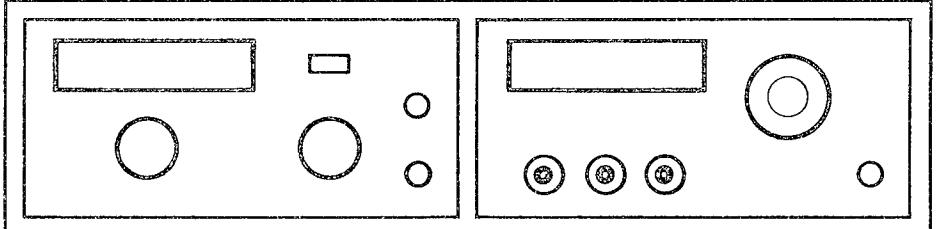
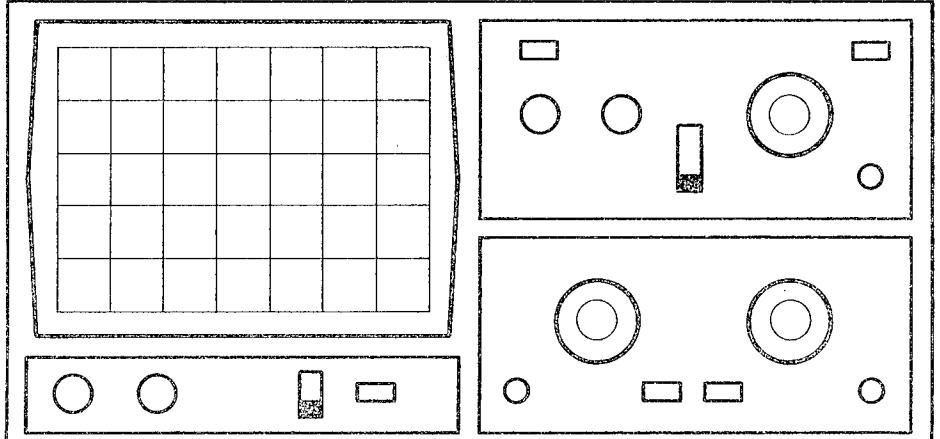


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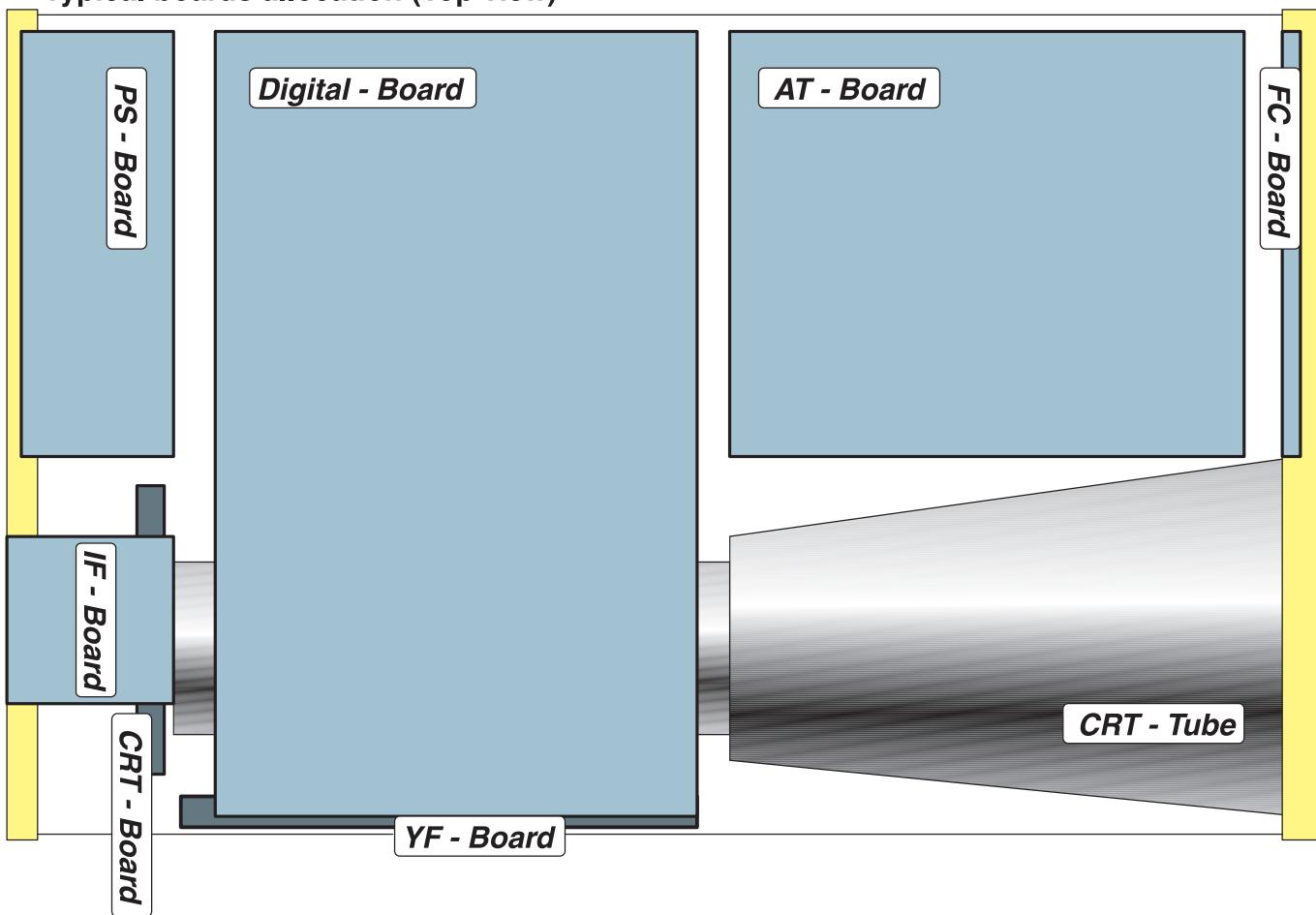
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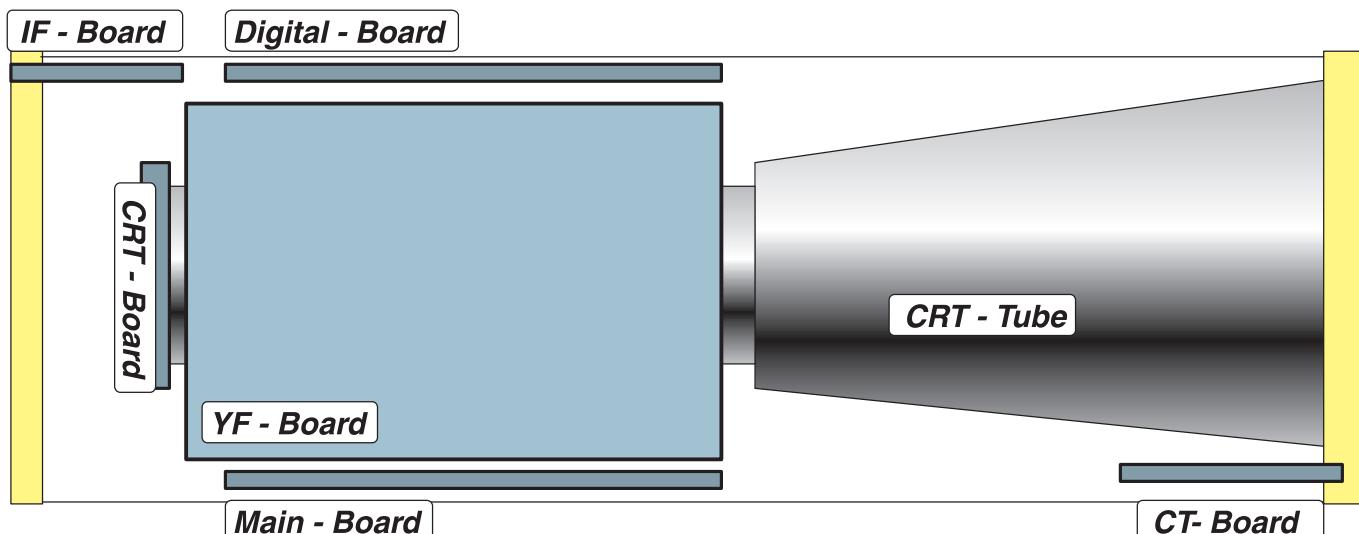
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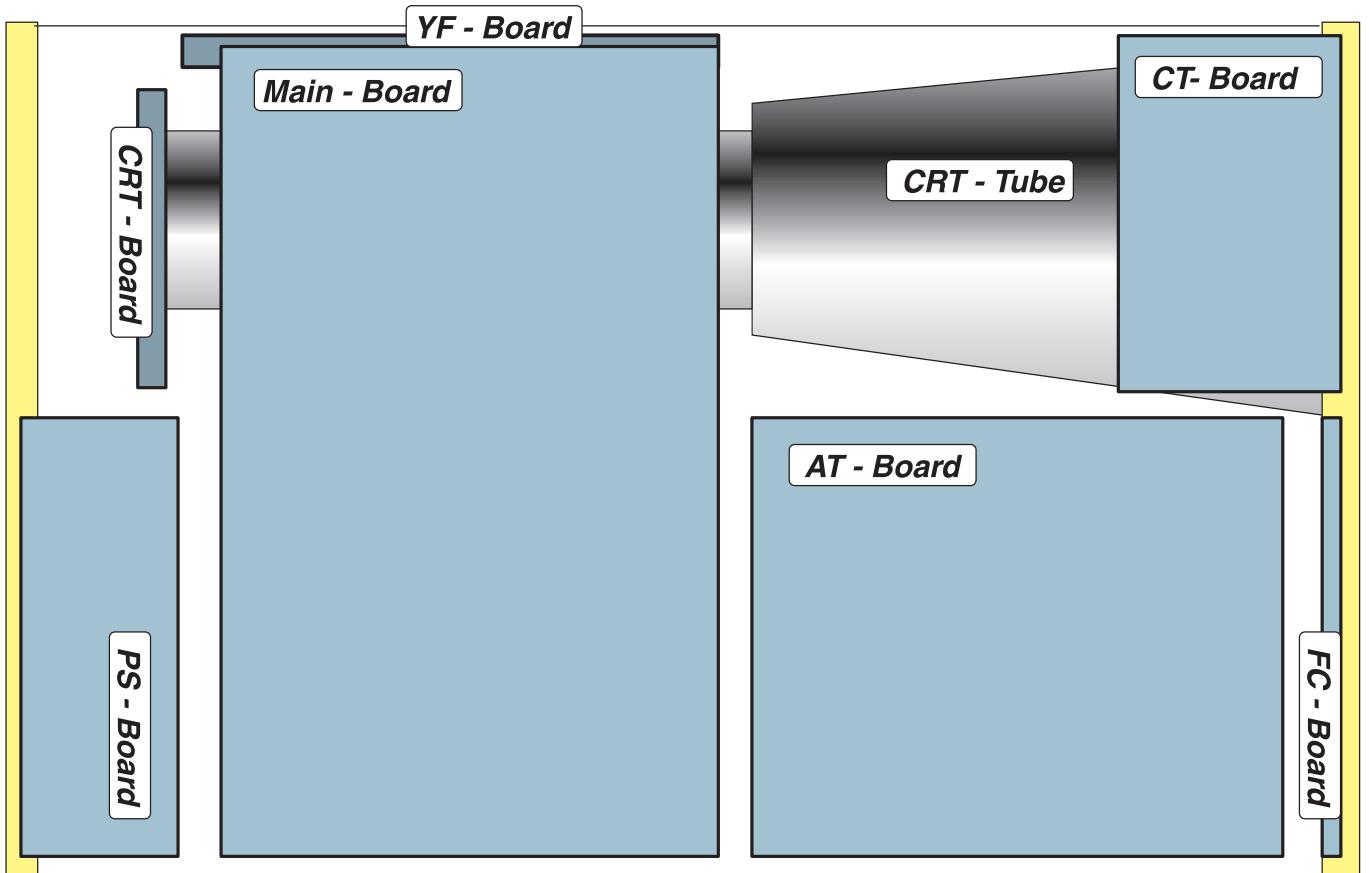
Typical boards allocation (Top view)



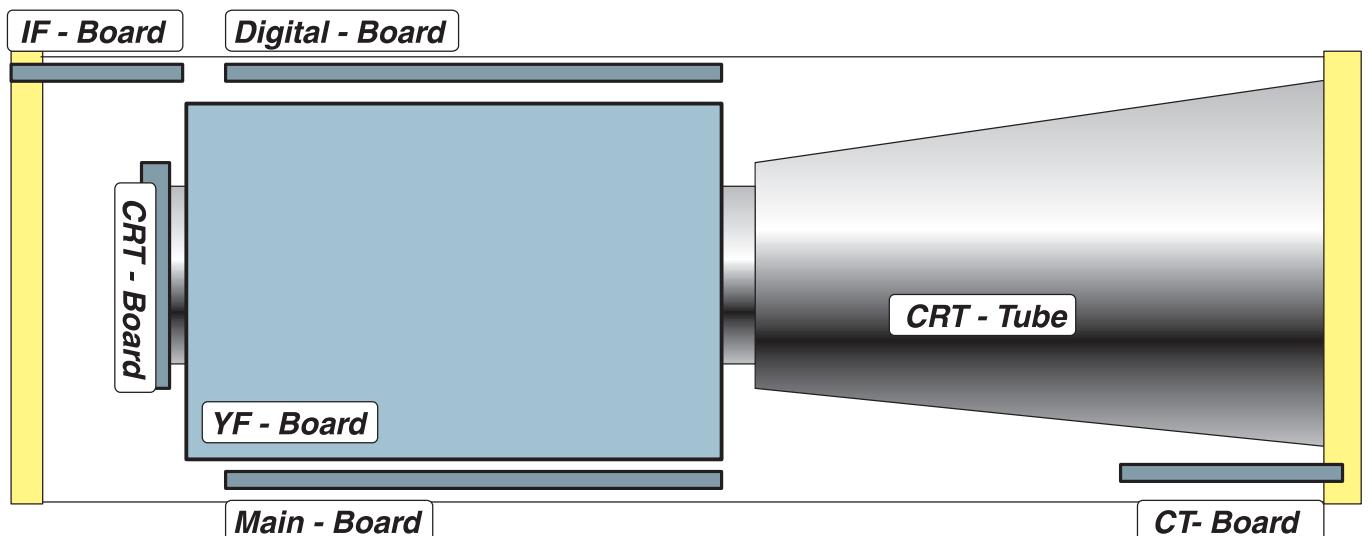
Typical boards allocation (Back side)

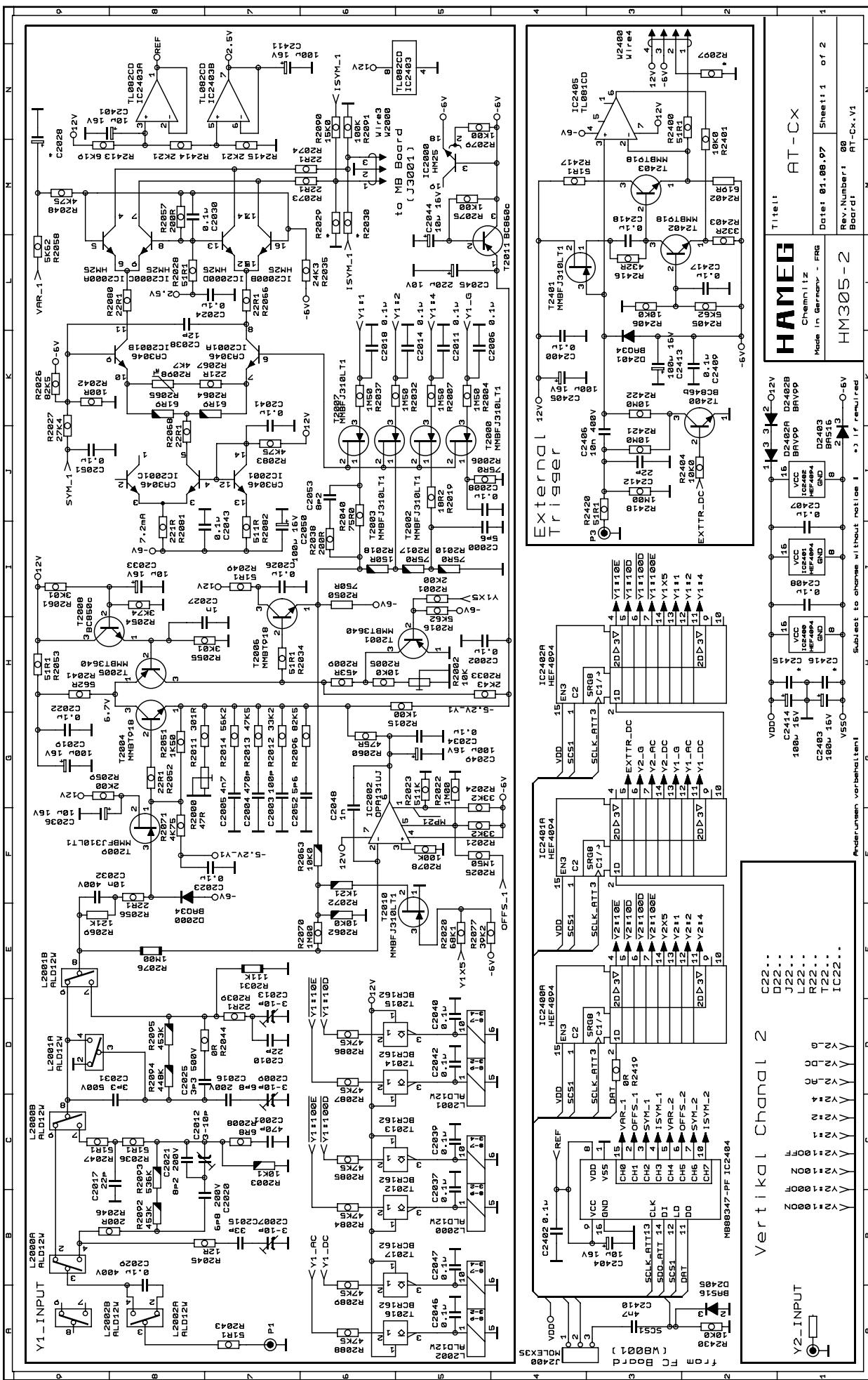


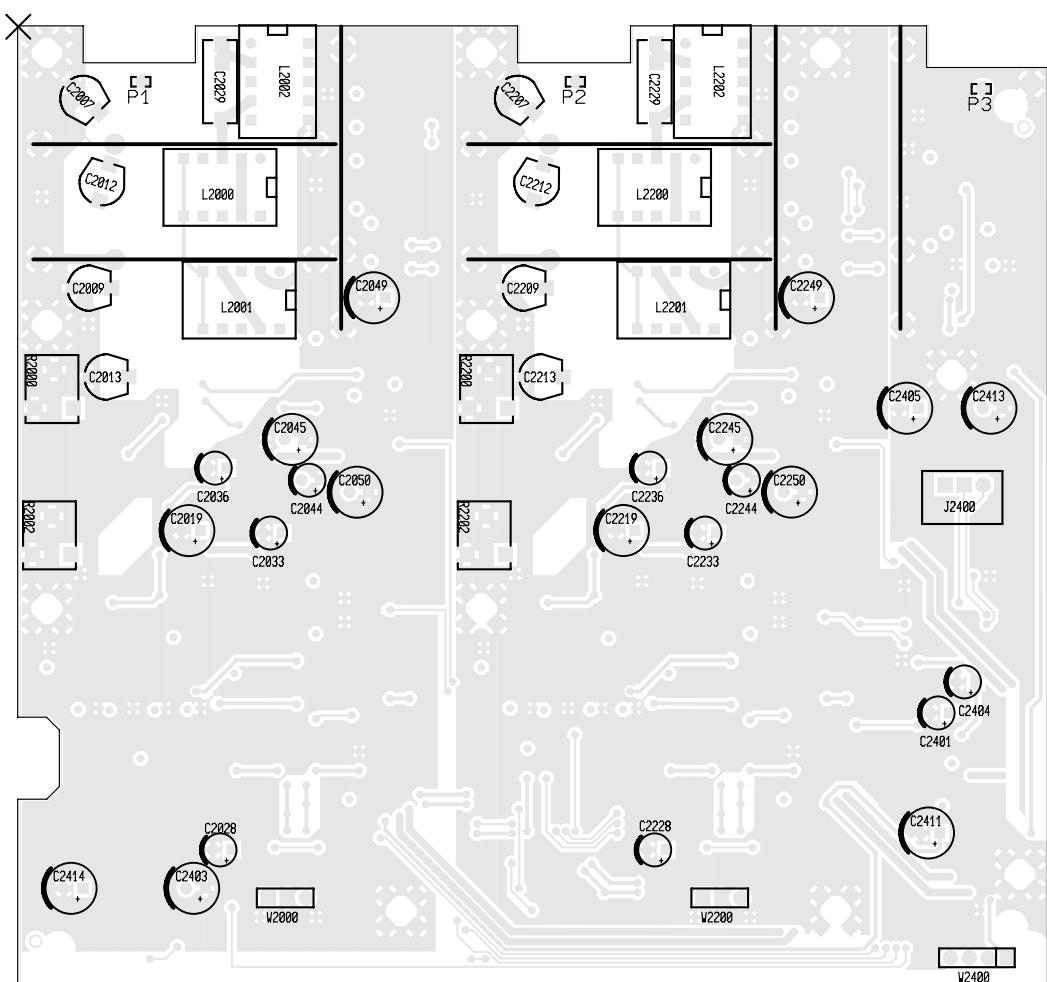
Typical boards allocation (Bottom view)



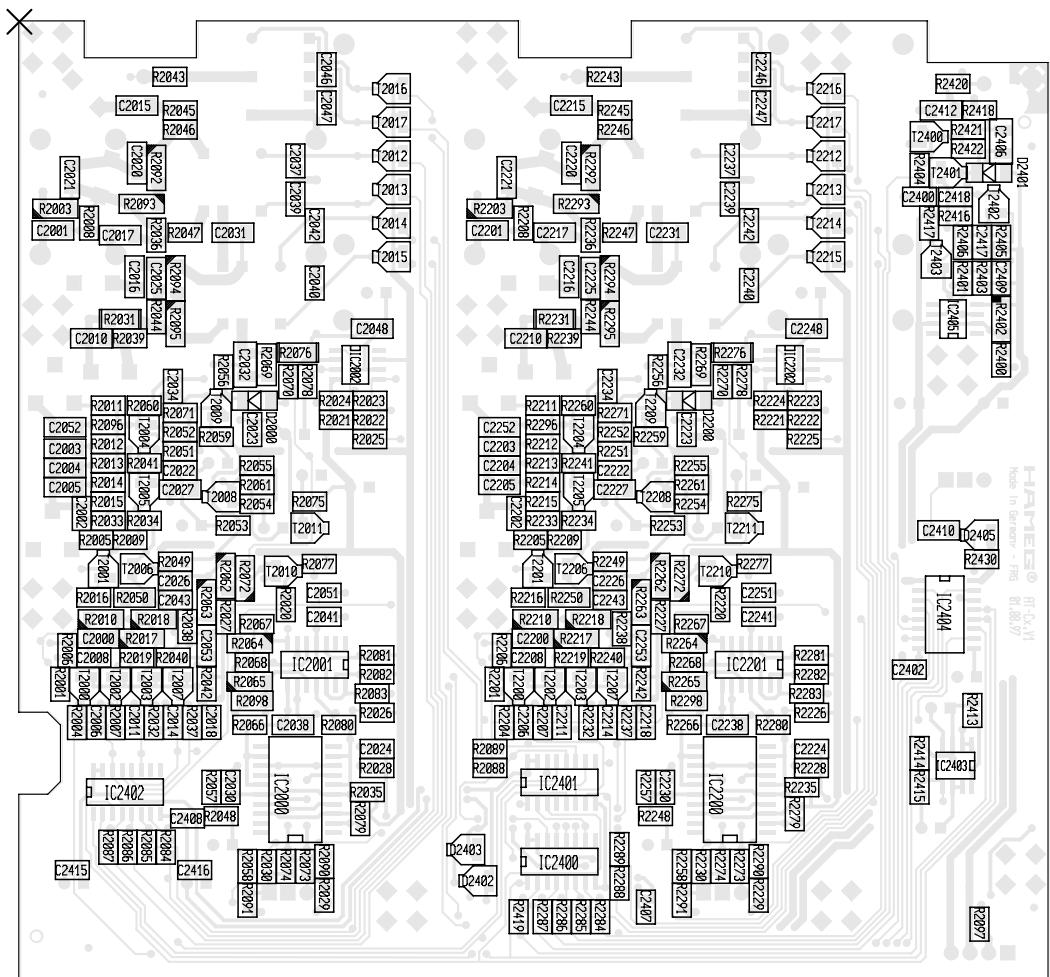
Typical boards allocation (Back side)

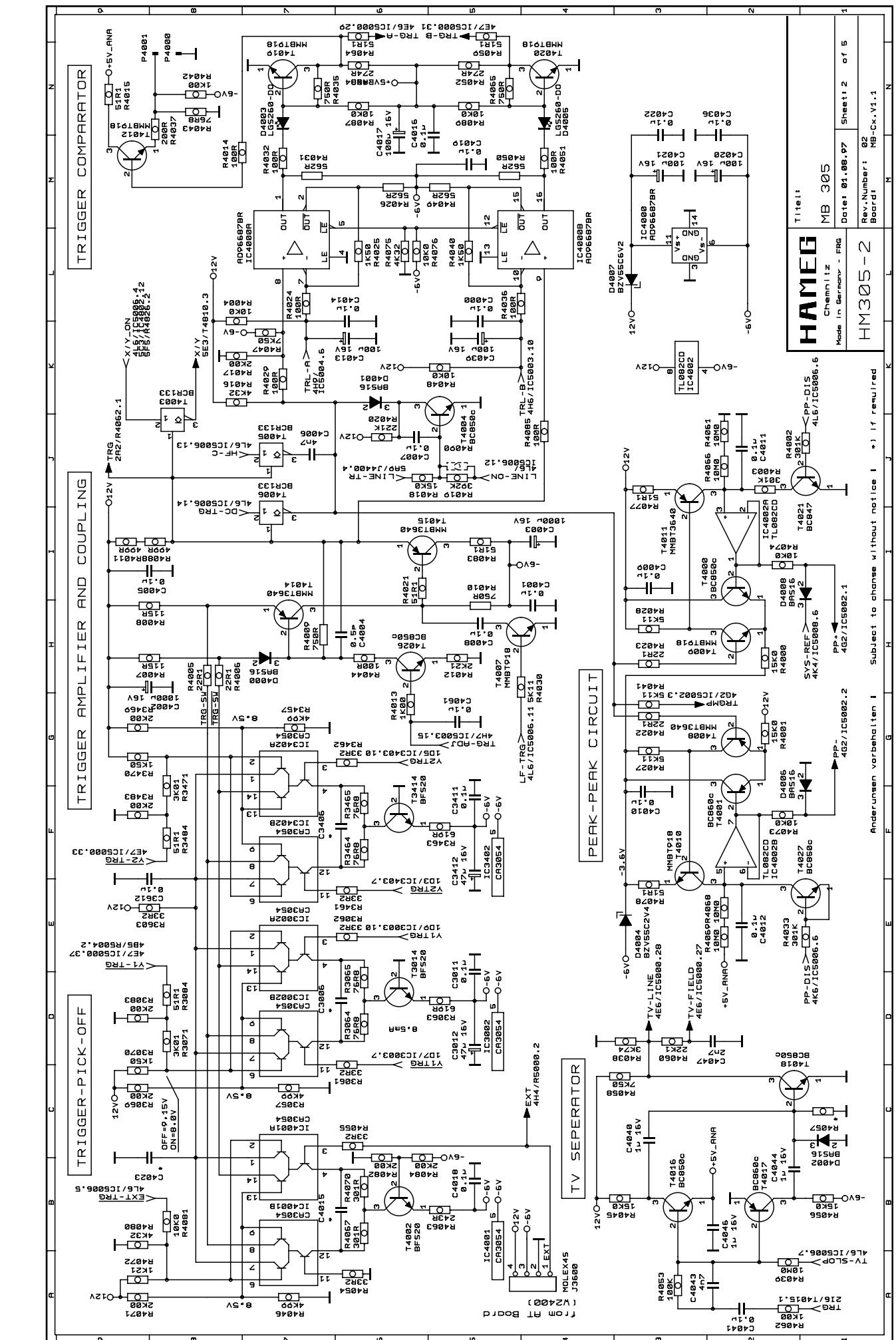


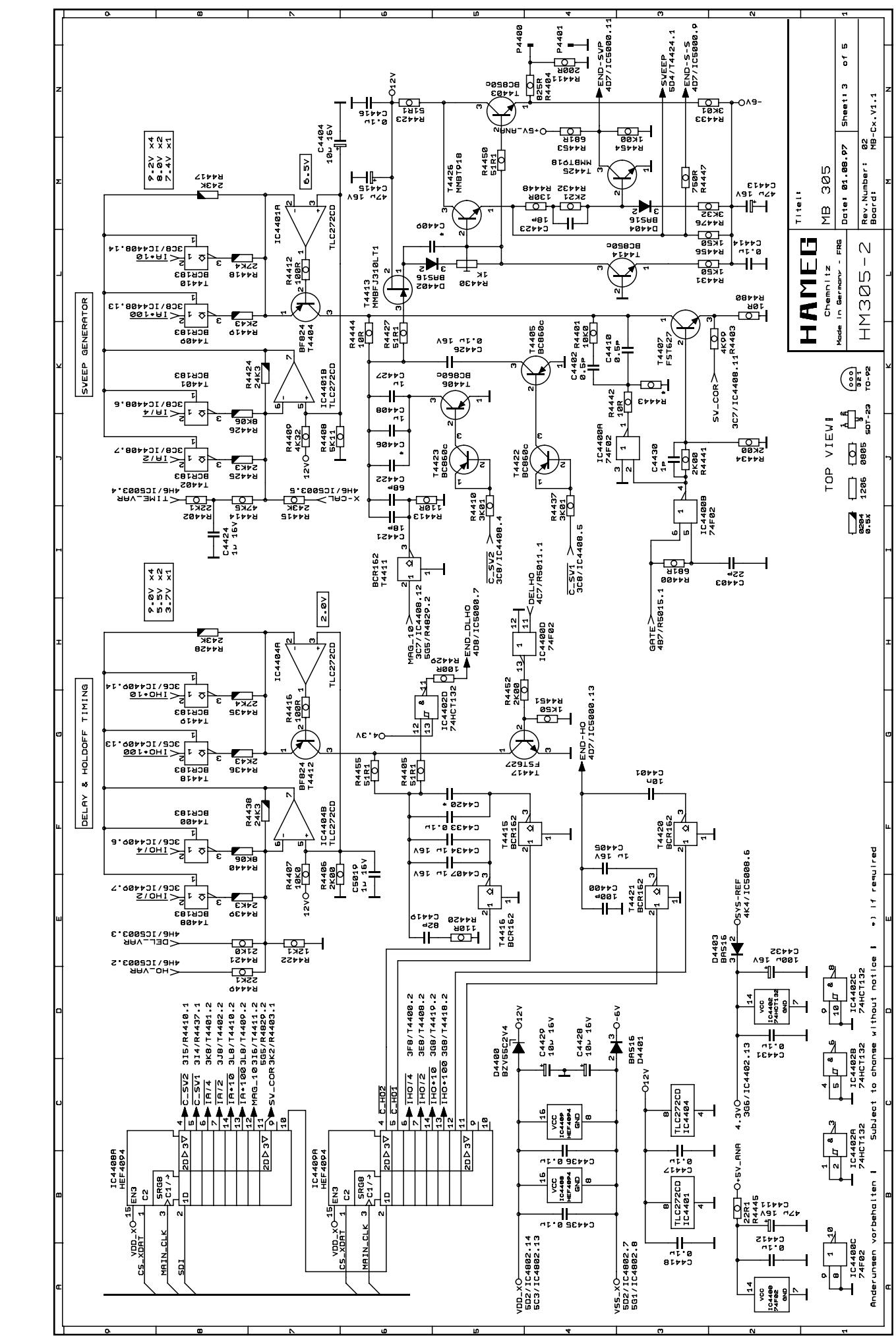




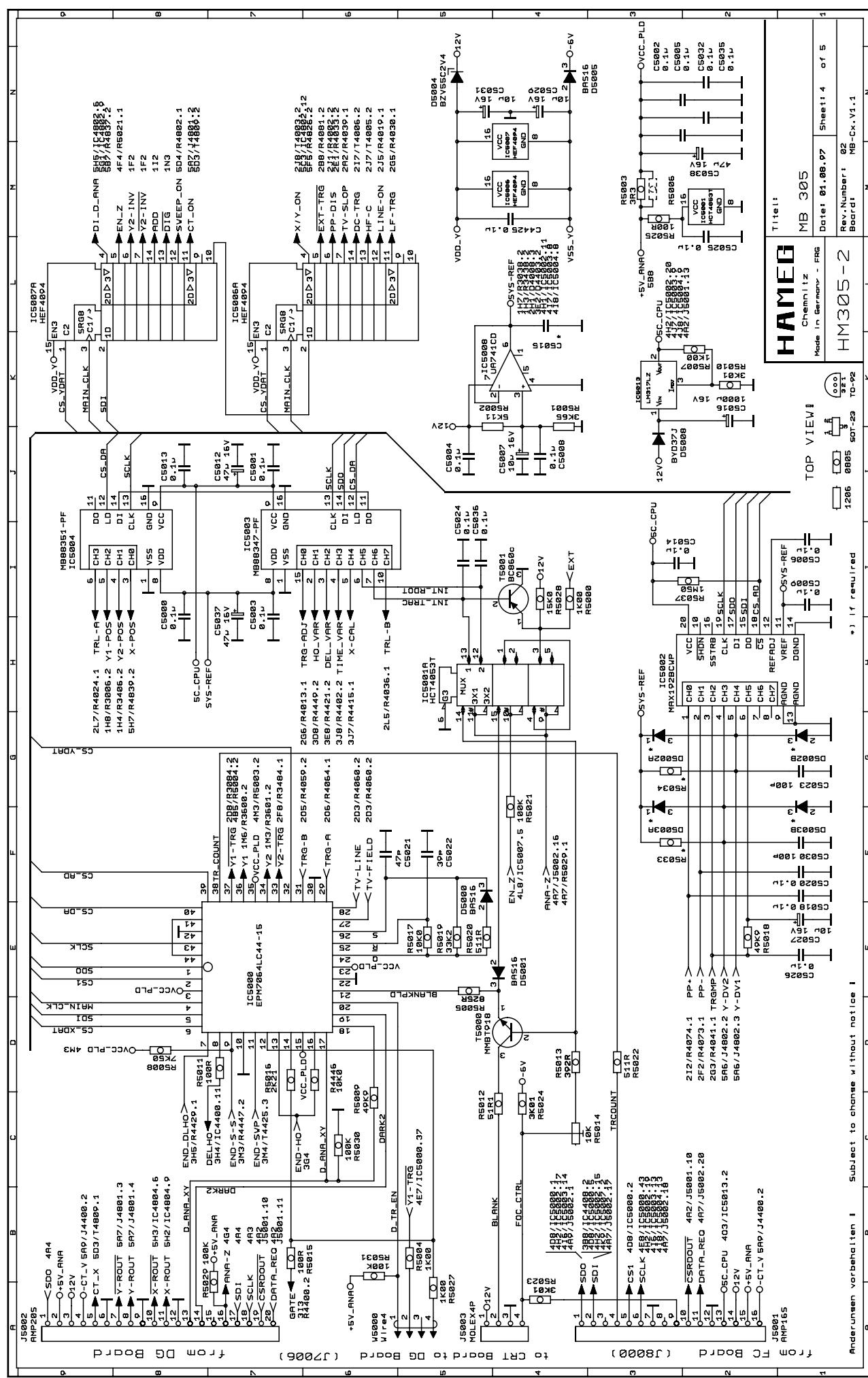
AT-Board Layout (Bottom side)

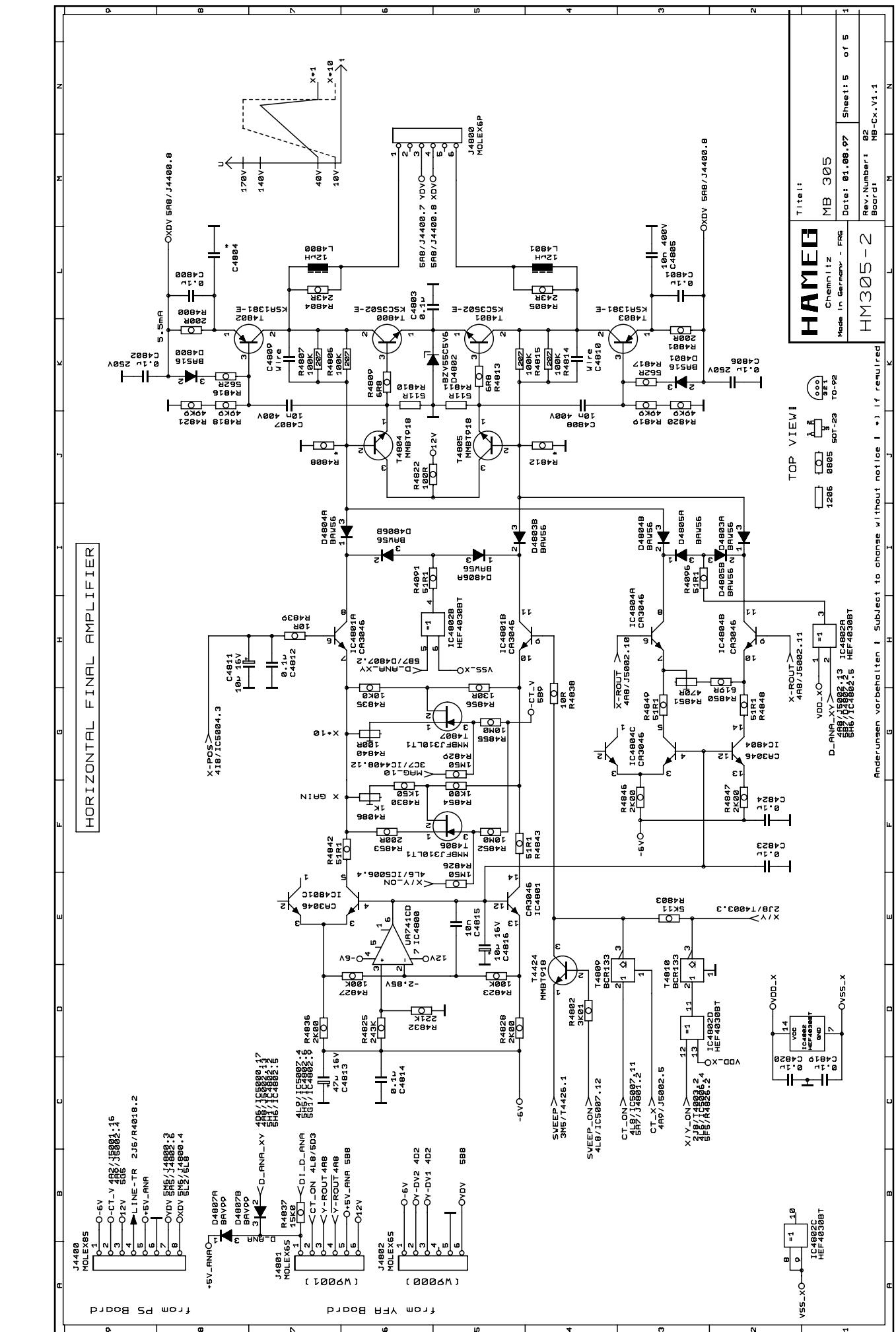


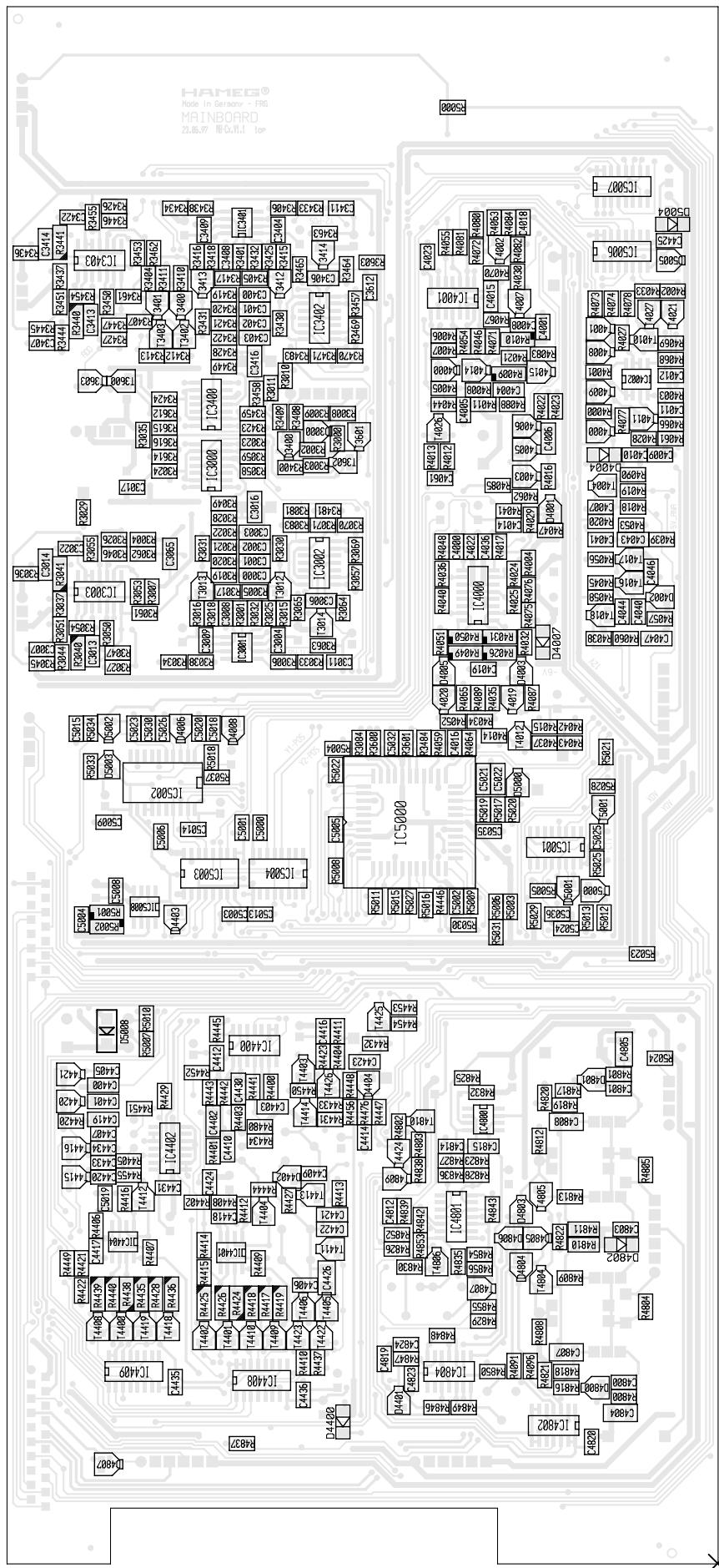




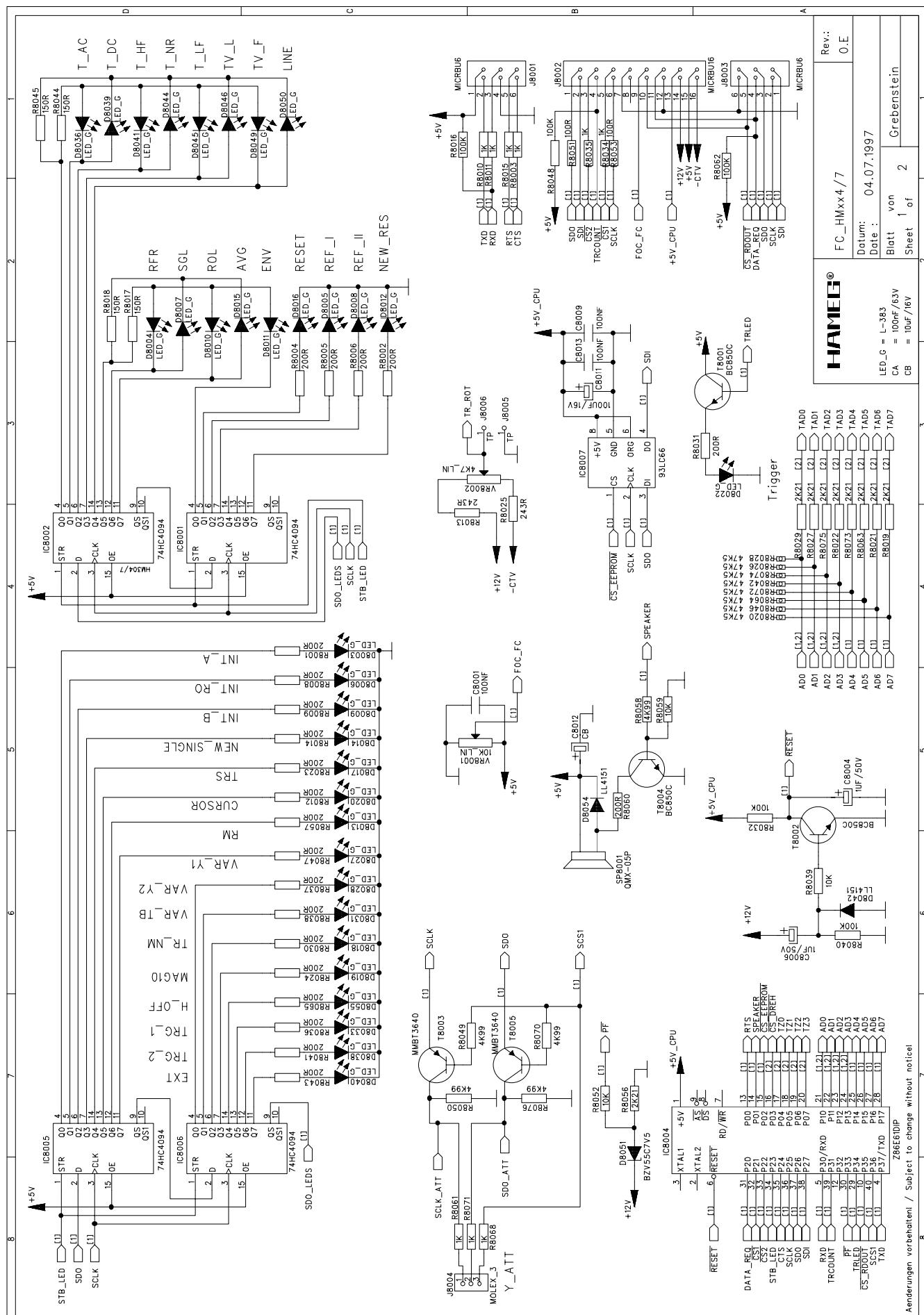
Main-Board Diagram



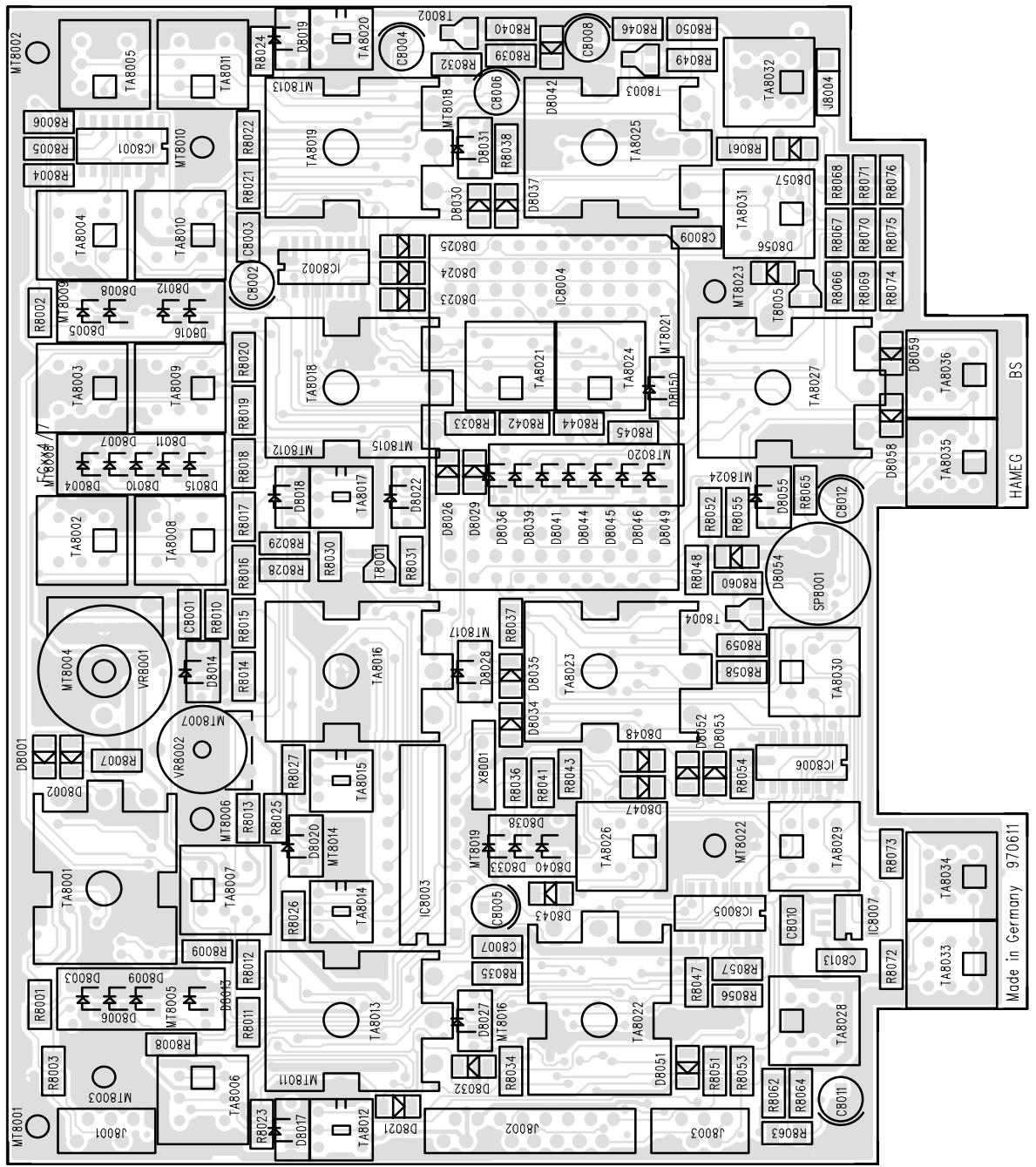


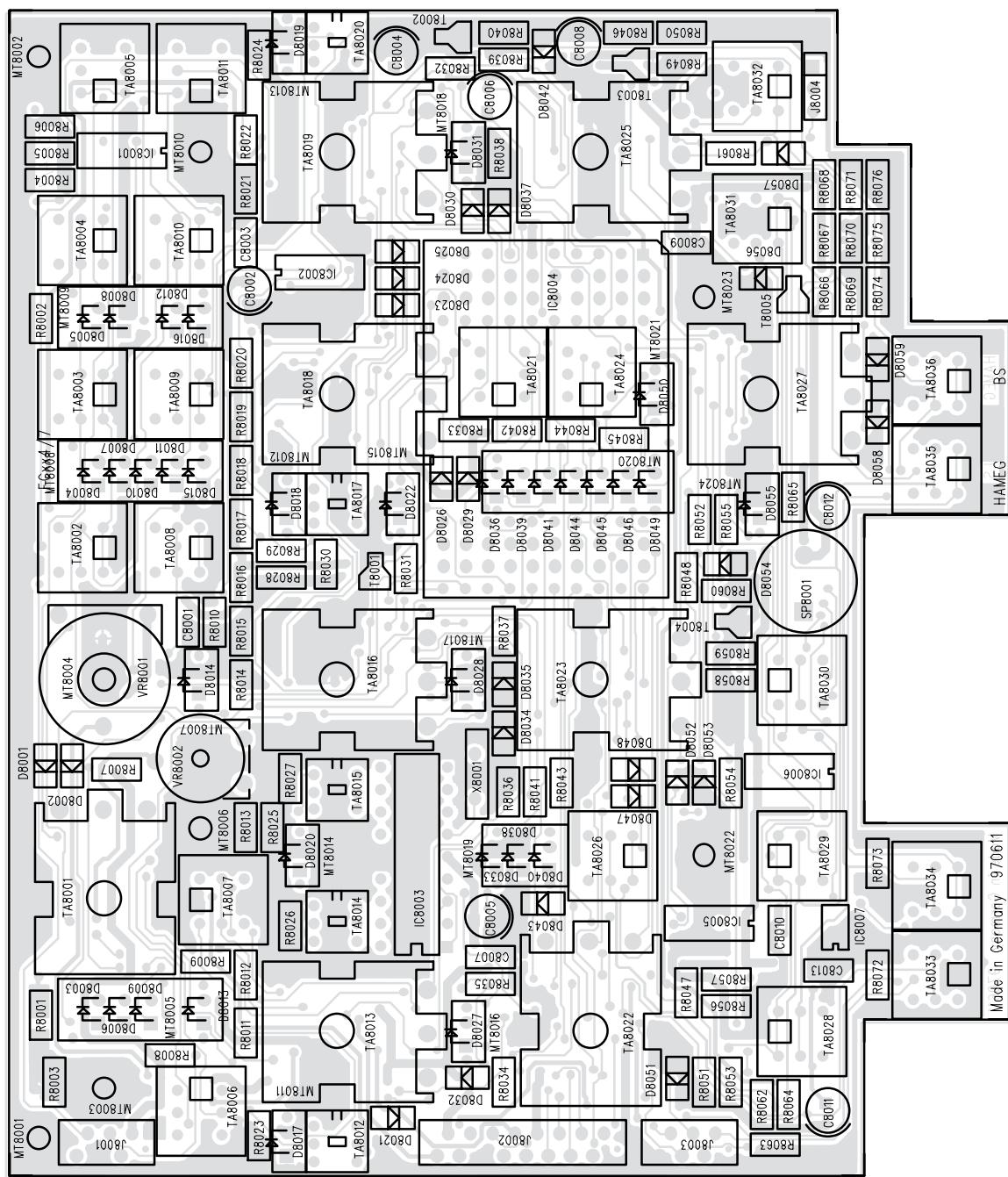


FC-Board Diagram

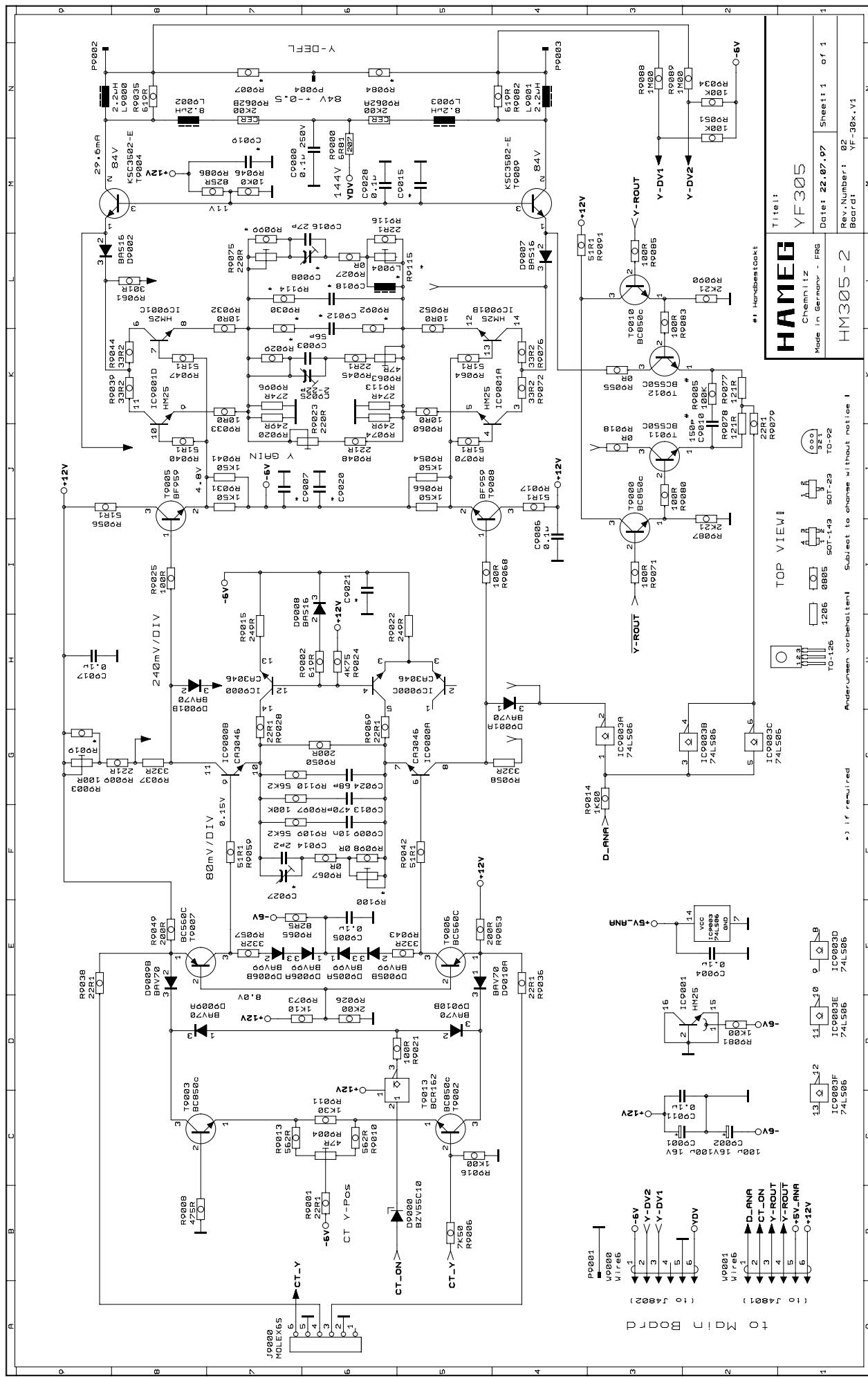


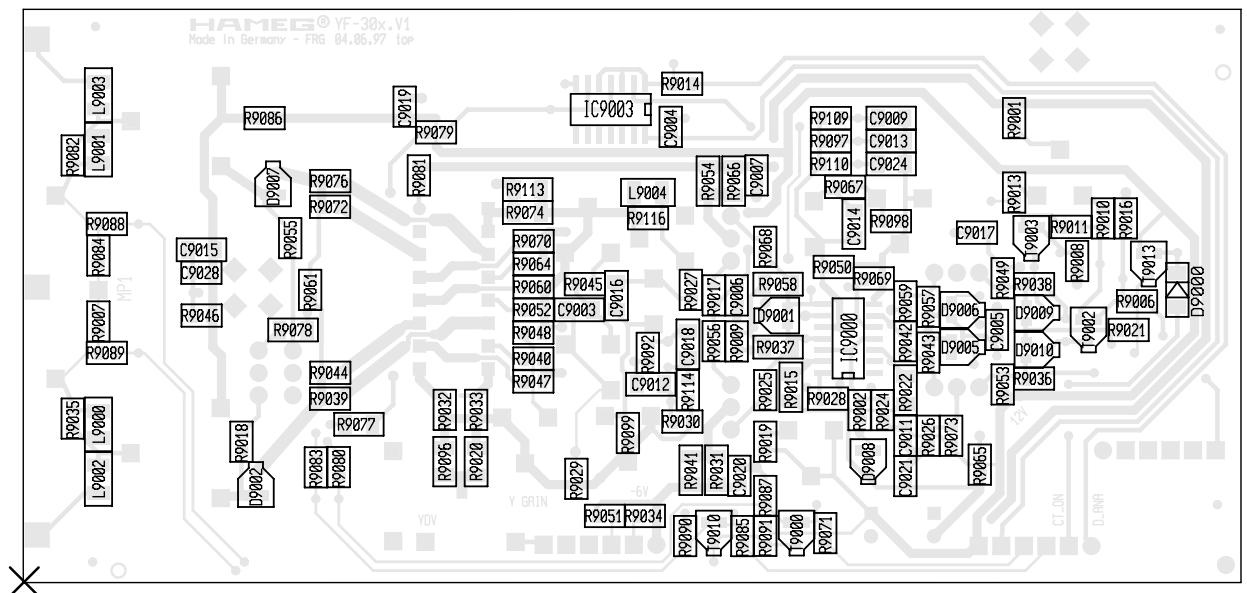
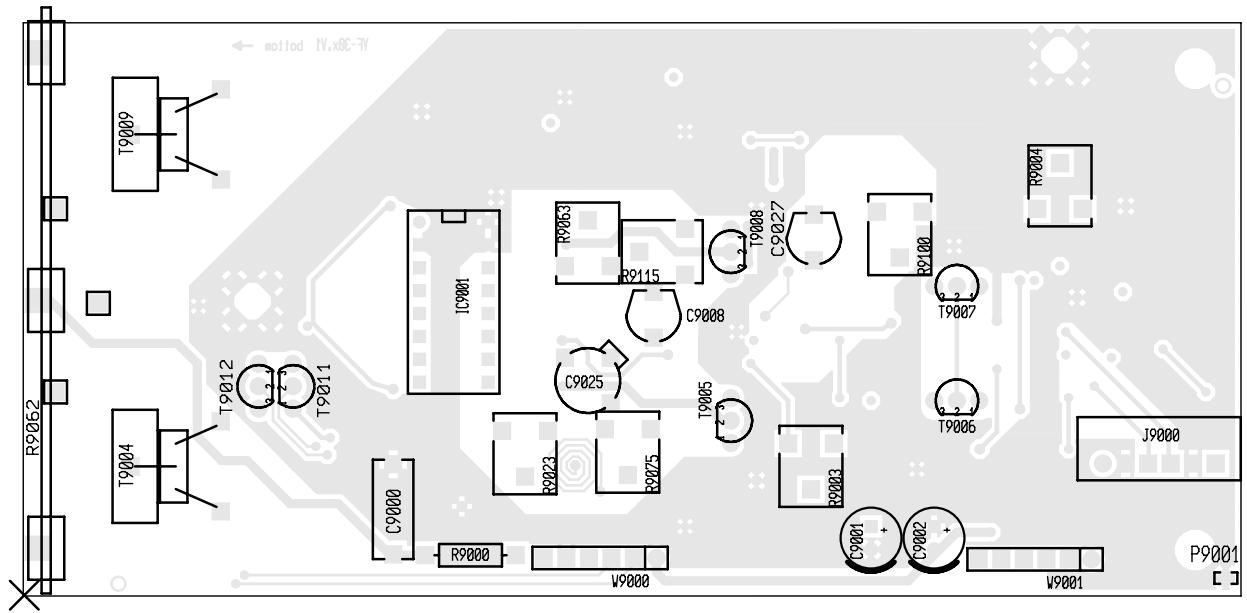
FC-Board Layout (Top side)



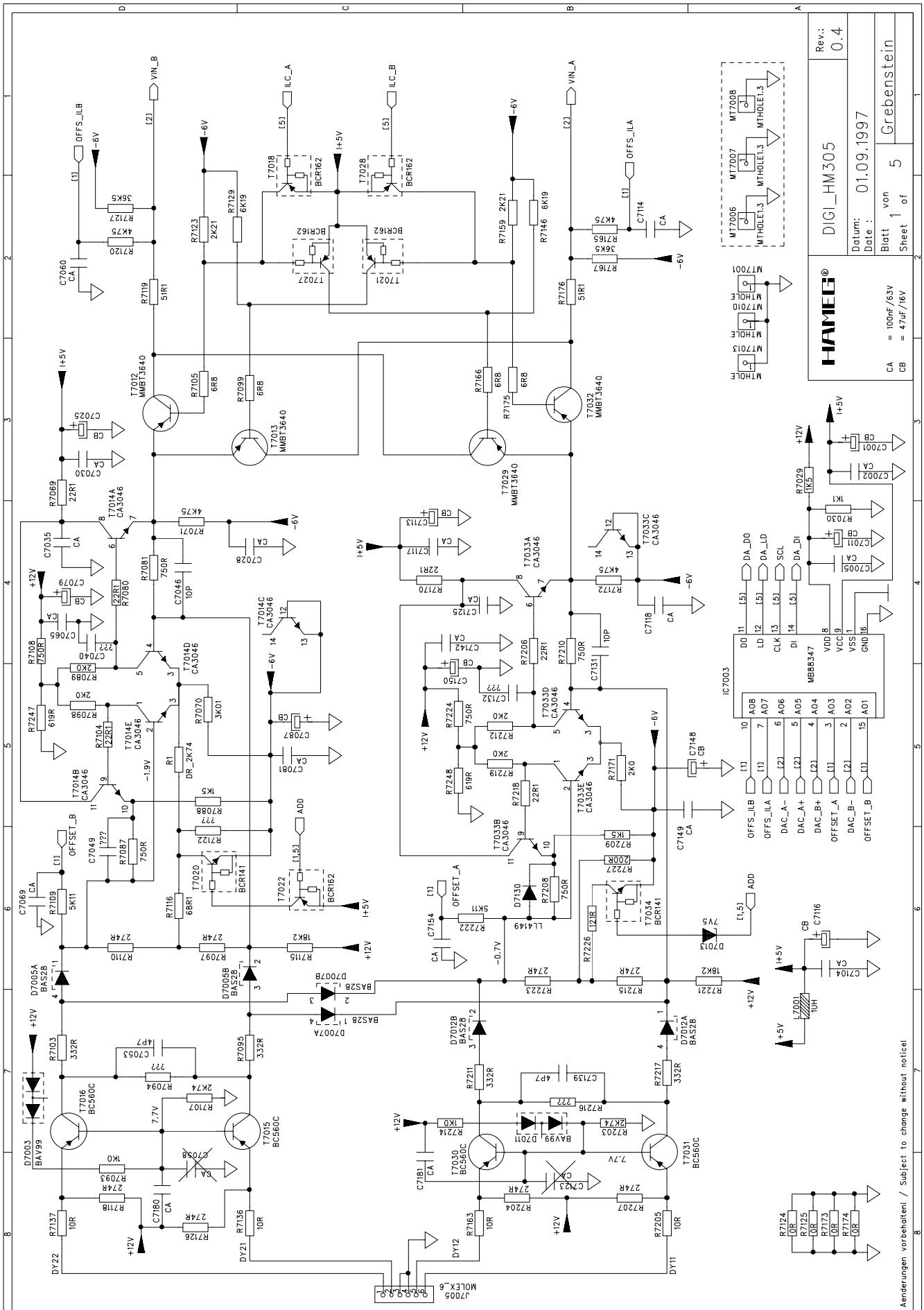


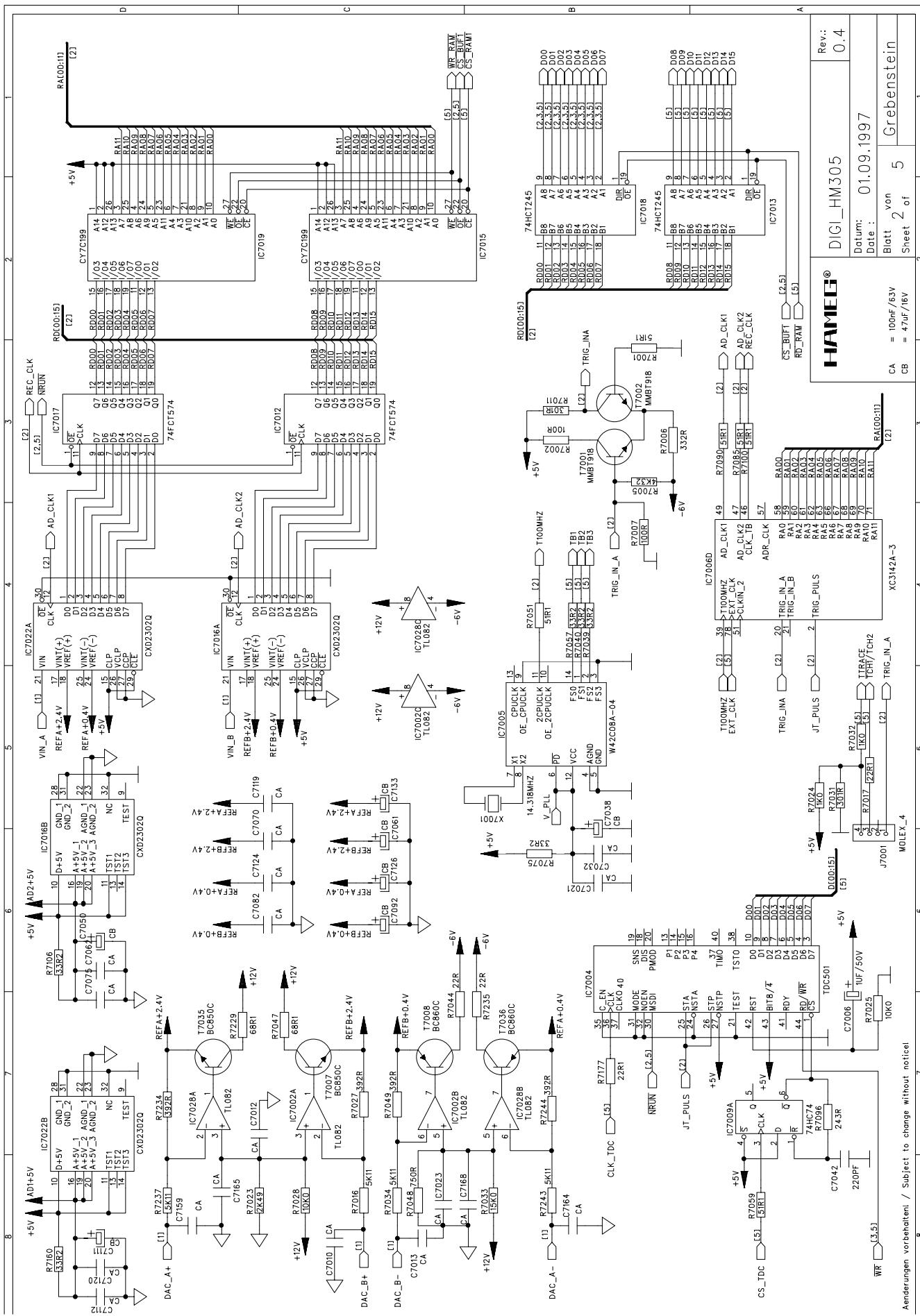
YF-Board Diagram



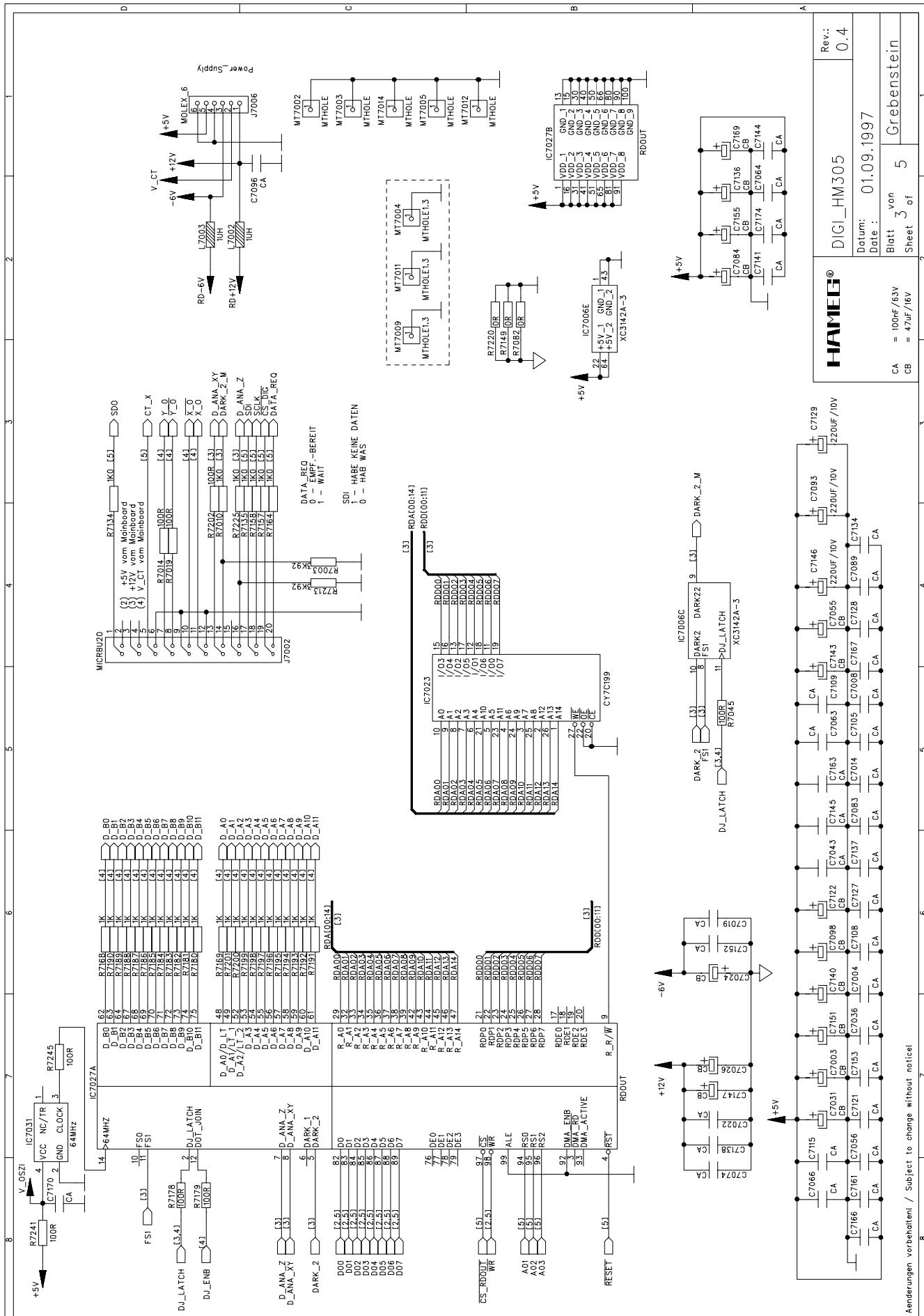


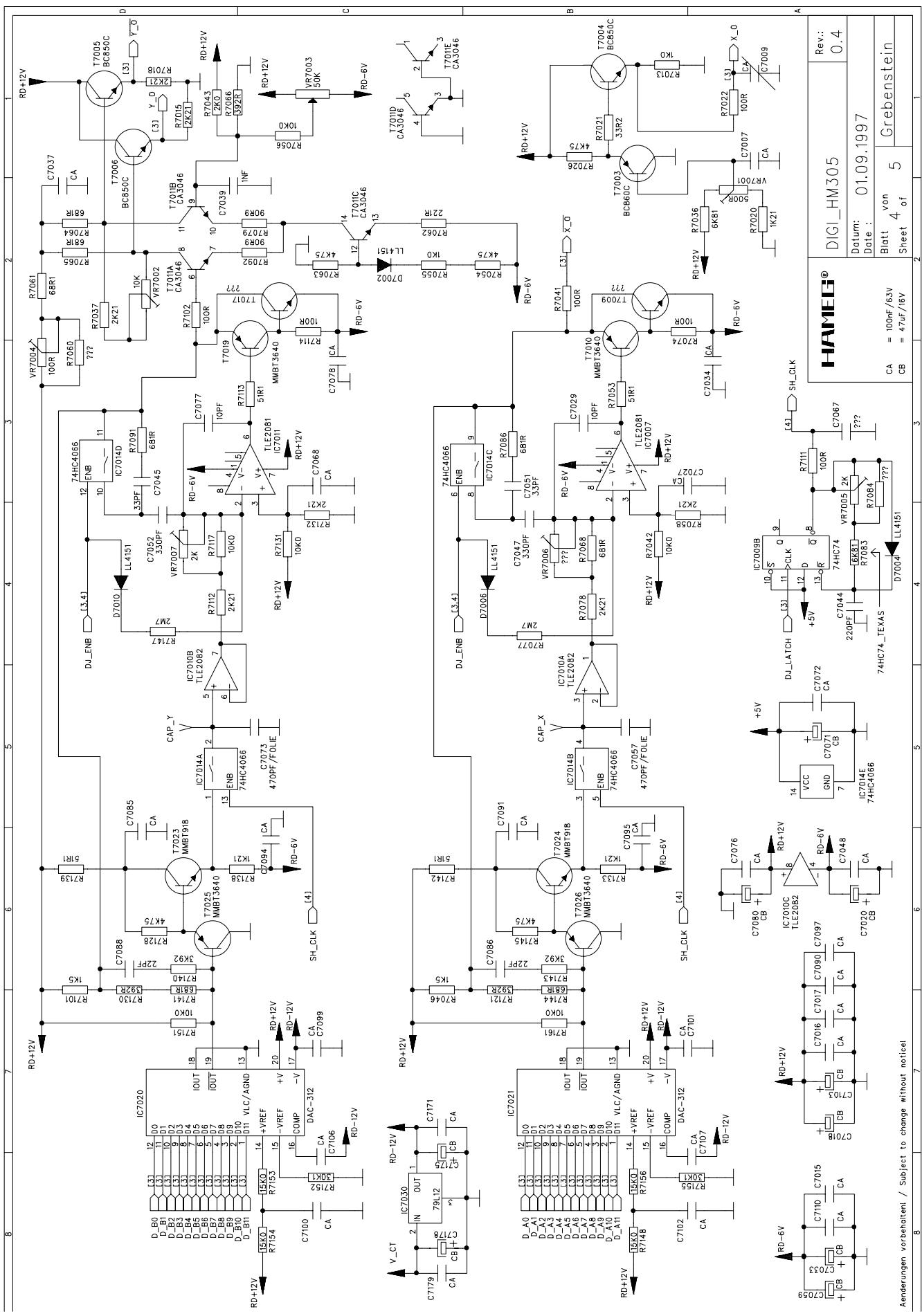
Digital-Board Diagram





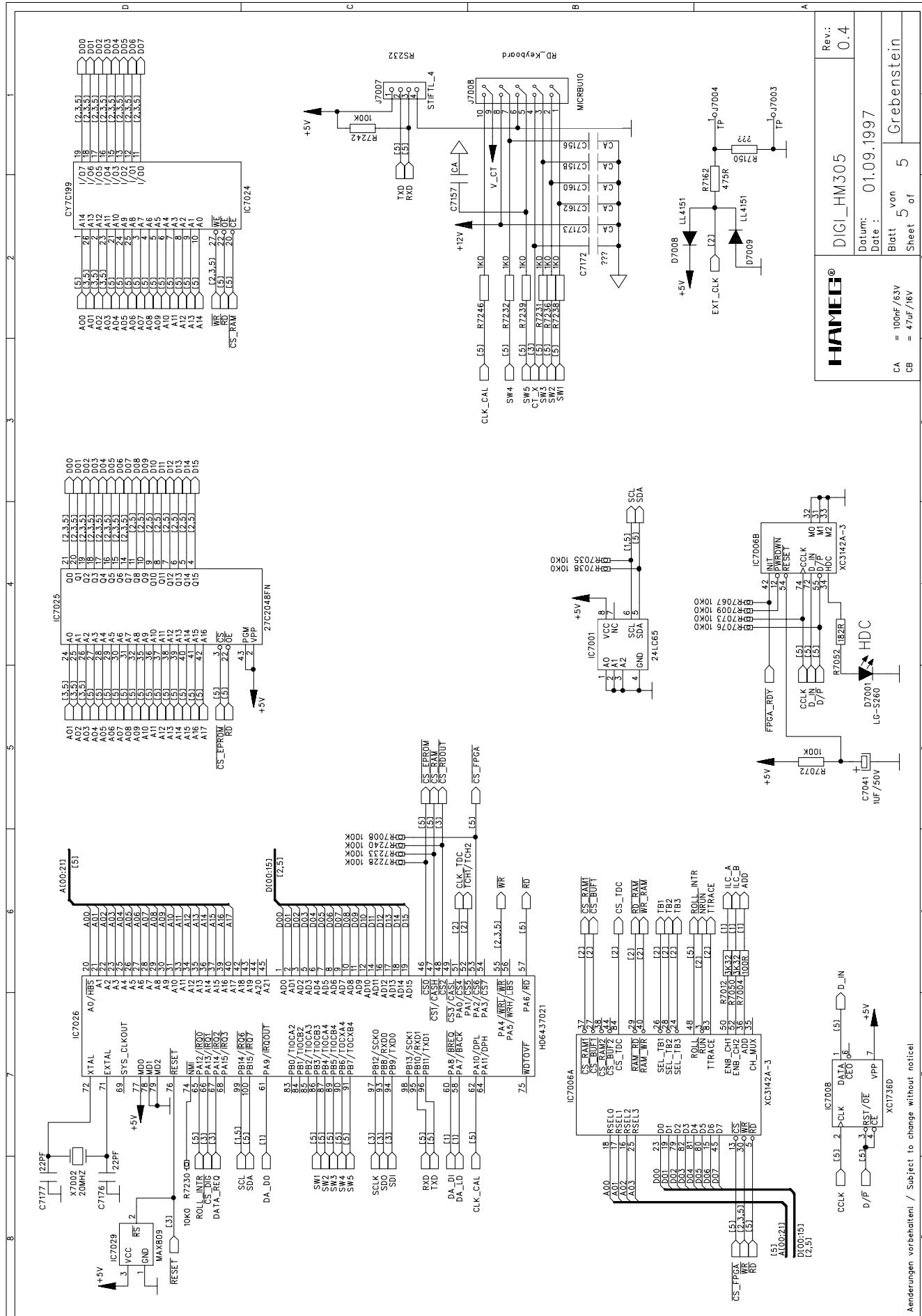
Digital-Board Diagram





Änderungen vorbehalten / Subject to change without notice

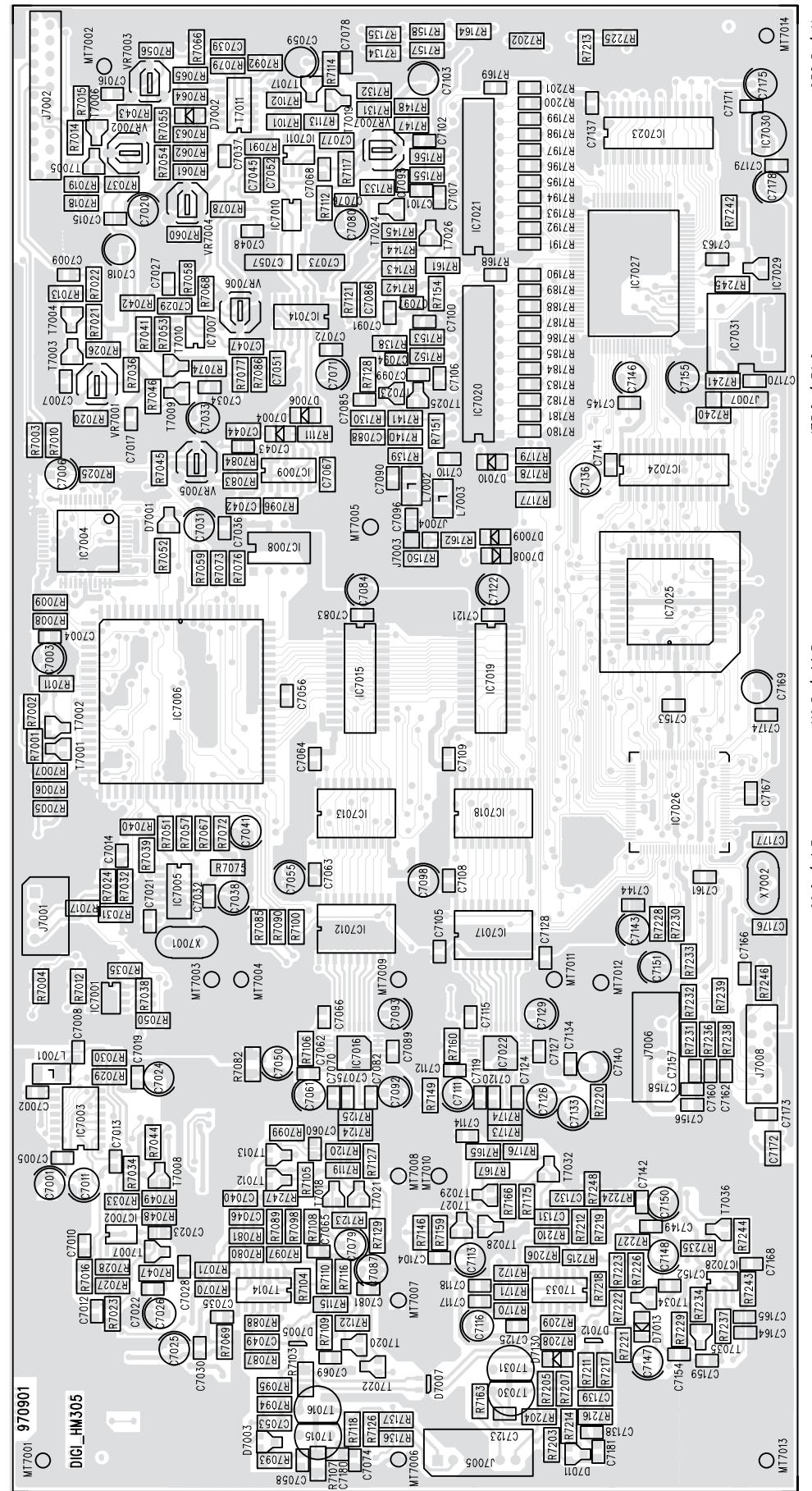
Digital-Board Diagram



DIGI_HM305 970901

Stand: 01.09.1997

5.5 / 113



99.0 / 4.3

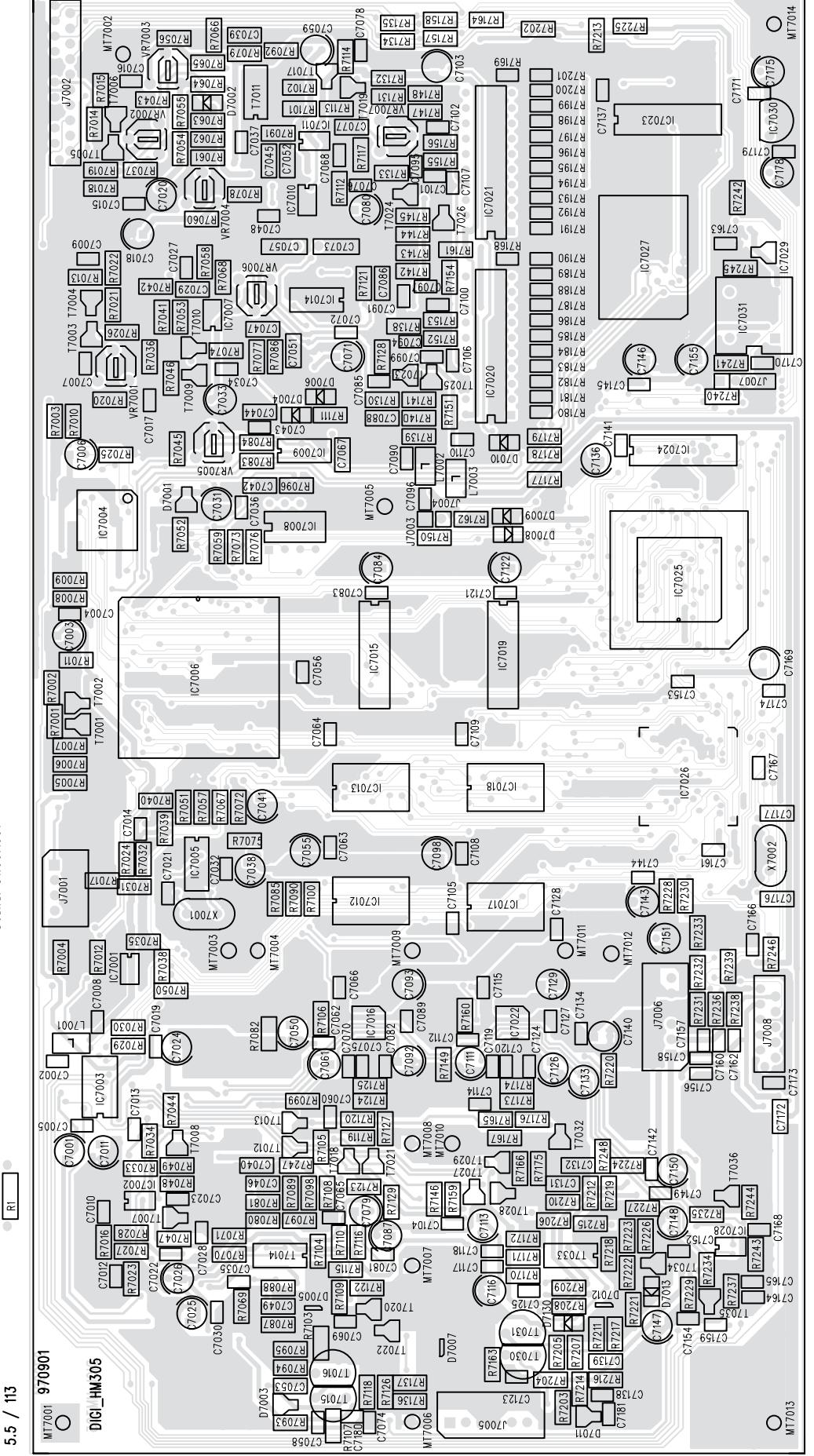
173.0 / 39.0

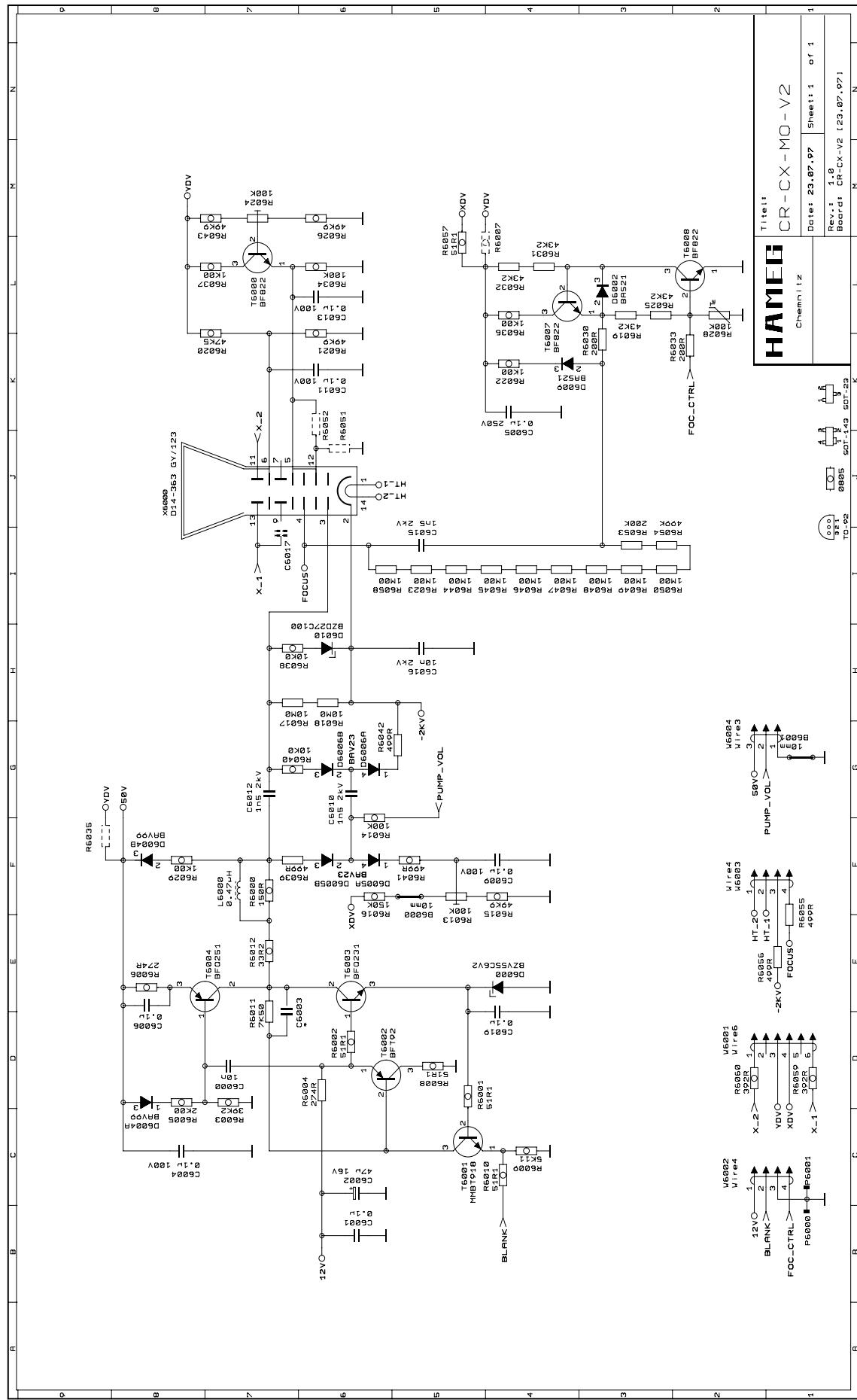
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Digital-Board Layout (Bottom side)

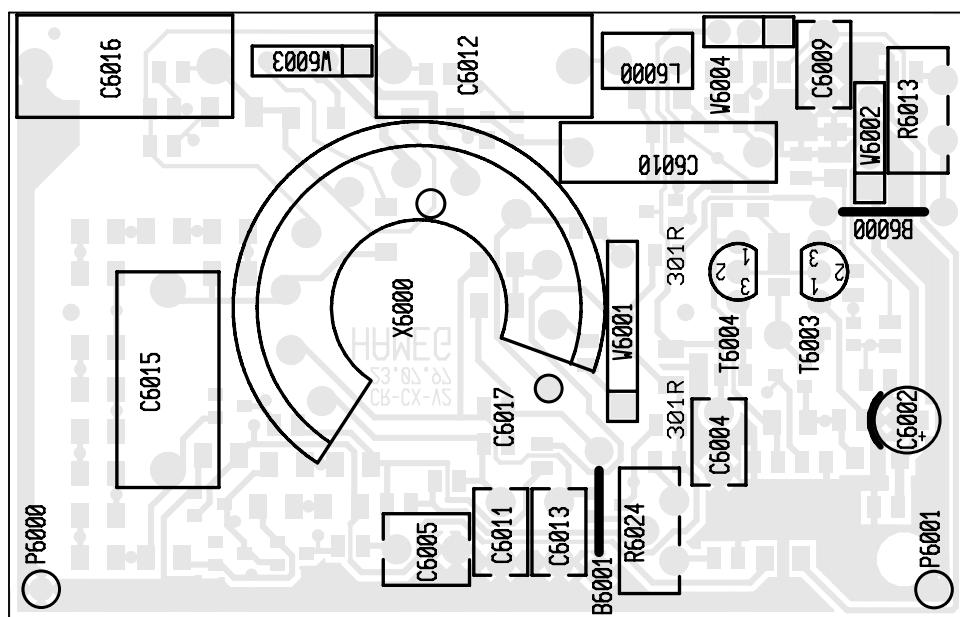
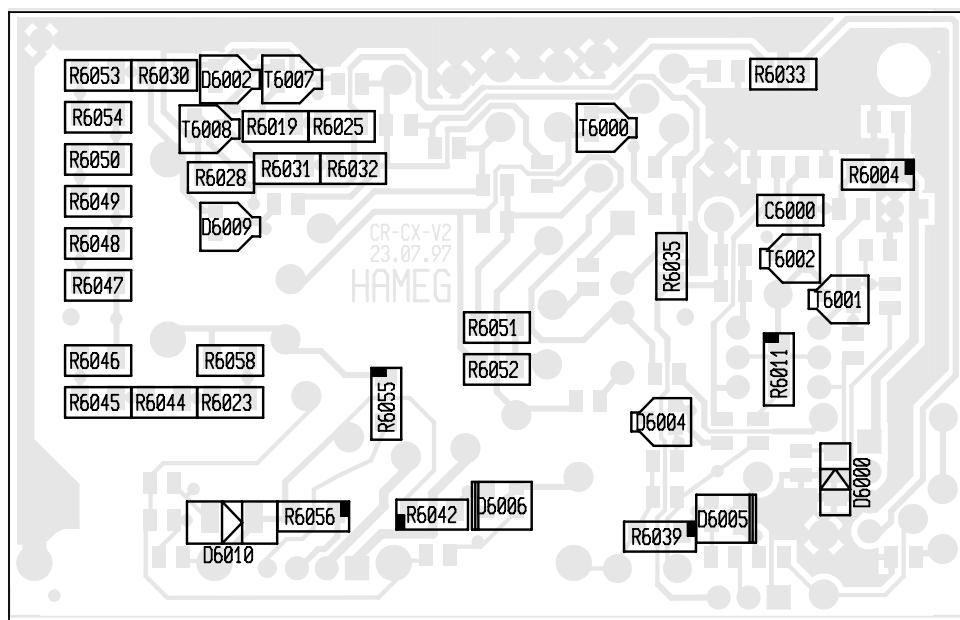
DIGI_HM305 970901

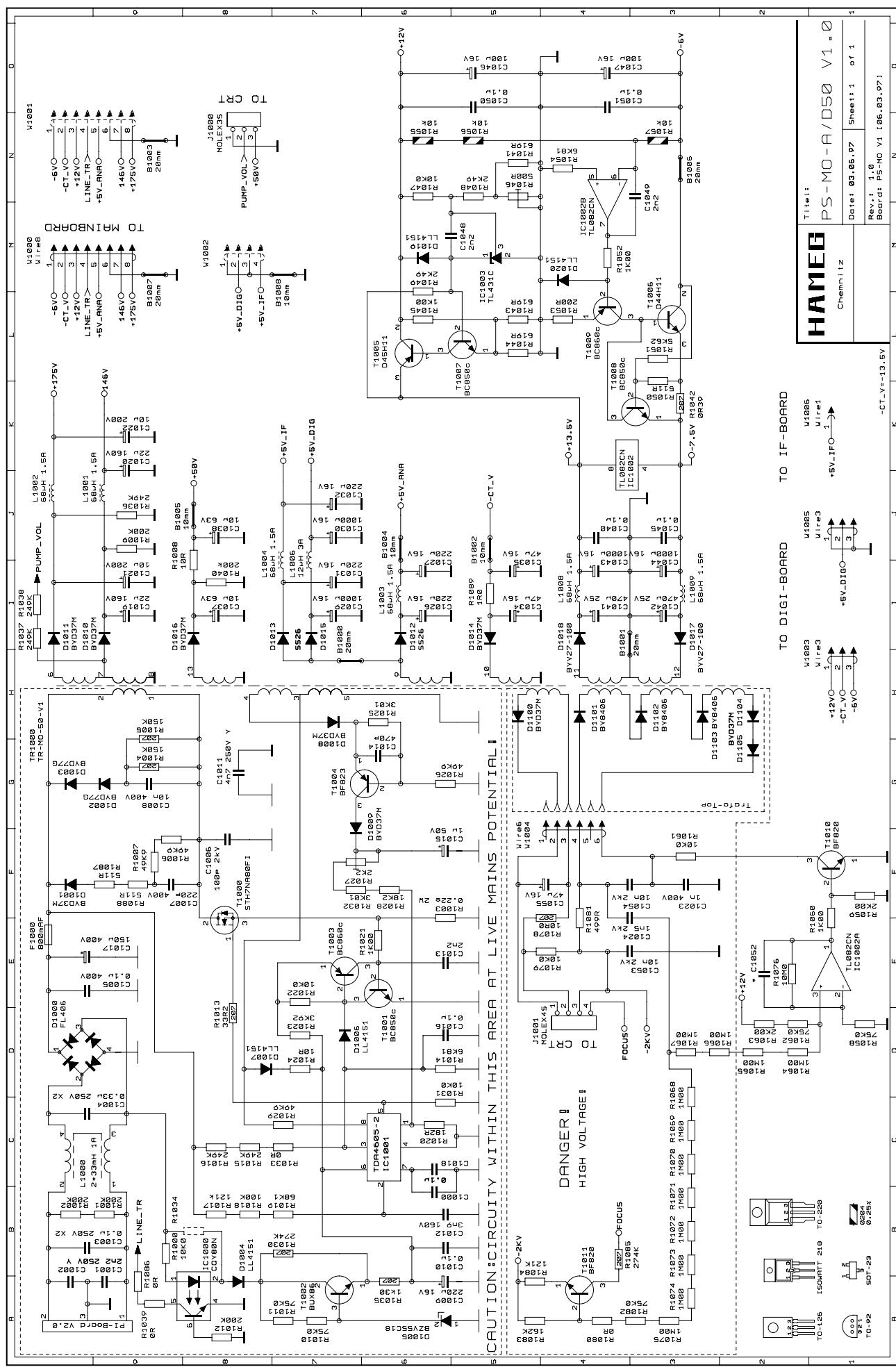
Stand: 01.09.1997



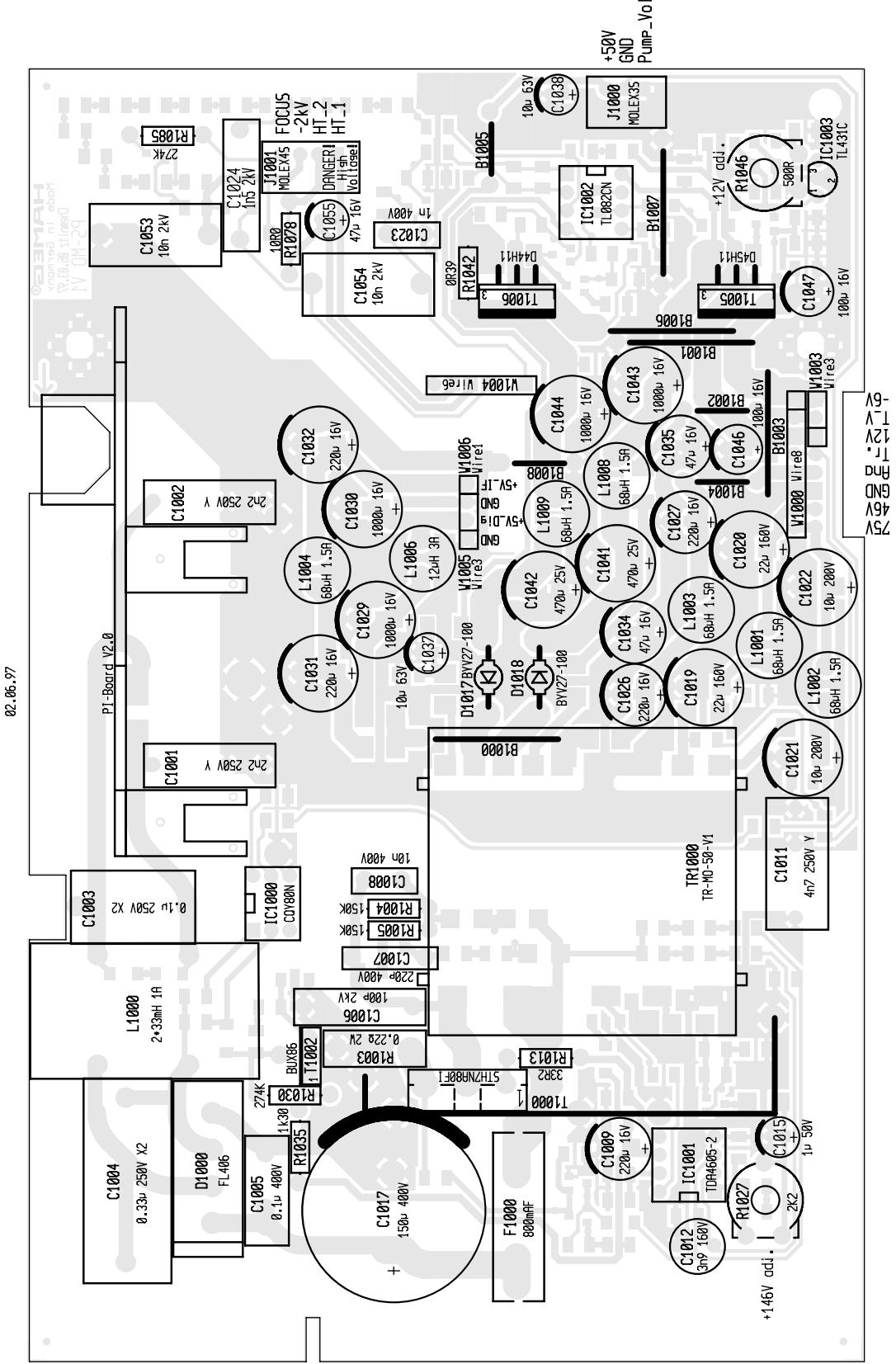


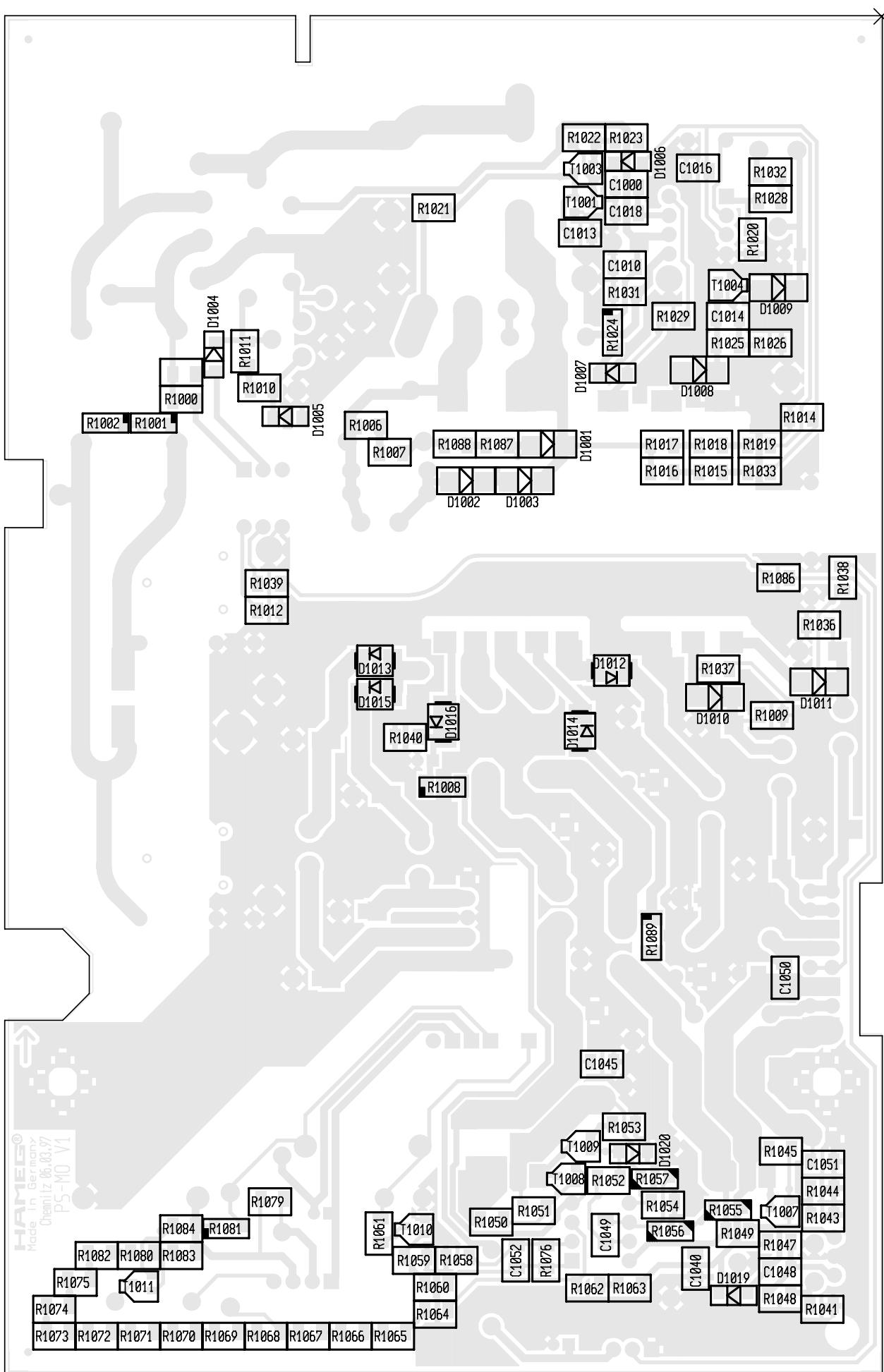
CRT-Board Layout (Top an Bottom side)



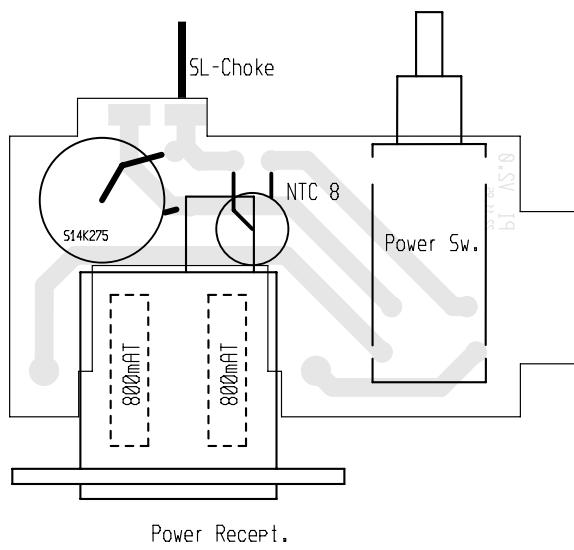
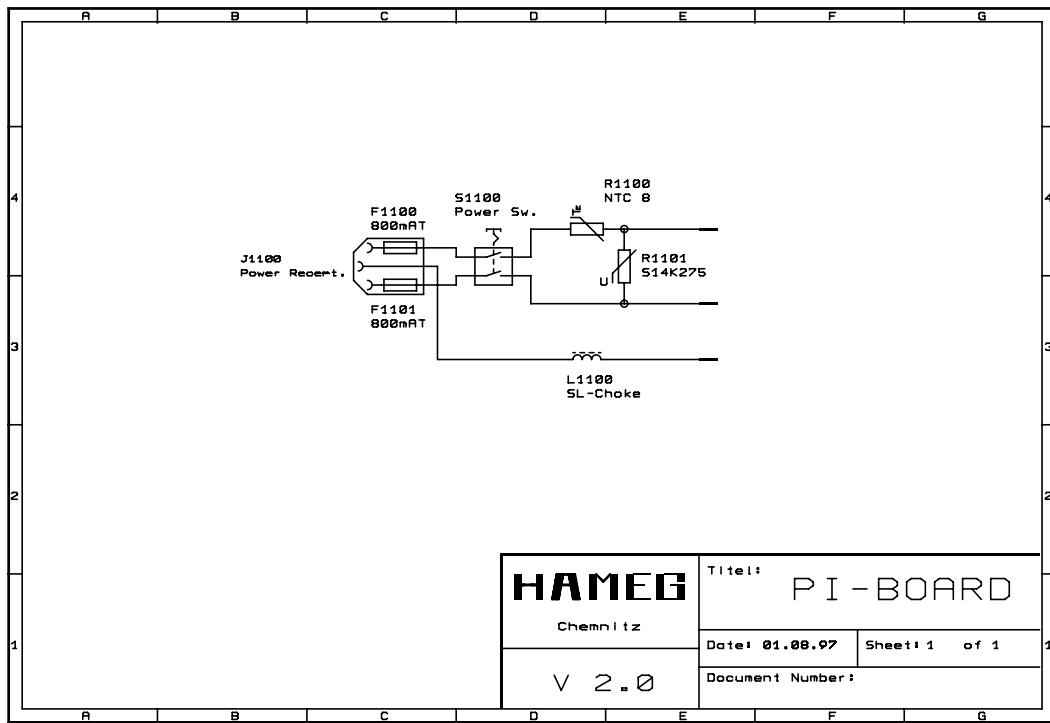


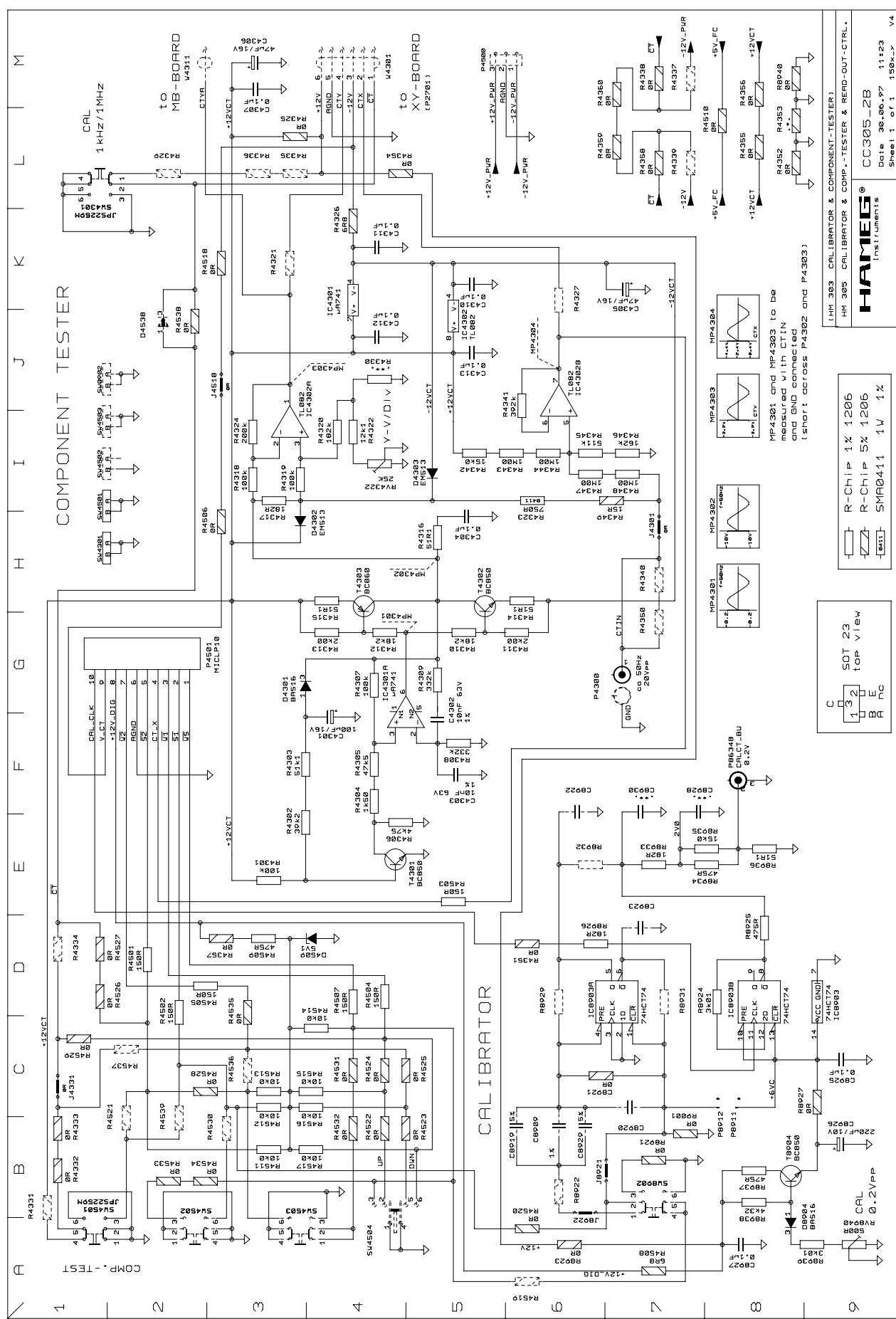
PS-Board Layout (Top side)



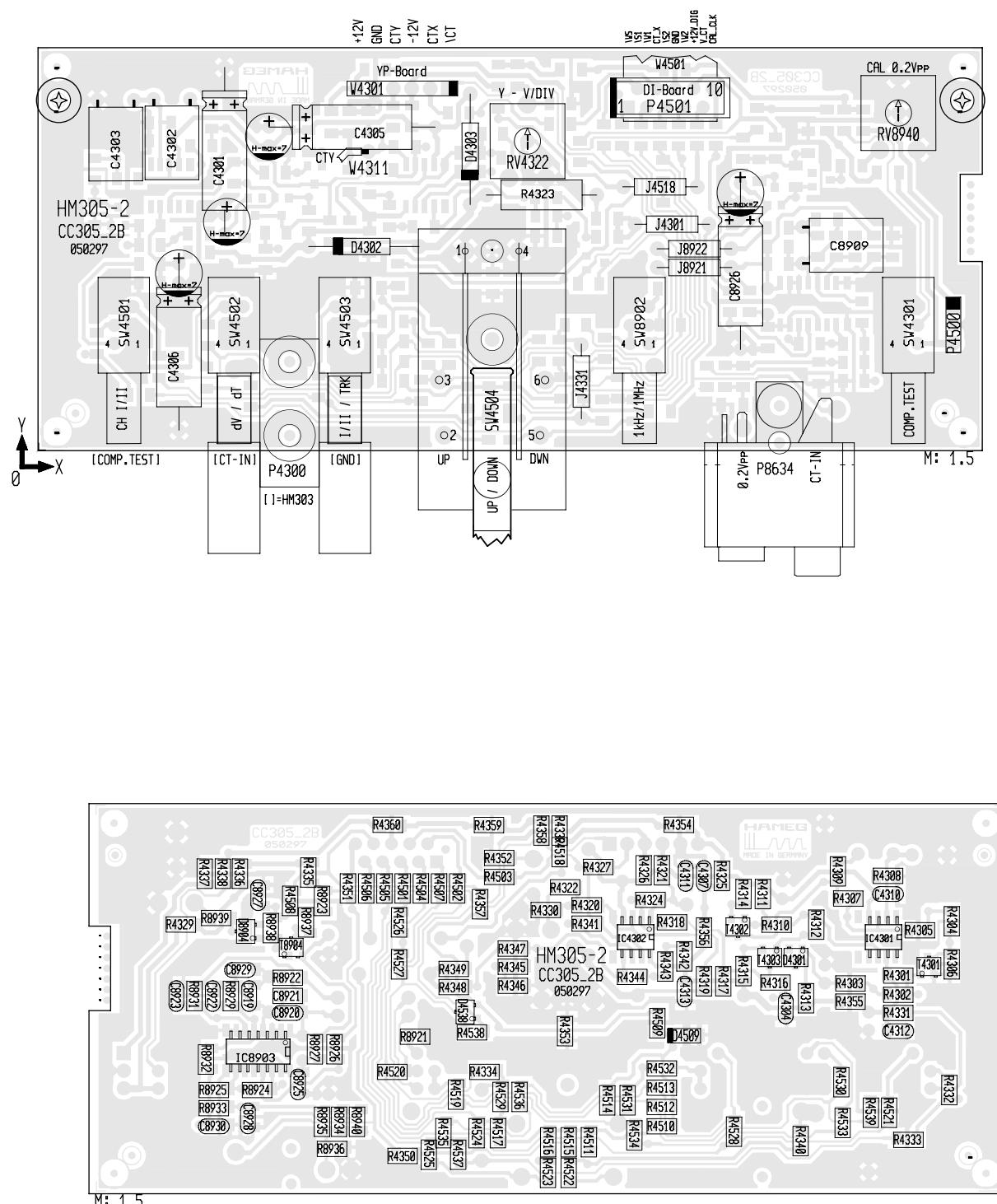


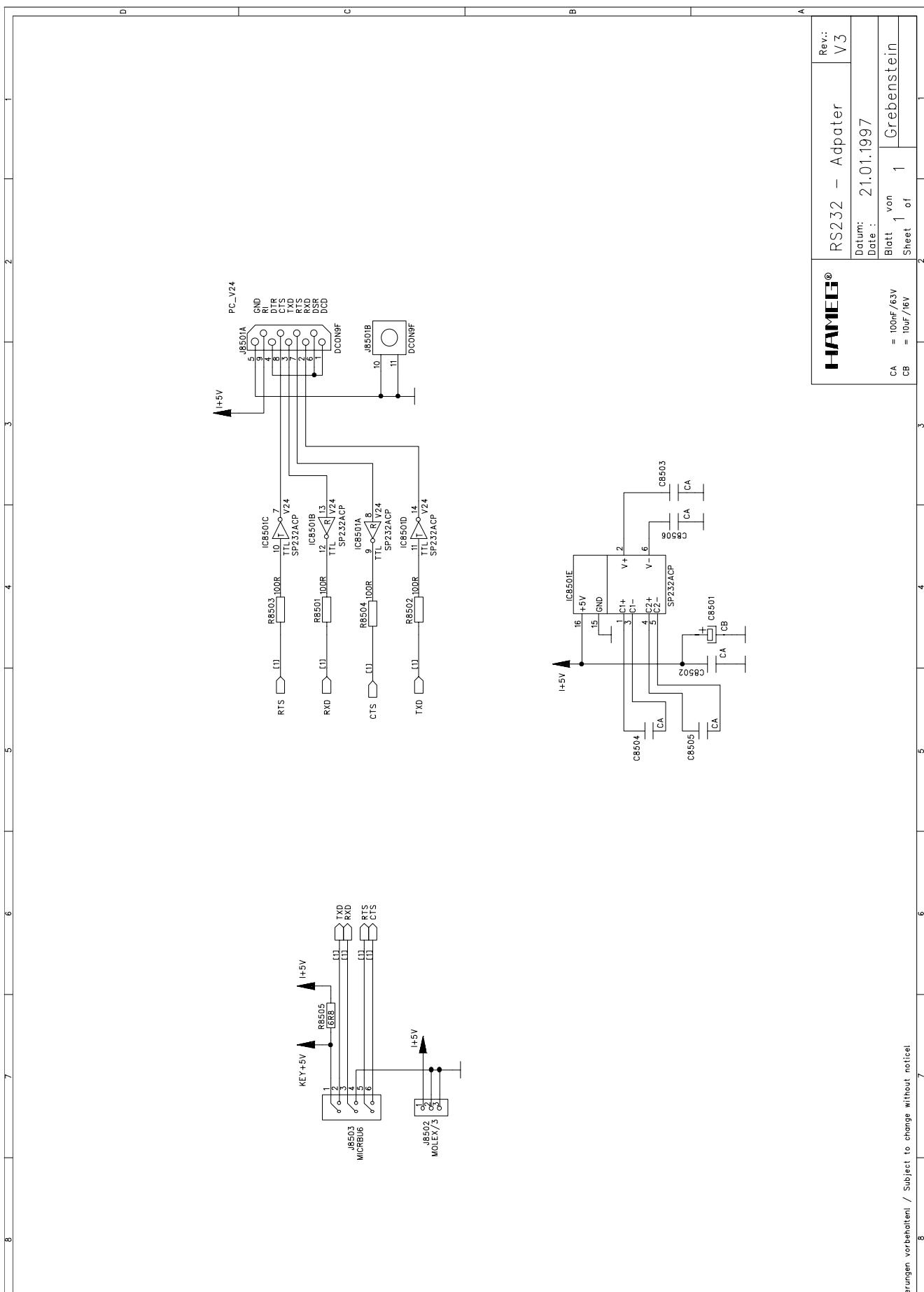
PI-Board Diagram & Layout (Top and Bottom side)





CT-Board Layout (Top and Bottom side)

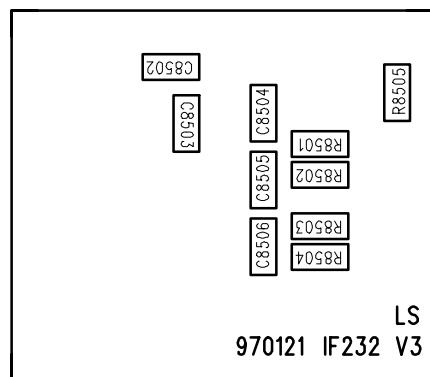
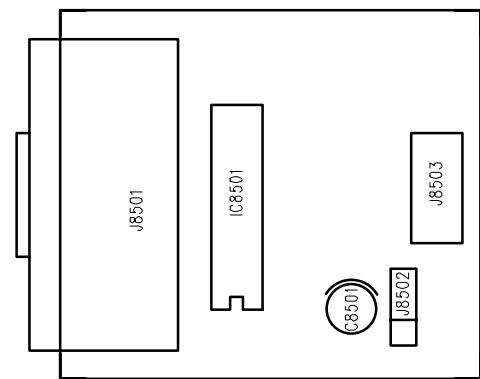




HAWMELE®		RS232 - Adapter	Rev.:
Datum:	21.01.1997	Blatt 1 von 1	Grebenstein

Änderungen vorbehalten / Subject to change without notice

IF-Board (Top and Bottom side)



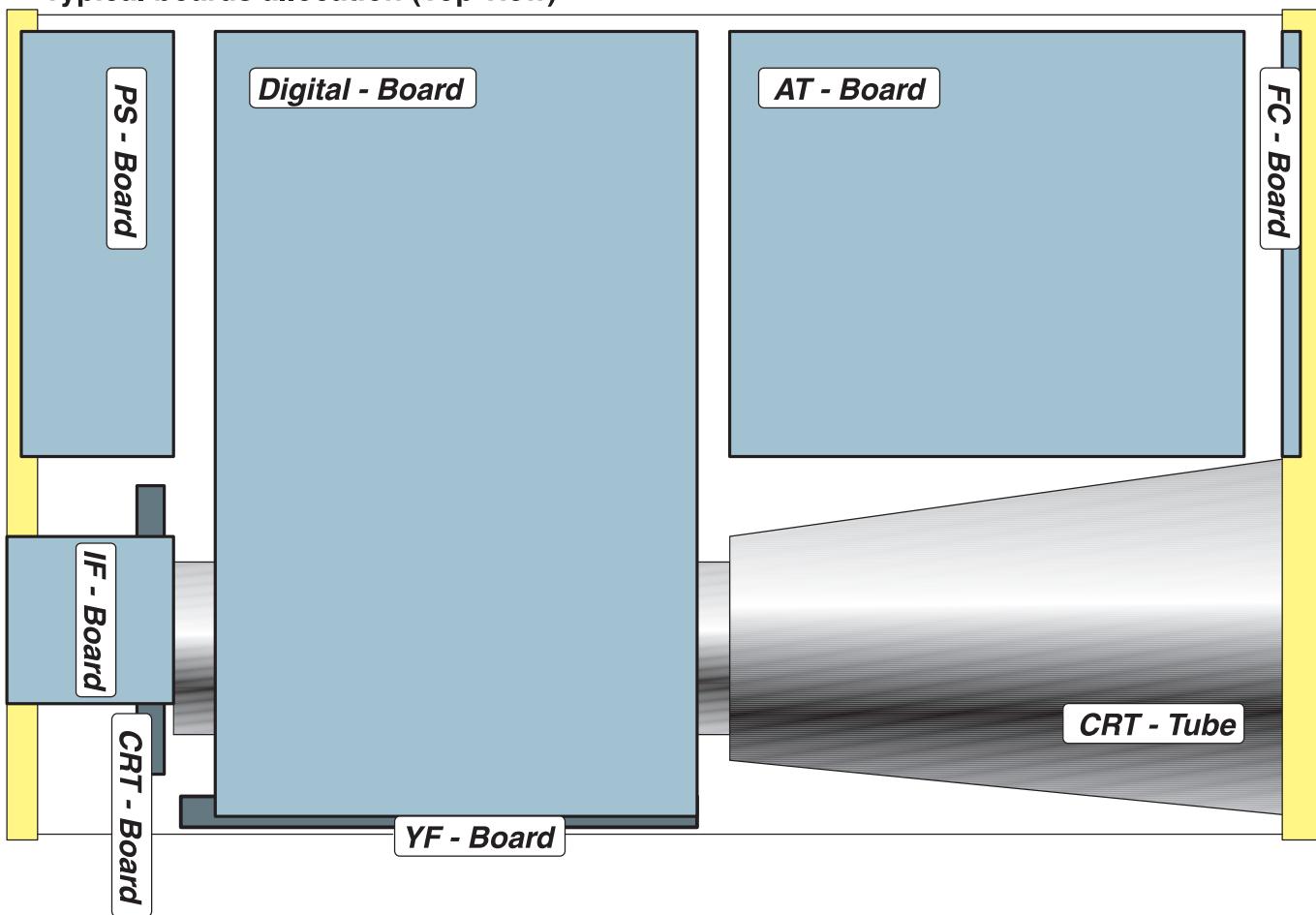
**Service Manual
Adjustment Procedure**



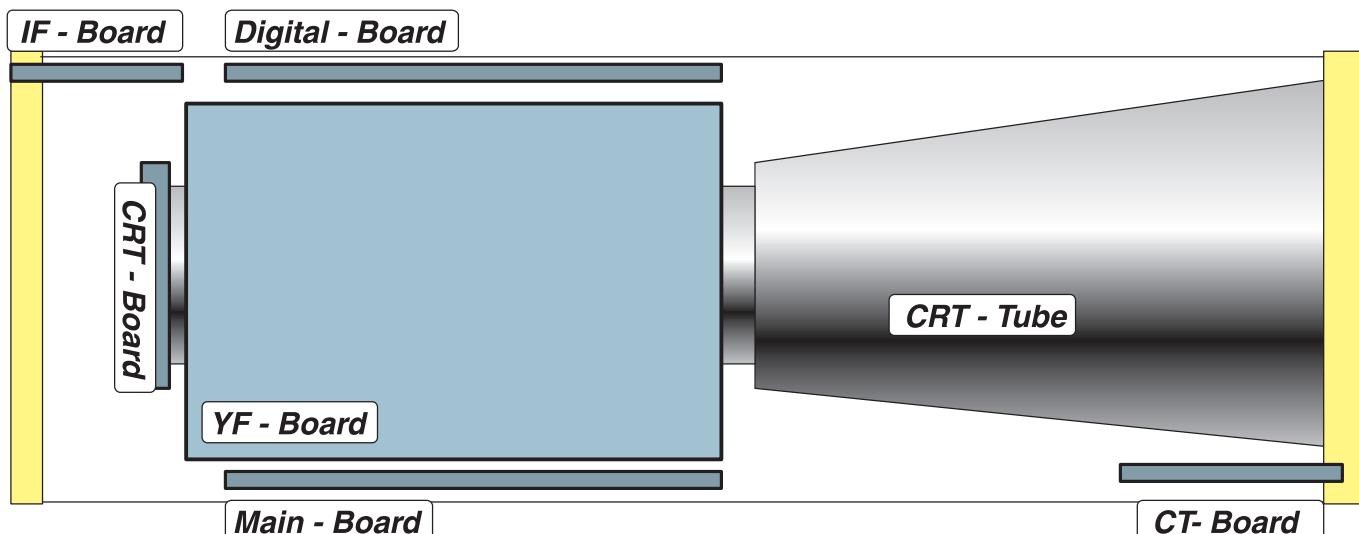
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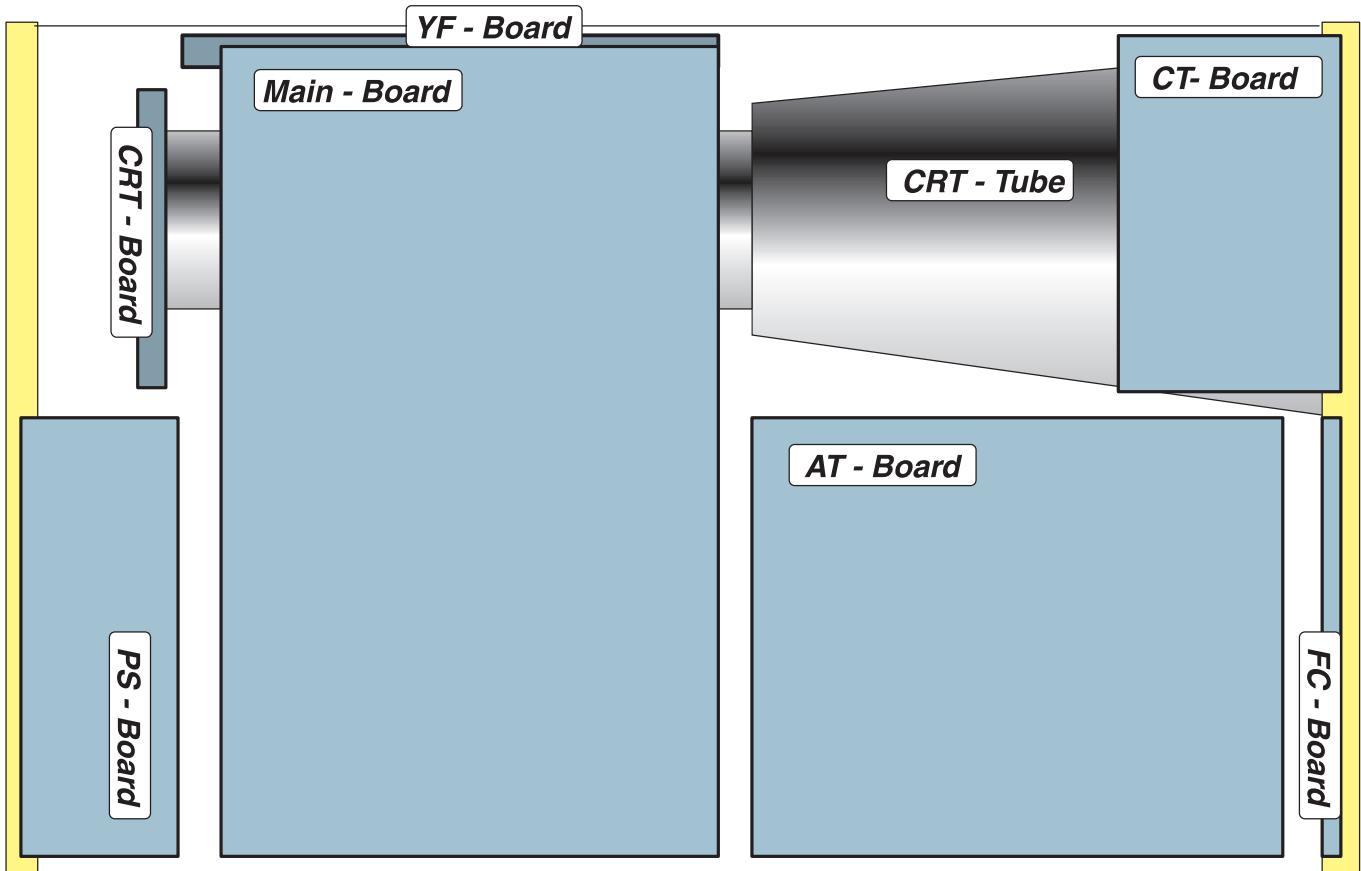
Typical boards allocation (Top view)



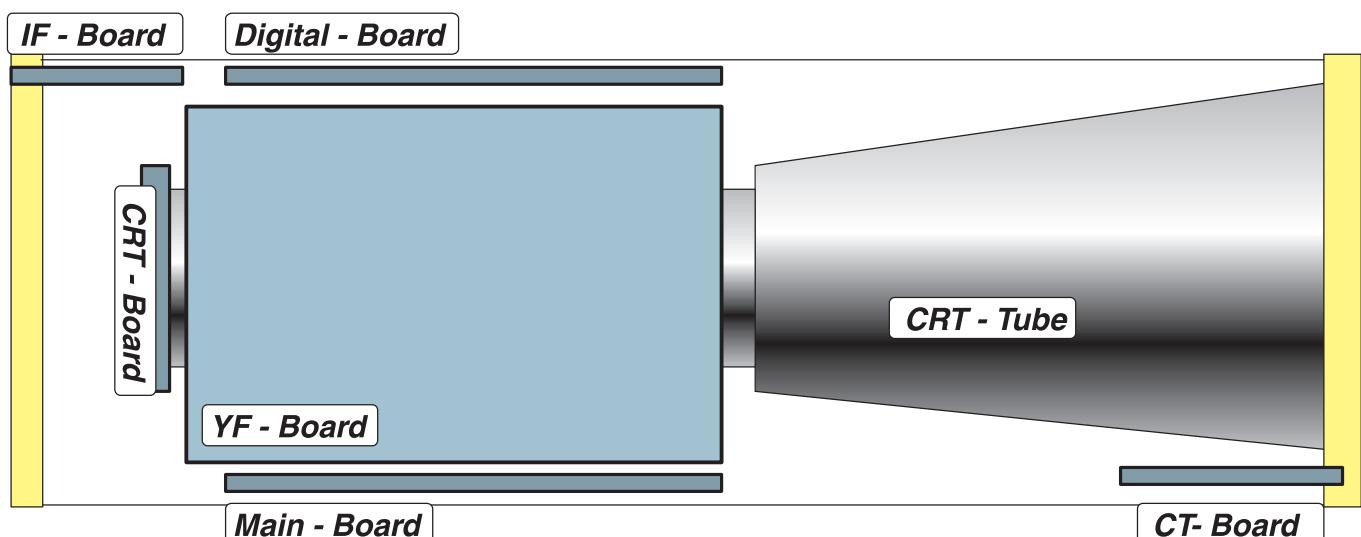
Typical boards allocation (Back side)



Typical boards allocation (Bottom view)



Typical boards allocation (Back side)



ADJUSTMENT PROCEDURE

Analog/Digital Scope HM305-2

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 and the CRT-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, particularly "Service Instructions" and "Operating Instructions".
- 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:

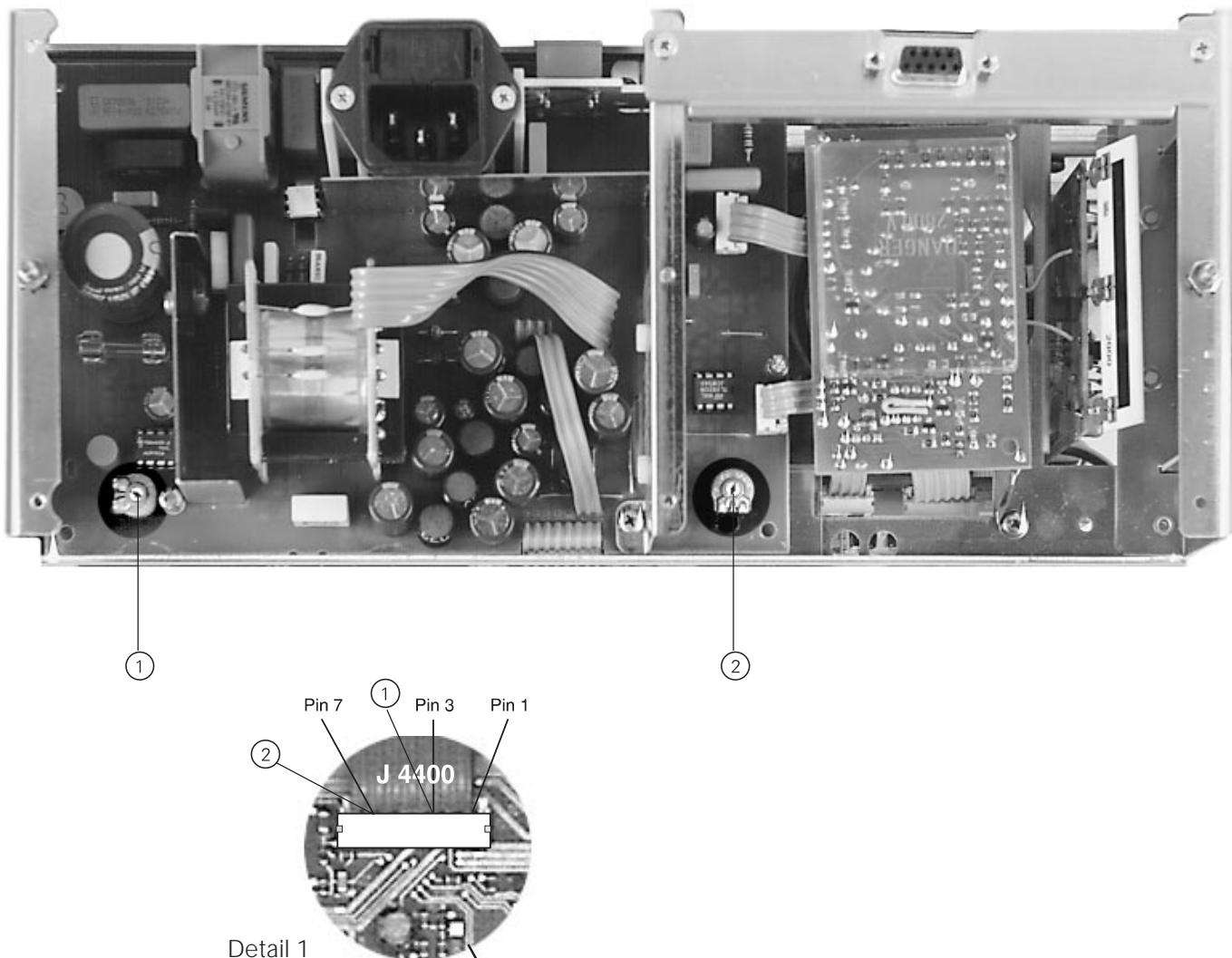
- 1) Scope Tester HZ 60-3.
- 2) Constant amplitude sinewave generator, 20Hz - 250MHz, output 5mV - 5V into 50 Ohm, preferably with 20dB attenuation (e.g. HM 8133, TEK SG502 + TEK SG503).
- 3) Amplitude Calibrator with 1kHz square wave output and 600 Ohm impedance, risetime faster than 150ns. Output voltage 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 Ohm (e.g. HZ62, TEK TG501).
- 5) Pre-attenuator 2:1 (1 M Ohm parallel with 12-48pF), e.g. HZ20.
- 6) 50 Ohm BNC through termination, e.g. HZ22.
- 7) 2 BNC-cables, 50 Ohm, e.g. HZ34.
- 8) BNC-T-connector.
- 9) Oscilloscope probe 10:1, with exactly 9M Ohm series resistance and compensated for test oscilloscope mentioned under 10).
- 10) Oscilloscope 150MHz, 5mV/div to 5V/div, e.g. HM1505.
- 11) Trimming/adjusting tool.
- 12) Variable output safety insulation transformer.
- 13) Video signal generator with positive and negative signal output.

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.

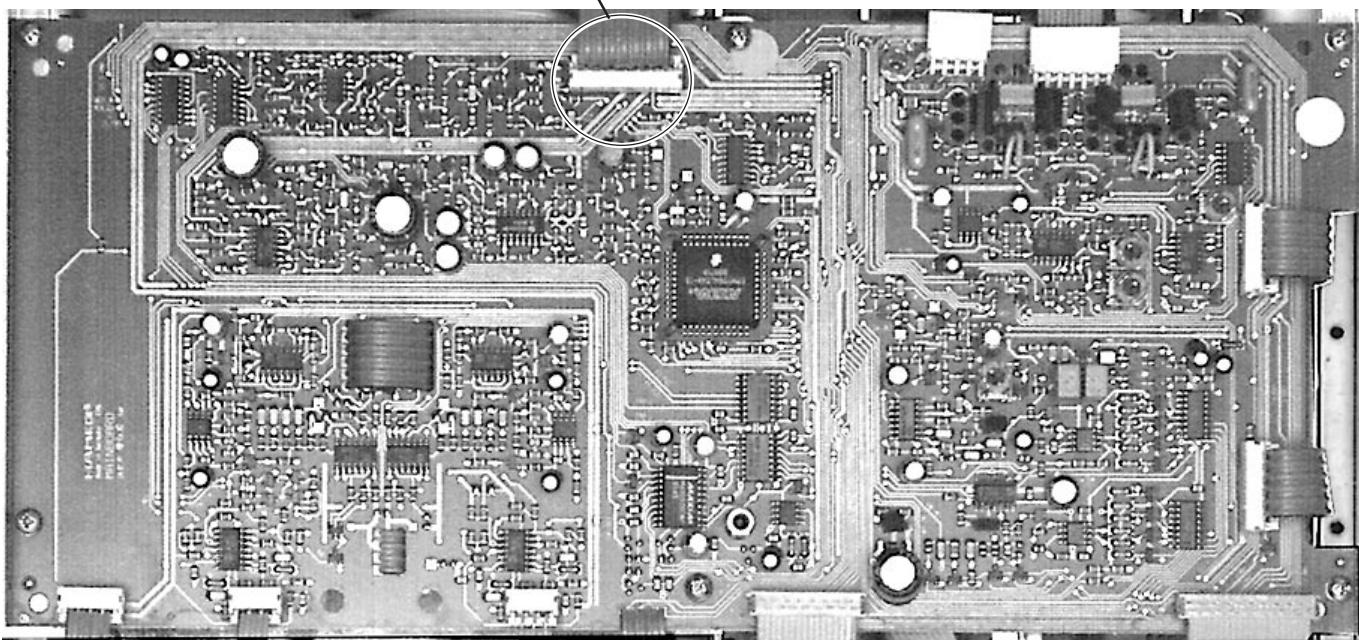
Exact adjustment is only possible when any influence of the earth's' magnetic field has been compensated with the trimmer marked TR (trace rotation).

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.

PS-Board



Main-Board



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.

Basic settings!

Before starting each adjustment procedure check that no signal is applied at the BNC connectors. Then set the oscilloscope to analog CH I mode. If a falling slope symbol is displayed in the readout, select the rising slope symbol by briefly pressing the NM - AT pushbutton. Briefly press the AUTO SET pushbutton. This causes the following basic settings:

X-Section:

TIME/DIV.	T: 100µs (readout)
TIME VAR.	calibrated detent (VAR-LED dark)
NM - AT (trigger)	Automatic-Trigger (NM LED dark)
TRIG. (coupling)	TRIG. MODE: AC (LED lit)
TRIG. LEVEL	electrical center position (triggerpoint symbol in trace position)
TRIG. (SLOPE)	rising slope symbol (readout)
HOLD OFF	minimum (HO LED dark)
XY	off (XY not displayed in the readout)
X-POS.	electrical center position
X-MAG. x10	off (X-MAG. x10 LED dark)

Y-Section:

CH I	on, 5mV/div, calibrated (VAR LED dark),
CH II	off (deflection coefficient and input coupling not displayed in the readout)
Y-POS II	electrical center position

Readout: ON

The following conditions must be set manually:

Select DC input coupling (readout: CH1: 5mV=) if not present.

Set CALIBRATOR signal to 1 kHz.

Adjust the baseline exactly parallel to the horizontal center line of the graticule, by using the trimpot marked "TR" on the front panel

Preparations regarding CH II:

Briefly press the CH II pushbutton and select:

5mV/div deflection coefficient, calibrated (VAR LED dark).

DC input coupling.

INV. (invert) off.

Set trace to the electrical center position by Y-POS II.

Note:

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

1) R1027: +146 Volt supply.

WARNING: To avoid damage use a fully insulated screwdriver!

-Locate and identify R1027 (1) on PS-Board (screened section).

-Locate connector J4400 (8pole Molex) on MB-Board and identify pin 7.

-Adjust R1027 (1) for exactly +146 Volts (± 0.1 Volt) at J4400 pin 7 with respect to chassis.

2) R1046: +12 Volt supply.

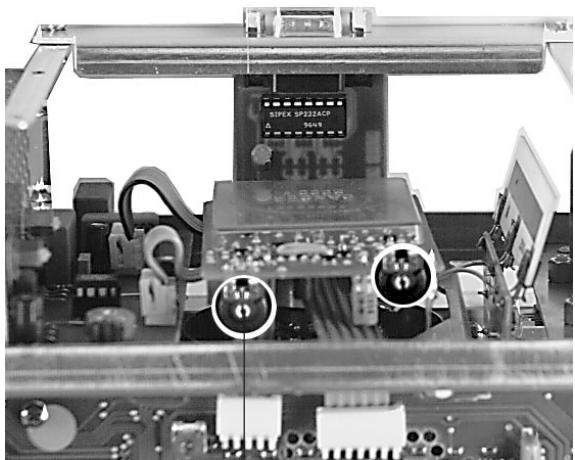
-Locate and identify R1046 (2) on PS-Board.

-Locate connector J4400 (8 pole Molex) on MB-Board and identify pin 3.

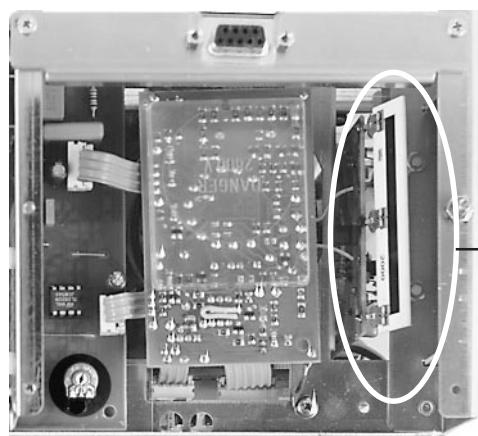
-Adjust R1046 (2) for exactly +12 Volts ($\pm 10mV$) at J4400 pin 3 with respect to chassis.

At J4400 the other voltages +175V (pin 8), -6V (pin1), +5V (pin 5) and -2000V on the cathode of the CRT depend on the correct +12 Volt adjustment. All these voltages with higher tolerances must be checked and verified.

CRT-Board

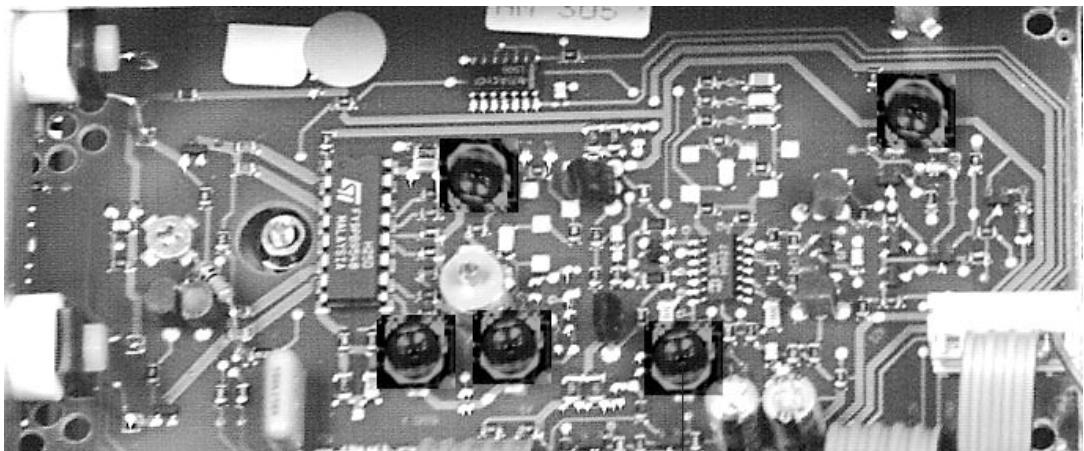


CRT and YF-Board (Oscilloscope rear side)



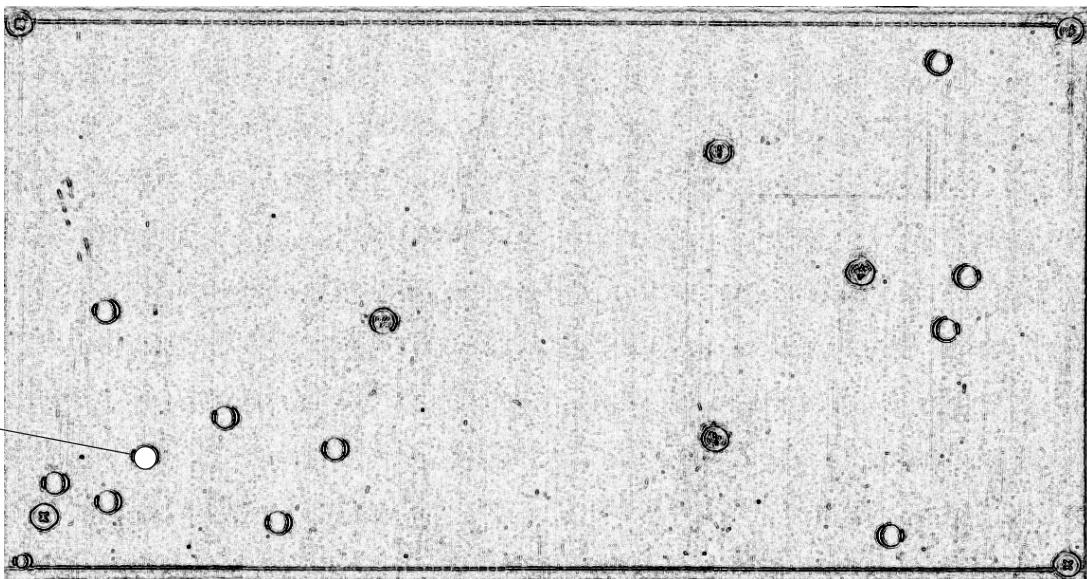
Detail 2. ④

YF-Board



④

Digital-Board



3) R6013: CRT minimum intensity.

- Locate and identify R6013 (3) on CRT-Board.
- Set INTENS. control to fully left position (beep).
- Press and hold DUAL pushbutton for XY mode (readout: both channel deflection coefficients and XY.)
- The following adjustment should be made under shaded conditions.
- Adjust R6013 (3) so that the dot just disappears.
- Press and hold DUAL pushbutton to revert to the previous operating conditions.

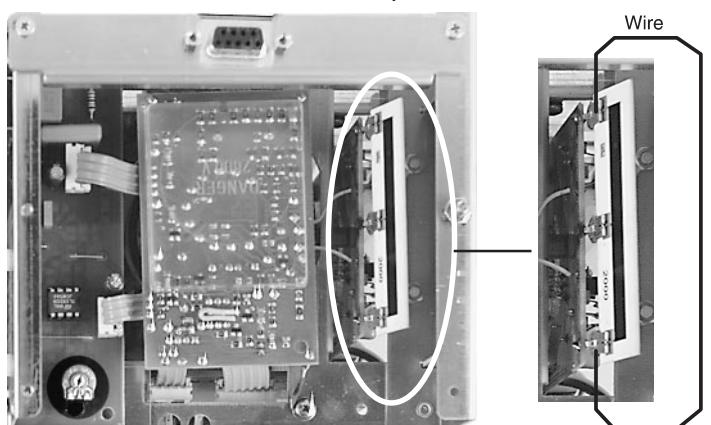
4) R9003: Analog Mean Y-Plate Voltage.

- Check that analog mode is present.
- Set trace to the horizontal center line of the graticule.
- Briefly press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Release POWER pushbutton (out!).
- Locate and identify R9003 (4) on YF-Board.
- Locate and identify the ceramic (double) resistor R9062 A and B on YF-Board.
- Connect (short circuit) both outer terminals of R9062 by a wire (0 Ohm).
- Press Power pushbutton (on!).
- Wait until a beep signalizes the end of the start procedure.
- Press and hold the READOUT pushbutton to switch the readout off, if the trace shows sections with vertical deflection.
- Adjust R9003 (4) for exactly +84 Volts (± 0.5 Volt) at one of the outside terminals of R9062 with respect to chassis. Please note down the exact value, as it is required in the next adjustment under item 5).
- Continue with 5), without change in operating conditions.

5) VR7004: Digital Mean Y-Plate Voltage.

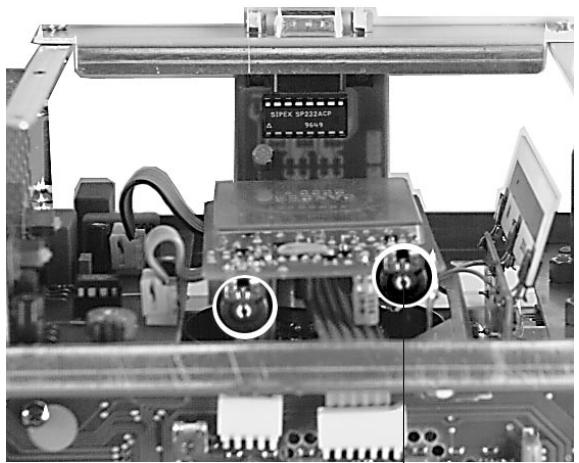
- Operate as mentioned under item 4).
- Press and hold STOR. MODE – ON/OFF pushbutton for digital mode.
- Briefly press the upper STOR. MODE pushbutton until the RFR-LED is on.
- Locate and identify VR7004 (5) on Digital-Board.
- Adjust VR7004 (5) for exactly the same voltage - as noted down under item 4) - at one of the outer (short circuit) terminals of R9062 with respect to chassis.
- Release POWER pushbutton (out!).
- Remove the short-circuit wire at R9062.
- Press Power pushbutton (on!).
- Press and hold the READOUT pushbutton to switch the readout on.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").
- Press and hold STOR. MODE – ON/OFF pushbutton for analog mode.

CRT and YF-Board (Oscilloscope rear side)



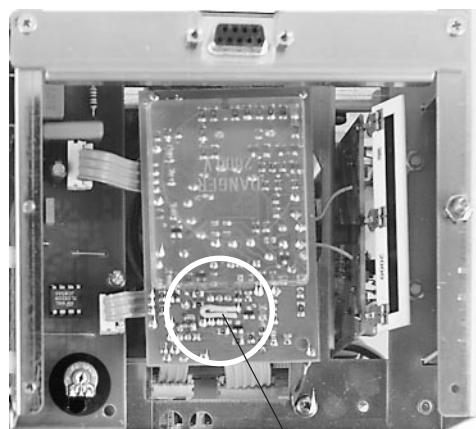
Detail 2.

CRT-Board

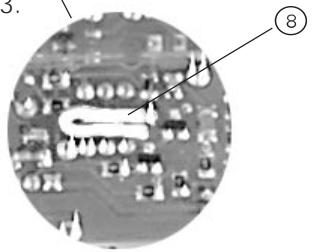


⑥

CRT and YF-Board (Oscilloscope rear side)



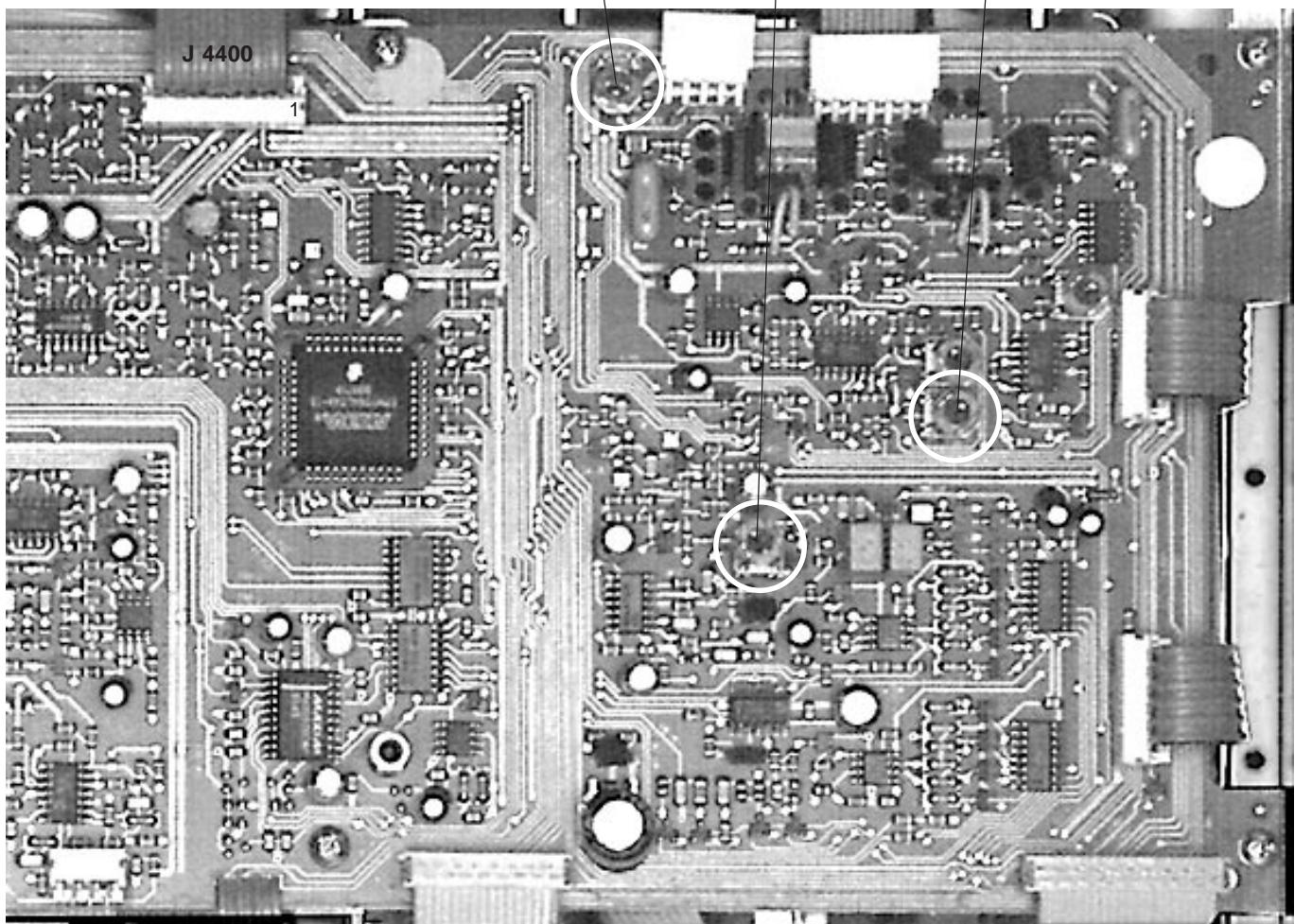
Detail 3.



⑧

⑨

Main-Board



⑦

⑩

6) R6024: Astigmatism correction.

- Locate and identify R6024 (6) on CRT-Board.
- Briefly press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Press and hold DUAL-XY pushbutton for XY mode (readout: both channel deflection coefficients and XY).
- Set the undeflected beam to the screen center.
- Adjust INTENS. (front panel) for low intensity.
- Turn the FOCUS knob continuously to defocus the spot in both directions from the focus point until the next procedure is finished.
- Adjust R6024 (6) so that the spot shape does not change when defocused.
- Press and hold DUAL-XY pushbutton for time base mode.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").

7) R5014: Automatic Focus.

- Locate and identify R5014 (7) on Main-Board.
- Press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Press and hold DUAL-XY pushbutton for XY mode (readout: both channel deflection coefficients and XY).
- Set the undeflected beam to the screen center.
- Turn the FOCUS knob for maximum trace sharpness. This setting must not be changed until the following adjustment procedure is finished.
- Press the INTENS. pushbutton briefly to switch over to readout intensity setting.
- Turn the INTENS. knob fully clockwise (beep) for maximum readout intensity setting.
- Adjust R5014 (7) for maximum readout sharpness.
- Press and hold DUAL-XY pushbutton for time base mode.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").

8) C6003 (wire): Beam Diameter in Sweep Start Position.

- Briefly press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Set time base to 50ns/div.
- Briefly press the X-MAG. pushbutton so that the x10 LED lits.
- Turn X-POS. control clockwise until the trace start position is in the center of the screen.
- Locate and identify the wire (C6003) on the CRT-Board, outside the high voltage section.
- Press or release the wire to or from the board to adjust the trace diameter at the trace start for the same thickness as the following – not effected – visible trace.
- Briefly press the X-MAG. pushbutton so that the x10 LED is dark.
- Set time base to 100μs/div.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").

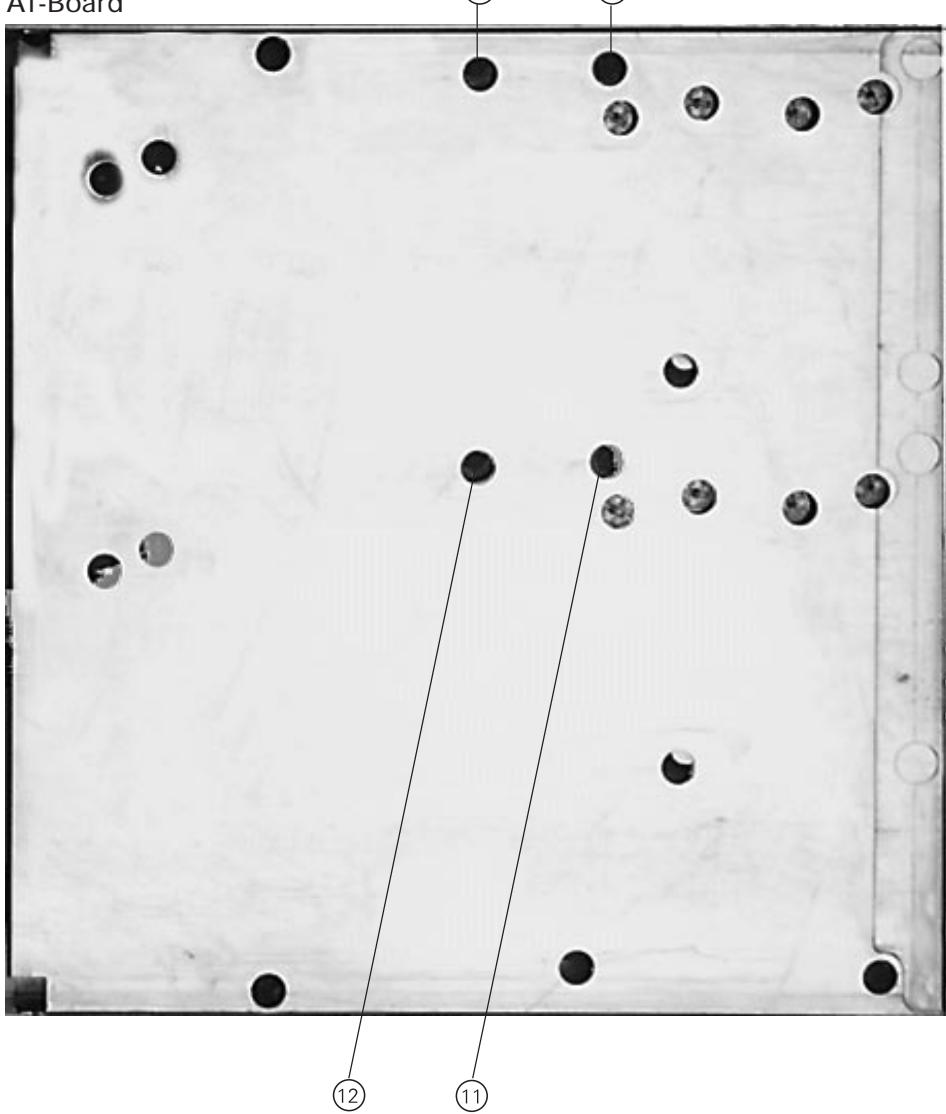
9) R4430: Sweep Start Position.

- Briefly press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Set time base to 500ns/div.
- Briefly press the X-MAG. pushbutton so that the x10 LED lits.
- Check that the readout displays T:50ns.
- Turn INTENS. control for medium intensity.
- Turn X-POS. control clockwise until a beep signalizes the maximum setting.
- Locate and identify R4430 on Main-Board.
- Adjust R4430 so that the trace starts on the vertical center line of the graticule.
- Briefly press the X-MAG. pushbutton so that the x10 LED is dark.
- Set time base to 100μs/div.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").

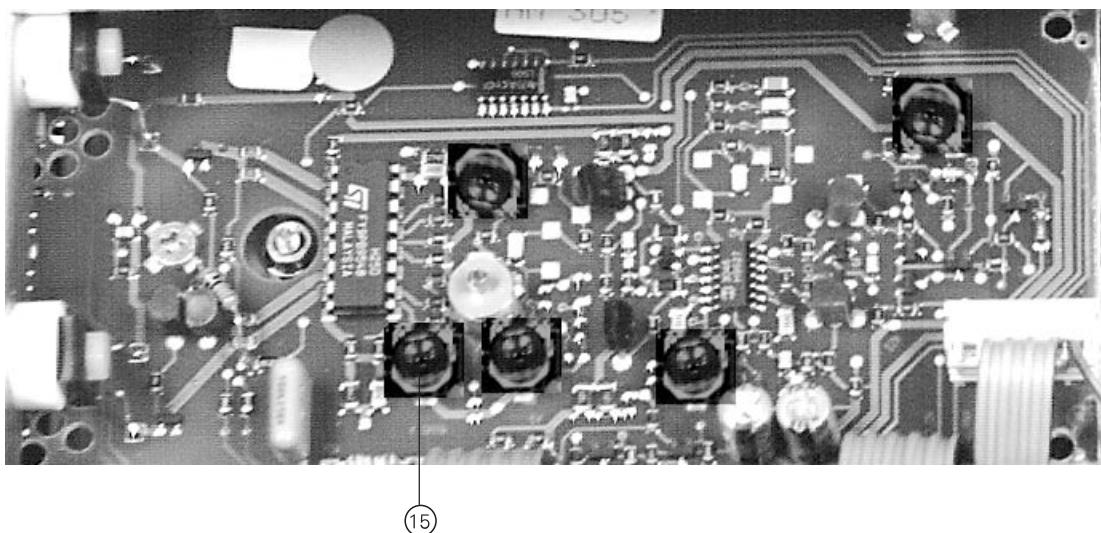
10) R4086: X-Gain x1.

- Briefly press channel I GD pushbutton to ground the input (readout: "CH1:ground symbol").
- Set time base to 500ns/div.
- Locate and identify R4086 on Main-Board.
- Adjust R4086 (10) for 10.4 div. sweep length.

AT-Board



YF-Board



- Set time base to 100 μ s/div.
- Briefly press channel I GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").

11) R2200: 100Hz Square Wave at 5mV/div CH II.

- Press CH II pushbutton to switch channel I off and channel II on.
- Connect a 25mVpp/100Hz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel II.
- Set time base to 1ms/div.
- Check that channel II DC input coupling is present.
- Check that channel II deflection coefficient is 5mV/div.
- Locate and identify R2200 (11) in CH II section of the AT-Board.
- Set the top of the square wave to the horizontal center line of the graticule.
- Adjust R2200 (11) for flat top.
- Disconnect the square wave signal from input channel II.
- Continue with 12), without change in operating conditions.

12) R2202: 100Hz Square Wave at 1mV/div CH II.

- Set channel II deflection coefficient to 1mV/div.
- Connect a 5mVpp/100Hz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel II.
- Locate and identify R2202 (12) in CH II section of the AT-Board.
- Set the top of the square wave to the horizontal center line of the graticule.
- Adjust R2202 (12) for flat top.
- Disconnect the square wave signal from input channel II
- Set channel II deflection coefficient to 5mV/div.
- Press CH I pushbutton to switch channel II off and channel I on.
- Continue with 13), without change in operating conditions.

13) R2000: 100Hz Square Wave at 5mV/div CH I.

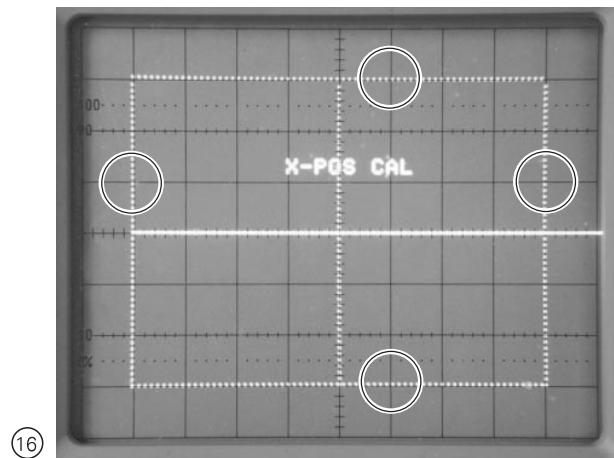
- Check that channel I is switched on.
- Connect a 25mVpp/100Hz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Check that time base is set to 1ms/div.
- Check that channel I DC input coupling is present.
- Check that channel II deflection coefficient is 5mV/div.
- Locate and identify R200 (13) in CH I section of the AT-Board.
- Set the top of the square wave to the horizontal center line of the graticule.
- Adjust R2000 (13) for flat top.
- Disconnect the square wave signal from input channel I.
- Continue with 14), without change in operating conditions.

14) R2002: 100Hz Square Wave at 1mV/div CH I.

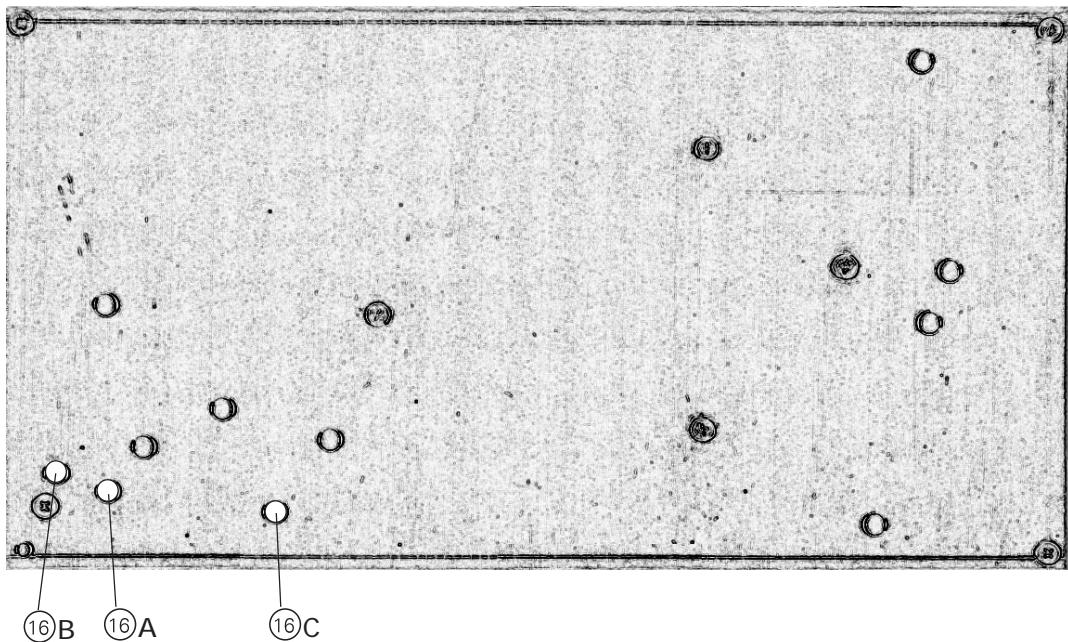
- Set channel I deflection coefficient to 1mV/div.
- Connect a 5mVpp/100Hz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Locate and identify R2002 (14) in CH II section of the AT-Board.
- Set the top of the square wave to the horizontal center line of the graticule.
- Adjust R2002 (14) for flat top.
- Disconnect the square wave signal from input channel I.
- Set channel I deflection coefficient to 5mV/div.

15) R9023: Y Gain CH I and CH II.

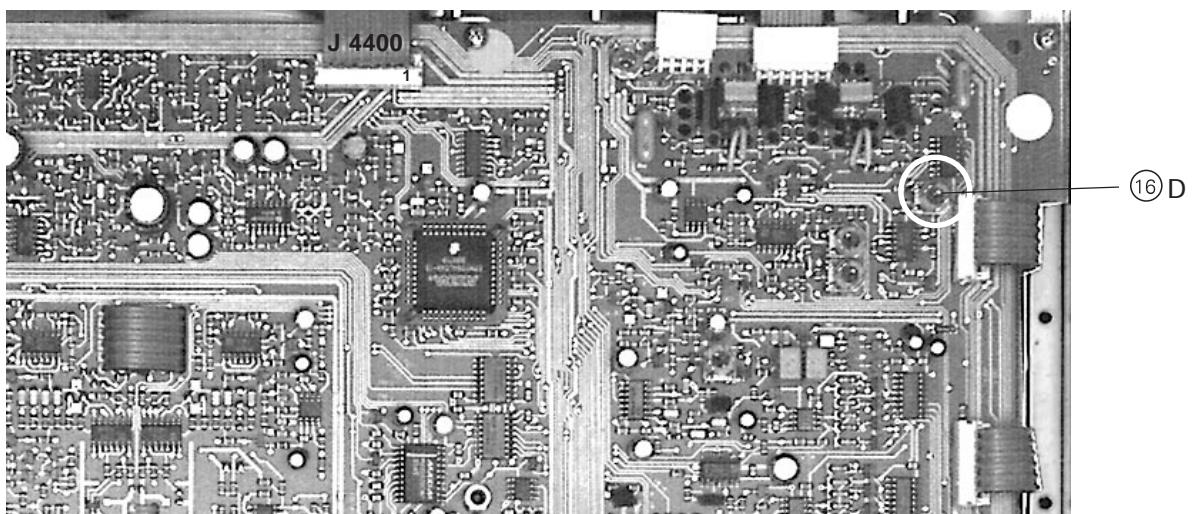
- Release POWER pushbutton (out!).
- Press and hold AUTOSET pushbutton constantly.
- Press Power pushbutton (on!).
- Wait until the headline MAIN MENU and the submenus CALIBRATE (highlighted) and SETUP are displayed on the screen.



Digital-Board



Main-Board



- Release AUTOSET pushbutton.
- Press and hold SAVE pushbutton (front panel) to call CALIBRATE.
- The CALIBRATE MENU offers several items.
- Briefly press RECALL pushbutton (front panel) until Y1/2 GAIN is highlighted.
- Press and hold SAVE pushbutton (front panel) to call Y1/2 GAIN.

Note:

This automatically sets the instrument to analog DUAL operation, timebase 100µs/div, channel I and II 5mV= uncalibrated, channel I and II VOLTS/DIV. knobs in vernier function, internal trigger source CHI, automatic triggering and AC trigger coupling. Additionally the readout displays Y-GAIN CAL.

- Turn channel I VOLTS/DIV knob fully clockwise (beep).
- Connect a 25mVpp/1kHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Locate and identify R9023 on YF-Board.
- Adjust R9023 for 5.3 div. signal height.
- Turn channel I VOLTS/DIV knob counter clockwise for exactly 5 div. signal height.

Note:

The VOLTS/DIV. setting must not be changed until the following procedure is completed.

- Disconnect the square wave signal from input channel I.
- Connect a 25mVpp/1kHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel II.
- Briefly press TRIG. pushbutton (front panel) to select CH II for internal triggering.
- Turn channel II VOLTS/DIV. knob for exactly 5 div. signal height.

-Press and hold SAVE pushbutton (front panel). Readout: WARNING! CALIBRATION OVERWRITE.

Note:

If the function was called inadvertently, briefly press AUTOSET.

- Press and hold SAVE pushbutton. This overwrites the Y-GAIN factory calibration values and the readout displays the CALIBRATION MENU.
- Continue with 16), without change in operating conditions.

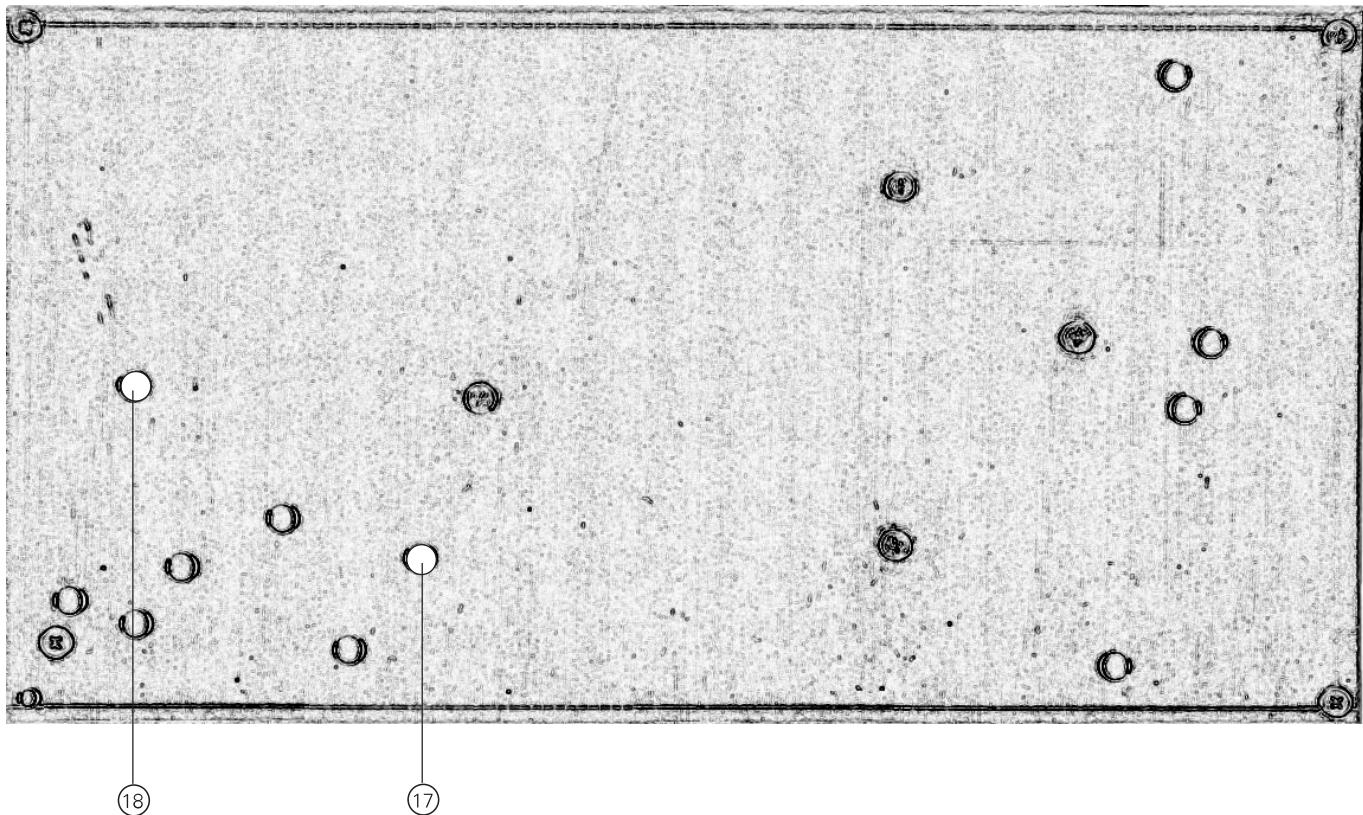
16) VR7002 (A), VR7003 (B), VR7001 (C), R4851 (D): Readout Position.

Attention!

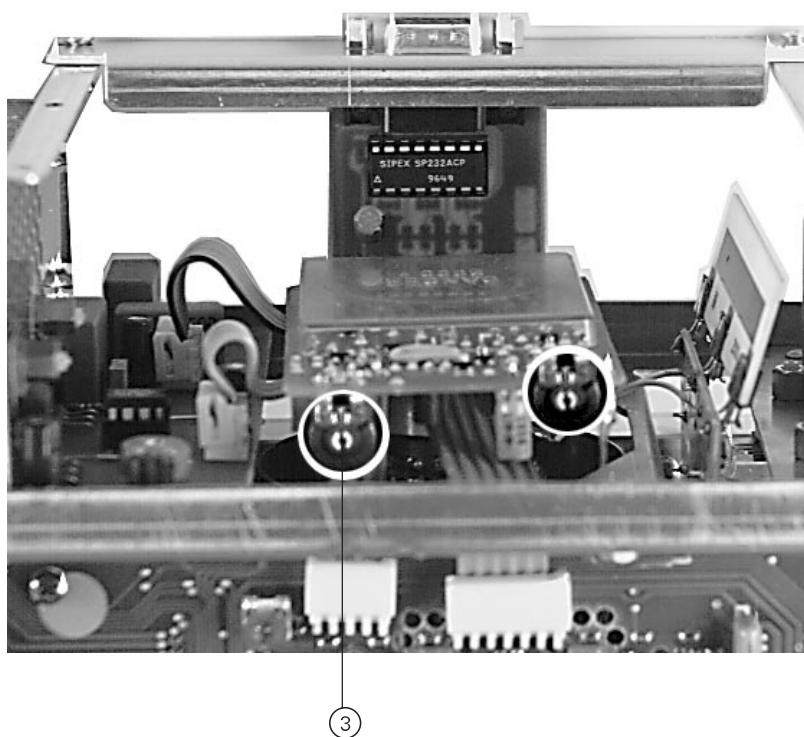
Do not change any front panel setting during the following procedure.

- Briefly press RECALL pushbutton (front panel) to highlight X-POSITION.
- Press and hold SAVE pushbutton (front panel).
- Now the trace and a rectangle with a horizontal and a vertical center line should be visible.
- Locate and identify VR7002 (16A) and VR7003 (16B) on Digital-Board.
- Adjust VR7002 (16A) for exactly 6 div. rectangle Y amplitude.
- Adjust VR7003 (16B) for symmetrical vertical position (horizontal lines 1 division above and below the graticule limits).
- If necessary repeat adjusting VR7002 (16A) and VR7003 (16B).
- Locate and identify VR7001 (16C) on Digital-Board.
- Locate and identify R4851 (16D) on Main-Board.
- Adjust R4851 (16D) for exactly 8 div. rectangle X amplitude.
- Adjust VR7001 (16C) for symmetrical horizontal position (vertical lines 1 division distance from the graticule boarder lines).
- If necessary repeat adjusting R4851 (16D) and VR7001 (16C).
- Briefly press AUTOSET until oscilloscope operation is present.
- Briefly press AUTOSET for basic conditions.

Digital-Board



CRT-Board



17) VR7005: Dot Join Sample & Hold.

- Check that channel I is switched on.
- Connect a 40mVpp/400Hz sine wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Set the signal (Y deflection: 8div.) within the vertical graticule limit lines.
- Press and hold STOR. MODE – ON / OFF pushbutton for digital mode.
- Check that RFR mode is present.
- Check that PT0% is displayed in the readout. Otherwise select that setting by briefly pressing the PT pushbutton (front panel).
- Set TIME/DIV knob to 2 μ s/div.
- Turn X-POS. knob (front panel) so that the trace start is moved 0.5 div. to the right.
- Check that rising trigger slope is selected.
- Turn LEVEL knob (front panel) so that the trace starts at the horizontal center line of the graticule.
- Briefly press the HOLD pushbutton (front panel) to activate the hold function.
- Press and hold READOUT pushbutton (front panel) to switch the readout off.
- Locate and identify R6013 (3) on CRT-Board.
- Turn R6013 (3) clockwise until the readout becomes visible and watch the trace start position.

Note:

By this reason the CRT minimum intensity adjustment must be repeated.

- Now a signal part of approx. 0.2 to 0.4 div. length in front of the previous signal start is displayed with reduced intensity.
- Locate and identify VR7005 (17) on Digital-Board.
- Adjust VR7005 (17) so that the signal part is displayed as a straight line without curvature.
- Disconnect the sine wave signal from input channel I.
- Briefly press HOLD pushbutton to switch this function off.
- Press and hold READOUT pushbutton to switch this function on.
- Press and hold STOR. MODE – ON/OFF pushbutton for analog operation.
- Briefly press AUTOSET pushbutton.

CRT minimum intensity:

- Set INTENS. control to fully left position (beep).
- Press and hold DUAL pushbutton for XY mode (readout: both channel deflection coefficients and XY.)
- The following adjustment should be made under shaded conditions.
- Adjust R6013 (3) so that the dot just disappears.
- Press and hold DUAL pushbutton to revert to the previous operating conditions which had been set automatically by AUTOSET.

18) VR7007: Dot Join Y Time Constant.

- Check that basic operating conditions are present.
- Press and hold STOR. MODE – ON/OFF pushbutton (front panel).
- Check that RFR mode is present.
- Connect a 25mVpp/10kHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Turn TIME/DIV knob for 20 μ s/div.
- Locate and identify VR7007 (18) on Digital-Board.
- Adjust VR7007 (18) for no overshoot or brightening on the slope.
- Disconnect the square wave signal from input channel I.

19) Y-Amplifier.

- Check that **no signal** is **applied** at the BNC connectors.
- Release POWER pushbutton (out!).
- Press and hold AUTOSET pushbutton constantly.
- Press Power pushbutton (on!).
- Wait until the headline MAIN MENU and the submenus CALIBRATE (highlighted) and SETUP are displayed on the screen.
- Release AUTOSET pushbutton.
- Press and hold SAVE pushbutton (front panel) to call CALIBRATE.
- The CALIBRATE MENU offers several items.
- The item Y AMP is highlighted.

- Press and hold SAVE pushbutton (front panel) to call Y AMP.
- This starts an automatic calibration procedure.
- After the automatic calibration procedure the readout displays the CALIBRATE MENU.
- Continue with 20), without change in operating conditions.

20) Trigger Amplifier.

- Briefly press RECALL pushbutton (front panel) to select (highlight) TRIGGER-AMP.
- Press and hold SAVE pushbutton (front panel) to call TRIGGER-AMP.
- This starts an automatic calibration procedure and the readout additionally displays WORKING.
- After the automatic calibration procedure the readout displays CALIBRATE MENU.
- Continue with 21), without change in operating conditions.

21) Analog Time Base Adjustment and Check.

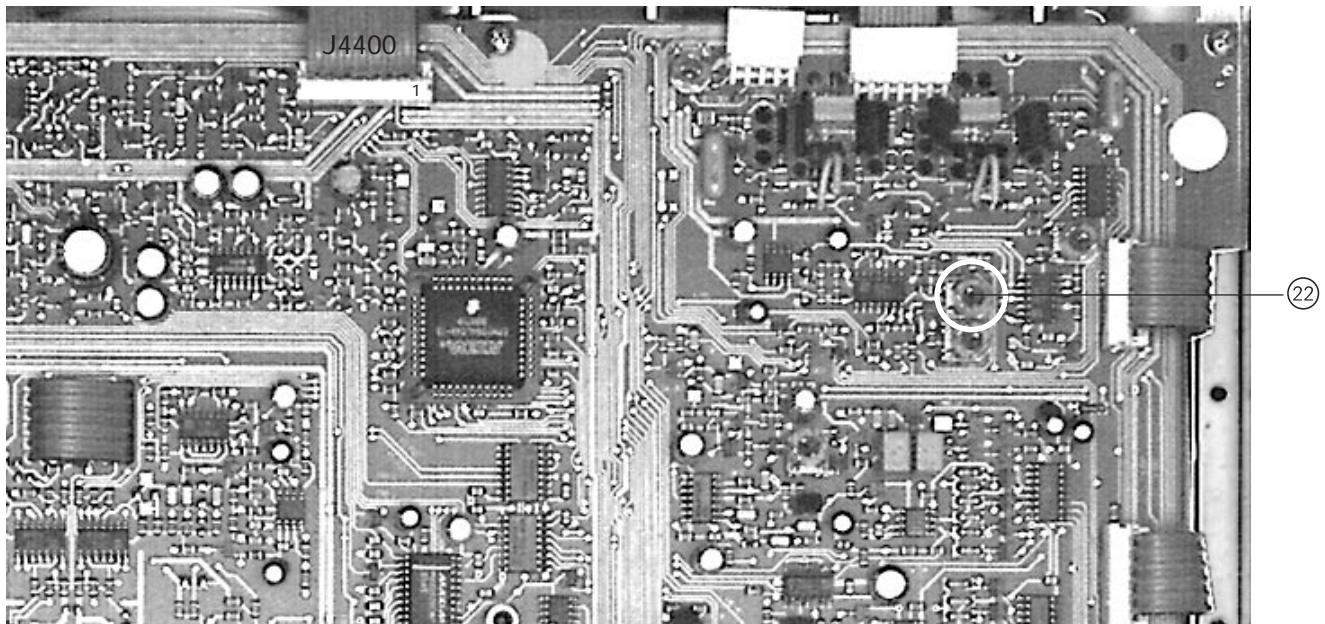
- Briefly press RECALL pushbutton (front panel) to select (highlight) the submenu SWEEP GENERATOR.
- Press and hold SAVE pushbutton (front panel) to call SWEEP GENERATOR. Then the readout displays SWEEP CAL.
- Briefly press channel II GD pushbutton to switch from ground condition to DC input coupling (readout: "CH1: 5mV=").
- Connect a suited time mark or sine wave signal to input channel II.
- Turn VOLTS/DIV knob channel II for a suited signal height (3-5 division).
- Set Y-POS. II for a reading at the horizontal center line of the graticule.
- Press and hold AT – NM pushbutton for normal triggering (NM LED on).

Time base accuracy check.

- Turn TIME/DIV knob fully clockwise (readout: 50ns).
- Set time mark generator to 50ns pulse interval or sine wave generator to 1/50ns = 20MHz.
- Move trace with X-POS. control so that the first time mark coincides with the first left graticule line of the screen.
- Theoretically the 11th time mark should coincide with the last right graticule line (0% error). Due to reading, time mark generator and temperature tolerances the 11th time mark may deviate 0.2div. (2mm) from the optimum.

Check all time deflection coefficients as described before. If an adjustment is required, proceed as described below under item " Time Base Adjustment" :

Digital-Board



Time Coefficient	Time Mark or Sine Wave Signal (frequency)
100ns/div	100ns
200ns/div	200ns
500ns/div	500ns
1µs/div	1µs
2µs/div	2µs
5µs/div	5µs
10µs/div	10µs
20µs/div	20µs
50µs/div	50µs
100µs/div	100µs
200µs/div	200µs
500µs/div	500µs
1ms/div	1ms
2ms/div	2ms
5ms/div	5ms
10ms/div	10ms
20ms/div	20ms
50ms/div	50ms
100ms/div	100ms
200ms/div	200ms
500ms/div	500ms

Time base adjustment

Note:

The instrument contains a memory in which correction values for each time coefficient are stored. The following description explains the adjustment and storing procedure.

- Move trace with X-POS. control so that the first time mark coincides with the first left graticule line of the screen.
- Press and hold DEL. TRIG. – VAR. pushbutton to switch the VAR.-LED in the TIME/DIV. sector on.
- Turn the TIME/DIV control so that the 11th time mark coincides with the last right graticule line (0% error).
- Press and hold SAVE pushbutton (SET function).
- The readout then displays "WARNING! CALBRATION OVERWRITE".
- If the SET function was called inadvertently, press AUTOSET to revert.
- Otherwise press and hold SAVE pushbutton again (SET function) to confirm the adjustment, which will be stored.
- Revert to time base accuracy check.

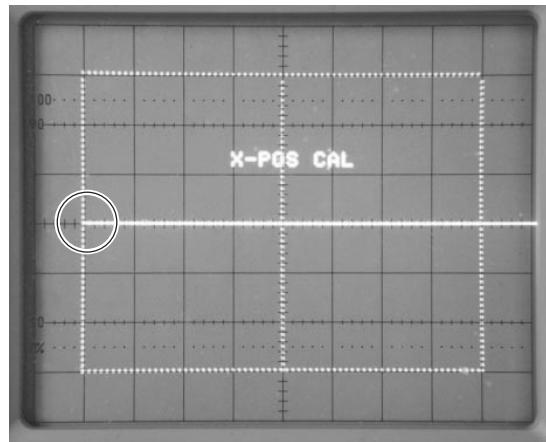
- After completion of the time base accuracy checks and adjustments, briefly press AUTOSET 3 times to revert to normal oscilloscope operation.

- Continue with 22), without change in operating conditions.

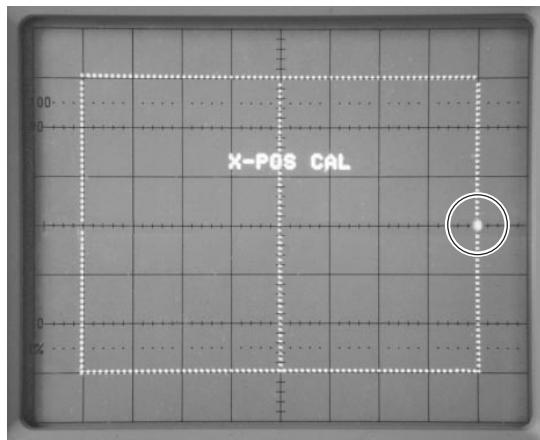
22) R4840: X-Magnification x10

- Locate and identify R4840 (22) on MB-Board.
- Press pushbutton X-Mag. x10 (x10 LED lit).
- Set time base to 500ns/div.
- Move trace with X-POS. control so that it is in center position.
- Briefly press X-MAG. pushbutton to switch the x10 LED on.
- Set time mark generator to 50ns or sine wave generator to 20 MHz.
- Using X-POS control, move the first visible time mark to the first left graticule line.
- The X-POS. control setting must be corrected during the following adjustment, so that the first time mark is always on the first left graticule line.
- Adjust R4840 (22) so that the next time mark coincides with the last (right) graticule line.

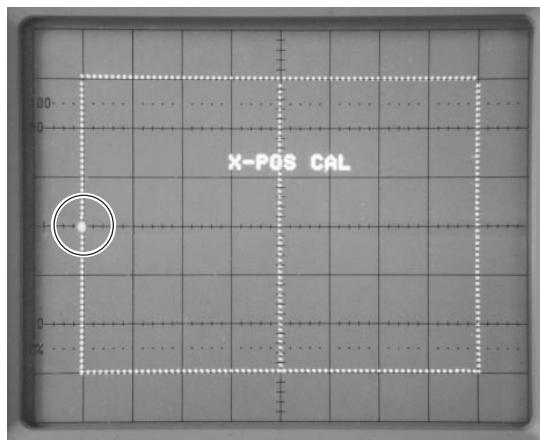
- Disconnect time mark (sine wave) signal from input.
- Briefly press AUTOSET.



(24)A



(24)B



(24)C

23) X-Gain in XY Mode.

- Release POWER pushbutton (out!).
- Press and hold AUTOSET pushbutton constantly.
- Press Power pushbutton (on!).
- Wait until the headline MAIN MENU and the submenus CALIBRATE (highlighted) and SETUP are displayed on the screen.
- Release AUTOSET pushbutton.
- Press and hold SAVE pushbutton (front panel) to call CALIBRATE.
- The CALIBRATE MENU offers several items.
- The item Y AMP is highlighted.
- Briefly press RECALL pushbutton until XY GAIN is highlighted.
- Press and hold SAVE pushbutton (SET function) to call XY GAIN.

- Then the readout displays XY-GAIN CAL and a dot is displayed.
- If the dot does not coincide with a vertical graticule line, use X-POS. control to move the dot to the next vertical line.
- The VAR-LED in the channel II VOLTS/DIV. sector is on.
- For channel II the readout displays "CHX>5mV=".
- Connect a 25mVpp/1kHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel II.
- Now 2 dots are visible on the screen.
- Turn VOLTS/DIV. control until the horizontal distance between both dots is exactly 5 division.
- Press and hold SAVE pushbutton (SET function).
- The readout then displays "WARNING! CALIBRATION OVERWRITE".
- If the SET function was called inadvertently, press AUTOSET to revert.
- Otherwise press and hold SAVE pushbutton again (SET function) to confirm the adjustment, which will be stored.
- After storing the readout displays CALIBRATE MENU.
- Disconnect signal from input channel II.

- Continue with 24), without change in operating conditions.

24) X-Position.

- Briefly press RECALL pushbutton (front panel) to highlight X-POSITION.
- Press and hold SAVE pushbutton (front panel).
- Now the trace and a rectangle with a horizontal and a vertical center line should be visible.
- Additionally the readout displays X-POS CAL.
- Check that the X and Y position of the rectangle is correct, as described under item 16).

A:

- Use X-POS. control to move the trace start on the left vertical line of the rectangle.
- Press and hold SAVE pushbutton (SET function).
- The readout then displays "WARNING! CALIBRATION OVERWRITE".
- If the SET function was called inadvertently, press AUTOSET to revert. Then X-POS CAL and the rectangle are displayed.
- Otherwise press and hold SAVE pushbutton again (SET function) to confirm the adjustment, which will be stored.

B:

Note.

Now the readout displays "XY-POS CAL", the trace is switched off and a dot is displayed.

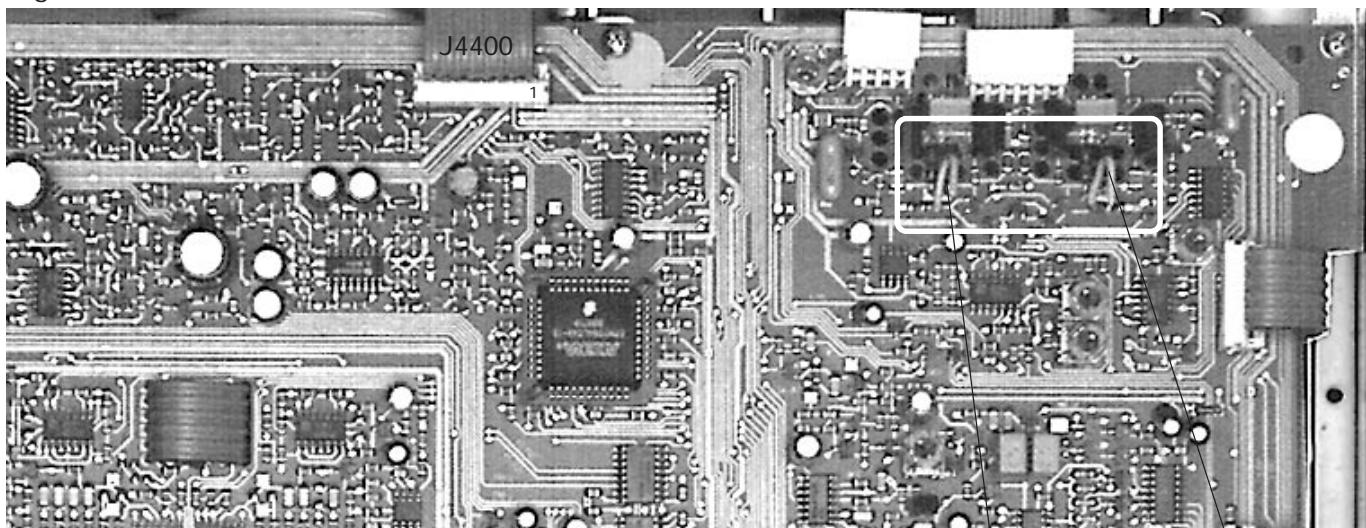
- Use X-POS. control to move the dot on the right vertical line of the rectangle.
- Press and hold SAVE pushbutton (SET function).
- The readout then displays "WARNING! CALIBRATION OVERWRITE".
- If the SET function was called inadvertently, press AUTOSET to revert. Then XY-POS CAL and the rectangle are displayed.
- Otherwise press and hold SAVE pushbutton again (SET function) to confirm the adjustment, which will be stored.

C:

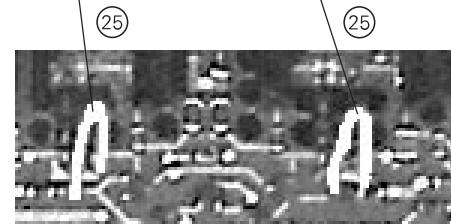
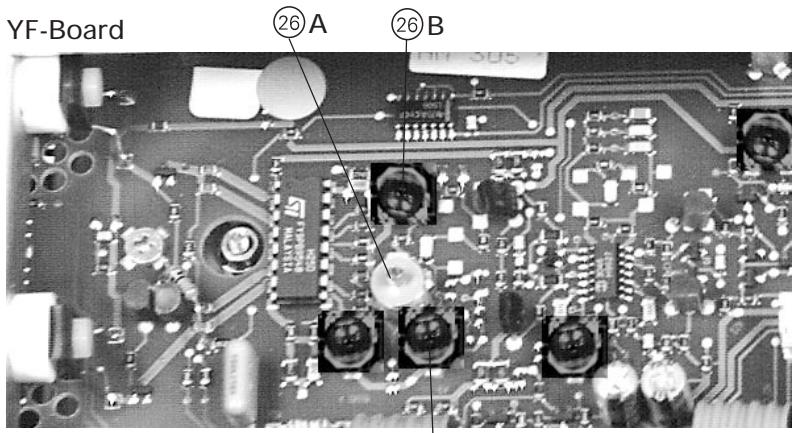
- Use X-POS. control to move the dot on the left vertical line of the rectangle.
- Press and hold SAVE pushbutton (SET function).
- The readout then displays "WARNING! CALIBRATION OVERWRITE".
- If the SET function was called inadvertently, press AUTOSET to revert. Then XY-POS CAL and the rectangle are displayed.
- Otherwise press and hold SAVE pushbutton again (SET function) to confirm the adjustment, which will be stored.

- Now the instrument is automatically set to condition "24) B".
- Repeat the adjustments "24) B" and "24) C" until maximum is achieved.
- Press AUTOSET several times until analog Yt mode is present.

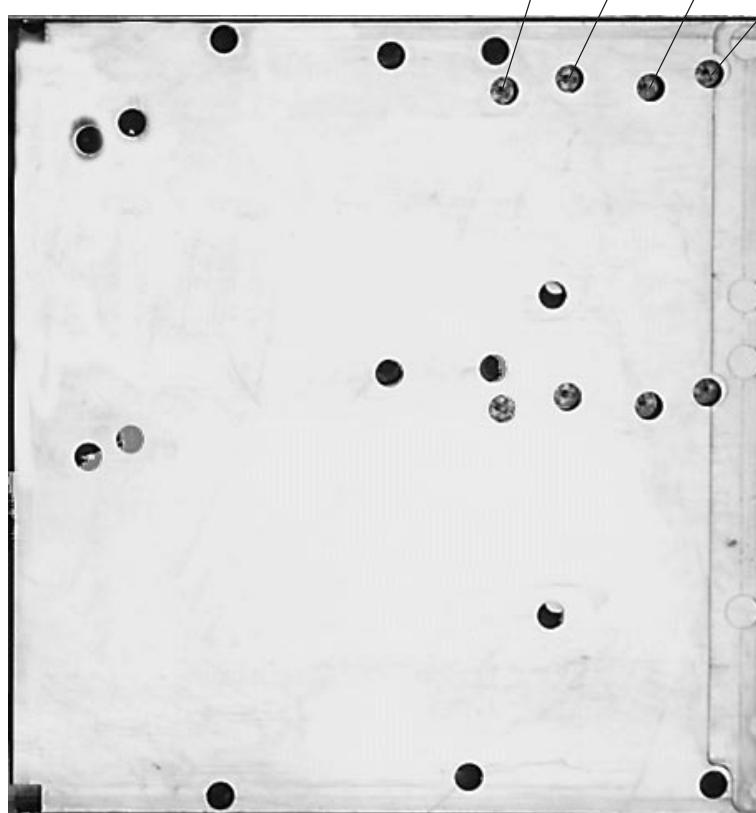
Digital-Board



YF-Board



YF-Board



25) C4809, C4810: X-Deflection Linearity.

- Press AUTOSET for basic settings.
- Turn TIME/DIV knob for time coefficient 50ns/div.
- Briefly press X-MAG. pushbutton so that the x10 LED is on (readout "T:10ns").
- Connect a 100MHz sine wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Set the sine wave generator output voltage for approx. 4 div. signal height.
- Locate and identify the wires C4809 and C4810 on Main-Board.
- Bend the wires to or from the board to adjust for 1div X-deflection per sine wave period.
- Briefly press the X-MAG. pushbutton so that the x10 LED is dark.
- Set time base to 100 μ s/div.

26) C9025 (A), R9063 (B), R9075 (C): Y-Final Amplifier Adjustment / Bandwidth Check.

- Check that channel I is switched on.
- Connect a 25mVpp/1MHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel I.
- Set time base to 200ns/div. (X-MAG x10 off).
- Check that channel I DC input coupling is present.
- Check that channel I deflection coefficient is 5mV/div.
- Locate and identify C9025 (A), R9063 (B) and R9075 (C) on YF-Board.
- Adjust all adjustment points for flat top, fast leading edge (minimum risetime) and minimum overshoot.

- Disconnect the square wave signal from input channel I.
- Briefly press CH II pushbutton.
- Connect a 25mVpp/1MHz square wave signal via 50 Ohm cable and 50 Ohm through terminator to input channel II.
- Check that the square wave is displayed in the same quality as in channel I condition.

Y-Amplifier Bandwidth Check.

- Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50-Ohm throughtermination to the input of channel II (CH2:5mV=).
- 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 adjustments of C9025 (A), R9063 (B), R9075 (C), if the frequency reading on the generator shows a value less than 35MHz.

- Briefly press CH I pushbutton.
- Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50-Ohm throughtermination to the input of channel I (CH1:5mV=).
- 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 of C9025 (A), R9063 (B), R9075 (C), if the frequency reading on the generator shows a value less than 35MHz.

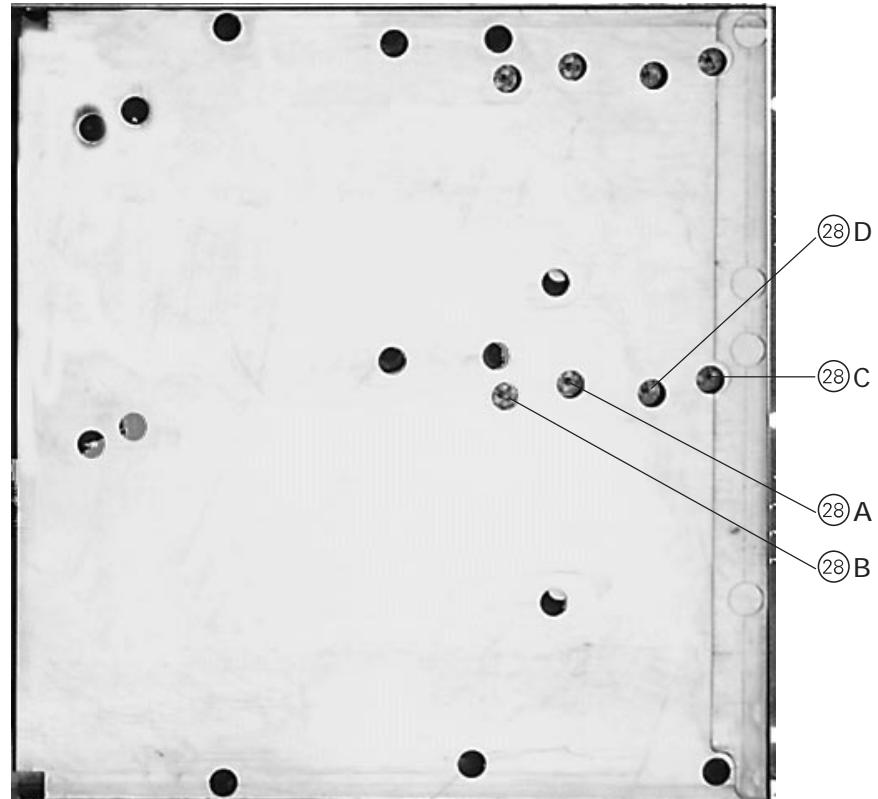
-Briefly press AUTOSET for basic settings.

27) C2009 (A), C2013 (B), C2007 (C), C2012 (D): Attenuator Compensation CH I.

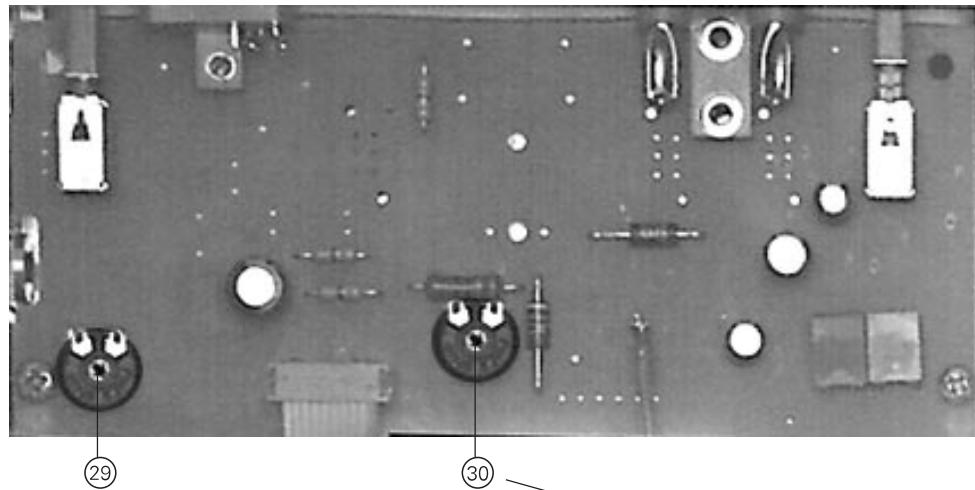
- Set time base to 200 μ s/div. (X-MAG x10 off).
- Check that the readout displays "CH1:5mV=".
- Set amplitude calibrator to 1kHz, connect the generator output via a 50 Ohm cable, a 50 Ohm through terminator and a 2:1 pre-attenuator to input CH I.
- Set calibrator output voltage to 50mVpp at 50 Ohm (25mVpp at the 2:1 pre-attenuator output).
- Check for 5 divisions signal height .
- Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.

- Turn channel I VOLTS/DIV control for 50mV/div.
- Set calibrator output voltage to 500mVpp at 50 Ohm (250mVpp at the 2:1 pre-attenuator output).
- Locate and identify C2009 (A) and C2013 (B) on AT-Board channel I section.
- Adjust C2009 (A) for flat top and C2013 (B) for no over and undershoot.

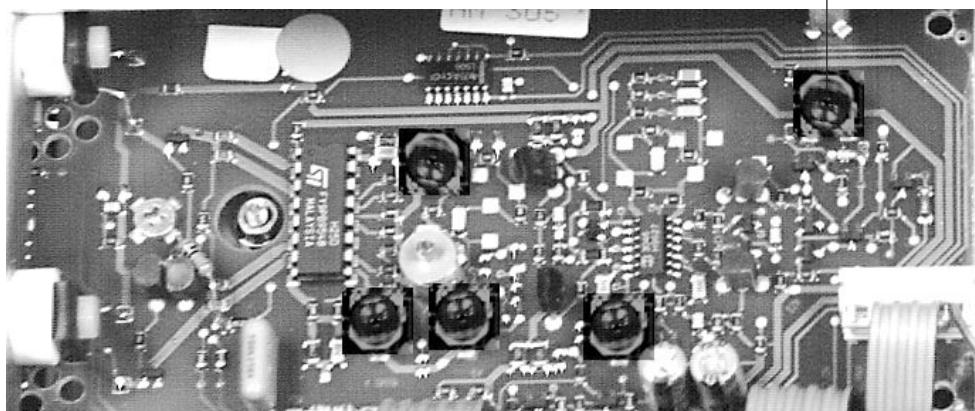
YF-Board



CT-Board



YF-Board



- Turn channel I VOLTS/DIV control for 500mV/div.
- Set calibrator output voltage to 5Vpp at 50 Ohm (2.5Vpp at the 2:1 pre-attenuator output).
- Locate and identify C2007 (C) and C2012 (D) on AT-Board channel I section.
- Adjust C2007 (C) for flat top and C2012 (D) for no over and undershoot.
- Disconnect the square wave signal from input channel I.
- Briefly press AUTOSET for basic settings.

28) C2209 (A), C2213 (B), C2207 (C), C2212 (D): Attenuator Compensation CH II.

- Briefly press CH II pushbutton.
- Set time base to 200 μ s/div. (X-MAG x10 off).
- Check that the readout displays "CH2:5mV=".
- Set amplitude calibrator to 1kHz, connect the generator output via a 50 Ohm cable, a 50 Ohm through terminator and a 2:1 pre-attenuator to input CH II.
- Set calibrator output voltage to 50mVpp at 50 Ohm (25mVpp at the 2:1 pre-attenuator output).
- Check for 5 divisions signal height .
- Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.
- Turn channel II VOLTS/DIV control for 50mV/div.
- Set calibrator output voltage to 500mVpp at 50 Ohm (250mVpp at the 2:1 pre-attenuator output).
- Locate and identify C2209 (A) and C2213 (B) on AT-Board channel II section.
- Adjust C2209 (A) for flat top and C2213 (B) for no over and undershoot.
- Turn channel II VOLTS/DIV control for 500mV/div.
- Set calibrator output voltage to 5Vpp at 50 Ohm (2.5Vpp at the 2:1 pre-attenuator output).
- Locate and identify C2207 (C) and C2212 (D) on AT-Board channel II section.
- Adjust C2207 (C) for flat top and C2212 (D) for no over and undershoot.
- Disconnect the square wave signal from input channel II.
- Briefly press CH I pushbutton.
- Briefly press AUTOSET for basic settings.

29) VR8940: Calibrator Output.

- Locate and identify VR8940 (29) on CT-Board.
- Connect a digital multimeter to the 0.2Vpp calibrator output and calibrator ground.
- Set up the digital multimeter for DC measurement on a suitable sensitivity setting.
- Adjust VR7006 (31) for exactly 100mV \pm 1mV DC.
- Connect a 10:1 probe to the 0.2Vpp calibrator output and connect it to the CH I input of the scope.
- Set time base to 200 μ s/div.
- Now approximately 2 signal periods should be visible on the screen.
- Press 1kHz/1MHz pushbutton (in!).
- Set time base to 200ns/div.
- Check 1MHz calibrator signal.

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

30) R9004, RV4322: Component Tester Position.

- Briefly press COMP. TESTER – ON/OFF pushbutton to select component tester mode (readout: CT).
- Check that component tester socket is not connected externally to ground.
- The following adjustments require normal operating conditions to reduce the influence of the earth magnetic field to a minimum.
- Locate and identify R9004 on YF-Board.
- Adjust R9004 to move CT trace (approx. 8 div length) to the screen center.
- Locate and identify RV4322 on CT-Board.
- Adjust RV4322 for trace which is parallel to the horizontal graticule line.
- Connect the component tester socket via a wire (0 Ohm) to ground.
- Check that the CT trace is now displayed as a vertical line (approx. 6 div. height).
- Briefly press COMP. TESTER – ON/OFF pushbutton to switch component tester mode off.

31) Store Amplifier.

- Release POWER pushbutton (out!).
- Press and hold AUTOSET pushbutton constantly.
- Press Power pushbutton (on!).
- Wait until the headline MAIN MENU and the submenus CALIBRATE (highlighted) and SETUP are displayed on the screen.
- Release AUTOSET pushbutton.
- Press and hold SAVE pushbutton (front panel) to call CALIBRATE.
- The CALIBRATE MENU offers several items.
- The item Y AMP is highlighted.
- Briefly press RECALL pushbutton until STORE AMP is highlighted.
- Check that no signal is applied at the inputs.
- Press and hold SAVE pushbutton (SET function) to call STORE AMP.
- This starts an automatic adjustment procedure which is indicated by "WORKING".
- After the adjustment the readout displays CALIBRATE MENU.
- Briefly press AUTOSET pushbutton several times until normal oscilloscope operation is present.
- Briefly press CH I pushbutton.

32) Trigger Filter Check.

- Set time base to 1ms/div.
- Connect a 1kHz sinewave signal of 25mVpp amplitude to input CH I and check for full screen deflection.
- Set input attenuator CH I to 50mV/div and check for 5mm display height.
- Select trigger coupling AC, DC, HF and LF.
- Except in HF trigger coupling condition, the signal must always trigger the oscilloscope.
- Set time base to 20µs/div.
- Set sinewave generator to 50kHz and 25mV output amplitude and check for 5mm display height.
- Select trigger coupling from AC, DC, HF and LF.
- Except in LF trigger coupling condition, the signal must always trigger the oscilloscope.

33) Trigger Bandwidth Check.

- Set time base to 50ns/div.
- Connect a 100MHz sinewave signal to input CH I.
- Adjust generator output for 5mm display height.
- The signal must be triggered.

34) External Trigger Check.

- Set time base to 20µs/div.
- Set input attenuator CH I to 100mV/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 trigger LEVEL to electrical midrange position.
- Check that the trigger ("TR") LED is lit.
- Briefly press TRIG. pushbutton until "EXT" -LED is on.
- The "TR" (trigger indicator) LED now must be dark.
- Remove signal cable from input CHI.
- Connect the signal cable to the TRIG. EXT. socket.
- Now the "TR" -LED must lit.



Service Manual Interface commands

*For Oscilloscope: HM305-2,
HM404, HM407, HM1004-2,
HM1505-2, HM1507, HM1507-2*

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Description of interface commands

Valid for oscilloscopes:

HM305-2, HM404, HM407, HM1004-2, HM1505-2, HM1507, HM1507-2

RS-232 cable

A 9 conductor serial interface cable (1:1 connection, i.e. without crossed pin connections) will be required to connect the oscilloscope to an external instrument.

Setting the baud rate

The RS 232 interface must be initialized before use. This is effected by the first transmission of SPACE CR (20 hex., 0D hex.) after POWER UP (*switching on*). This will automatically set the baud rate.

The following baud rates will be recognized:

110 Baud	4800 Baud
150 Baud	9600 Baud
300 Baud	19200 Baud
600 Baud	38400 Baud ^(1.19)
1200 Baud	56700 Baud ^(1.19)
2400 Baud	115200 Baud ^(1.19)

Data transmission format: No parity, data length 8 bits,
2 stop bits, RTS/CTS handshake.

If the PC has a COM interface with FIFO buffer, then the maximum depth of the send buffer must be set to 8 bytes.

The baud rate set will remain operative until POWER DOWN (*switch off*) or until the remote mode is disabled with the command 'RMO', or until the pushbutton LOCAL (AUTOSET button) is activated, assuming this is not inhibited (LK=0).

Once the remote mode is disabled, the data transmission can be only restored by again sending SPACE CR.

If the oscilloscope does not recognize SPACE CR as first characters, or if Low-level exists on the RTS line longer than for about 2 seconds, then the oscilloscope exits the remote mode and sets the TxD Low for about 0.3s and thus generates a frame error.

The oscilloscope answers with a RETURNCODE (0 CR LF) if it has recognized SPACE CR and has set the baud rate.

The scope sends 'ESC RMLK=0' (ESC=1B hex.) and exits the Remote state if the button LOCAL is activated in Remote-ON state. The time between the reception of the RETURNCODE Remote-OFF and Remote-ON must be at least

$$t_{min} = 2 * (1 / \text{Baudrate}) + 60\mu\text{s}$$

Data transmission

After successfully setting the baud rate, the oscilloscope is in Remote state and is ready to accept commands. The commands can be in capital or lower case. The commands can be divided into two basic groups:

Interrogation of parameters

This group of commands is distinguished by a question mark at the end of the command. When such a command is transmitted to the scope, it answers by repeating the syntax followed by a colon and the parameters asked for. These can be binary or ASCII data depending on the command. The number of data bytes to be received is dependent on the command and can be seen from the command description.

Example: Command to the scope: VERS?
 Answer: VERS:FC1.01 DG1.02

Set parameter

The parameters of the scope can be influenced with this command. Here commands with and without parameter can be differentiated.

Example: Command to the scope: LK=1
 Answer: RETURNCODE

Example: Command to the scope: RES
 Answer: RETURNCODE

All commands are answered either with parameters or with a RETURNCODE in ASCII format (see description of commands). One must wait for all parameters or RETURNCODE for the previous command before a new command can be sent to the scope.

WORD-parameters require first the low byte and then the high byte. The setting of the scope is effected over the instrument data field (DeviceDataField DDF) as *binary array*. Each byte of this data field can also be accessed by individual commands.

The following tables show the build up of the instrument data field and the corresponding individual commands.

Definition of characters for the commands

Interrogation	?	Interrogates for parameters
Assign	=	Set parameter
State	:	Gives current parameter
Binary data	b	Data field is binary data of 1 byte
ASCII data	a	Data field is ASCII data of 1 Byte
WORD (2 bytes)	w	Data field consists of 2 bytes (low and high bytes)
ASCII data	ARRAY	Data field is ASCII data
Binary data	array	Data field is binary data
Terminating character	CR LF	Carriage return and/or Line feed
RETURNCODE	R	ASCII parameter
Parameter	x	x stands for A or B
Parameter	z	z stands for 1 or 2

Table of commands:

Command: PC -> Scope	Acknowledgment Scope -> PC	Description
AUTOSET	(R CR LF)	AUTO SET function will be carried out
AVRNM? ⁽³⁾	AVRNM:(b)	AVERAGE NUMBER OF ACQUISITIONS Delivers the number of acquisitions carried out for averaging b = 01 hex.: 2^1 = 2 acquisitions b = 02 hex.: 2^2 = 4 acquisitions ... b = 09 hex.: 2^9 = 512 acquisitions
AVRNM=(b) ⁽³⁾	(R CR LF)	AVERAGE NUMBER OF ACQUISITIONS Sets the number of acquisitions to be carried out for averaging
AVRNMSW? ⁽³⁾⁽⁵⁾	AVRQTSW:(a)	AVERAGE NUMBER OF ACQUISITIONS SWITCH Delivers the function of the Store Up/Down buttons a = 0: Store Up/Down buttons change Store Mode a = 1: Store Up/Down buttons change Average Number of Acquisitions
AVRNMSW=(a) ⁽³⁾⁽⁵⁾	(R CR LF)	AVERAGE NUMBER OF ACQUISITIONS Sets Average Number of Acquisition Switch
BELL=(a)	(R CR LF)	Tone output a = 0: Buttons OK tone a = 1: Buttons ERROR tone a = 2: ERROR (longer tone) a = 3: 2 short tones a = 4: 3 short tones a = 5: 6 short tones
CH<z>?	CH<z>:(b)	Delivers CH1/2 settings see table of instrument fields DDF
CH<z>=(b)	(R CR LF)	Sets CH1/2 settings see table of instrument fields DDF
CH<z>VAR?	CH<z>VAR:(b)	Delivers CH1/2 VARI-GAIN setting b = FF hex.: CH<z> (1 or 2) calibrated
CH<z>VAR=(b)	(R CR LF)	Sets CH1/2 VARI-GAIN setting
CTRLBP?	CTRLBP:(a)	Delivers CONTROL BEEP setting a = 0: Off (key activation without control tone) a = 1: On
CTRLBP=(a)	(R CR LF)	Sets CONTROL BEEP setting
DDF?	DDF:(array)	Delivers DEVICE DATA FIELD see table of instrument fields (4 bytes of commands + 14 bytes of parameters)
DDF=(array)	(R CR LF)	Sets new DEVICE DATA FIELD see table of instrument fields DDF

DDF1?	DDF1:(array)	Delivers DEVICE DATA FIELD1 see table of instrument fields DDF1 (5 bytes of commands + 16 bytes of parameters.)
DDF1=(array)	(R CR LF)	Sets new DEVICE DATA FIELD1 see table of instrument fields DDF1
DELPOS?	DELPOS:(w)	Delivers DELAY POS.(12 Bit) w = 000 hex.: Shortest DELAY time
DELPOS=(w)	(R CR LF)	Sets DELAY POS.(12 bit)
ERRBP?	ERRBP:(a)	Delivers ERROR BEEP setting a = 0: Off (no error tone output) a = 1: On (with error tone output)
ERRBP=(a)	(R CR LF)	Sets ERROR BEEP
ERRMSGE?	ERRMSGE:(a)	Delivers ERROR MESSAGE setting a = 0: Off (Error messages are only sent to the interface) a = 1: On (Error messages are displayed with Read out and also sent to the interface)
ERRMSGE=(a)	(R CR LF)	Sets ERROR MESSAGE setting
FCCMD? ^(1,1)	FCCMD:(a)	FRONT CONTROLLER COMMAND Informs whether the scope has been manually operated. Will be reset after each interrogation.. a = 0: Scope has not been manually operated. a = 1: Scope has been operated manually (in the mean time).
HLD<z>POS? ⁽³⁾	HLD<z>POS:(b)	Delivers HOLD 1/2 POSITION Y-offset carried out after HOLD referred to Store position. b = 00 hex.: Position shifted maximum upwards.
HLD<z>POS=(b) ⁽³⁾	(R CR LF)	Sets HOLD 1/2 POSITION
HOLDOFF?	HOLDOFF:(b)	Delivers HOLD OFF value b = 00 hex.: Shortest Hold off time
HOLDOFF=(b)	(R CR LF)	Sets HOLD OFF value
HORMODE?	HORMODE:(b)	Delivers HORIZONTAL MODE setting see table of instrument fields DDF
HORMODE=(b)	(R CR LF)	Sets HORIZONTAL MODE setting see table of instrument fields DDF
HLDWFM? ⁽³⁾	HOLDWFM:(a)	HOLD WAVE FORM Delivers HOLD function setting in Store mode a = 0: Off (HOLD switched off) a = 1: On (HOLD switched on)
HLDWFM=(a) ⁽³⁾	(R CR LF)	HOLD WAVE FORM Sets HOLD setting

ID?	ID: (ARRAY)(CR LF)	IDENTIFICATION (Hardware) Delivers instrument name and hardware identification bytes (3 bytes of commands + 27 bytes of parameters)
INT<x>?	INT<x>:(b)	Delivers INTENS A/B ⁽⁹⁾ value b = 00 hex.: Trace blank timebase <x> (A or B) ⁽⁹⁾
INT<x>=(b)	(R CR LF)	Sets INTENS A/B ⁽⁹⁾ value
INTRO?	INTRO:(b)	Delivers INTENS READ OUT value b = 00 hex.: Read out blanked
INTRO=(b)	(R CR LF)	Sets INTENS READ OUT value
LK?	LK:(a)	Delivers the function of LOCAL LOCK OUT key (AUTO SET) a = 0: Locked a = 1: Free (The Remote mode will be exited on activation of the AUTOSET button and 'RMLK=0' will be sent to the interface)
LK=(a)	[R](CR LF)	Setting the LOCAL LOCK OUT function
PSINT?	PSINT:(a)	Delivers PULSE SWITCH INTENS function of the rotary control: INTENS a = 0: INT A (Intens. trace A) a = 1: INT RO (Intens. Read out) a = 2: INT B (Intens. trace B) ⁽⁹⁾
PSINT=(a)	(R CR LF)	Sets PULSE SWITCH INTENS function of the rotary control: INTENS
PSY1POS?	PSY1POS:(a)	Delivers PULSE SWITCH Y 1 POSITION function of the rotary control: Y-POS. I a = 0: Y1 Position setting a = 3: Y Position setting of timebase B (Trace sep.) in alternating timebase mode ⁽⁹⁾
PSY1POS=(a)	(R CR LF)	Sets PULSE SWITCH Y 1 POSITION (function of the rotary control: Y-POS. I)
PSY2POS?	PSY2POS: (a CR LF)	Delivers PULSE SWITCH Y 2 POSITION function of the rotary control: Y-POS. II a = 0: Y2 Position setting
PSY2POS=(a)	(R CR LF)	Sets PULSE SWITCH Y 2 POSITION function of the rotary control: Y-POS. II
PSTB?	PSTB:(a)	Delivers PULSE SWITCH TB function of the rotary control: TIME/DIV. a = 0: COARSE (1-2-5 sequence) a = 1: FINE (variable, depending on the timebase mode A or B)
PSTB=(a)	(R CR LF)	Sets PULSE SWITCH TB function of the rotary control: TIME/DIV.

PSCH<z>?	PSCH<z>:(a)	Delivers PULSE SWITCH CH1/2 function of the rotary control: VOLTS/DIV (CH I or CH II) a = 0: CHI or II COARSE (1-2-5 sequence) a = 1: CHI or II FINE (variable)
PSCH<z>=(a)	(R CR LF)	Sets PULSE SWITCH CH1/2 function of the rotary control: VOLTS/DIV (CH I or CH II)
QUICKST? ^(1.05)	QUICKST:(a)	Delivers QUICK START MODE a = 0: QUICK START off a = 1: QUICK START on
QUICKST=(a) ^(1.05)	(R CR LF)	Sets QUICK START MODE
RDWFM<z>: (w w) ⁽³⁾ ⁽⁷⁾ 1st WORD Offset hex. (2 Kbytes) 2nd WORD length hex. (2 Kbytes)	RDWFM<z>: (W W array) ⁽⁷⁾	READ WAVE FORM 1/2 Delivers signal data of channel <z> (1 or 2), from Offset address (first WORD) with the given length (second WORD) Offset + length max. 2 Kbytes Complete transmission from channel 1: Offset = 0, length = 2048 dec. (2 Kbytes) 'RDWFM1:00000008' (figures in hex.) Data from the right half of the signal of channel 2: Offset = 1024 dec., length = 1024 dec. 'RDWFM2:00040004' (figures in hex.)
READOUT?	READOUT:(a)	Delivers READ OUT setting a = 0: Read out off a = 1: Read out on
READOUT=(a)	(R CR LF)	Sets READ OUT setting
RDREF<z>: (w w) ⁽³⁾ ⁽⁷⁾ 1st WORD Offset hex. (2 Kbytes) 2nd WORD length hex. (2 Kbytes)	RDREF<z>: (W W array) ⁽⁷⁾	READ REFERENZ 1/2 Delivers Signal data from Reference store <z> (1 or 2), from Offset address (first WORD) with given length (second WORD) Offset + length max. 2 Kbytes See 'RDWFM<z>'
RECDF=(a)	(R CR LF)	RECALL DDF Reads instrument data field of "SAVE/ RECALL-Store" (a = 1 ... 9) and sets the scope accordingly.
REF<z>POS? ⁽³⁾	REF<z>POS:(b)	Delivers REF 1/2 POSITION Y Position of the reference traces in Digital mode b = FF hex. REF<z> shifted max. upwards
REF<z>POS=(b) ⁽³⁾	(R CR LF)	Sets REF 1/2 POSITION

REF<z>PRE? ⁽³⁾	REF<z>PRE: (array)	REFERENZ 1/2 PREAMBLE Sets the scope in the state in which the reference traces were stored. Besides, information will be sent to the PC. array: 1st WORD: Memory address at the time of triggering 2nd WORD: X resolution = 200 bit/DIV 3rd WORD: Y resolution = 25 bit/DIV 4th WORD: Y1 standardized position based on the value of WORD 3 (Integer value) 5th WORD: Y2 standardized position based on the value of WORD 3 (Integer value)
RES(CR LF) ⁽²⁾	(R CR LF)	Sets RESET function in SINGLE mode
RMO(CR LF)	(R CR LF)	REMOTE Exit remote mode
RREFPRE ⁽³⁾	(R CR LF)	RECALL REFERENZ PREAMBLE Sets the scope in the state in which the current acquisition was stored as reference. (HM1507/1507-2: The REF1 preamble will be loaded if both traces are switched on.)
RODDF?	RODDF:(array)	Delivers READ OUT DEVICE DATA FIELD (RO device data field) (6 bytes of commands + 10 bytes of parameters) See table read out data field RODDF
RODDF=(array)	(R CR LF)	Sets new READ OUT DEVICE DATA FIELD (RO device data field)
SAVEDF=(a)	(R CR LF)	SAVE DEVICE DATA FIELD Stores the current instrument settings in the "SAVE/RECALL-Store" in memory position a (a = 1 ... 9)
SAVREF<z> (CR LF) ⁽³⁾	(R CR LF)	SAVE REFERENZ 1/2 In STORE MODE, stores the current signal data in reference store <z> (1 or 2)
STRMODE? ⁽³⁾	STRMODE:(b)	Delivers STORE MODE see table of instrument fields DDF
STRMODE=(b) ⁽³⁾	(R CR LF)	Sets STORE MODE see table of instrument fields DDF
TB<x>?	(R CR LF)	TIMEBASE A/B Sets timebase A/B setting see table of instrument fields DDF
TB<x>=(b)	TB<x>:(b)	TIMEBASE A/B Delivers timebase A/B setting see table of instrument fields DDF

TB< x >VAR?	TB< x >VAR:(w)	Delivers TIMEBASE A/B VAR setting (10 bits) w = 000 hex.: TB< x > (A or B) calibrated w = 001 .. 3FF hex.: TB< x > uncalibrated
TB< x >VAR=(w)	(R CR LF)	Sets TIMEBASE A/B VAR setting (10 bit)
TRIG?	TRIG:(b)	Delivers TRIGGER parameter see table of instrument fields DDF
TRIG=(b)	(R CR LF)	Sets TRIGGER parameter see table of instrument fields DDF
TRSEP? ⁹	TRSEP:(b)	Delivers TRACE SEP. Y position of the timebase B referred to the Y position of the timebase A b = 00 hex.: B maximum above A b = FF hex.: B maximum below A b = 80 hex.: Y position of B = Y position of A
TRSEP=(b) ⁹	(R CR LF)	Sets TRACE SEP.
TRGSTA?	TRGSTA:(b) TRGSTA:(a) ^(1.17)	Delivers TRIGGERSTATUS a(or b) = 0: Instrument does not trigger a(or b) = 1: Instrument triggers a(or b) = 2: Instrument is in SINGLE RESET MODE or, acquisition not yet terminated.
TRGSTA(CR LF)	(R CR LF)	TRIGGERSTATUS Reset Automatic monoflop (\approx 200ms) Enables immediate interrogation with 'TRGSTA?'.
TRGVAL?	TRGVAL:(array)	Delivers trigger signal voltage value (measured at the trigger amplifier) TRIGGERVALUE array: 16 Bit INTEGER; 1st WORD: Positive peak value 2nd WORD: Negative peak value 3rd WORD: Peak to peak value 4th WORD: DC trigger working point (reference value) Weighting : - WORD 1-3 : ca. 20mV/LSB - WORD 4 : ca. 5mV/LSB and 250mV/DIV (2.00: 1st WORD: Positive peak value 2nd WORD: Negative peak value 3rd WORD: Mean arithmetic value 4th WORD: Reserved Weighting: 1000 Bit/DIV
TRGLEV< x >?	TRGLEV< x >:(w)	Delivers TRIGGER-LEVEL A/B setting (10 bits) w = 3FF hex.: max. positive (right limit) w = 000 hex.: max. negative (left limit)
TRGLEV< x >=(w)	(R CR LF)	Sets TRIGGER-LEVEL A/B setting (10 bits)

VERMODE?	VERMODE:(b)	Delivers VERTICAL MODE (vertical setting) see table of instrument fields DDF
VERMODE=(b)	(R CR LF)	Sets VERTICAL MODE (vertical setting) see table of instrument fields DDF
VERS?	VERS:(ARRAY)	Delivers SOFTWAREVERSIONs 5 bytes of commands + 15 bytes of parameters
WFMPRE? ³	WFMPRE:(array)	WAVE FORM PREAMBLE Delivers Data for the stored traces array: 1st WORD: Memory address at the time of trigger 2nd WORD: X resolution = 200 bit/DIV 3rd WORD: Y resolution = 25 bit/DIV 4th WORD: Y1 position standardized on the value of WORD 3 (integer value) 5th WORD: Y2 position standardized on the value of WORD 3 (integer value)
WRREF<z>: ³ ((w w array) 1st WORD Offset hex. (2 Kbytes) 2nd WORD length hex. (2 Kbytes)	(R CR LF)	WRITE REFERENZ 1/2 writes signal data into the reference store <z> (1 or 2), from offset address (first WORD) with given length (second WORD) Offset + length max. 2 Kbytes See 'RDWFM<z>'
XPOS?	XPOS:(w)	Delivers X-POSITION setting (10 bits) w = 3FF hex.: "right limit" w = 000 hex.: "left limit" (1.1: 16 Bit INTEGER value in two's complement referred to graticule center (1000 bits/DIV) ¹⁰)
XPOS=(w)	(R CR LF)	Sets X-POSITION setting (10 bits) (1.1: (16 Bit INTEGER))
Y<z>POS?	Y<z>POS:(w)	Y 1/2 POSITION Delivers CH<z> (1 or 2) position setting (10 bits) w = 3FF hex.: Y position maximum upwards w = 000 hex.: Y position maximum downwards (1.1: 16 Bit INTEGER value in twos complement referred to graticule center (1000 bits/DIV) ¹⁰)
Y<z>POS=(w)	(R CR LF)	Y 1/2 POSITION Sets CH<z> (1 or 2) position setting (10 bits) (1.1: (16 Bit INTEGER))

All commands will be internally checked for any conflicts and protocoled in RETURNCODE.
The following RETURNCODES (ASCII characters) have been implemented:

0 = no error
1 = syntax error
2 = data error
3 = buffer overflow
4 = bad data set
5 = adjustment error
6 = timing error (internal data transmission FC /STORE)

Instrument data field (DDF)

	D7	D6	D5	D4	D3	D2	D1	D0								
CH1	GND	AC	INV1	ON	VOLT/DIV - Counter 0-13 0000(1mV/DIV)...1101(20V/DIV)											
CH2	GND	AC	INV2	ON	VOLT/DIV - Counter 0-13											
VERMODE	Alt.-TRG	Probe CH1: 0 = 1:1 1 = 10:1	0	CHOP	ADD	Probe CH2: 00 = CH1 01 = CH2 1x = EXT										
TBA	0	0	ANA SING	MODE Analog: Store: ⁽³⁾ Store XY: ⁽³⁾ Store ROLL: ⁽³⁾	TIME/DIV – Counter 00hex. - 15hex.{SEA:11hex} 50ns/DIV - 0,5s/DIV{SEA:20ms} 04{03 ⁽⁸⁾ }hex. - 1Chex 1µs{500ns ⁽⁸⁾ }DIV - 100s/DIV 06{05 ⁽⁸⁾ }hex. - 1Chex 40MS{100MS ⁽⁸⁾ }s - 2S/s 12hex. - 1Chex 50MS/s - 100S/s											
TBB	B +/- (1=neg. Trigger- edge)	B-TR	0	MODE Analog: Store: ⁽³⁾	TIME/DIV – Counter 00hex. - TBA(max.11hex.) 50ns - TBA(max.20ms/DIV) 04{03 ⁽⁸⁾ }hex. - TBA(max.11hex.) 1µs{500ns ⁽⁸⁾ }DIV - TBA(max.20ms/DIV)											
HORMODE	CT (Components- tester)	XY	x10	STORE ⁽³⁾	0	TB-MODE HM1004-2/1505-2 HM305-2 HM1507/1507-2 HM404/407 000: TBA TBA 001: TBA + TBB reserv. 010: TBA alt.TBB SEARCH 011: TBB DELAY TRG										
TRIG	+/- (1=neg Trigger- edge)	0	P-P	NORM	0	Kopplung 0-7 HM1004-2/1505-2 HM305-2 HM1507/1507-2 HM404/407 000: AC AC 001: DC DC 010: HF HF 011: NR LF 100: LF TVLine 101: TVLine TVField 110: TVField LINE 111: LINE reserv.										
STRMODE ⁽³⁾	REF2	REF1	PRE TRIGGER 000 = -75% 001 = -50% 010 = -25% 011 = 0% 100 = 25% 101 = 50% 110 = 75% 111 = 100%			STOREMODE 000 = REF 001 = SGL 010 = ROL (TB=100s..50ms) 011 = ENV 100 = AVR										
CH2 VAR	8-BIT															
CH1 VAR	8-BIT															
TRSEP ⁽⁹⁾	8-BIT															
HOLD OFF	8-BIT															
INTENS A	8-BIT															
INT B ⁽⁹⁾	8-BIT															

Instrument data field 1 (DDF1)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
TR A LEV	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X
TB A VAR	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X
X POS	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
Y2 POS	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
Y1 POS	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
TR B LEV	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X
TB B VAR	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X
DEL POS	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X

Read out data field (RODDF)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
CURSOR MODE	0	0=CH1 1=CH2	0	0=X 1=Y	1=Trk	0dt 1=f	0	1=Crs On	I	N	T	-	R	O	U	T
CURSOR X active	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
CURSOR X passive	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
CURSOR Y active	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X
CURSOR Y passive	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	(1.1)	X	X	X	X	X	X	X	X	X	X

- (1.05) From FC-Version 1.05
 (1.1) From FC-Version 1.10
 (1.17) From FC-Version 1.17
 (1.19) From FC-Version 1.19
 (2.00) From FC-Version 2.00
 (2) Analog SINGLE MODE: RES = 1 -> Prepares for a trigger event
 STORE MODE: RES = 1 -> Starts the digital acquisition anew.
 (Exception SINGLE Mode: Trigger event necessary)
 (3) Only in Analog / Digital Scope
 (4) The data will be loaded in an EEPROM. This consists of only a limited number ($\geq 1\,000\,000$) of program cycles. Therefore this command should not be used too often unnecessarily.
 (5) This function will be reset after a counter has run down (ca. 5s). Each further output before the end of the interval sets the counter anew and thus prolongs the time until reset.
 (6) The maximum interval permitted between the transmission of each trace byte is 2s, otherwise the scope will exit the remote state.
 (7) Valid for FC-Versions lower 1.05:
 For (w w) stands (w,w); comma as ASCII character.
 For (w w array) stands (w,w:array); comma and colon as ASCII character.
 (8) Only HM1507 and HM1507-2
 (9) Only for instruments with 2 timebases.
 (10) 16 Bit INTEGER value in two's complement based on the graticule center (1000 bit/DIV).
 Ex. 1: Set Y position to graticule center Output: 0 dec. = 0 hex.
 Ex. 2: Set Y position to +1 division Output: 1000 dec. = 3E8 hex.
 Ex. 3: Set Y position to -1 division Output: 64536 dec. = FC18 hex.

Examples

Some examples, with detailed explanations regarding the command, are given below.
Most of the commands are terminated with CR (ENTER)= 0Dhex and LF = 0Ahex. Also, the scope terminates each acknowledgment string with these characters.
The command parameters (given in brackets) may be ASCII characters (a), or binary values (b).

BELL=(a)

Explanation: This command outputs the tone 2.

String to scope: BELL=2 CR

Character sequence in hex representation: 42 45 4C 4C 3D 32 0D

Answer from scope: 0 CR LF

Answer from scope in hex representation: 30 0D 0A

CH1=(b)

Explanation: This command switches the channel on, with 5mV and AC.
See also byte 1 of DDF.

String to scope: CH1= (52hex) CR

Character sequence in hex representation: 43 48 31 3D 52 0D

Answer from scope: 0 CR LF

Answer from scope in hex representation: 30 0D 0A

ERRBP?

Explanation: This command interrogates the status of the control tone
for error. 1 means Error beep is switched on, 0 corresponds to off.

String to scope: ERRBP? CR

Character sequence in hex representation: 45 52 52 42 50 3F 0D

Answer from scope: ERRBP:1

Answer from scope in hex representation: 45 52 52 42 50 3A 31

RDWFM1:(ww)

Explanation : Read signal trace from channel 1.
 Parameter 1: Start address in acquisition store = 0 dec. = (00 00)hex.
 Parameter 2: Number of bytes to be read = 2048 = (08 00) hex. When transmitting word data,
 note that the low byte must be output first.
 It is possible to read only a part of the acquired signal by transmitting other values
 for the start address and the number of bytes to read.

String to scope: RDWFM1:(00hex)(00hex)(00hex)(08hex) CR
 Character sequence
 in hex representation: 52 44 57 46 4D 31 3A 00 00 00 08 0D
 Answer from scope
 in hex representation: 52 44 57 46 4D 31 3A 08 00 00 08 XX XX ...
 ... XX ;(2048 Byte XX)

WFMPRE?

String to scope: WFMPRE?
 Answer from scope
 in hex representation: 57 46 4D 50 52 45 3A XX XX C8 00 19 00 YY YY ZZ ZZ
 Explanation: Byte 1 to 7: WFMPRE:
 Byte 8 & 9: Number of the byte at trigger
 Byte 10 & 11: Resolution in X direction per Div. (200)
 Byte 12 & 13: Resolution in Y direction per Div. (25)
 Byte 14 & 15: (YY YY) Y1 position as 16 bit integer variable standardized on
 25 per Div., where the value 0 signifies no shift, 25 shifted
 one division up and -25 shifted one division down.
 Byte 16 & 17: (ZZ ZZ) Y2 position standardized on 25 per Div.

Calculating the voltage of the sampled signal form:

Given: UN : Voltage value of the Nth sample
 25 : Y resolution per Div. (see WFMPRE?)
 Y1Pos : Y1 position of the signal form (see WFMPRE? YY YY)
 ByteN : Value of the signal form byte (see RDWFM1 XX)
 V/Div : Attenuator setting (e.g.: 5mV)

Calculation without taking the Y1 position into account:

$$UN = (ByteN - 128)/25 * V/Div$$

With this method it is only possible to evaluate the voltage difference of the acquired signal, since there is no reference (Zero voltage). In order to calculate the absolute voltage of the sample one should include the Y position in the calculations.

$$UN = (ByteN - 128 - Y1Pos)/25 * V/Div$$

The deflection coefficient (V/DIV) is obtained from the DDF byte 1 or with the command CH1?.

TRGVAL?

With this command it is possible to evaluate the peak value and the arithmetical mean value of the measured signal. This is shown in the following example.

Scope setting: Channel 1 on; 5mV deflection sensitivity; DC input coupling; probe 1:1; 1kHz calibration; probe in the calibration socket; trigger source - channel 1; AC Trigger coupling; Timebase A set to 200µs; analog mode.

A positive square wave signal with an amplitude of 4 div. can be seen on the oscilloscope display.

String to scope: TRGVAL?

Answer from scope

in hex representation: 54 52 47 56 41 4C 3A D0 07 30 F8 D0 07 XX XX

Explanation: Byte 1 to 7: String TRGVAL:

Byte 8 and 9: Positive peak value (signal)

Byte 10 & 11: Negative peak value (signal)

Byte 12 & 13: Arithmetic mean value (signal)

Byte 14 & 15: Reserved (value undefined)

Positive and negative peak values are integer values referred to the mean value with the weighting of 1000/div.

Then follows: 07D0 hex. = +2000 decimal

F803 hex. = - 2000 decimal

Mean value: $Um = 2000/1000 * 5mV = 10mV$

positive peak value: $Upp+ = 2000/1000 * 5mV + Um = 20mV$

negative peak value: $Upp- = -2000/1000 * 5mV + Um = 0mV$

Since the trigger amplifier is not calibrated there can be a deviation from the values.

Remote control with the Term9X program of NORTON COMMANDER

1. Settings

1.1 term90.exe

Under 'Settings \ Interface': Port: Your free serial port, e.g. COM2.
Baud rate: recommended 19200.
Data bits: 8 BITS
Parity: None
Stop bits: 2 BITS
Data exchange: Xon/Xoff to off.
RTS/CTS/ to on.

Under 'Settings \ Terminal' mark the 'ANSI' .

Under 'Settings \ ' mark the option 'Echo'.

1.2 term95.exe

Under 'Settings \ Driver' mark the option 'Standard'.

Under 'Settings \ Line...': Port: Your free serial port, e.g. COM2.
Baud rate: Recommended 19200.
Data bits: 8 BITS
Parity: None
Stop bits: 2 BITS
Data exchange: Xon/Xoff to off.
RTS/CTS/ to on.

Under 'Settings \ Terminal Emulation' mark the option 'ANSI'.

Under 'Settings \ Terminal settings' mark the option 'Echo'.

2. Remote control

The transmission can be started after all settings have been correctly set.,.

Remote On: Enter one after the other a SPACE and ENTER.
The instrument goes into remote mode, which is evident from the Remote LED.
Now you can enter any desired command such as, for example, 'vers?'.

Example: Switch on channel 2 of the instrument and at the same time set it to 5mV.
Enter 'ch2=', press the key "Alt Gr" and simultaneously enter from the number keyboard one after the other the numbers 0,1 and 8. After releasing the "Alt Gr" key, the instrument will be set.
The RETURNCODE will be displayed behind the transmitted command.

The value 0 ("Alt Gr" 000) will not be transmitted



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