
- Disconnect the square wave signal from input CH 1.

Continue with item 41.



41 Horizontal XY Position (Automatic Software Adjustment)

Continue the adjustment under the last conditions of item 40.
- Press "XY Position" function key for automatic XY Position adjustment.
- Wait until the automatic adjustment has been finished.
- Press "MENU OFF" pushbutton to return to "Adjust Adjust 1" menu.
- Leave the Software Adjustment menu by pressing the MENU OFF pushbutton several times until the normal oscilloscope operation is present.

42 **Self Cal** (Automatic Software Adjustment)

- Press SETTINGS pushbutton to call the Settings menu.
- Press "Self Cal" function key to call the "Settings Self Cal" submenu.
- Check that no probes or cables are connected to the oscilloscope inputs.
- Press "Start" function key.
- Wait until the self calibration has been finished.

Continue with item 43.

43 **Trigger Point** (Automatic Software Adjustment)

- Press "PROBE ADJ." pushbutton, "COMP. TESTER On" function key and press "AUTO MEASURE" and "SETTINGS" pushbutton simultaneously to enter the "Settings Adjust" menu.
- Check that no signal is applied at the BNC connectors.
- Press "Adjust 1" function key to call the "Adjust 1 Adjust" submenu.
- Press "Trigger" function key to call the "Adjust 1 Trigger" submenu.
- Press "Point" function key for automatic trigger point adjustment.
- Wait until the automatic adjustment has been finished.
- Press "MENU OFF" pushbutton to return to "Adjust 1 Trigger" menu.

Continue with item 44.

44 **Trigger Peak Peak CH 1** (Automatic Software Adjustment)

- Continue the adjustment under the last conditions of item 43.
- Press "Peak Peak" function key to call the "Trigger Peak Peak" submenu.
- Press "CH 1" function key to call the "Peak Peak CH 1" submenu.
- Connect a 1 kHz square wave signal from HZ60 25 mV_{pp} output or HZ620 (50 mV setting) via 50Ω cable and 50Ω through terminator to input CH 1 (X-INP).
- Press "Save" function key to store the data and to return to "Trigger Peak Peak" submenu.
- Disconnect the square wave signal from input CH 1.

Continue with item 45.

45 **Trigger Peak Peak CH 2** (Automatic Software Adjustment)

- Continue the adjustment under the last conditions of item 44.
- Press "CH 2" function key to call the "Peak Peak CH 2" submenu.
- Connect a 1 kHz square wave signal from HZ60 25 mV_{pp} output or HZ620 (50 mV setting) via 50Ω cable and 50Ω through terminator to input CH 2 (X-INP).
- Press "Save" function key to store the data and to return to "Trigger Peak Peak" submenu.
- Disconnect the square wave signal from input CH 2.

Continue with item 46.

46 Trigger Peak Peak External (Automatic Software Adjustment)

Continue the adjustment under the last conditions of item 45.
- Press "External" function key to call the "Peak Peak External" submenu.
- Connect a 1 kHz square wave signal from HZ60 2.5 V_{pp} output or HZ620 (2.5V setting) via 50Ω cable (without 50Ω through terminator) to AUXILIARY INPUT.
- Press "Save" function key to store the data and to return to "Trigger Peak Peak" submenu.
- Disconnect the square wave signal from AUXILIARY INPUT.
- Press "MENU OFF" pushbutton to return to "Adjust 1 Trigger" menu.

Continue with item 47.

47 Trigger Counter (Automatic Software Adjustment)

Continue the adjustment under the last conditions of item 46.
- Press "Counter" function key to call the "Trigger Counter" submenu.
- Connect a 25 mV_{pp} (approx. -28 dBm), 100 MHz (accuracy ±10 Hz) sine wave signal via 50Ω cable and 50Ω through terminator to input CH 1. (If HM8134/8135 is used in combination with HM200x LF Box, the 50Ω through terminator is not required)
- Press "Save" function key to store the data and to return to "Adjust 1 Trigger" menu.
- Disconnect the sine wave signal from input CH 1.
- Press "MENU OFF" pushbutton to return to "Adjust Adjust 1" menu.

Continue with item 48.

48 Calibrator (Software Supported Adjustment)

- Press "Adjust 2" function key to call the "Adjust Adjust 2" submenu.
- Press "Calibrator" function key to call "Adjust 2 Calibrator" submenu.
- Connect a 1:1 probe with its tip to the PROBE ADJ. output.
- Connect the 1:1 probe BNC plug to a Digital Multimeter Input.
- Set Digital Multimeter to a DC measurement range suitable for 0.2 V measurement with an accuracy better than 0.1%.
- Turn INTENS for a reading of 200 mV on the multimeter.
- Press "Save" function key to store data into user memory and to return to "Adjust Adjust 2" submenu.

Continue with item 49.

49 COMP. Tester X Position (Automatic Software Adjustment)

Note: This and the following adjustments 50 and 51 assume that the adjustment under item 3 "Trace Rotation Check" has been made (trace parallel to the horizontal centre line of the graticule) and the instrument's position has not been changed in respect to the Earth`s magnetic field.

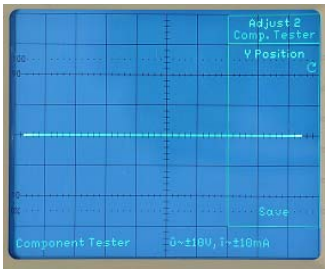
Continue the adjustment under the last conditions of item 58.
- Check that no signal is applied to the COMPONENT TESTER sockets.
- Press "Comp. Tester" function key to call "Adjust 2 Comp. Tester" menu.
- Press "X Position" function key to start the automatic adjustment.
- Wait until the adjustment has been finished and the "Adjust 2 Comp. Tester" menu is displayed.

Continue with item 50.

50 COMP. Tester Y Position (Automatic Software Adjustment)

Continue the adjustment under the last conditions of item 49.
- Check that no signal is applied at the COMPONENT TESTER sockets.
- Press "Y Position" function key to activate "INTENS" control.
- Turn "INTENS" to move the Component Tester trace centre in vertical direction to the graticule horizontal centre line.

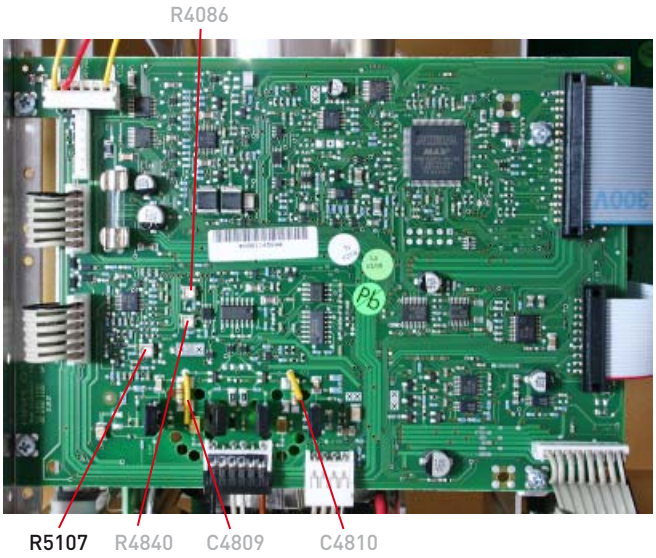
Continue with item 51.

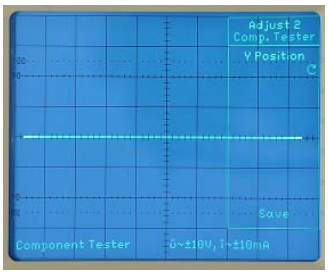


51 R5107: COMP. Tester Trace Rotation (Software Supported Adjustment)

Continue the adjustment under the last conditions of item 50.
- Check that no signal is applied at the COMPONENT TESTER sockets.
- Locate and identify R5107 on MB-Board.
- Adjust R5107 so that the horizontal Component Tester trace is parallel to the horizontal centre line of the graticule.
- Repeat the adjustment of item 60 and 61 until optimum is reached.
- Press "Save" function key to store data into user memory and to return to "Adjust Adjust 2" submenu.

Continue with item 52.





52 Timebase A (Software Adjustment)

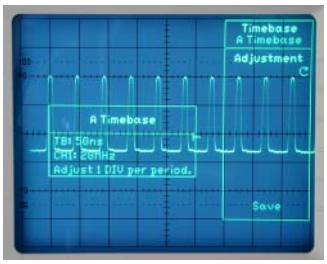
Continue the adjustment under the last conditions of item 51.
- Check that "Adjust Adjust 2" menu is displayed.
- Press "Timebase" function key to call the "Adjust 2 Timebase" submenu.
- Press "A Timebase" function key to call the "Timebase A Timebase" menu.

Note: The actual timebase setting and the required signal frequency are displayed on the screen.

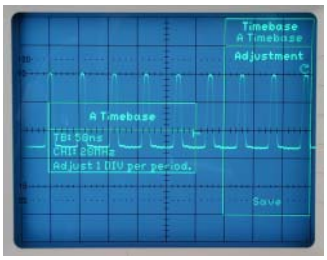
Instrument Settings:
- Set "TIME/DIV" knob for "TB: 50ns" display.
- Connect a 20 MHz signal from HZ620 (SIGNAL pushbutton setting "Pulse 50Ω") to the input of CH 1.
- Turn "CH 1 VOLTS/DIV" knob for a suitable signal height of 2 to 3 divisions.
- Turn "LEVEL A/B" knob to set the trigger point symbol above the signal baseline.
- Set "POSITION 1" knob reading at the horizontal centre line of the graticule.
- Set "LEVEL A/B" knob for stable triggering.

Adjustment Procedure:
- Move trace with "HORIZONTAL" knob so that the first zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Turn "INTENS" knob, so that 1 signal period per division is displayed.
- Press "Save" function key to store the adjustment into user memory.
- Turn "TIME/DIV" knob one step to the left, change the signal generator frequency as displayed, repeat the adjustment and "Save" to store it into user memory.
- Repeat this procedure until the 500 ms timebase setting has been adjusted and saved.
- Press "MENU OFF" pushbutton to return to "Adjust 2 Timebase" menu.

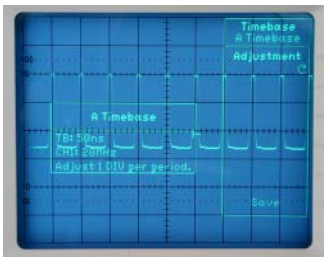
Continue with item 53.



too slow



too fast



correct

53 Timebase B (Software Adjustment)

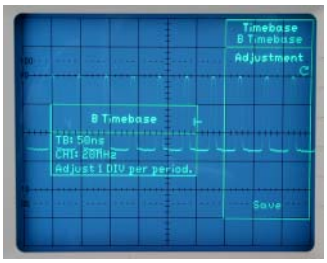
Continue the adjustment under the last conditions of item 52.
- Press "B Timebase" function key to call the "Timebase B Timebase" menu.

Note: The actual timebase setting and the required signal frequency are displayed on the screen.

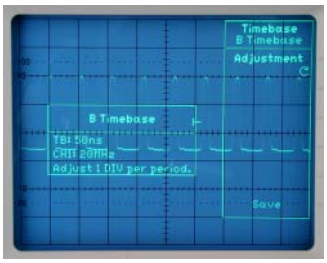
Instrument Settings:
- Set "TIME/DIV" knob for "TB: 50ns" display.
- Connect a 20 MHz signal from HZ620 (SIGNAL pushbutton setting "Pulse 50Ω") to the input of CH 1.
- Turn "CH 1 VOLTS/DIV" knob for a suitable signal height of 2 to 3 divisions.
- Turn "LEVEL A/B" knob to set the trigger point symbol above the signal baseline.
- Set "POSITION 1" knob for reading at the horizontal centre line of the graticule.
- Set "LEVEL A/B" knob for stable triggering.

Adjustment Procedure:
- Move trace with "HORIZONTAL" knob so that the first zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Turn "INTENS" knob, so that 1 signal period per division is displayed.
- Press "Save" function key to store the adjustment into user memory.
- Turn "TIME/DIV" knob one step to the left, change the signal generator frequency as displayed, repeat the adjustment and press "Save" to store it into user memory.
- Repeat this procedure until the 20 ms timebase setting has been adjusted and saved.
- Press MENU OFF pushbutton to return to "Adjust 2 Timebase" menu.
- Press MENU OFF pushbutton to return to "Adjust Adjust 2" menu.
- Press MENU OFF pushbutton to return to "Settings Adjust" menu.
- Remove signal from the input.

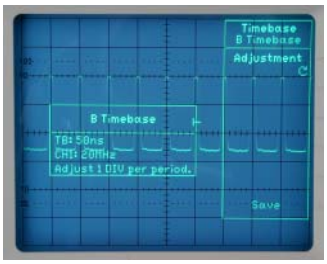
Continue with item 54.



too slow



too fast



correct

54 Saving Software Adjustments

Continue under the last conditions of item 63.

- Check that "Settings Adjust" menu is displayed.
- Press "Service" function key to call "Adjust Service" menu.
- Press "Factory" function key to call "Service Factory" menu.
- Press "User >Factory" function key to save the software adjustment data – stored before in the user memory – into a second memory called Factory for security purposes.
- Press "MENU OFF" pushbutton to return to "Adjust Service" menu.
- Press "MENU OFF" pushbutton to return to "Settings Adjust" menu.

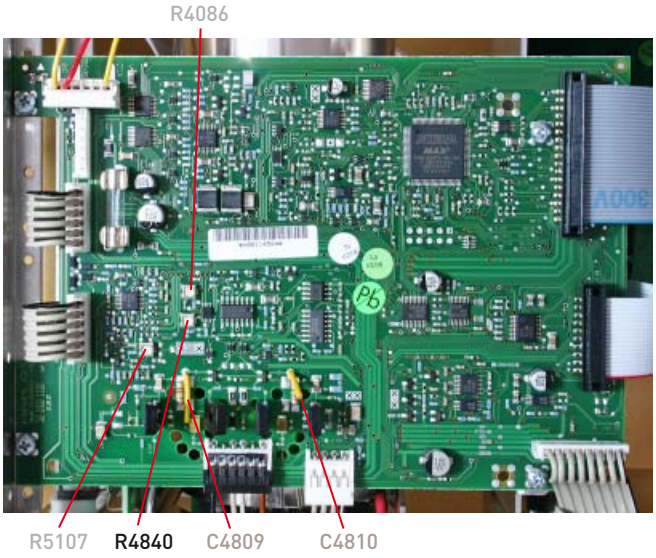
Continue with item 55.

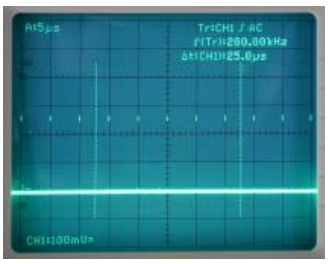
55 R4840: X-Mag. x10 Adjustment

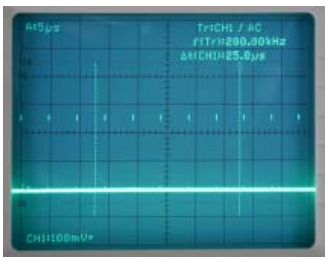
- Locate and identify R4840 on MB-Board.
- Set "TIME/DIV" knob for "TB: 50µs" display.
- Move trace with "HORIZONTAL" knob so that it is centred.
- Press "MAG x10" pushbutton so that x10 is lit.
- Set "POSITION 1" knob so that the trace is displayed in the vertical centre of the graticule.
- Connect a 200 kHz signal from HZ620 (SIGNAL pushbutton setting "Pulse 50Ω") to the input of CH 1.
- Turn "CH 1 VOLTS/DIV" knob for approx. 2 divisions signal height.
- Set "LEVEL A/B" knob for stable triggering.

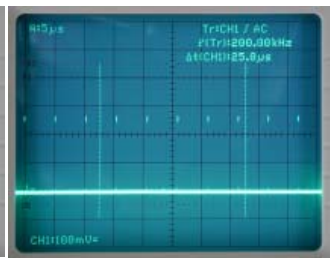
Adjustment Procedure:

- Move trace with "HORIZONTAL" knob so that the first zero crossing coincides with the first or second vertical graticule line at the left side of the screen.
- Adjust R4840 so that 1 signal period per division is displayed and the rightmost zero crossing coincides with the vertical graticule line as on the left side.




correct


too slow

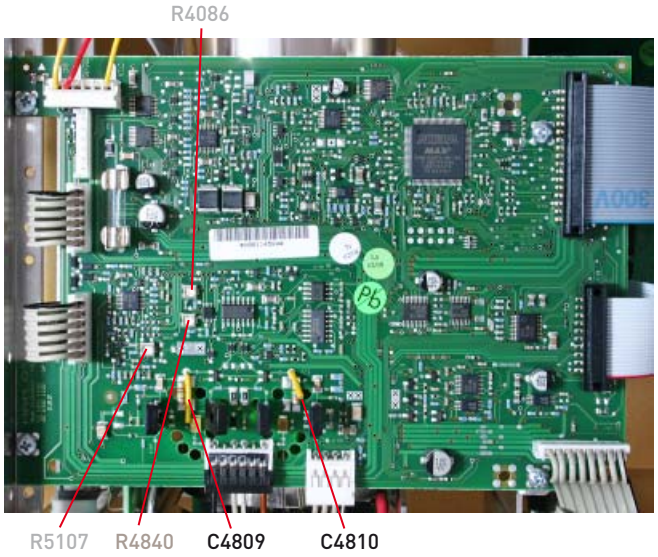

too fast

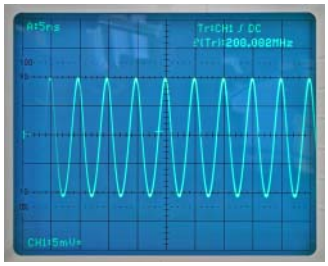
56 C4809, C4810: X-Mag. x10 Trace Start Linearity Adjustment

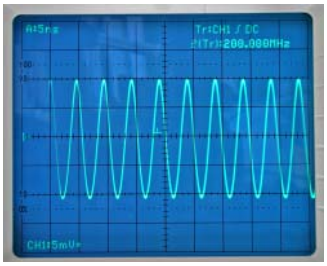
- Locate and identify C4809, C4810 (one or two wires close to the X final amplifier transistors) on MB-Board.
- Set "TIME/DIV" knob for "TB: 50ns" display.
- Turn the "HORIZONTAL" knob to move the trace start to the centre.
- Press "MAG x10" pushbutton so that it is lit.
- Connect a 200 MHz sine wave signal (accuracy 0.1 ppm or better) to the input of CH 1.
- Turn "CH 1 VOLTS/DIV" knob for a suitable signal height.
- Set "POSITION 1" knob for a reading at a horizontal line of the graticule.
- Set "LEVEL A/B" knob for stable triggering.

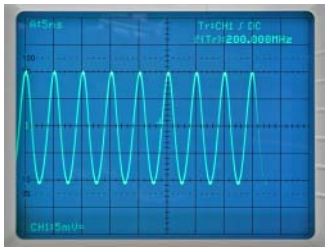
Adjustment Procedure:

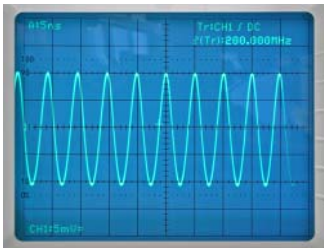
- Move trace with "HORIZONTAL" knob so that the trace start is displayed and the first signal peak coincides with a vertical graticule line at the left side of the screen.
- Adjust (move) C4809 so that each following signal peak coincides with the next vertical graticule line.
- Move trace with "HORIZONTAL" knob so that the trace end is displayed and the last signal peak coincides with a vertical graticule line at the right side of the screen.
- Adjust (move) C4810 so that each signal peak coincides with a vertical graticule line.




C4809: correct


too slow

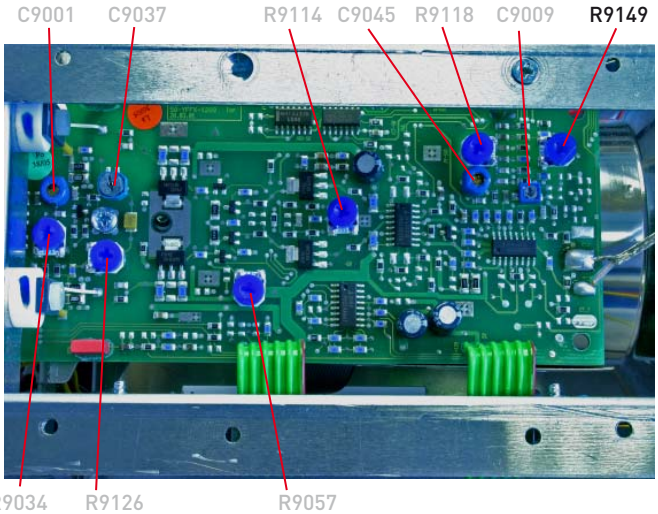

C4810: correct

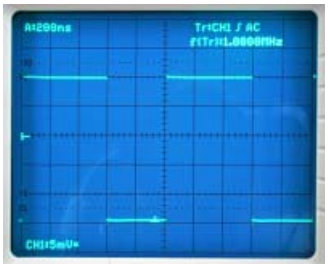

too fast

57 R9149: Y-Final Amplifier Adjustment

- Connect a 1 MHz square wave signal of 25 mV_{pp} via – 50Ω cable and 50Ω through termination to input CH 1.
- Set A timebase to 200 ns/div.
- Locate and identify R9149 on YF board.
- Adjust R9149 for a flat top of the 1 MHz top.

Continue with item 58

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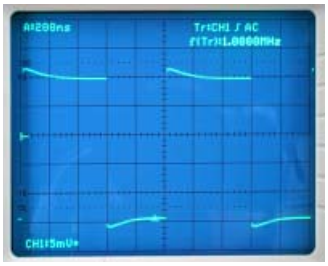
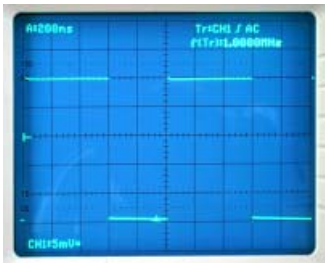
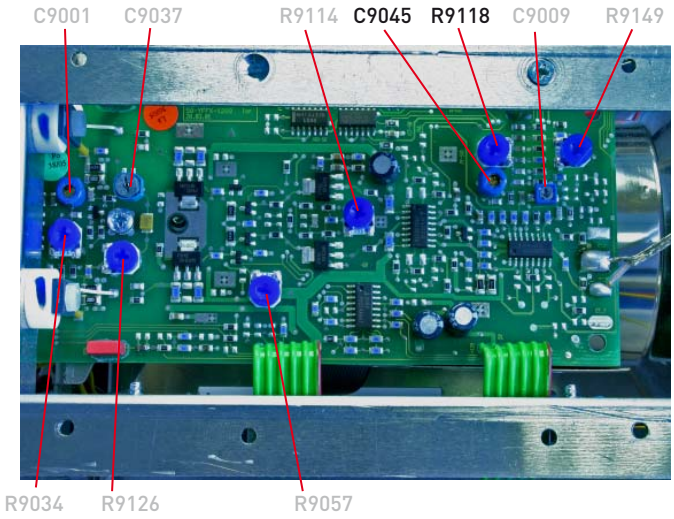

overcompensated


undercompensated

58 R9118, C9045: Y-Final Amplifier Adjustment

- Connect a 1 MHz square wave signal of 25 mVpp via 50Ω= cable and 50Ω through termination to input CH 1.
- Set A timebase to 50 ns/div.
- Locate and identify R9118 and C9045 on YF board.
- Adjust R9118 and C9045 for a flat top of the first third of the 1 MHz top.

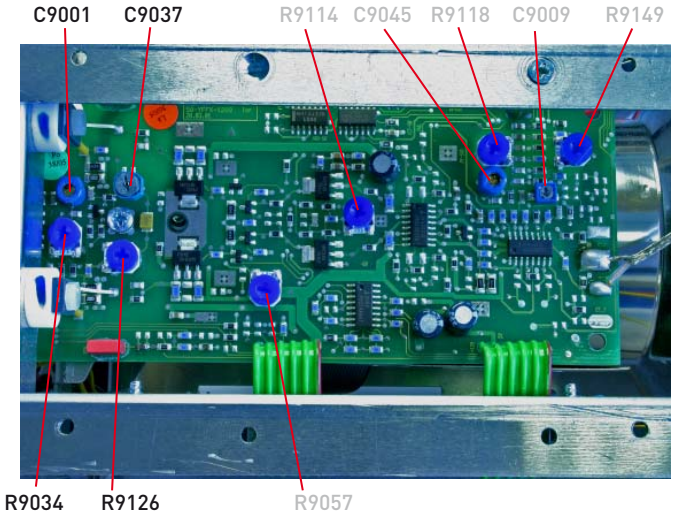
Continue with item 59.



59 R9034, C9001 and R9126, C9037: Y-Final Amplifier Adjustment

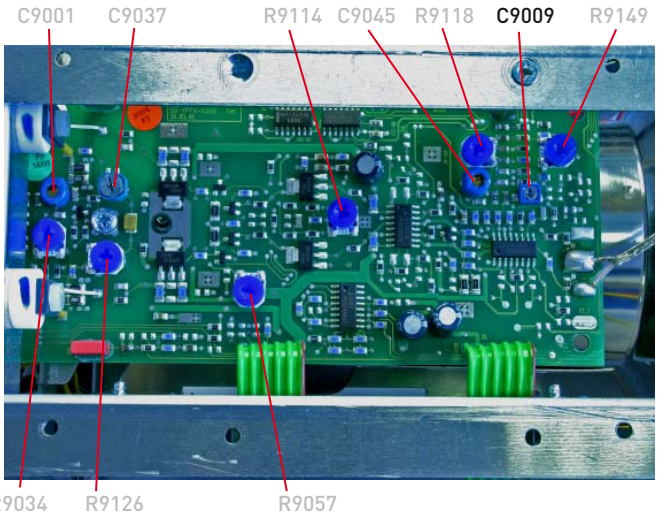
- Connect a 1 MHz square wave signal of 25 mVpp via 50Ω cable and 50Ω through termination to input CH 1.
- Check that A timebase is set to 50 ns/div.
- Locate and identify R9034 and C9001 on YF board.
- Adjust R9034 and C9001 for fast leading edge (minimum risetime) and minimum overshoot.
- Set A timebase to 200 ns/div.
- Adjust R9126 and C9001 for a straight top of the first 20 ns.
- Locate and identify R9126 and C9037 on YF board.
- Adjust R9126 and C9037 for minimum ripple.
- Repeat item 57, 58 and 59 for optimum performance.
- Remove signal from input CH 1.

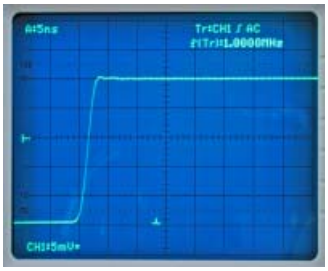
Continue with item 60.

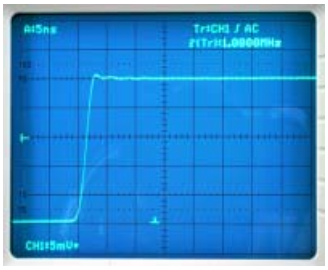


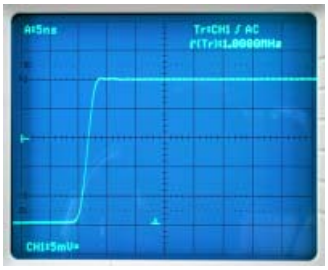
60 C9009: HF Adjustment CH1

- Connect a 1 MHz square wave signal of 25 mVpp via 50Ω cable and 50Ω through termination to input CH 1.
- Check that A timebase is set to 50 ns/div.
- Press "MAG x10" pushbutton so that it is lit (5 ns/div).
- Locate and identify C9009 on YF board.
- Adjust C9009 for fast leading edge (minimum risetime) and minimum overshoot.



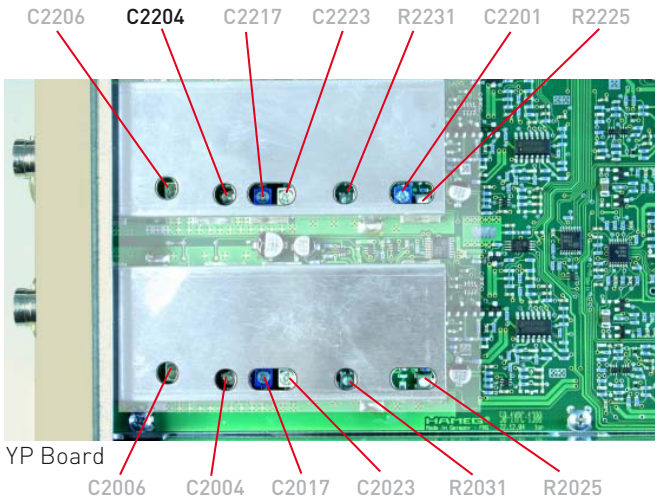

correct


overcompensated

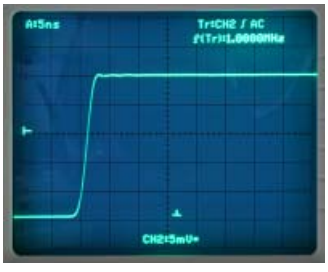

undercompensated

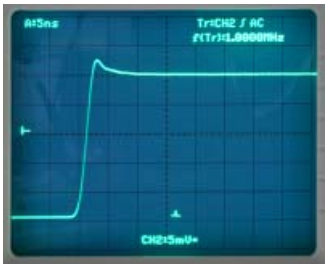
61 C2201: HF Adjustment CH2

- Press "VERT/XY" pushbutton to call the Vertical menu.
- Press "CH2" function key to select CH 2 mode.
- Press "CH2 VAR" pushbutton and select "DC" input coupling.
- Set A timebase to 50 ns/div.
- Press "MAG x10" pushbutton so that it is lit (5 ns/div).
- Set "VOLTS/DIV" CH 2 to 5 mV/div.
- Connect a 1 MHz square wave signal of 25 mVpp via 50Ω cable and 50Ω through termination to input CH 2.
- Locate and identify C2201 on YP board.
- Adjust C2201 for fast leading edge (minimum risetime) and minimum overshoot.



YP Board


correct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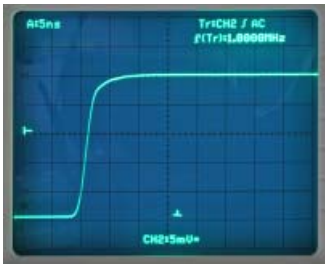
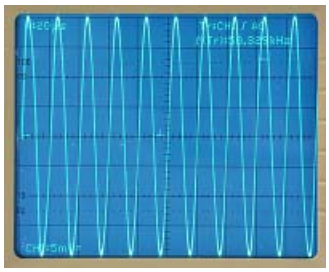
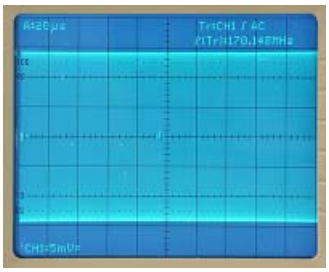

undercompensated

62 CH1 Y-Amplifier Bandwidth Check

- Check that CH 1 mode is present.
- Check that "VOLTS/DIV" CH 1 is set to 5 mV/div.
- Set A timebase to 20 µs/div.
- Connect a 40 mVpp / 4 MHz sinewave signal from a constant amplitude generator via a 50 Ω cable and a 50 Ω through terminator to the input of CH 1.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).
- If the bandwidth is less than 160 MHz adjust C9009 on YF board for 5.6 div. height at 160 MHz and repeat all adjustments of item 57, 58, 59 and 60 until bandwidth and squarewave are OK.



CH1, 50 kHz 8 div. Reference



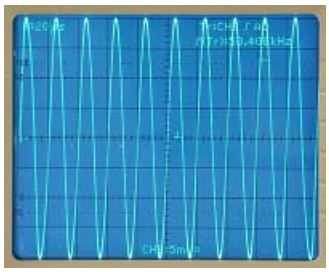
CH1, –3dB (5.6 div.) Frequency

Continue with item 63.

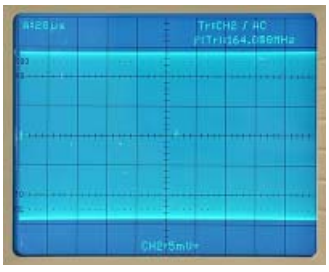
63 CH2 Y-Amplifier Bandwidth Check

- Continue the adjustment under the last conditions of item 62.
- Press "VERT/XY" pushbutton to call the Vertical menu.
- Press "CH 2" function key to select CH 2 mode.
- Check that "VOLTS/DIV" CH 2 is set to 5 mV/div.
- Check that A timebase is set to 20 µs/div.
- Connect a 40 mVpp / 4 MHz sinewave signal from a constant amplitude generator via a 50 Ω cable and a 50 Ω through terminator to the input of CH 2.
- Adjust the generator amplitude for 8 div. display height on the screen.
- Increase the generator frequency until the signal height is 5.6 div. (-3dB).

- If the bandwidth is less than 160 MHz adjust C2201 on YP board for 5.6 div. height at 160 MHz and repeat the adjustment of item 61 until bandwidth and squarewave are OK.



CH2, 50 kHz 8 div. Reference



CH2, –3dB (5.6 div.) Frequency

64 Video Trigger Check

- Connect a Composite Video Signal with positive polarity (line and frame content above the sync pulses) to input CH 1.
- Set A timebase to 100 µs/div.
- Press "MODE" pushbutton to call "Trigger" menu.
- Press "Video" function key to activate Video triggering.
- Press "FILTER" pushbutton to call "Video" menu.
- Press "Frame Line" function key to activate Frame triggering.
- Press "All" function key to accept all frame sync pulses for triggering.
- Check that "Polarity Positive" is selected.
- Check that the "Norm ...." setting (625/50 or 525/60) is in accordance with the Video Signal applied.
- Reduce the signal height so that the sync pulses height is 5mm.
- Check that the Video Signal is a (triggered) stable display.

65 Trigger Filter Check

- Set timebase to 500 µs/div.
- Set attenuator CH 1 to 5 mV/div.
- Connect a 1kHz sinewave signal of 25 mV_{pp} amplitude to input CH 1 and check for 5 div. Y deflection.
- Set attenuator CH 1 to 50 mV/div and check for 5mm display height.
- Press "MODE" pushbutton to call "Trigger" menu.
- Press "Edge" function key to activate Edge triggering.
- Press (Trigger) "FILTER" pushbutton to call "Edge" menu.
- Select trigger coupling AC, DC, HF, Noise Reject and LF.
- With the exception of HF, the signal must always trigger the oscilloscope. As in DC trigger coupling mode the peak value triggering is switched off, turn the "LEVEL A/B" knob until stable triggering is performed.
- Set timebase to 20 µs/div.
- Set sinewave generator to 50 kHz and 25 mV_{pp} output amplitude and check for 5 div. Y deflection.
- Set attenuator CH 1 to 50 mV/div and check for 5mm display height.
- Select trigger coupling AC, DC, HF, Noise Reject and LF.
- Except in LF trigger coupling condition, the signal must always trigger the oscilloscope. As in DC trigger coupling mode, the peak value triggering is switched off; turn the LEVEL A/B knob until stable triggering is performed.

66 Trigger Bandwidth Check

- Set timebase to 50 ns/div.
- Press "MAG x10" pushbutton to activate 10-fold X magnification, so that the time deflection coefficient is 5 ns/div..
- Connect a 200 MHz sinewave signal to input CH 1.
- Adjust generator output for 5mm display height.
- The signal must trigger the oscilloscope.

67 External Trigger Check

- Set timebase to 20 µs/div.
- Set input attenuator CH 1 to 100 mV/div.
- Connect a 50 kHz sinewave signal via a 50Ω cable and a 50Ω through terminator with an amplitude of 300 mVpp to input CH 1 and check for 3 div display height.
- Press (Trigger) "MODE" pushbutton and check that automatic triggering in combination with edge triggering ("Auto", "Edge") is activated.
- Press (Trigger) "FILTER" pushbutton and check that AC trigger coupling is chosen.
- Check that the trigger ("TRIG`d") LED is lit.
- Press (Trigger) "SOURCE" pushbutton to call the "Trig. Source" menu.
- Press "External" function key to activate the AUXILIARY INPUT as external trigger signal input.
- Check that the signal is displayed untriggered and the TRIG`d LED is not lit.
- Remove signal from input CH 1.
- Connect the signal to the AUXILIARY INPUT BNC connector.
- Now the TRIG`d- LED must light.

78 Z Input

- Press "ANALOGUE/DIGITAL" pushbutton to select mode.
- Check that "External" triggering is not active.
- Press "LC/AUX" pushbutton to call the "Z Input" menu (impossible when "External" trigger mode is chosen).
- Press "On Off" function key to select "On" and to activate the Z Input function.
- Set timebase to 20 µs/div.
- Connect a 2.5 Vpp, 1 Hz square wave signal (switching between 0 V and 2.5 V and vice versa) to AUXILIARY INPUT.
- Check that the trace is continuously switching between unblank and blank.

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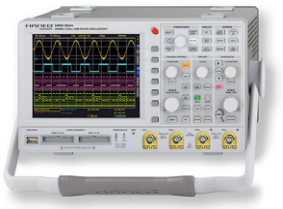

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