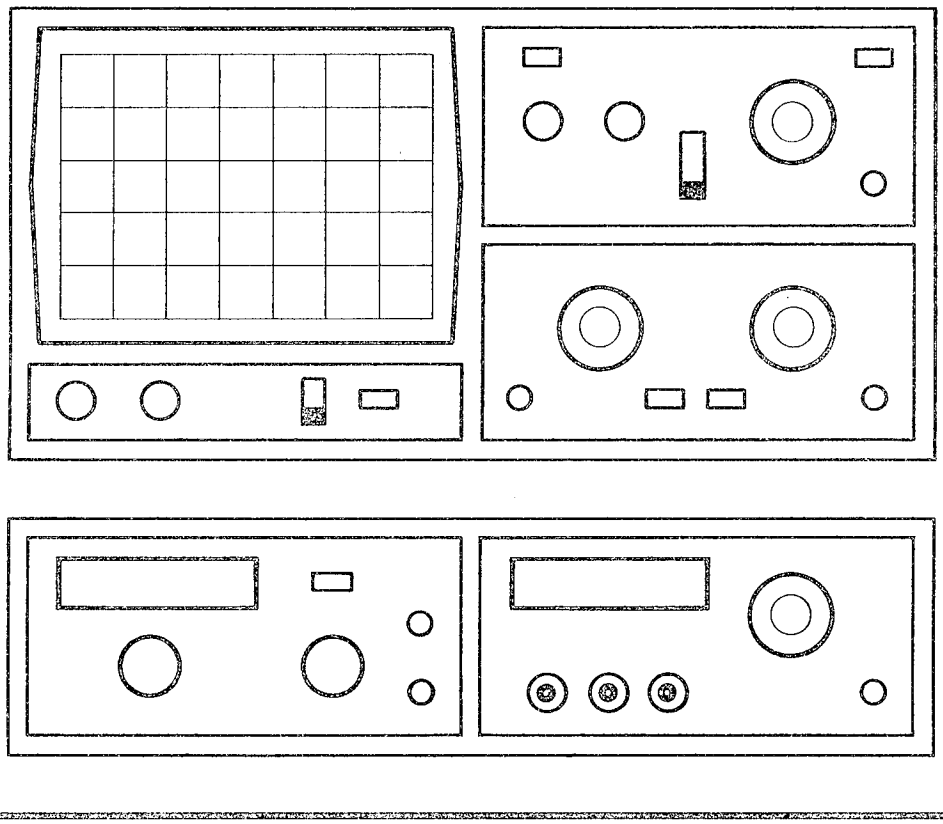
HAMEG
Instruments

MANUAL

Function Generator HM8030-4



Specifications

(Reference Temperature: 23 °C ± 1 °C)

Operating Modes

Sine-Square-Triangle-DC
free running, int. ext. frequency modulated, with or without DC offset

Frequency Range

0.3 Hz to 3 MHz in 7 decade steps
variable control: x0.09 to x1.1 (12:1)
Frequency Stability: < 0.5%/h or 0.8%/24 h at constant ambient temperature (medium position of frequency control)

Waveform Characteristics

Sine Wave Distortion:
0.3 Hz to 100 kHz: max. 0.5%
0.1 MHz to 0.5 MHz: max. 1.5%
0.5 MHz to 3 MHz: max. 3%
Square Wave Risetime: typ. <20 ns (10 to 90%)
Overshoot: < 5%
(when output is terminated with 50 Ω)
Triangle Non-Linearity: < 1% (up to 100 kHz)

Display

Frequency: 4 digit 7 Segm. LED, 8x5 mm each
Accuracy up to 3 Hz: ±(3% + 3 digit)
3 Hz to 3 MHz: $\pm(5 \times 10^{-6} + 1$ digit)
LED-indicator for Hz and kHz

Outputs (short-circuit proof)

Signal output:
Impedance: 50 Ω
Output voltage: 20 V_{pp} open circuit
max. 10 V_{pp} into 50 Ω
Attenuation: approx. − 60 dB
2 steps: − 20 dB ± 0.2 dB each
Variable attenuation: 0 to − 20 dB
Amplitude Flatness: (sine/triangle)
0.3 Hz up to 0.3 MHz: max. 0.2 dB
0.3 MHz up to 3 MHz: max. 0.5 dB
DC Offset: continuously variable (disconnectable)
Offset range: max. ± 2.5 V into 50 Ω
max. ± 5 V open circuit
Trigger Output: square wave synchronous to signal output; approx. +5 V (TTL).

FM Input (VCF; rear panel)

Frequency change: approx. 1:100
Input impedance: 50 kΩ ǁ 25 pF
Input voltage: ± 30 V max.

Internal sweep

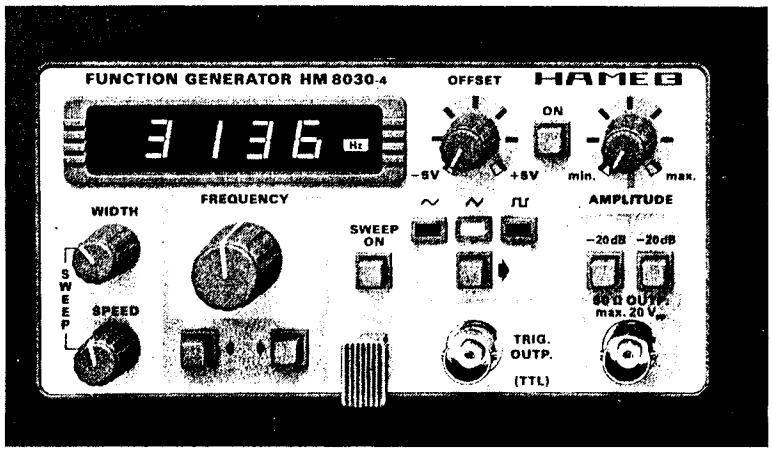
Sweep speed: 20 ms to 4 s
Sweep range: approx. 1 : 100

General Information

Operating conditions: + 10 °C to + 40 °C
max. relative humidity: 80%
Supply (from HM 8001): + 5 V/130 mA
+ 16 V/310 mA, − 16 V/250 mA (∑ 9.6 W).
Dimensions (mm): (without multipoint conn.)
W 135, **H** 68, **D** 228 mm
Weight: approx. 0.80 kg

Values without tolerances are intended as guide lines and represent characteristics of the average instrument.

Subject to change without notice



Function Generator HM 8030-4

- **Frequency Range 0.3 Hz to 3 MHz**
- **Operating Modes: Sine, Square, Triangle, DC**
- **Digital Frequency Readout**
- **DC-Offset Adjustment**
- **Internal sweep facilities; Trigger Output**
- **Square Wave Risetime typ. < 20 ns**

The **various signals** available from the **HM 8030-4** function generator module make it a versatile signal source useful for most measurement and test applications. Its **low frequency ranges** are particularly well suited for simulating mechanical and servo techniques.
Frequencies are read out on a **4 digit LED display** with a maximum resolution of 1 mHz. A variable frequency control with a gear ratio of 4.6:1 facilitates accurate frequency adjustments. Additional quality features include the relatively **low distortion factor** of the generated signals and **constant amplitude flatness** throughout the entire frequency range of the instrument.
All outputs are **short-circuit-proof** and protected against external DC-voltages up to ±45 V.
Due to an internal signal source, the **HM 8030-4** can also be used in the **sweep mode**.

Optional Accessories

HZ 33, HZ 34: 50 Ω test cable BNC-BNC.
HZ 22: 50 Ω through-termination.

General information

The operator should not neglect to carefully read the following instructions and those of the mainframe HM8001, to avoid any operating errors and to be fully acquainted with the module when later in use.

After unpacking the module, check for any mechanical damage or loose parts inside. Should there be any transportation damage, inform the supplier immediately and do not put the module into operation.

This plug-in module is primarily intented for use in conjunction with the Mainframe HM8001. When incorporating it into other systems, the module should only be operated with the specified supply voltages.

Safety

Every module is manufactured and tested for use only with the mainframe HM8001 according to IEC 348 Part 1 and 1a (Safety requirements for electronic test and measurement equipment). All case and chassis parts are connected to the safety earth conductor. Corresponding to Safety Class 1 regulations (three-conductor AC power cable). Without an isolating transformer, the instrument's power cable must be plugged into an approved three-contact electrical outlet, which meets International Electrotechnical Commission (IEC) safety standards.

Warning!

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

The istrument must be disconnected and secured against unintentional operation if there is any suggestion that safe operation is not possible. This may occur:
- if the instrument has visible damage,
- if the instrument has loose parts.
- if the instrument does not function,
- after long storage under unfavourable circumstances (e.g. outdoors or in moist environments),
- after excessive transportation stress (e.g. in poor packaging).

When removing or replacing the metal case, the instrument must be completely disconnected from the mains supply. If any measurement or calibration procedures are unavoidable on the opened-up instrument, these must only be carried out by qualified personnel acquainted with the danger involved.

Symbols As Marked on Equipment

DANGER – High voltage

Protective ground (earth) terminal.

ATTENTION – refer to manual.

Operating conditions

The ambient temperature range during operation should be between +10°C and +40°C and should not exceed −40°C or +70°C during transport or storage. The operational position is optional, however, the ventilation holes on the HM8001 and on the plug-in modules must not be obstructed.

Warranty

Before being shipped, each plug-in module must pass a 24 hour quality control test.

Provided the instrument has not undergone any modifications Hameg warrants that all products of its own manufacture conform to Hameg specifications and are free from defects in material and workmanship when used under normal operating conditions and with the service conditions for wich they were furnished.

The obligation of HAMEG hereunder shall expire two (2) years after delivery and is limited to repairing, or at its option, replacing without charge, any such product which in Hameg's sole opinion proves to be defective with the scope of this warranty.

This is Hameg's sole warranty with respect to the products delivered hereunder. No statement, representation, agreement or understanding, oral or written, made by an agent, distributor, representative or employee of, which is not contained in this warranty will be binding upon Hameg, unless made in writing and executed by an authorized Hameg employee. Hameg makes no other warranty of any kind whatsoever, expressed or implied, and all implied warranties of merchantibility and fitness for a particular use which exceed the aforestated obligation are hereby disclaimed by Hameg be liable to buyer, in contract or in tort, for any special, indirect, incidental or consequential damages, espresses, losses or delays however caused.

In case of any complaint, attach a tag to the instrument with a description of the fault observed. Please supply name and department, address and telephone number to ensure rapid service.

The instrument should be returned in its original packaging for maximum protection. We regret that transportation damage due to poor packaging is not covered by this warranty.

Maintenance

The most important characteristics of the instruments should be periodically checked according th the instructions provided in the sections "Operational check" and "Alignment procedcure". To obtain the normal operating temperature, the mainframe with inserted module should be turned on at least 60 minutes before starting the test. The specified alignment procedure should be strictly observed.

When removing the case detach mains/line cord and any other connected cables from case of the mainframe HM8001. Remove both screws on rear panel and, holding case firmly in place, pull chassis forward out of case. When later replacing the case, care should be taken to ensure that it properly fits under the edges of the front and rear frames.

After removal of the two screws at the rear of the module, both chassis covers can be lifted. When reclosing the module, care should be taken that the guides engage correctly with the front chassis.

Operation of the module

Provided that all hints given in the operating instructions of the HM8001 Mainframe were followed – especially for the selection of the correct mains voltage – start of operation consists practically of inserting the module into the right or left opening of the mainframe. The following precautions should be observed:

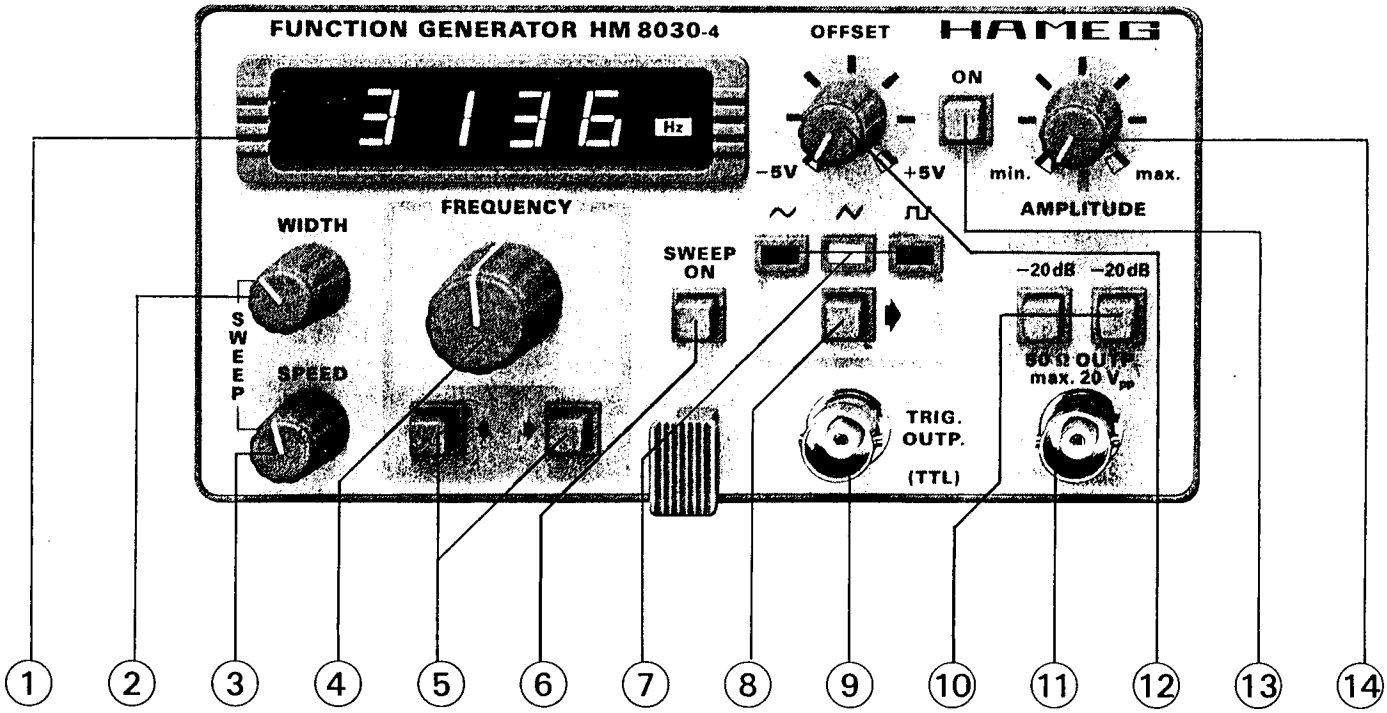
Before exchanging the module, the mainframe must be switched off. A small circle (o) is now revealed on the red power button in the front centre of the mainframe.

If the BNC sockets at the rear panel of the HM8001 unit were in use before, the BNC cables should be disconnected from the basic unit for safety reasons. Slide in the new module until the end position is reached.

Before being locked in place, the cabinet of the instrument is not connected to the protective earth terminal (banana plug above the mainframe multipoint connector). In this case, no test signal must be applied to the input terminals of the module.

Generally, the HM8001 set must be turned on and in full operating condition, before applying any test signal. If a failure of the measuring equipment is detected, no further measurements should be performed. Before switching off the unit or exchanging a module, the instrument must be disconnected from the test circuit.

Control elements of HM8030-4



① **DISPLAY** (7-segment LED)
4-digit frequency meter.
LED indicators for Hz and kHz.

② **WIDTH** (adjusting knob)
Setting of wobulation width.

③ **SPEED** (adjusting knob)
Setting of wobulation speed.

④ **FREQUENCY** (adjusting knob)
Continuous and linear frequency fine adjustment, overlapping the ranges selected with ⑤. Setting range from x0.09 to x1.1 of selected range. Gear ratio is 4.6:1. Adjustable frequency range 300mHz – 3MHz.

⑤ **FREQUENCY** (2 pushbuttons)
Frequency range selection from 0.3Hz to 3MHz in 7 decade steps.

⑥ **SWEEP ON** (pushbutton)
Activates internal sweep.

⑦ ∼ - ⩘ - ⊓⊔ (LEDs)
Indication of selected function.

⑧ ∼ - ⩘ - ⊓⊔ (pushbutton)
Mode selection: Triangle – Sine – Square.

⑨ **TRIGGER OUTPUT** (BNC connector)
This short-circuit-proof output supplies a square signal in synchronism with the output signal. It is TTL compatible and has a duty-factor of approx. 50%.

⑩ **–20dB, –20dB** (pushbutton)
Two fixed attenuators, –20dB each. They can be used separately. When both pushbuttons are activated, a total attenuation of –40dB results. Including the amplitude control ⑭, the max. attenuation amounts to –60dB (factor 1000).

⑪ **50 Ω OUTPUT** (BNC connector)
Short-circuit-proof signal output of the generator. The output impedance is 50Ω, and the max. output amplitude is 20Vpp (o.c.) or 10Vpp respectively when terminated with 50Ω.
Attention! The output is protected against external DC voltages up to max. ±45V.

⑫ **OFFSET** (adjusting knob)
Adjustment of the positive or negative offset voltage. This DC voltage can be superimposed on the output signal. The max. offset voltage is ±5V (o.c.) or ±2.5V respectively when terminated with 50Ω.

⑭ **ON** (pushbutton)
Activates the offset function.

⑭ **AMPLITUDE** (adjusting knob)
Continuous adjustment of the output amplitude from 0 to –20dB.

Function selection

The type of output signal is selected with the function selection switch ⑧. A total number of 3 different waveforms – sine, square and triangle – are available. The functions are marked with the corresponding symbols. If the "ON" pushbutton ⑬ is activated a DC voltage level is supplied by the HM8030-4 or supperimposed on the output signal.

Frequency adjustment

Coarse adjustment is performed with the range keys. The desired frequency is selected by turning the FREQUENCY control ④. The selected frequency appears on the 4-digit display ①. Compared to knob scales, this display has a much higher resolution. To facilitate a precise frequency adjustment of the last digit, a gear ratio of 4.6:1 of the frequency adjustment potentiometer is provided.

Output amplitude and signal connection

Adaptation in decade steps to the desired amplitude range is performed by the use of two attenuators with −20dB each, which are activated by pushbuttons.

Including the continuously adjustable AMPLITUDE control ⑭, the maximum attenuation amounts to −60dB. With the maximum amplitude of $10V_{pp}$, the minimum signal voltage to be supplied is about 10mV. These values are obtained when the generator output is terminated with 50Ω. In the open-circuit condition, the available signal amplitude is about twice as high. Therefore the maximum output voltage of the output socket is specified with $20V_{pp}$. If exact square-shaped signals are required, care should be taken that only 50Ω coaxial cables (e.g. HZ34) are used. Furthermore, this cable must be terminated with a 50Ω through-termination (e.g. HZ22). If these precautions are not observed, overshoot may occur, especially when high frequencies are selected. If test circuits having a 50Ω input impedance are connected, this termination is not required. In high signal voltage ranges, it should be noted that the used terminating resistor must dissipate the corresponding effective power.

The output terminal of the HM8030-4 is short circuit proof. However, if an external DC voltage exceeding ±45V is applied to the output, the output stage is likely to destruction.

If the output of the HM8030-4 unit comes into contact with components of the circuit under test, which are carrying DC voltage, an isolationg capacitor of appropriate dielectric strength should be connected in series with the output of the generator. The capacitance of this isolating capacitor should be selected in that way that the frequency response of the output signal is not affected over the whole frequency range of the HM8030-4 unit.

Trigger output

In the sine, square and triangle modes, the trigger output ⑨ supplies a square signal in synchronism with the output signal. An offset voltage adjusted at the 50Ω output has no influence upon the trigger signal. The trigger output is short-circuit-proof and can drive several TTL inputs.

Sweep facilities

1) Internal sweep

The internal sweep facility of the HM8030-4 allows checking of filters and equipment in the frequency range from 0.3Hz to 3MHz. Operation is very easy and is confined to the setting of sweep-speed and sweep–width. Activation is by simply pressing the SWEEP ON push button and can be combined with all available functions on the HM8030-4. The Stop-frequency is automatically given by the settings of the range selector and the frequency dial and is shown on the 4-digit display. Start frequency is related to the stop-frequency by the sweep-width factor. Latter is set by means of the (Sweep-) Width potentiometer and is up to approx. 100. The sweep speed is set by means of the (Sweep-) Speed potentiometer and ranges from 20ms to 4s. For external wobbulation please refer to "FM input".

2) FM input

If a positive DC voltage is applied to the FM input on the rear panel of the HM8001, the generator frequency increases and is accordingly displayed. A negative DC voltage reduces the frequency. The frequency displacement depends on the value and polarity of the DC voltage **U** and on the **FREQUENCY** setting. The set frequency $\mathbf{N_0}$ (DC voltage not included) can be selected at will.

Computation: $\mathbf{N = N_0 + A \cdot U}$ or $\mathbf{U = (N - N_0) : A}$

$\mathbf{N_0}$ = digit display without voltage **U**,
N = digit display including voltage **U**,
U = ± voltage at the FM input.
A = 680 (digits per volt),

It should be noted that only the displayed digits are valid; the decimal point is not taken into consideration (e.g. 100.0 ≙ 1000 digit). The max. frequency (3MHz) cannot and "000" should not be exceeded. Any zeroes preceding the decimal point are dropped.

Limits: if the highest displayed number is **N** = 1998 and the smallest $\mathbf{N_0}$ = 090, then **U** will be + 2.8V max. The frequency increases by a factor of 22.2. If the smallest displayed number is **N** = 011 (lower numbers are possible, but inaccurate) and the highest $\mathbf{N_0}$ = 1100, then **U** will be −1.6V max. The frequency changes by a factor of 100.

The frequency change is ***linear*** as a function of the voltage **U** and has the same value in all ranges.

DC offset

When the switch ⑬ ON is depressed, a DC voltage can be superimposed on the output signal. The maximum offset voltage with open output is ±5V.

Operational check

Measuring equipment required

20 MHz Oscilloscope: HM 203 or HM 204
HZ 22 50 Ω Through-Termination
HM 8011-3 Digital Multimeter or similar
Adjustable DC voltage source (max. 30 V) e.g. HM 8040
HM 8021-3 Frequency Counter

Frequency variation

The adjustment range of the **VARIABLE** knob ④ must in any case overlap the selected decade on both sides by min. 5%.

Amplitude stability

Setting:	⑧	⑤	④	⑭
	∿	1 k	max	max

Connect oscilloscope to output ⑪. Use a 50 Ω through-termination. Set oscilloscope to DC coupling. Adjust signal height to 6 div. Check all frequency ranges with ⑤ and ④. The signal height should not vary by more than 0.2 Div.

Maximum output amplitude

Setting:	⑧	⑤	④	⑭	⑩
	∿	1 k	max.	max.	released

Connect oscilloscope to output ⑪. The signal amplitude should be 20 V_{pp} ± 500 mV_{pp}. With a 50 Ω load at the output ⑪, the signal amplitude should still be 10 V_{pp} ± 250 mV_{pp}.

Output attenuator function

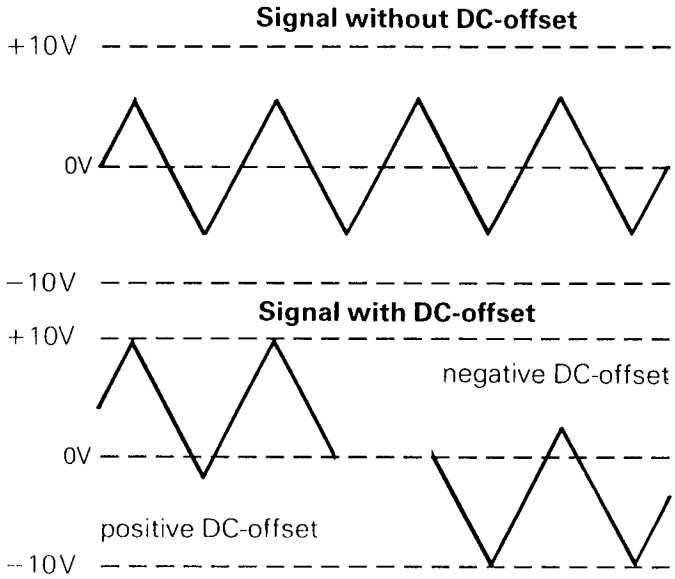
Setting:	⑧	⑤	④	⑭	⑩
	∼	100	50 Hz	max.	released

Connect digital multimeter (V_{AC}) to output ⑪. Set knob ⑭ for 5 V display. Firstly depress one button ⑩ (– 20 dB) only, then both buttons ⑩ (– 40 dB) simultaneously. The DVM should display 0.5 V or 0.05 V ± 2% respectively.

Adjustment range of the offset voltage

Setting:	⑬	⑫	⑭	⑩
	depressed	max	max	released

Connect DVM to the output ⑪. Use a 50 Ω through-termination. The DC potential should vary between about + 2.5 V and – 2.5 V by use of control ⑫.



Frequency variation by FM input

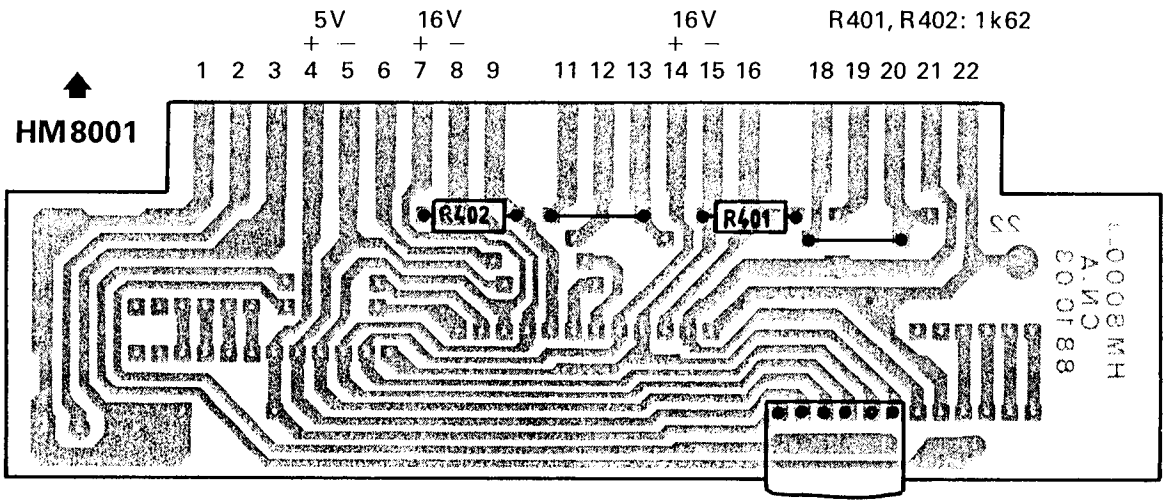
Setting: ⑥ released (sweep off).

Apply an adjustable DC voltage (± 30 V max.) to the FM input. Display indication ① will vary as a function of the applied DC voltage. The obtained results can be examined by use of the formulas specified in the **"FM input"** section of the operating instructions.

Trigger signal waveform

Connect the oscilloscope to output ⑪. A square wave signal with TTL level and a 50% duty factor will be shown on the screen ("Low": about 0.4 V; "High": about 5 V).

Steckerleiste; Versorgungsspannungen / Multipoint Connector; Supply Voltages



Alignment procedure HM8030-4

The calibration of the HM8030-4 is performed by means of a built-in calibration program. Alignment is carried out by passing through the 11 consecutive steps of the calibration program. To procede please use the ➧ ⑤ key, the previous program is reached by using the ➧ ⑤ key. The actual step is shown at the least significant digit (blinking) of the frequency display ①, except at step 6. This program uses the entire display (4 digit) to indicate the alignment result.

Measuring equipment required
60MHz Oscilloscope (e.g. HM604)
Frequency Counter (e.g. HM8021-3)
Digital Multimeter (e.g. HM8011-3)
Distortion Meter (e.g. HM8027)
Through-terminator 50Ω (e.g. HZ22)

Functions of the calibration program

Step 1: Amplitude and offset voltage of triangle signal.

Step 2: Slope symmetry of triangle signal at lower and upper end of the 3 highest ranges.

Step 3: Slope symmetry of triangle signal of the 4 lower ranges.

Step 4: Square wave amplitude adjustment.

Step 5: Preamplifier offset alignment.

Step 6: Frequency accuracy of the display.

Step 7: Distortion alignment.

Step 8: Low frequency gain adjustment of output amplifier.

Step 9: Compensation of output amplifier.

Step A, Step I: Max. frequency and triangle amplitude of the 3 MHz range.

Start calibration program:
To start the calibration process firstly, switch off the HM8001. Short circuit the two pins of connector PT101 at the HM8030-4. Switch HM8001 on again and remove the short on PT101. The least significant digit indicates now step 1.

Settings:
Offset ⑬, Sweep ⑥ and Attenuators ⑩: off.

Step 1:
a) Set frequency ④ to max. and connect DMM HM8011-3 (2V AC) to PT100. Adjust VR102 to 0,5773±0,005V.
b) Set Multimeter to 0,2V DC and adjust VR103 to 0±5mV.
c) Repeat step a) and b).

Step 2:
a) Set frequency ④ to max.
Connect Frequency counter to TRIG OUT ⑨. Set counter to Auto Trigger and pulse-width. Note measured time.
b) Set counter to measure pulse-pause. Adjust VR101 for the same time like a).
c) Set frequency ④ to min., switch counter to pulse-width and note measured time.
d) Set counter to pulse pause and adjust VR104 to the same value.
e) Repeat step a) to d).

Step 3:
a) Set counter to pulse-width and frequency ④ to min. Note measured time.
b) Set counter to pulse-pause and adjust VR106 to the same value.
c) Repeat step a) and b).

Step 4:
Connect DMM HM8011-3 (20V AC) to OUTPUT ⑪. Set frequency ④ to min. and amplitude ⑭ to max.
Adjust VR110 to 10±0,1V.

Step 5:
Set frequency ④ to max. and Multimeter to 2V DC. Adjust VR111 to 0±0,01V.

Step 6:
Set frequency ④ to max. and adjust VR105 to 0 on the display ①.

Step 7:
Set frequency ④ to approx. 2000 Hz and amplitude ⑭ to max.
Connect the Distortion Meter (2kHz range) to OUTPUT ⑪. Adjust VR108 and VR109 to obtain minimum distortion (typ. 0,3%).

Step 8:
Connect OUTPUT ⑪ via 50Ω through terminator (HZ22) to the oscilloscope (2V/div., 50µs/div).
Set amplitude ⑭ to max. and frequency ④ to approx. 2kHz.
Adjust VR107 for best possible square-wave shape.

Step 9:
Set the oscilloscope to 0,1µs/div. range. Adjust VC102 for best possible square-wave shape.

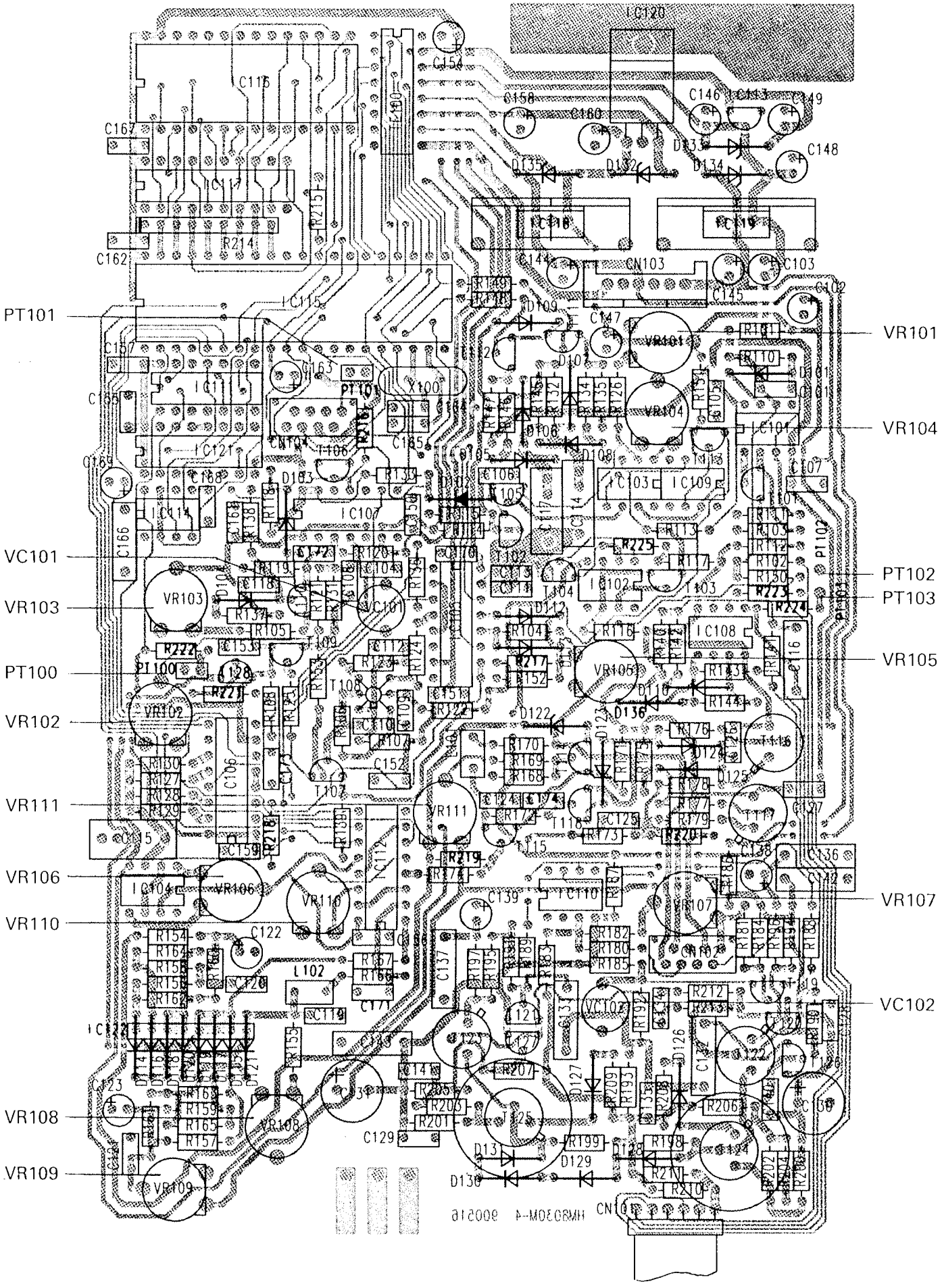
Step A:
Set frequency ④ to maximum. Note measured voltage.

Step I:
Adjust VC101 for the same voltage as in step A.

To leave the calibration mode push the "➧ ⑤" button or switch off the HM8001.

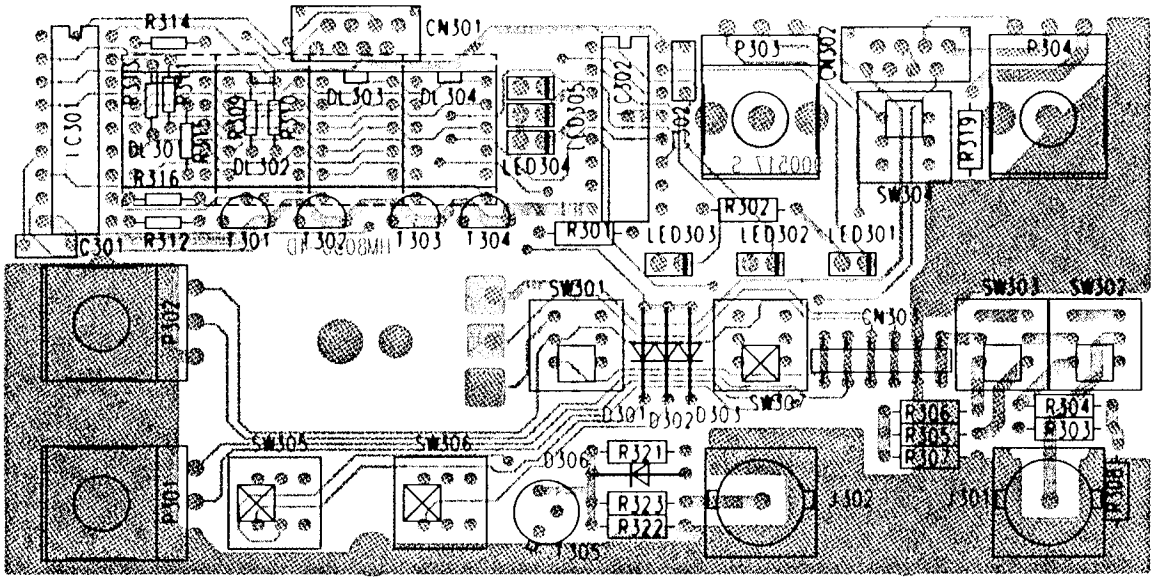
Bestückungsplan
Implantation de composants

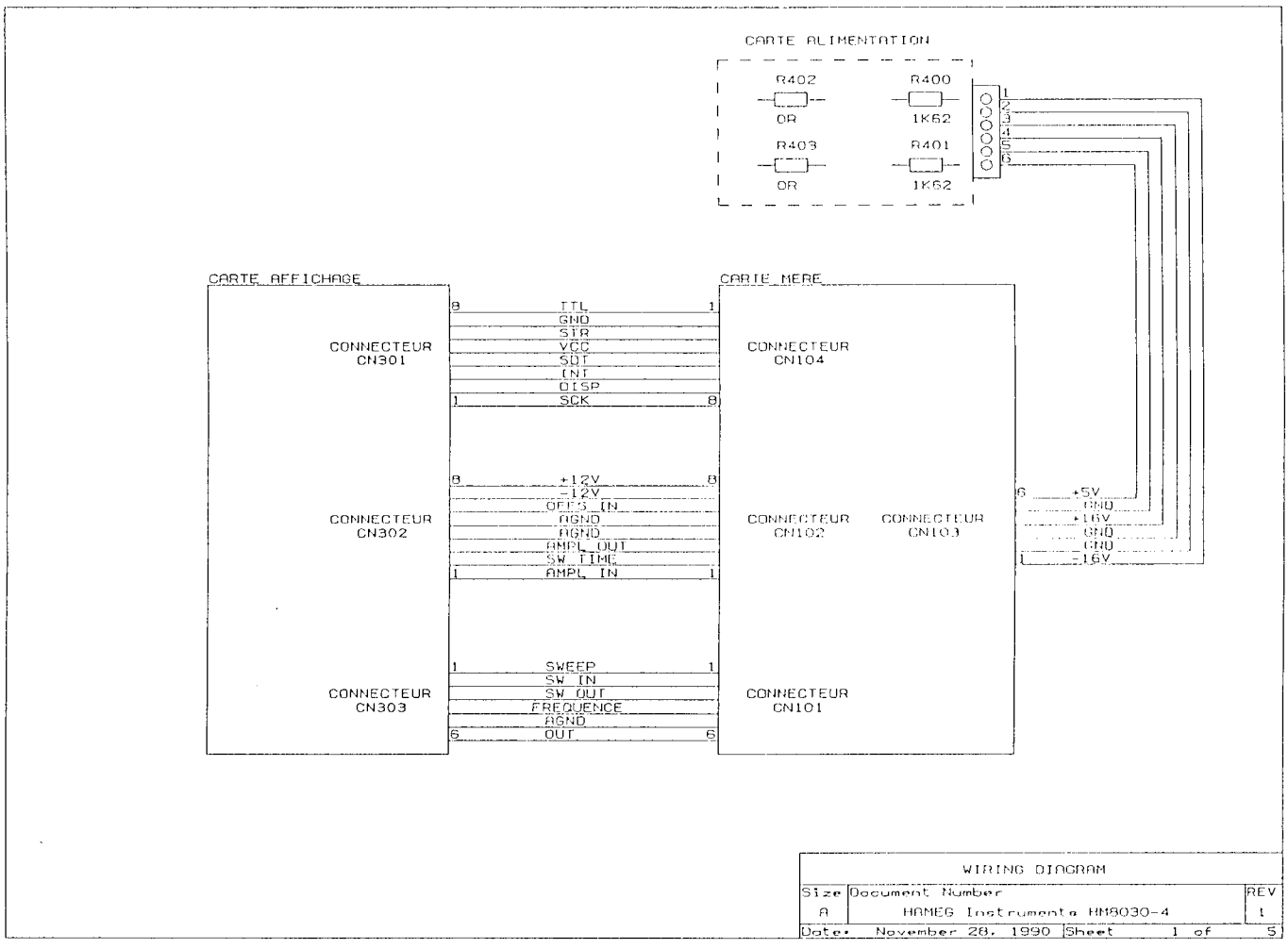
Component Locations, Main Board
Localizacion de componentes; placa base

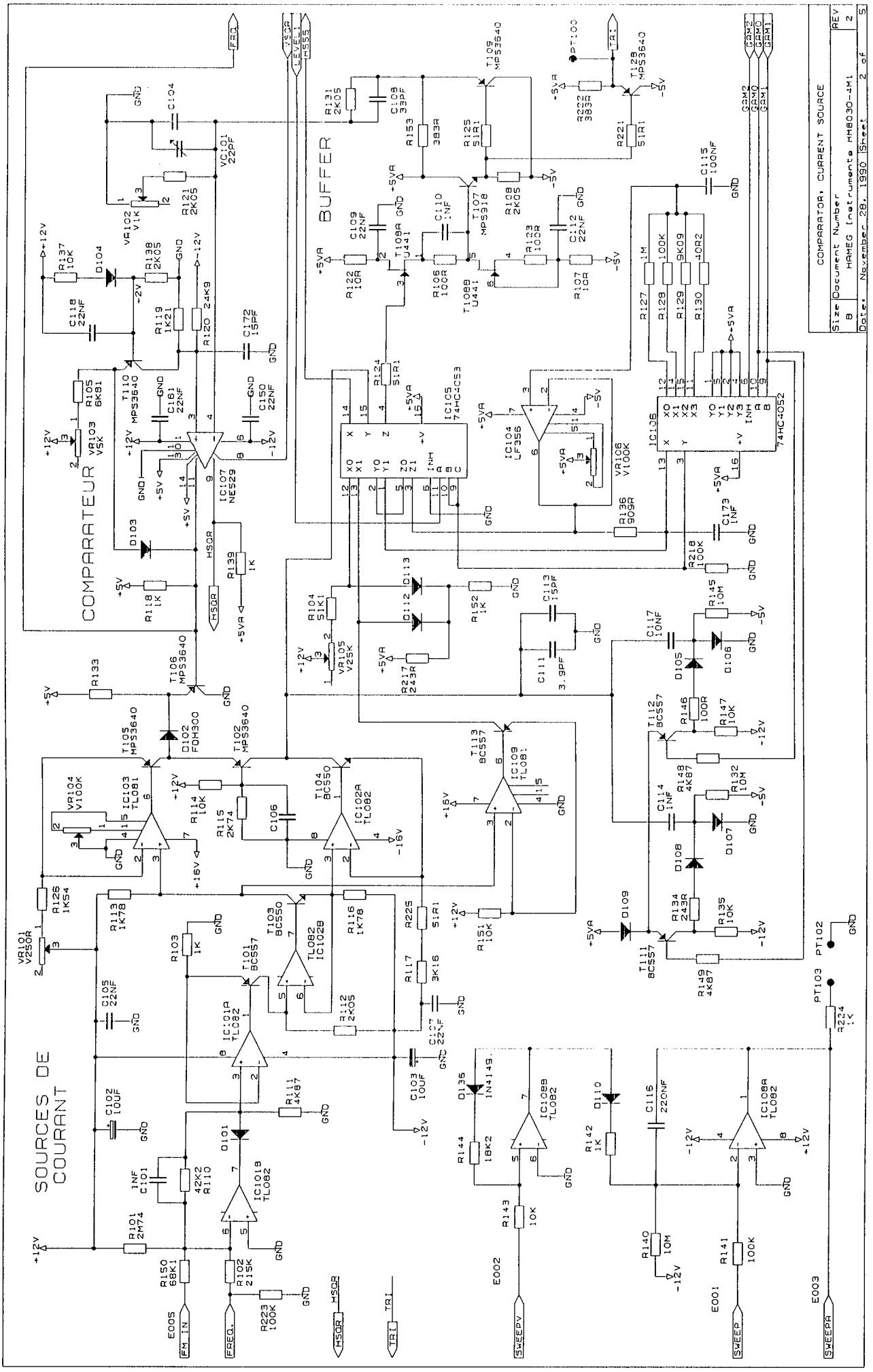


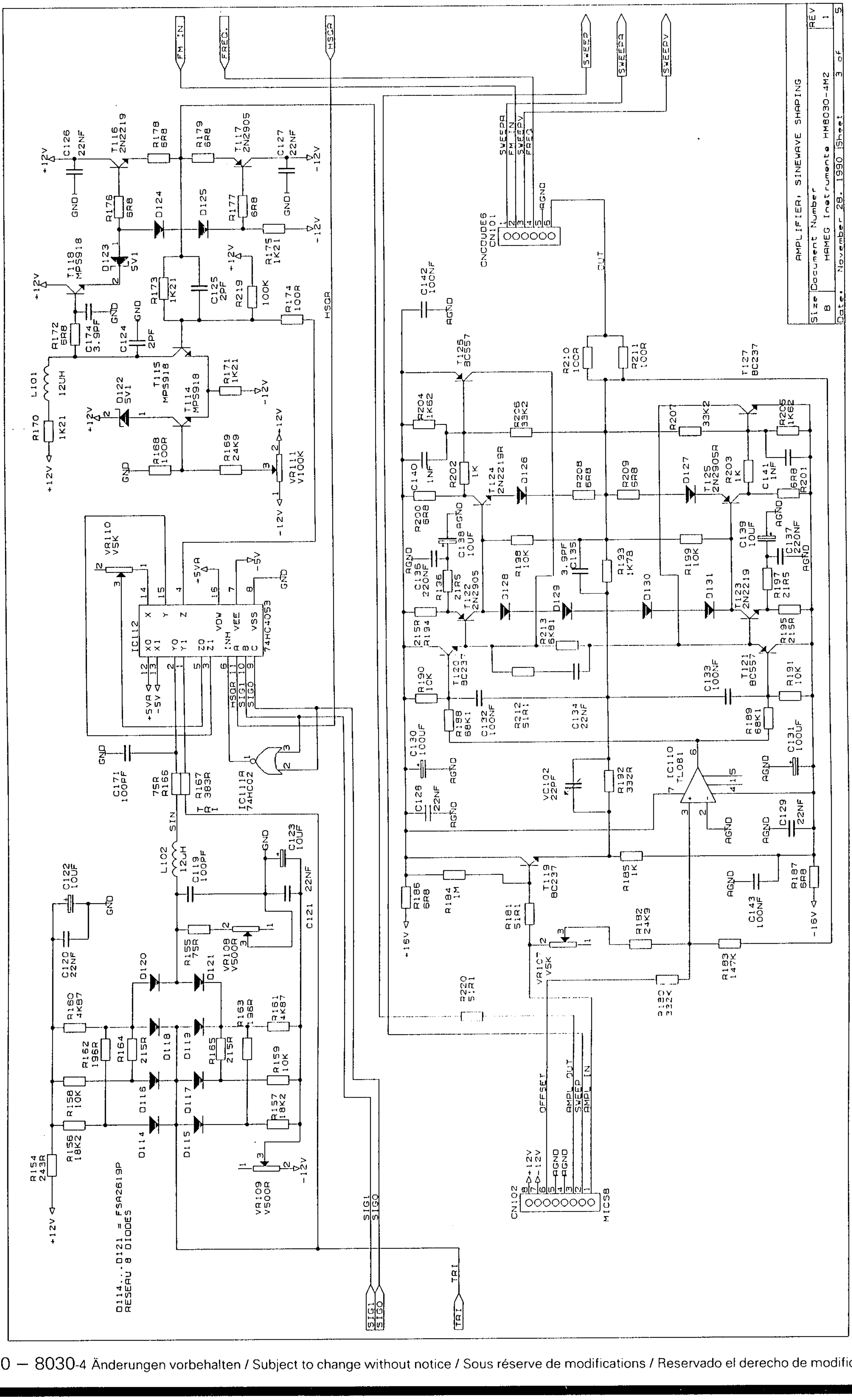
Anzeigeplatte
Carte affichage

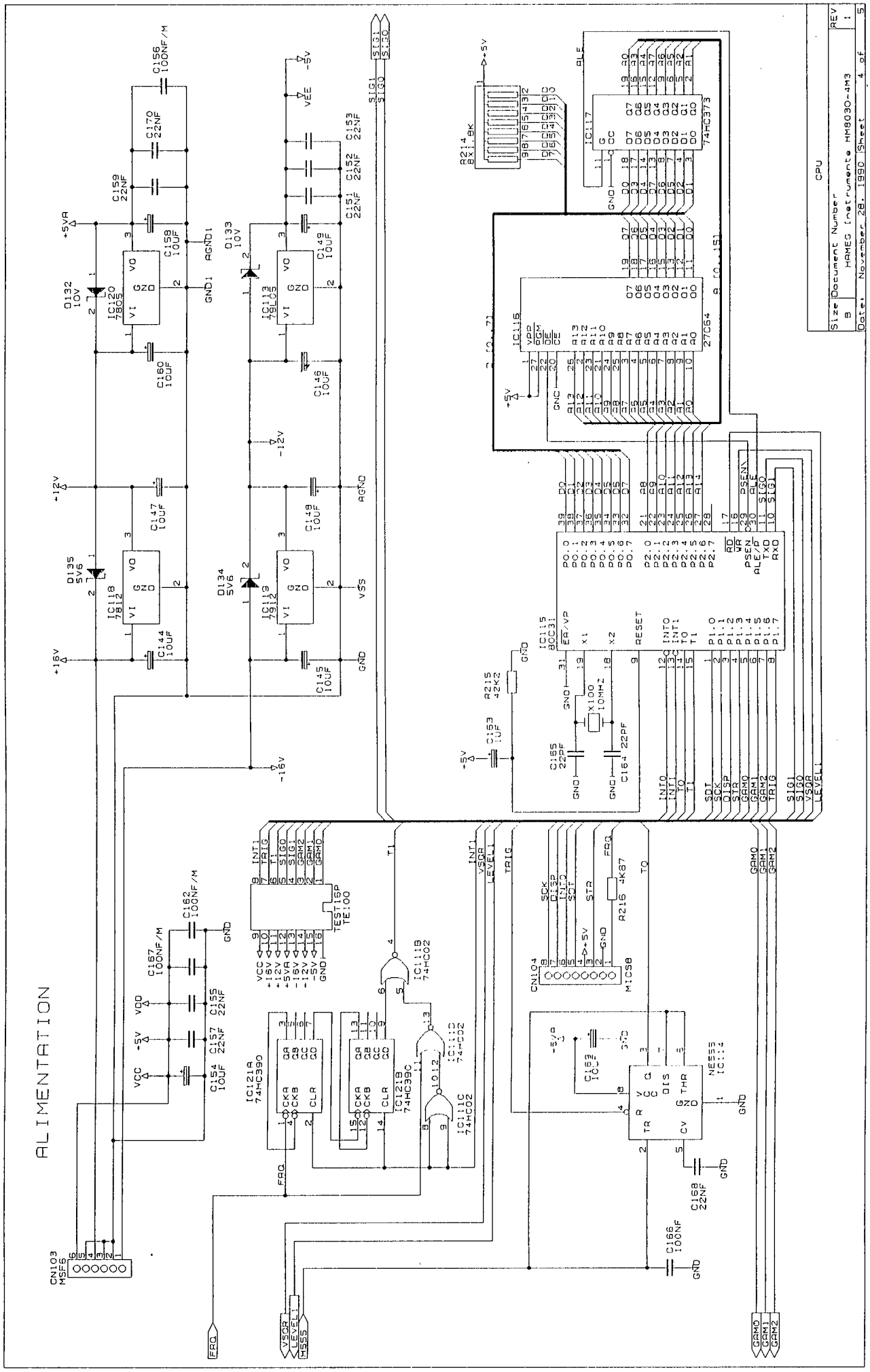
Display Board
Placa indicador






COMPARATEUR
BUFFER
SOURCES DE COURANT
COMPARATOR, CURRENT SOURCE
Size B
Document Number
HAMEG Instruments HM8030-4M1
REV 2
Date: November 28, 1990
Sheet 2 of 5


AMPLIFIER, SINEWAVE SHAPING
Size
B
Document Number
HAMEG Instruments HM8030-4M2
REV
1
Date: November 28, 1990
Sheet 3 of 5


ALIMENTATION
CPU
Size Document Number REV
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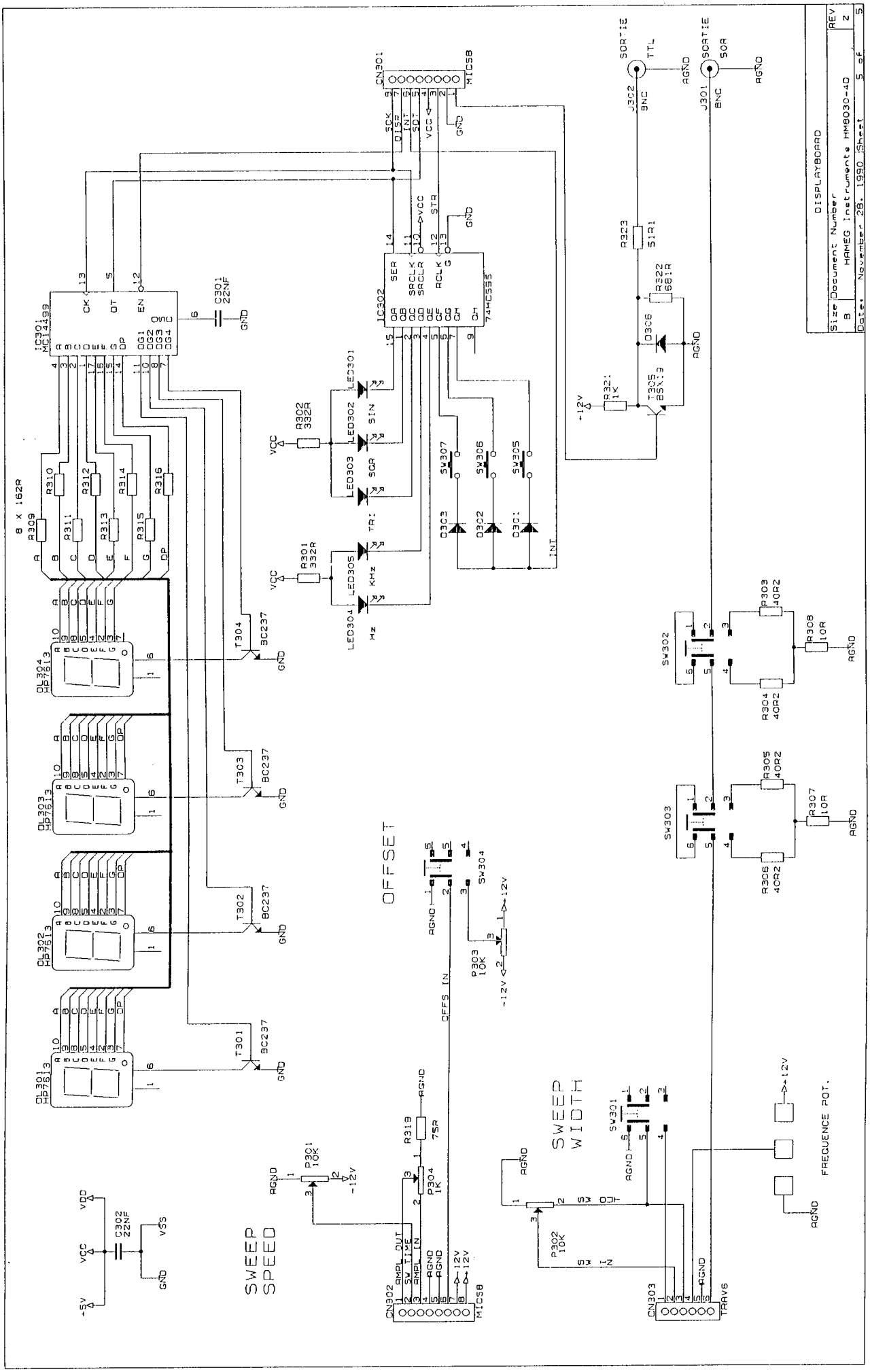
Date: November 28, 1990 Sheet 4 of 5


DISPLAYBOARD
Size: A3 Document Number REV 2
Date: November 28, 1990 Sheet 5 of 5
HAMEG Instruments HM8030-4D
SORTIE TTL
SORTIE SQR
AGND
J302 BNC
J301 BNC
R323 51R1
R322 68R
D306
T305 BSX19
+12V
R321 1K
CN301 MIC58
SCK DISP INT SDT VCC GND
IC302 74HC595
SER SRCLK SRCLR RCLK G
QA QB QC QD QE QF QG QH
VCC STR
C301 22NF
IC301 MC14499
CK DT EN DIG
OG1 OG2 OG3 OG4
8 x 162R
R309 R310 R311 R312 R313 R314 R315 R316
A B C D E F G DP
LED301 LED302 LED303 LED304 LED305
SIN SQR TRI KHz Hz
R302 332R
R301 332R
VCC
SW307 SW306 SW305
D303 D302 D301
INT
DL304 HP7513
DL303 HP7513
DL302 HP7513
DL301 HP7513
T304 T303 T302 T301 BC237
GND
SW302 SW303
R303 40R2
R304 40R2
R305 40R2
R306 40R2
R308 10R
R307 10R
OFFSET
OFFS IN
P303 10K
SW304
-12V
SWEEP SPEED
P301 10K
R319 75R
P304 1K
SWEEP WIDTH
SW301
P302 10K
SWP OUT
SWP IN
FREQUENCE POT.
CN302 MIC58
SWP OUT SWP IN AMPL OUT AMPL IN AGND AGND 12V 12V
CN303 TRV6
C302 22NF
VDD VCC VSS GND +5V

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Printed in Germany