ENGLISH

4S-0303-04E0

10 JUN 1998

HAMEG®
Instruments

Oscilloscope
HM 303-4

SERVICE-MANUAL HM303-4

Service Manual
Circuit Diagrams
Adjustment Procedure

HM303-4

St. 100698. Hüb/goRR

Specifications

Vertical Deflection

Operating modes: Channel I or II separate, both Channels (alternated or chopped), (Chopper frequency approx. 0.5MHz).
Sum or **difference** with Ch. I and Ch. II (both channels invertable).
XY-Mode: via channel I and channel II
Frequency range: 2xDC to 30MHz (–3dB)
Risetime: <12ns.
Overshoot≤1%.
Deflection coefficients: 12 calibrated steps from 5mV/div. to 20V/div. (1-2-5 sequence) with variable 2.5:1 up to **50V/div.**
Accuracy in calibrated position: ±3%
Y-expansion x5 (calibrated) to **1mV/div.** (±5%) in the frequency range from DC - 10MHz (–3dB)
Input impedance: 1MΩ II 20pF.
Input coupling: DC-AC-GD (ground).
Input voltage: max. 400V (DC + peak AC).

Triggering

Automatic: (peak to peak) **<20Hz-100MHz** (≤ 0.5div.)
Normal with level control: **DC-100MHz** (≤0.5div.)
ALT. Triggering; LED indicator for trigger action
Slope: positive or negative,
Sources: Channel I or II, CH. I alternating CH II, line, external
Coupling: **AC** (10Hz to 100MHz),
DC (0 to 100MHz),
LF (0 to 1.5kHz)
Active TV-Sync-Separator (pos. and neg.)
External: ≥0.3$_{p\text{-}p}$ from 30Hz to 30MHz

Horizontal Deflection

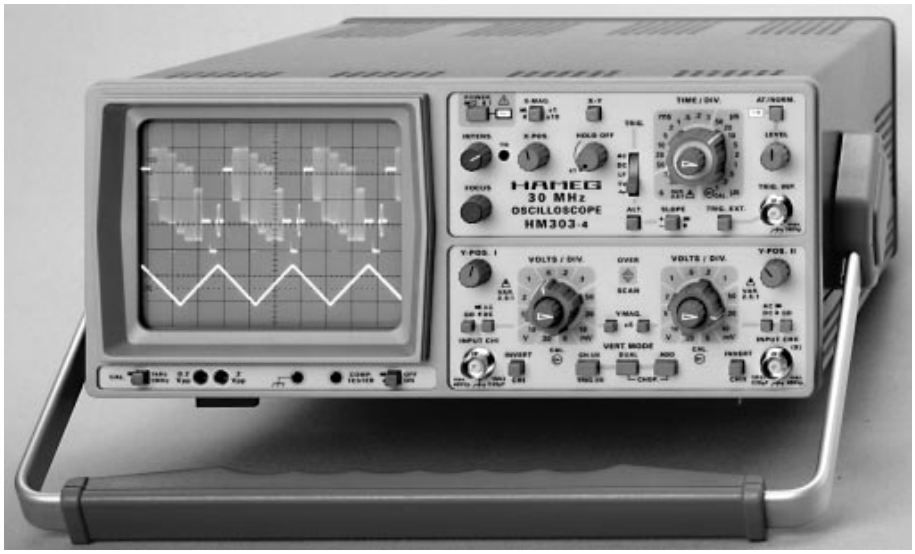
Time coefficients: 20 calibrated steps from 0.2s/div. - 0.1µs/div. in 1-2-5 sequence
Accuracy in calibrated position: ±3%.
Min. speed incl. variable 2.5:1 up to 0.5s/div. with X-Mag. x10: ±5%; 10ns/div.: ±8%
Holdoff time: variable to approx. 10:1
Bandwidth X-amplifier: 0-3MHz (–3dB).
Input X-Amplifier via Channel II, (sensitivity see Channel II specification)
X-Y phase shift: <3° below 220kHz.

Component Tester

Test voltage: approx. 6V$_{rms}$ (open circuit).
Test current: approx. 5mA$_{rms}$ (shorted).
Test frequency: approx. 50Hz
Test connection: 2 banana jacks 4mm ∅
One test lead is grounded (Safety Earth)

General Information

CRT: D14-364GY/123 or ER151-GH/-, 6" rectangular screen (8x10cm) internal graticule
Acceleration voltage: approx 2000V
Trace rotation: adjustable on front panel
Calibrator: square-wave generator (t$_r$ <4ns) ≈1kHz / 1MHz; Output: 0.2V ±1% and 2V
Line voltage: 100-240V AC ±10%, 50/60Hz
Power consumption: approx. 36 Watt at 50Hz.
Min./Max. ambient temperature: 0°C...+40°C
Protective system: Safety class I (IEC 1010-1)
Weight: approx. 5.6kg, color: techno-brown
Cabinet: **W** 285, **H** 125, **D** 380 mm
Lockable tilt handle



30MHz Standard Oscilloscope HM 303

Dual Channel, DC to 30MHz, 1mV/div.; Overscan Indicator
Time Base: 0.2s to 10ns/div.; Variable Holdoff; Alternate Triggering
Triggering: DC-100MHz; Auto Peak to Peak; Active TV-Sync-Separator
Additional Features: Component Tester, 1kHz/1MHz Calibrator

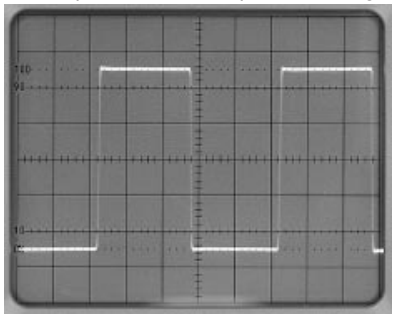
The new **HAMEG HM303** oscilloscope succeeds the HM203 (over 170,000 sold worldwide). The bandwidth has been extended from 20 to **30MHz**, the sweep rate increased to **10ns/div.** and improvements added to the already legendary **HAMEG** auto triggering system. The **HM303** is the ideal instrument for waveform display in the **DC** to **100MHz** frequency range.

A key feature of this oscilloscope is the vertical amplifier's pulse fidelity, limiting overshoot to only 1%. The **HM303** offers a special fast rise time **1kHz/1MHz Calibrator**, permitting high quality probe compensation across the entire frequency range to ensure probe-tip thru to display integrity. An **Overscan Indicator** assists in vertical display amplitude and position adjustment.

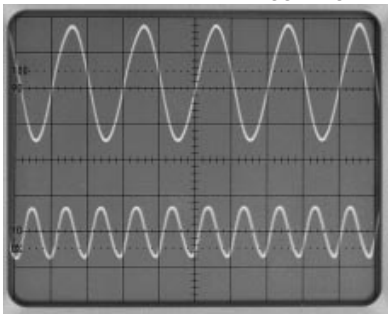
The **HM303** is capable of triggering on input waveforms over **100MHz** and on signal levels as small as 0.5 division. **Alternate triggering** mode enables the display of two asynchronous signals simultaneously. An active **Video Sync-Separator** permits detailed examination of complex TV signal inputs. A well proven, built-in **component tester** is now equipped with a stabilized measuring voltage. The use of a switching type of power supply minimizes both weight and power consumption and universally accepts a wide range of input power line voltages, without the requirement to change jumpers or switch positions. The **HM303's** CRT is fully **mu-metal shielded** against outside magnetic fields.

HAMEG is setting new **price/performance** breakthroughs with the introduction of this fine oscilloscope. This performance packed scope will tempt all users to run it through its paces.

Screen photo of 1 MHz square wave signal

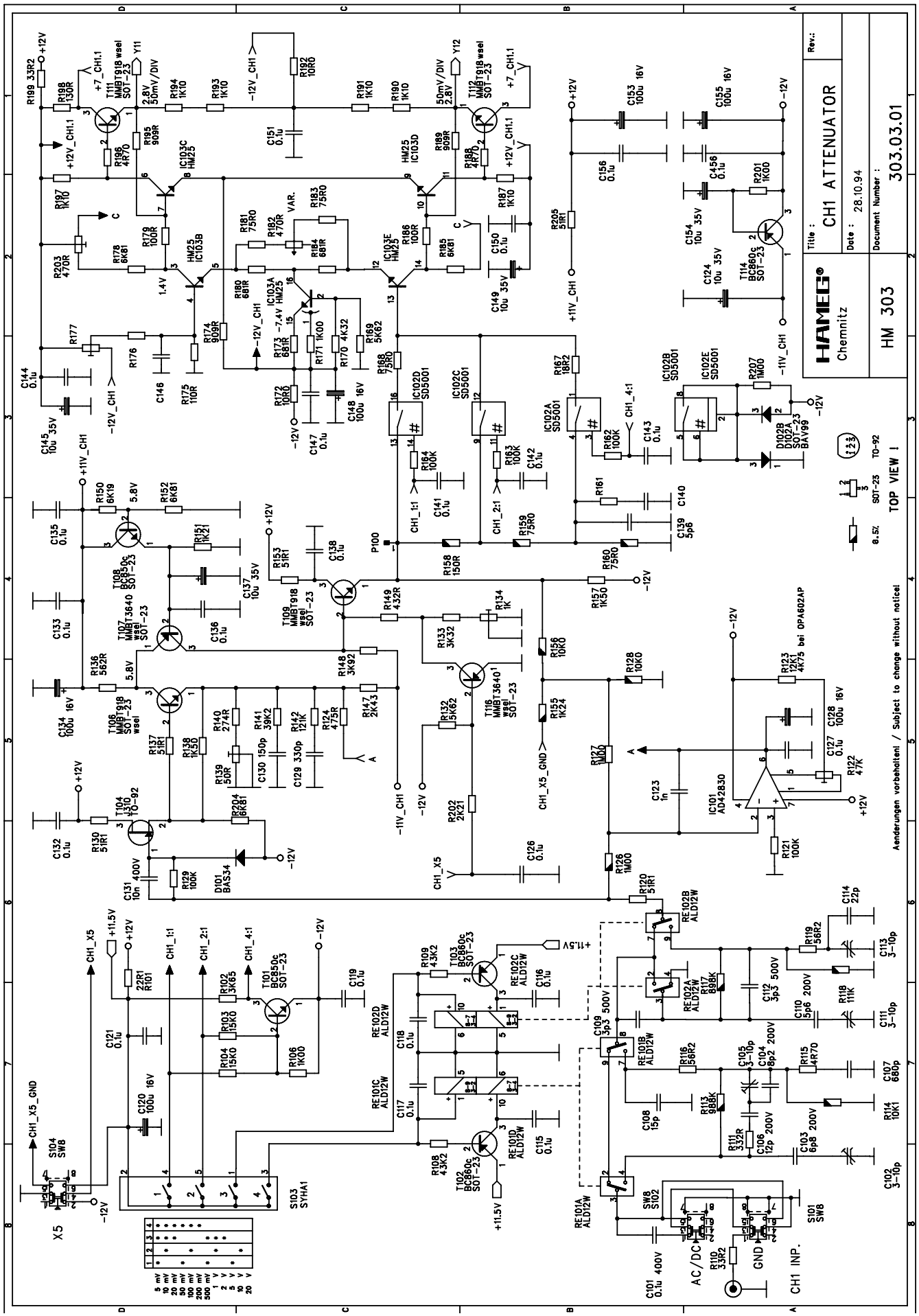


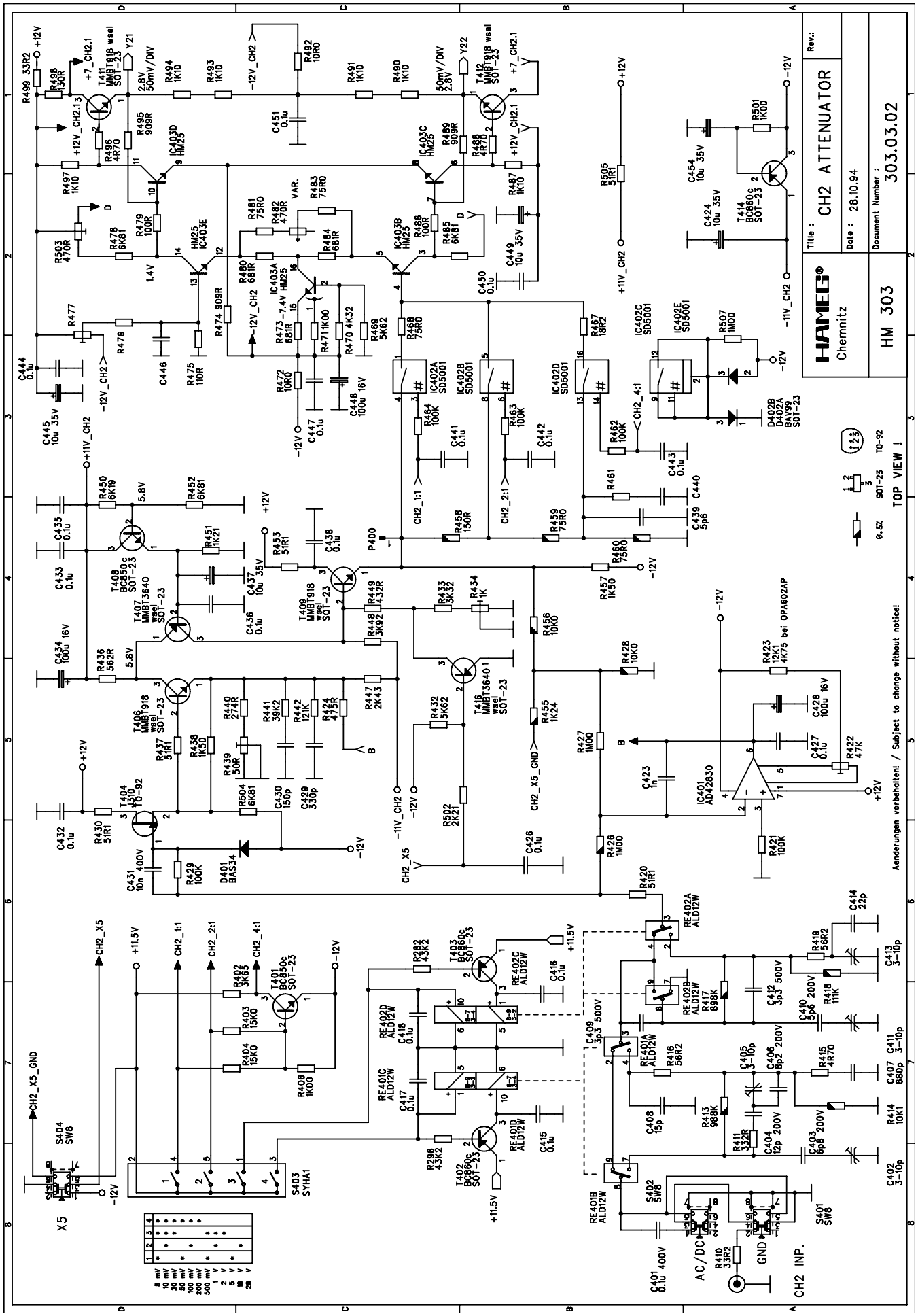
Screen photo of 50 and 100MHz sine wave with alternate triggering

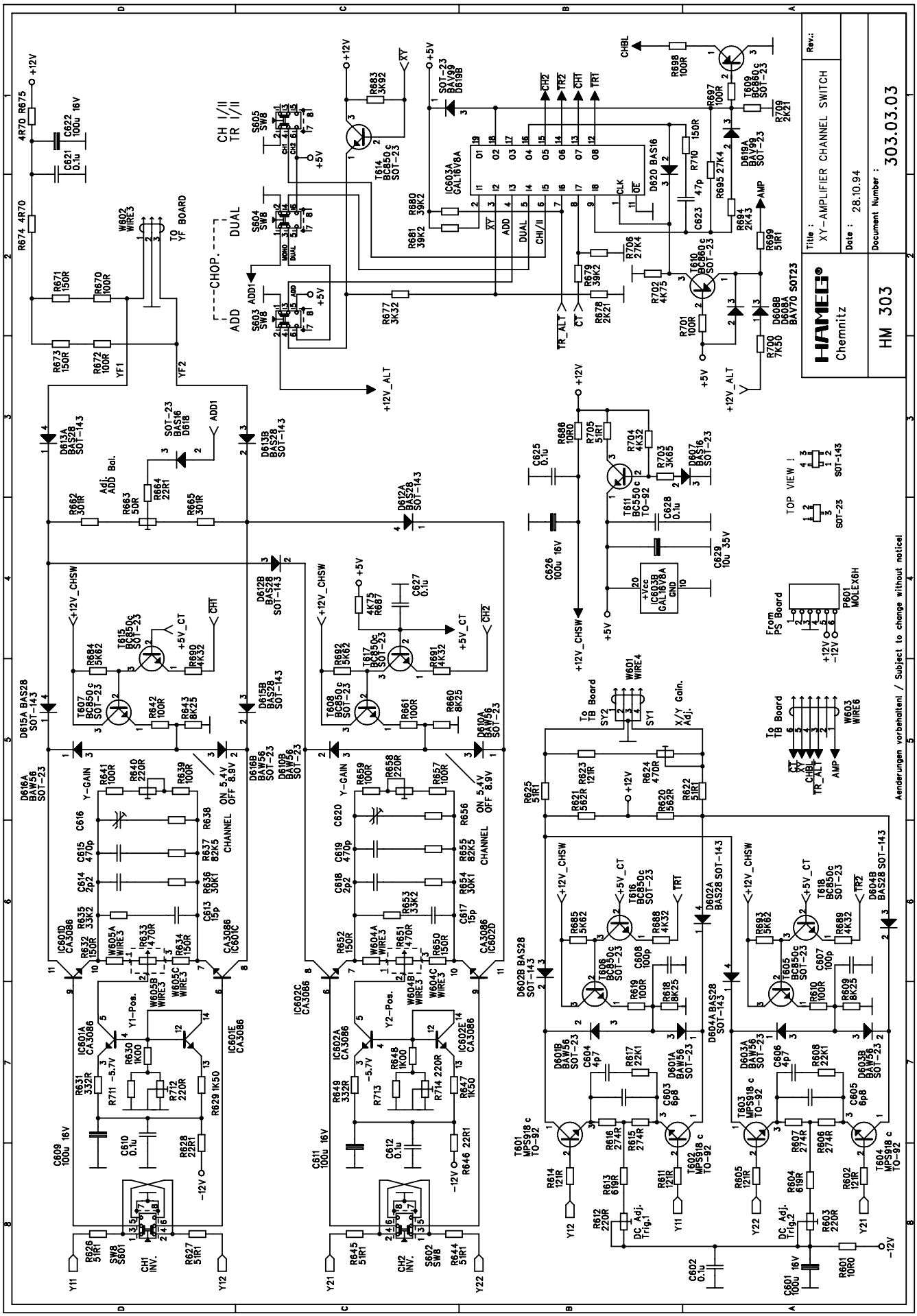


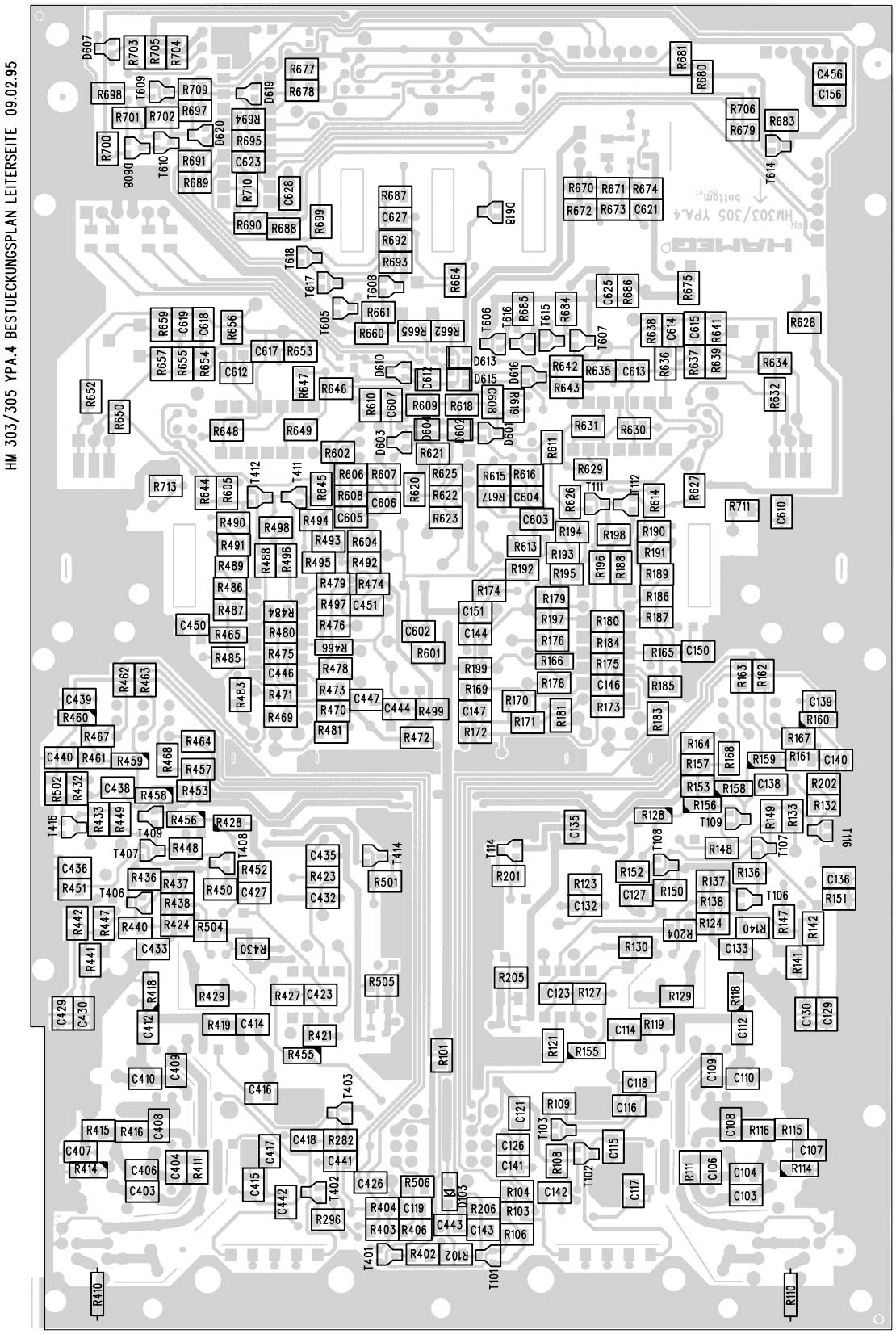
5/96

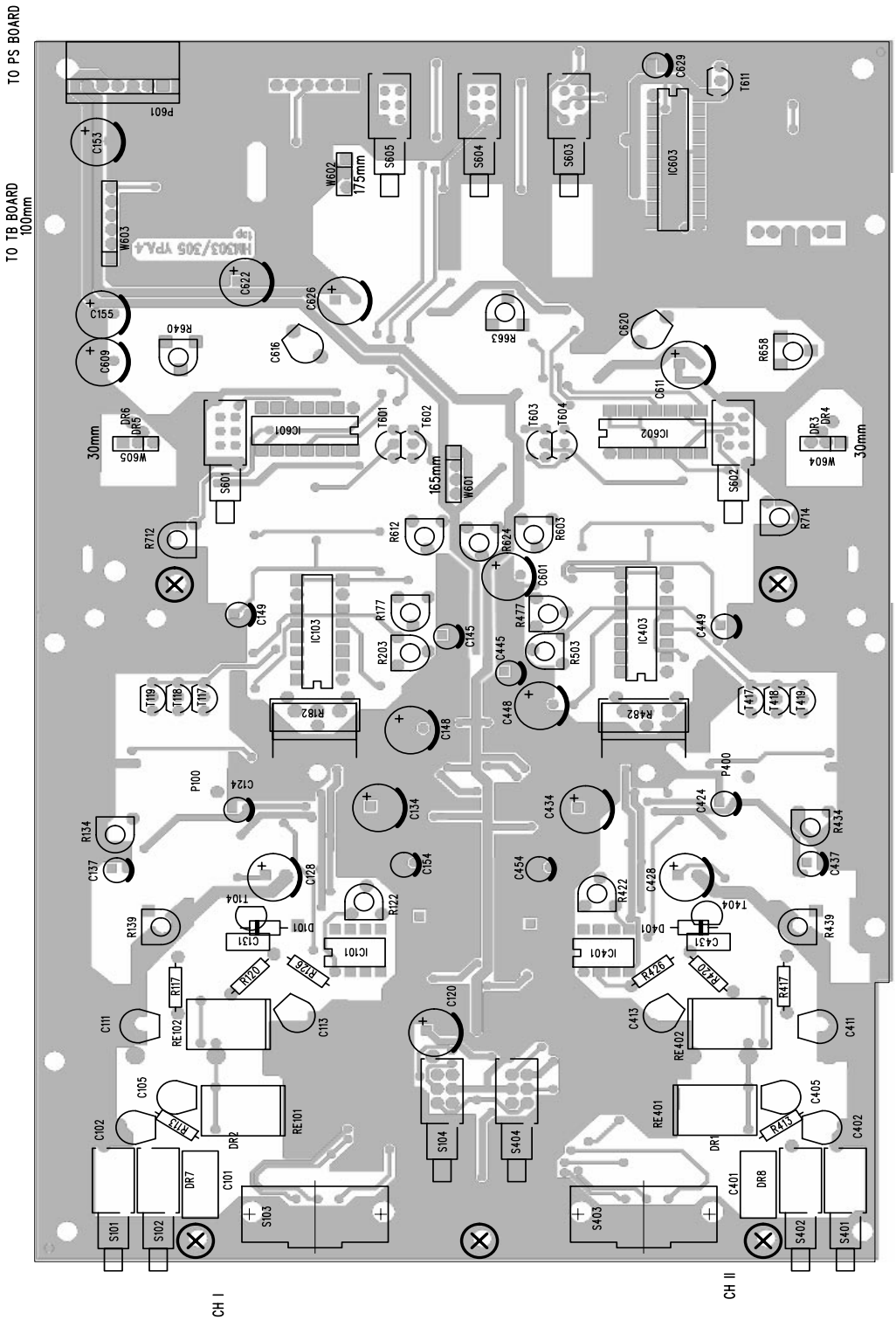
Accessories supplied: Line cord, Operators Manual, 2 Probes 1:1/10:1

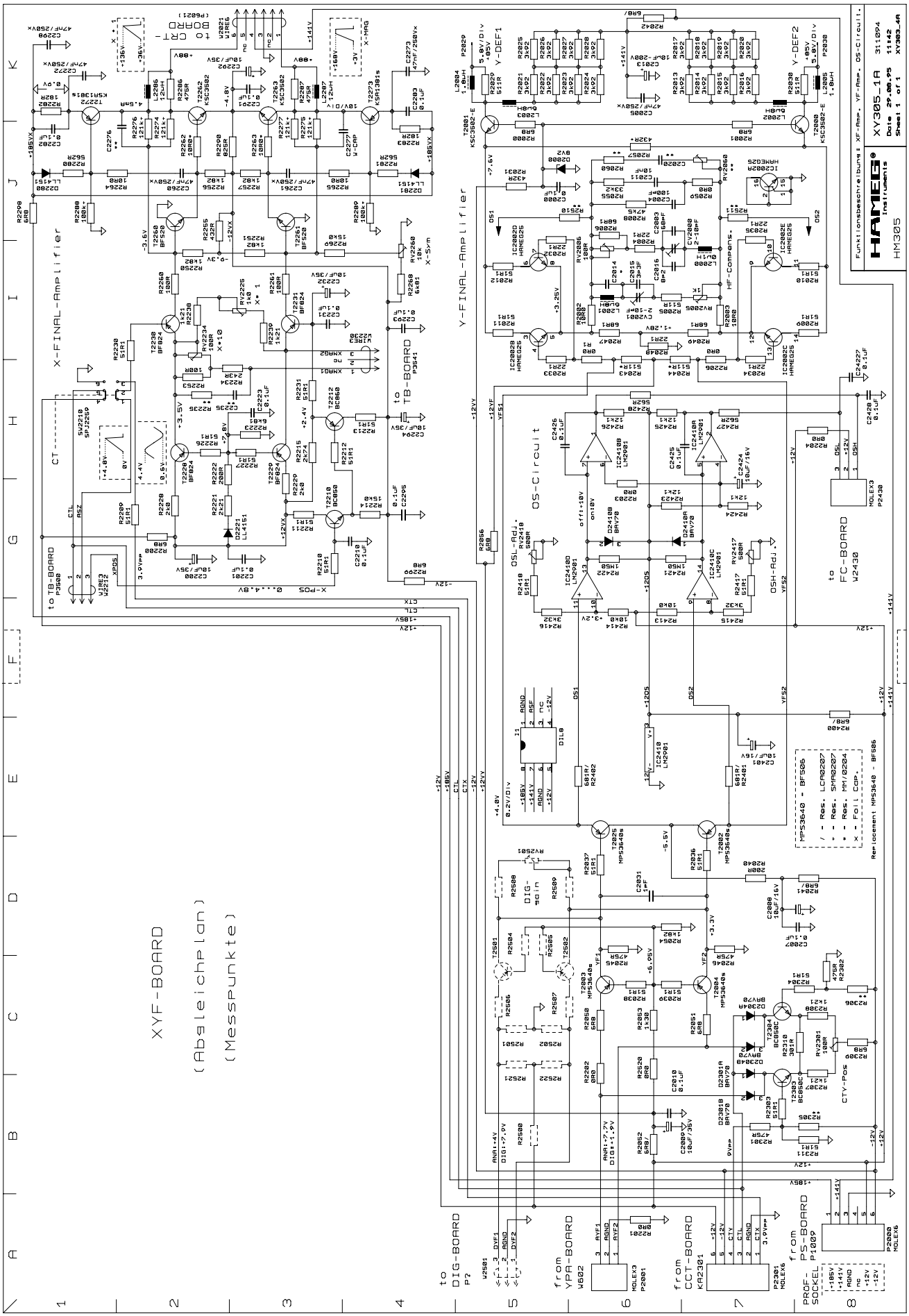

HAMEG
Chemnitz
Title : CH1 ATTENUATOR
Rev.:
Date : 28.10.94
Document Number : 303.03.01
HM 303
TOP VIEW I
CH1 INP.
AC/DC
GND
X5
Aenderungen vorbehalten! / Subject to change without notice!


HAMEG
Chemnitz
HM 303
Title : CH2 ATTENUATOR
Date : 28.10.94
Document Number : 303.03.02
Rev.:
TOP VIEW !
Aenderungen vorbehalten! / Subject to change without notice!
CH2 INP.
AC/DC
GND
X5
S401 SW8
S402 SW8
S403 SYHA1
S404 SW8
IC401 AD42830
IC402A SD5001
IC402B SD5001
IC402C SD5001
IC402D SD5001
IC402E SD5001
IC403A HM25
IC403B HM25
IC403C HM25
IC403D HM25
IC403E HM25
D401 BAS34
D402A BAV99
D402B BAV99
P400
+12V
-12V
+11V
-11V
+11.5V
-11.5V
CH2_X5
CH2_X5_GND
CH2_1:1
CH2_2:1
CH2_4:1
+7_CH2.1
-12V_CH2
+11V_CH2
+12V_CH2.13
+12V_CH2.1
-12V_CH2.1
Y21
Y22
2.8V 50mV/DIV
50mV/DIV 2.8V
5 mV
10 mV
20 mV
50 mV
100 mV
200 mV
500 mV
1 V
2 V
5 V
10 V
20 V

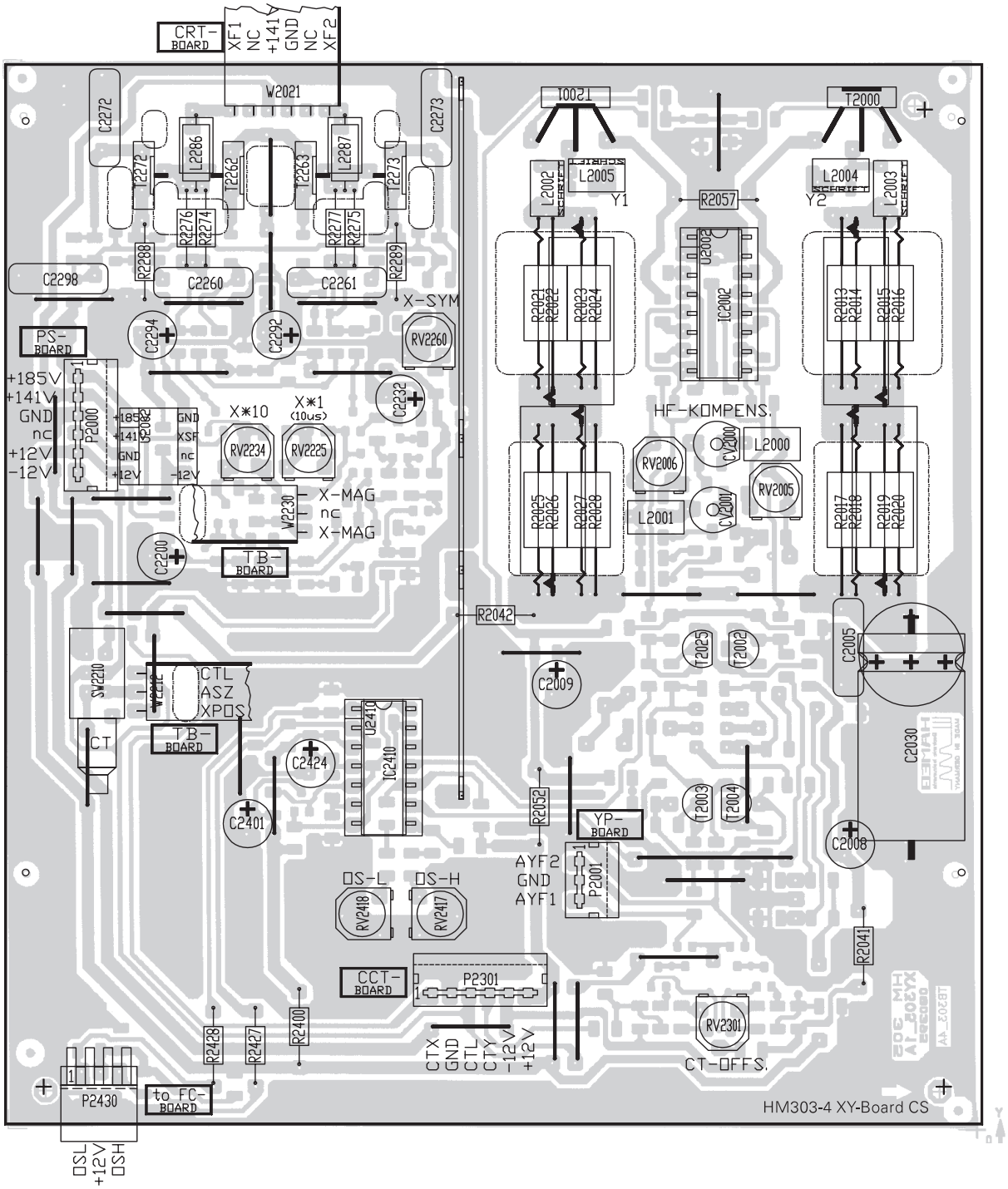

HAMEG
Chemnitz
HM 303
Title : XY-AMPLIFIER CHANNEL SWITCH
Date : 28.10.94
Document Number : 303.03.03
Rev.:
Änderungen vorbehalten! / Subject to change without notice!
CHOP.
ADD
DUAL
CH I/II
TR I/II
TO YF BOARD
Y-GAIN
CHANNEL
ON 5.4V
OFF 8.9V
Y1-Pos.
Y2-Pos.
DC Adj. Trig.1
DC Adj. Trig.2
CH1 INV.
CH2 INV.
X/Y Gain Adj.
To TB Board
From PS Board
TOP VIEW !

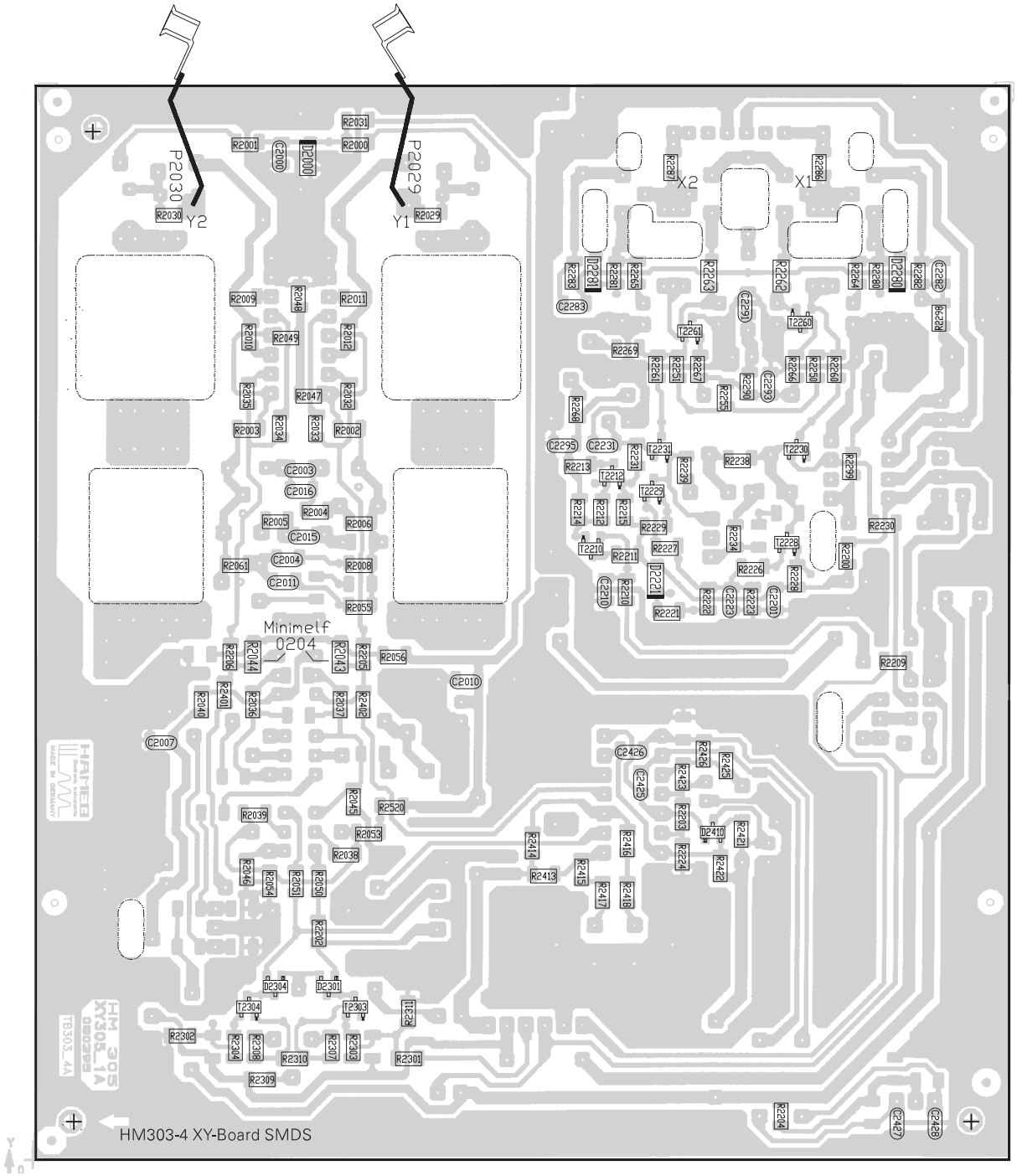

HM 303/305 YPA.4 BESTUECKUNGSPLAN LEITERSEITE 09.02.95

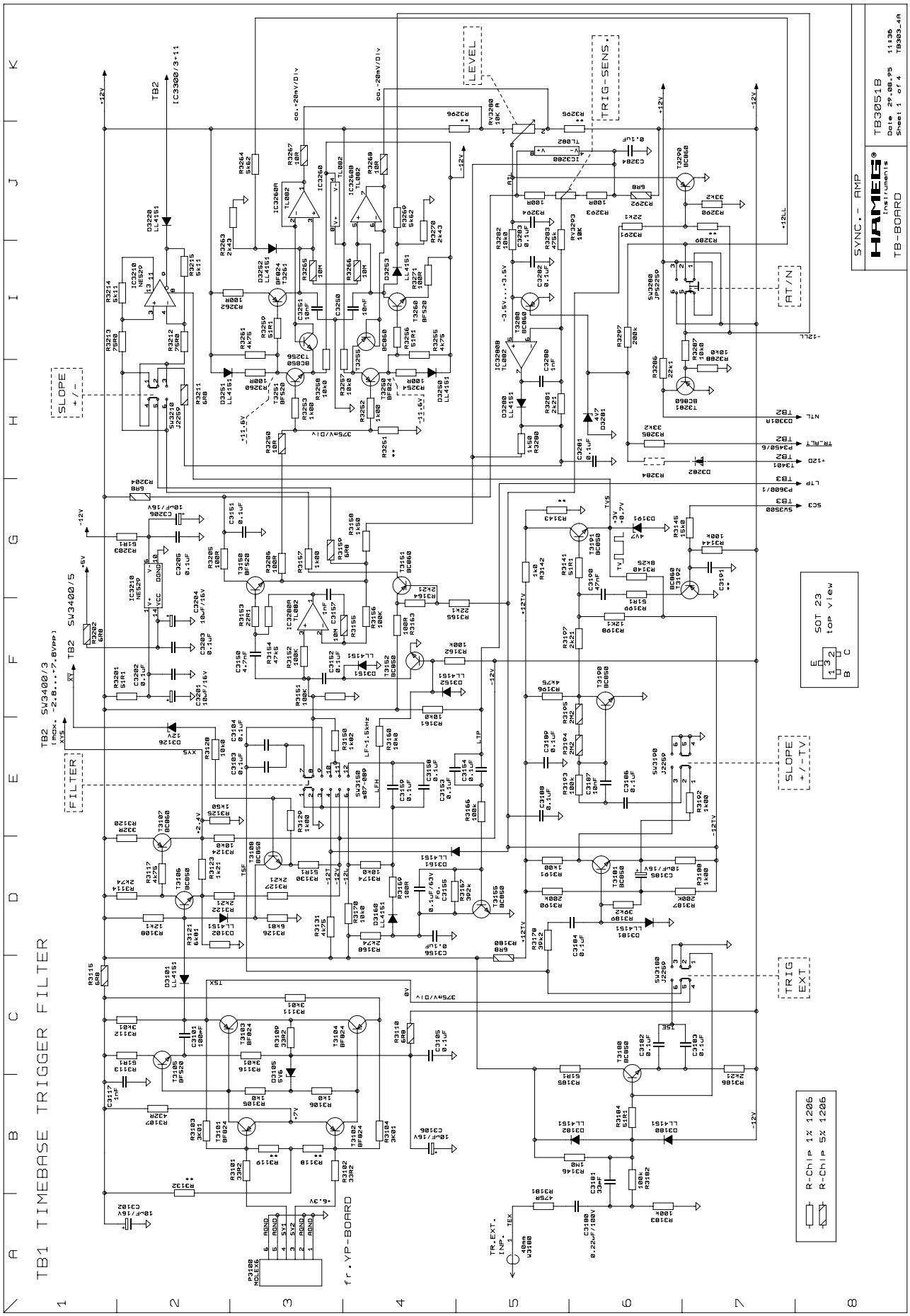

TO PS BOARD
TO TB BOARD
100mm
30mm
165mm
175mm
CH I
CH II

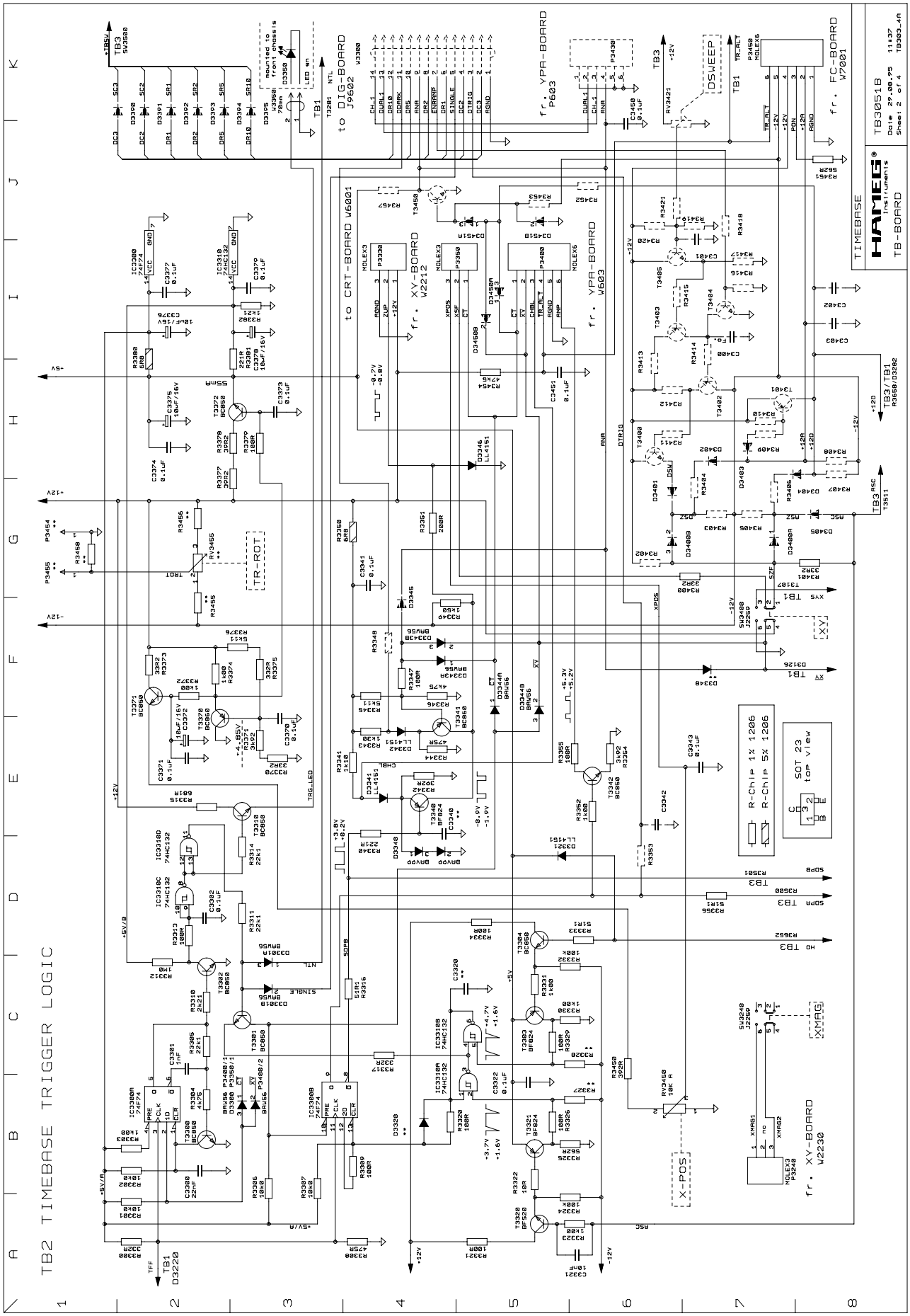

X-FINAL-Amplifier
Y-FINAL-Amplifier
OS-Circuit
XYF-BOARD
(Ableichplan)
(Messpunkte)
to TB-BOARD P3641
to TB-BOARD P3640
to FC-BOARD W2430
to DIG-BOARD P?
from YPA-BOARD W502
from CCT-BOARD KA2301
from PS-BOARD SOCKEL P1009
CTY-POS
HF-Compens.
XY305_1A
HM305
HAMEG
Instruments

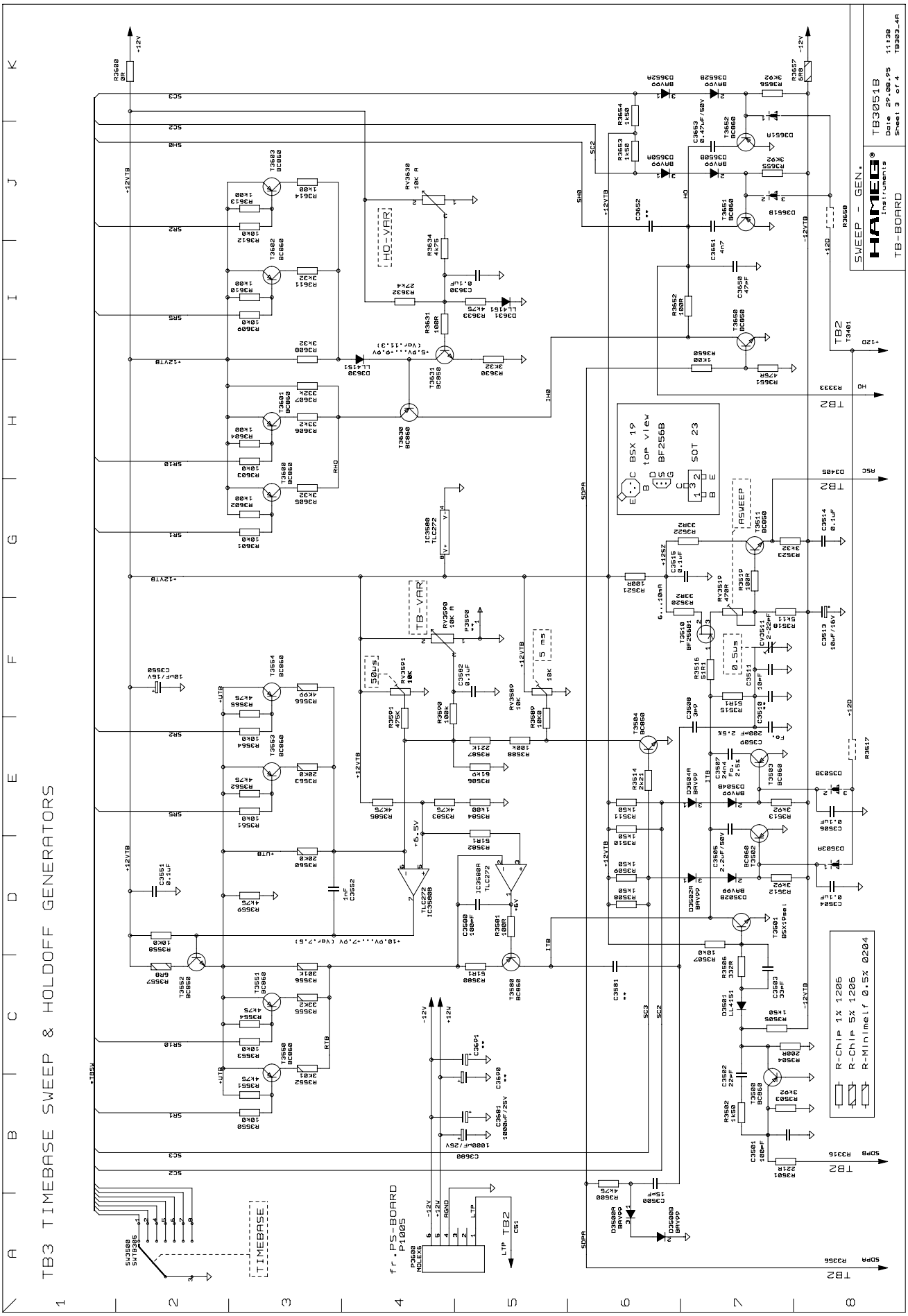
XY Board (Top side)

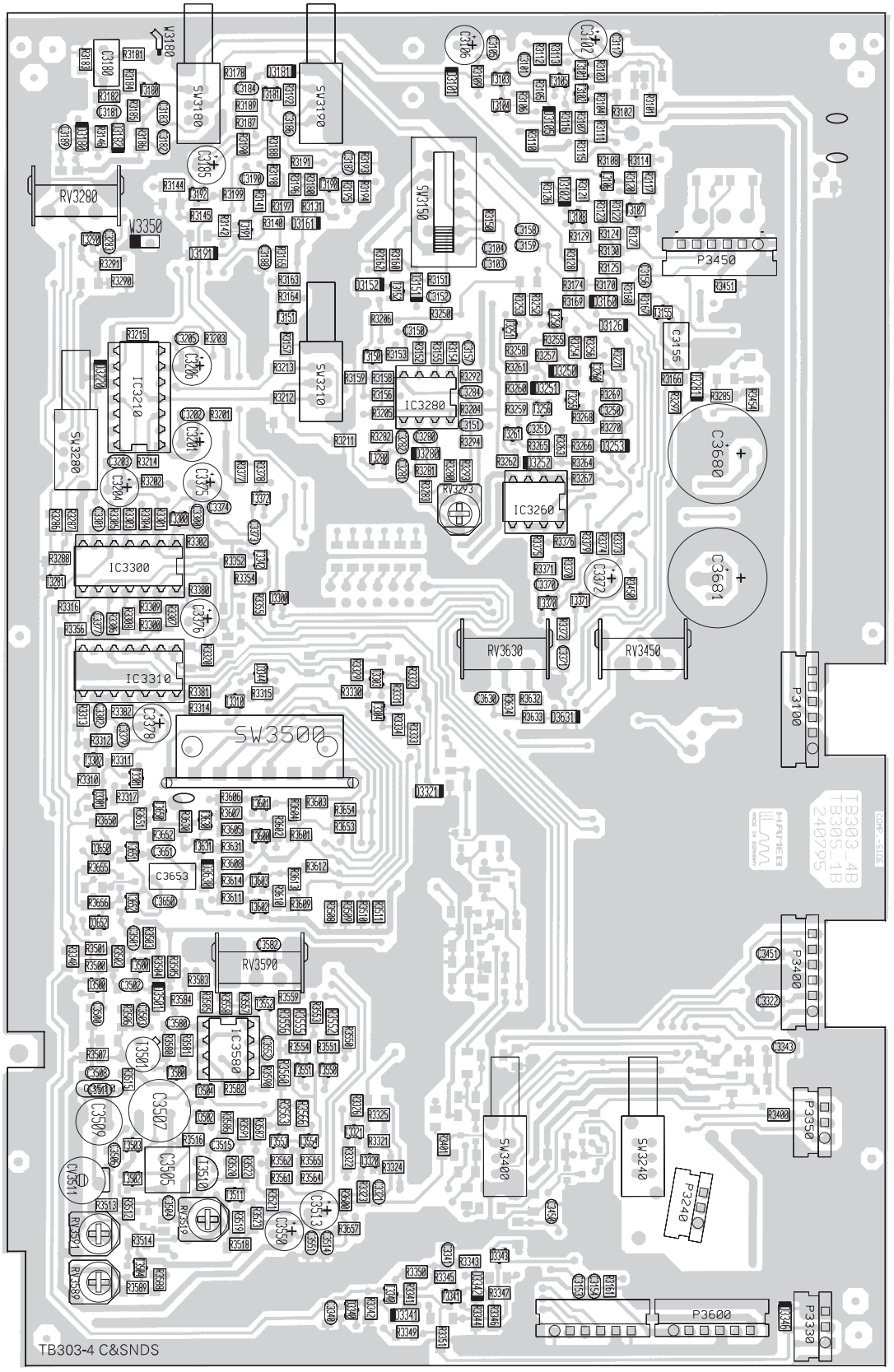


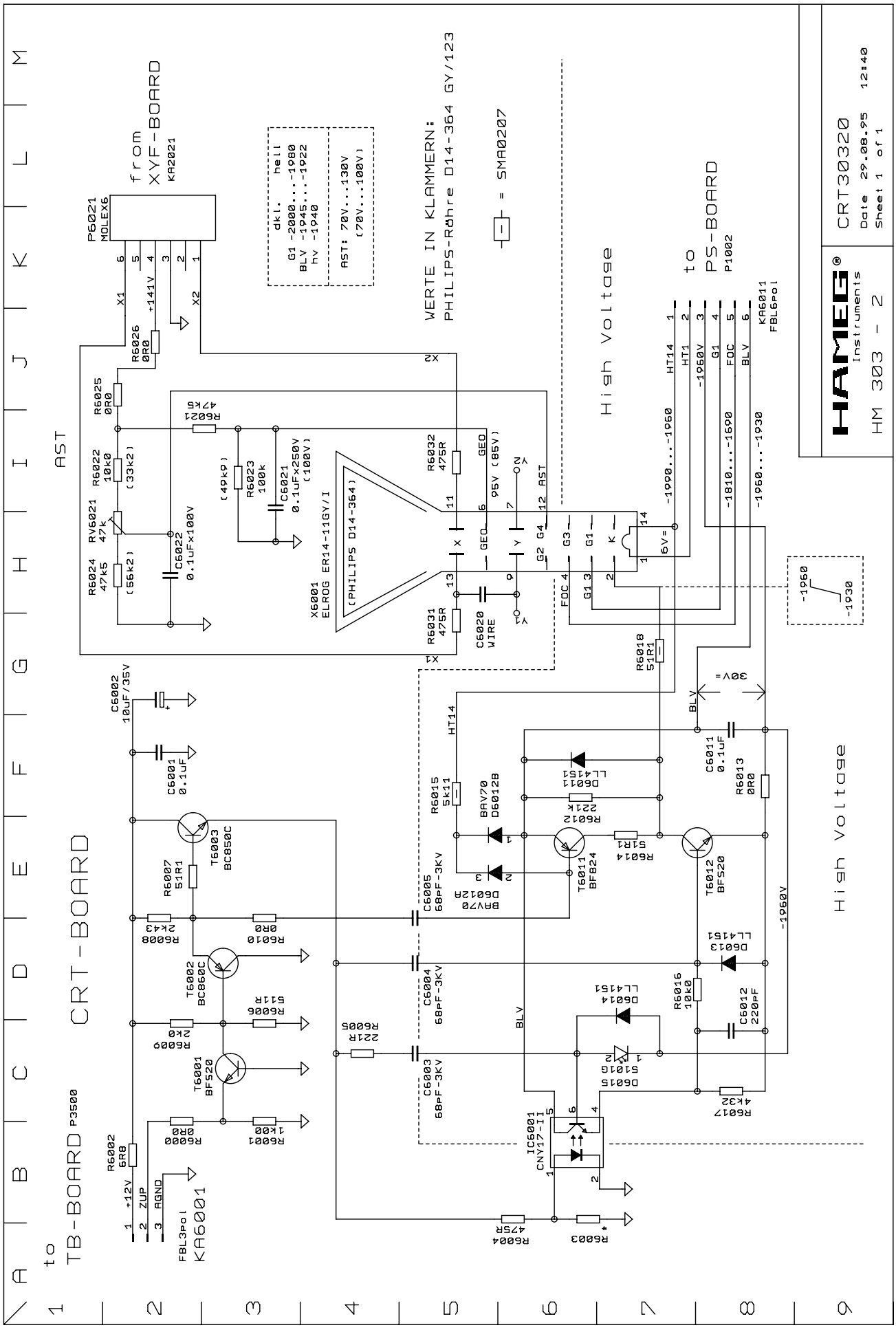

P2030
P2029
Y2
Y1
X2
X1
Minimelf
0204
HM303-4 XY-Board SMDS

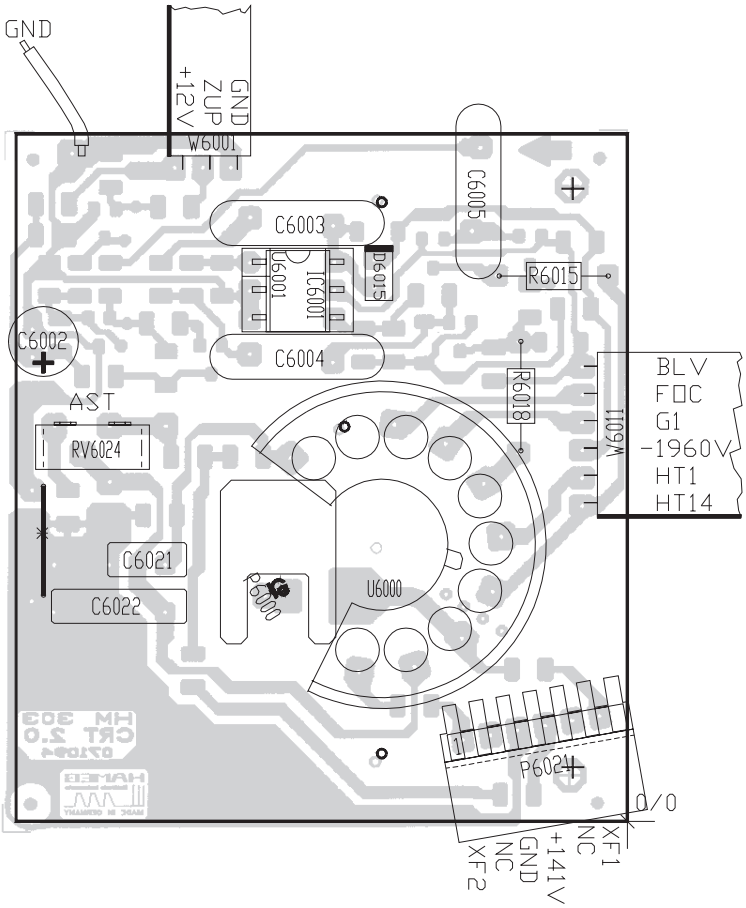

TB1 TIMEBASE TRIGGER FILTER
SYNC.- AMP
TB-BOARD
TB30518
HAMEG
Instruments
LEVEL
TRIG-SENS.
SLOPE
+/-
FILTER
SLOPE
+/-TV
TRIG
EXT
AT/N
SOT 23
top view
R-Chip 1% 1206
R-Chip 5% 1206
fr.VP-BOARD

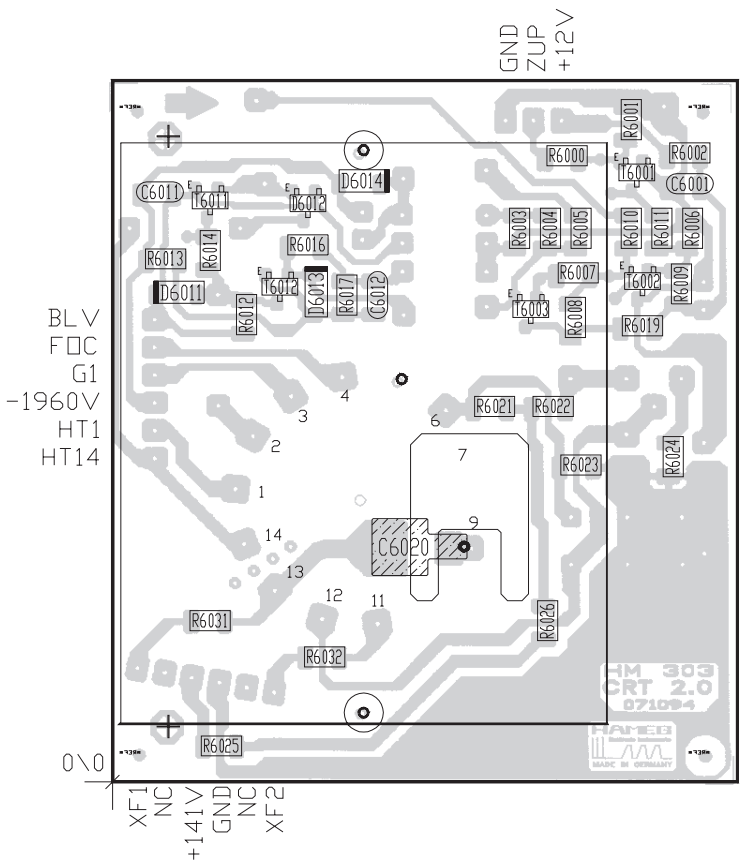

TB2 TIMEBASE TRIGGER LOGIC
TB3051B
TB-BOARD
HAMEG Instruments
TIMEBASE
to CRT-BOARD W6001
to DIG-BOARD J9602 W3300
fr. XY-BOARD W2212
fr. YPA-BOARD W603
fr. YPA-BOARD P603
fr. FC-BOARD W7001
fr. XY-BOARD W2230
TR-ROT
X-POS
XMAG
DSWEEP
R-Chip 1% 1206
R-Chip 5% 1206
SOT 23 top view

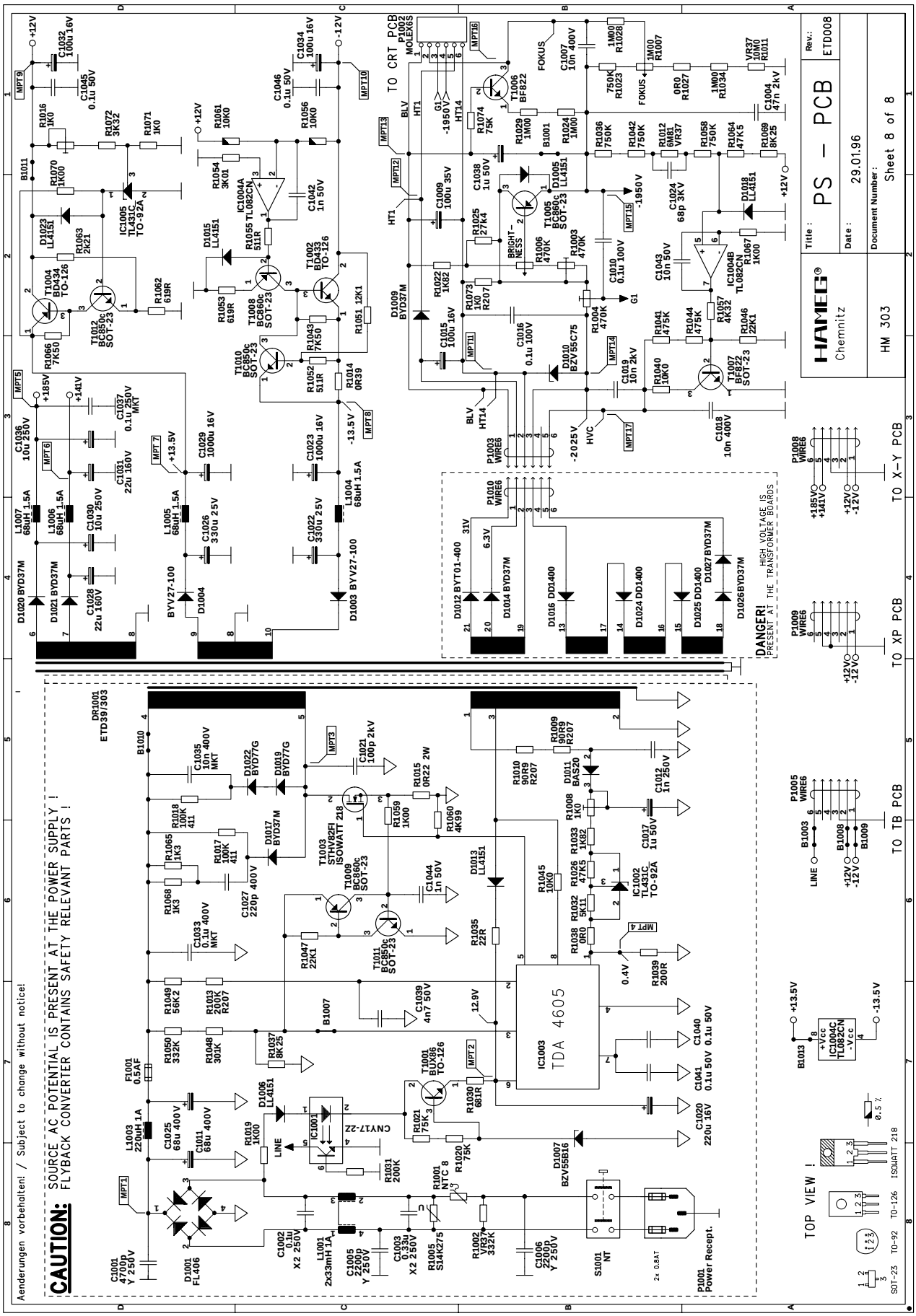

TB3 TIMEBASE SWEEP & HOLDOFF GENERATORS
TB3051B
SWEEP - GEN.
TB-BOARD
HAMEG
Instruments
Date 29.08.95
Sheet 3 of 4
TB303_4A
HO-VAR
TB-VAR
ASWEEP
TIMEBASE
BSX 19 top view
BF256B
SOT 23
R-Chip 1% 1206
R-Chip 5% 1206
R-Minimelf 0.5% 0204
fr.PS-BOARD P1005

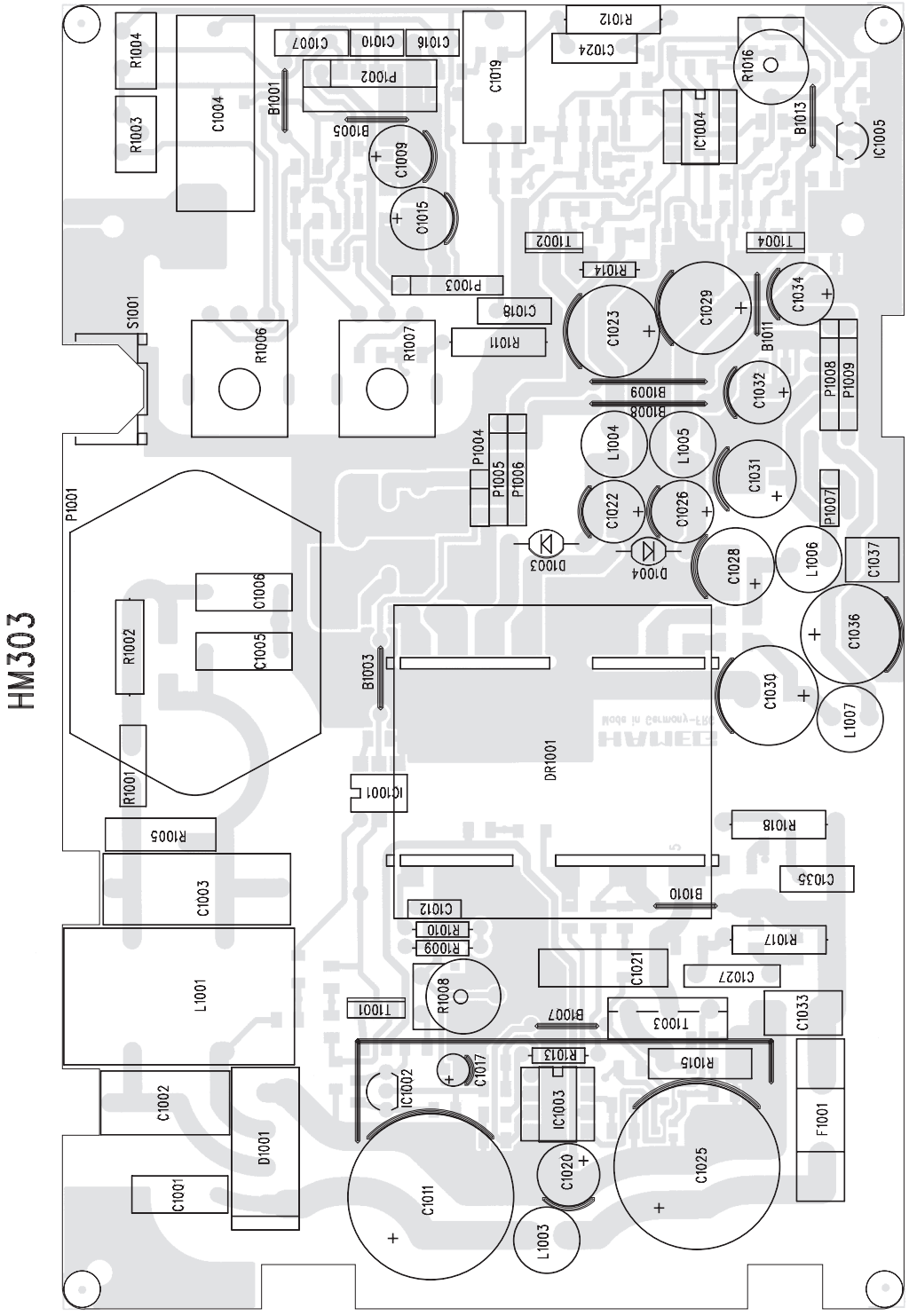

TB303-4 C&SNDS
SW3500
IC3300
IC3310
IC3280
IC3260
IC3210
IC3580
RV3590
RV3630
RV3450
RV3293
C3653
C3680
C3681
P3450
P3100
P3400
P3350
P3240
P3600
P3330
SW3180
SW3190
SW3150
SW3210
SW3280
SW3400
SW3240
W3180
W3350
RV3280

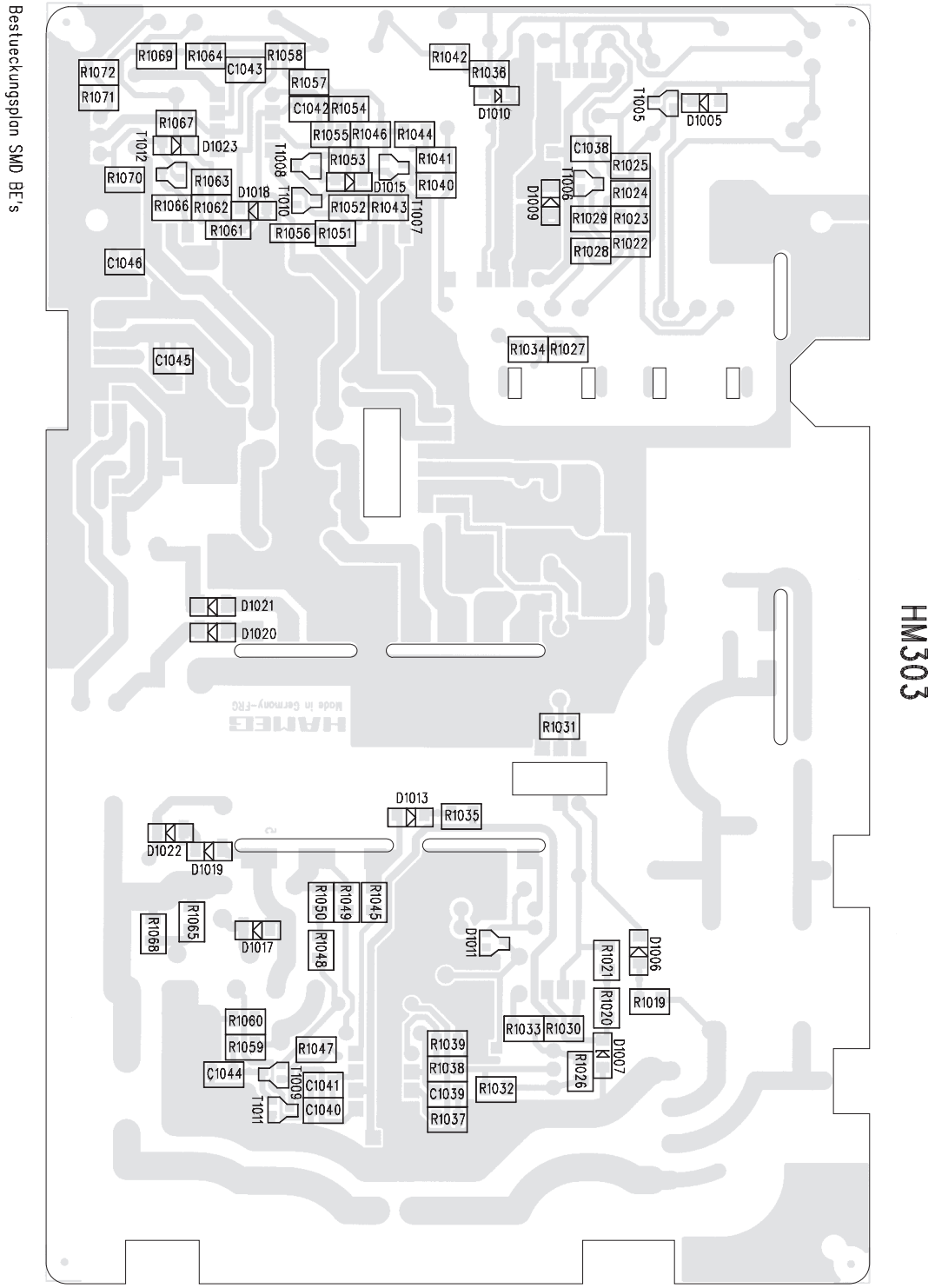

CRT-BOARD
TB-BOARD P3500
KA6001
FBL3pol
+12V
ZUP
AGND
R6002 6R8
R6000 0R0
R6001 1K00
R6009 2K0
R6006 511R
R6010 0R0
R6008 2K43
T6001 BF520
T6002 BC860C
T6003 BC850C
R6007 51R1
C6001 0.1uF
C6002 10uF/35V
C6003 68pF-3KV
C6004 68pF-3KV
C6005 68pF-3KV
R6005 221R
R6004 475R
R6003 *
IC6001 CNY17-II
D6015 S1015
D6014 LL4151
D6013 LL4151
D6011 LL4151
D6012B BAV70
D6012A BAV70
R6017 4K32
R6016 10k0
C6012 220pF
T6012 BF520
T6011 BF824
R6012 221K
R6014 51R1
R6015 5k11
C6011 0.1uF
R6013 0R0
R6018 51R1
C6020 WIRE
R6031 475R
X6001 ELROG ER14-11GY/1
(PHILIPS D14-364)
R6032 475R
C6021 0.1uFx250V (100V)
R6023 100k
R6021 47K5
C6022 0.1uFx100V
RV6021 47k
R6022 10k0 (33k2)
R6024 47k5 (56k2)
R6025 0R0
R6026 0R0
+141V
X1
X2
P6021 MOLEX6
from XYF-BOARD
KA2021
dkl. hell
G1 -2000...-1980
BLV -1945...-1922
hv -1940
AST: 70V...130V (70V...100V)
WERTE IN KLAMMERN:
PHILIPS-Röhre D14-364 GY/123
= SMA0207
High Voltage
to PS-BOARD
P1002
KA6011 FBL6pol
-1990...-1960
-1960...-1930
-1810...-1690
-1960V
30V=
HAMEG Instruments
HM 303 - 2
CRT30320
Date 29.08.95 12:40
Sheet 1 of 1

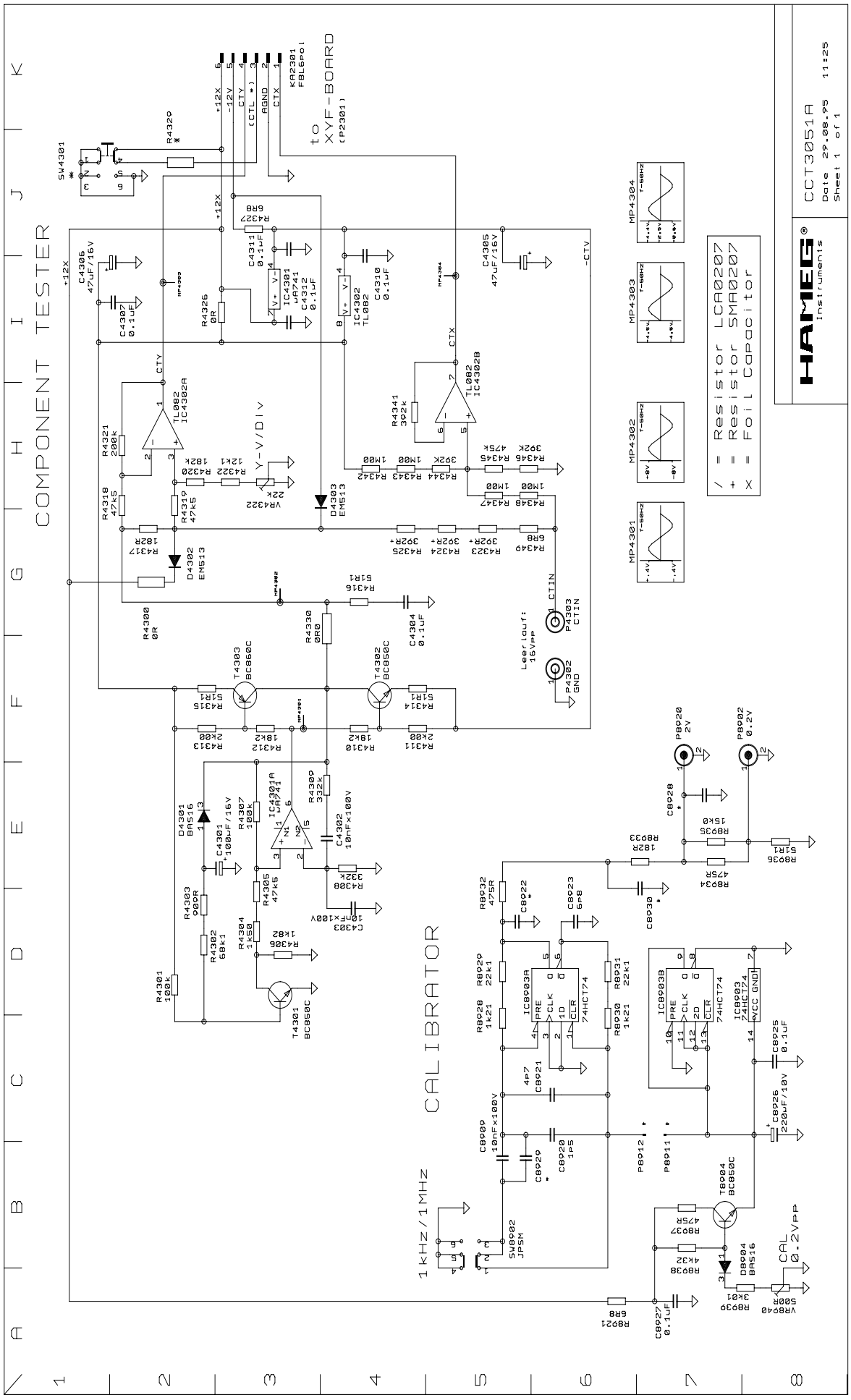

GND
+12V
ZUP
GND
W6001
C6003
D6001
IC6001
D6015
C6005
R6015
C6002
C6004
R6018
AST
RV6024
W6011
BLV
FOC
G1
-1960V
HT1
HT14
C6021
C6022
C6009
U6000
P6024
0/0
XF1
NC
+141V
GND
NC
XF2


GND
ZUP
+12V
BLV
FOC
G1
-1960V
HT1
HT14
C6020
R6031
R6032
R6025
R6026
0\0
XF1
NC
+141V
GND
NC
XF2

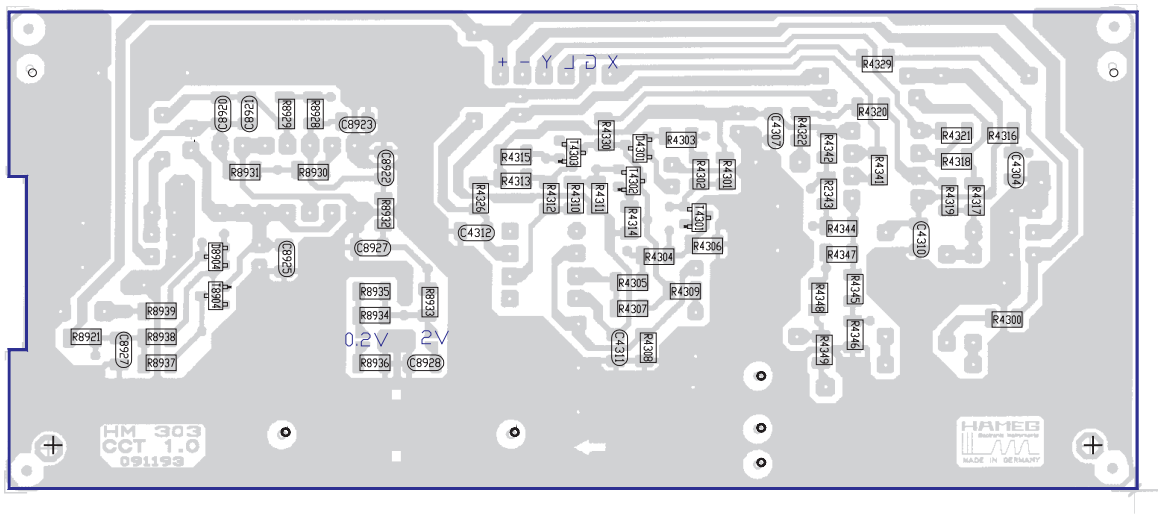

CAUTION: SOURCE AC POTENTIAL IS PRESENT AT THE POWER SUPPLY !
FLYBACK CONVERTER CONTAINS SAFETY RELEVANT PARTS !
Aenderungen vorbehalten! / Subject to change without notice!
DANGER! HIGH VOLTAGE IS PRESENT AT THE TRANSFORMER BOARDS
TO CRT PCB
TO X-Y PCB
TO XP PCB
TO TB PCB
TOP VIEW !
HAMEG Chemnitz
Title : PS – PCB
Rev.: ETD008
Date : 29.01.96
Document Number : HM 303
Sheet 8 of 8

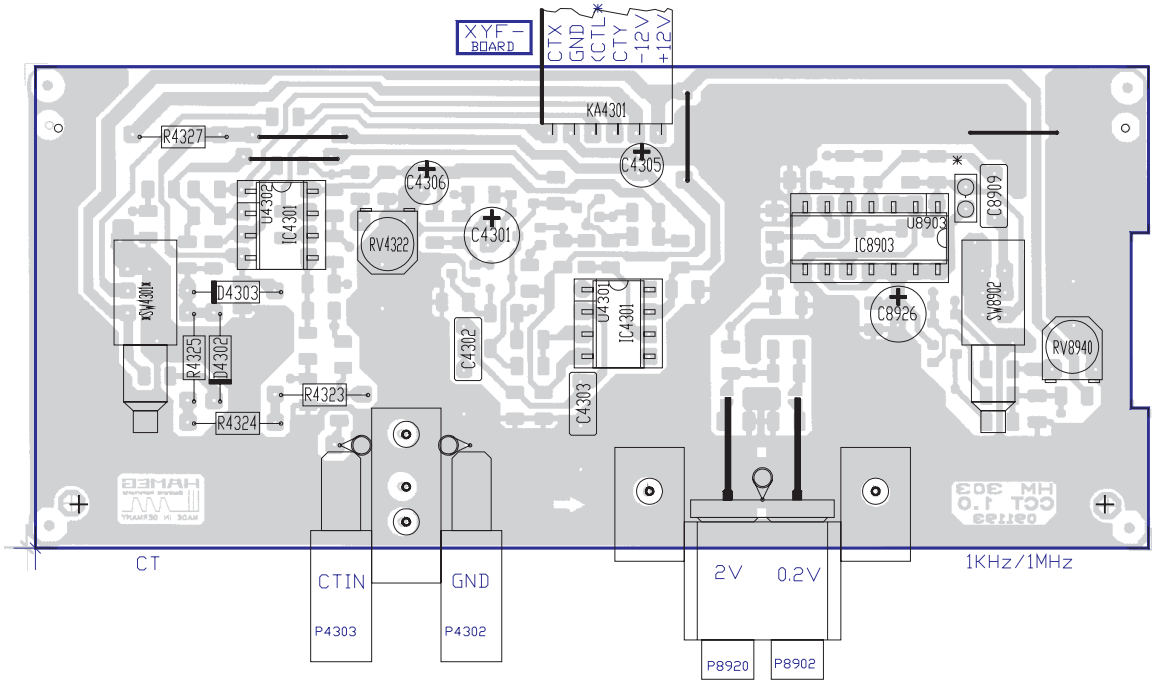

HM303
Bestueckungsplan bedrahtete BE's

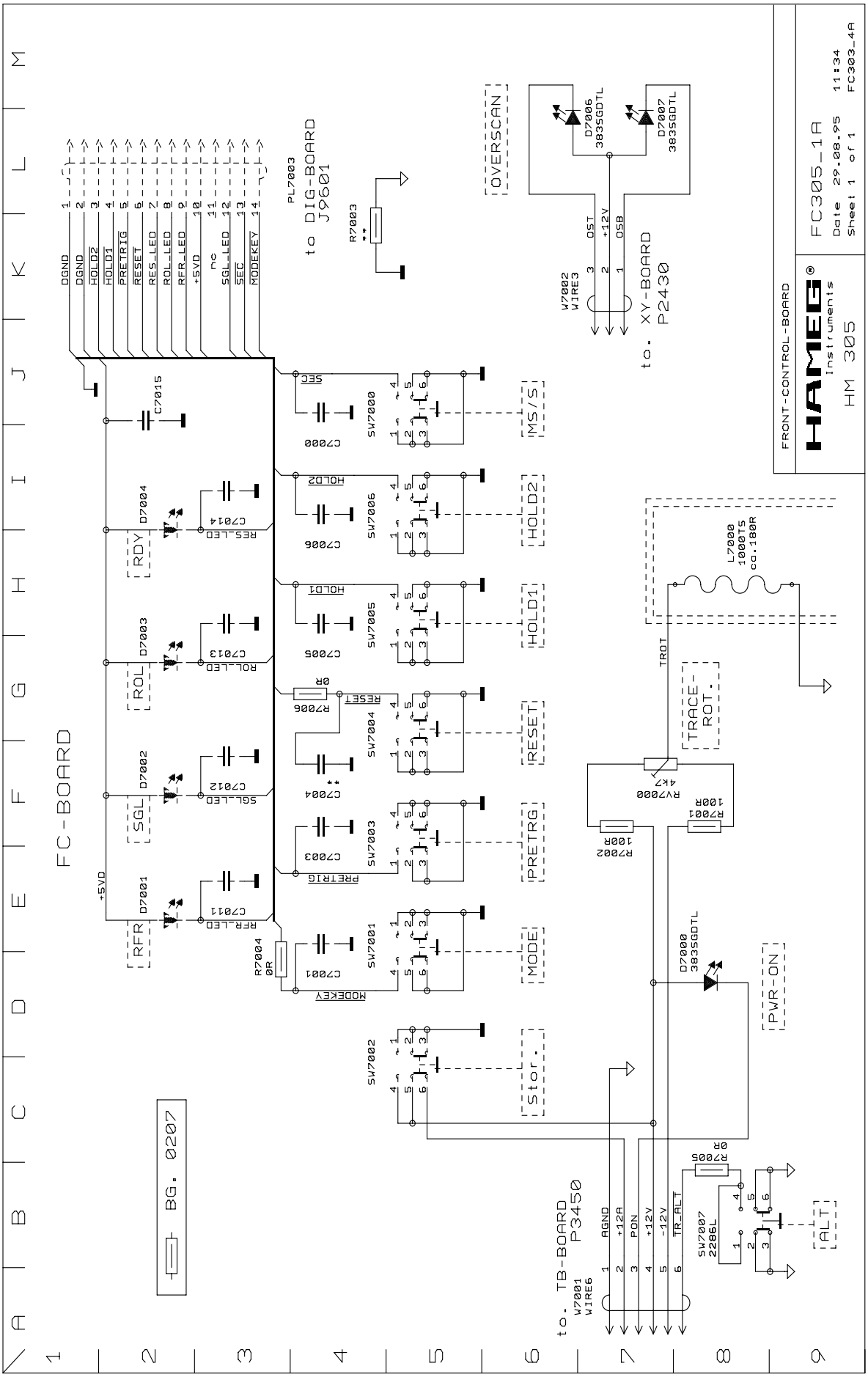

Bestueckungsplan SMD BE's
R1069
R1064
R1058
C1043
R1072
R1071
R1057
C1042
R1054
R1042
R1036
D1010
T1005
D1005
R1067
T1012
D1023
R1055
R1046
R1044
C1038
R1025
R1053
R1041
T1008
R1070
R1063
D1015
R1040
T1006
R1024
D1018
T1010
D1009
R1066
R1062
R1052
R1043
T1007
R1029
R1023
R1061
R1056
R1051
R1028
R1022
C1046
C1045
R1034
R1027
D1021
D1020
HAMEG
Made in Germany-FRG
R1031
D1013
R1035
D1022
D1019
R1050
R1049
R1045
R1065
R1068
D1017
R1048
D1011
D1006
R1021
R1019
R1020
R1033
R1030
D1007
R1060
R1059
R1047
R1039
R1038
R1026
C1044
T1009
C1041
C1039
R1032
T1011
C1040
R1037
HM303


COMPONENT TESTER
CALIBRATOR
to XYF-BOARD (P2301)
HAMEG Instruments
CCT3051A
Date 29.08.95 11:25
Sheet 1 of 1
/ = Resistor LCR0207
+ = Resistor SMR0207
X = Foil Capacitor
Y-V/Div
1 KHz / 1 MHz
CAL 0.2Vpp
Leerlauf: 16Vpp
CTIN
GND
+12X
-12V
CTY
(CTL *)
AGND
CTX
-CTY

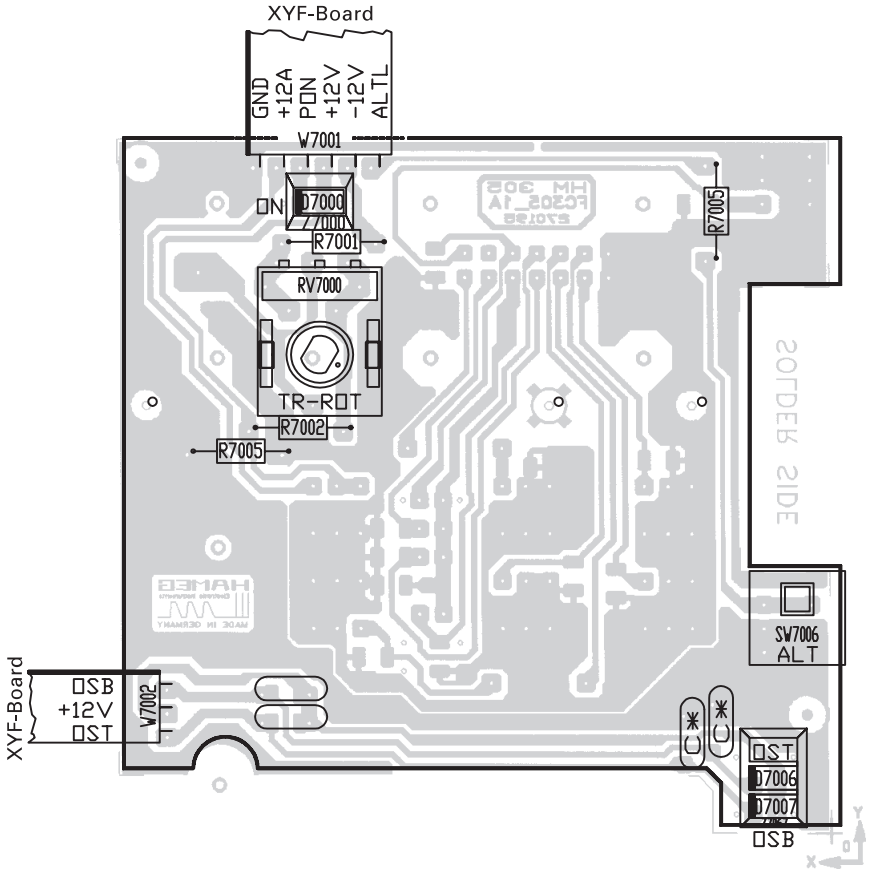
CCT Board (Top and Bottom side)






FC-BOARD
FRONT-CONTROL-BOARD
HAMEG
Instruments
HM 305
FC305_1A
Date 29.08.95 11:34
Sheet 1 of 1 FC303_4A
to DIG-BOARD J9601
PL7003
DGND
DGND
HOLD2
HOLD1
PRETRIG
RESET
RES_LED
ROL_LED
RFR_LED
+5VD
nc
SGL_LED
SEC
MODEKEY
OVERSCAN
D7006 3835GDTL
D7007 3835GDTL
W7002 WIRE3
OST
+12V
OSB
to. XY-BOARD P2430
R7003 **
C7015
D7004
D7003
D7002
D7001
RDY
ROL
SGL
RFR
RES_LED
ROL_LED
SGL_LED
RFR_LED
C7014
C7013
C7012
C7011
+5VD
SEC
HOLD2
HOLD1
RESET
PRETRIG
MODEKEY
C7000
C7006
C7005
C7004
C7003
C7001
R7006 0R
R7004 0R
SW7000
SW7006
SW7005
SW7004
SW7003
SW7001
SW7002
MS/S
HOLD2
HOLD1
RESET
PRETRG
MODE
Stor.
L7000 1000TS ca.180R
TRACE ROT.
TROT
RV7000 4K7
R7002 100R
R7001 100R
D7000 3835GDTL
PWR-ON
R7005 0R
SW7007 2286L
ALT
to. TB-BOARD P3450
W7001 WIRE6
AGND
+12A
PON
+12V
-12V
TR_ALT
BG. 0207

Front Control board (Top and Bottomside)



Adjustment Procedure

ADJUSTMENT PROCEDURE

30MHz Standard Oscilloscope HM303-4

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 2,000 Volts is present inside this Instrument. The areas particularly affected by High Voltage are the high voltage circuit on the PS-board, the CRT-board and the CRT-socket.

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 suitable qualified and experienced service personnel, or should be referred to one of the HAMEG companies listed on the rear cover of the manual.

Test Instruments required:

1) Scope Tester HZ60-2.
2) Constant amplitude sinewave generator, 20Hz - 250MHz, output 5mV - 5V into 50Ω, preferably with 20dB attenuation (e.g. HM8133, TEK SG502 + TEK SG503).
3) Amplitude Calibrator with 1kHz squarewave output and 600Ω impedance, risetime faster than 150ns.Output voltage 2mV - 20Volts in 1-2-5 sequence for 4 divisions display amplitude (e.g. HZ62, TEK PG506).
4) Time mark generator from 5ns/div to 5s/div. Output min. 10mV into 50Ω (e.g. HZ62, TEK TG501).
5) Pre-attenuator 2:1 (1MΩ , 12-48pF), e.g. HZ20.
6) 50Ω BNC through termination, e.g. HZ22.
7) 2 BNC-cables, 50Ω, e.g. HZ34.
8) BNC-T-connector.
9) Oscilloscope probe 10:1, with exactly 9MΩ series resistance and compensated for test oscilloscope mentioned under 10).
10) Oscilloscope 100MHz, 5mV/div to 5V/div, e.g. HM1005.
11) Trimming/adjusting tool.
12) Variable output safety insulation transformer.
13) Video signal generator with positive and negative signal output.
14) Yt-EPROM HM1007.

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 earths‘ magnetic field has been compensated with the trimmer marked TR (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.

NOTE

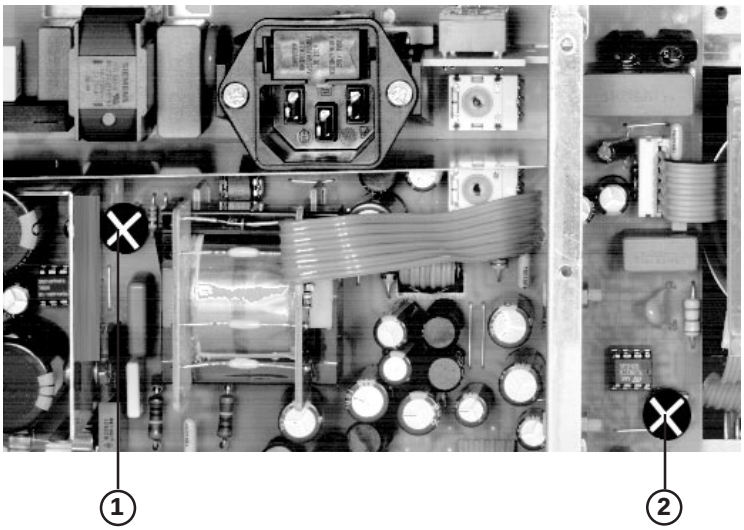
The adjustment procedures assume that the instrument had once been properly adjusted in the factory and adjustments are required due to temperature drift or the replacement of defective components.

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

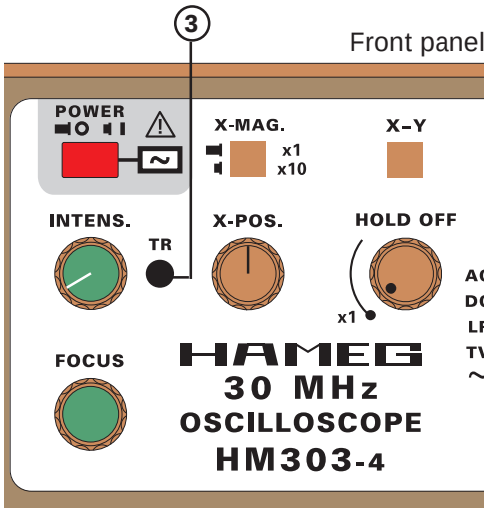
- Press POWER pushbutton (in!).
- Release all other pushbuttons (out!) except AC/DC input coupling.
- Rotate the three variable controls (TIME/DIV. and VOLTS/DIV.) to their (calibrated) detent positions.
- Set TIME/DIV. switch to 50µs/div.
- Set both VOLTS/DIV switches to 5mV/div.
- Rotate the HOLD OFF knob fully counterclockwise.
- Trigger coupling set to AC.
- Set all other controls to their midrange positions.

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

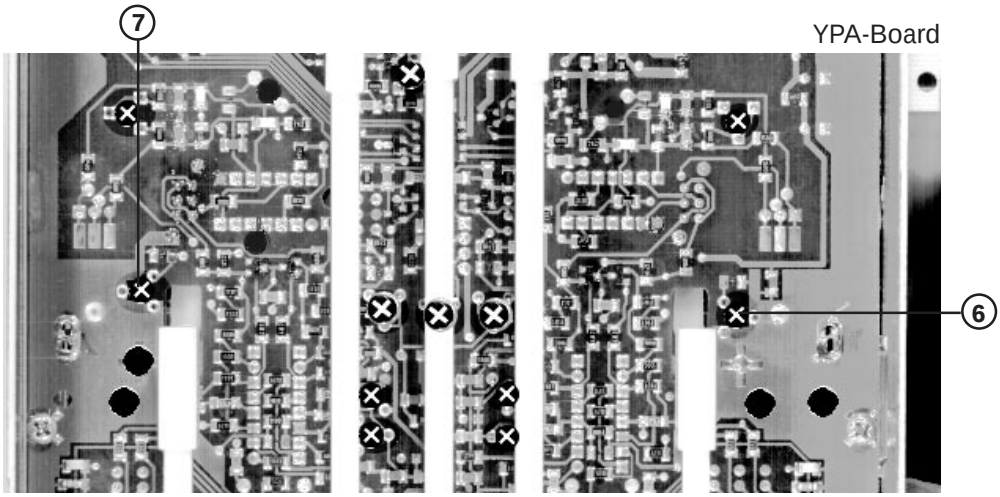
PS-Board



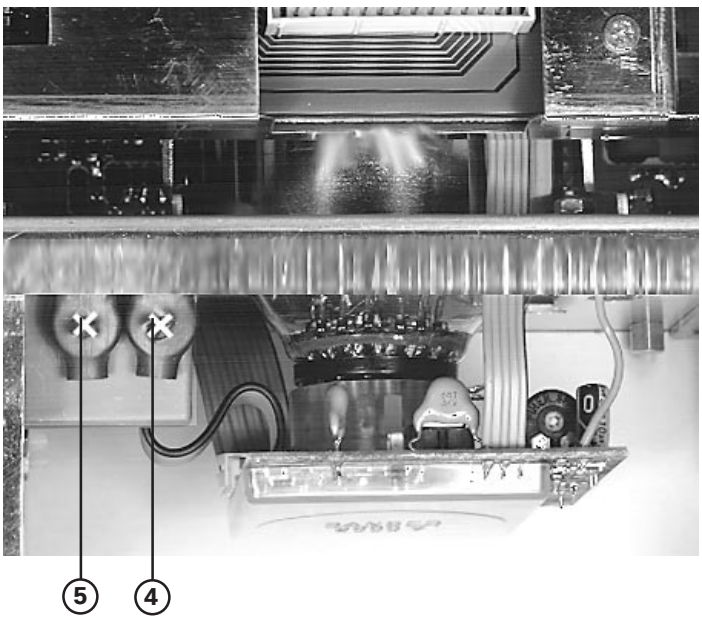
Front panel



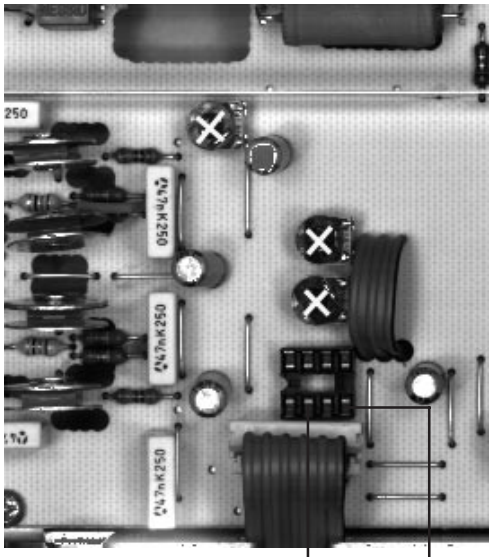
YPA-Board



PS-Board



XY-Board



(1) R1008: +141 Volt supply.

WARNING: *To avoid damage use a fully insulated screwdriver!*
Locate and identify R1008 (1) on PS-Board (screened section).
Locate 8 pole checkpoint socket on XY-Board and identify pin 2.
Adjust R1008 (1) for exactly +141Volts (± 0.1 Volt).

(2) R1016: +12 Volt supply.

Locate and identify R1016 (2) on PS-Board.
Locate 8 pole checkpoint socket on XY-Board and identify pin 4.
Adjust R1016 (2) for exactly +12Volts (± 10mV). All other voltages +185V (pin 1), -12V (pin 5) and -1950V on cathode of CRT depend on the correct +12 Volt adjustment. All these voltages must be checked and verified.

(3) VR7000: Trace Rotation Check.

Locate and identify VR703 (3) „TR“ on the front panel.
Using Y-Pos.I and X-Pos. controls, move baseline to the center of the graticule.
Press channel I GD pushbutton (in!).
When turning VR703 (3), check that the range of inclination of the baseline is at least 1mm at both horizontal limits of the graticule.
Readjust baseline exactly parallel to the horizontal center line of the graticule.

(4) R1004 : CRT minimum intensity.

Locate and identify R1004 (4) on PS-Board.
Set INTENS. control to fully left position.
Press XY pushbutton (in!).
Adjust R1004 (4) so that the dot just disappears.
Release XY pushbutton.

(5) R1003 : CRT maximum intensity.

Locate and identify R1003 (5) on PS-Board.
Set INTENS. control to fully right position.
Set FOCUS knob on the front panel for optimum sharpness.
Adjust R1004 (5) so that the beam diameter is 1.5mm.

Repeat adjustment 4 and 5 until optimum is obtained!

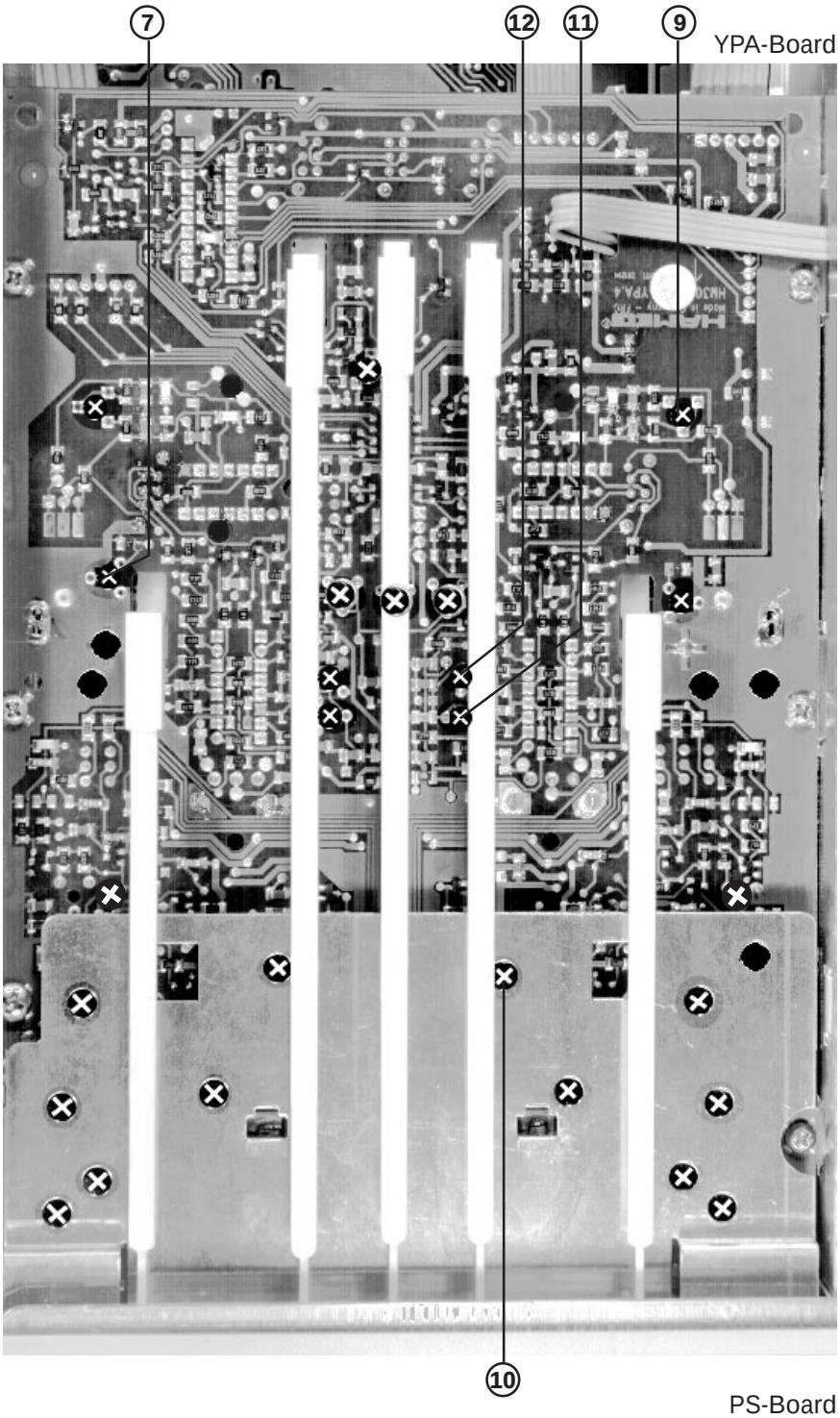
(6) R712: Mean Y-plate Potential Channel I.

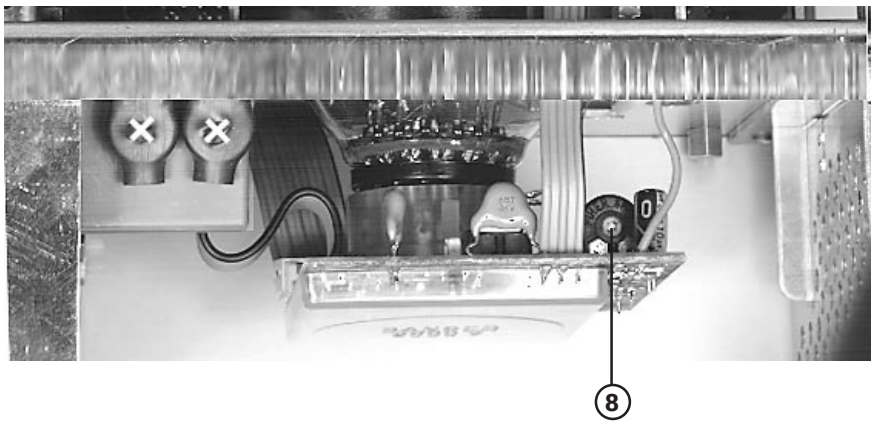
Locate and identify R712 (6) on YPA-Board.
Press DUAL pushbutton (in!).
Set both beams to the horizontal center line of the graticule by using Y-position I and II knobs on the front panel. The Y-position knob settings must not be changed during the following procedure until item 7) is finished.
Release DUAL pushbutton (out!).
Switch the oscilloscope OFF.
Locate and identify both lines from the Y-final amplifier to the Y-plates of the CRT.
Connect both lines (short)galvanically.
Switch the oscilloscope ON.
Measure the DC voltage at the Y-plates in respect to ground.
Adjust R712 (6) for +85Volt Y-plate voltage.

Note: *Do not remove the short at the Y-plates until item 7) is finished.*

(7) R714: Mean Y-plate Potential Channel II.

Note: *Do not start item 7) until item 6) is finished.*
Locate and identify R714 (7) on YPA-Board.
Press CHI/II pushbutton (in!) for channel II mode.
Measure the DC voltage at the Y-plates in respect to ground.
Adjust R714 (7) for +85Volt Y-plate voltage.
Switch the oscilloscope OFF.
Remove the connection between both Y-plates.
Switch the oscilloscope ON.


7
12
11
9
YPA-Board
10


PS-Board
8

(8) RV6021 : Astigmatism correction.

Locate and identify RV6021 (8) on CRT-Board.
Connect a 1MHz squarewave signal with 25mVpp at 50Ω (HZ22) to input CHI.
Set time base to 0.1µs/div.
Adjust FOCUS control for optimum sharpness.
Adjust RV6021 (8) until leading edge and top of signal have equal sharpness.
Recheck range of FOCUS control.
Adjust FOCUS control for optimum sharpness.

(9) R640: Y-Gain CH I.

Locate and identify R640 (9) on YPA-Board.
Connect a 25mV/1kHz squarewave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 1ms/div.
Adjust R640 (9) for 5 division signal height.

(10) R122: FET operating point CH I.

Locate and identify R122 (10) in CH I section of the YPA-Board.
Release all pushbuttons (out!) for channel I mode.
Press Y x5 channel I (in!) for 1mV/div.
Press GD pushbutton channel I (in!).
Switch the attenuator channel I constantly between 5mV/div (1mV) and 10mV/div (2mV).
Adjust R122 (10) until no Y-position change occurs.

Do not change the operating conditions.

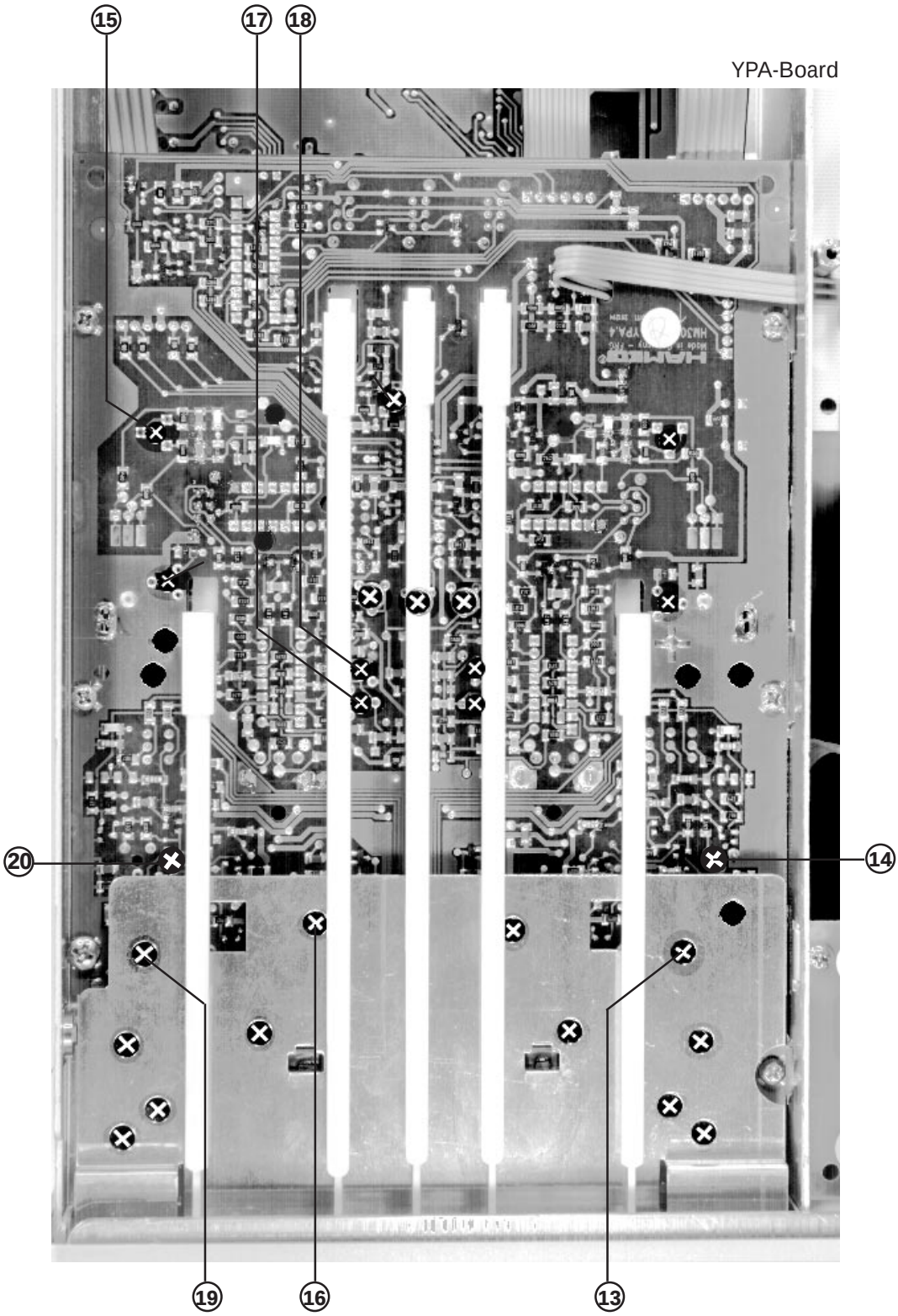
(11) R203: Invert-Balance CH I.

Press GD pushbutton channel I (in!).
Press Y x5 channel I (in!) for 1mV/div.
Using Y-POS.I control set trace to the horizontal center line.
Locate and identify R203 (11) on YPA-Board.
Adjust R203 (11) so that the baseline will not move, when pressing and releasing the INVERT CH I pushbutton.

(12) R177: Variable-Balance CH I.

Locate and identify VR177 (12) in CH I section of the YPA-Board.
Press channel I Y-MAG. x5 pushbutton for 1mV/div.
Press channel I GD pushbutton (in!).
Adjust VR177 (12) so that the baseline will not move when turning the channel I Y-variable control through the entire range.

Check adjustment 11) again and repeat it if required.



(13) R139: 100Hz Squarewave 5mV/div CH I.

Locate and identify R139 (13) in CH I section of the YPA-Board.
Connect a 25mV/100Hz squarewave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 2ms/div.
Check that DC input coupling is selected.
Adjust R139 (13) for flat top.

(14) R134: 100Hz Squarewave 1mV/div Adjustment CH I.

Locate and identify R134 (14) in CH I section of the YPA-Board.
Connect a 5mV/100Hz squarewave signal via 50Ω cable and 50Ω through terminator to input channel I.
Press Yx5 channel I (in!) for 1mV/div.
Set time base to 2ms/div.
Check that DC input coupling is selected.
Adjust R134 (14) for flat top.

(15) R658: Y-Gain CH II.

Locate and identify R658 (15) on YPA-Board.
Connect a 25mV/1kHz squarewave signal via 50Ω cable and 50Ω through terminator to input channel II.
Check that DC input coupling is selected.
Set time base to 1ms/div.
Adjust R658 (15) for 5 division signal height.

(16) R422: FET operating point CH II.

Locate and identify R422 (16) in CH II section of the YPA-Board.
Press CHI/II pushbutton (in!) for channel II mode.
Press Y x5 channel II (in!) for 1mV/div.
Press GD pushbutton channel II (in!).
Switch the attenuator channel II constantly between 5mV/div (1mV) and 10mV/div (2mV).
Adjust R422 (16) until no Y-position change occurs.

(17) R503: Invert-Balance CH II.

Press GD pushbutton channel II (in!).
Press Y x5 channel II (in!) for 1mV/div.
Using Y-POS.II control set trace to the horizontal center line.
Locate and identify R503 (17) on YPA-Board.
Adjust R503 (17) so that the baseline will not move, when pressing and releasing the INVERT CH II pushbutton.

(18) R477: Variable-Balance CH II.

Locate and identify VR477 (18) in CH II section of the YPA-Board.
Press channel II Y-MAG. x5 pushbutton for 1mV/div.
Press channel II GD pushbutton (in!).
Adjust VR477 (18) so that the baseline will not move when turning the channel I Y-variable control through the entire range.

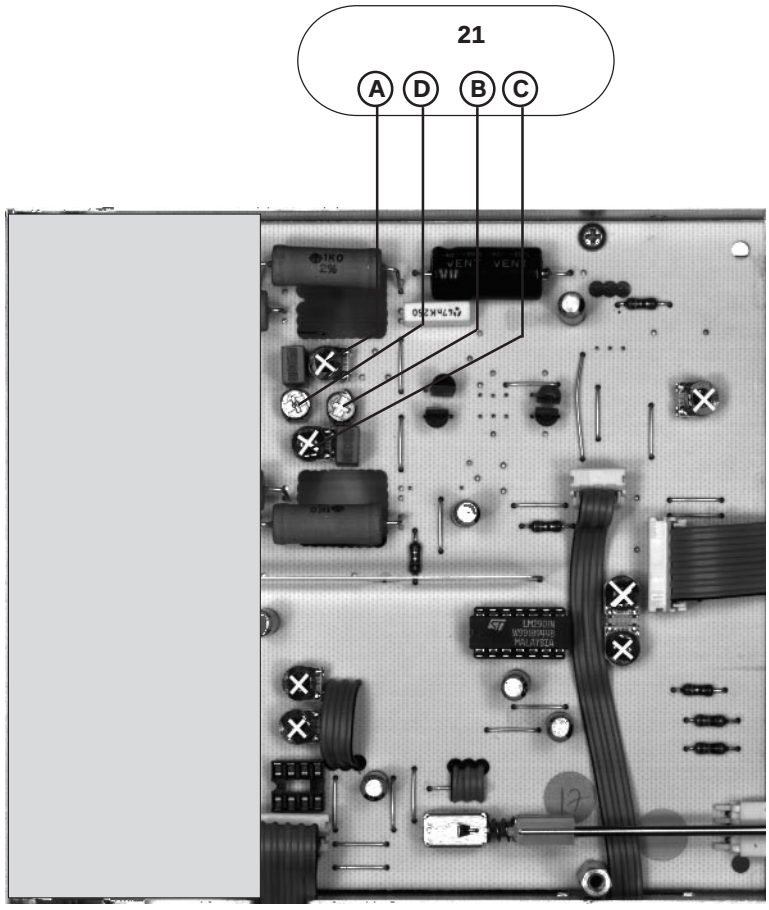
Check adjustment 17) again and repeat it if required.

(19) R439: 100Hz Squarewave 5mV/div CH II.

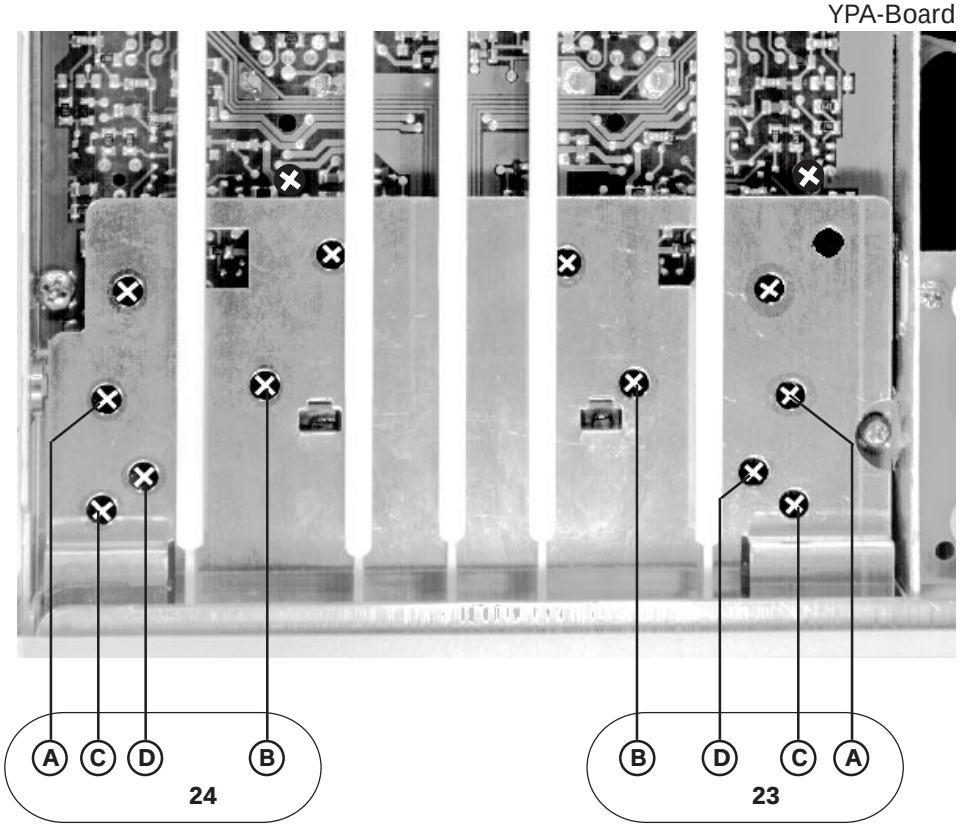
Locate and identify R439 (19) in CH II section of the YPA-Board.
Connect a 25mV/100Hz squarewave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set time base to 2ms/div.
Check that DC input coupling is selected.
Adjust R439 (19) for flat top.

(20) R434: 100Hz Squarewave 1mV/div CH II.

Locate and identify R434 (20) in CH II section of the YPA-Board.
Connect a 5mV/100Hz squarewave signal via 50Ω cable and 50Ω through terminator to input channel II.
Press Yx5 channel II (in!) for 1mV/div.
Set time base to 2ms/div.
Check that DC input coupling is selected.
Adjust R434 (20) for flat top.



YPA-Board



(21) RV2005 (A), RV2006 (C), CV2000 (D) and CV2001 (B): Y-Final Amplifier.

Connect a 1MHz squarewave signal of 25mV via 50Ω cable and 50Ω through termination to input CH I.
Check that DC input coupling is selected.
Set time base to 0.2µs/div.
Locate and identify the adjustment points RV2005 (21A), RV2006 (21B), CV2000 (21C) and CV2001 (21D) on XY-Board.
As the capacitive influence of the cabinet is of importance, a metal sheet above the Y-final amplifier section is required.
Adjust RV2005 (21A) and CV2001 (21B) for flat top, RV2006 (21C) and CV2000 (21D) for fast leading edge with minimum overshoot.
Repeat until optimum is obtained.
Check channel II under the same conditions.

(22) Y-Amplifier Bandwidth Check.

Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50Ω throughtermination to the input of channel I.
Adjust the generator amplitude for 8 div. display height on the screen.
Increase the generator frequency until the signal is displayed with 5.6 div. height (-3dB).
Repeat the adjustment under item 21), if the frequency reading on the generator shows a value less than 30MHz.
Press CHI/II-TRIGI/II pushbutton (in!).
Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50Ω throughtermination to the input of channel II.
Adjust the generator amplitude for 8 div. signal height displayed on the screen.
Increase the generator frequency until the signal is displayed with 5.6 div. height (-3dB).
Repeat the adjustments under item 21), if the frequency reading on the generator shows a value less than 30MHz.

(23) C113/111/102/105: Attenuator Compensation CH I.

Locate and identify trimmers VC102-113 for CH I on YPA-Board.
Check that DC input coupling is selected.
Check that input attenuator CH I is in 5mV/div setting.
Set time base switch to 0.5ms/div.
Set amplitude calibrator to 1kHz and connect a 2:1 pre-attenuator via 50Ω cable to input of CH I.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 pre-attenuator output, if terminated with 1MΩ).
Adjust trimmer in pre-attenuator for flat squarewave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

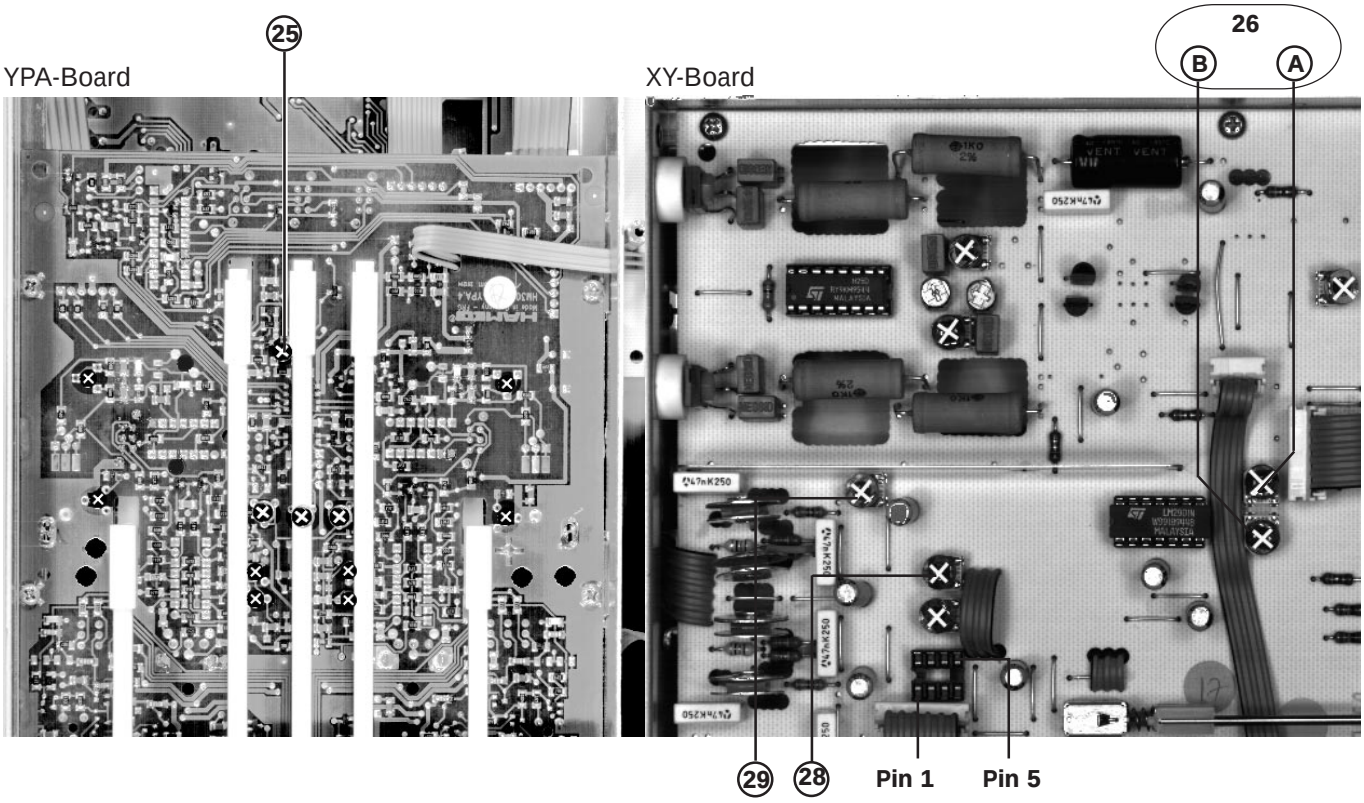
Scope Input	Input Atten.	Adjustment CH I
250mVpp	50mV/div	A (VC111) flat top + B (VC113) leading edge
2.5Vpp	0.5V/div	C (VC102) flat top + D (VC105) leading edge

(24) C413/411/402/405: Attenuator Compensation CH II.

Locate and identify trimmers VC402-413 for CH II on YPA-Board.
Check that DC input coupling is selected.
Check that input attenuator CH II is in 5mV/div setting.
Set time base switch to 0.5ms/div.
Set amplitude calibrator to 1kHz and connect a 2:1 pre-attenuator via 50Ω cable to input of CH II.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 pre-attenuator output, if terminated with 1MΩ).
Adjust trimmer in pre-attenuator for flat squarewave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

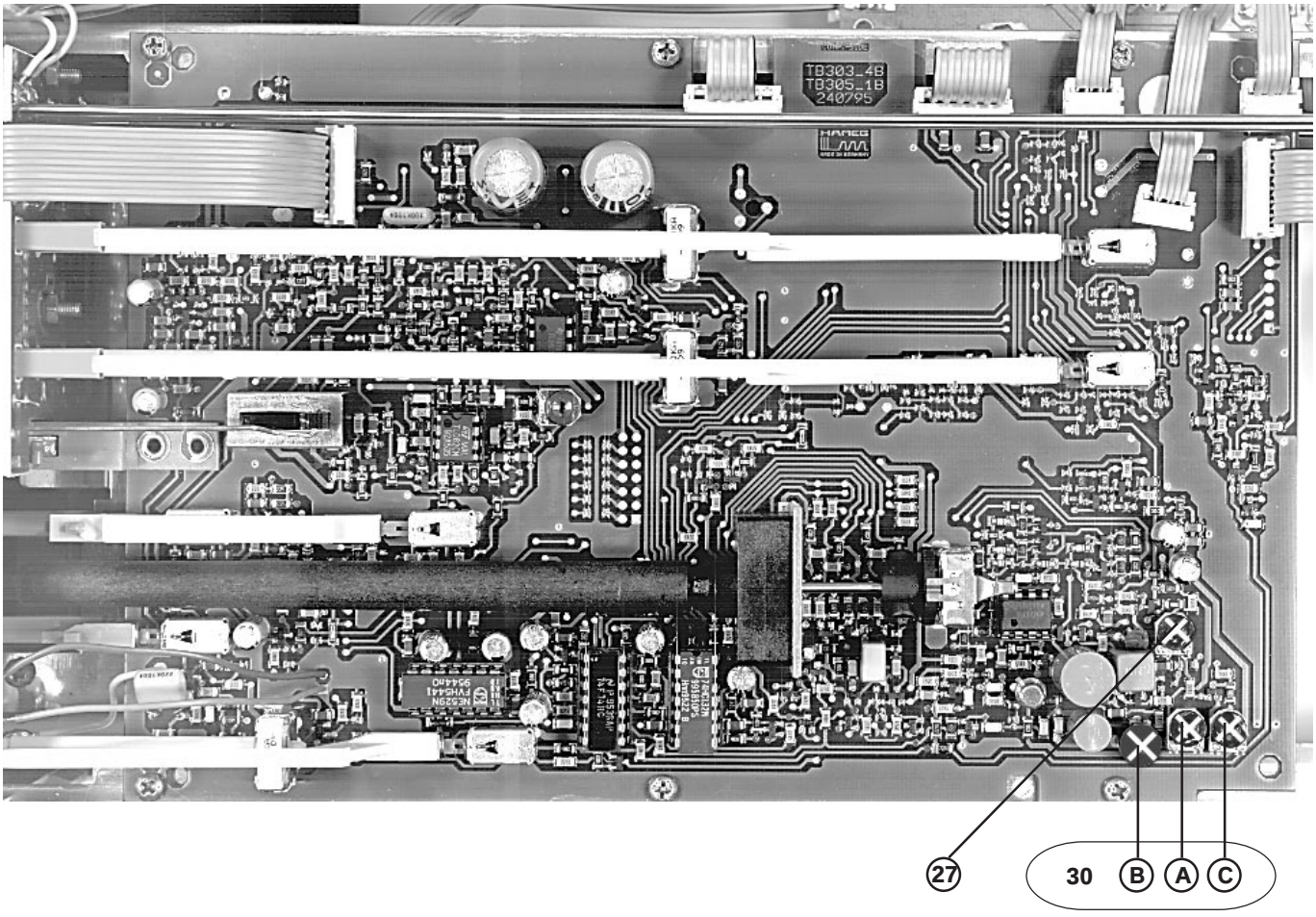
Scope Input	Input Atten.	Adjustment CH II
250mVpp	50mV/div	A (VC411) flat top + B (VC413) leading edge
2.5Vpp	0.5V/div	C (VC402) flat top + D (VC405) leading edge

YPA-Board



XY-Board

TB-Board



(25) R663: ADDition/Offset.

Press DUAL pushbutton (in!).
Locate and identify R663 (25) on YPA-Board.
Set input coupling CH I and II to GD.
Move both baselines with Y-POS. I and II controls to the horizontal center line of the graticule.
Release DUAL pushbutton (out!).
Press ADD pushbutton (in!).
Adjust R663 (25) for the same signal position as before in DUAL mode.

(26) RV2417 (A), RV2418 (B): Overscan.

Locate and identify RV2417 (26A) and RV2418 (26B)on XY-Board.
Press channel I and channel II GD pushbuttons (in!).
Press DUAL pushbutton (in!).
Set baseline with Y-POS.I control to the top line of the graticule.
Set baseline with Y-POS.II control to the bottom line of the graticule.
Adjust RV2417 (26A) for just lighting up of the upper LED.
Adjust RV2418 (26B) for just lighting up of the lower LED.
Repeat both procedures until both adjustments are correct.

(27) RV3519: Sweep start voltage.

Locate and identify RV3519 (27) on TB-Board.
Set time base to .2ms/div.
Locate and identify pin 7 of test socket on XY-Board.
Use a control oscilloscope with a x10 (10:1) probe and measure under DC input coupling conditions the sawtooth voltage at pin 7.
Adjust RV3519 (27) for 0 volts DC at the sawtooth start (end of the hold off time).

(28) RV2225: X-Magnification x1.

Locate and identify RV2225 (28) on XY-Board.
Set time base to .2ms/div.
Adjust RV2225 (28) for 10.2 div sweep length.

(29) RV2260: X-Symmetry.

Locate and identify RV2260 (29) on XY-Board.
Set the X-POS. knob to the mechanical center position.
Adjust RV2260 (29) for a symmetrical trace position in respect to the graticule.

(30) RV3591 (A)/3589 (C), CV3511 (B): Time base.

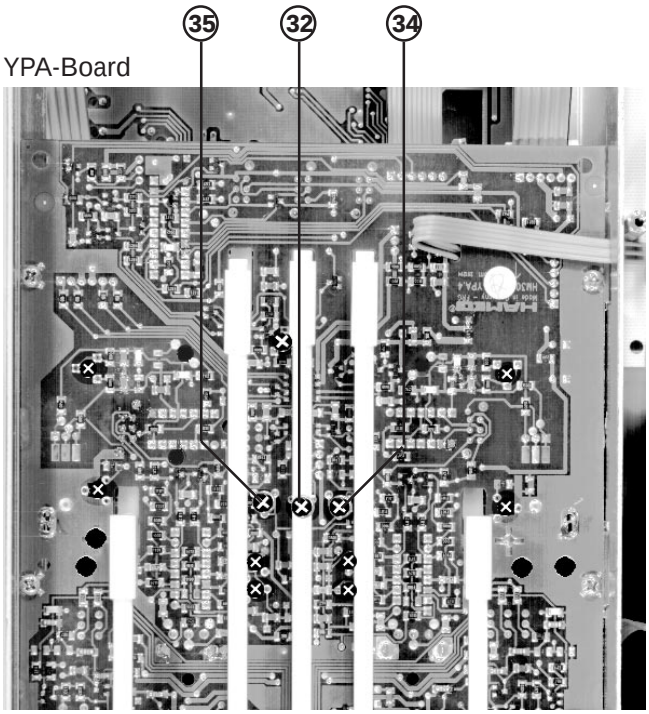
a) Locate and identify RV3591 (A) on TB-Board.
Set time mark generator to f= 20kHz and connect signal to CH I input.
Set time base to 50µs/div.
Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Adjust RV3591 (30A) so that the 11th time mark coincides with the last right graticule line.
Rotate time base variable control to fully left position.
Now more than 2.5 time marks per division should be displayed.

b) Locate and identify CV3511 (30B) on TB-Board.
Set time base to 0.5µs/div. and time base variable control to CAL position.
Set time mark generator to f= 2MHz.
Move trace with X-POS. control so that the first time mark coincides with the first left graticule line of the screen.
Adjust CV3511 (30B) so that the 11th time mark coincides with the last right graticule line.

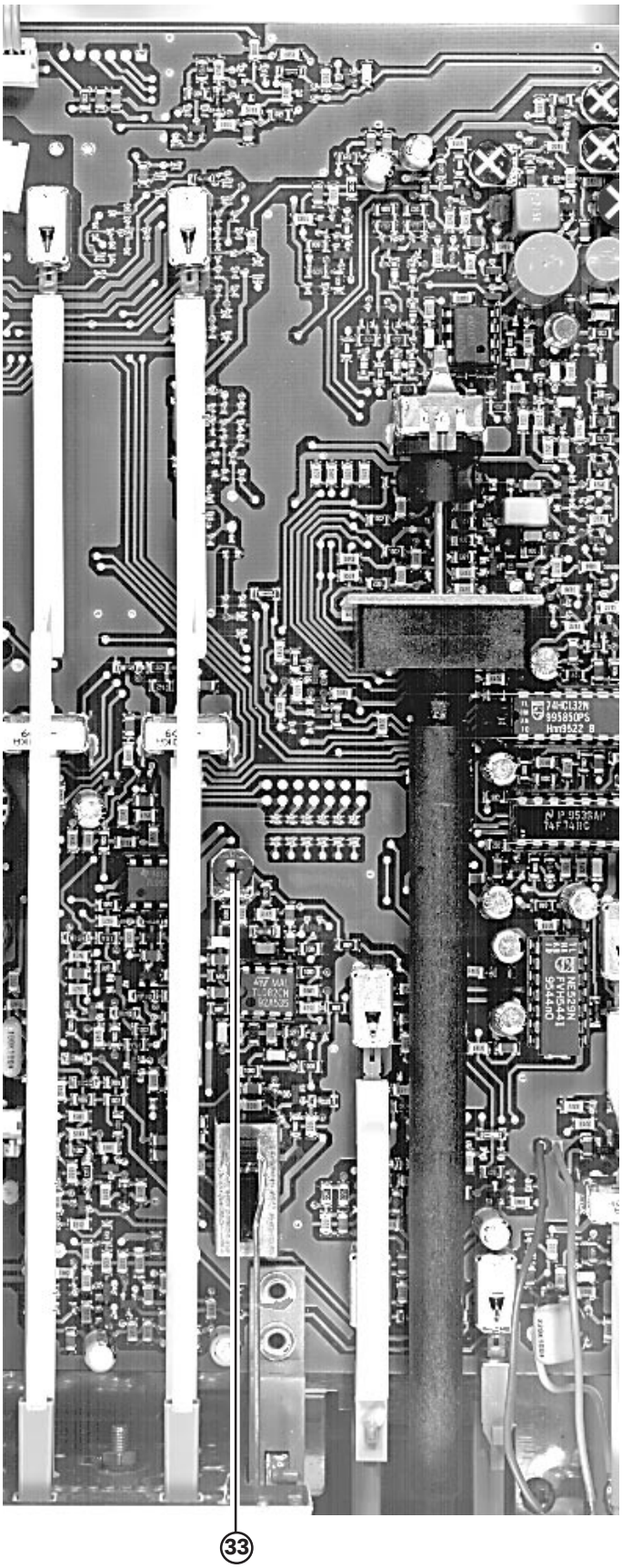
c) Locate and identify RV3589 (30C) on TB-Board.
Set time base to 5ms/div. and time base variable control to CAL position.
Set time mark generator to f= 200Hz.
Move trace with X-POS. control so that the first time mark coincides with the first left graticule line of the screen.
Adjust RV3589 (30C) so that the 11th time mark coincides with the last right graticule line.

Check all time base settings with suitable time mark signals.

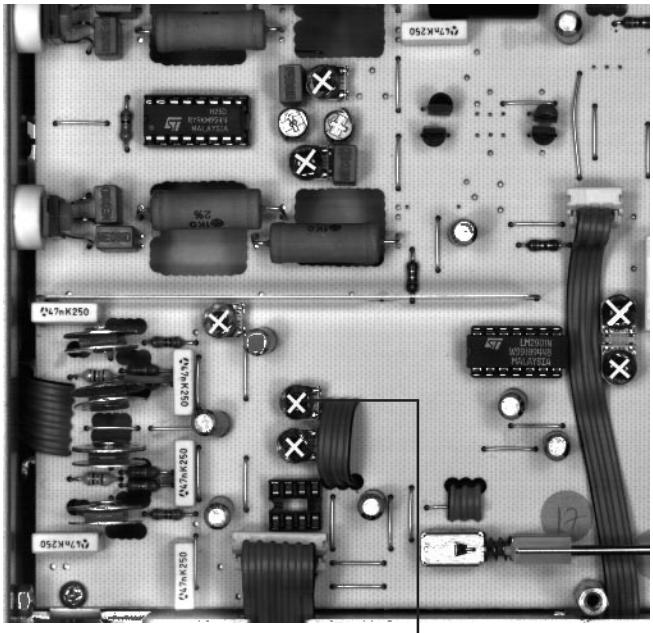
YPA-Board



TB-Board



XY-Board



(31) RV2234: X-Magnification x10.

Locate and identify RV2234 (31) on XY-Board.
Press pushbutton X-Mag. x10.
Set time base to 50µs/div.
Set time mark generator to f= 20kHz and connect signal to CH I input.
Set X-POS control to mechanical center.
Using X-POS control, move the visible time mark to the first left graticule line.
Adjust RV2234 (31) so that the next time mark coincides with the last (right) graticule line.
Release X-MAG. x10 pushbutton (out!).

(32) R624: XY-Gain

Connect a 1kHz squarewave signal of 25mVpp amplitude (HZ60-2) to input CH II.
Check that the CH II input sensitivity is 5mV/div.
Check that DC input coupling is selected.
Locate and identify R624 (32) on YPA-Board.
Press XY pushbutton.
Set X-POS control that the left dot coincides with the graticule center.
Adjust R624 (32) for a distance of 5 division between left and right dot.

(33) RV3293: Trigger-Symmetry

Locate and identify RV3293 (33) on TB-Board.
Connect a 50kHz sinewave signal of 40mVpp amplitude to input CH I.
Set input coupling CH I to AC.
Check that trigger coupling is in AC position.
Set attenuator switch CH I to 0.1V/div (calibrated position).
Press AT/NORM. pushbutton (in!).
Turn LEVEL control for triggering (center position).
Reduce signal height and correct LEVEL setting for just triggering with a minimum signal height.
Press and release the trigger SLOPE ± pushbutton and adjust RV3293 (33) for stable triggering in both SLOPE conditions.

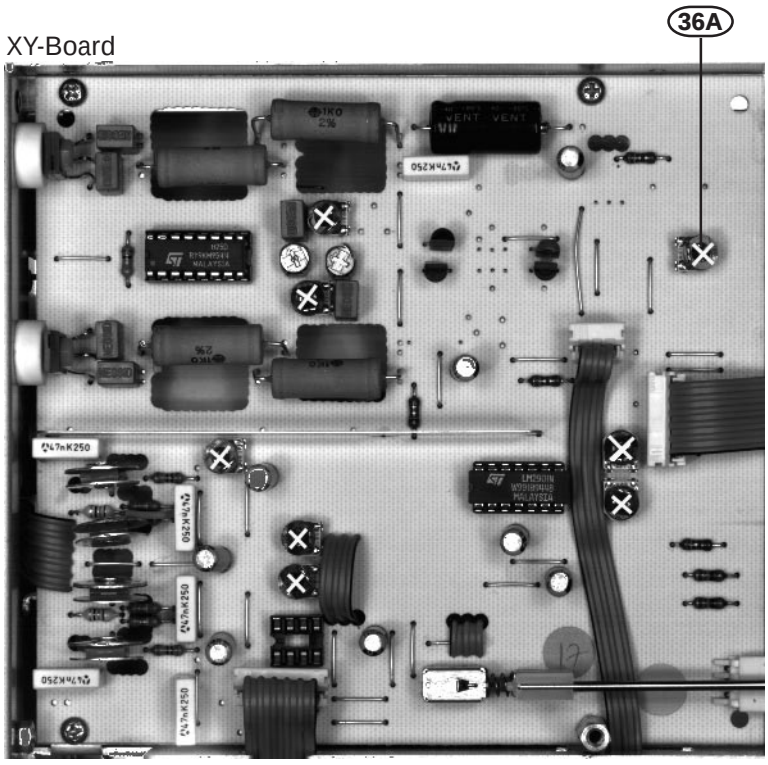
(34) R612: DC-Triggering CH I.

Locate and identify R612 (34) on YPA-Board.
Connect a 50kHz sinwave signal to input CH I.
Set generator amplitude to 8cm.
Set time base to 10µs/div.
Press AT/NORM. pushbutton (in!).
Turn LEVEL control to the center position.
Release AC/DC input coupling pushbutton CH I (out!).
Constantly switch between AC and DC trigger coupling and watch the trace start position.
Adjust R612 (34) so that there is no difference regarding the signal start position on the signal slope between DC and AC trigger coupling.

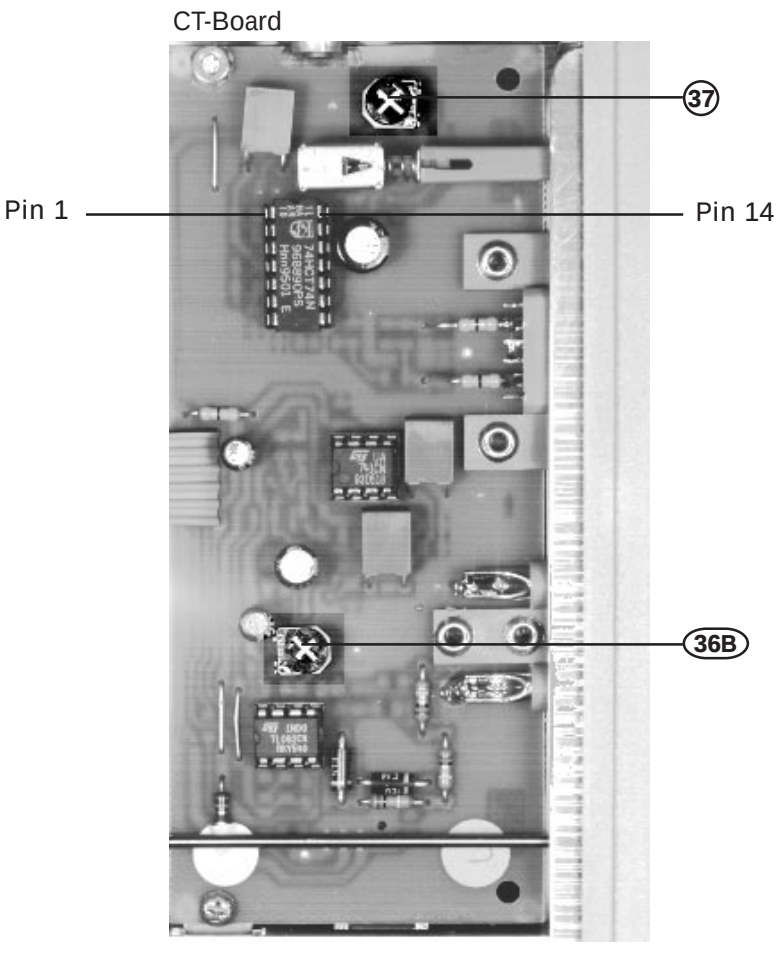
(35) R603: DC-Triggering CH II.

Locate and identify R603 (35) on YPA-Board.
Connect a 50kHz sinwave signal to input CH II.
Press CH I/II-TRIG I/II pushbutton (in!).
Set generator amplitude to 8cm.
Set time base to 10µs/div.
Press AT/NORM. pushbutton (in!).
Turn LEVEL control to the center position.
Release AC/DC input coupling pushbutton CH II (out!).
Constantly switch between AC and DC trigger coupling and watch the trace start position.
Adjust R603 (35) so that there is no difference regarding the signal start position on the signal slope between DC and AC trigger coupling.

XY-Board



CT-Board



(36) RV2301 (A), 4322 (B): Component Tester Y-Position and Tilt.

Release all pushbuttons (out!).
Press COMPONENT TESTER pushbutton (in!).
Locate and identify RV2301 (36A) on XY-Board.
Adjust RV2301 (36A) to shift the approx. 8 div. horizontal component tester trace to the horizontal center of the CRT graticule.
Locate and identify RV4322 (36B) on CC-Board.
Set up the instrument on a table in normal operating conditions to avoid misadjustment due to the influence of the earth magnetic field.
Adjust RV4322 (36B) in such a way that the trace is parallel to the horizontal graticule center line and not tilt. This adjustment

(37) VR8940: Calibrator Output.

Locate and identify VR8940 (37) on CC-Board.
Connect a digital multimeter to the 0.2Vpp calibrator output.
Set up the digital multimeter for DC measurement in a suited sensitivity setting.
Locate and identify IC8903 on CC-Board.
Connect pin 1 and pin 14 of IC8903 galvanically together.
Adjust VR8940 (37) for exactly 0.2V DC.
Check 2V calibrator output.
Remove the connection between pin 1 and pin 14 of IC8903.

Connect a 10:1 probe to the 0.2Vpp calibrator output and connect it to the CH I input of the scope.
Release all pushbuttons (out!).
Select CH I DC input coupling.
Set attenuator CH I to 5mV/div (calibrated detent).
Set time base to 0.2ms/div.
Now approximately 2 signal periods should be visible on the screen.
Press 1kHz/1MHz pushbutton (in!).
Set time base to 0.5µs position.
Check 1MHz calbrator signal.

Please note: *Neither the calibrator frequency nor the pulse duty factor are specified.*

(38) Trigger Filter Check.

Set time base to 1ms/div.
Connect a 1kHz sinewave signal of 40mVpp amplitude to input CH I and check for full screen deflection.
Set input attenuator CH I to 50mV/div and check for 8mm display height.
Select trigger coupling from AC to DC and LF. The signal must always trigger .
Set sinewave generator to 50kHz and 40mV output amplitude and check for 8mm display height.
Select trigger coupling from AC to DC. The signal must always trigger.
Select LF trigger coupling. Now the signal should not trigger.

(39) Triggerbandwidth Check.

Set time base to 0.05µs/div, time base variable to CAL position.
Set input coupling switch CH I to DC.
Set trigger coupling to AC.
Release AUTO/NORM pushbutton (out!).
Set input attenuator CH I to 5mV/div.
Connect a 100MHz sinewave signal to input CH I.
Adjust generator output for 5mm display height.
The signal must be triggered.

(40) External Trigger Check.

Set time base to 20µs/div.
Set input attenuator CH I to 0.1V/div.
Connect a 50 kHz sinewave signal via a 50-Ohm through terminator with an amplitude of 280mVpp (100mVrms) to input CH I and check for 2.8div display height.
Set LEVEL to midrange position.
Check that the Trigger-LED is ON.
Press EXT. pushbutton. The Trigger-LED (TR) should now be OFF.

Set input coupling CH I to GD.
Remove signal cable from input CH I and connect it to TRIG.INP. socket. Do not change generator settings.
Now the Trigger-LED should be ON again.

(41) Video Trigger Check.

Set CH I input coupling switch to DC.
Connect video signal with positiv sync. pulses to input CH I.
Adjust input attenuator switch CH I for 1 div display amplitude of video signal.
Set time base to 5ms/div (time base ≥ 1ms/div = frame triggering).
Set trigger coupling switch to TV.
Check that trigger starts with vertical sync. pulses.
Now approx. 2.5 frames should be visible.
Change polarity of video signal.
Press SLOPE pushbutton (in!).
Again approx. 2.5 frames should be displayed triggered.
Set time base to 20µs/div (time base range 0.5ms/div - 0.1µs/div = line triggering).
Recheck trigger SLOPE pushbutton procedure, using video signal with polarity change.

Note: *Invert pushbutton does not affect trigger polarity.*

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