ENGLISH

4S-1004-00E0

01 NOV 1996

HAMEG®
Instruments

Oscilloskop HM1004

SERVICE-MANUAL HM1004

Service Manual
Circuit Diagrams
Adjustment Procedure

HM1004/1505

St.1196-Hüb/Brü/Schm

KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE

HAMEG ®
Instruments

Herstellers **HAMEG GmbH**
Manufacturer **Kelsterbacherstraße 15-19**
Fabricant **D - 60528 Frankfurt**

Bezeichnung / Product name / Designation:

Oszilloskop/Oscilloscope/Oscilloscope

Typ / Type / Type: HM1505

mit / with / avec: -

Optionen / Options / Options: -

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

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

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

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées

Sicherheit / Safety / Sécurité

EN 61010-1: 1993 / IEC (CEI) 1010-1: 1990 A 1: 1992 / VDE 0411: 1994
Überspannungskategorie / Overvoltage category / Catégorie de surtension: II
Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2

Elektromagnetische Verträglichkeit / Electromagnetic compatibility
Compatibilité électromagnétique

EN 50082-2: 1995 / VDE 0839 T82-2
ENV 50140: 1993 / IEC (CEI) 1004-4-3: 1995 / VDE 0847 T3
ENV 50141: 1993 / IEC (CEI) 1000-4-6 / VDE 0843 / 6
EN 61000-4-2: 1995 / IEC (CEI) 1000-4-2: 1995 / VDE 0847 T4-2
Prüfschärfe / Level / Niveau = 2

EN 61000-4-4: 1995 / IEC (CEI) 1000-4-4: 1995 / VDE 0847 T4-4:
Prüfschärfe / Level / Niveau = 3

EN 50081-1: 1992 / EN 55011: 1991 / CISPR11: 1991 / VDE0875 T11: 1992
Gruppe / group / groupe = 1, Klasse / Class / Classe = B

Datum /Date /Date
24.07.1996

Unterschrift / Signature /Signatur

Dr. J. Herzog
Technical Manager/Directeur Technique

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Prüfschärfe / Level / Niveau = 2

EN 61000-4-4: 1995 / IEC (CEI) 1000-4-4: 1995 / VDE 0847 T4-4:
Prüfschärfe / Level / Niveau = 3

EN 50081-1: 1992 / EN 55011: 1991 / CISPR11: 1991 / VDE0875 T11: 1992
Gruppe / group / groupe = 1, Klasse / Class / Classe = B

Datum /Date /Date
18.06.1996

Unterschrift / Signature /Signatur

Dr. J. Herzog
Technical Manager/Directeur Technique

General information regarding the CE marking

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

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

1. Data cables

For the connection between instruments resp. their interfaces and external devices, (computer, printer etc.) sufficiently screened cables must be used. Without a special instruction in the manual for a reduced cable length, the maximum cable length of a dataline must be less than 3 meters long. If an interface has several connectors only one connector must have a connection to a cable.

Basically interconnections must have a double screening. For IEEE-bus purposes the double screened cables HZ72S and HZ72L from HAMEG are suitable.

2. Signal cables

Basically test leads for signal interconnection between test point and instrument should be as short as possible. Without instruction in the manual for a shorter length, signal lines must be less than 3 meters long.

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

3. Influence on measuring instruments.

Under the presence of strong high frequency electric or magnetic fields, even with careful setup of the measuring equipment an influence of such signals is unavoidable.
This will not cause damage or put the instrument out of operation. Small deviations of the measuring value (reading) exceeding the instruments specifications may result from such conditions in individual cases.

December 1995
HAMEG GmbH

Technische Daten

Vertikal-Ablenkung

Betriebsarten: Kanal I oder Kanal II,
Kanal I und Kanal II alternierend oder chop.,
(Chopperfrequenz ca. 0,5MHz)
Summe oder **Differenz** von K I und K II
(beide Kanäle invertierbar)
XY-Betrieb: über Kanal I und Kanal II
Bandbreite: **HM1004** 2x 0–100MHz (-3dB)
HM1505 2x 0–150MHz (-3dB)
Anstiegszeiten: HM1004 <3,5ns, HM1505 <2,3ns
Überschwingen: max. 1%
Ablenkkoeffizienten: 14 kalibrierte Stellungen **von 1mV/cm** bis **20V/cm** mit 1-2-5 Teilung variabel 2.5:1 bis mindestens **50V/cm**
Genauigkeit der kal. Stellungen:
1mV/cm – 2mV/cm: ±5% (0 bis 10MHz (-3dB))
5mV/cm – 20V/cm: ±3%
Eingangsimpedanz: 1MΩ II 15pF
Eingangskopplung: DC-AC-GD
Eingangsspannung: max. 400V (DC + Spitze AC).
Verzögerungsleitung: ca. 70ns

Triggerung

Automatik(Spitzenwert): **<20Hz-200MHz** (≤0,5cm)
Normal mit Level-Einstellung: **DC-250MHz** (≤0,5cm)
Flankenrichtung: positiv oder negativ
ALT.-Triggerung; Triggeranzeige mit LED
Quellen: Kanal I oder II, K I alternierend K II, Netz und extern. **Kopplung**: **AC** (10Hz- 200MHz), **DC** (0 -200MHz), **HF** (1,5kHz - 250MHz), **LF** (0 - 1,5kHz). **NR** (Noise reject): DC–50MHz (≤ 8mm)
Aktiver TV-Sync-Separator für Bild und Zeile
Triggerung extern: ≥0,3V_{ss} von DC bis 100MHz
Triggerung Zeitbasis B: mit Level-Einstellung und Flankenwahl. DC–250MHz.

Horizontal-Ablenkung

Zeitbasis A: 22 kalibrierte Stellungen von 0,5s/cm bis 50ns/cm mit 1-2-5 Teilung, Genauigkeit der kalibrierten Stellungen: ±3% variabel 2,5:1 bis mindestens 1,25s/cm, mit **X-Dehnung x10** bis **5ns/cm** ±5%
Hold-off-Zeit: variabel bis ca. 10:1
Zeitbasis B: 18 kalibrierte Stellungen von 20ms/cm bis 50ns/cm mit 1-2-5 Teilung,
Betriebsarten: **A** / **ALT** / **B**, (**Single** nur 1505)
Bandbreite X-Verstärker: 0-3MHz (-3dB).
Eingang X-Verstärker über Kanal II,
Ablenkkoeffizienten wie Kanal II,
X–Y- Phasendifferenz: <3° unter 120kHz.

Bedienung / Steuerung

Manuellüber Bedienungsknöpfe
Auto Set(automatische Parametereinstellung)
Save und **Recall** für 10 Einstellprogramme
Schnittstelle: **RS-232**(serienmäßig).
Fernbedienung HZ68 (optionell).

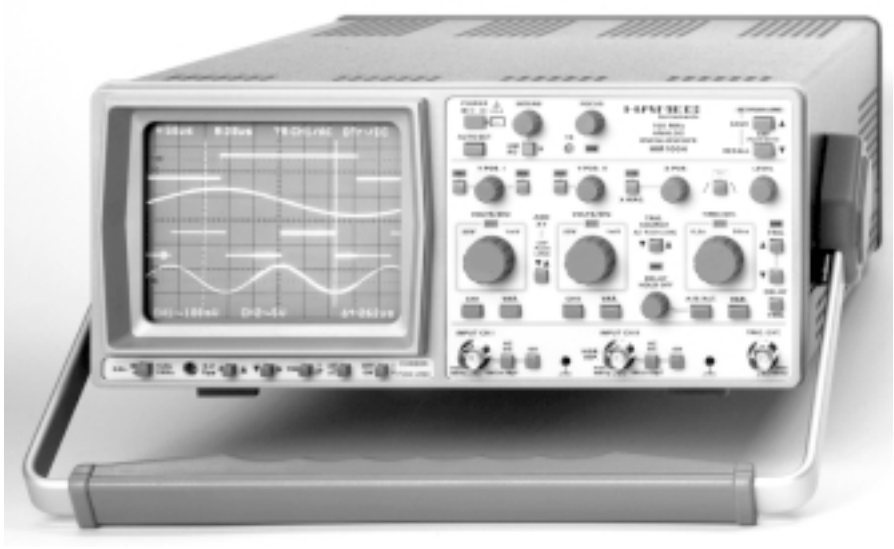
Readout / Cursoren

Anzeige der Meßparameter und diverser Funktionen auf dem Bildschirm.
Cursormessungen von ΔU, Δt oder 1/Δt (Frequenz), (Einzeln oder im Tracking-Betrieb).
Separate Einstellung der Readout-Helligkeit

Verschiedenes

Röhre: D14-375GH, 8x10cm, Innenraster.
Beschleunigungsspannung: ca. 14kV
Strahldrehung: auf Frontseite einstellbar
Kalibrator: Rechteckgenerator (t_a <4ns), ≈1kHz/1MHz; 0,2V ±1%
Netzanschluß: 100-240V ±10%, 50/60Hz
Leistungsaufnahme: ca. 35 Watt bei 50Hz
Zul. Umgebungstemperatur: 0°C...+40°C
Schutzart: Schutzklasse I (IEC1010-1 / VDE 0411)
Gewicht: ca. 5,6kg. Farbe: techno-braun
Gehäusemaße: **B** 285, **H** 125, **T** 380 mm

Änderungen vorbehalten. 7/96



100MHz Analog-Oszilloskop HM1004 & 150MHz Analog-Oszilloskop HM1505

mit Auto-Set, Save / Recall, Readout und Cursor

2 Kanäle, 1mV – 50V/cm mit Verzögerungsleitung, 1MHz Kalibrator
2 Zeitbasen bis 5ns/cm, alternierend und mit 2. Triggerung
Triggerung: DC –250MHz, TV-Sync. Separator. RS232-Schnittstelle

Die mit modernster Technik ausgestatteten Oszilloskope **HM1004**und **HM1505** verfügen über ein **prozessorgesteuertes System**, das vor allem die Bedienung weitgehend automatisiert. Dominierend sind dabei die **"Autoset"**- und **"Save/ Recall**"- Funktionen, mit welchen auch ungeübte Personen die Geräte sehr leicht bedienen können. Selbstverständlich sind alle über **"Autoset"** gesetzten Meßparameter danach noch manuell veränderbar. Mit Hilfe der **"Save/Recall"**-Funktionen können **10 komplette Einstellprogramme inclusive Cursor** gespeichert und jederzeit wieder aufgerufen werden. Der Abruf ist auch über die Fernbedienung **HZ68** möglich.

Alle kalibrierten Werte und diverse Funktionen werden mit Hilfe der **"Readout"**-Funktion auf dem Bildschirm angezeigt. Für die genaue Ermittlung der Zeit-, Frequenz- und Amplitudenwerte stehen **2 Cursoren** zur Verfügung.

Die hohe Übertragungsgüte der Meßverstärker mit **Verzögerungsleitung** erlaubt sowohl die **naturgetreue Darstellung** von impulsartigen Signalen, wie auch Aufzeichnungen mit dem **HM1004** bis in den Frequenzbereich um **200MHz** und dem **HM1505** bis über **250MHz**. Ebenso exzellent ist die Triggerung beider Geräte. Bereits ab 5mm Bildhöhe werden einwandfrei stehende Bilder dargestellt. Ferner gestattet die echte **2. Zeitbasis** mit Hilfe der **2. Triggerung** die Aufzeichnung stark gedehnter Signalausschnitte, auch wenn sie asynchron sind.

Als High-Tech-Geräte verfügen die Oszilloskope **HM1004** und **HM1505** selbstverständlich über ein Kalibrier-Menü. Mit diesem werden verschiedene Funktionen durch Tastendruck automatisch kalibriert. Für die Verwendung als Systemgeräte sind beide Typen mit einer **RS-232** Schnittstelle ausgerüstet. Als Zubehör werden Betriebsanleitung, Netzkabel und 2 Tastköpfe mitgeliefert.

Foto mit 1MHz Rechteck- und 200MHz Sinus-Signal, alternierend getriggert

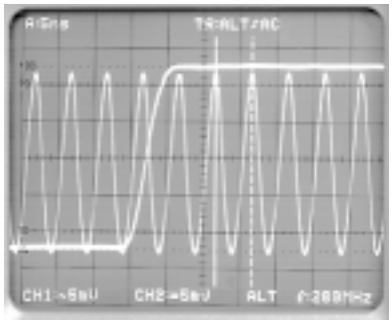
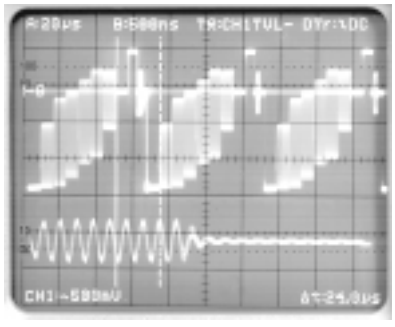
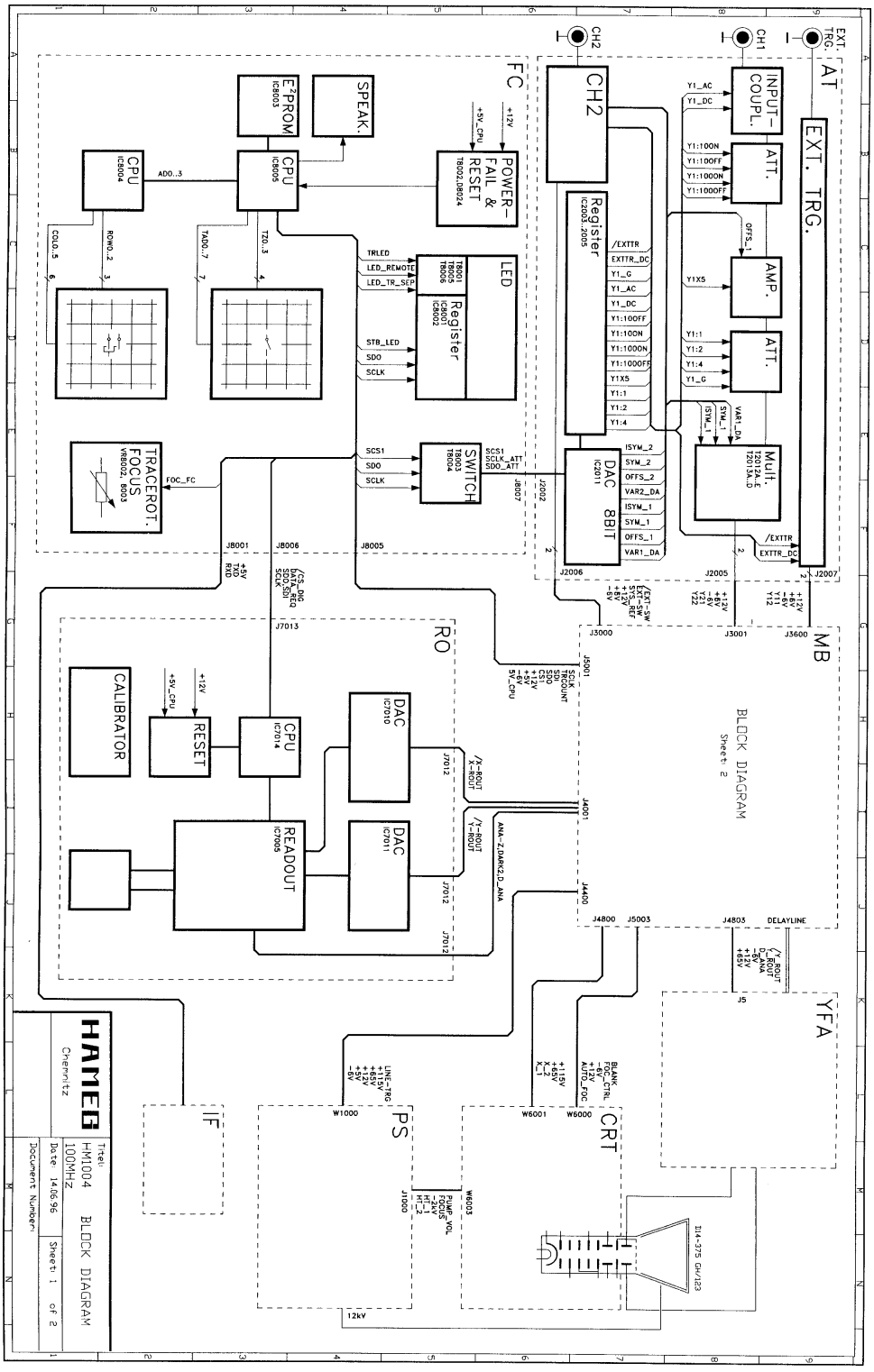
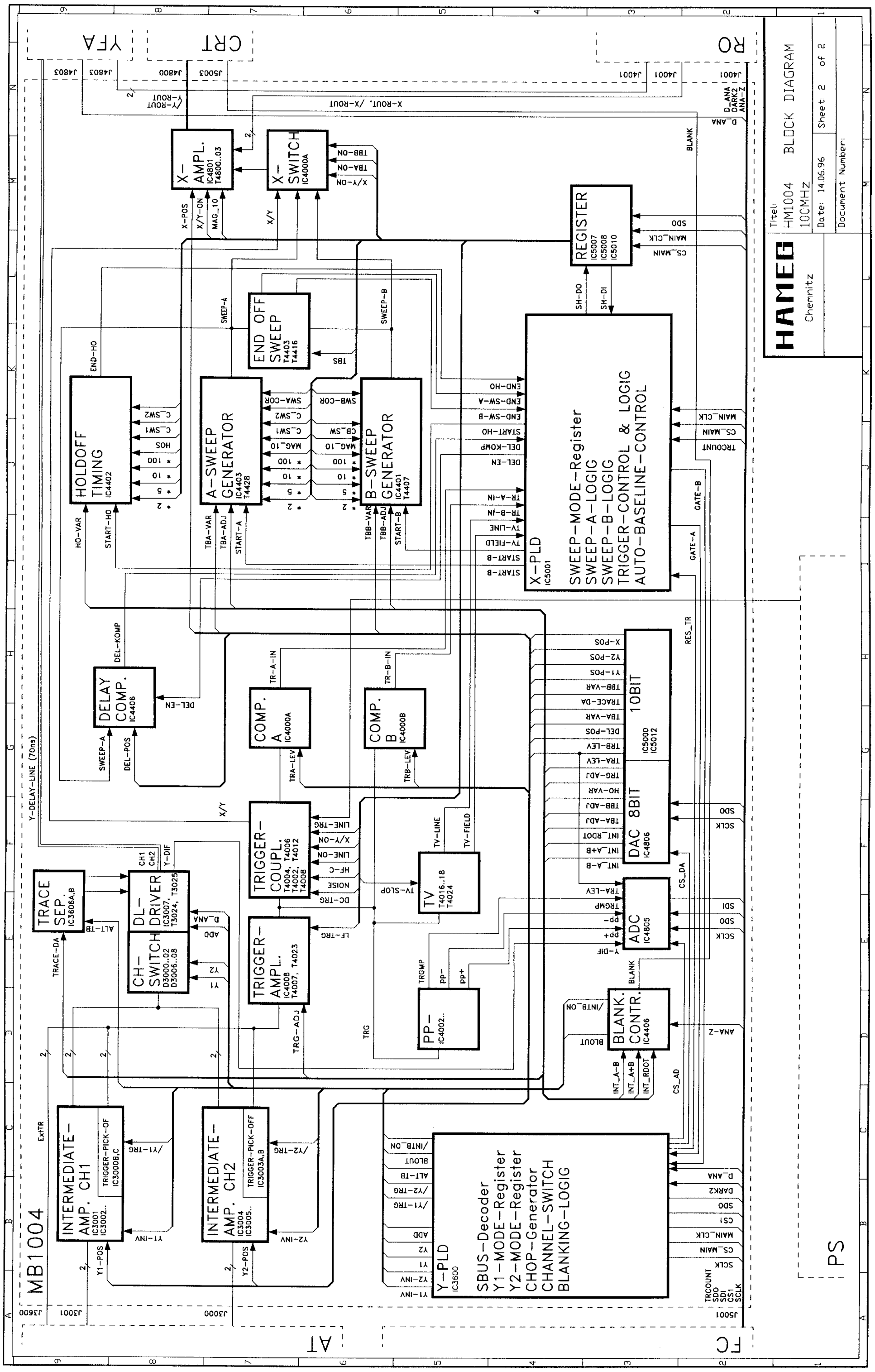


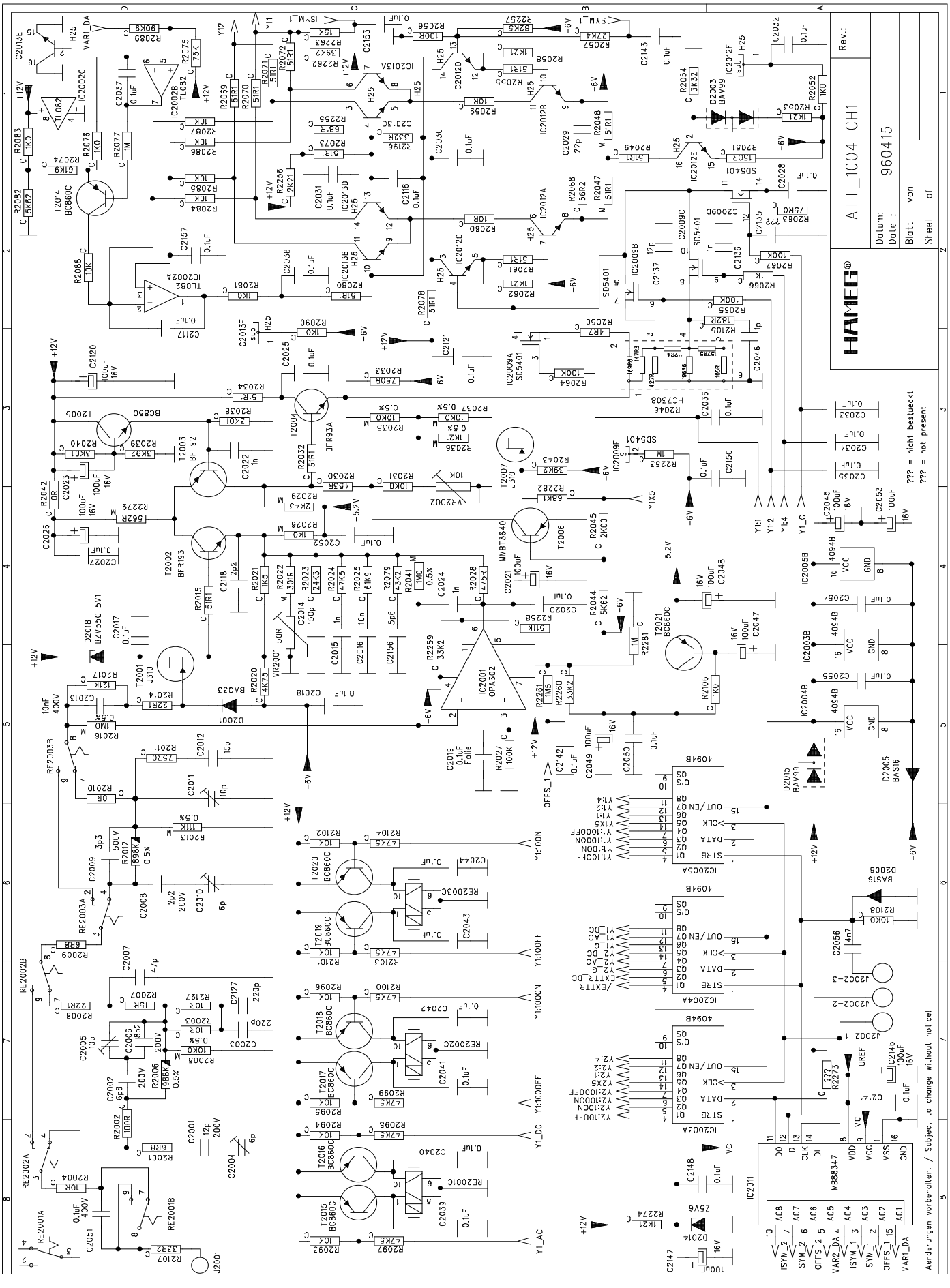
Foto eines FBAS -Signals mit Burst-Darstellung über Zeitbasis B u. 2.Triggerung



HM1004 Block diagram




YFA
CRT
RO
X-AMPL.
X-SWITCH
REGISTER
END OFF SWEEP
HOLDOFF TIMING
A-SWEEP GENERATOR
B-SWEEP GENERATOR
X-PLD
SWEEP-MODE-Register
SWEEP-A-LOGIC
SWEEP-B-LOGIC
TRIGGER-CONTROL & LOGIC
AUTO-BASELINE-CONTROL
DELAY COMP.
COMP. A
COMP. B
10BIT
DAC 8BIT
TRIGGER-COUPL.
TV
ADC
TRACE SEP.
DL-DRIVER
CH-SWITCH
TRIGGER-AMPL.
PP-
BLANK. CONTR.
INTERMEDIATE-AMP. CH1
INTERMEDIATE-AMP. CH2
Y-PLD
SBUS-Decoder
Y1-MODE-Register
Y2-MODE-Register
CHOP-Generator
CHANNEL-SWITCH
BLANKING-LOGIC
MB1004
AT
FC
PS
HAMEG
Chemnitz
HM1004 100MHz
BLOCK DIAGRAM
Date: 14.06.96
Sheet: 2 of 2
Document Number:


ATT_1004 CH1
Datum: 960415
Date :
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Sheet of
Rev.:
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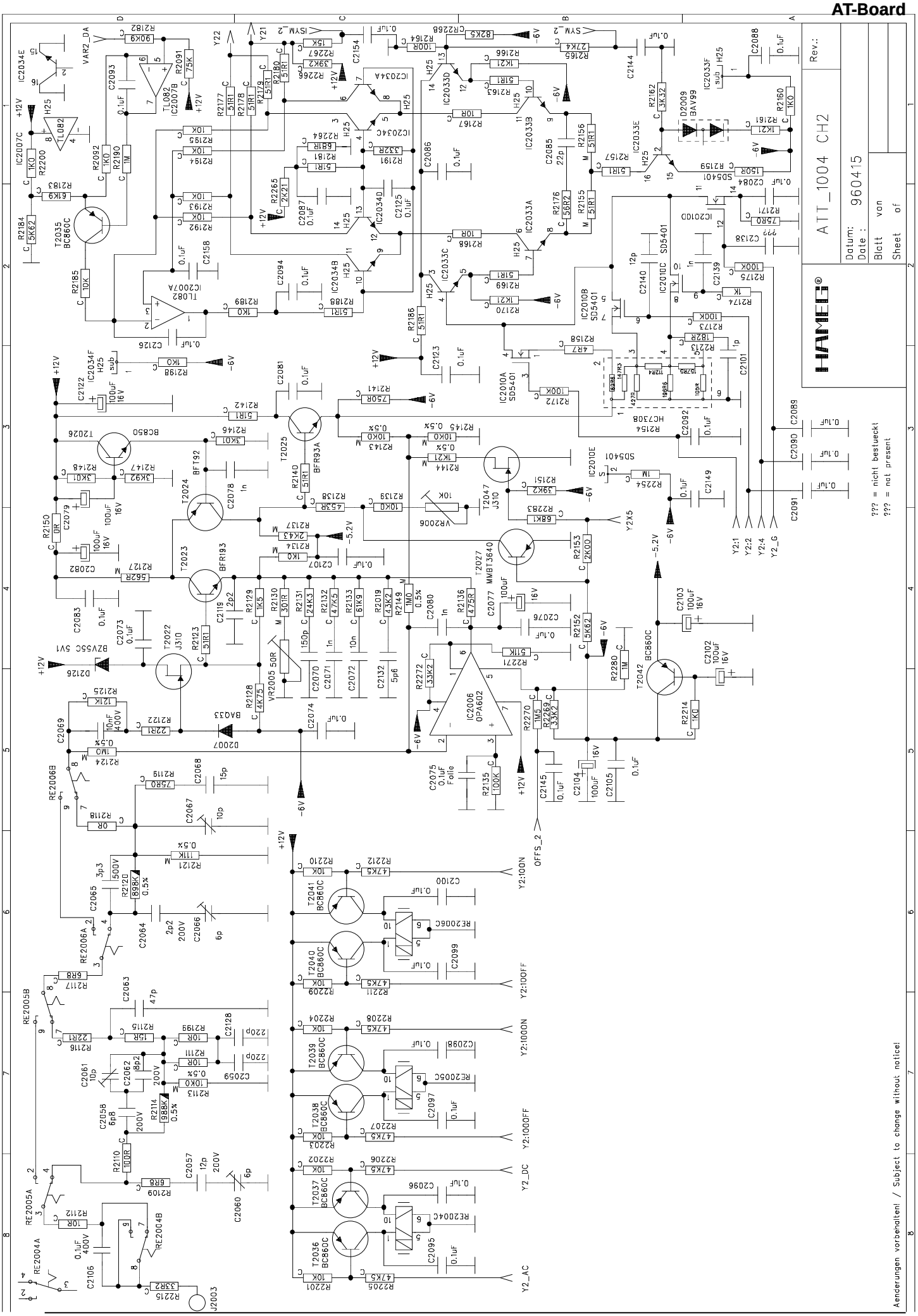
ATT_1004 CH2
Datum: 960415
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Rev.:
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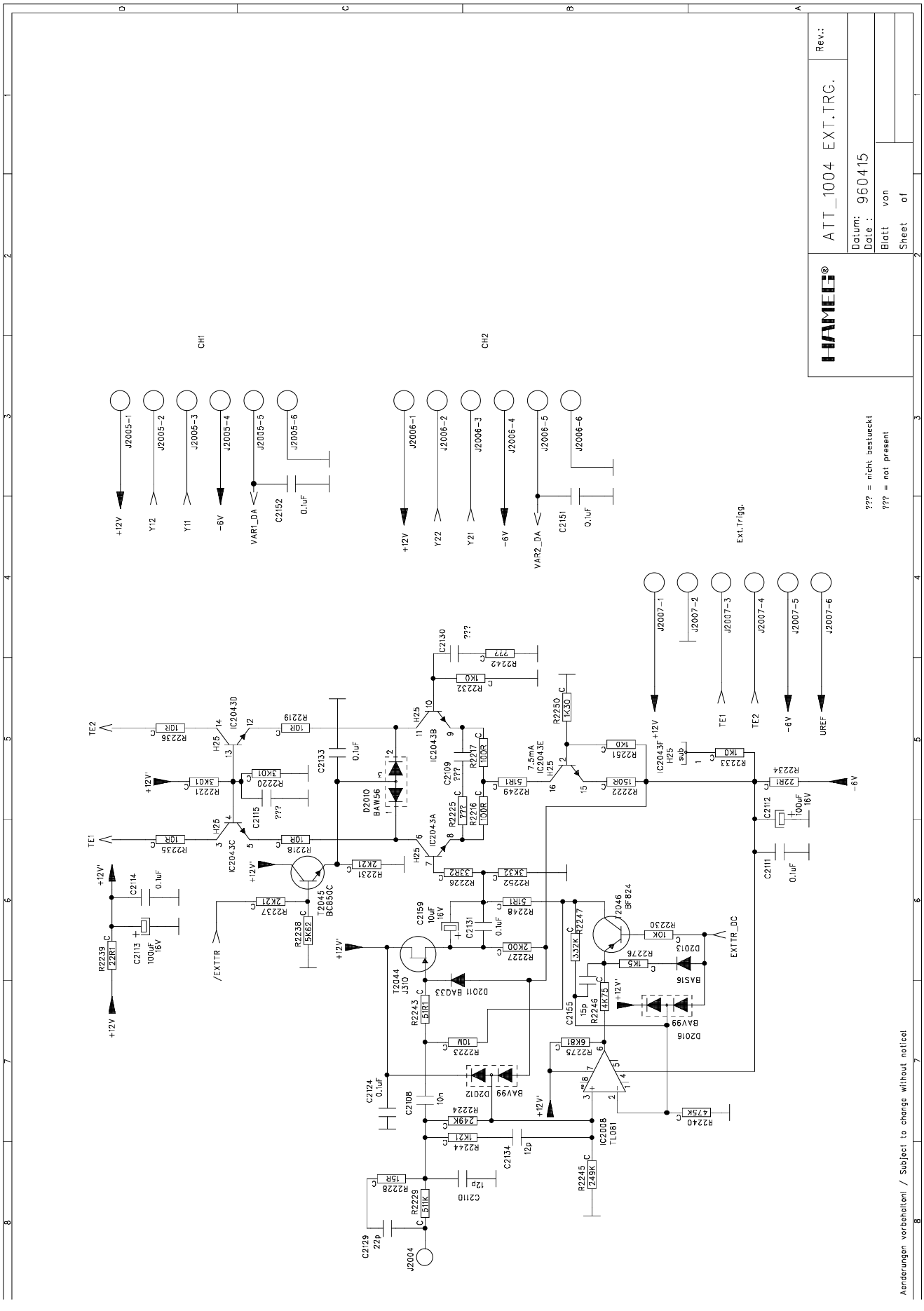
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ATT_1004 EXT.TRG.
Rev.:
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Date :
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CH1
CH2
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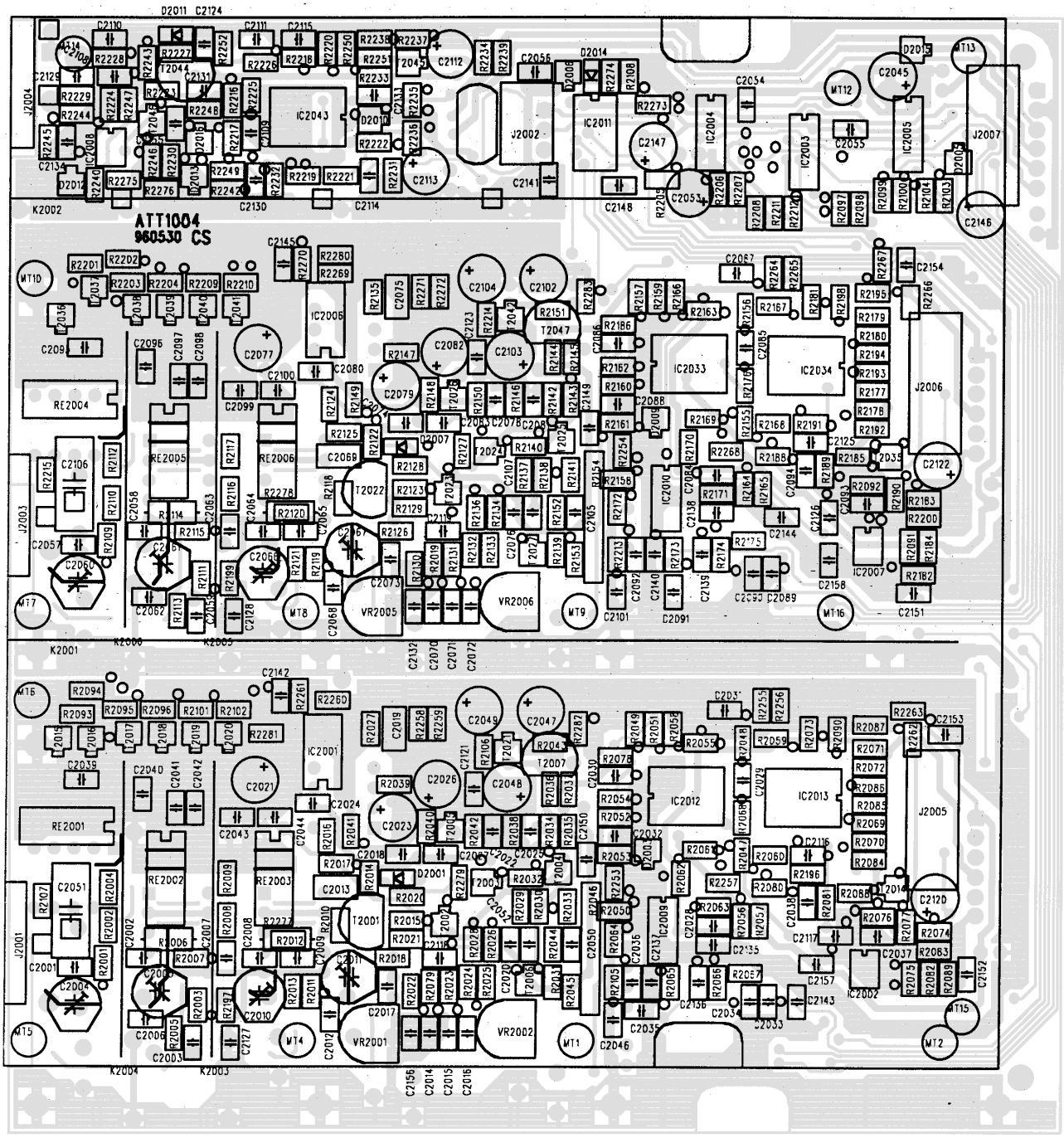
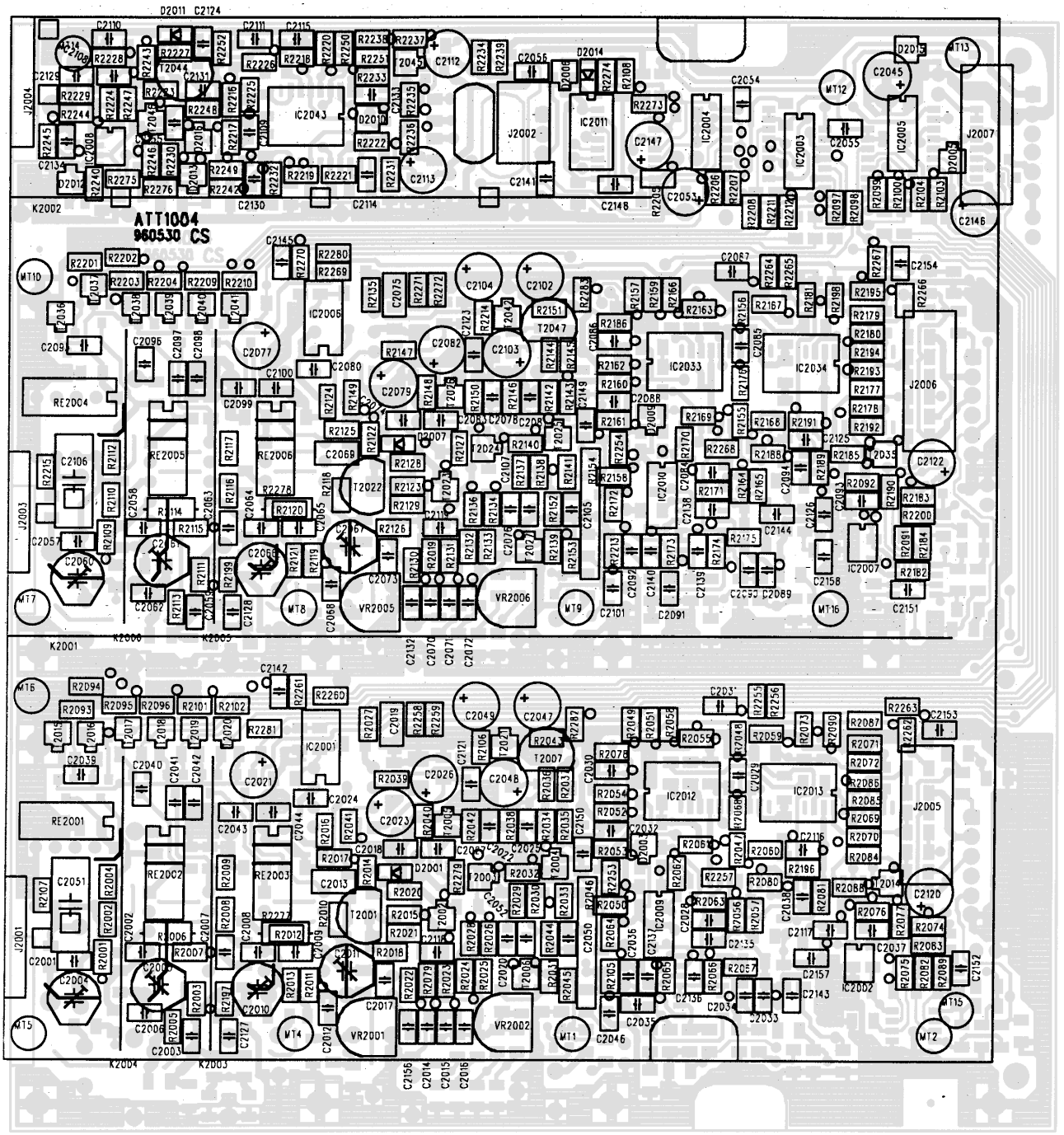
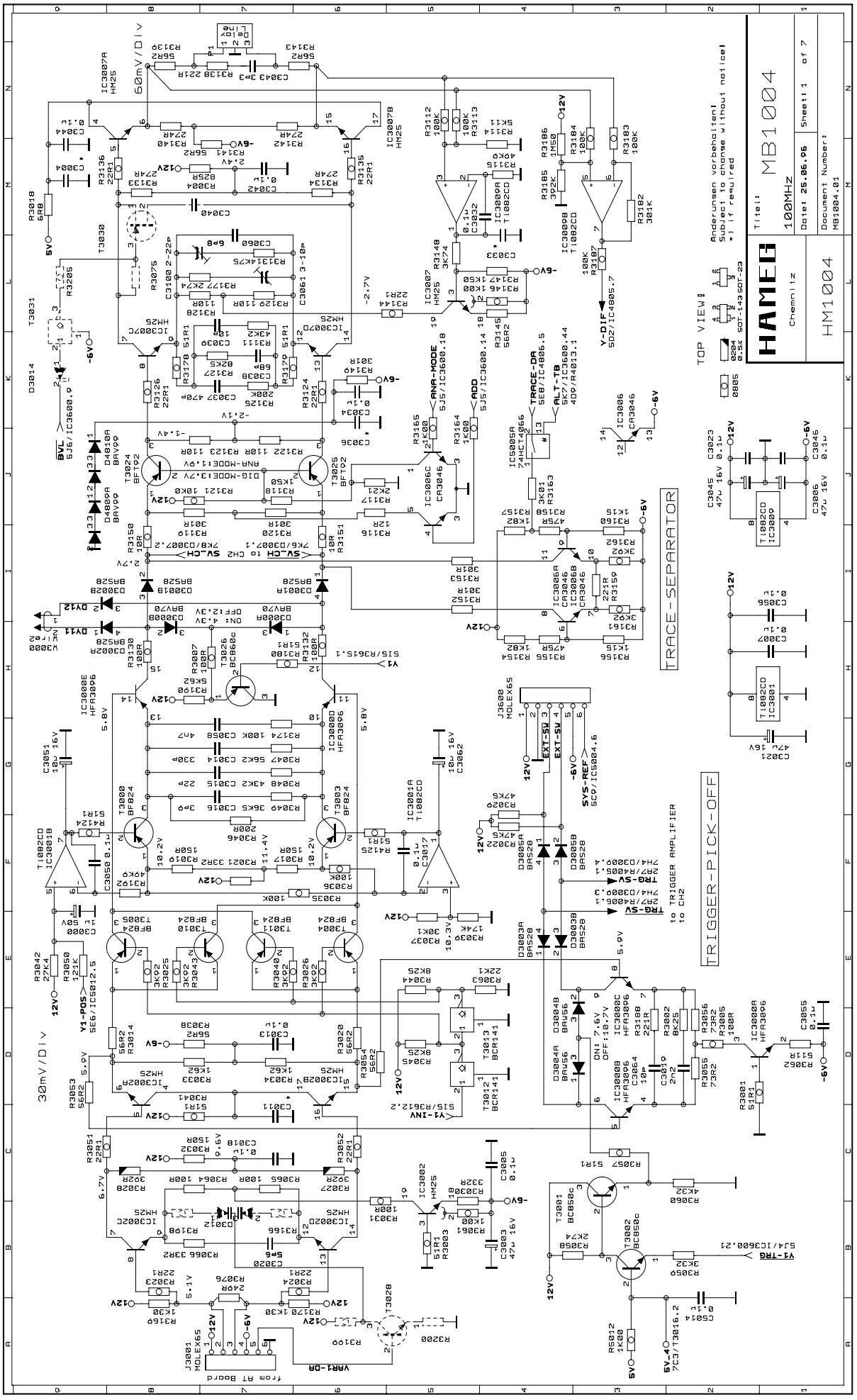
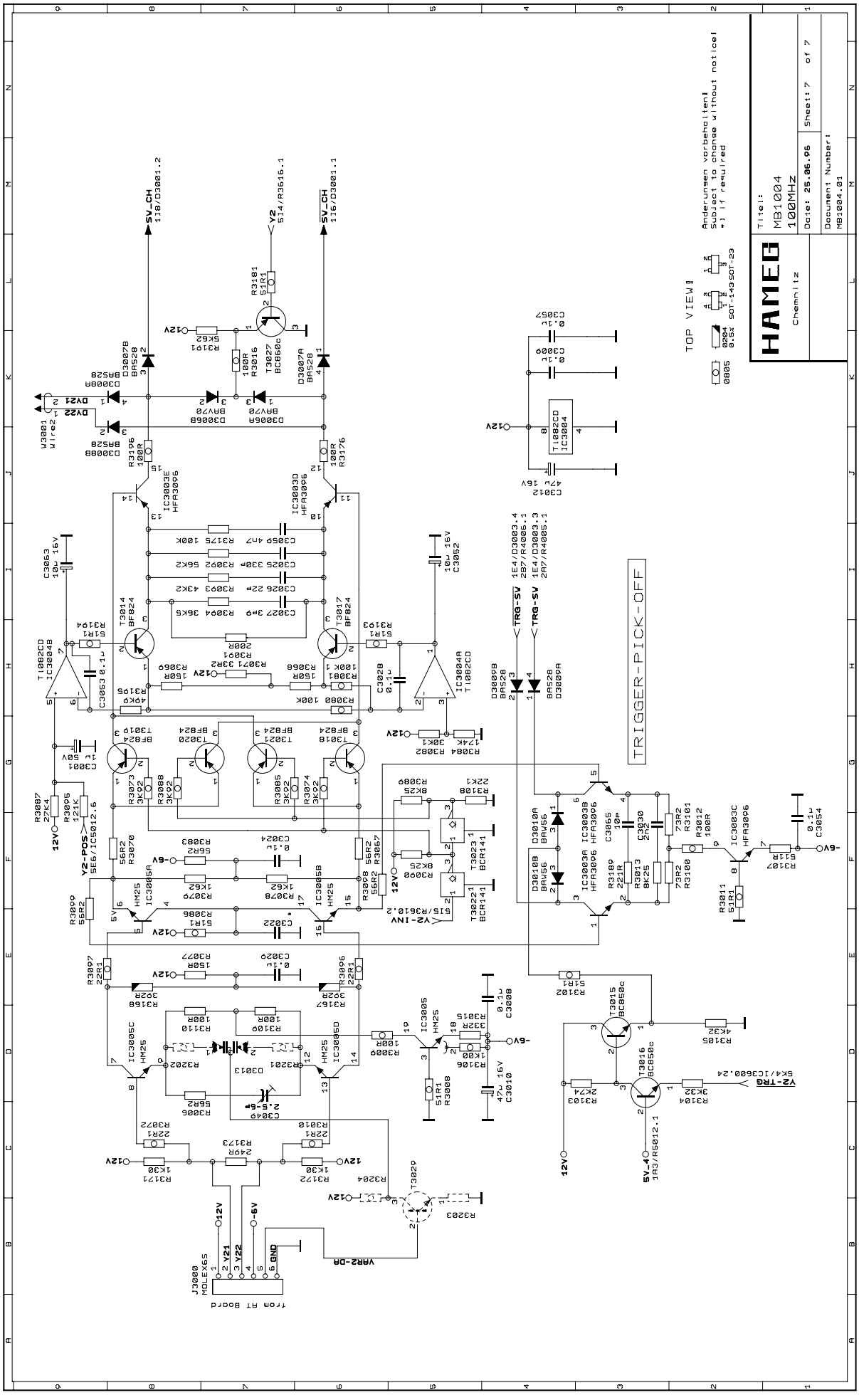
Ext.Trigg.
Aenderungen vorbehalten! / Subject to change without notice!

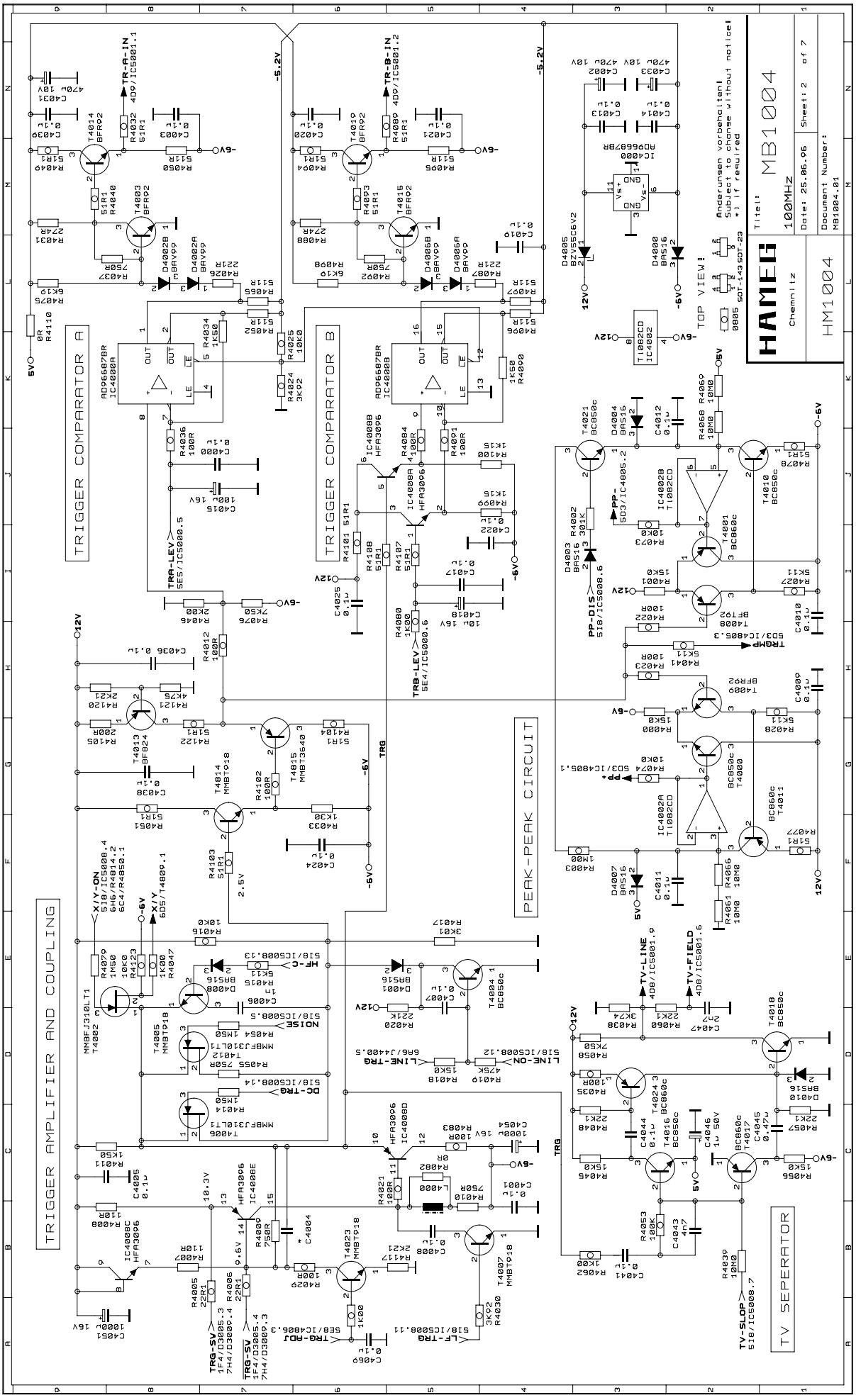

ATT1004
960530 CS

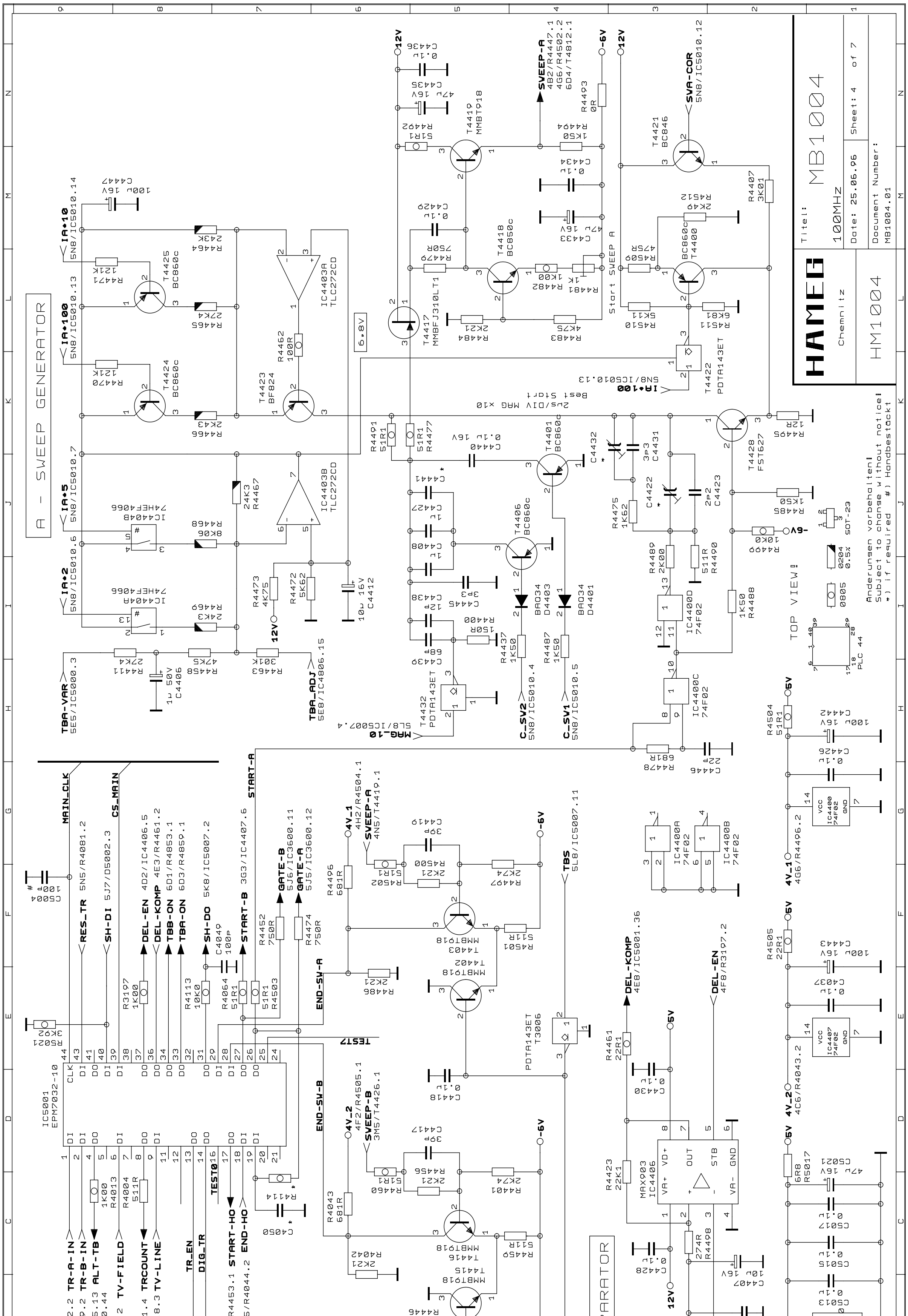
AT-Board (Bottomside)

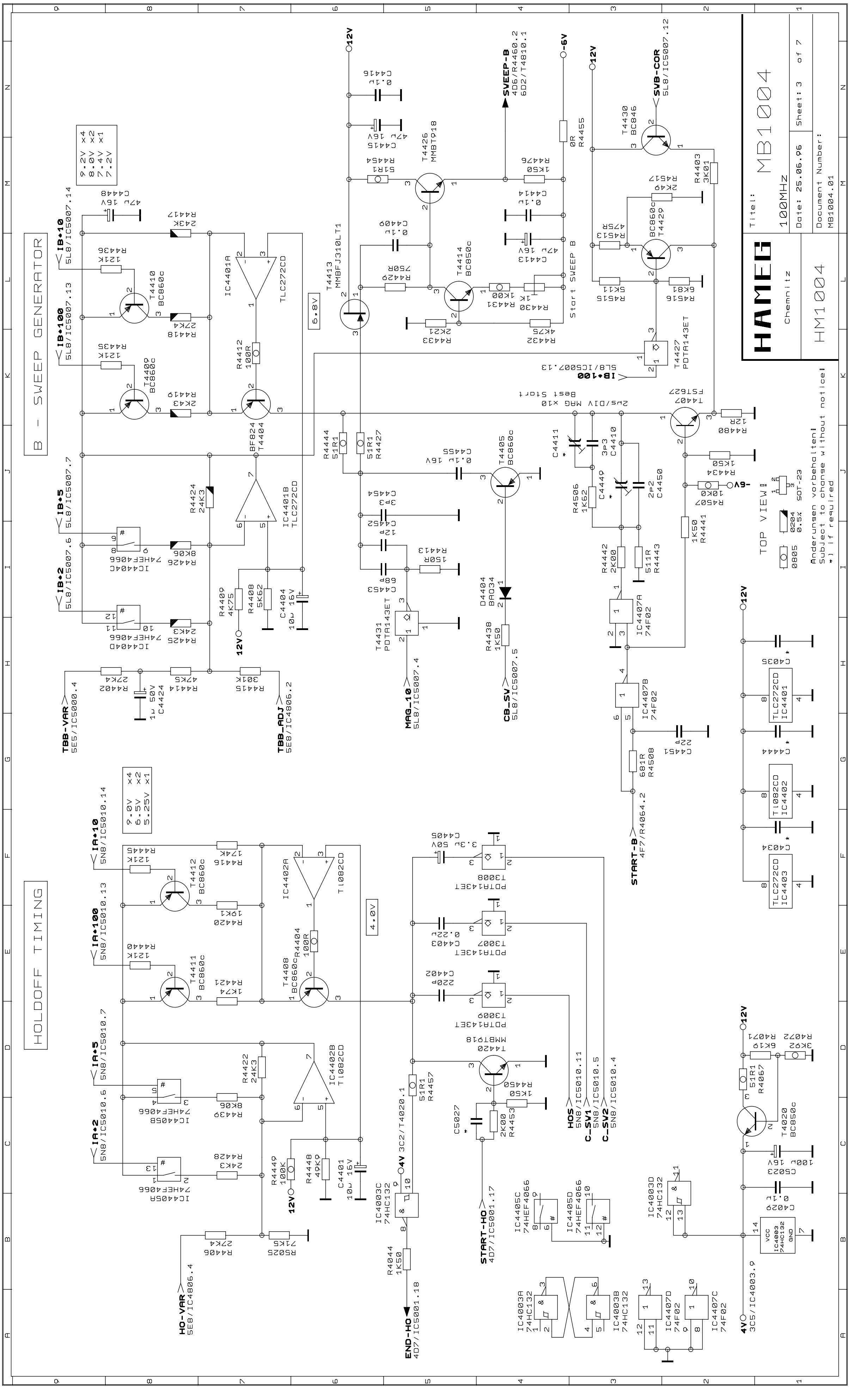


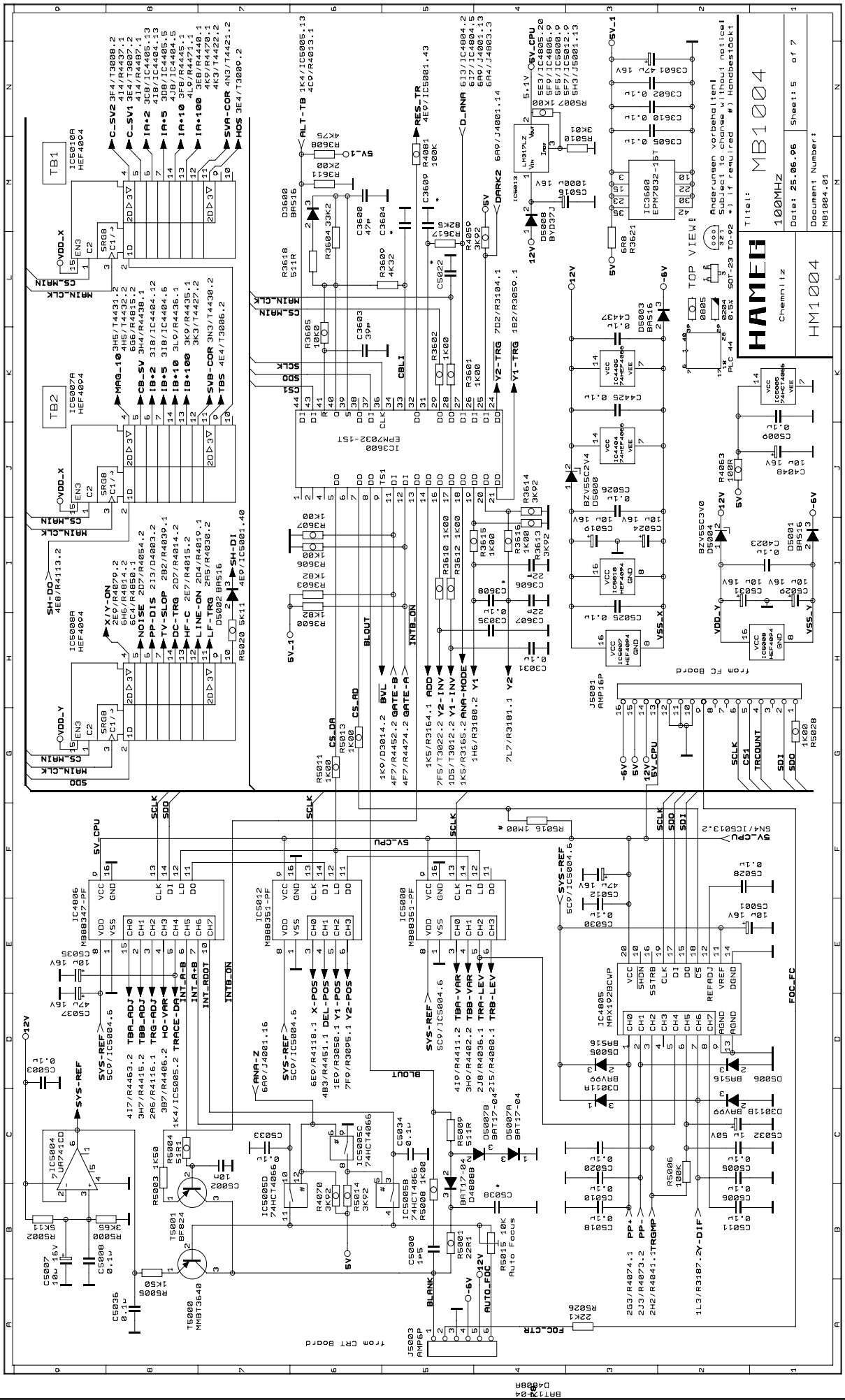

TRACE-SEPARATOR
TRIGGER-PICK-OFF
TOP VIEW!
HAMEG
Chemnitz
HM1004
Titel: MB1004
100MHz
Date: 25.06.96
Sheet: 1 of 7
Document Number:
MB1004.01
Änderungen vorbehalten!
Subject to change without notice!
*) if required
60mV/Div
30mV/Div
TRG-SV
to TRIGGER AMPLIFIER
to CH2
from AT Board
VAR1-DR
V1-TRG
V1-INV
SYS-REF
EXT-5V
SW_CH to CH2 SW_CH
ANA-MODE
ADD
TRACE-DR
ALT-TB
BVL
Y-DIF

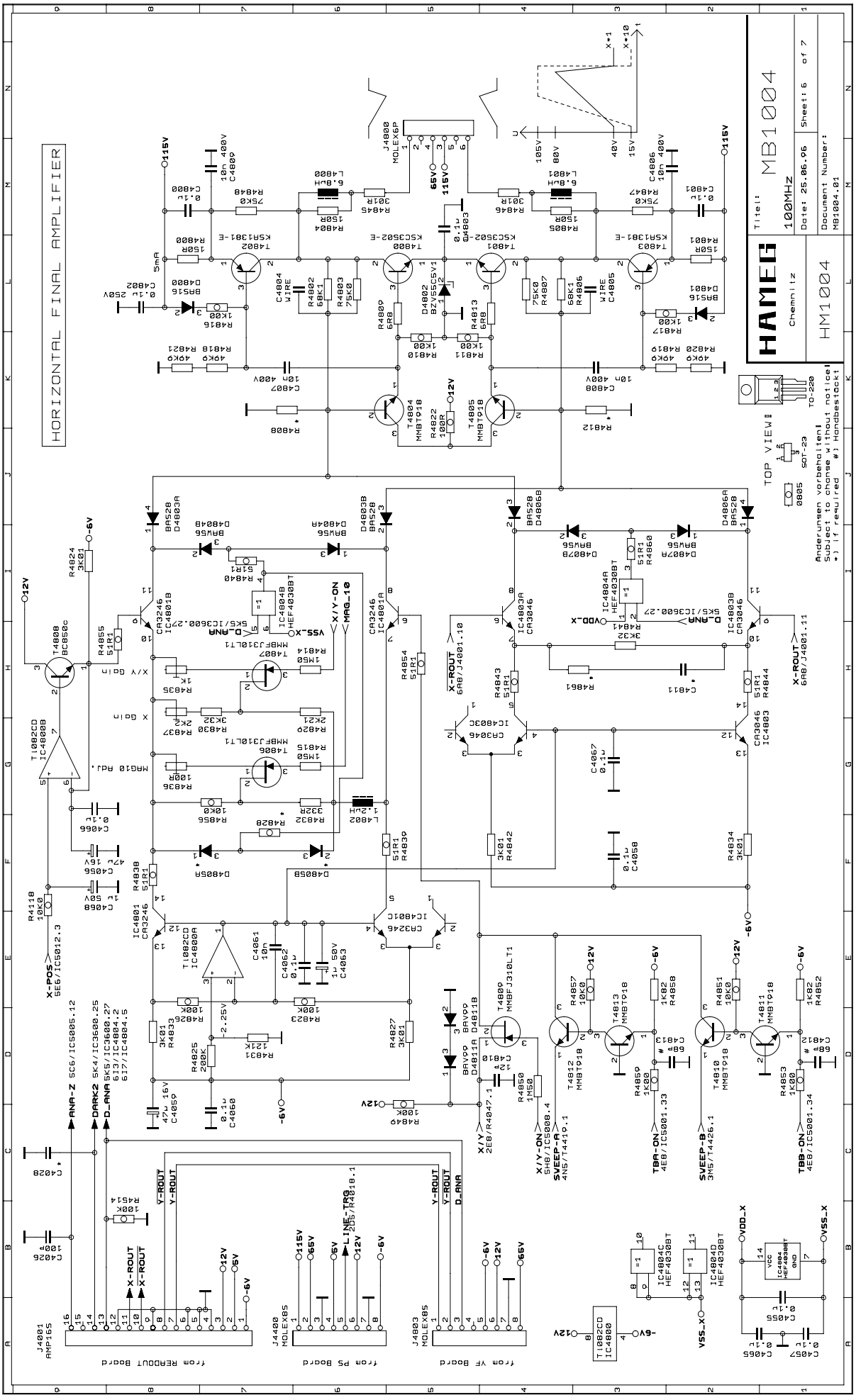

TRIGGER-PICK-OFF
HAMEG
Chemnitz
Titel:
MB1004
100MHz
Date: 25.06.96
Sheet: 7 of 7
Document Number:
MB1004.01
Änderungen vorbehalten!
Subject to change without notice!
*) if required
TOP VIEW!
SV_CH
Y2
12V
-6V
TRG-SV
Y2-POS
Y2-INV
Y2-TRG
VAR2-DR
from AT Board

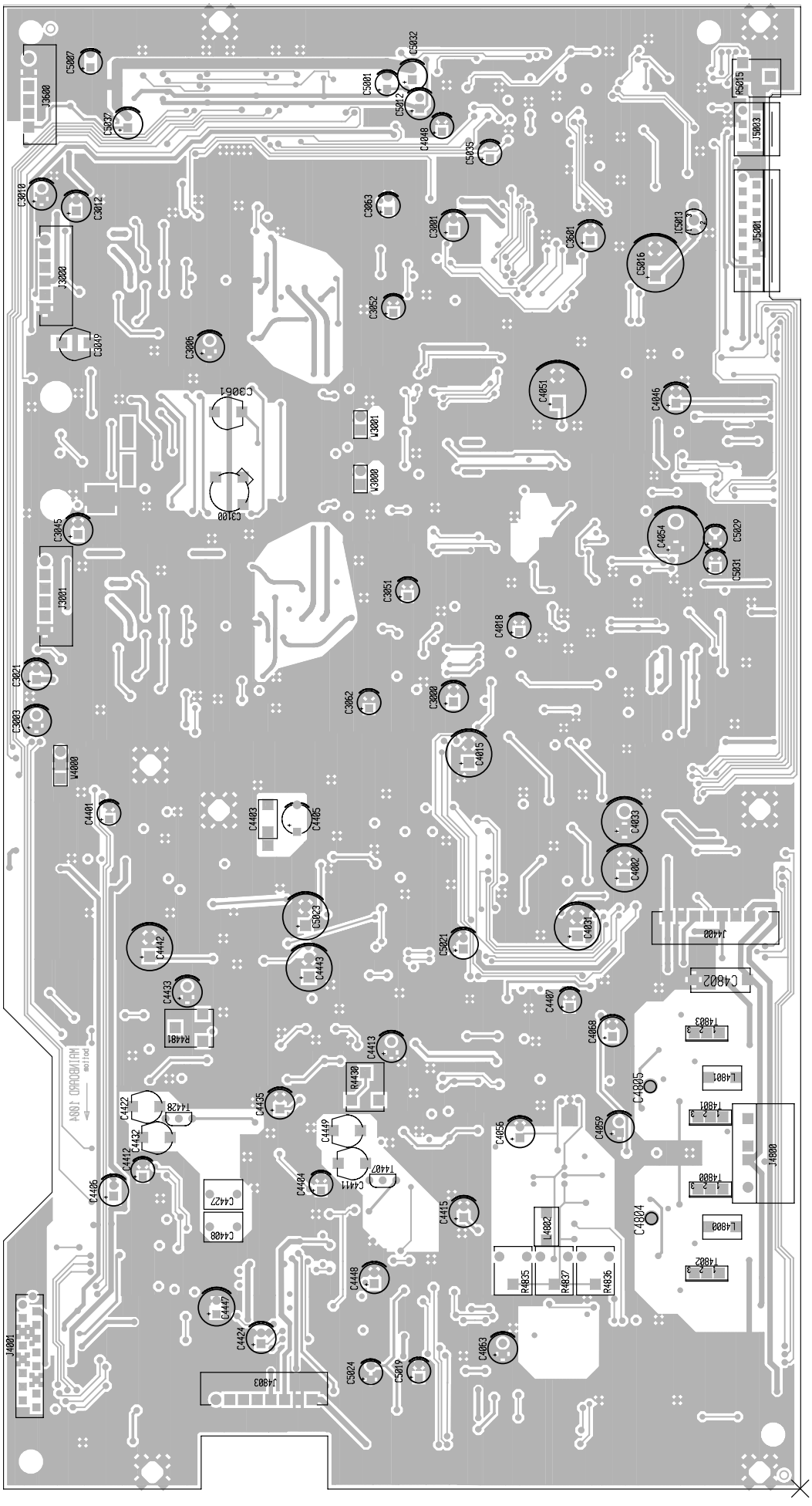

TRIGGER COMPARATOR A
TRIGGER COMPARATOR B
TRIGGER AMPLIFIER AND COUPLING
PEAK-PEAK CIRCUIT
TV SEPERATOR
HAMEG
Chemnitz
Titel: MB1004
100MHz
Date: 25.06.96
Sheet: 2 of 7
Document Number: MB1004.01
HM1004
Änderungen vorbehalten! Subject to change without notice! *) if required
TOP VIEW
TR-A-IN
TR-B-IN
TRA-LEV
TRB-LEV
PP-DIS
PP-
TRGMP
X/Y-ON
X/Y
TV-LINE
TV-FIELD
LINE-ON
LINE-TRG
NOISE
HF-C
DC-TRG
TRG-SV
TRG-ADJ
LF-TRG
TV-SLOP
TRG
-5.2V
-6V
12V
5V

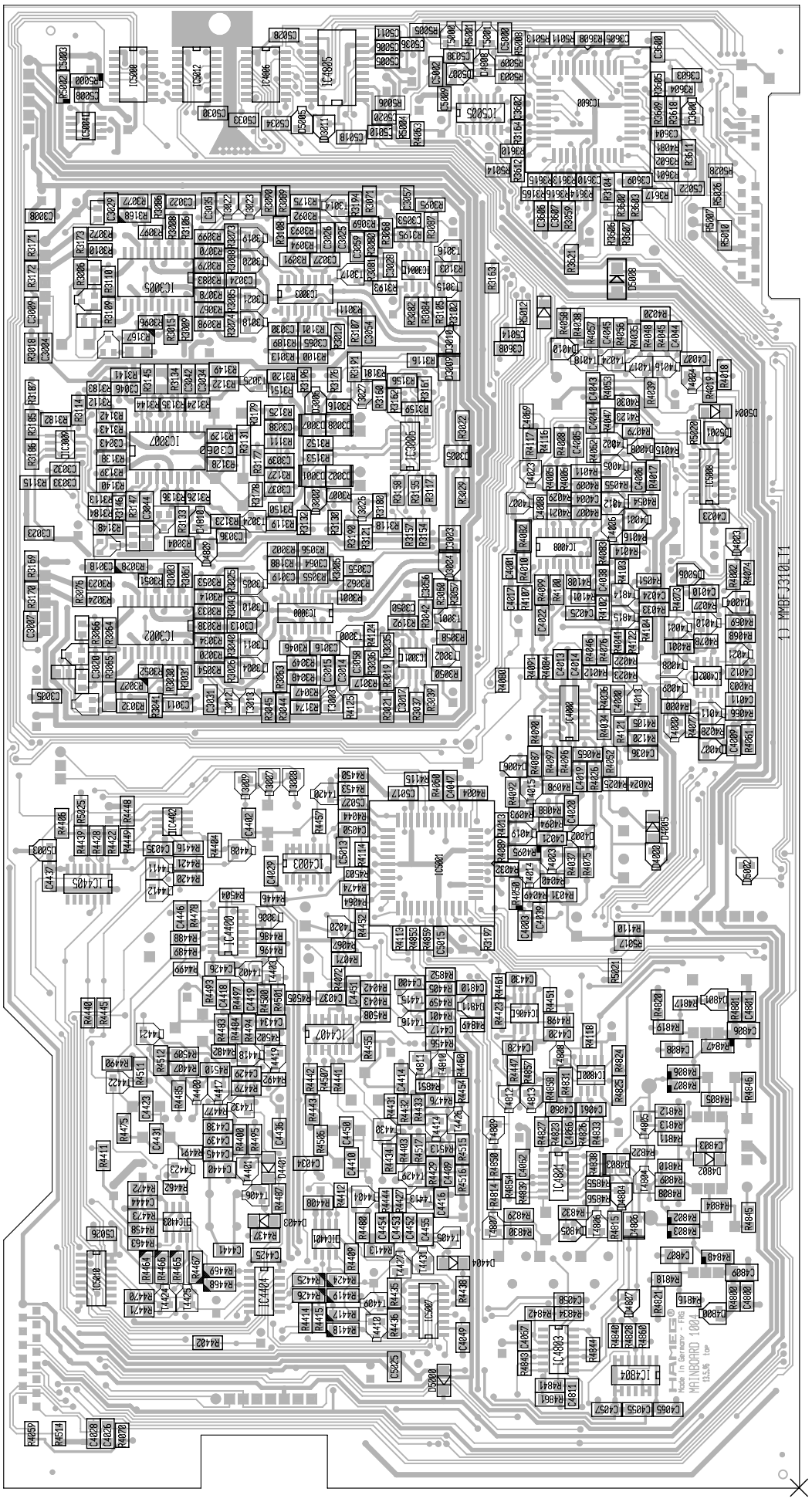

A - SWEEP GENERATOR
DELAY COMPARATOR
HAMEG
MB1004
HM1004
100MHz
Chemnitz

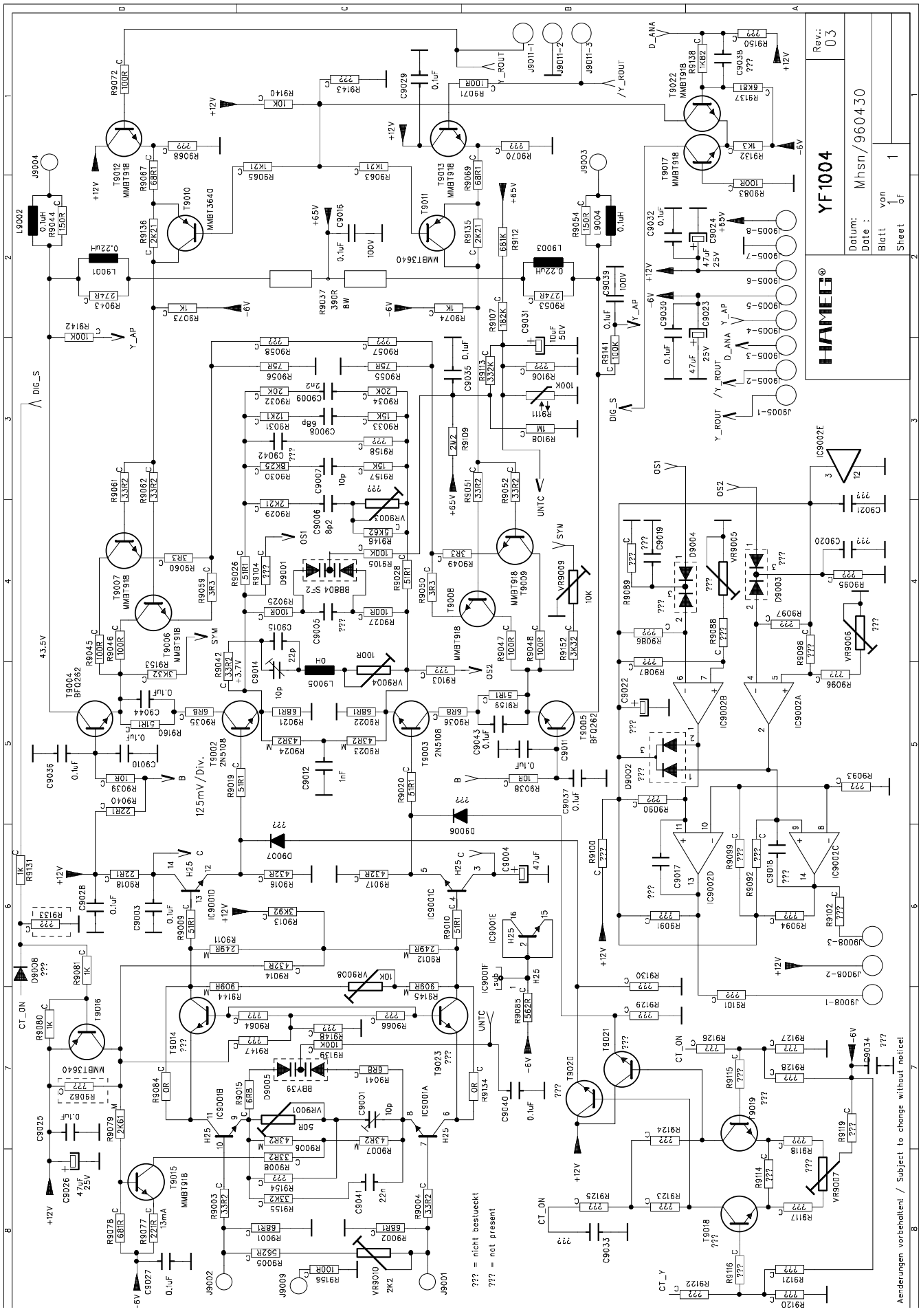

B - SWEEP GENERATOR
HOLDOFF TIMING
HAMEG
Chemnitz
HM1004
MB1004
100MHz
Date: 25.06.96
Document Number:
MB1004.01

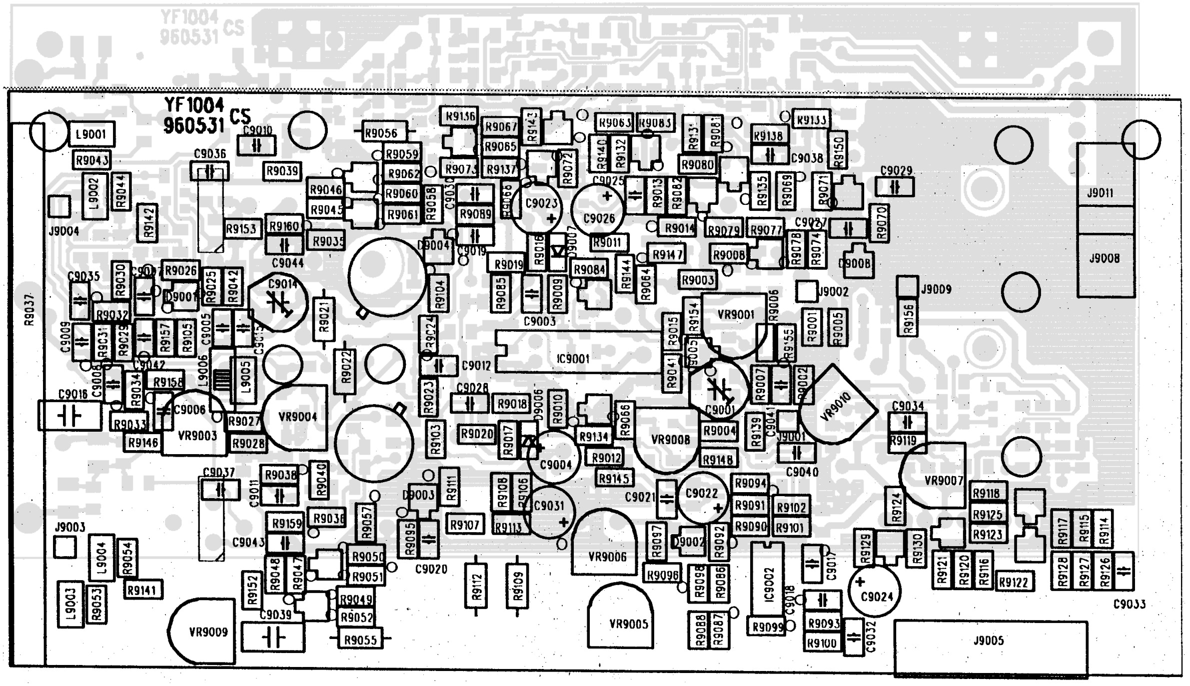


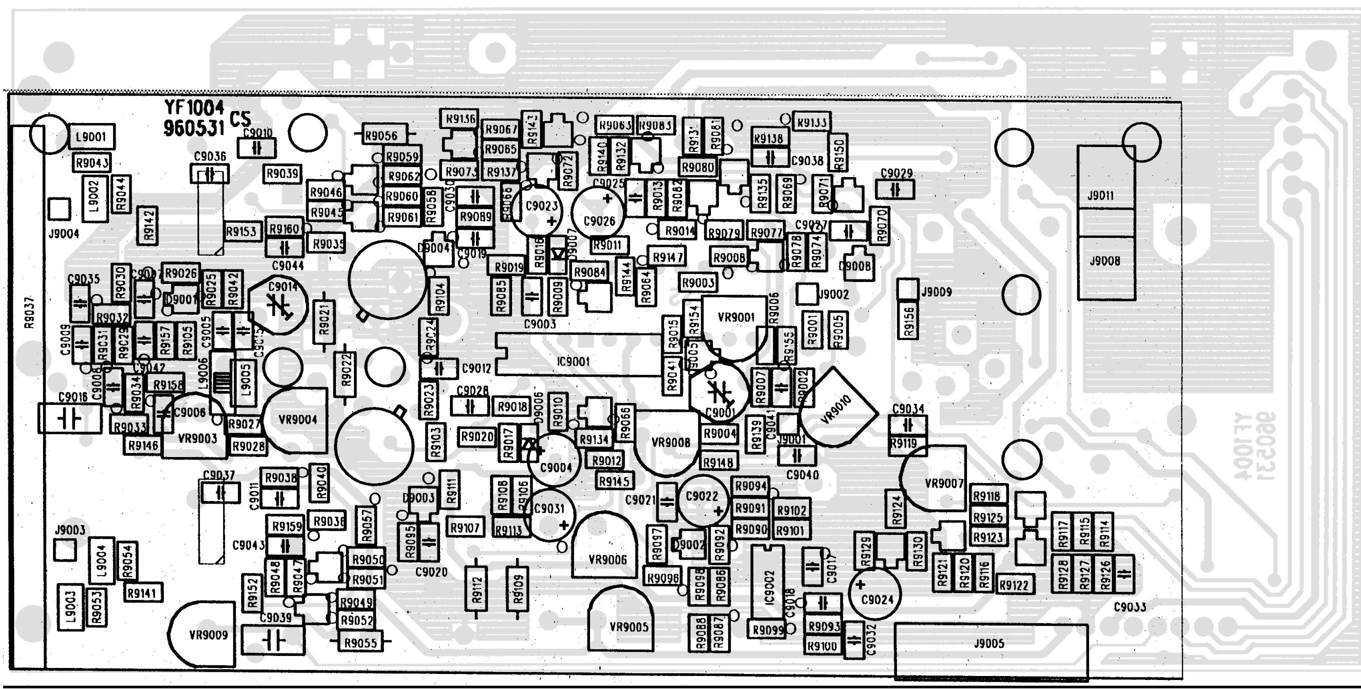

HORIZONTAL FINAL AMPLIFIER
HAMEG
Chemnitz
HM1004
Titel: MB1004
100MHz
Date: 25.06.96
Sheet: 6 of 7
Document Number: MB1004.01
TOP VIEW
Änderungen vorbehalten!
Subject to change without notice!
*) if required
X-POS
ANA-Z
DARK2
D_ANA
X-ROUT
Y-ROUT
X/Y-ON
SVEEP-A
SVEEP-B
TBA-ON
TBB-ON
LINE-TRG
VDD_X
VSS_X
from READOUT Board
from PS Board
from YF Board

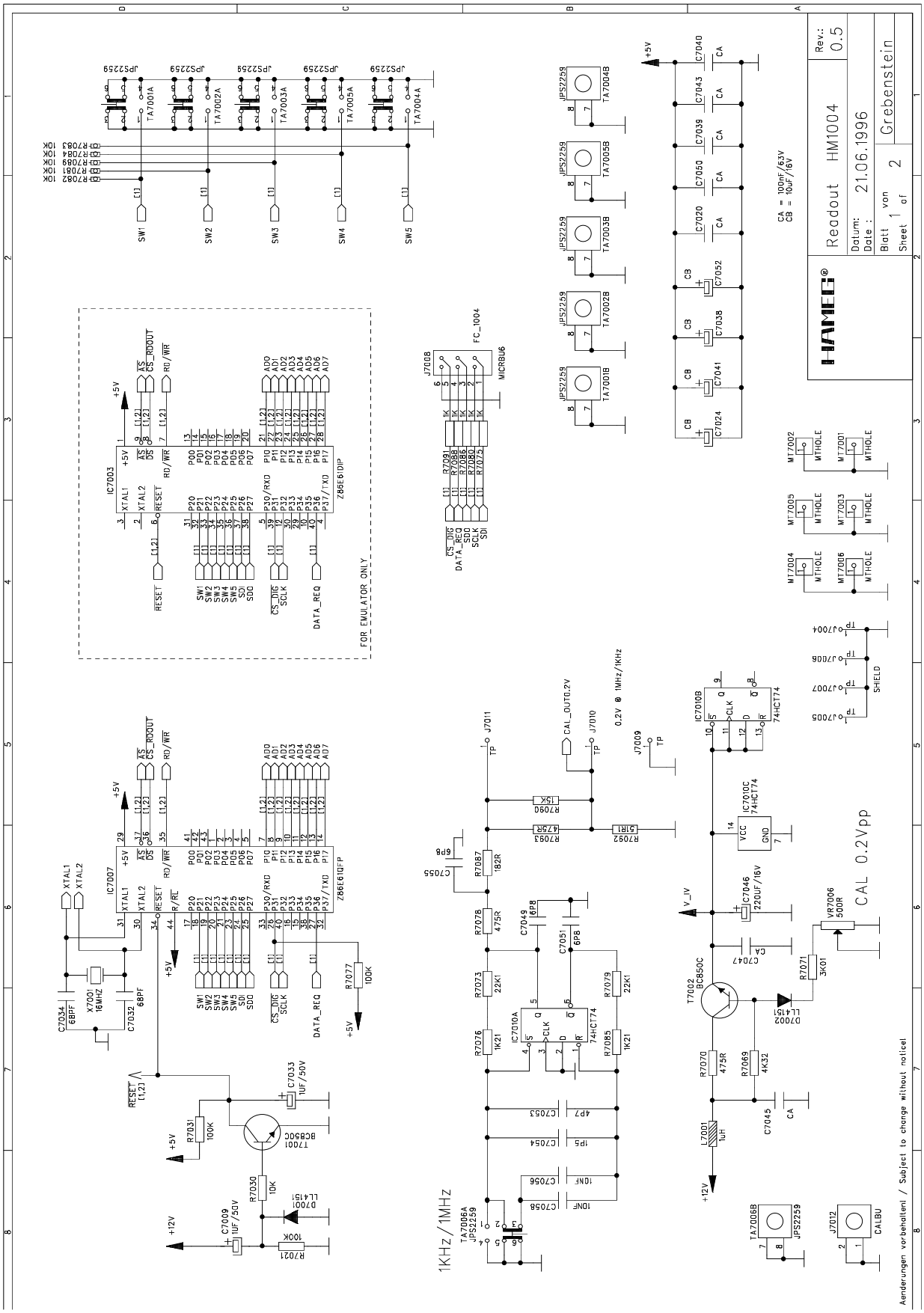


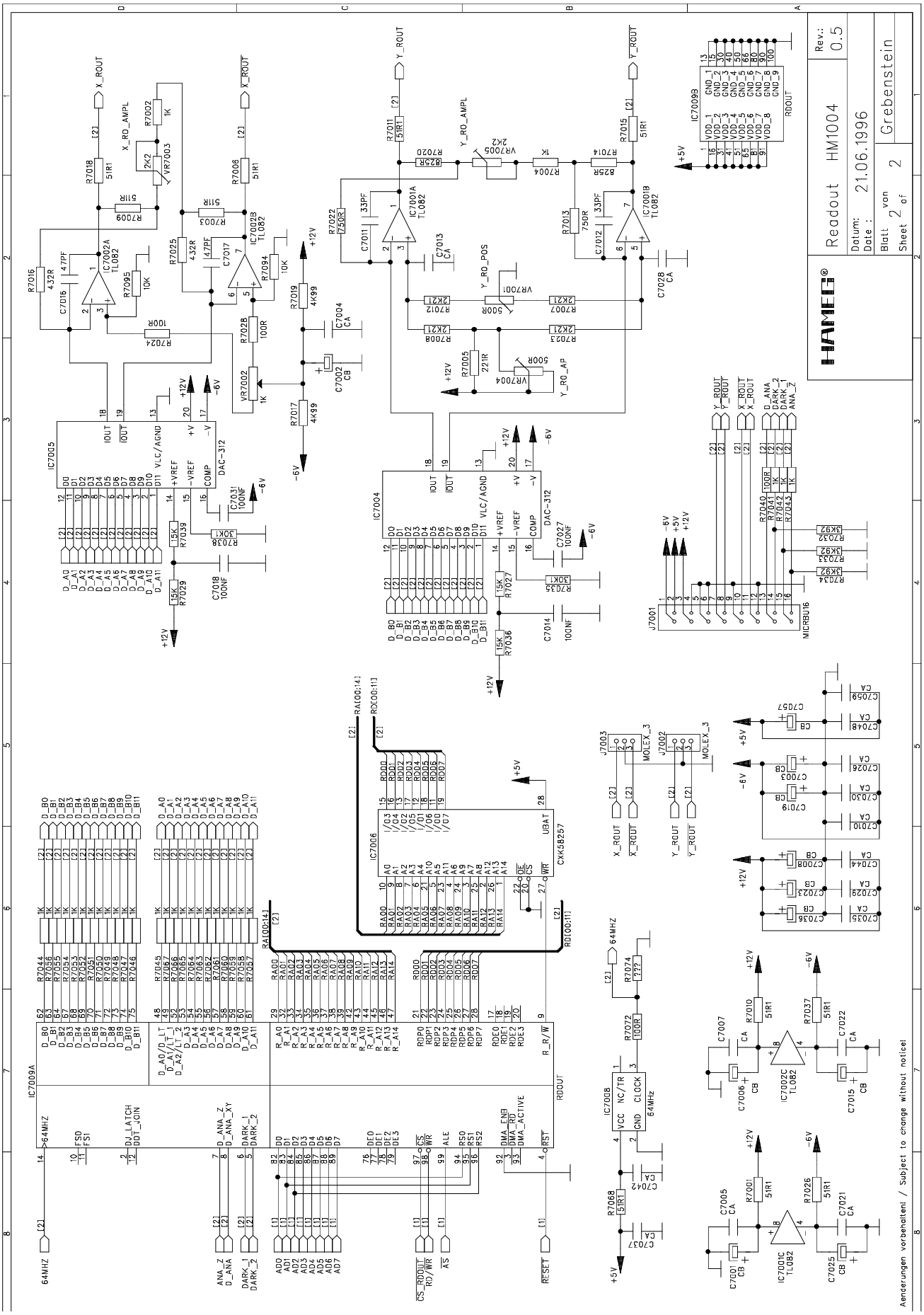

11-MBBJ310LT1
MAINBOARD 1004


YF1004
HAMEG
Rev.: 03
Datum: Mhsn/960430
Date :
Blatt von 1
Sheet 1 of
??? = nicht bestueckt
??? = not present
Aenderungen vorbehalten / Subject to change without notice
125mV/Div.
43.5V
+12V
-6V
+65V
UNTC
SYM
DIG_S
Y_AP
Y_ROUT
/Y_ROUT
D_ANA
CT_ON
CT_Y
OS1
OS2

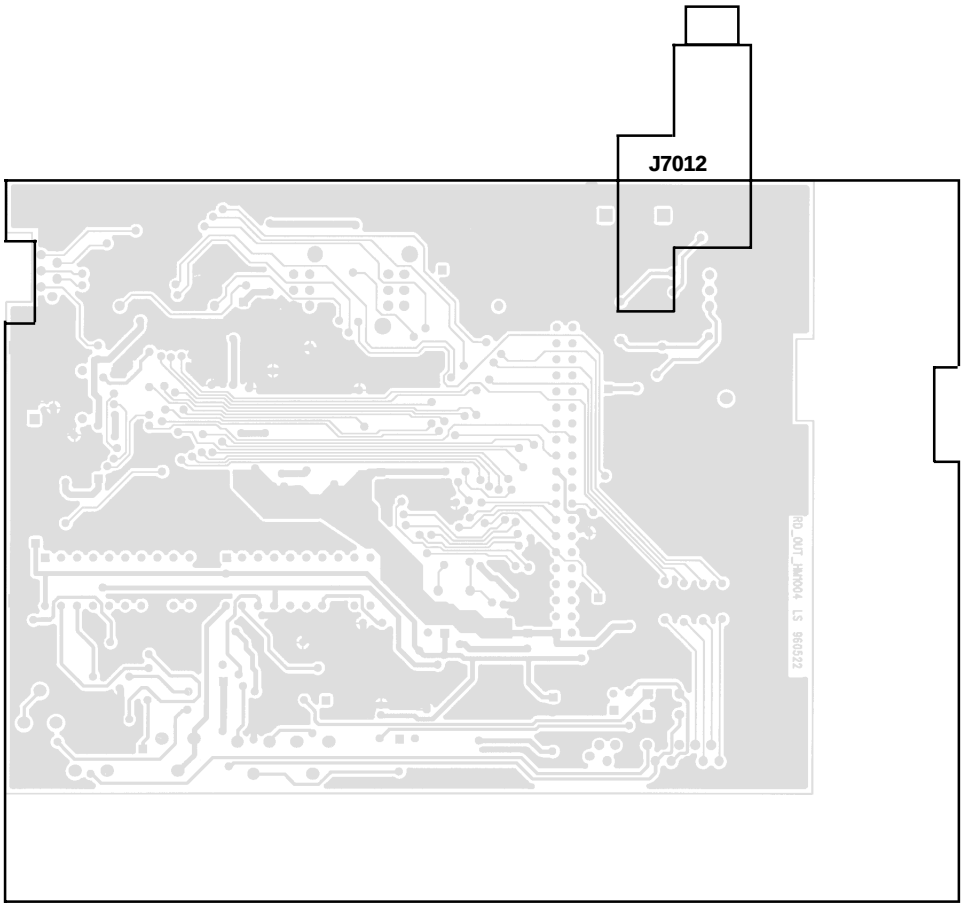

YF1004
960531 CS
IC9001
IC9002
VR9001
VR9003
VR9004
VR9005
VR9006
VR9007
VR9008
VR9009
VR9010
J9005
J9008
J9011

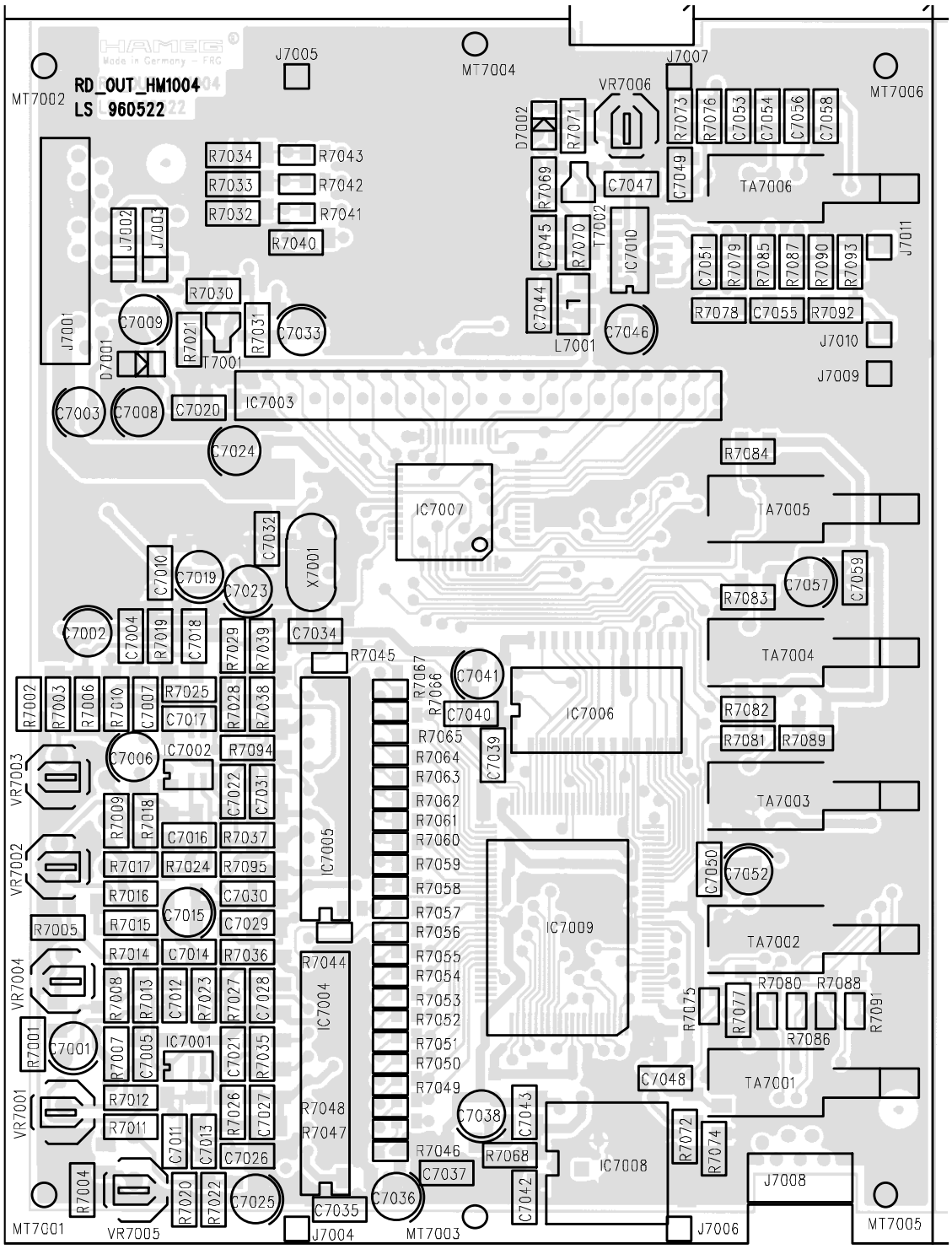

YF1004
960531 CS
IC9001
IC9002
VR9001
VR9003
VR9004
VR9005
VR9006
VR9007
VR9008
VR9009
VR9010
J9005
J9008
J9011


HAMEG®
Readout HM1004
Rev.: 0.5
Datum: 21.06.1996
Date : 21.06.1996
Blatt 1 von 2
Sheet 1 of 2
Grebenstein
FOR EMULATOR ONLY
CAL 0.2Vpp
1KHz/1MHz
0.2V @ 1MHz/1KHz
CA = 100nF/63V
CB = 10uF/16V
SHIELD
Aenderungen vorbehalten! / Subject to change without notice


HAMEG
Readout HM1004
Rev.: 0.5
Datum: 21.06.1996
Date :
Blatt 2 von 2
Sheet 2 of 2
Grebenstein
Aenderungen vorbehalten! / Subject to change without notice!
IC7009A
IC7005
IC7004
IC7006
CXK58257
IC7002A TL082
IC7002B TL082
IC7001A TL082
IC7001B TL082
IC7001C TL082
IC7002C TL082
IC7008
IC70093
J7001
J7002
J7003
MICRBU16
MOLEX_3
X_ROUT
Y_ROUT
X_RO_AMPL
Y_RO_AMPL
Y_RO_POS
Y_RO_AP
RDOUT
64MHZ
64MHz
+12V
-6V
+5V

Readout-Board (Bottomside)




RD_OUT_HM1004
LS 960522
MT7002
J7005
MT7004
J7007
MT7006
VR7006
D7002
R7071
R7073
R7076
C7053
C7054
C7056
C7058
R7034
R7033
R7032
R7043
R7042
R7041
R7040
R7069
C7047
C7049
TA7006
J7002
J7003
J7001
C7045
R7070
T7002
IC7010
C7051
R7079
R7085
R7087
R7090
R7093
J7011
R7030
C7009
R7021
T7001
R7031
C7033
C7044
L7001
C7046
R7078
C7055
R7092
J7010
D7001
J7009
C7003
C7008
C7020
IC7003
C7024
R7084
IC7007
TA7005
C7032
X7001
C7010
C7019
C7023
C7057
C7059
R7083
C7002
C7004
R7019
C7018
R7029
R7039
C7034
TA7004
R7045
R7067
R7066
C7041
R7002
R7003
R7006
R7010
C7007
R7025
R7028
R7038
C7040
IC7006
R7082
C7017
R7065
R7081
R7089
C7006
C7002
R7094
R7064
C7039
R7063
VR7003
C7022
C7031
R7062
TA7003
R7009
R7018
R7061
C7016
R7037
R7060
C7050
C7052
VR7002
R7017
R7024
R7095
R7059
R7016
C7030
R7058
C7015
R7057
IC7009
R7005
R7015
C7029
R7056
TA7002
R7014
C7014
R7036
R7055
R7044
R7054
R7080
R7088
VR7004
R7008
R7013
C7012
R7023
R7027
C7028
R7053
R7075
R7077
R7091
R7052
R7086
R7001
C7001
R7007
C7005
IC7001
C7021
R7035
R7051
C7048
R7050
TA7001
R7012
R7049
VR7001
R7048
C7038
C7043
R7011
R7047
R7046
R7068
R7072
R7074
C7011
C7013
R7026
C7027
C7037
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R7004
R7020
R7022
C7025
C7035
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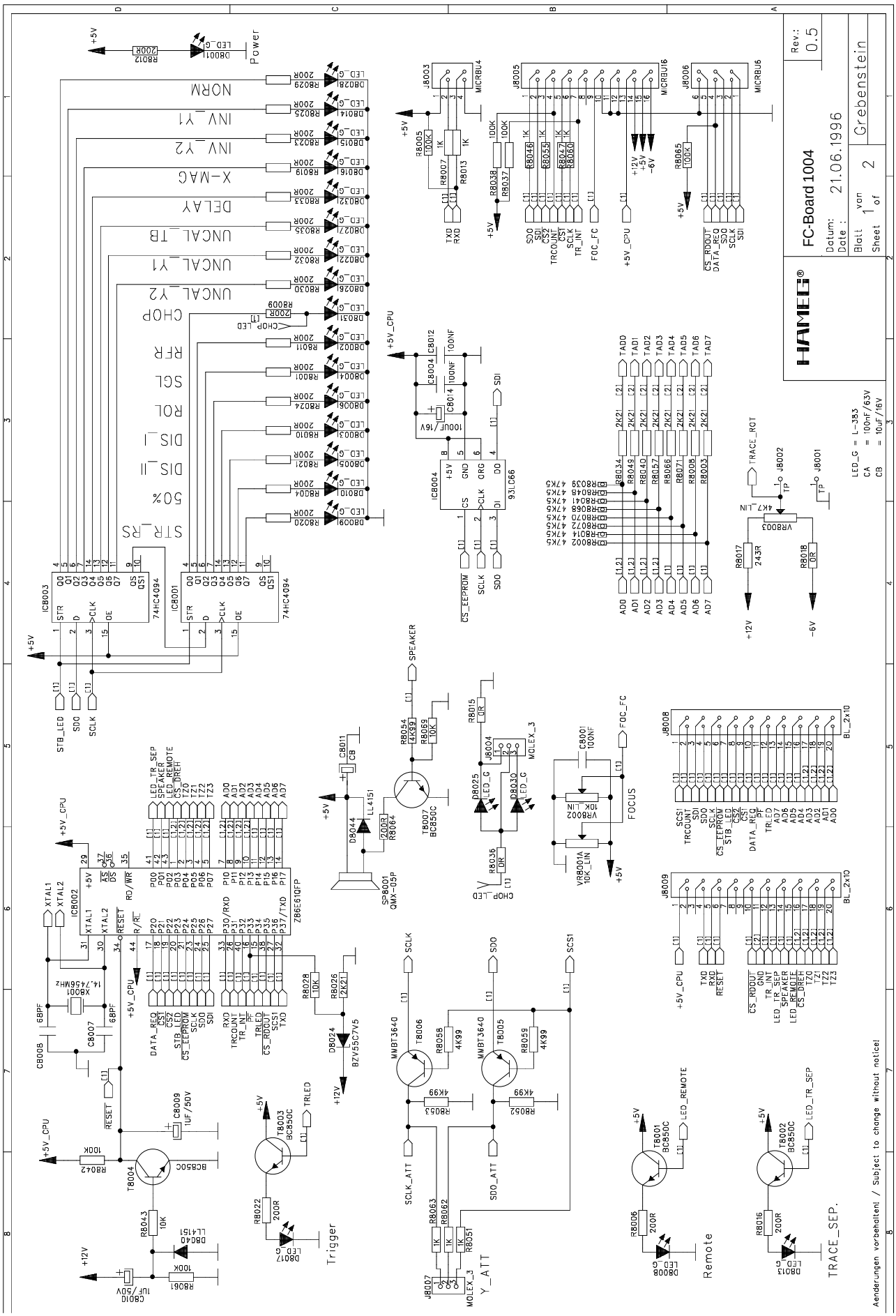
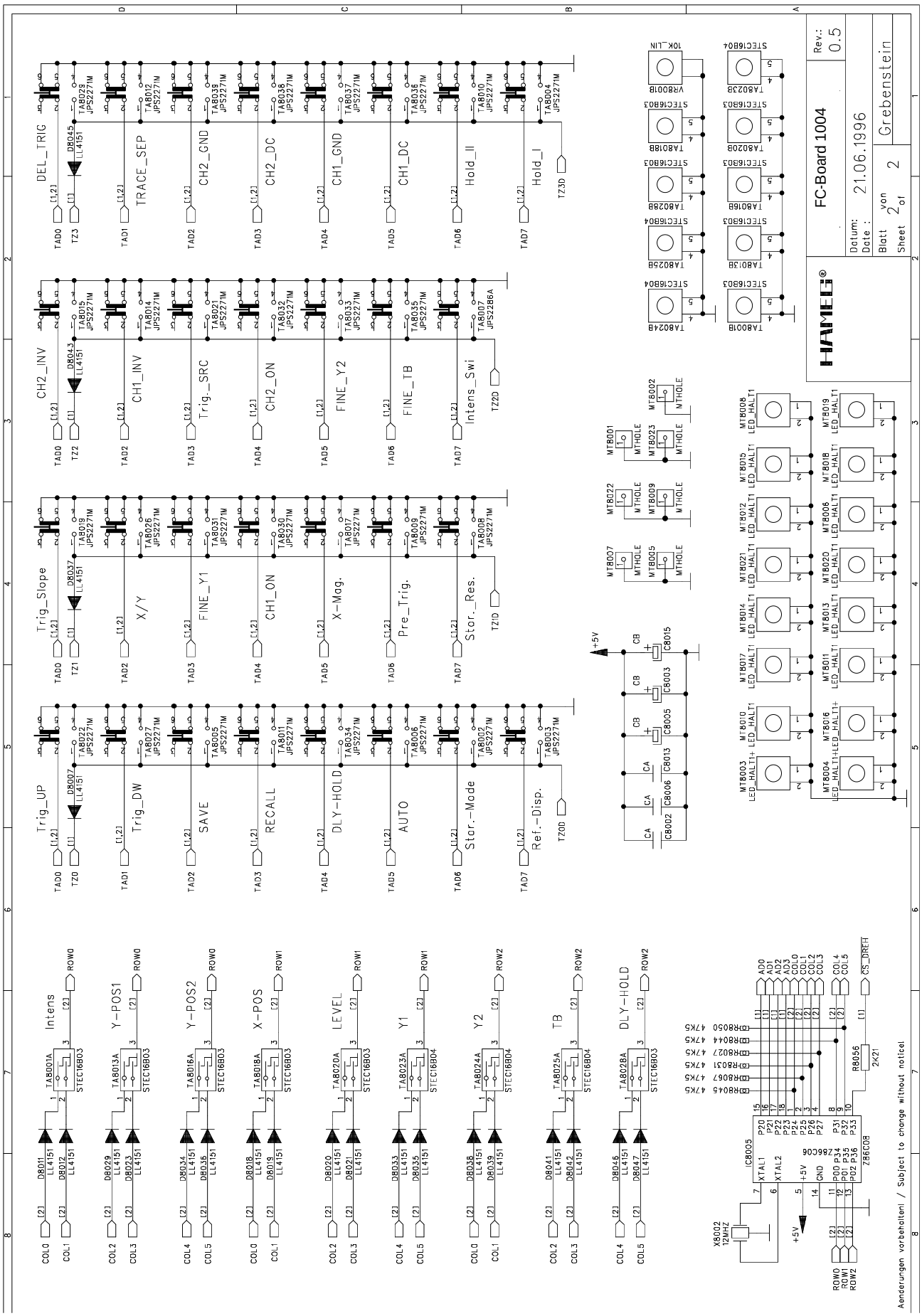
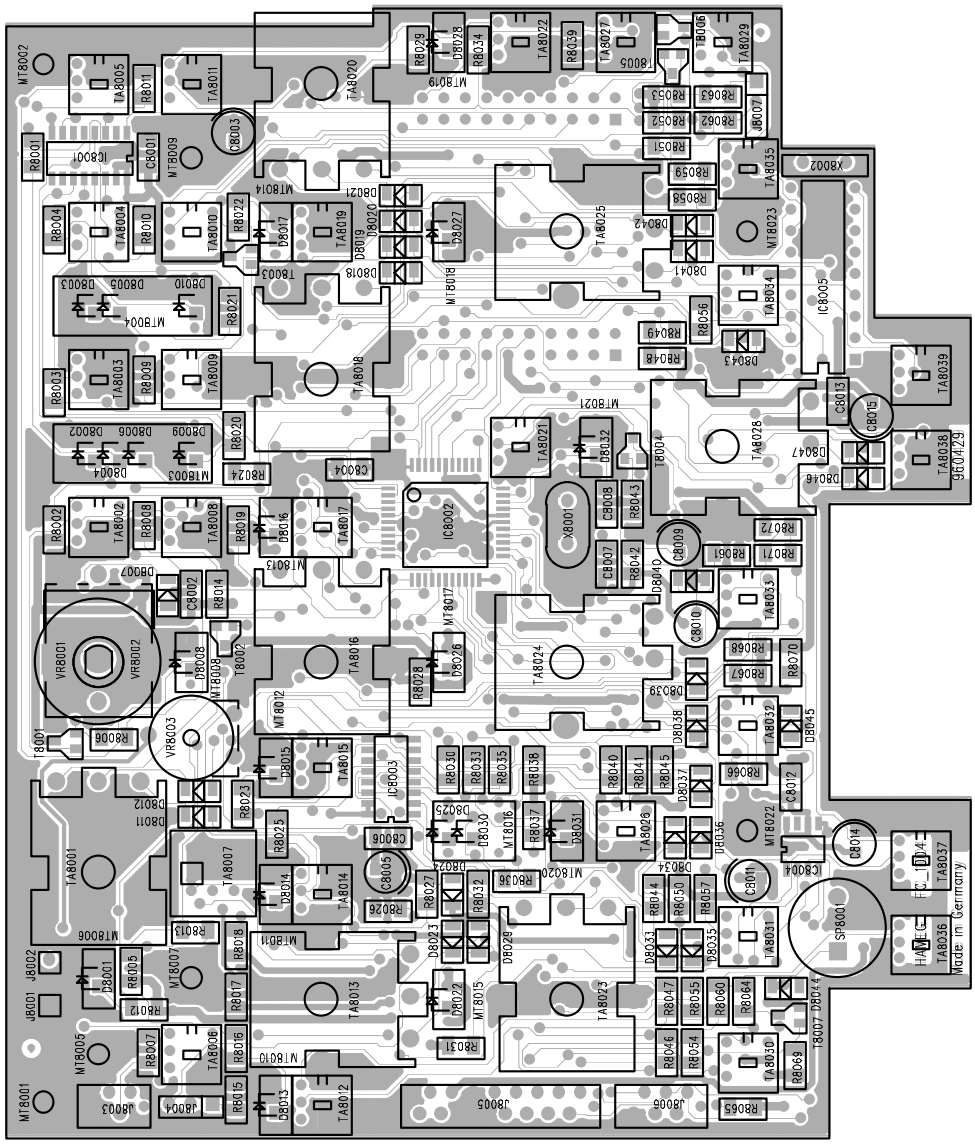
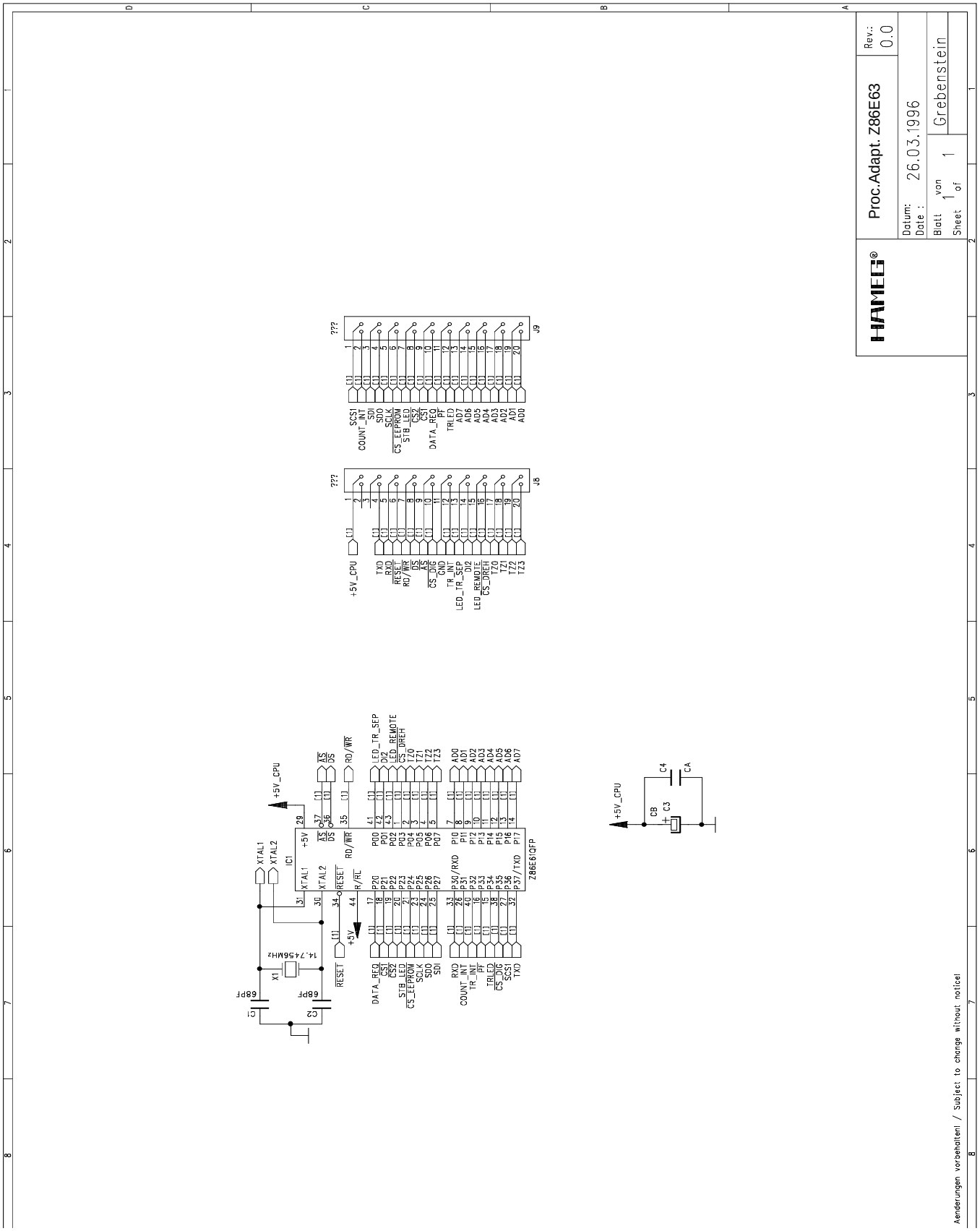
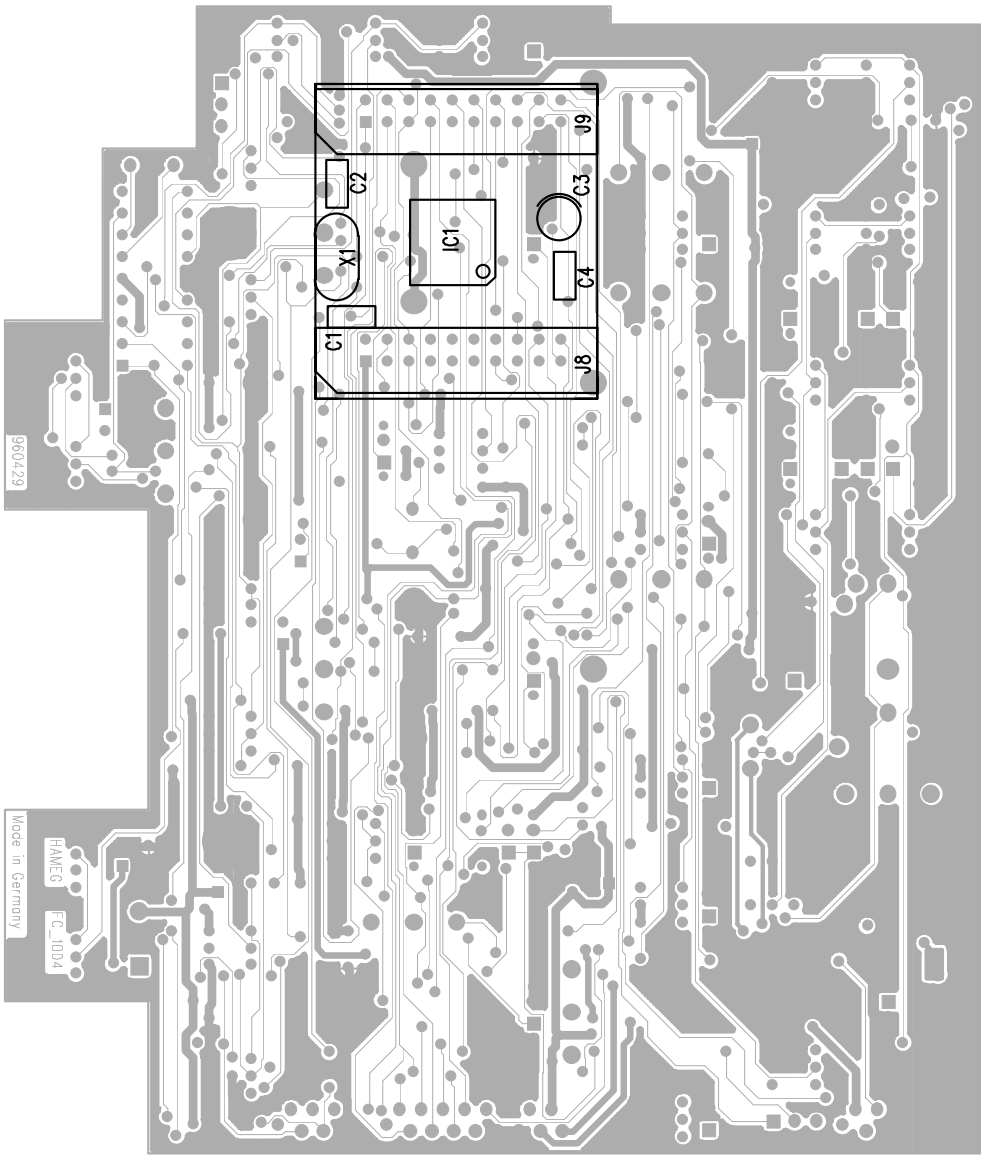
MT7001
VR7005
J7004
MT7003
J7006
MT7005
IC7004
IC7005

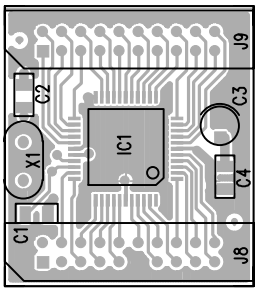

FC-Board 1004
Datum: 21.06.1996
Blatt 1 von 2
Sheet 1 of 2
Grebenstein
Rev.: 0.5
HAMEG
Power
NORM
X-MAG
INV_Y1
INV_Y2
DELAY
UNCAL_TB
UNCAL_Y1
UNCAL_Y2
CHOP
ROL
SCL
RFR
DIS_L
DIS_H
50%
STR_RS
Trigger
Remote
TRACE_SEP.
Y_ATT
FOCUS
SPEAKER
Aenderungen vorbehalten! / Subject to change without notice!

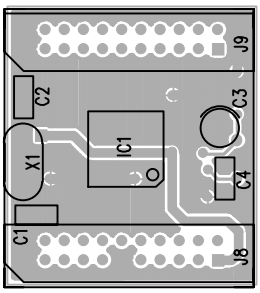

FC-Board 1004
Rev.: 0.5
Datum: 21.06.1996
Date:
Blatt 2 von 2
Sheet
Grebenstein
HAMEG
Trig_UP
Trig_DW
SAVE
RECALL
DLY-HOLD
Str.-Mode
Ref.-Disp.
Trig_Slope
X/Y
FINE_Y1
CH1_ON
X-Mag.
Pre_Trig.
Str._Res.
CH2_INV
CH1_INV
Trig._SRC
CH2_ON
FINE_Y2
FINE_TB
Intens_Swi
DEL_TRIG
TRACE_SEP
CH2_GND
CH2_DC
CH1_GND
CH1_DC
Hold_II
Hold_I
Intens
Y-POS1
Y-POS2
X-POS
LEVEL
Y1
Y2
TB
DLY-HOLD
ROW0
ROW1
ROW2
Aenderungen vorbehalten! / Subject to change without notice!


Made in Germany

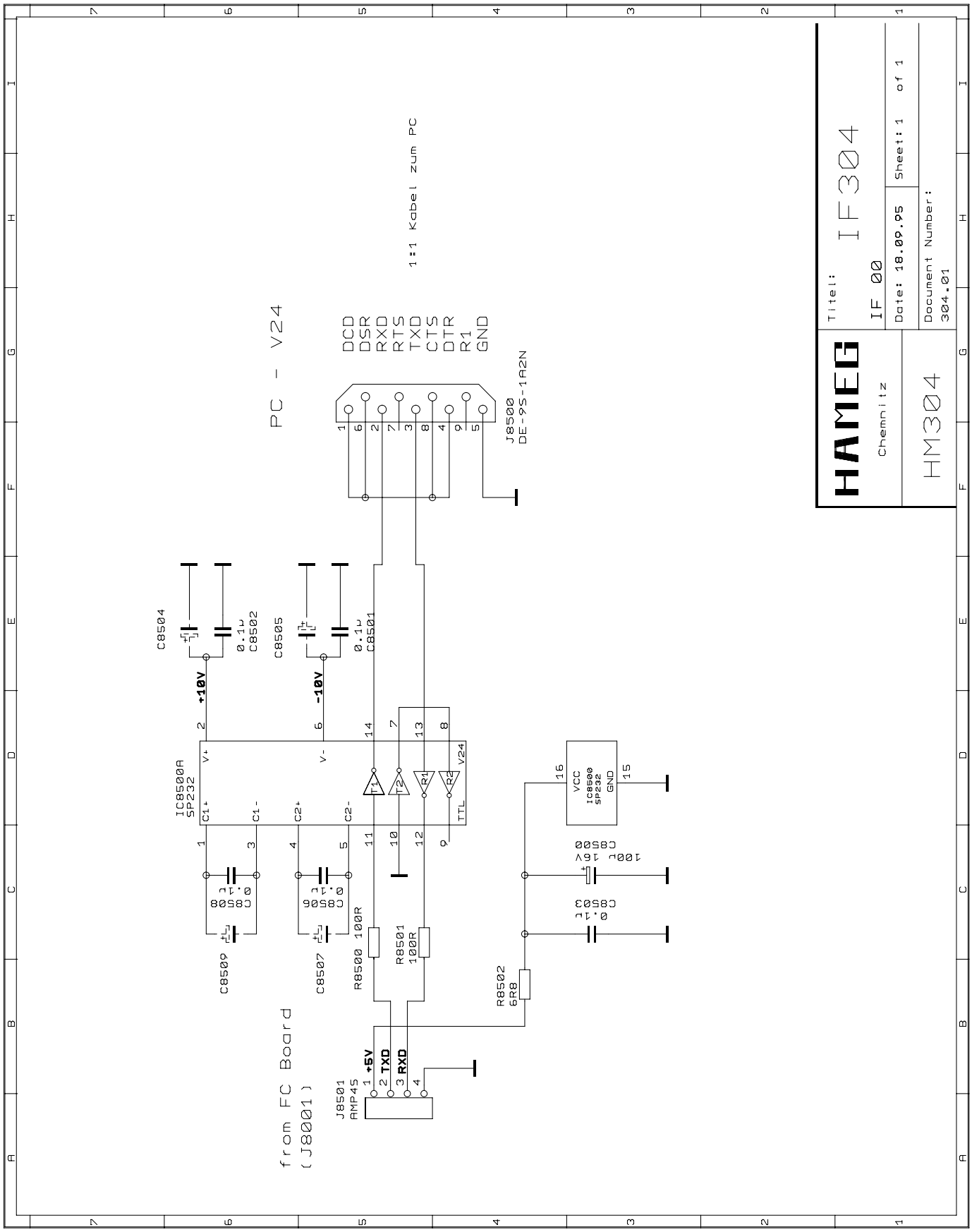

HAMEG®
Proc.Adapt. Z86E63
Rev.: 0.0
Datum: Date: 26.03.1996
Blatt Sheet 1 von of 1
Grebenstein
Aenderungen vorbehalten! / Subject to change without notice!
J9
J8
IC1
Z86E61QFP
X1
14.7456MHz
C1
C2
C3
C4
CA
CB
+5V_CPU
RESET
XTAL1
XTAL2
RD/WR
DATA_REQ
CS2
CS1
STB_LED
CS_EEPROM
SCLK
SDO
SDI
RXD
COUNT_INT
TR_INT
DF
TRLED
CS_DIG
SCS1
TXD
LED_TR_SEP
LED_REMOTE
CS_DREH



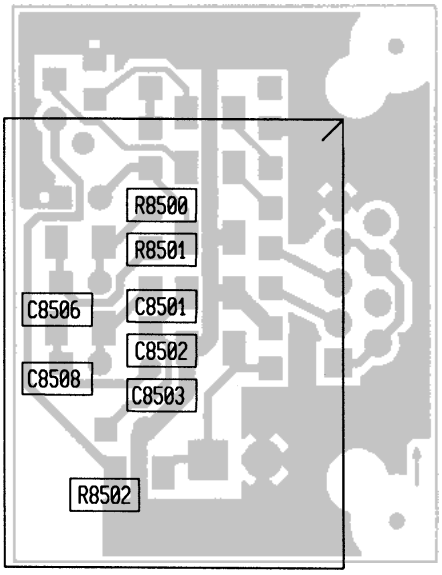


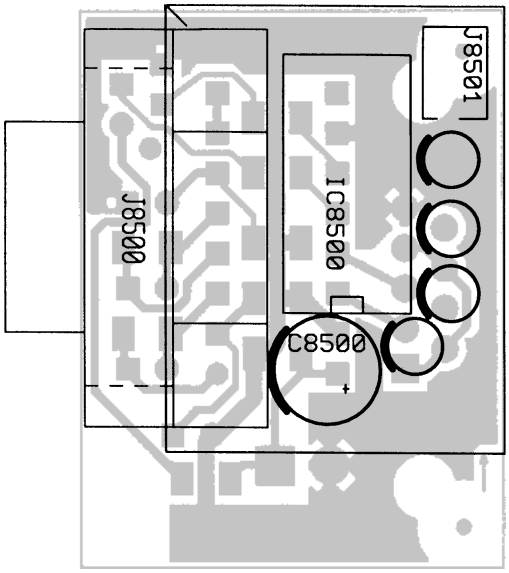


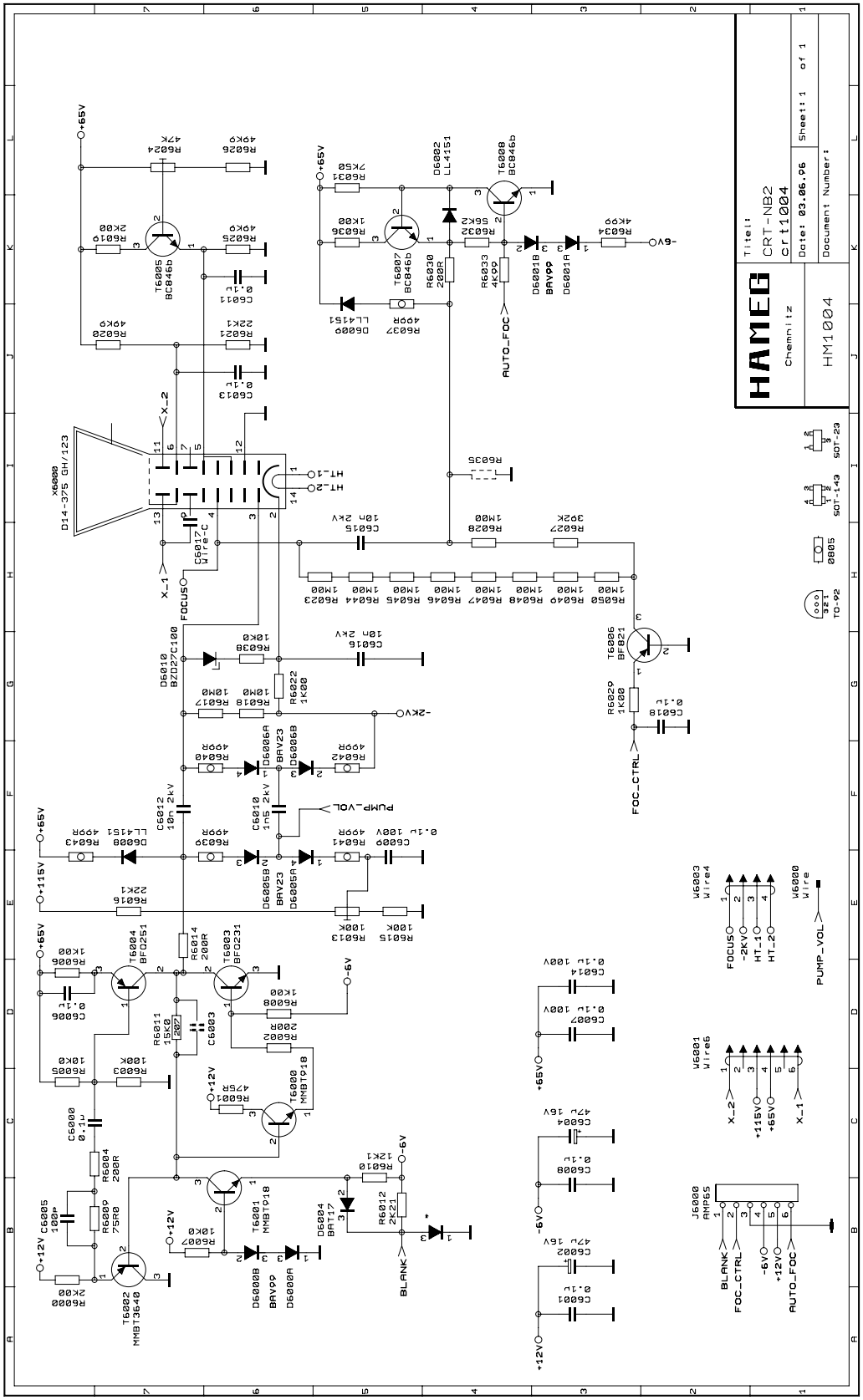
Note:
IF304 = IF1004/1505



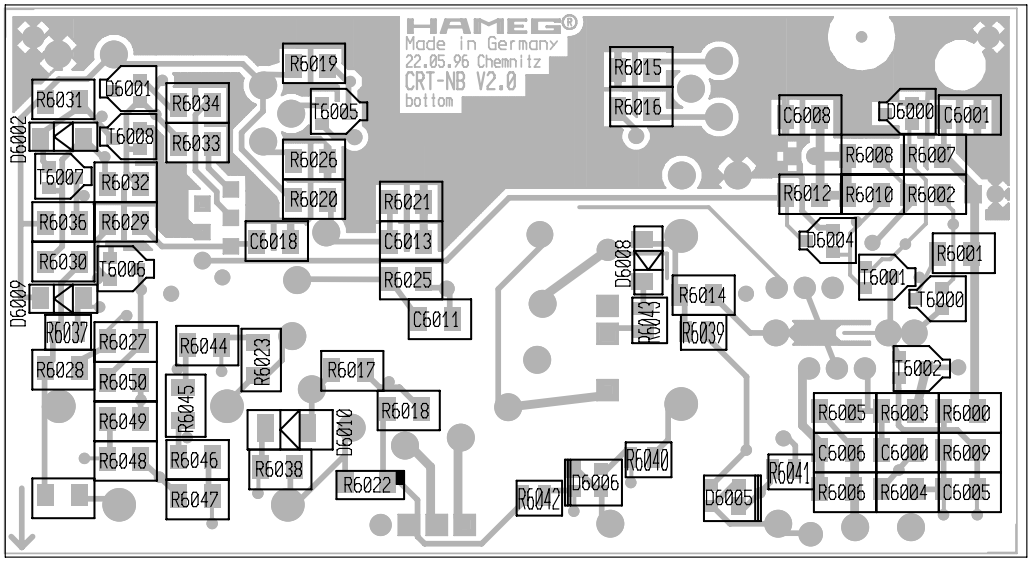
IF-Board (Top and Bottomside)

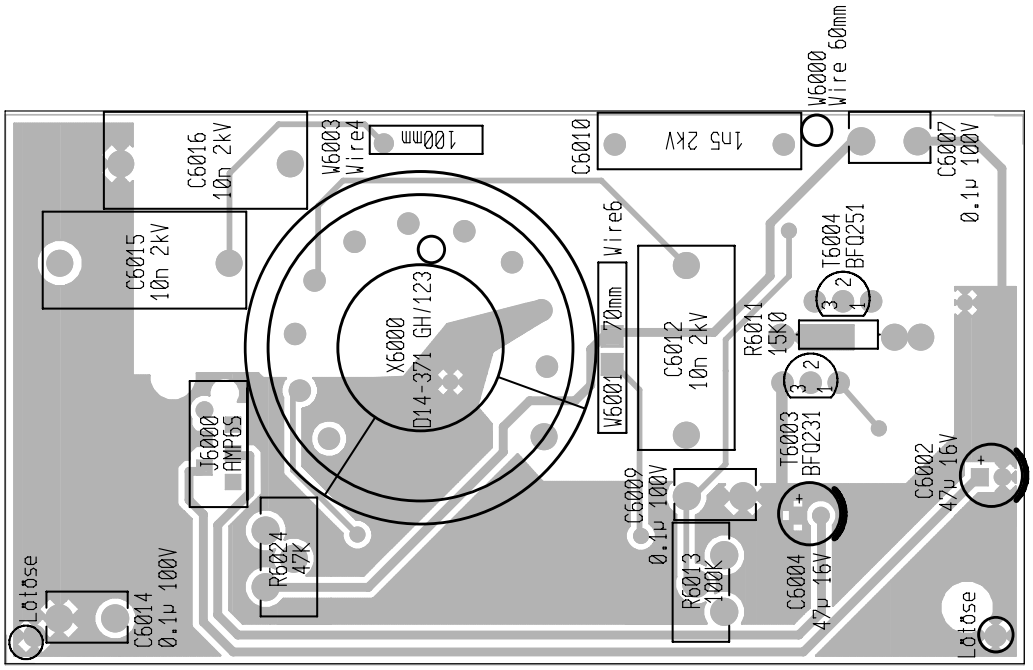


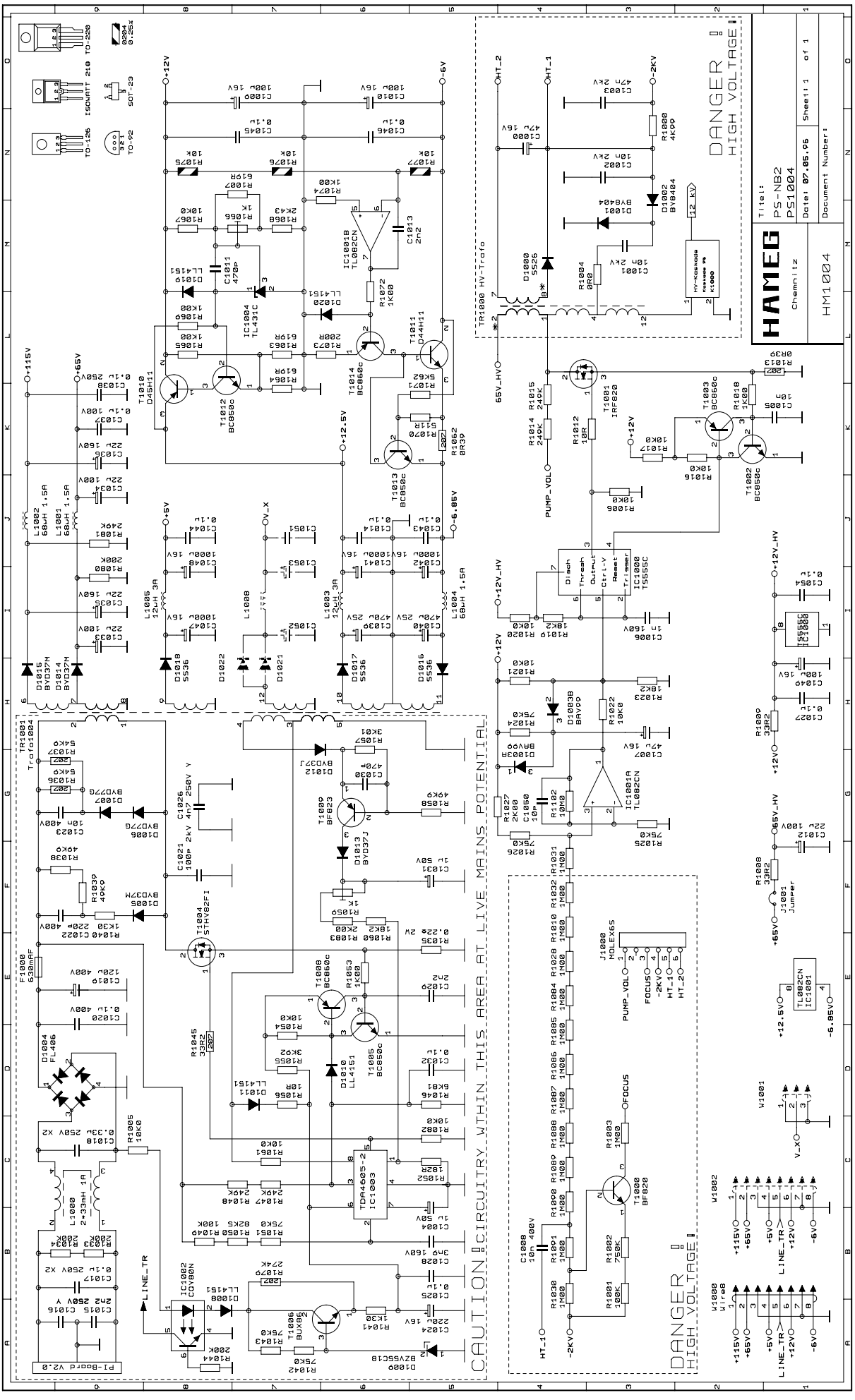


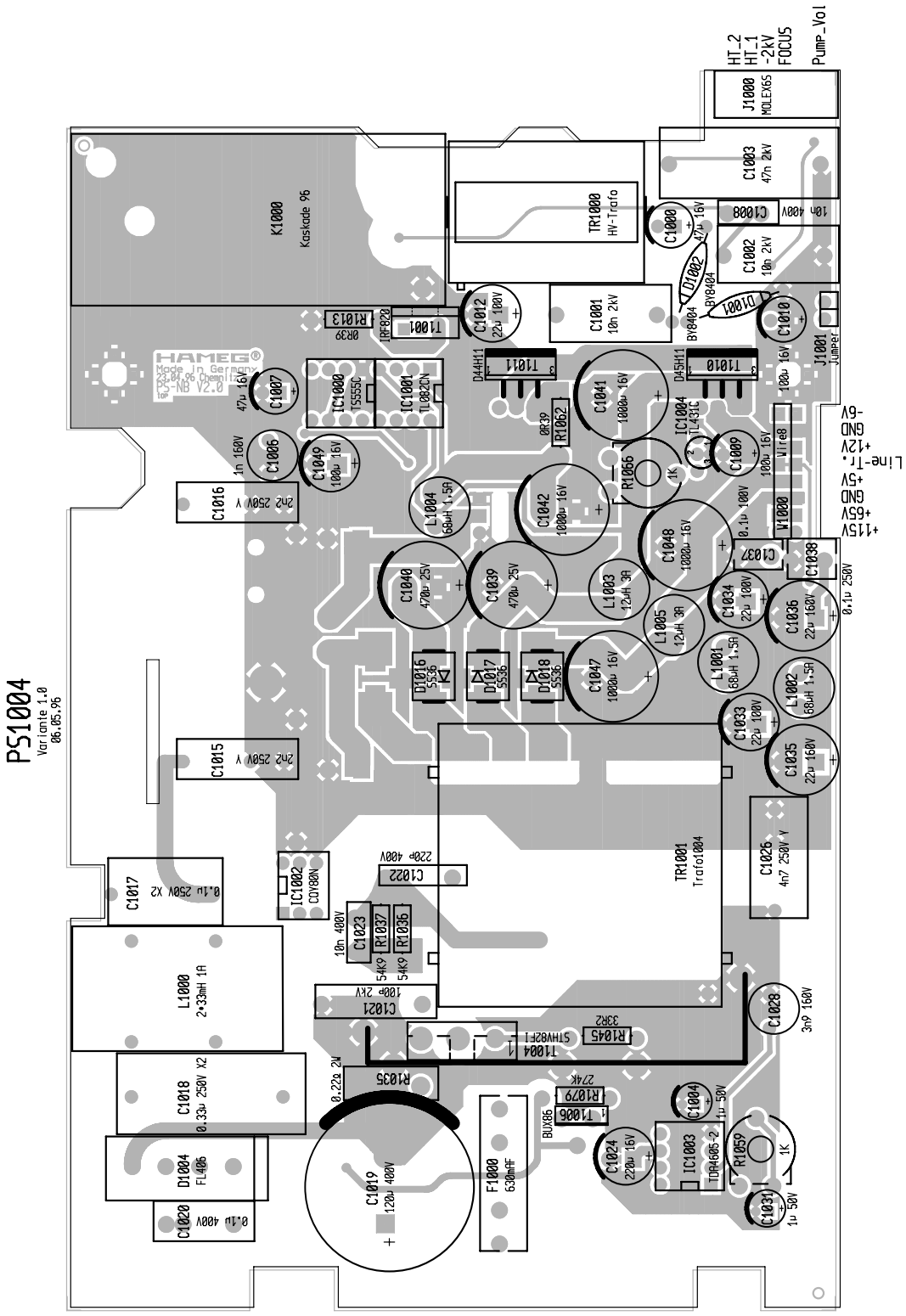

HAMEG
Chemnitz
HM1004
Titel: CRT-NB2 crt1004
Date: 03.06.96
Sheet: 1 of 1
Document Number:
+65V
-65V
+115V
+12V
-12V
-6V
-2kV
FOCUS
FOC_CTRL
PUMP_VOL
BLANK
AUTO_FOC
X_1
X_2
HT_1
HT_2
D14-375 GH/123
BZD27C100
BRV23
MMBT918
MMBT3640
BC846b
BF821
BF0251
BF0231
TO-92
SOT-143
SOT-23
0805

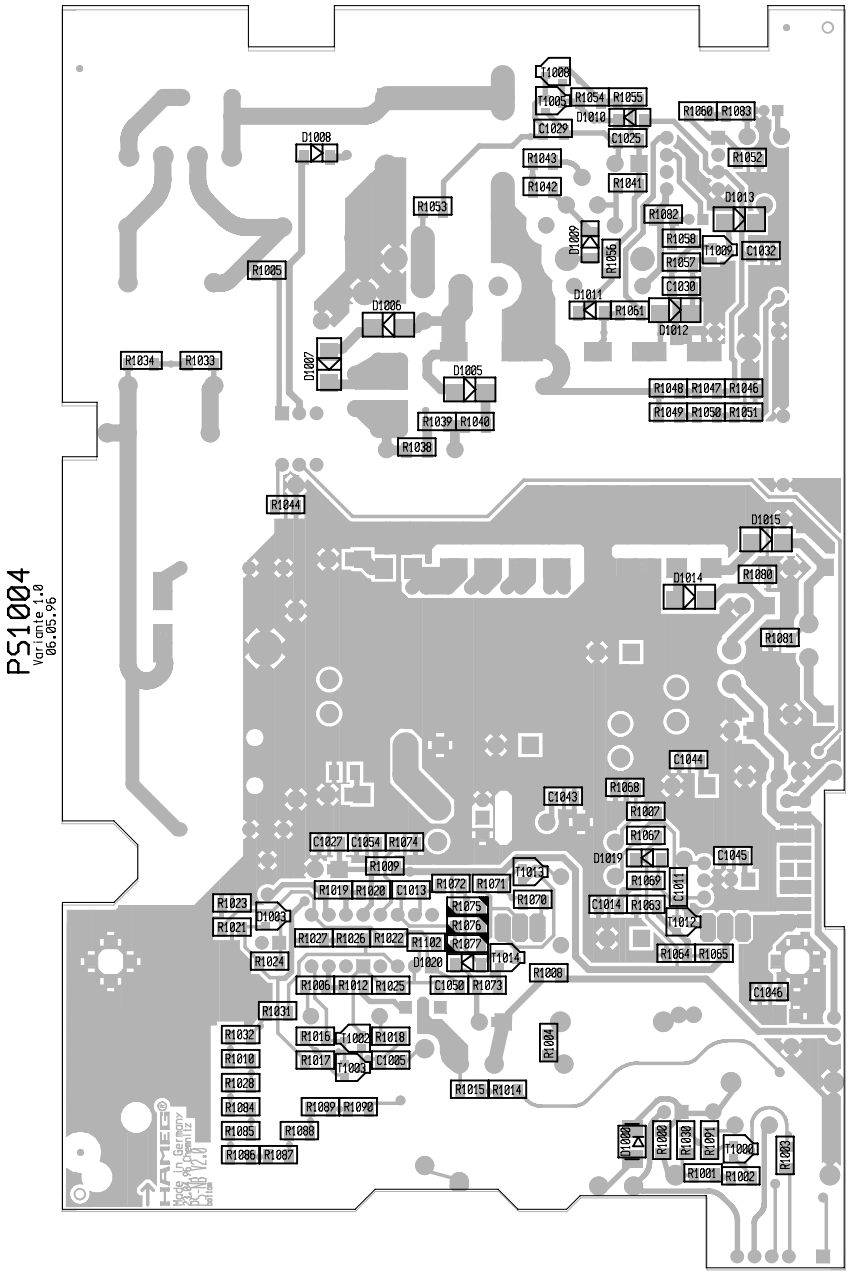
CRT-Board (Bottom and Topside)






HAMEG
Chemnitz
HM1004
Title: PS-NB2
PS1004
Date: 07.05.96
Sheet: 1 of 1
Document Number:
DANGER !
HIGH VOLTAGE !
CAUTION ! CIRCUITRY WITHIN THIS AREA AT LIVE MAINS POTENTIAL
TR1000 HV-Trafo
TR1001 Trafo1004
PI-Board V2.0
LINE_TR
PUMP_VOL
FOCUS
+12V
+5V
-6V
+65V
+115V
-2KV
HT_1
HT_2


PS1004
Variante 1.0
06.05.96
HT_2
HT_1
-2kV
FOCUS
PUMP_VOL
J1000
MOLEX65
K1000
Kaskade 96
TR1000
HV-Trafo
C1003
47n 2kV
C1000
47µ 16V
C1008
10n 400V
C1002
10n 2kV
D1002
BY8404
D1001
BY8404
C1010
100µ 16V
J1001
Jumper
C1012
22µ 100V
C1001
10n 2kV
R1013
0R39
T1001
IRF820
D44H11
T1011
D45H11
T1010
C1007
47µ 16V
IC1000
TS555C
IC1001
TL082CN
C1041
1000µ 16V
IC1004
TL431C
R1062
0R39
R1065
1K
C1009
100µ 16V
Wire8
W1000
C1006
1n 150V
C1049
100µ 16V
C1016
2n2 250V Y
L1004
68uH 1.5A
C1042
1000µ 16V
C1048
1000µ 16V
C1037
0.1µ 100V
C1038
0.1µ 250V
C1040
470µ 25V
C1039
470µ 25V
L1003
12uH 3R
L1005
12uH 3R
C1034
22µ 100V
C1036
22µ 160V
D1016
SS36
D1017
SS36
D1018
SS36
C1047
1000µ 16V
L1001
68uH 1.5A
L1002
68uH 1.5A
C1033
22µ 100V
C1035
22µ 160V
C1015
2n2 250V Y
C1026
4n7 250V Y
TR1001
Trafo1004
C1017
0.1µ 250V X2
IC1002
COY80N
C1022
220p 400V
C1023
10n 400V
R1037
54K9
R1036
54K9
C1021
100p 2kV
R1045
33R2
T1004
S1HV82FI
C1028
3n9 160V
L1000
2*33mH 1A
C1018
0.33µ 250V X2
R1035
0.22Ω 2W
R1079
27K
T1006
BUX85
C1004
1µ 50V
C1024
220µ 16V
IC1003
TDA4605-2
R1059
1K
C1031
1µ 50V
D1004
FL406
C1020
0.1µ 400V
C1019
120µ 400V
F1000
630mAF
Line-Tr.
-6V
GND
+12V
GND
+65V
+115V
GND
+5V


PS1004
Variante 1.0
06.05.96

Timebase A:

	C-SW1	C-SW2	IA*2	IA*5	IA*10	IA*100
500ms	H	L	H	H	H	H
200ms	H	L	H	L	H	H
100ms	H	L	L	L	H	H
50ms	H	L	H	H	H	H
20ms	L	H	L	H	H	H
10ms	L	H	H	L	H	H
5ms	L	H	L	L	H	H
2ms	L	H	L	H	L	H
1ms	L	H	H	L	L	H
500µs	L	H	L	L	L	H
200µs	L	H	L	H	H	L
100µs	L	H	H	L	H	L
50µs	L	H	L	L	H	L
20µs	H	H	L	H	H	H
10µs	H	H	H	L	H	H
5µs	H	H	L	L	H	H
2µs	H	H	L	H	L	H
1µs	H	H	H	L	L	H
500ns	H	H	L	L	L	H
200ns	H	H	L	H	H	L
100ns	H	H	H	L	H	L
50ns	H	H	L	L	H	L

Timebase B:

	C-SW1	C-SW2	IB*2	IB*5	IB*10	IB*100
20ms	L	H	L	H	H	H
10ms	L	H	H	L	H	H
5ms	L	H	L	L	H	H
2ms	L	H	L	H	L	H
1ms	L	H	H	L	L	H
500µs	L	H	L	L	L	H
200µs	L	H	L	H	H	L
100µs	L	H	H	L	H	L
50µs	L	H	L	L	H	L
20µs	H	H	L	H	H	H
10µs	H	H	H	L	H	H
5µs	H	H	L	L	H	H
2µs	H	H	L	H	L	H
1µs	H	H	H	L	L	H
500ns	H	H	L	L	L	H
200ns	H	H	L	H	H	L
100ns	H	H	H	L	H	L
50ns	H	H	L	L	H	L

	Name	Type of signal	Board	Meaning
1	\EXT-SW	analog	MB, AT	signal from external trigger unit
2	\INTBON	digital	MB	control signal for timebase B intensity
3	\V1-TRG	digital	MB	trigger mode switch CH1
4	\V2-TRG	digital	MB	trigger mode switch CH2
5	5V CPU	5V stabil.	MB. FC	supply voltage for ADC, DACs, CPU
6	ADD	digital	MB	addition CH1 + CH2
7	ALT-TB	digital	MB	alternate timebase
8	ANA_MODE	digital	MB	controls analog- / digital mode
9	ANA-Z	digital	MB, RO	control signal for READOUT intensity (analog-/ digital intens.)
10	AUTO_FOC	analog	MB, CRT	optimizes beam sharpness (max./min. intensity)
11	BLANK	analog	MB, CRT	blanking signal
12	BLOUT	digital	MB	unblank pulse
13	C_SW1	digital	MB	selects timebase A timing and holdoff capacitors
14	C_SW2	digital	MB	selects timebase A timing and holdoff capacitors
15	CB_SW	digital	MB	selects timebase B timing capacitors
I6	CS_AD	digital	MB	chip select ADC
17	CS_DA	digital	MB	chip select DACs
18	CS_MAIN	digital	MB	chip select X-PLD, TB & TRG-register
19	CS1	digital	MB	chip select V-PLD
20	D_ANA	digital	MB, RO, YFA	controls digital-/analog readout
21	DARK2	digital	MB. RO	unblank signal for readout
22	DEL-EN	digital	MB	enable DELAV-comparator
23	DEL-POS	analog 10 bits	MB	DELAV-comparator reference voltage
24	DIG_TR	digital	MB	prepared for digital board
25	DY11	Signal	MB	prepared for digital board
26	DY12	Signal	MB	prepared for digital board
27	DY21	Signal	MB	prepared for digital board
28	DY22	Signal	MB	prepared for digital board
29	END-HO	digital	MB	indicates the end of the holdoff time
30	END-SW-A		MB	indicates the end of timebase A ramp
31	END-SW-B		MB	indicates the end of timebase B ramp
32	EXT-SW	Signal	MB, AT	external trigger signal
33	FOC_CTR	analog	MB, CRT	line from focus potentiometer to CRT
34	FOC_FC	analog	MB, FC	line from focus potentiometer to CRT
35	GATE-A	digital	MB	timebase A control line
36	GATE-B	digital	MB	timebase B control line
37	HOS	digital	MB	minimum holdoff in AUTOSET condition
38	IA*10	digital	MB	timebase A
39	IA*100	digital	MB	timebase A
40	IA*2	digital	MB	timebase A
41	IA*5	digital	MB	timebase A
42	I8*10	digital	MB	timebase B
43	IB*100	digital	MB	timebase B
44	IB*2	digital	MB	timebase B
45	I8*5	digital	MB	timebase B
46	INT A+B	analog 8 bits	MB	intensity for A+B
47	INT A-B	analog 8 bits	MB	intensity for A-B
48	INT RDOT	analog 8 bits	MB	intensity for READOUT
49	LF-TRG	digital	MB	control signal for LF trigger coupling
50	LINE-ON	digital	MB	control signal for line (mains) triggering
51	LINE-TRG	signal	MB, PS	line (mains) trigger signal
52	MAG_10	digital	MB	control signal for magnification
53	MAIN_CLK	digital	MB	gated SCLK for X-PLD & register
54	PP-	analog	MB	negative peak value
55	PP+	analog	MB	positive peak value
56	PP-DIS	digital	MB	control signal for peak value discharge (i.e. Autoset..)
57	SCLK	digital	MB, FC, RO	system clock
58	SDI	digital	MB, FC, RO	serial data ADC,RO → CPU
59	SDO	digital	MB. FC. RO	serial data CPU → V-PLD. ADC. DAC. Register, RO
60	SH-DI	digital	MB	serial data register → X-PLD

	Name	Type of signal	Board	Meaning
62	START-A	digital	MB	start timebase generator A
63	START-B	digital	MB	start timebase generator B
64	START-HO	digital	MB	start holdoff time
65	SWEEP-A	analog	MB	timebase generator A output
66	SWEEP-B	analog	MB	timebase generator B output
67	SYS-REF	2.5V	MB, AT	system reference
68	TBA ADJ	analog 8 bits	MB	calibrating voltage for timebase A
69	TBA-ON		MB	timebase A → X final amplifier
70	TBA-VAR	10 bit	MB	timebsae A variable
71	TBB ADJ	analog 8 bits	MB	calibration voltage for timebase B
72	TBB-ON	digital	MB	timebase B → X final amplifier
73	TBB-VAR	analog 10 bits	MB	timebase B variable
74	TBS	digital	MB	signals the sawtooth maximum (0.5V) in AUTOSET condition
75	TR EN	digital	MB	prepared for digital board
76	TRACE-DA	analog 8 bits	MB	Y position of the separated Y-Signal
77	TR-A-IN		MB	trigger signal A
78	TRA-LEV	analog 10 bits	MB	trigger level A
79	TR-B-IN		MB	trigger signal B
80	TRB-LEV	analog 10 bits	MB	trigger level B
81	TRCOUNT	digital	MB	Autoset: trigger counter: normal mode: trigger interrupt
82	ADJ	analog 8 bits	MB	DC-AP at trigger amplifier output
83	TRGMP	analog	MB	trigger amplifier operating point
84	TV-FIELD	digital	MB	frame sync. pulse for TV triggering
85	TV-LINE	digital	MB	line sync. pulse for TV triggering
86	TV-SLOP	digital	MB	polarity TV signal
87	X/Y	Signal	MB	X signal in X/Y mode, originates from channel 2
88	X/Y-ON	digital	MB	control signal for X/Y mode
89	X-POS	analog 10 bits	MB	X position voltage
90	Y1	digital	MB	channel switch
91	V1-INV	digital	MB	control signal for Invert switch CH1
92	Y1-POS	analog 10 bits	MB	Y2 position voltage
93	Y2	digital	MB	channel switch
94	Y2-INV	digital	MB	control signal for Invert CH2
95	Y2-POS	analog 10 bits	MB	Y2 position voltage

Adjustment Procedure

HM1004/1505

ADJUSTMENT PROCEDURE

Analog Scope HM1004 / HM1505

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

HIGH VOLTAGE WARNING!

Hazardous High Voltage of up to 12,000 Volts is present inside this Instrument. The areas particularly affected by High Voltage are the high voltage circuit on the PS-board, the CRT anode contact and the 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 60-2.
2) Constant amplitude sinewave generator, 20Hz - 250MHz, output 5mV - 5V into 50Ω, preferably with 20dB attenuation (e.g. HM 8133, TEK SG502 + TEK SG503).
3) Amplitude Calibrator with 1kHz square wave output and 600Ω impedance, risetime faster than 150ns. Output voltage 2mV - 20Volts in 1-2-5 sequence for 4 divisions display amplitude (e.g. HZ62, TEK PG506).
4) Time mark generator from 5ns/div to 5s/div. Output min. 10mV into 50Ω (e.g. HZ62, TEK TG501).
5) Pre-attenuator 2:1 (1 MΩ parallel with 12-48pF), e.g. HZ20.
6) 50Ω BNC through termination, e.g. HZ22.
7) 2 BNC-cables, 50Ω, e.g. HZ34.
8) BNC-T-connector.
9) Oscilloscope probe 10:1, with exactly 9MΩ series resistance and compensated for test oscilloscope mentioned under 10).
10) Oscilloscope 100MHz, 5mV/div to 5V/div, e.g. HM1005.
11) Trimming/adjusting tool.
12) Variable output safety insulation transformer.
13) Video signal generator with positive and negative signal output.

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

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

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

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

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

X-Section:

TIME/DIV. (TB-A)	100ns (readout)
TIME VAR. (TB-A)	calibrated detent (A: 100ns)
NORM (trigger)	off (NM LED dark)
TRIG. (coupling)	AC (readout TR:...)
TRIG. LEVEL	electrical center position (triggerpoint symbol in trace position)
TRIG. (SLOPE)	rising slope symbol (readout TR:...)
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)
ALT/B Timebase	off (B time coefficient not displayed in the readout)

Y-Section:

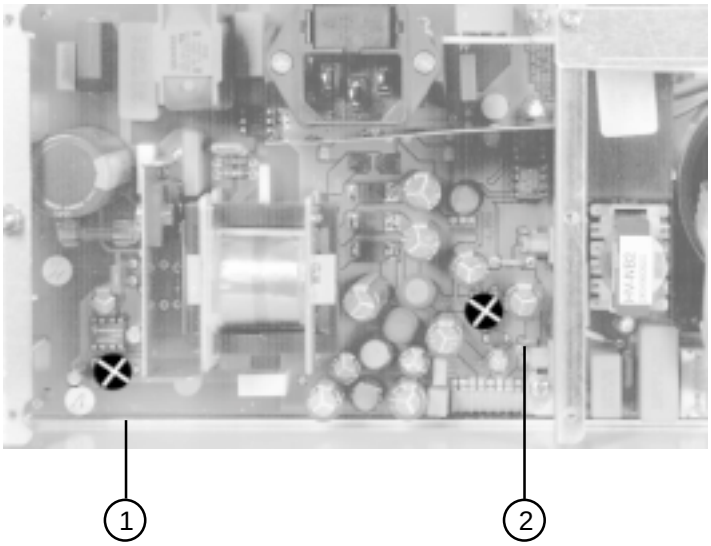
CH I	on, 5mV/div, calibrated, DC input coupling (readout CH1:5mV=)
CH II	off (deflection coefficient and input coupling not displayed in the readout)
INV CH I & II	off (both INV LEDs dark)
Y-POS I & II	electrical center position
EXTern (trigger)	off (TR: EXT... not displayed in the readout)

CAL.-Section

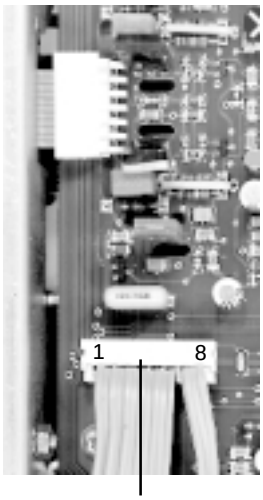
CALIBRATOR	1 kHz

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

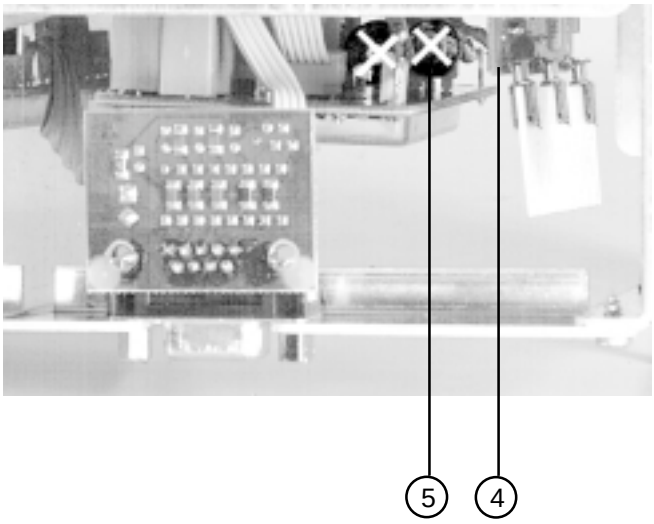
PS-Board



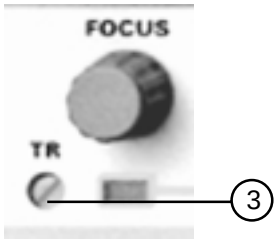
MB-Board



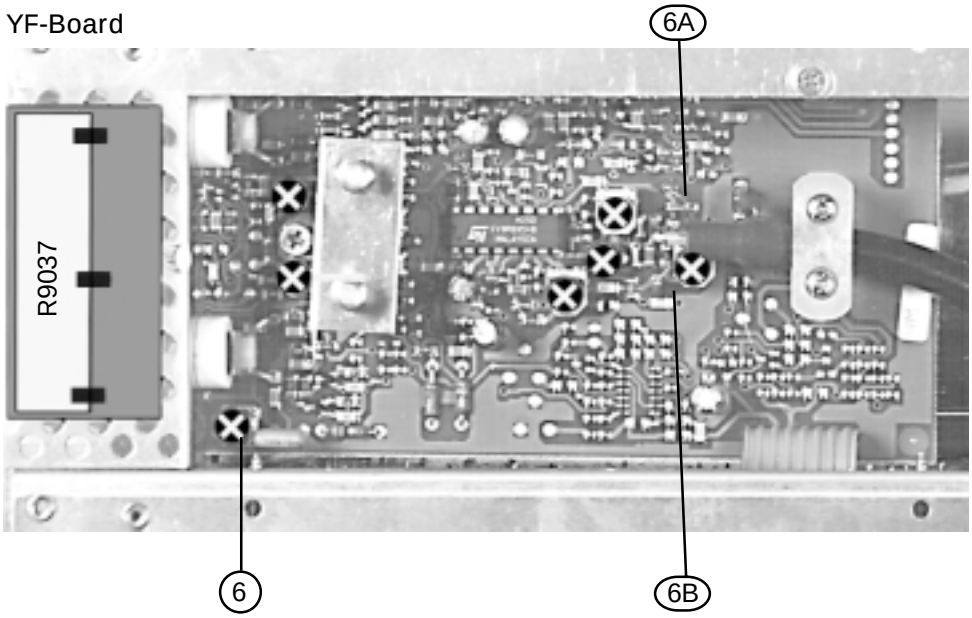
CRT-Board



Front Panel HM1004



YF-Board



ADJUSTMENT PROCEDURE

Locate and identify R1059 (1) on PS-Board (screened section).
Locate connector J4400 (8pole Molex) on MB-Board and identify pin 1.
Adjust R1059 (1) for exactly +115 Volts (± 0.1 Volt) at J4400 pin 1 with respect to chassis.

2) R1066: +12 Volt supply.

Locate and identify R1066 (2) on PS-Board.
Locate connector J4400 (8pole Molex) on MB-Board and identify pin 6.
Adjust R1066 (2) for exactly +12 Volts (± 10mV) at J4400 pin 6 with respect to chassis.
At J4400 the other voltages +65V (pin 2), -6V (pin 8), +5V (pin 4) and -1950V on the cathode of the CRT depend on the correct +12 Volt adjustment. All these voltages with higher tolerances must be checked and verified.

3) VR8003: Trace Rotation Check.

Locate and identify VR8003 (3) „TR“ on the front panel.
Press channel I GD pushbutton to ground the input (readout: „CH1:ground symbol“).
Rotate VR8003 (3) and 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.
Press channel I GD pushbutton to switch back to the basic setting.

4) R6013: CRT minimum intensity.

Locate and identify R6013 (4) on CRT-Board.
Set INTENS. control to fully left position (beep).
Press ADD-XY pushbutton briefly for XY mode (readout: both channel deflection coefficients and XY.)
Adjust R6013 (4) so that the dot just disappears.
Press ADD-XY pushbutton briefly for time base mode.

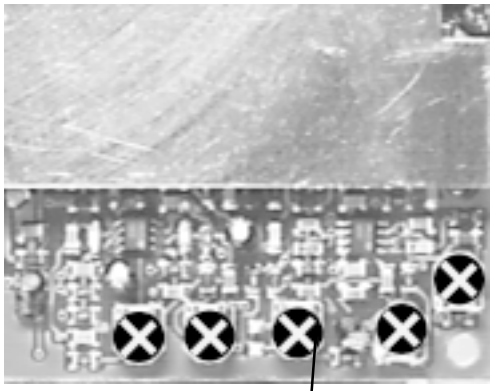
5) R6024: Astigmatism correction.

Locate and identify R6024 (5) on CRT-Board.
Press channel I GD pushbutton to ground the input (readout: „CH1:ground symbol“).
Press ADD-XY pushbutton briefly for XY mode (readout: both channel deflection coefficients and XY.)
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 (5) so that the spot shape does not change when defocussed.
Press ADD-XY pushbutton briefly for time base mode.

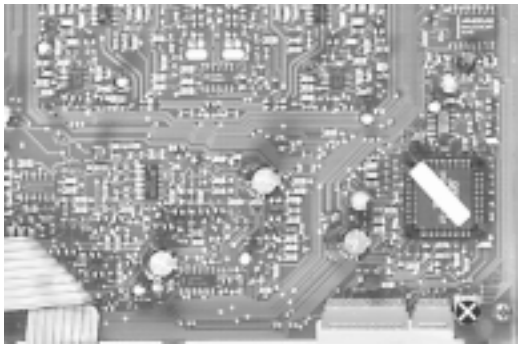
6) VR9009: Y-Final Amplifier Balance.

Locate and identify VR9009 (6) on YF-Board.
Switch the oscilloscope OFF.
Locate and identify the Delay-Line with the connections 6A and 6B.
Connect 6A and 6B (short) galvanically (wire with crocodile clips).
Switch the oscilloscope ON.
Adjust VR9009 (6) to set the trace to the horizontal center line of the graticule.
Switch the oscilloscope OFF.
Remove the short-circuiting wire.
Switch the oscilloscope ON.

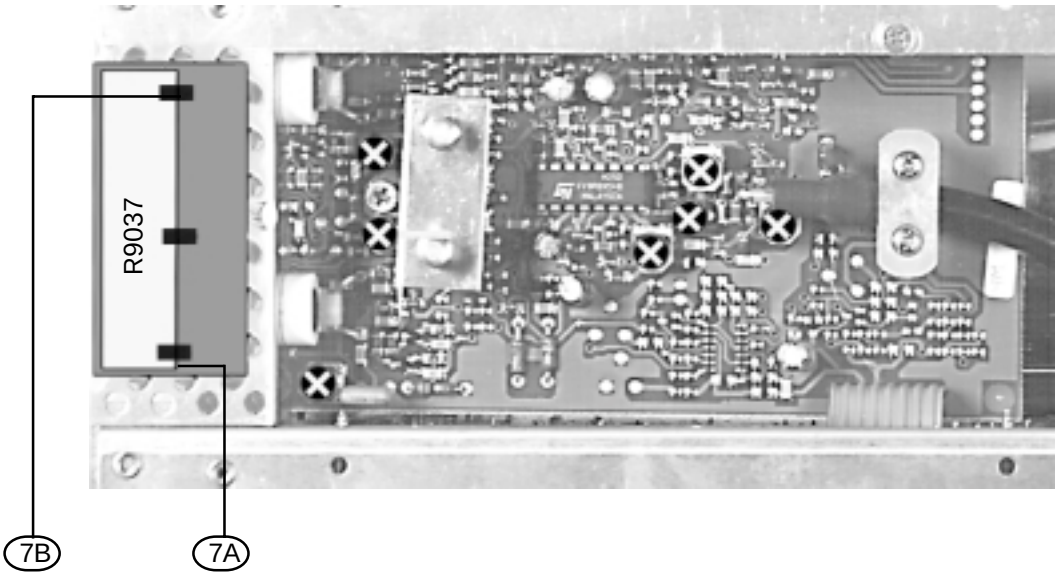
Readout-Board (Detail)



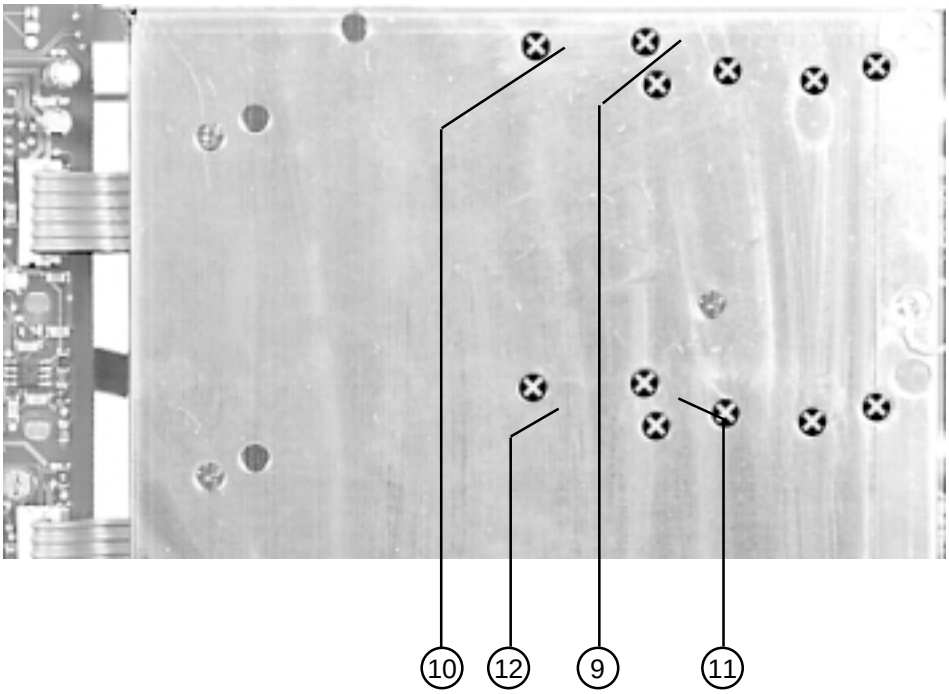
MB-Board (Detail)



YF-Board



AT-Board



7) R7004: Mean Readout Y-Plate Potential.

Locate and identify R7004 (7) on Readout-Board.
Press channel I GD pushbutton to ground the input (readout: „CH1:ground symbol“).
Set trace to the horizontal center line of the graticule.
Locate and identify the ceramic (double) resistor R9037 with the connections 7A and 7B.

Connect a 10:1 probe to the Y-input of the control oscilloscope.
Set the controlscope to DC input coupling, 1V/div and 2ms/div time deflection coefficient.
Connect the probe crocodile clip with chassis.
Connect the probe tip with connector 7B.
Set the Y position control of the control oscilloscope in such a way, that the signal becomes visible.
The signal contains of a trace (+45V) that represents the trace and two 2ms AC signals representing the readout signal.
Adjust R7004 (7) that the AC signal is set symmetrically to the DC content.
Remove the probe from connector 7B.

8) R5015: Auto Focus correction.

Locate and identify R5015 (8) on Main-Board.
Press channel I GD pushbutton to ground the input (readout: „CH1:ground symbol“).
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 R5015 (8) for maximum readout sharpness.

9) R2001: 10Hz Squarewave 5mV/div CH I.

Locate and identify R2001 (9) in CH I section of the AT-Board.
Connect a 25mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 10ms/div.
Adjust R2001 (9) for flat top.

10) R2002: 10Hz Squarewave 1mV/div Adjustment CH I.

Locate and identify R2002 (10) in CH I section of the AT-Board.
Connect a 5mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set input attenuator channel I to 1mV/div
Set time base to 10ms/div.
Adjust R2002 (10) for flat top.

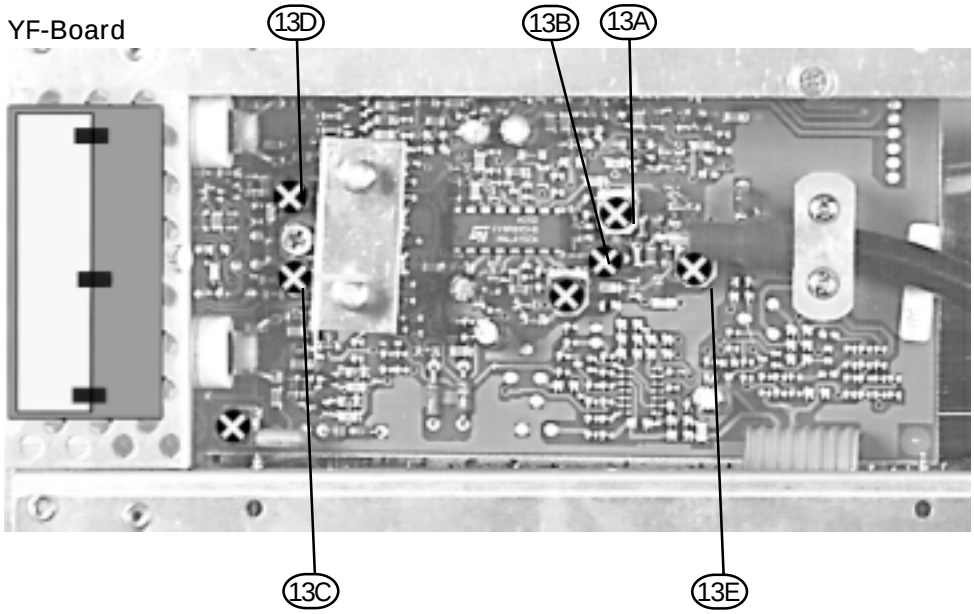
11) R2005: 10Hz Squarewave 5mV/div CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R2005 (11) in CH II section of the AT-Board.
Connect a 25mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set time base to 10ms/div.
Adjust R2005 (11) for flat top.

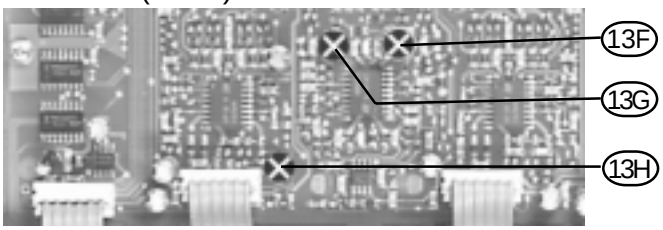
12) R2006: 10Hz Squarewave 1mV/div CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R2006 (12) in CH II section of the AT-Board.
Connect a 5mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set input attenuator channel II to 1mV/div
Set time base to 10ms/div.
Adjust R2006 (12) for flat top.

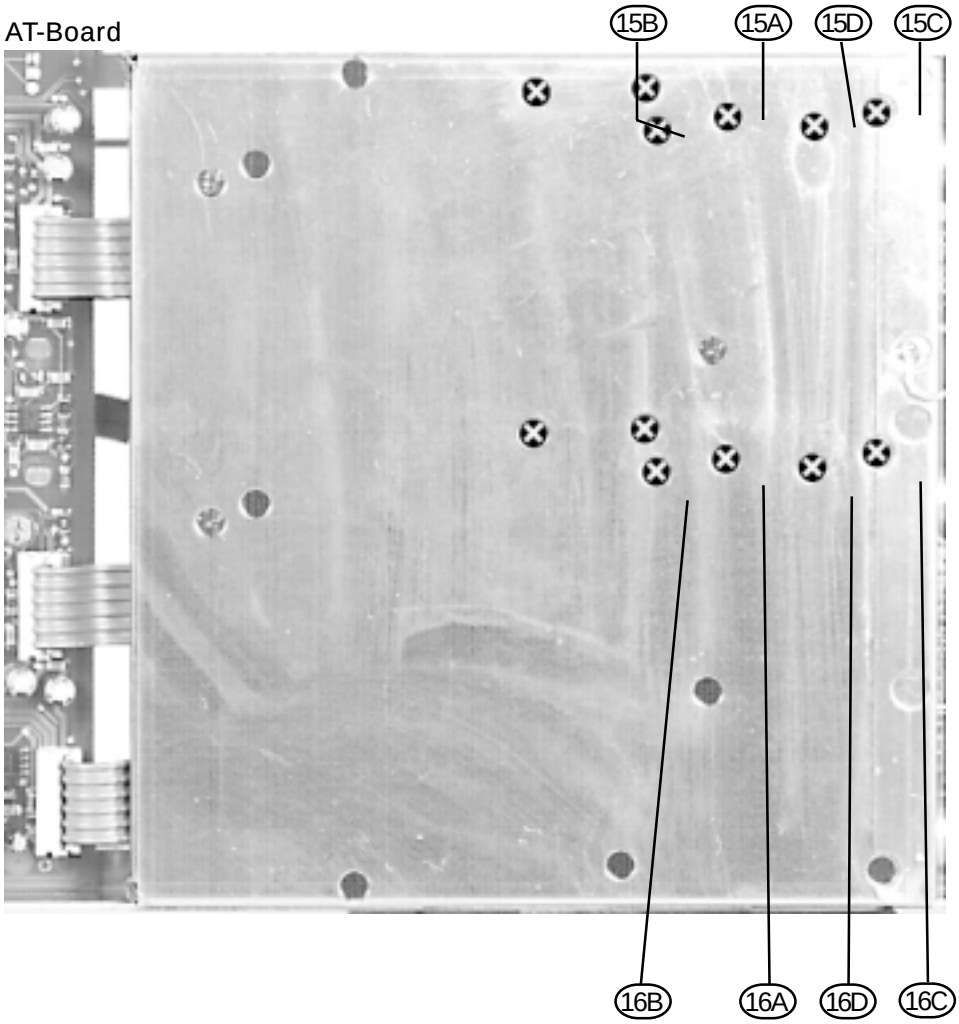
YF-Board



MB-Board (Detail)



AT-Board



13) R9001 (A),C9001 (B),R9004 (C),C9014 (D),R9010 (E): Y-Final Amplifier.
C3061 (F),C3100 (G),C3049 (H): Main-Board

Connect a 1MHz square wave signal of 25mVpp via 50Ω cable and 50Ω throughtermination to input CH I.
Set time base to 0.05µs/div. for overshoot and 0.2µs/div. for adjustments of the top.
Locate and identify the adjustment points R9001 (13A), C9001 (13B), R9004 (13C), C9014 (13D), R9010 (13E) on YF-Board and C3061 (13F), C3100 (13G) on Main-Board.
Adjust all adjustment points for flat top, fast leading edge (minimum risetime) and minimum overshoot.

Please note: The adjustment points A and B are most important for the overshoot and bandwidth. C, D, E, F and G influence the top.
Repeat the adjustment of each adjustment point until optimum is obtained.
Check channel II under the same conditions and adjust C3049 (13H) for same bandwidth like CH I.

14) Y-Amplifier Bandwidth Check.

Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50Ω throughtermination to the input of channel I.
Adjust the generator amplitude for 8 div. display height on the screen.
Increase the generator frequency until the signal height is 5.6 div. (-3dB).
Repeat the adjustment under item 13), if the frequency reading on the generator shows a value less than 100MHz.(150MHz for HM1505).
Repeat the same procedure under channel II operating conditions.

15) C2004, C2005, C2010, C2011: Attenuator Compensation CH I.

Locate and identify trimmers C2004(15C), C2005(15D), C2010(15A) and C2011(15B) in CH I section of the AT-Board.
Set time base switch to 0.2ms/div.
Set amplitude calibrator to 1kHz, connect a 50Ω cable at the generator output and via a 2:1 pre-attenuator to input of CH I.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 pre-attenuator output).
Check for 8 divisions signal height (5mV/div. attenuator setting).
Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

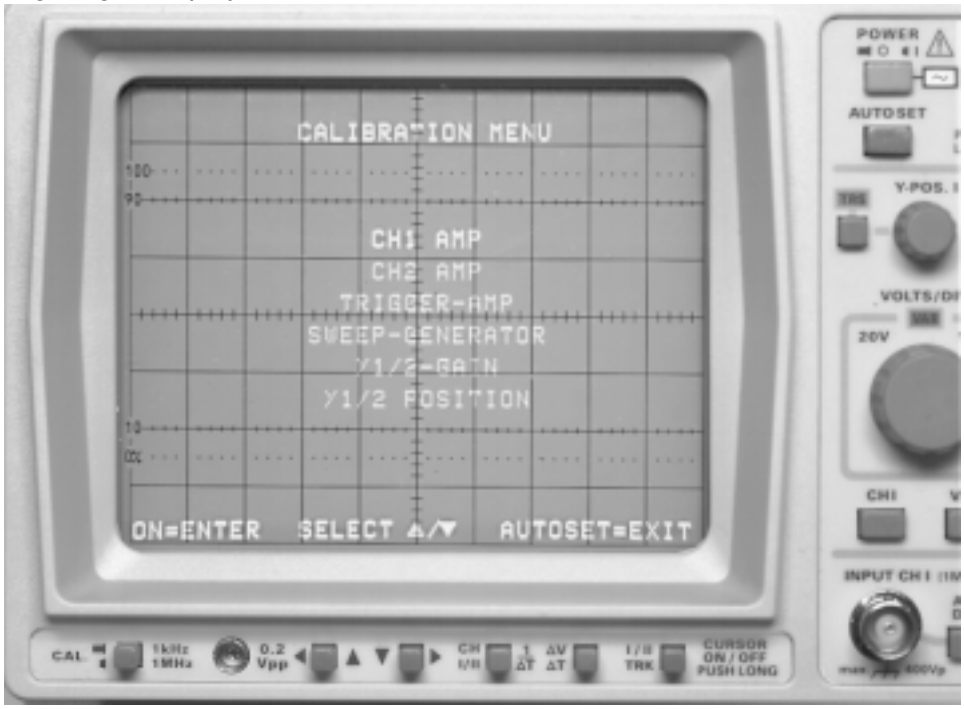
Scope Input	Input Atten.	Adjustment CH I
250mVpp	50mV/div	15A (C2010) flat top 15B (C2011) leading edge
2.5Vpp	0.5V/div	15C (C2004) flat top 15D (C2005) leading edge

16) C2060, C2061, C2066, C2067: Attenuator Compensation CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify trimmers C2060(16C), C2061(16D), C2066(16A), C2067(16B) in CH II section of the AT-Board. Set time base switch to 0.2ms/div.
Set amplitude calibrator to 1kHz, connect a 50Ω cable to the generator output and, via a 2:1 pre-attenuator to input of CH I.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 pre-attenuator output).
Check for 8 divisions signal height (5mV/div. attenuator setting).
Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

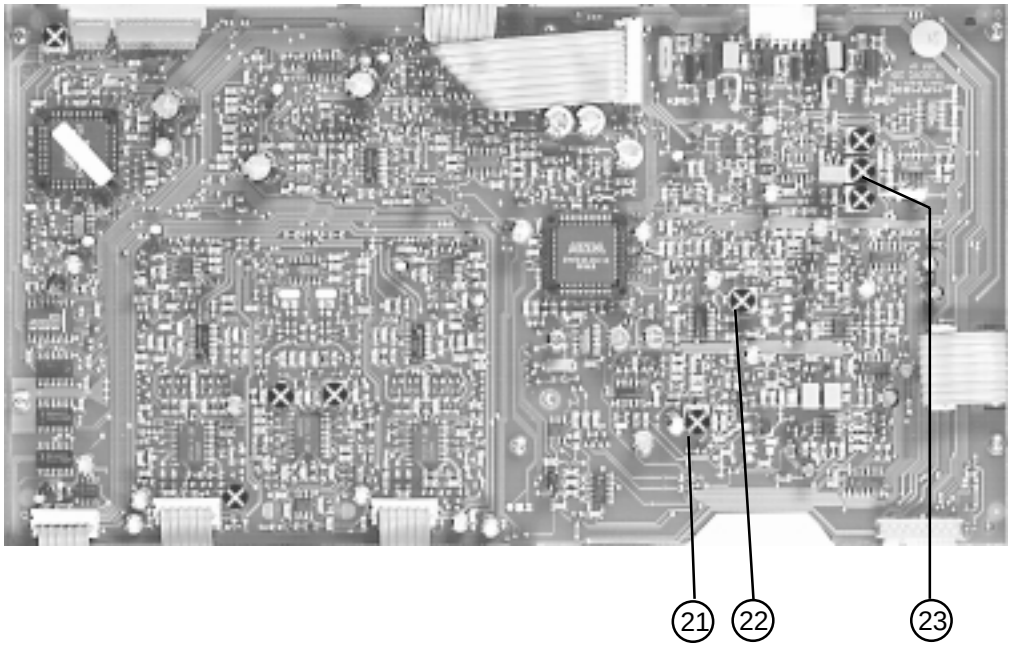
Scope Input	Input Atten.	Adjustment CH II
250mVpp	50mV/div	16A (C2066) flat top 16B (C2067) leading edge
2.5Vpp	0.5V/div	16C (C2060) flat top 16D (C2061) leading edge

High-Light Display select



UP DOWN ENTER

MB-Board



17) Calibration Menue.

Note: The oscilloscope must first be switched to the adjustment mode for the next 12 points.

Switch the oscilloscope OFF.
Switch the oscilloscope ON.
Press and hold the AUTO SET pushbutton after the HAMEG Logo appears.
Release the AUTO SET pushbutton after the Calibration Menue is on screen.
For error messages see 35).

18) CH I Amplifier

CH 1 AMP is highlight, press CURSOR ON/OFF pushbutton.
Oscilloscope is „working".CH 1 amplifier will be now adjusted.

19) CH II Amplifier.

press Cursor Down pushbutton once.
CH 2 AMP is highlight, press CURSOR ON/OFF pushbutton.
Oscilloscope is „working".CH 2 amplifier will be now adjusted.

20) Trigger Amplifier.

press Cursor Down pushbutton once.
TRIGGER-AMP is highlight, press CURSOR ON/OFF pushbutton.
Oscilloscope is „working".Trigger-amplifier will be now adjusted.

21) R4481: A-Sweep Start Position.

Press Cursor Down pushbutton once.
SWEEP-GENERATOR is highlight, press CURSOR ON/OFF pushbutton.
Locate and identify R4481 (21) on MB-Board.
Set A-time base to 200µs/div.
Press A/ALT/B once, set B-time base also to 200µs/div.
Turn DEL.POS left until Dt:39.0µs in display shows.
Adjust R4481 (21) the dim A-trace 2mm before the bright B-trace.

22) R4430: B-Sweep Start Position.

Locate and identify R4430 (22) on MB-Board.
Adjust R4430 (22) to the beginning of A-trace on left side.

23) R4841: X-Gain x1.

Locate and identify R4841 (23) on MB-Board.
Adjust R4841 (23) for 10.2 div sweep length.

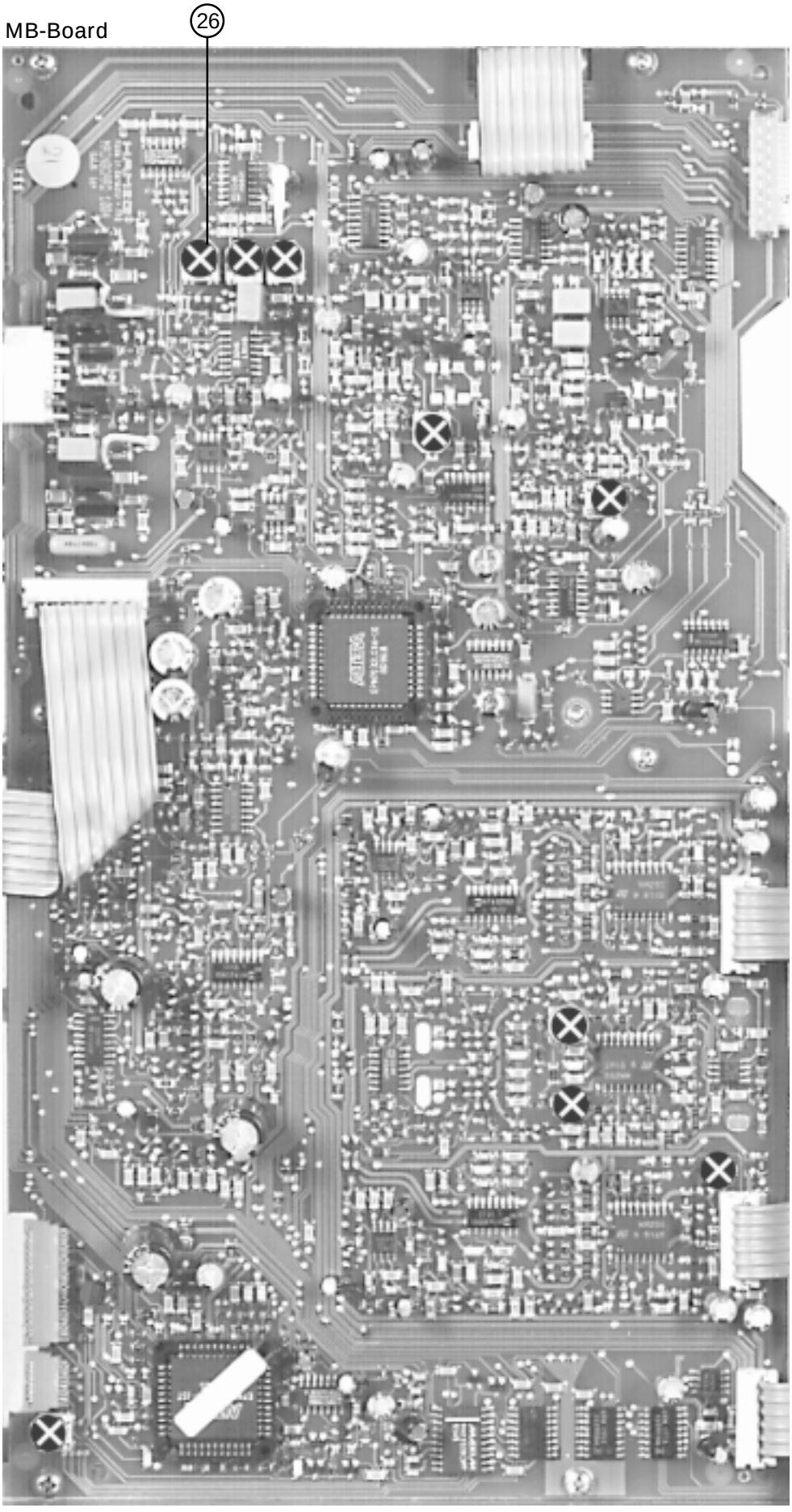
24) A-Time Base Adjustment.

Note: Now the adjustment mode is present. Any change of the VAR. 2.5:1 knob in the TIME/DIV. section of the front panel causes a new adjustment of the selected time coefficient. After the TIME/DIV. setting was changed, the adjustment is stored.

Remark: The horizontal center line of the graticule must be used for the reading to avoid uncertainties due to deflection unlinearities. The manual contains a list of frequencies which must be used for the different time base settings if a sine wave generator is used for adjustment purposes. For a high accuracy use the zero (voltage) crossing of a sine wave signal for the reading.

Set time mark generator to 20 MHz (0.05µs/period) and connect the signal to CH I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Press both NORM pushbuttons briefly for normal triggering mode.
Turn TRIG. LEVEL knob for exact triggering.
Set time base to 0.05µs/div.

MB-Board



Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Rotate VAR. 2.5:1 (TIME/DIV) (24) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Save the time base adjustment by pressig the SAVE pushbutton.
Set time mark generator to 10 MHz and time base to 0.1µs/div.
Rotate VAR. 2.5:1 (TIME/DIV) (24) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Save the time base adjustment by pressig the SAVE pushbutton.
Operate for each time base setting in the same way until 500ms/div.
Set time base from 500ms/div to 0.05µs/div.
Set time mark generator to 20 MHz (0.05µs/period) and connect the signal to CH I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Press both NORM pushbuttons briefly for normal triggering mode.
Turn TRIG. LEVEL knob for exact triggering.
Set time base to 0.05µs/div.
Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Rotate time base variable control to fully left position.
Now more than 2.5 time marks per division must be displayed.
Check all TIME/DIV. settings with suitable signals in the same way.

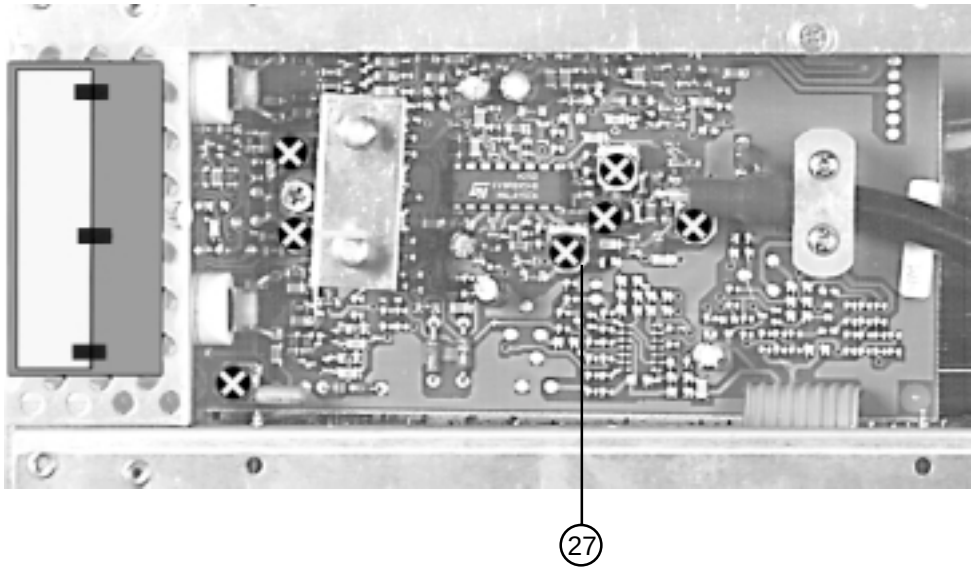
25) B-Time Base Adjustment.

Set time mark generator to 20 MHz (0.05µs/period) and connect the signal to CH I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Press both NORM pushbuttons briefly for normal triggering mode.
Turn TRIG. LEVEL knob for exact triggering.
Set A-time base to 5µs/div.
Press A/ALT/B pushbutton two times.
Set B-time base to 50ns.
Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Rotate VAR. 2.5:1 (TIME/DIV) (24) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Save the time base adjustment by pressig the SAVE pushbutton.
Set time mark generator to 10 MHz and time base to 0.1µs/div.
Rotate VAR. 2.5:1 (TIME/DIV) (24) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Save the time base adjustment by pressig the SAVE pushbutton.
Adjust B-time base up to 5µs/div the same way.
Press A/ALT/B pushbutton once.
Set A-time base to 1ms/div.
Press A/ALT/B pushbutton two times.
Set B-time base to 10µs/div.
Set time mark generator to 100KHz.
Rotate VAR. 2.5:1 (TIME/DIV) (24) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Operate for each time base setting in the same way until 20ms/div.

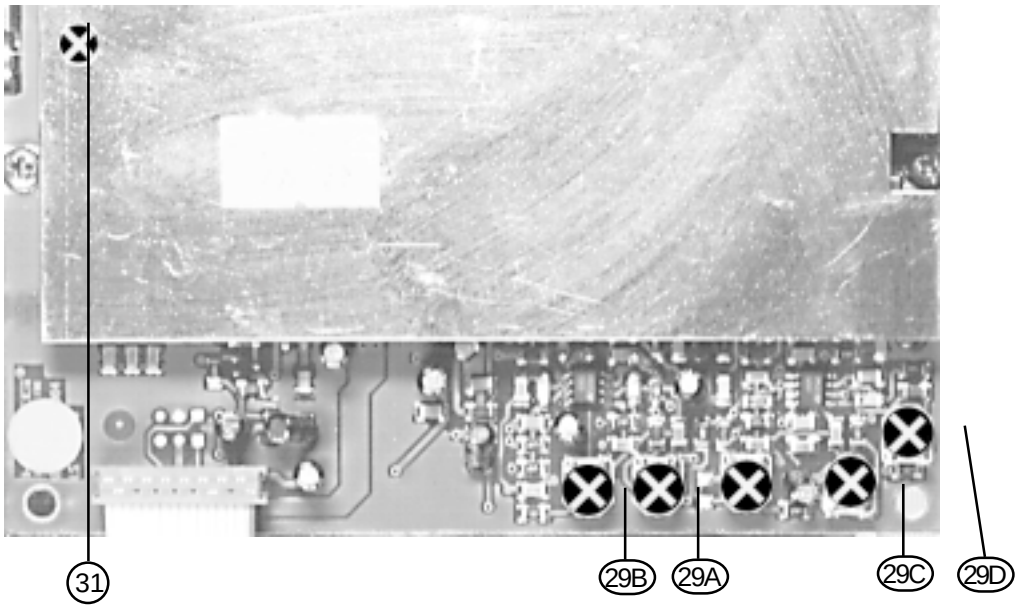
26) R4840: X-Magnification x10.

Locate and identify R4840 (26) on MB-Board.
Press pushbutton X-Mag. x10 (x10 LED lit).
Set time base to 1µs/div. Set time mark generator to 10 MHz and connect signal to channel I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Set X-POS control to mechanical center.
Using X-POS control, move the first visible time mark to the first left graticule line.
Adjust R4840 (28) so that the next time mark coincides with the last (right) graticule line.
Press RECALL pushbutton to exit SWEEP-GENERATOR adjust.

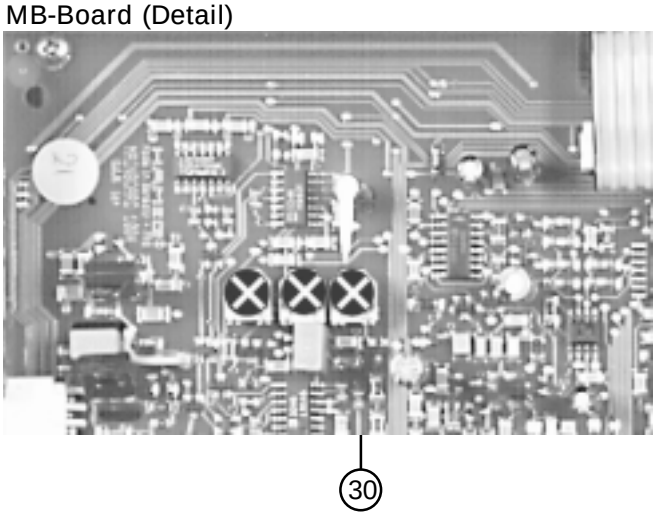
YF-Board



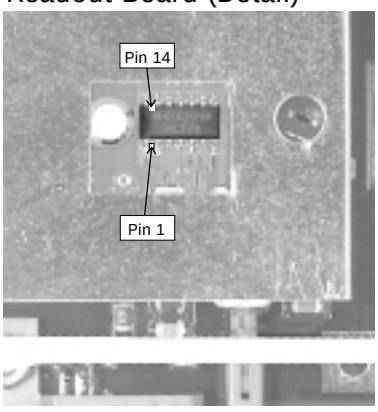
Readout-Board (Detail)



MB-Board (Detail)



Readout-Board (Detail)



27) R9008: Y-Gain CH I.

press Cursor Down pushbutton once.
Y1/2-GAIN is highlight, press CURSOR ON/OFF pushbutton.
Locate and identify R9008 (27) on YF-Board.
Connect a 25mVpp/1kHz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 1ms/div.
Adjust R9008 (27) for 5 division signal height.

Note: This adjustment affects Y-Gain CH II.

28) Y-Gain CH II.

Note: The adjustment under item 27) must be finished before this procedure is started.

Press TRIG.SOURCE pushbutton once.
Connect a 25mVpp/1kHz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set time base to 1ms/div.
Press VAR. pushbutton for CH II once
Rotate VAR.(28) for 5 division signal height.
Press RECALL pushbutton to exit Y1/2-GAIN adjust.

29) R7002, R7003, R7001, R 7005: Readout Position.

Press Cursor Down pushbutton once.
Y1/2 POSITION is highlight, press CURSOR ON/OFF pushbutton.
Readout net and two traces appears.
Locate and identify R7002 (29A), R7003 (29B), R7001 (29C)and
R 7005 (29D) on Readout-Board.
Adjust net with R7002 (29A), R7003 (29B), R7001 (29C)and
R 7005 (29D) to the position on the CRT-GRID.
Set trace with POS I to upper net line.
Set trace with POS II to lower net line.
Press SAVE pushbutton once.
Set trace with POS I to lower net line.
Set trace with POS II to upper net line.
Press SAVE pushbutton once.
Press RECALL pushbutton to exit Y1/2 POSITION adjust.

Press AUTOSET pushbutton once to exit CALIBRATION MENUE.

30) R4839: XY-Gain

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R4839 (30) on MB-Board.
Connect a 10kHz square wave signal of 25mVpp amplitude (HZ60-2) to input CH II.
Press XY pushbutton.
Set X-POS control that the left dot coincides with the graticule center.
Adjust R4839 (30) for a distance of 5 division between left and right dot.

31) VR7006: Calibrator Output.

Locate and identify VR7006 (31) on Readout-Board.
Connect a digital multimeter to the 0.2Vpp calibrator output.
Set up the digital multimeter for DC measurement on a suitable sensitivity setting.
Locate and identify IC7010 on CT-Board.
Connect pin 1 and pin 14 of IC7010 galvanically together.
Adjust VR7006 (31) for exactly 200mV ± 1mV DC.
Remove the connection between pin 1 and pin 14 of IC7010.
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 0.2ms/div.

Now approximately 2 signal periods should be visible on the screen.
Press 1kHz/1MHz pushbutton (in!).
Set time base to 0.5µs position.
Check 1MHz calibrator signal.

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

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) Triggerbandwidth Check.

Set time base to 50ns/div.
Connect a 200MHz 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 50Ω 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.
Press TRIG. SOURCE pushbutton (readout: TR: EXE ...).
The TRIG. LED now must be dark.
Remove signal cable from input CH I.
Connect the signal cable to the TRIG.EXT. socket.
Now the TRIG. LED must lit.

35) Error Code Tabel:

The data field is internally checked for logical errors which are protocolled in the RETURNCODE. The following RETURNCODEs are implemented:

0 = no error	**1** = syntax error	**2** = data error
3 = buffer overlow	**4** = bad data set	**5** = adjustment error

Explanation of the calibration menu

Precondition: All BNC sockets not connected (open).

CH1 AMP

1. Automatic Attenuator-Balance Adjustment.

ERROR = 0F (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) or at IC2011 / R2261 (attenuator board) exceeded.
Supposed error: attenuator board.

ERROR = 13 is displayed if the peak-peak circuit is defective.

2. Automatic Variable-Gain Balance Adjustment.

ERROR = 11 (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) or at IC2011/R2057 (attenuator board) exceeded.
Supposed error: Amplifier-symmetry IC2012/IC2013 (attenuator board).

ERROR = 13 is displayed if the peak-peak circuit is defective.

3. Automatic Invert-Balance Adjustment.

ERROR = 0A (adjustment impossible)
Voltage range at IC3009B (main board) or at IC2011 / R2263 (attenuator board) exceeded.
Supposed error: Y-amplifier between IC2012 and transistors T3004/5, T3010/11 (main board).

ERROR = 13 is displayed if the peak-peak circuit is defective.

CH2 AMP

1. Automatic Attenuator-Balance Adjustment.

ERROR = 10 (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) or at IC2011 / R2270 (attenuator board) exceeded.
Supposed error: attenuator board.

ERROR = 13 is displayed if the peak-peak circuit is defective.

2. Automatic Variable-Gain Balance Adjustment.

ERROR = 12 (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) or at IC2011/R2165 (attenuator board) exceeded.
Supposed error: Amplifier-symmetry IC2033/IC2034 (attenuator board).

ERROR = 13 is displayed if the peak-peak circuit is defective.

3. Automatic Invert-Balance Adjustment.

ERROR = 0A (adjustment impossible)
Voltage range at IC3009B (main board) or at IC2011 / R2165 (attenuator board) exceeded.
Supposed error: Y-amplifier between IC2012 and transistors T3018/3019/3020/3021 (main board).

ERROR = 13 is displayed if the peak-peak circuit is defective.

4. Automatic IC3009B (main board) check.

ERROR = 14 is displayed if the output voltage at IC3009B pin 7 exceeds the limits.

CH1/2 AMP

1. Manual Y-Position Adjustment.

ERROR = 14.
Y-Position control voltage exceeds the normally required value for this position setting. The error message appears if the voltage difference indicates a + or - 5 division (voltage) deviation caused by a defective component in the Y position control circuit.

TRIGGER-AMP

1. CH1 Automatic Trigger Operating Point Adjustment.

Determines the trigger operating point under HF trigger coupling conditions and sets it to the same value as under AC trigger coupling conditions.
ERROR = 0C (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) exceeded.

2. CH2 Automatic Trigger Operating Point Adjustment.

Determines the trigger operating point under HF trigger coupling conditions and sets it to the same value as under AC trigger coupling conditions.
ERROR = 0D (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) exceeded.
Adjustment by T4023 (main board).

3. Automatic Trigger Amplifier Operating Point Adjustment in XY Mode.

Adjusts the trigger operating point on 2.5 Volt in XY mode.
ERROR = 0E (adjustment impossible).
Voltage range at TRGMP (R4041 on main board) exceeded.
Adjustment by T4023 (main board).

4. Peak to Peak Voltage Check.

ERROR = 13.
Peak to Peak voltage deviates from 0 Volt. Supposed error: Peak - Peak circuit.

5. Automatic Trigger Offset Adjustment.

ERROR = 16.
Correction voltage for trigger comparator exceeded (i.e. comparator defective).

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