



**Service Manual  
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HM303-5**

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St. 010998. Htb/gcRR



## Technische Daten

### Vertikal-Ablenkung

**Betriebsarten:** Kanal I oder II einzeln, Kanal I und Kanal II alternierend oder chop., (Chopperfrequenz ca. 0,5MHz)

**Summe** oder **Differenz** von KI und KII, (beide Kanäle invertierbar),

**XY-Betrieb:** über Kanal I und Kanal II

**Frequenzbereich:** 2xDC bis 35MHz (-3dB)

Anstiegszeit: <10ns

Überschwingen:  $\leq 1\%$

**Ablenkoeffizienten:** 12 kalibrierte Stellungen von **5mV/cm** bis **20V/cm** (1-2-5 Teilung)

variabel 2,5:1 bis mindestens **50V/cm**

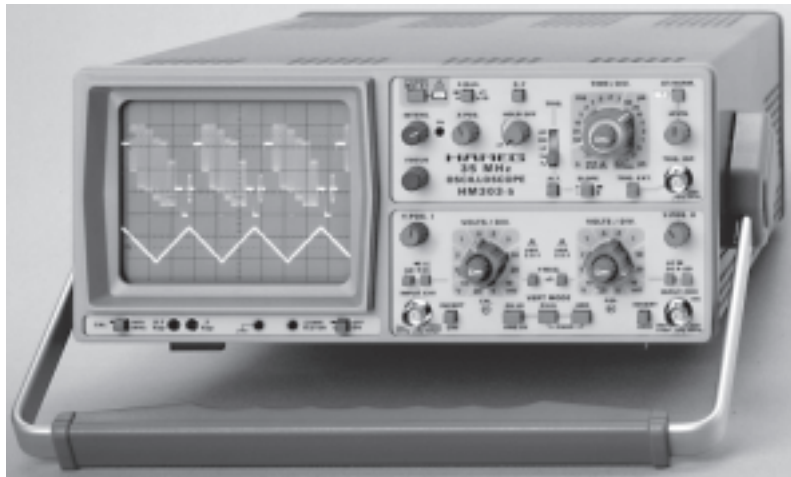
Genauigkeit der kalibrierten Stellungen:  $\pm 3\%$

**Y-Dehnung x5** (kalibriert) bis **1mV/cm**  $\pm 5\%$  im Frequenzbereich 0 - 10MHz (-3dB)

**Eingangsimpedanz:** 1M $\Omega$  || 20pF

Eingangskopplung: DC-AC-GD (Ground)

Eingangsspannung: max. 400V (DC + Spitze AC)



### Triggrung

**Automatik** (Spitzenwert): <20Hz-100MHz ( $\leq 5\text{mm}$ ),

Normal mit Level-Einstellung: **DC->100MHz** ( $\leq 5\text{mm}$ )

**LED-Anzeige** für Triggereinsatz

Flankenrichtung: positiv oder negativ,

Alternierende Triggrung von KI und KII,

**Quellen:** Kanal I, Kanal II, Netz, extern

Kopplung: **AC** (10Hz bis 100MHz),

**DC** (0 bis 100MHz),

**LF** (0 bis 1,5kHz)

**Extern:**  $\geq 0,3V_{ss}$  von 30Hz bis 30MHz

**Aktiver TV-Sync-Separator** (pos. und neg.)

### Horizontal-Ablenkung

**Zeitkoeffizienten:** 20 kalibrierte Stellungen

von 0,2s/cm - 0,1 $\mu$ s/cm mit 1-2-5 Teilung

Genauigkeit der kalibrierten Stellungen:  $\pm 3\%$

variabel 2,5:1 bis max. 0,5s/cm

mit **X-Mag. x10**  $\pm 5\%$ ; 10ns/cm:  $\pm 8\%$

**Holdoff:** variabel bis ca. 10:1

**Bandbreite X-Verstärker:** 0-3MHz (-3dB)

Eingang X-Verstärker über Kanal II,

Empfindlichkeiten wie Kanal II

**X-Y** Phasendifferenz: <3° unter 220kHz

### Komponententester

**Testspannung:** ca. 6V<sub>eff</sub> (Leerlauf)

**Teststrom:** ca. 5mA<sub>eff</sub> (Kurzschluß)

**Testfrequenz:** ca. 50Hz

Testkabelanschluß: 2 Steckbuchsen 4mm  $\varnothing$

Prüfkreis liegt einpolig an Masse (Schutzleiter)

### Verschiedenes

**Röhre:** D14-364GY/123 oder ER151-GH/-,

Rechteckform (8x10cm), Innenraster

**Beschleunigungsspannung:** ca. 2000V

**Strahldrehung:** auf Frontseite einstellbar

**Kalibrator:** Rechteckgenerator ( $t_a < 4\text{ns}$ )

$\approx 1\text{kHz} / 1\text{MHz}$ ; Ausgang: 0,2V  $\pm 1\%$  und 2V

Netzanschluß: 100-240V  $\sim \pm 10\%$ , 50/60Hz

**Leistungsaufnahme:** ca. 36 Watt bei 50Hz

Zul. Umgebungstemperatur: 0°C...+40°C

**Schutzart:** Schutzklasse I (IEC1010-1/VDE 0411)

Gewicht: ca. 5,6kg, Farbe: techno-braun

Gehäuse: **B** 285, **H** 125, **T** 380 mm

Mit verstellbarem Aufstell-Tragegriff

## 35MHz Standard Oszilloskop HM 303

**Vertikal: 2 Kanäle, 5mV – 50V/cm, mit Dehnung x5 ab 1mV/cm**

**Zeitbasis: 0.5s – 0,1 $\mu$ s/cm, mit Dehnung x10 bis 10ns/cm**

**Triggrung: DC – 100MHz, TV-Sync-Separator, Altern. Triggrung**

**Komponenten-Tester, 1kHz/1MHz Kalibrator**

Der neue **HM303** ist der Nachfolger des bisher weltweit mehr als **180000**mal verkauften HM203. Wesentliche Neuerungen betreffen vor allem die Erhöhung der Bandbreite von 20 auf **35MHz**, die Erweiterung des horizontalen Ablenkbereiches bis max. **10ns/cm** und eine nochmalige Verbesserung der schon seit Jahren einzigartigen Triggrung. In seiner jetzigen Ausführung eignet sich der **HM303** für die Darstellung von Signalen im Frequenzbereich von **DC** bis ca. **100 MHz**.

Ein wesentliches Qualitätsmerkmal dieses Oszilloskops ist vor allem die hohe Übertragungsgüte der Meßverstärker mit max. **1% Überschwingen**. Damit diese – von der Tastspitze bis zum Bildschirm – ständig kontrollierbar ist, besitzt der **HM303** als erster seiner Preisklasse einen **Kalibrator mit geringer Anstiegszeit**.

Wirklich außergewöhnlich ist die Triggrung des **HM303**. Bereits **ab 5mm Bildhöhe** kann sie noch Signale bis über **100MHz** triggern. Für die exakte Darstellung von TV-Signalen wird ein aktiver **Sync-Separator** verwendet. In **alternierender Betriebsart** ist auch die Triggrung von zwei Signalen mit unterschiedlicher Frequenz möglich. Wie sein Vorgänger ist das Gerät ebenfalls mit dem bewährten **Komponententester** ausgestattet. Seine Meßspannung ist jetzt amplitudenstabilisiert. Vorbildlich ist auch die Stromversorgung. Das eingebaute **Schaltnetzteil** arbeitet ohne Netzspannungsumschaltung immer mit dem geringstmöglichen Leistungsverbrauch. Gegen magnetische Einwirkungen von außen ist die Strahlröhre des **HM303** mit Mumetall abgeschirmt.

Alles in allem hat **HAMEG** mit diesem Gerät wieder einmal Maßstäbe gesetzt, die entsprechend seinem Preis-/Leistungs-Standard einfach beispiellos sind. Kenner werden von den Eigenschaften des neuen **HM303** begeistert sein.

Foto: 1MHz Rechteck-Signal

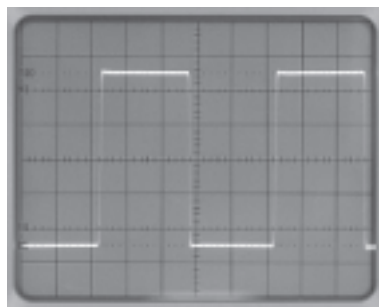
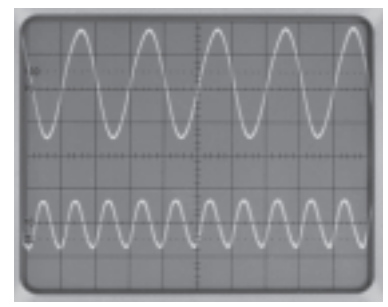


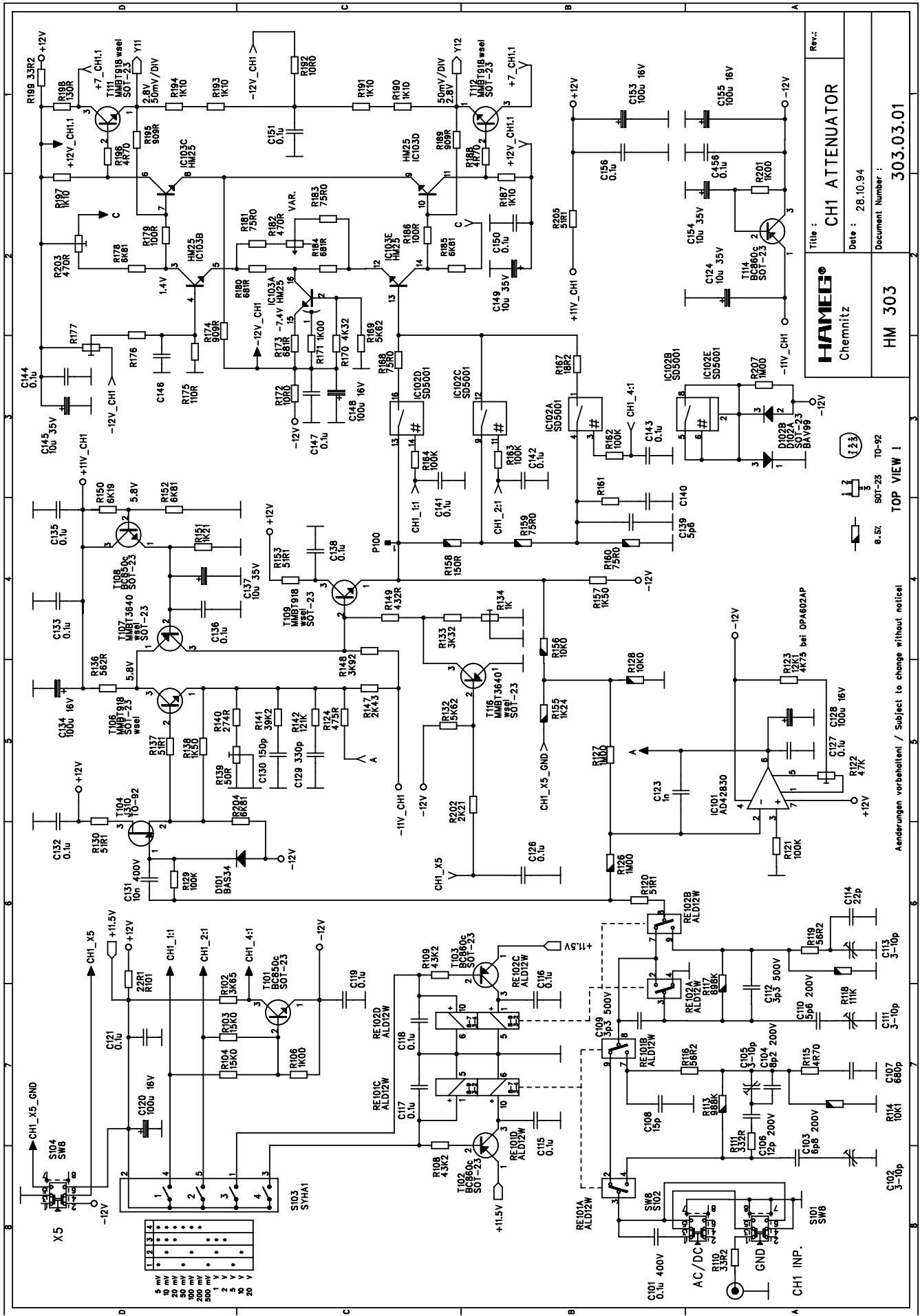
Foto: 50MHz und 100MHz Sinus-Signal mit alternierender Triggrung

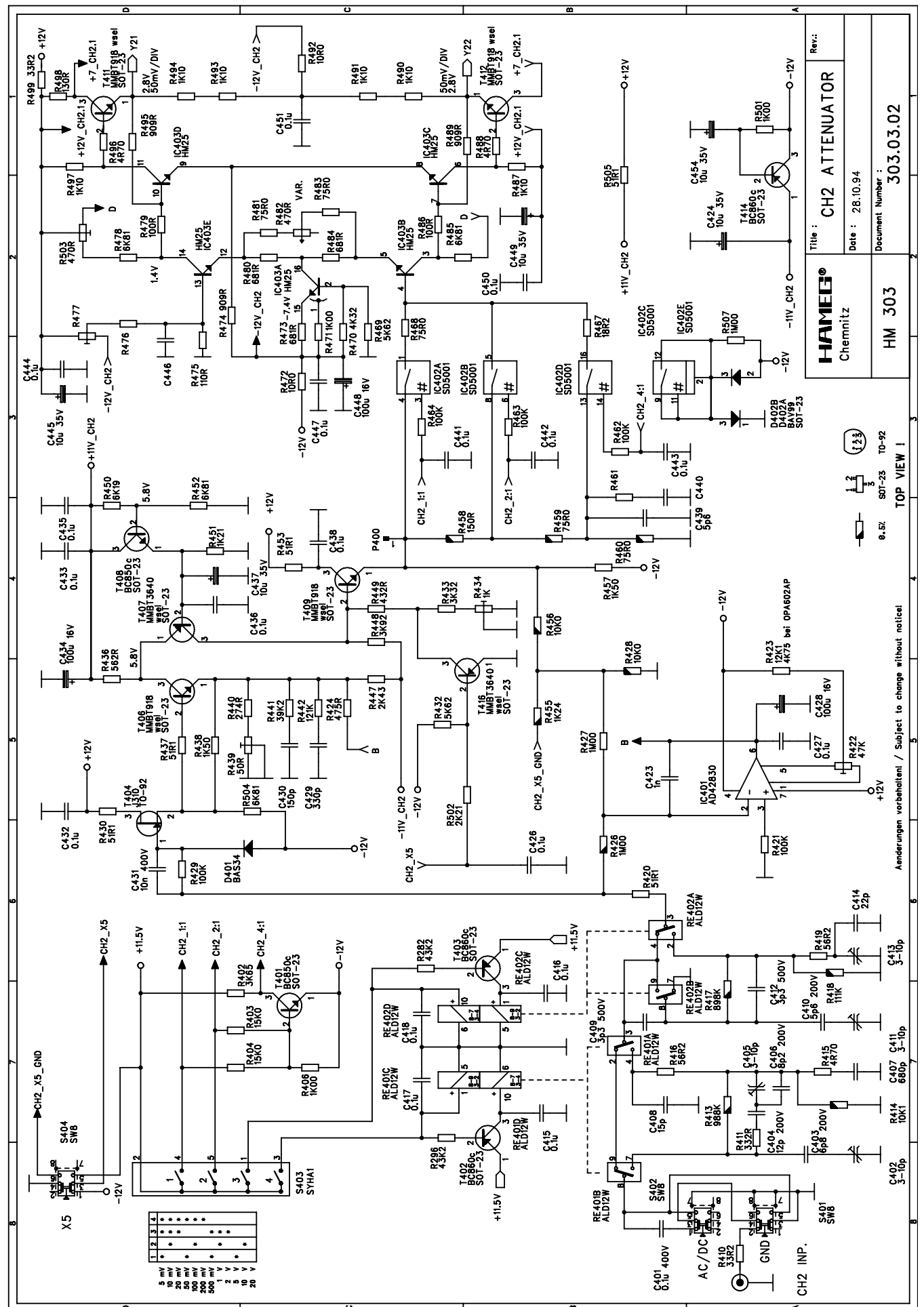


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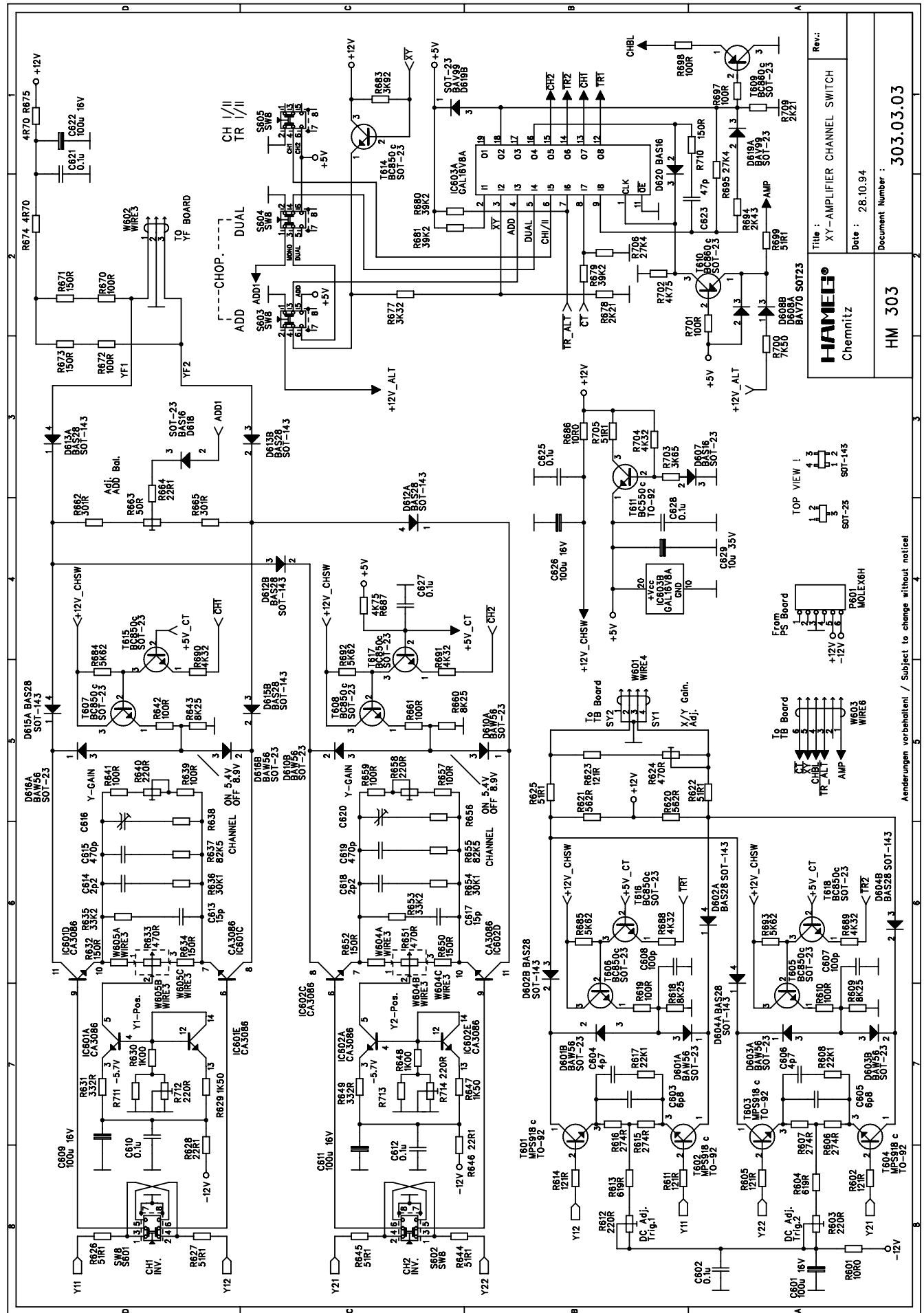
**Inkl. Zubehör: Netzkabel, Betriebsanleitung, 2 Tastköpfe 1:1/10:1**

Y-Preamplifier CH I (YP-Board)

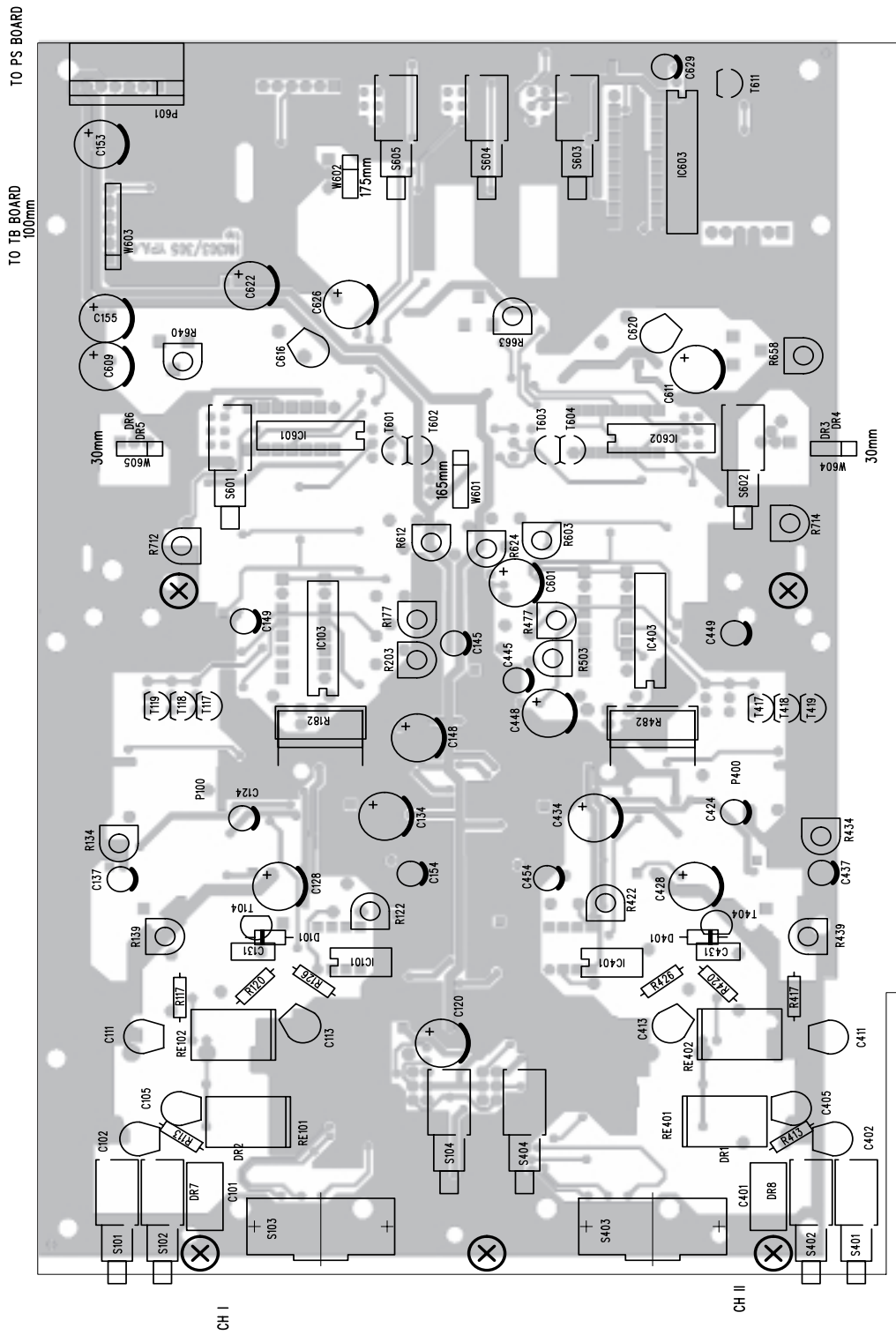




# Y-Intermediate Amplifier and Trigger Amplifier (YP-Board)

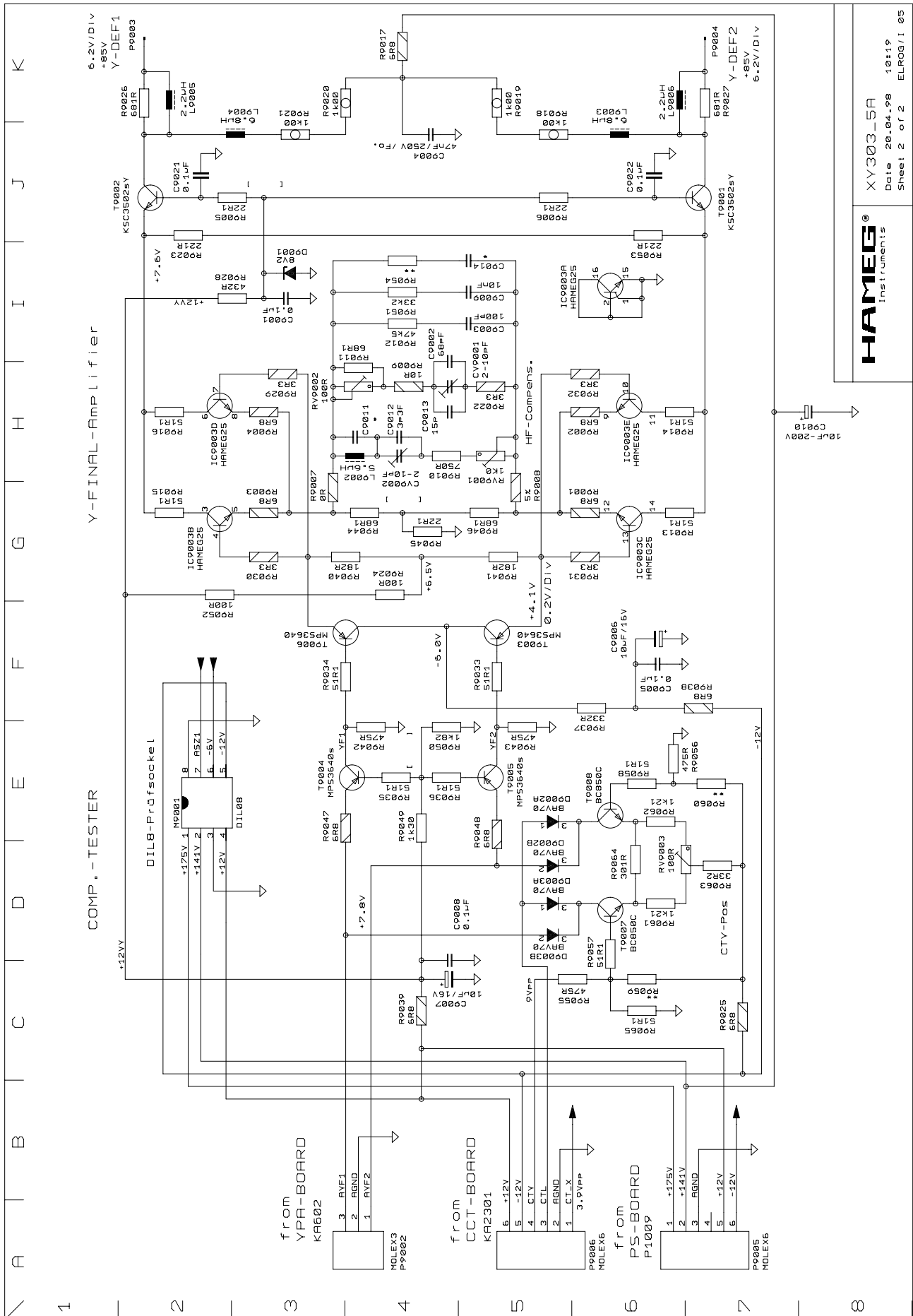








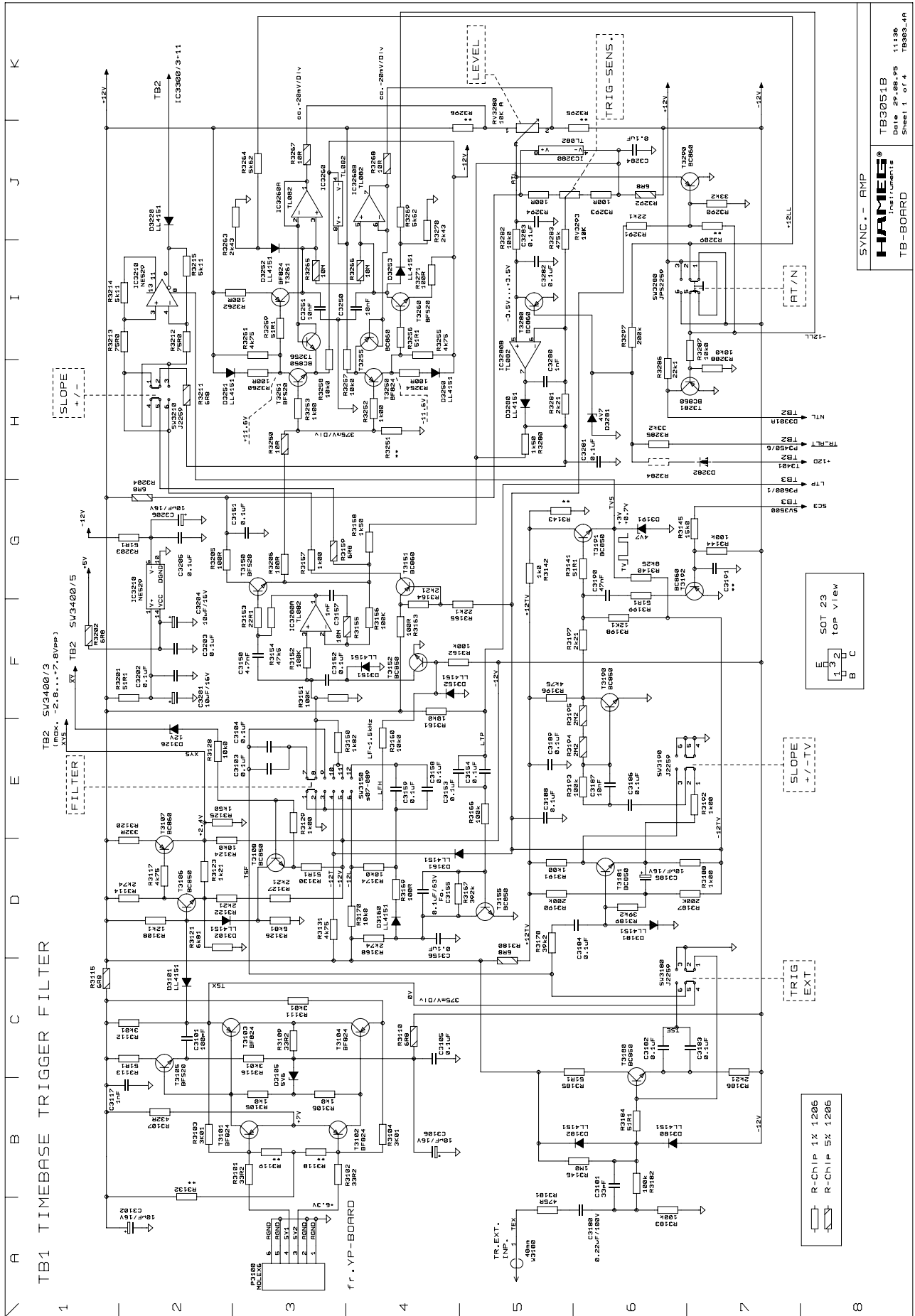




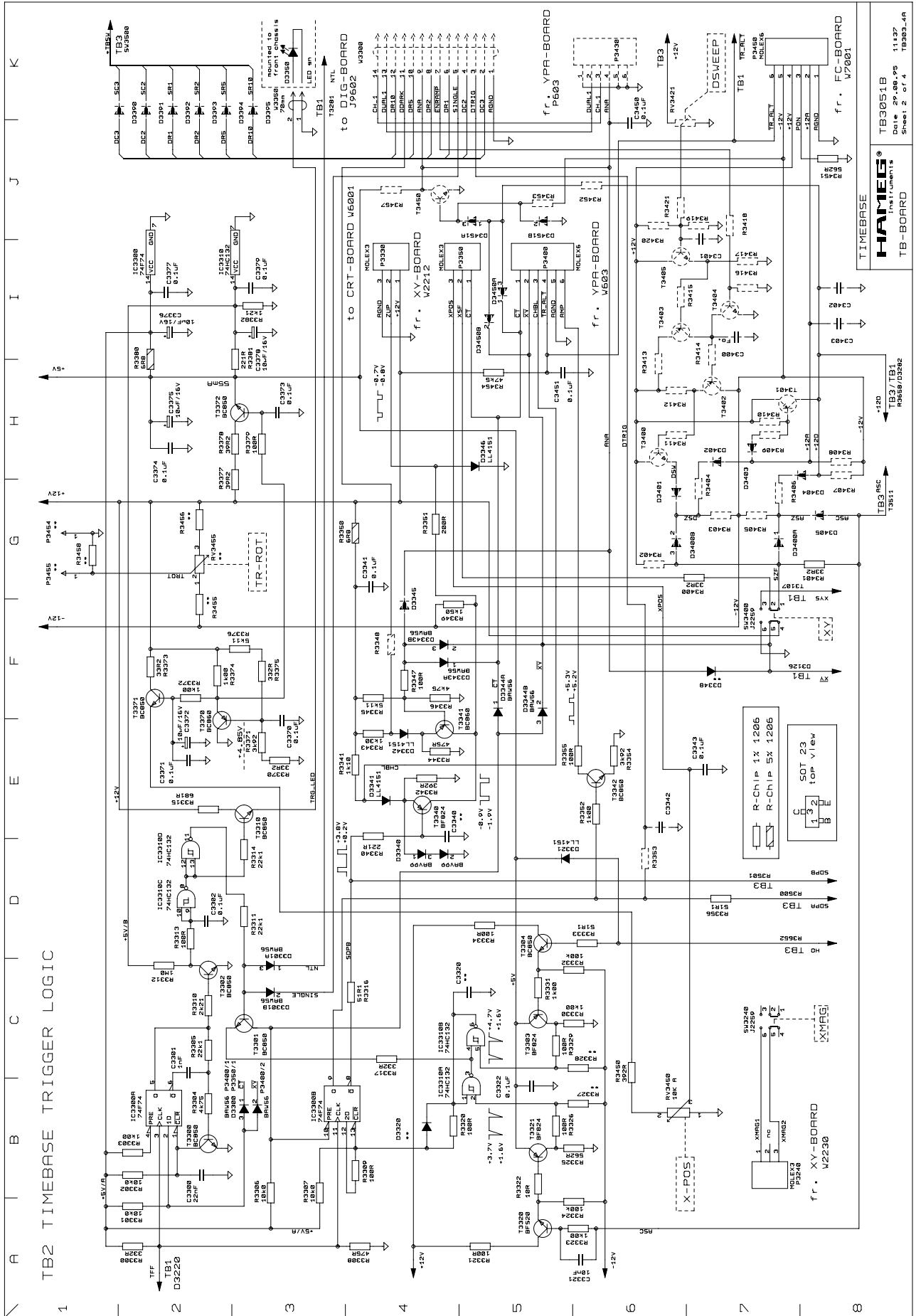
**HAMEG**  
Instruments

XY303\_5A  
Date 20.04.98 10:19  
Sheet 2 of 2 ELROG/1 05





SYNCRAMP  
**HAMEL**  
 Instruments  
 TB3051B  
 Date 29.08.95 11:50  
 Sheet 1 of 4 TB3051A



TIMEBASE  
INSTRUMENTS  
TB-BOARD

TB3051B  
Date: 29-08-95  
Sheet 2 of 4  
TB303-4A

TO CRT-BOARD M6001  
f.f. XY-V2212

TO YPA-BOARD  
f.f. YPA-BOARD P603

TO DIG-BOARD  
J9602

TO FC-BOARD  
f.f. V7001

TO X-POS  
f.f. XY-V2230

TO DSWEEP

TO TB1

TO TB2

TO TB3

TO TB4

TO TB5

TO TB6

TO TB7

TO TB8

TO TB9

TO TB10

TO TB11

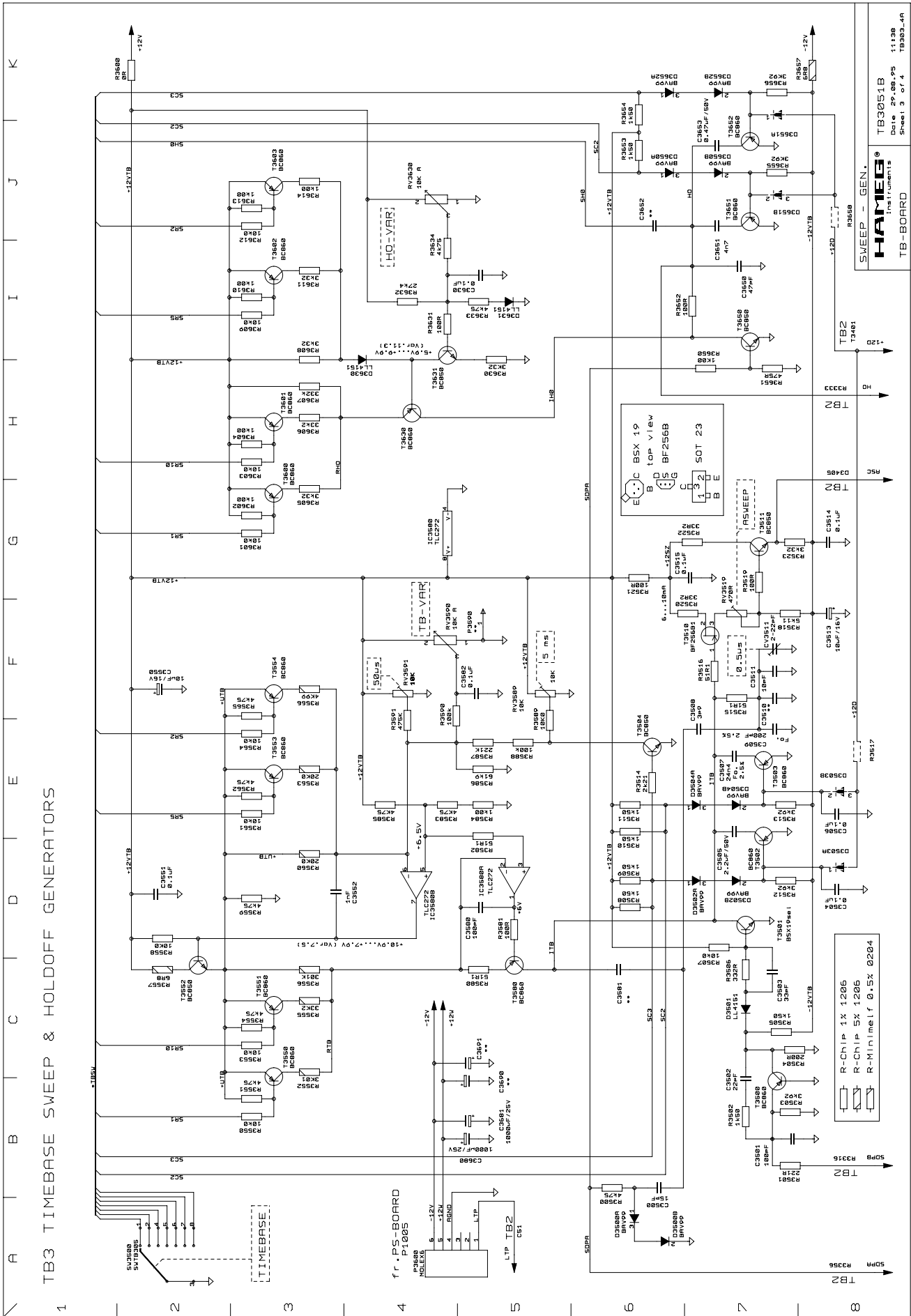
TO TB12

TO TB13

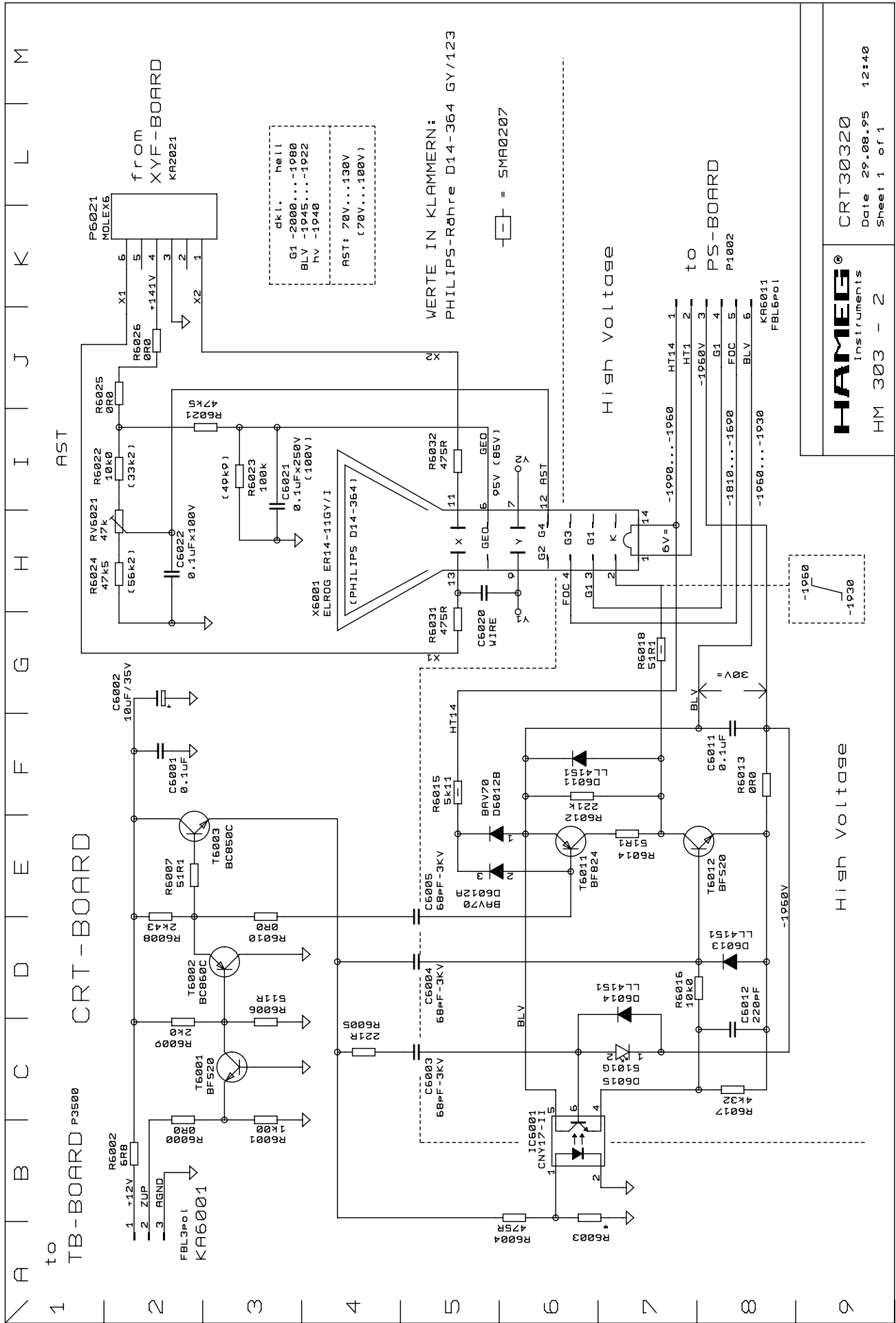
TO TB14

TO TB15

TO TB16







dkl. hell  
 G1 -2000...-1080  
 BLV -1945...-1922  
 HV -1940

AST: 70V...130V  
 (70V...100V)

WERTE IN KLAMMERN:  
 PHILIPS-Röhre D14-364 GY/123

= SMA0207

High Voltage

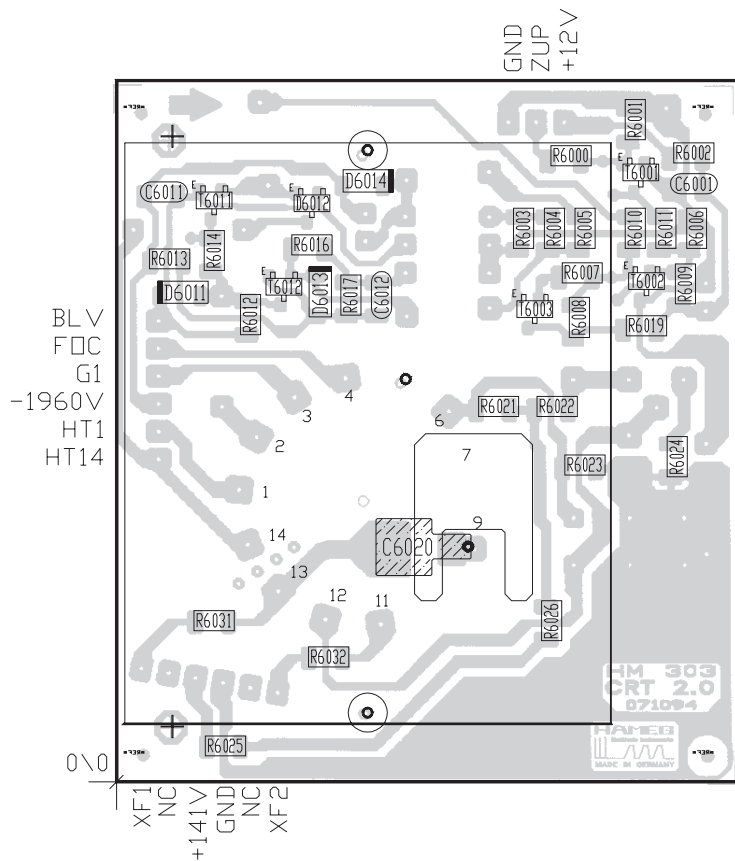
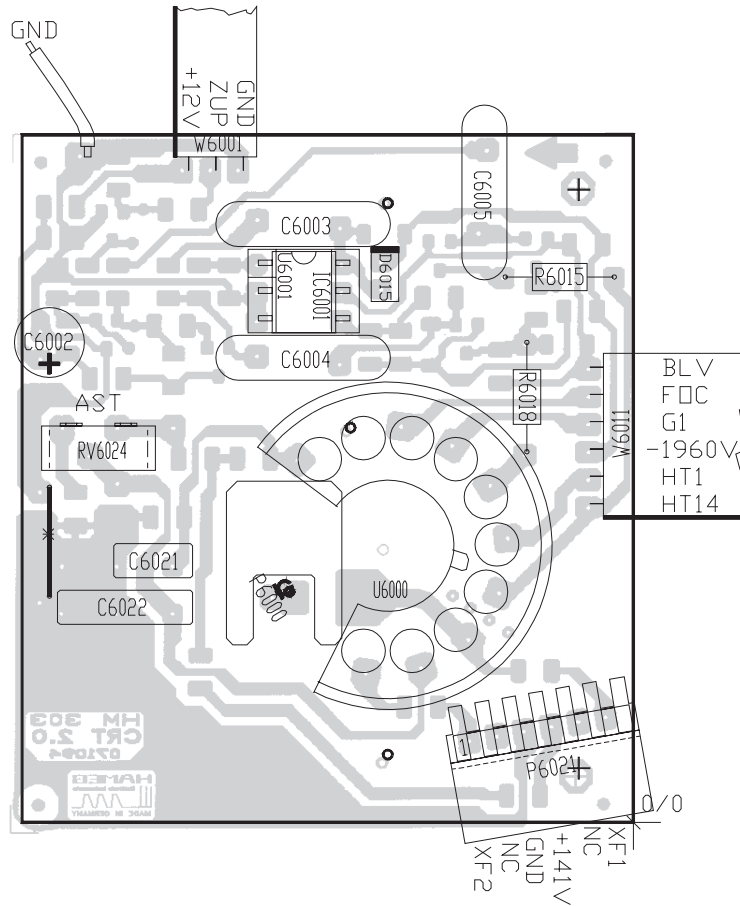
-1960  
 -1930

High Voltage

**HAMEG®**  
 Instruments  
 HM 303 - 2

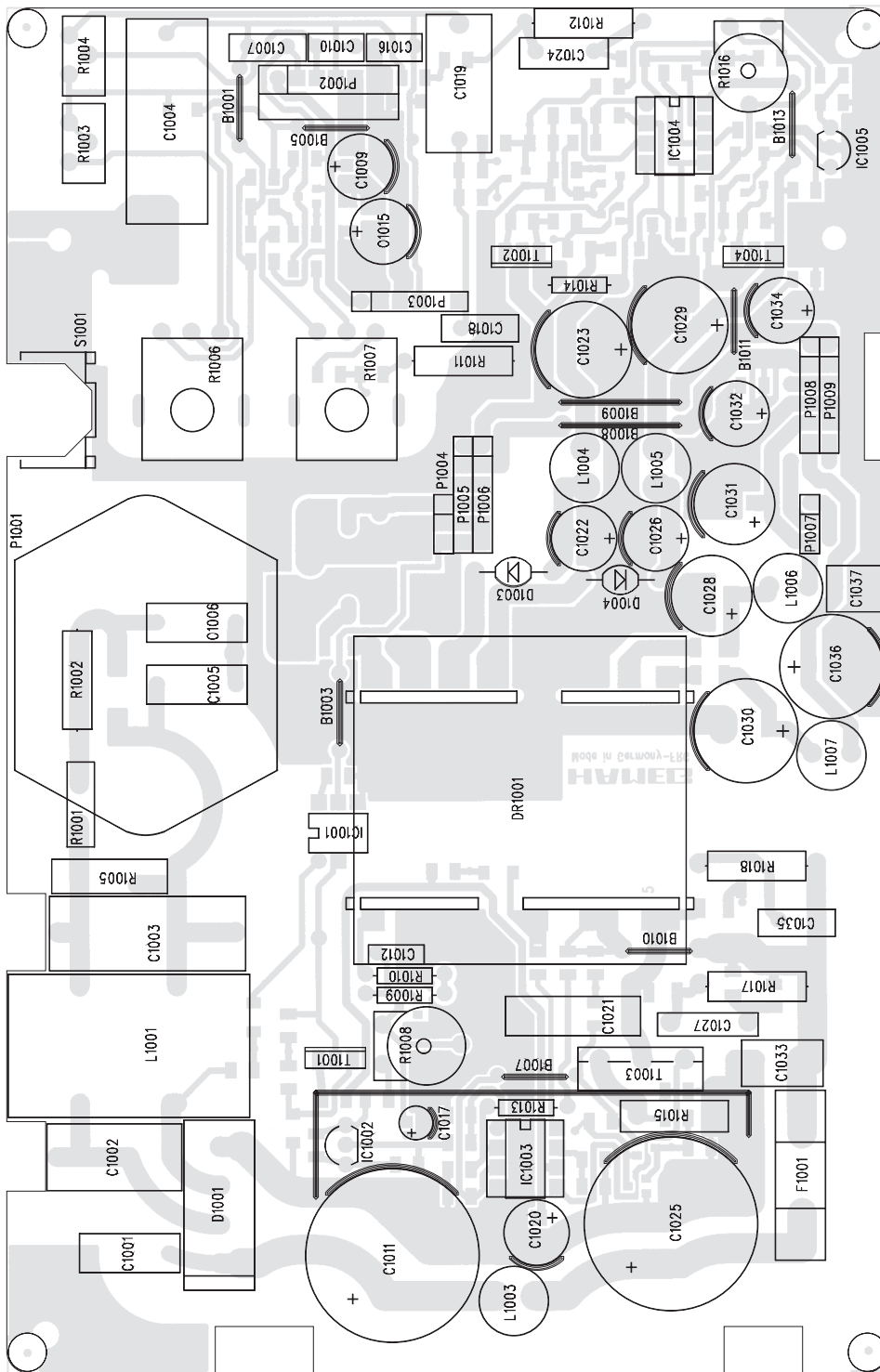
CRT30320  
 Date 29.08.95 12:40  
 Sheet 1 of 1





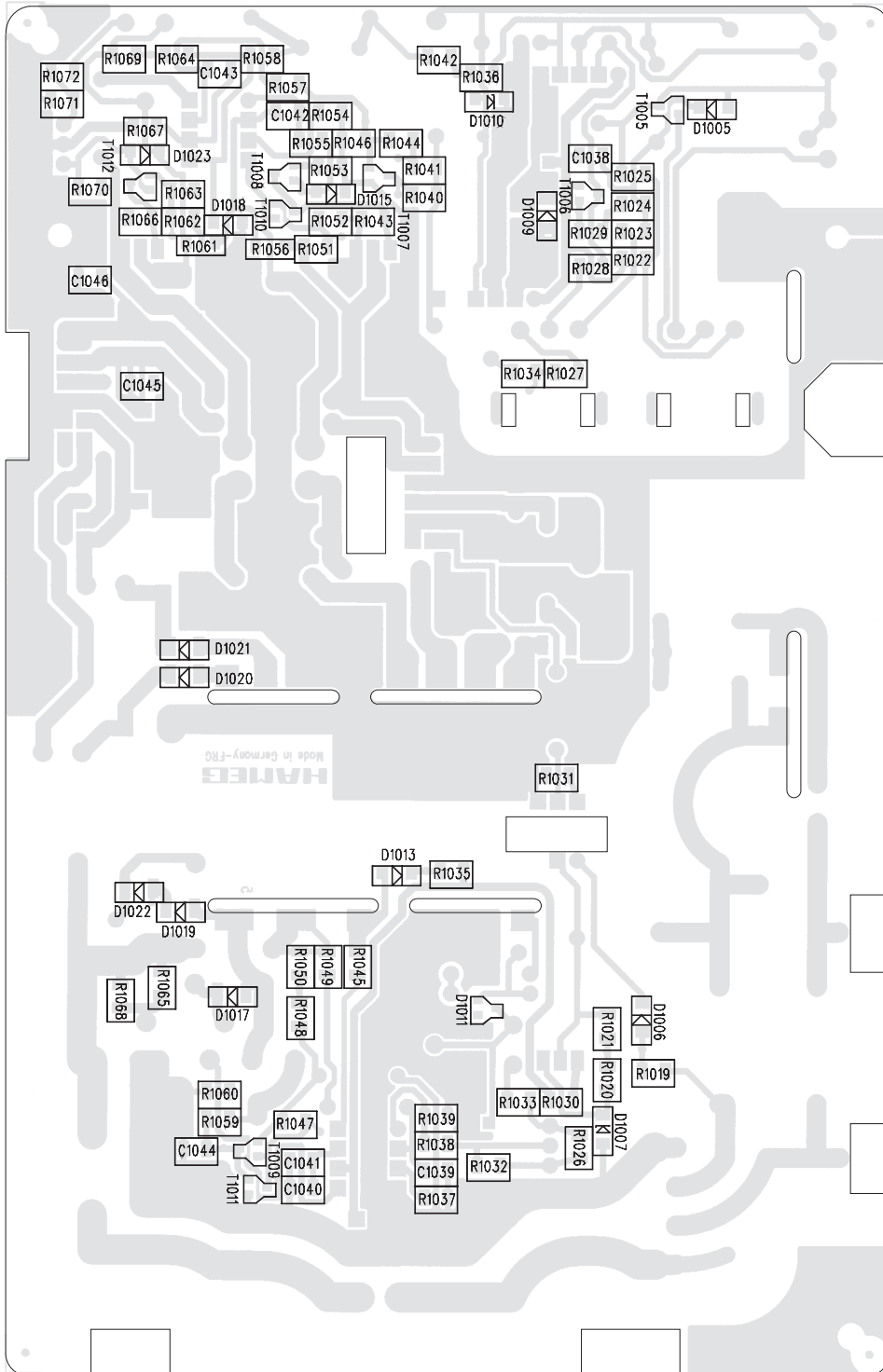


HM303

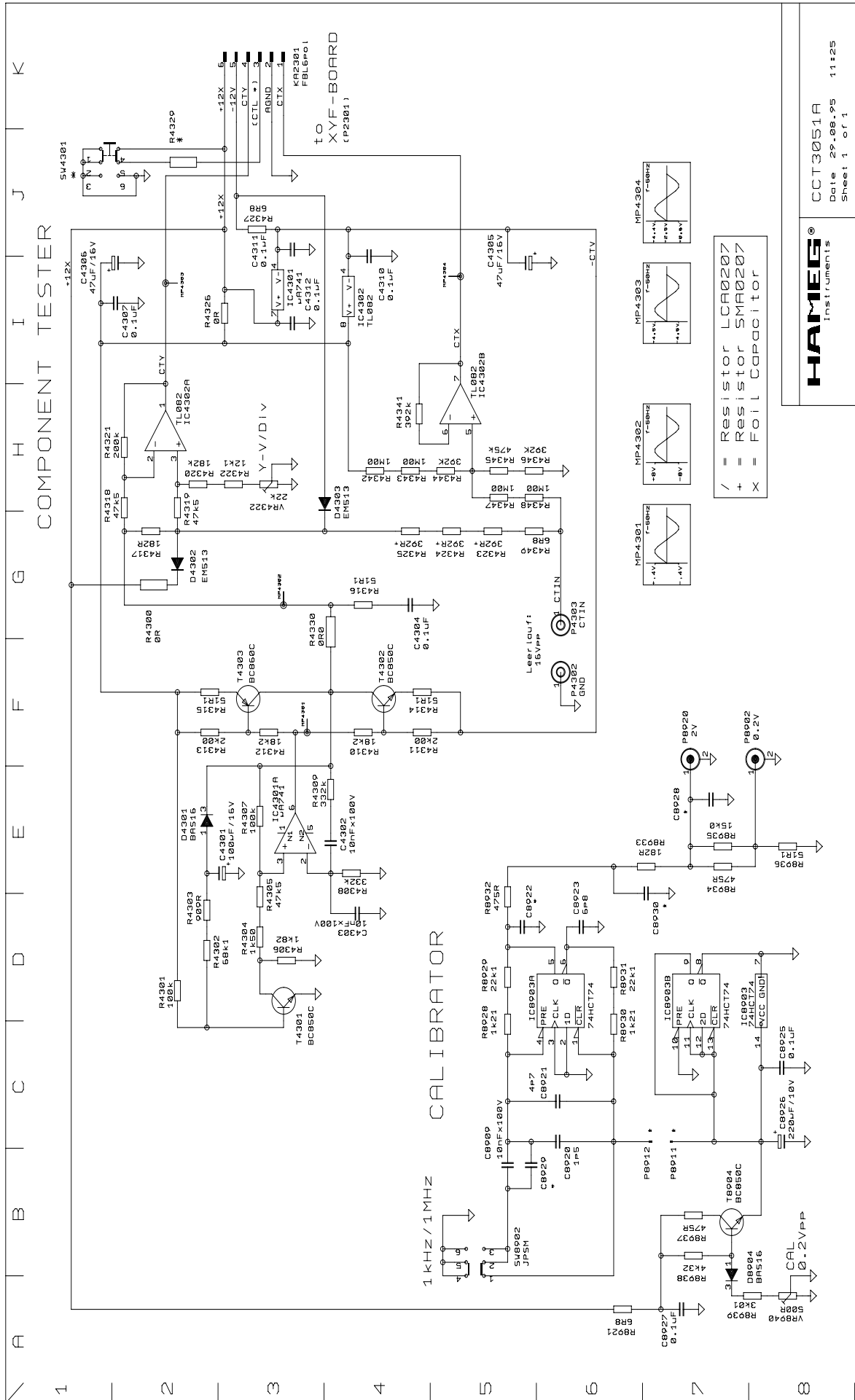


Besteckungsplan bedrante BE's

Bestückungsplan SMD BE's



HM303

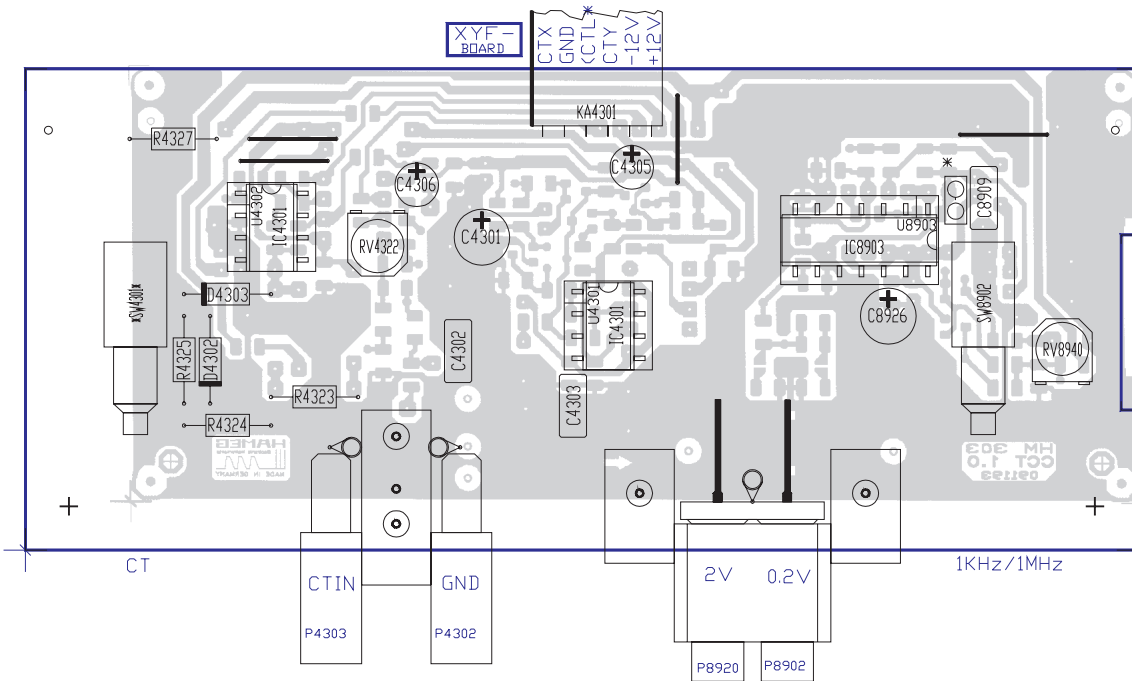
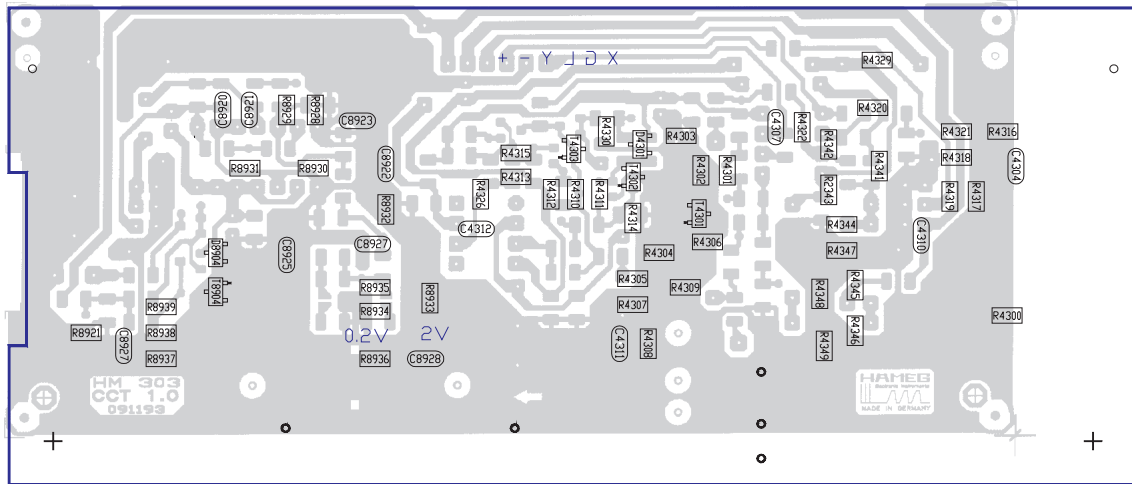


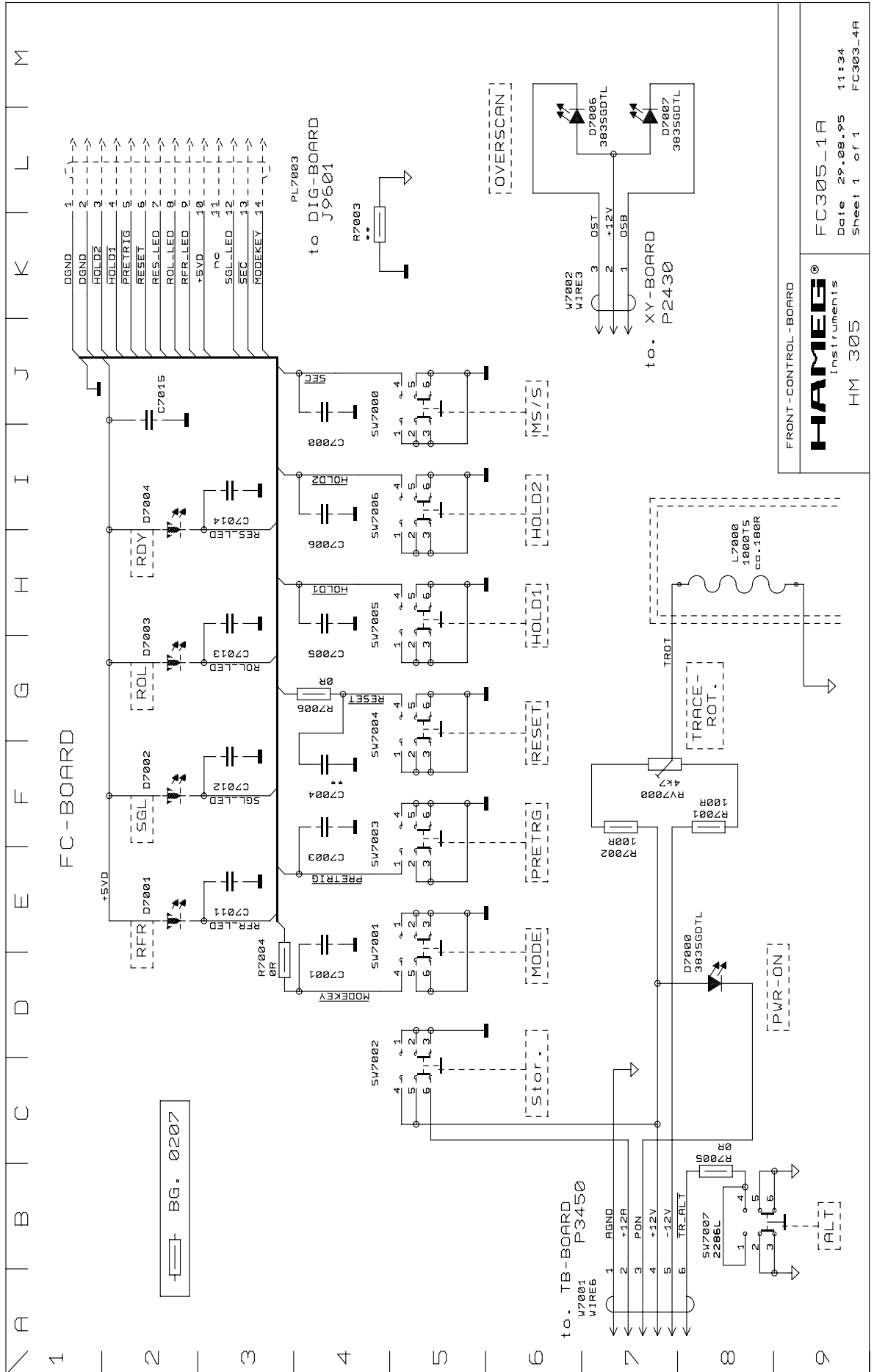
- ✓ = Resistor LCA0207
- + = Resistor SMA0207
- X = Foil Capacitor

**HAMEG**  
Instruments

CCT3051A  
Date 29.08.95 11:25  
Sheet 1 of 1

CCT Board (Top and Bottom side)





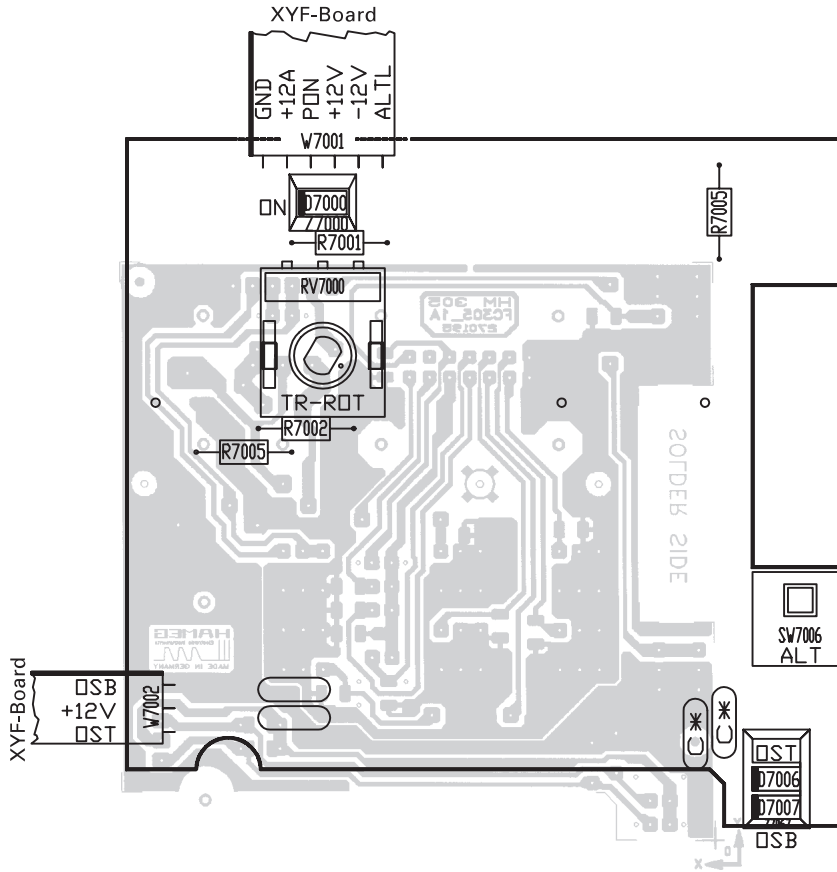
FRONT-CONTROL-BOARD

**HAMEE**<sup>®</sup>  
Instruments

HM 305

FC305-1A  
Date 29.08.95 11:34  
Sheet 1 of 1 FC303-4A

# Front Control board (Top and Bottomside)





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## **Adjustment Procedure**

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## ADJUSTMENT PROCEDURE

30MHz Standard Oscilloscope HM303-5



### 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 50 $\Omega$ , preferably with 20dB attenuation (e.g. HM8133, TEK SG502 + TEK SG503).
- 3) Amplitude Calibrator with 1kHz squarewave output and 600 $\Omega$  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 50 $\Omega$  (e.g. HZ62, TEK TG501).
- 5) Pre-attenuator 2:1 (1M $\Omega$ , 12-48pF), e.g. HZ20.
- 6) 50 $\Omega$  BNC through termination, e.g. HZ22.
- 7) 2 BNC-cables, 50 $\Omega$ , e.g. HZ34.
- 8) BNC-T-connector.
- 9) Oscilloscope probe 10:1, with exactly 9M $\Omega$  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.

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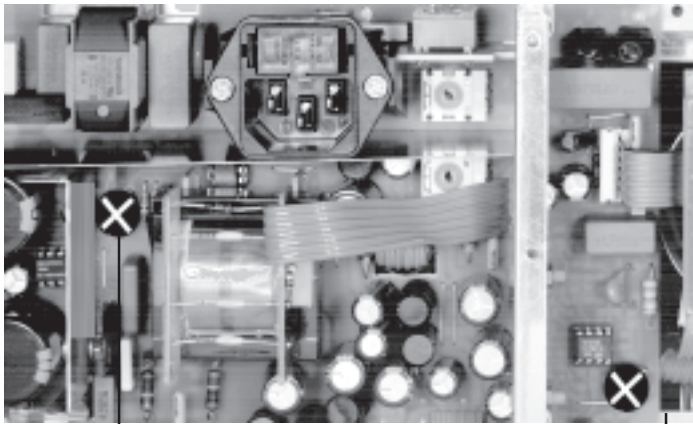
**NOTE**

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 50 $\mu$ s/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.

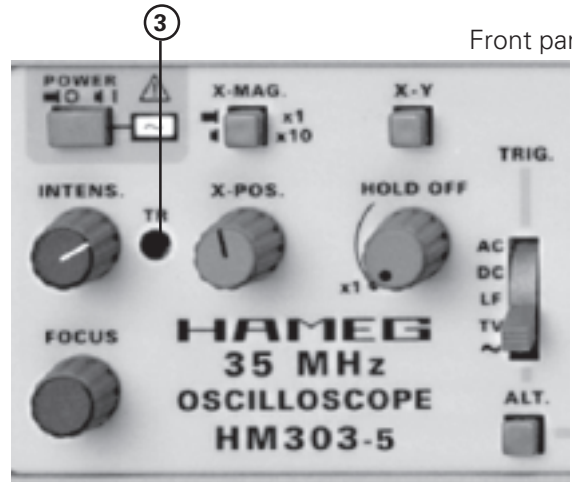
If different settings are required, they are mentioned particularly for each subject.



PS-Board

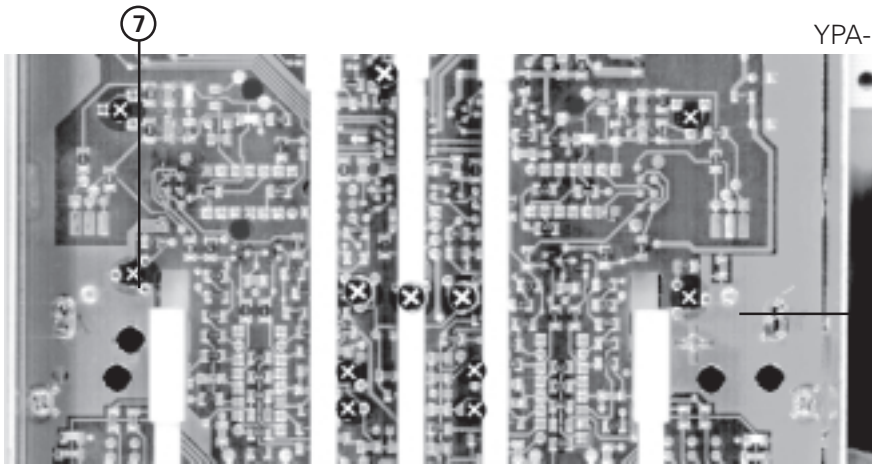
①

②



Front panel

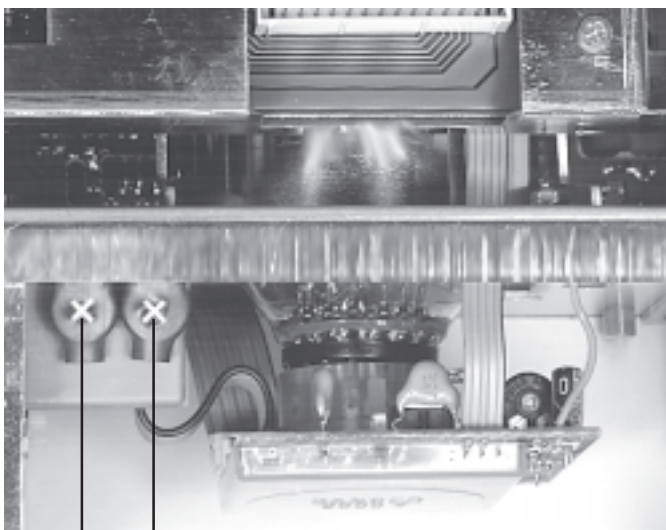
③



YPA-Board

⑦

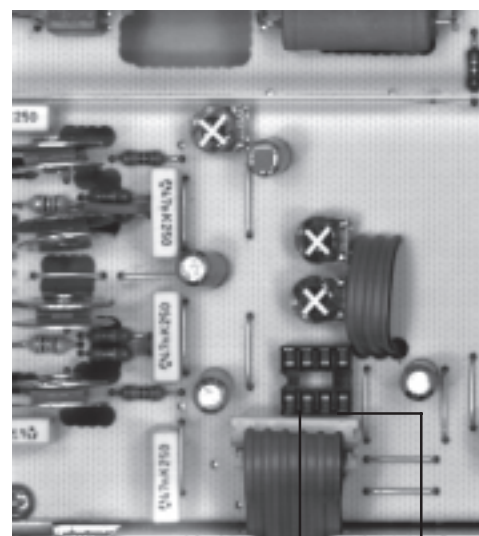
⑥



PS-Board

⑤

④



XY-Board

Pin 2

Pin 4

---

(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 ( $\pm 0.1$  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 ( $\pm 10$ mV). 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.

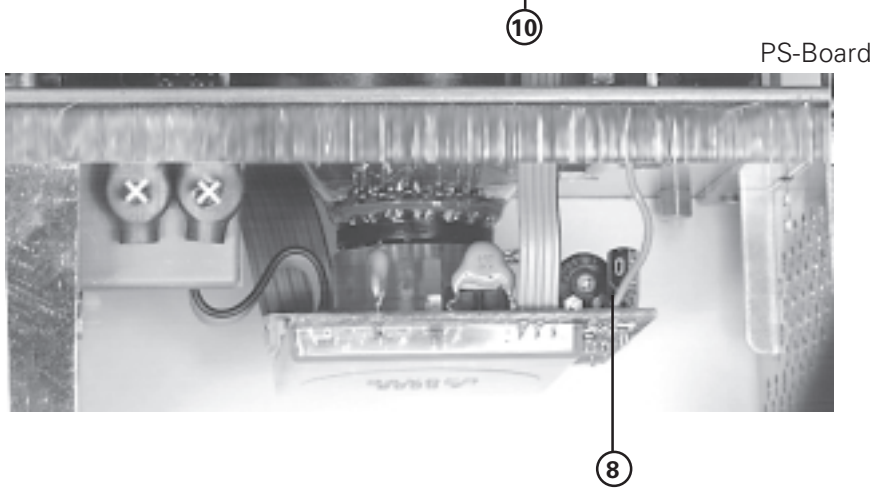
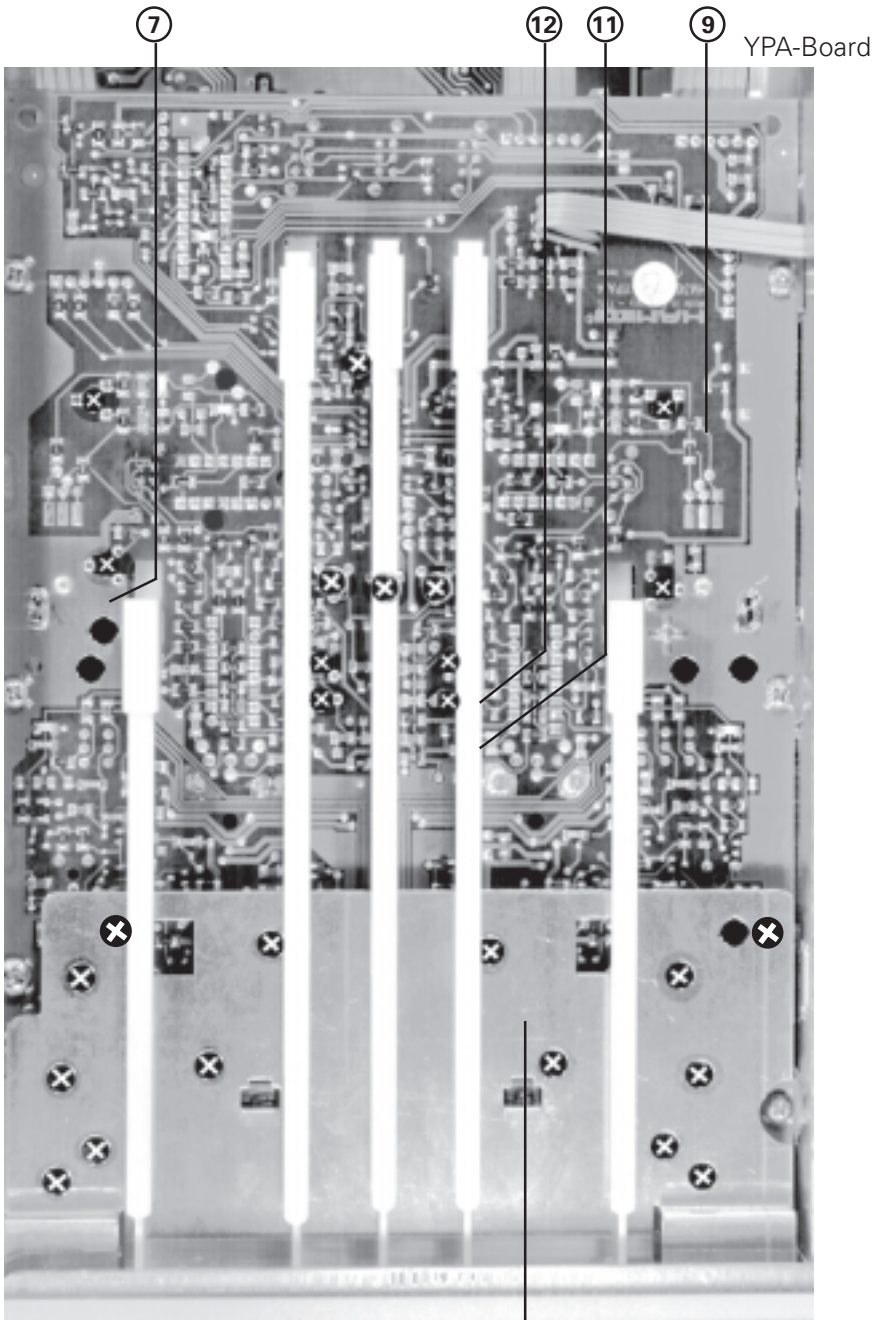


**Note:** Do not remove the short at the Y-plates until item 7) is finished.

(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.



---

**(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.

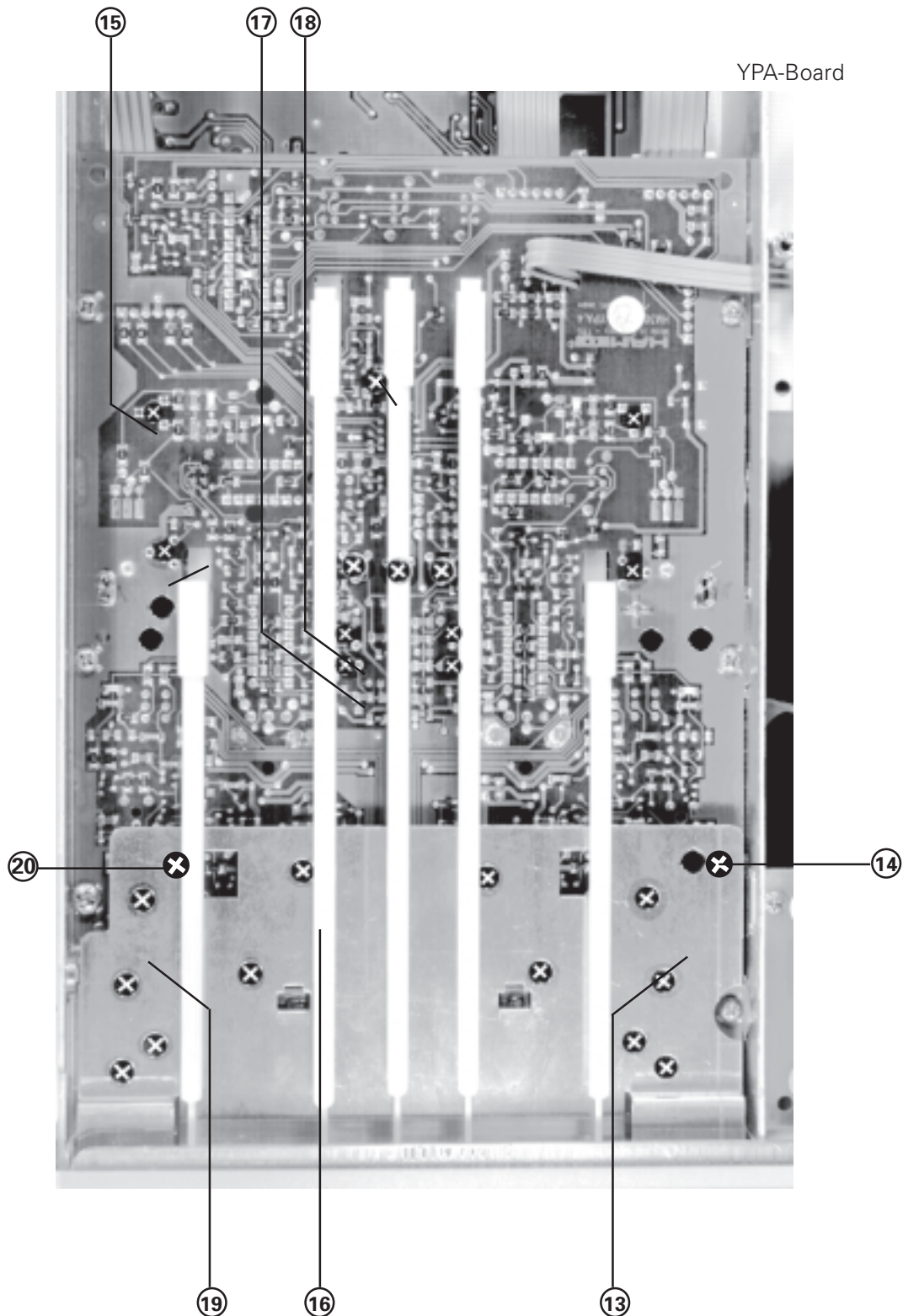
**(11) R203: Invert-Balance CH I.**

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.



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**(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 CH I/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.

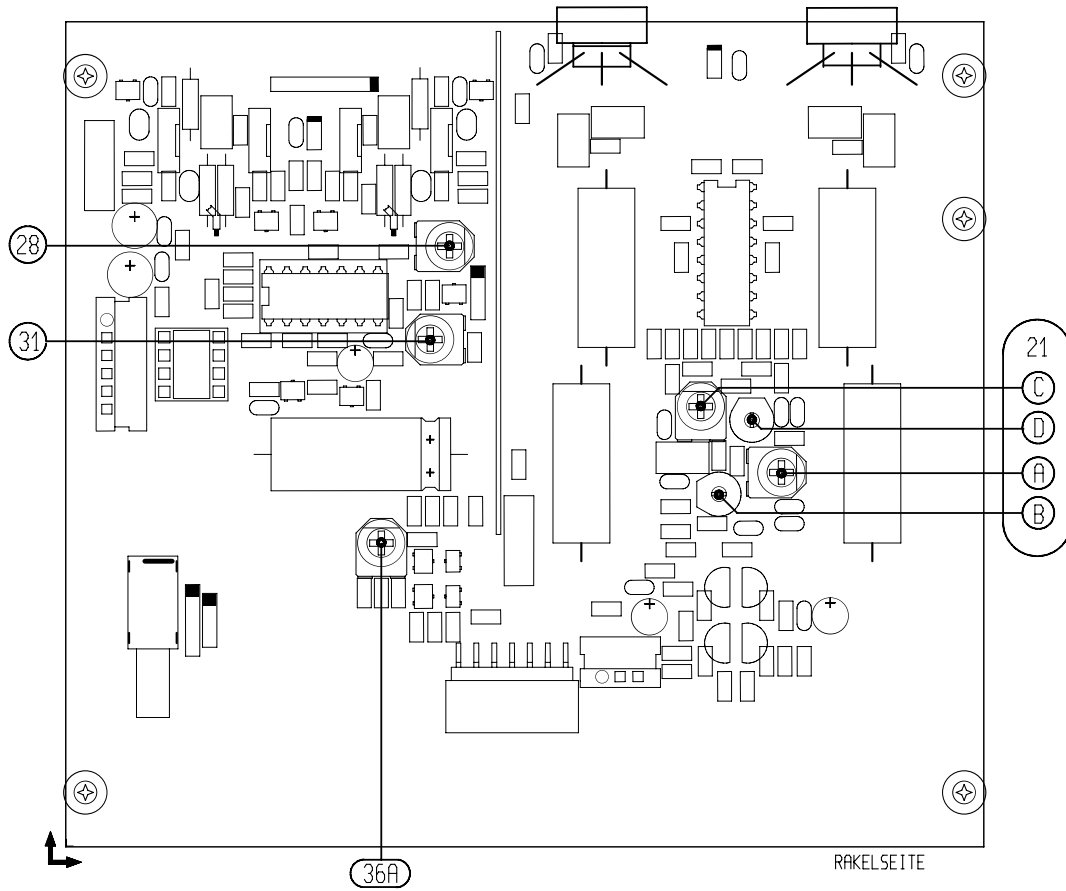
**(19) R439: 100Hz Squarewave 5mV/div CH II.**

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.

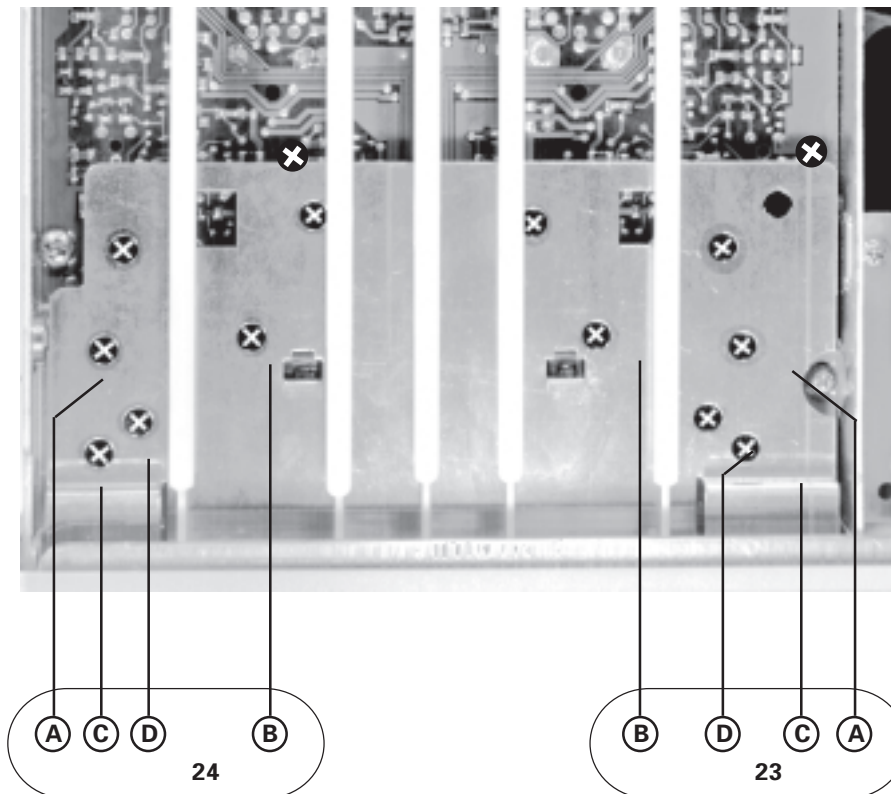
**(20) R434: 100Hz Squarewave 1mV/div CH II.**

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.

XY-Board



YPA-Board



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**(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 through termination 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 CH/II-TRIG/II pushbutton (in!).  
Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50Ω through termination 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:

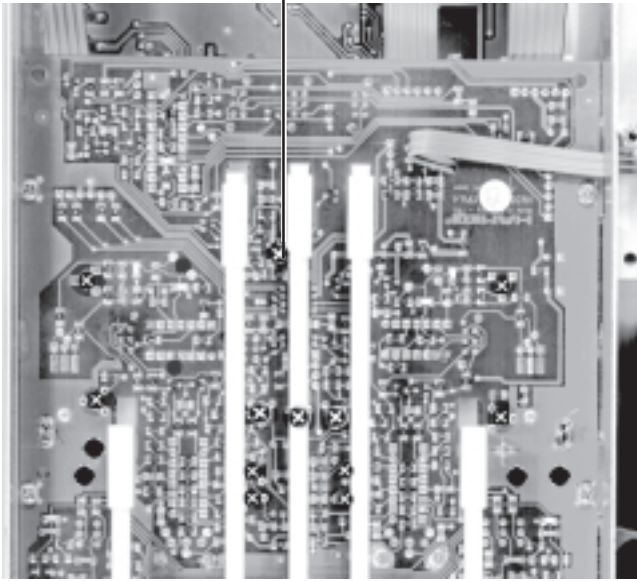
Scope Input	Input Atten.	Adjustment CH I
250mVpp 2.5Vpp	50mV/div 0.5V/div	A (VC111) flat top + B (VC113) leading edge C (VC102) flat top + D (VC105) leading edge

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

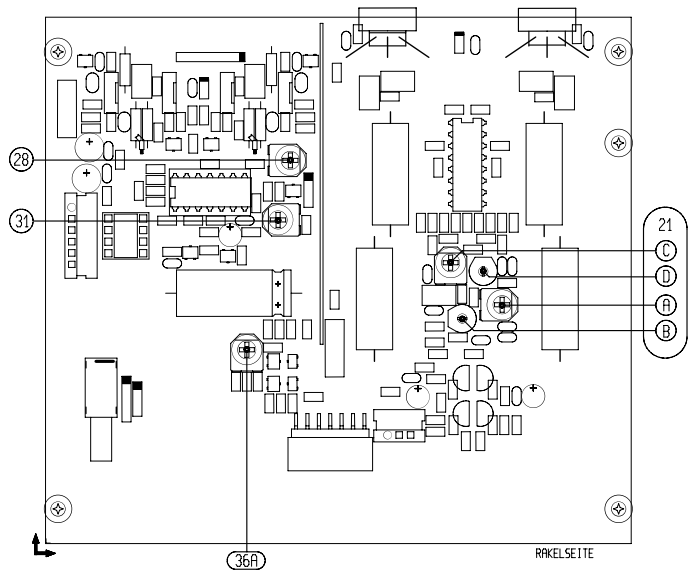
Locate and identify trimmers VC402-413 for CH II on YPA-Board.  
Check that DC input coupling is selected.  
Check that input attenuator CH II is in 5mV/div setting.  
Set time base switch to 0.5ms/div.  
Set amplitude calibrator to 1kHz and connect a 2:1 pre-attenuator via 50Ω cable to input of CH II.  
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 2.5Vpp	50mV/div 0.5V/div	A (VC411) flat top + B (VC413) leading edge C (VC402) flat top + D (VC405) leading edge

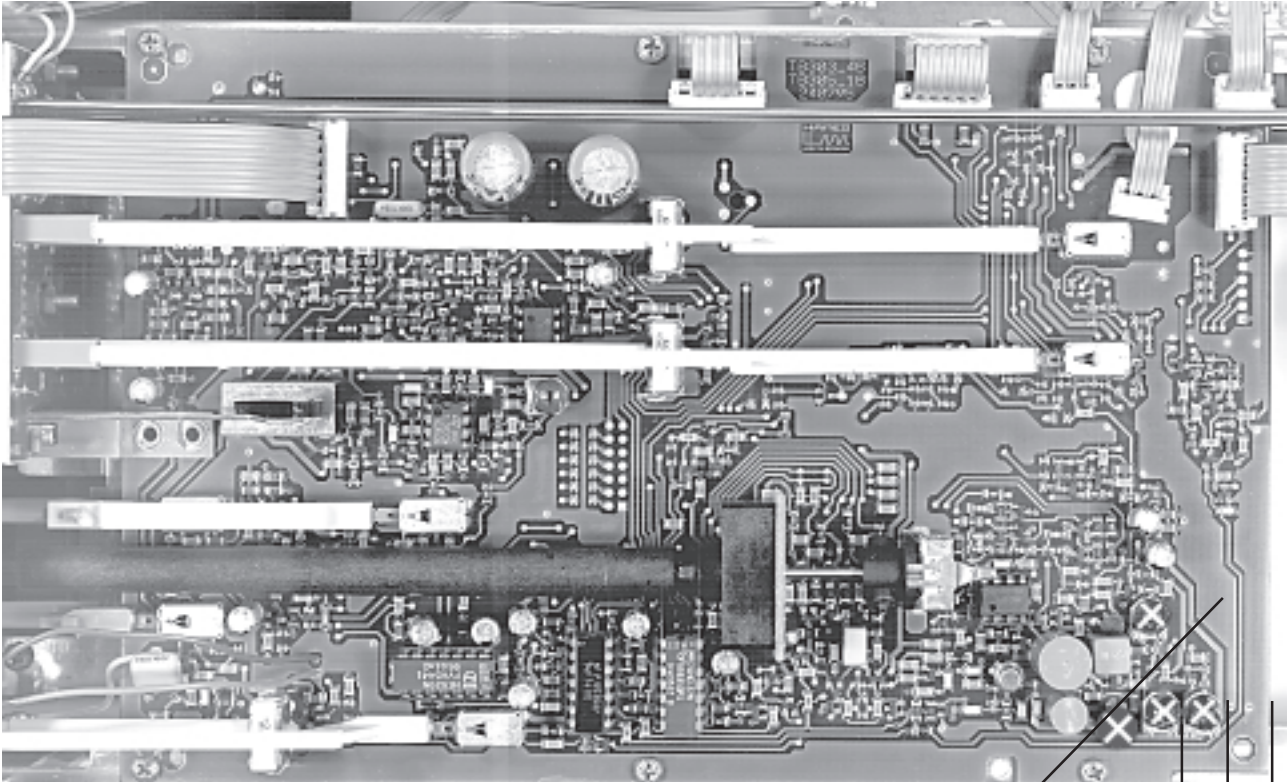
YPA-Board



XY-Board



TB-Board



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**(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.

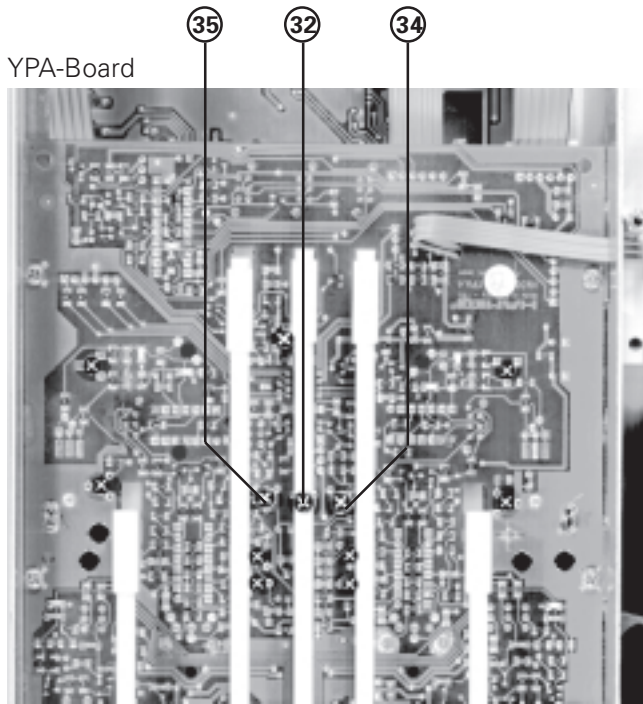
**(29) RV2260: X-Symmetry.**

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.

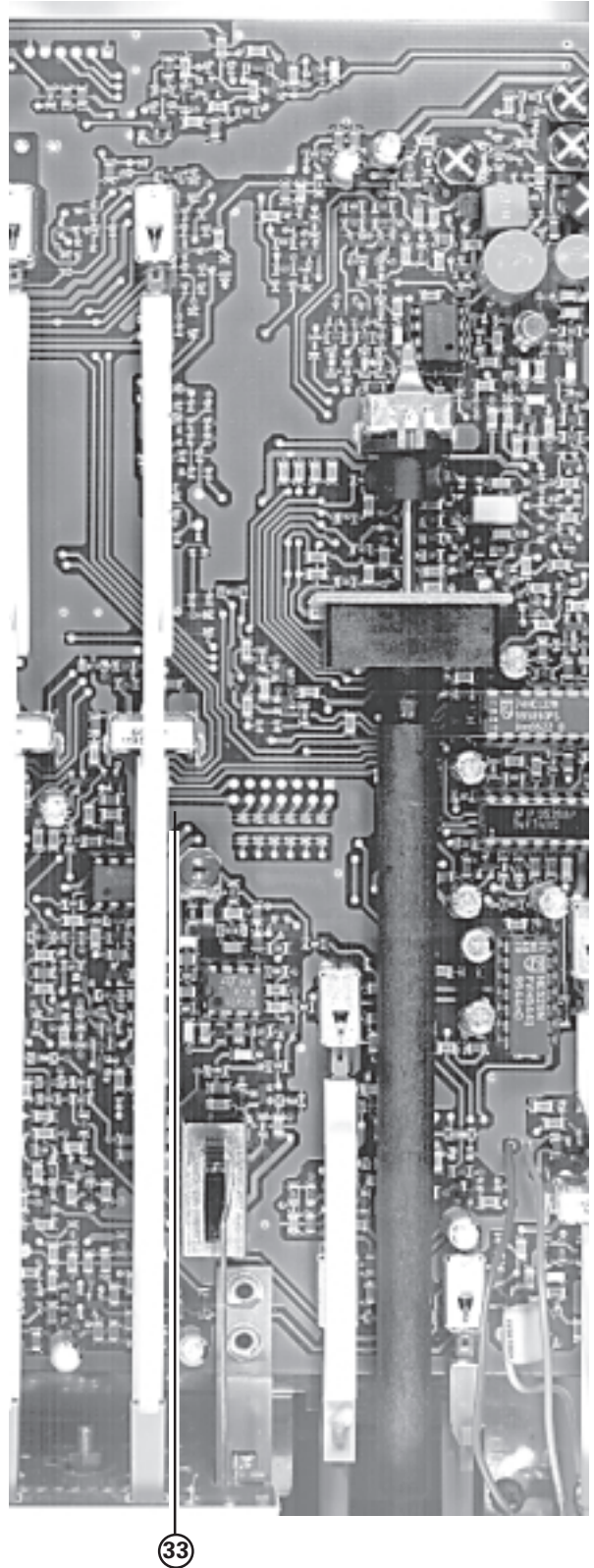
**(30) RV3591 (A)/3589 (C), CV3511 (B): Time base.**

- a) Locate and identify RV3591 (A) on TB-Board.  
Set time mark generator to  $f = 20\text{kHz}$  and connect signal to CH I input.  
Set time base to  $50\mu\text{s/div}$ .  
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  $0.5\mu\text{s/div}$ . and time base variable control to CAL position.  
Set time mark generator to  $f = 2\text{MHz}$ .  
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  $5\text{ms/div}$ . and time base variable control to CAL position.  
Set time mark generator to  $f = 200\text{Hz}$ .  
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.

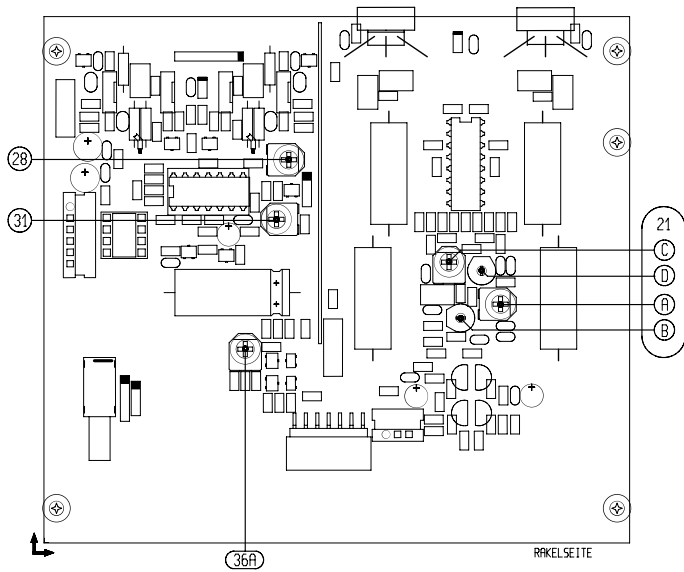
Check all time base settings with suitable time mark signals.



TB-Board



XY-Board



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**(31) RV2234: X-Magnification x10.**

Locate and identify RV2234 (31) on XY-Board.  
Press pushbutton X-Mag. x10.  
Set time base to 50 $\mu$ s/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  $\pm$  pushbutton and adjust RV3293 (33) for stable triggering in both SLOPE conditions.

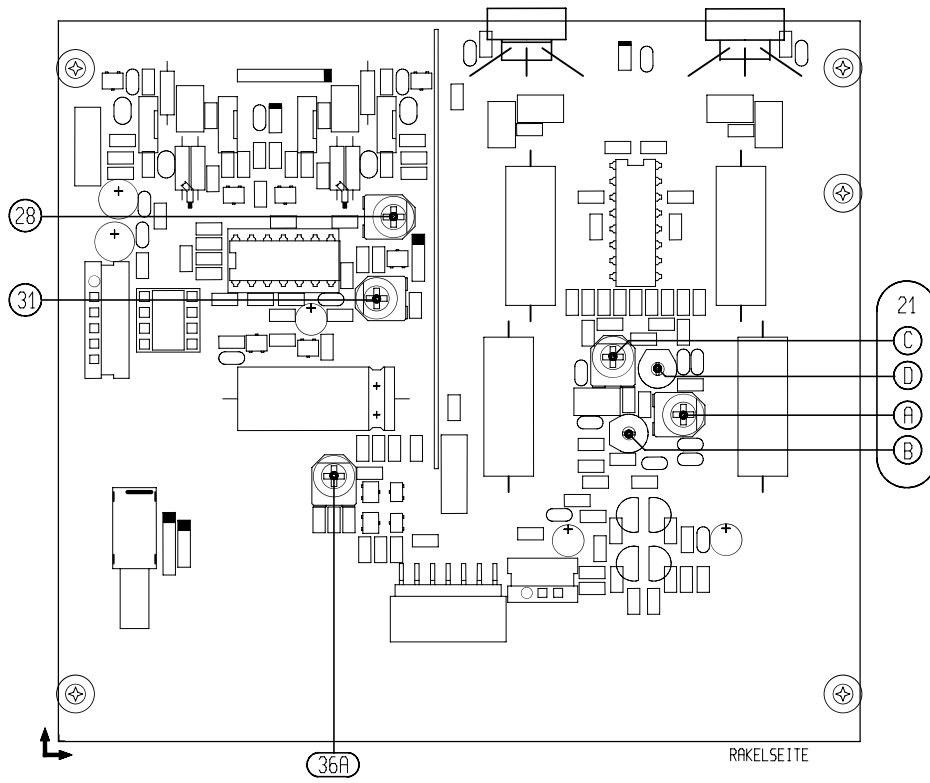
**(34) R612: DC-Triggering CH I.**

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 10 $\mu$ s/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.

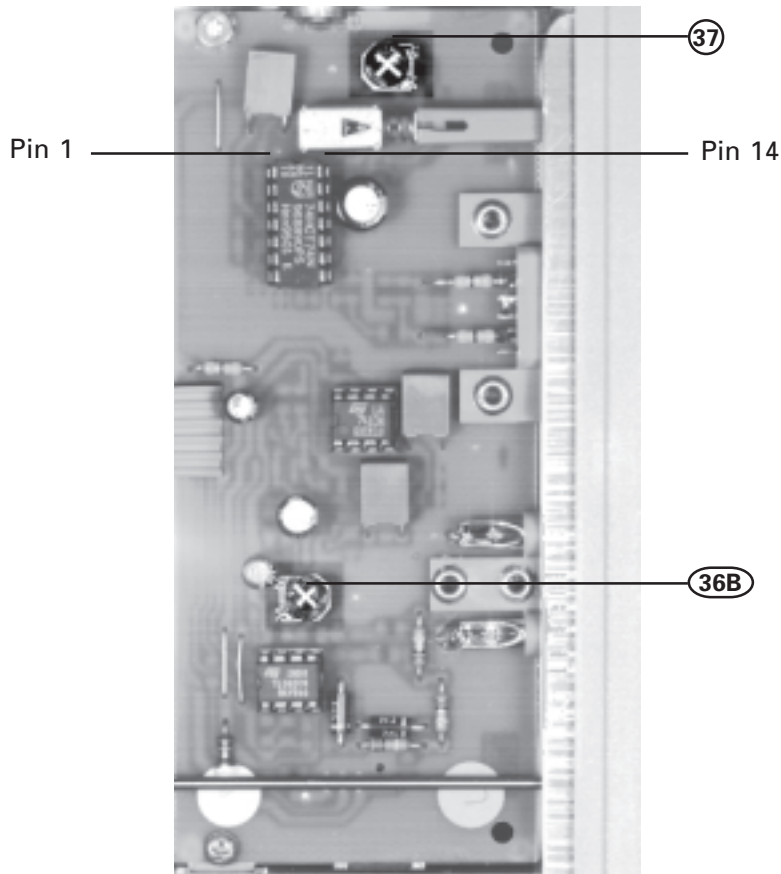
**(35) R603: DC-Triggering CH II.**

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 10 $\mu$ s/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





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**(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 0.5 $\mu$ s position.  
Check 1MHz calibrator 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 0.05 $\mu$ s/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 20 $\mu$ s/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.

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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  $\geq$  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 20 $\mu$ s/div ( time base range 0.5ms/div - 0.1 $\mu$ s/div = line triggering).  
Recheck trigger SLOPE pushbutton procedure, using video signal with polarity change.



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