

# Distortion Meter HM 8027

## Service-Manual



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 emission 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 and not be used outside buildings. 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 and not be used outside buildings. Signal lines must be 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.

HAMEG Instruments GmbH

**KONFORMITÄTSERKLÄRUNG  
DECLARATION OF CONFORMITY  
DECLARATION DE CONFORMITE  
DECLARACIÓN DE CONFORMIDAD**

**Hersteller / Manufacturer / Fabricant / Fabricante:**  
HAMEG Instruments GmbH · Industriestraße 6 · D-63533 Mainhausen

Die HAMEG Instruments GmbH bescheinigt die Konformität für das Produkt  
The HAMEG Instruments GmbH herewith declares conformity of the product  
HAMEG Instruments GmbH déclare la conformité du produit  
HAMEG Instruments GmbH certifica la conformidad para el producto

<b>Bezeichnung:</b>	Klirrfaktor Messbrücke
<b>Product name:</b>	Distortion Meter
<b>Designation:</b>	Distorsionmètre
<b>Descripción:</b>	Medidor de distorsión

**Typ / Type / Type / Tipo:** HM8027

**mit / with / avec / con:** HM8001-2

**Optionen / Options / Options / Opciones:** -

mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes / con las siguientes directivas:

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  
Directiva EMC 89/336/CEE enmendada por 91/263/CEE, 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 équipements basse tension 73/23/CEE amendée par 93/68/CEE  
Directiva de equipos de baja tensión 73/23/CEE enmendada por 93/68/EWG

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées / Normas armonizadas utilizadas:

**Sicherheit / Safety / Sécurité / Seguridad:**

EN 61010-1: 1993 / IEC (CEI) 1010-1: 1990 A 1: 1992 / VDE 0411: 1994  
Überspannungskategorie / Overvoltage category / Catégorie de surtension / Categoría de sobretensión: II

**Verschmutzungsgrad / Degree of pollution / Degré de pollution / Nivel de polución:** 2

**Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique / Compatibilidad electromagnética:**

EN 61326-1/A1: Störaussendung / Radiation / Emission: Tabelle / table / tableau 4; Klasse / Class / Classe / classe B.


**Störfestigkeit / Immunity / Imunitee / inmunidad:**  
Tabelle / table / tableau / tabla A1.

EN 61000-3-2/A14: Oberschwingungsströme / Harmonic current emissions / Émissions de courant harmonique / emisión de corrientes armónicas:  
Klasse / Class / Classe / clase D.

EN 61000-3-3: Spannungsschwankungen u. Flicker / Voltage fluctuations and flicker / Fluctuations de tension et du flicker / fluctuaciones de tensión y flicker.

**Datum / Date / Date / Fecha:**  
22.07.2004

**Unterschrift / Signature / Signatur / Signatura**



**G. Hübenett**  
Product Manager

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## Distortion Meter HM8027



Frequency range 20 Hz to 20 kHz

Resolution up to 0.01 %

Low inherent distortion of 0.005 %

Automatic frequency fine tuning (capture range 15 %)

Control output for residual distortion measurement

A complete measurement system for AF measurement equipment in combination with the HM8037

Mainframe HM8001-2 required for operation

Mainframe HM8001-2



HZ32 Test cable



HM8037 Low-distortion sine wave generator



**Distortion Meter HM8027**

Valid at 23 °C after a 30 minute warm-up period

**Frequency range**

20 Hz - 20 kHz  
 subdivided into 3 ranges  
 variable frequency control 10:1, overlapping ranges

**Distortion measurement range**

0.01% - 50%, subdivided into 2 ranges

**Full range:** 10% and 100%**Display resolution:** 100% range: 0.1%

10% range: 0.01%

**Display accuracy**100% range:  $\pm 5\% \pm 1$  digit for  $k \leq 10\%$ 10% range:  $\pm 5\% \pm 1$  digit for  $k \leq 1\%$ **Inherent distortion + noise** $\leq 0.5$  digit**Fundamental rejection**

30 dB greater than the measured distortion factor

or  $\geq 70$  dB in the 100% rangeor  $\geq 90$  dB in the 10% range**Input voltage**

min. for 100% calibration: 300 mV

max. for 100% calibration: 50 V

**Input impedance**100 k $\Omega$ **Monitor output****Output voltage:** 1 mV/digit (short-circuit proof)**Output impedance:** 10 k $\Omega$ **Input attenuation**

1 constant attenuator - 20 dB

1 constant attenuator - 10 dB

1 variable attenuator - 15 dB

**Miscellaneous**

1 selectable high-pass filter: 1 kHz, 12 dB/octave

**Power supply** +12V/60 mA**(from mainframe):** - 12V/60 mA

+5V/100 mA

( $\Sigma = 1.94$  W)**Operating temperature:** +10° C to +40° C**Max. relative humidity:** 80% (without condensation)**Dimensions (W x H x D) (without 22-pole flat plug):**

135 x 68 x 228 mm

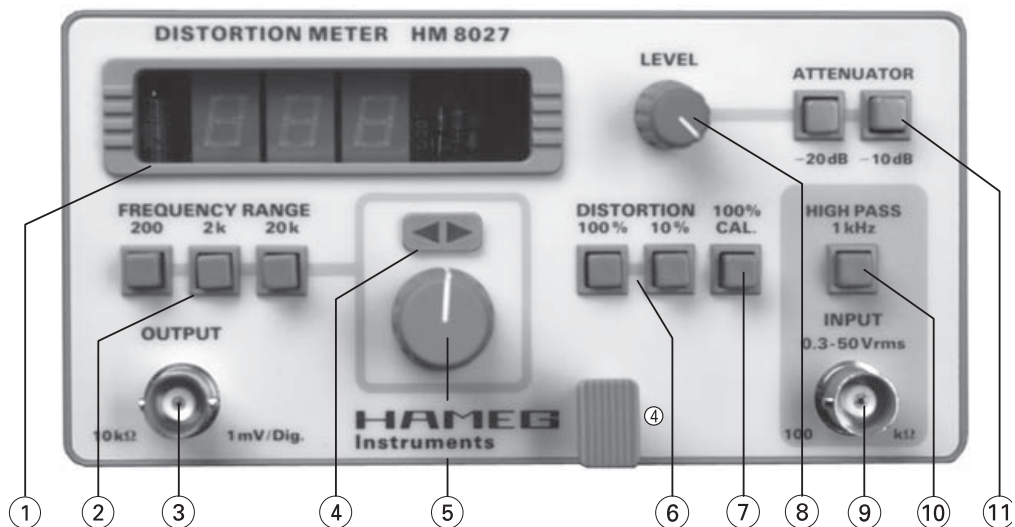
**Weight:** approx. 0.65 kg**Accessories supplied:** Operator's Manual**Optional accessories:** HZ33/HZ34 BNC Test Cable, HZ20 BNC banana adapter, HZ10 Silicone test leads

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## Control elements

- ① **Display(7-segment LEDs)**  
3-digit display for indication of the measured distortion factor in %.
- ② **FREQUENCY RANGE**  
(Pushbutton switches)  
Selection of frequency range for signal under test (20 Hz-200 Hz, 200 Hz-2 kHz, 2 kHz-20 kHz).
- ③ **OUTPUT (BNC connector)**  
Monitor output for distortion factor (Residual distortion). Output voltage is 1 mV/digit.
- ④ **TUNING INDICATOR (LEDs)**  
If the built-in filter is incorrectly tuned, one of the two LEDs will indicate in which direction the filter frequency deviates from the input frequency. Turn the tuning knob in the opposite direction until the LED goes out.
- ⑤ **TUNING (Adjusting knob)**  
Permits tuning of the built-in filter for maximum rejection of the fundamental wave. Fine tuning is automatic with a capture range of approx. 15%. If both LEDs ④ are off, the filter is properly synchronised.
- ⑥ **DISTORTION (Pushbutton switches)**  
Range selection for 10% or 100% full scale.
- ⑦ **100%-CALIBRATION**  
(Pushbutton switch)  
Selection of calibration mode. Adjustment for 100% reading with LEVEL ⑧.
- ⑧ **LEVEL (Adjusting knob)**  
Continuous attenuation of input signal up to max. 15 dB to achieve 100% reading when in the calibration mode.
- ⑨ **INPUT (BNC connector)**  
Input for measurement signal. The permissible input voltage range is 0.3V - 50V for a valid measurement.

- ⑩ **1 kHz HIGH-PASS**  
(Pushbutton switch)  
1 kHz high-pass filter with a roll off of 12 dB/octave for rejection of low frequency hum and noise.
- ⑪ **ATTENUATOR (Pushbutton switch)**  
Input signal attenuation with two pushbutton switches of 20 dB or 10 dB attenuation, respectively. They can be used separately. Both pushbutton switches activated, together with the variable attenuator ⑧ must enable a 100% reading when in the calibration mode, otherwise the input voltage should be adjusted.

## Operational check

### Measuring equipment required

- 2 Low Distortion Generators (e.g. HM8037)
- Digital multimeter with 200 mV<sub>AC</sub> range (e.g. HM8012)

### Check of input sensitivity

Setting:      ②      ⑦      ⑧      ⑪      ⑩  
                  2k      Cal.      max.      0dB      released

- 1) Adjust the output voltage of the HM8037 to 300 mV at 1 kHz.
- 2) Connect the output of the HM8037 to the input ⑨ of HM8027.
- 3) With the above setting the display ① of the HM8027 should indicate a value  $\geq 100$ .

### Check of input signal attenuation

Setting:      ②      ⑦      ⑧      ⑪      ⑩  
                  2k      Cal.      max.      0dB      released

- 1) Connect the output of the HM8037 to the input ⑨ of the HM8027.
- 2) Adjust readout ① to 100 by means of the amplitude control of the Sine Wave Generator HM8037.

- 3) Check the following values:  
 ⑧ Min. position, ⑪ = 0dB, Display  $\leq 19$   
 ⑧ Max. position, ⑪ = -10dB, Display  $\leq 30$   
 ⑧ Max. position, ⑪ = -20dB, Display  $\leq 10$

**Check of monitor output**

Setting: ② ⑦ ⑧ ⑪ ⑩  
 2k Cal. max. 0dB released

- 1) Connect the output of the HM8037 to the input ⑨ of HM8027.
- 2) Adjust the output voltage of the Sine Wave Generator HM8037 at 1 kHz to get a readout ① of 100 on HM8027.
- 3) Measure the output voltage at the monitor output ③ of HM8027 using the DMM HM8012. The obtained value should be  $100\text{ mV} \pm 5\%$ .

**Check of high pass filter**

Setting: ② ⑦ ⑧ ⑪ ⑩  
 2k Cal. 100% Cal. released

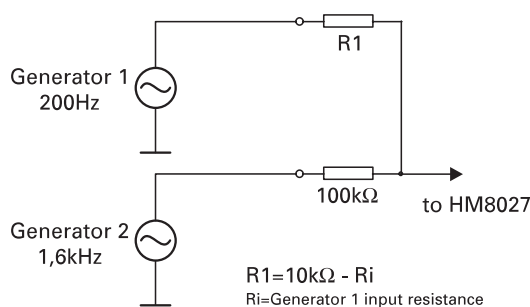
- 1) Set the frequency of the Sine Wave Generator HM8037 to 100 Hz.
- 2) Calibrate the display ① of HM8027 to 100.
- 3) Select the 100%-distortion range with one of the pushbuttons ⑥.
- 4) Switch the high-pass filter on by pushing pushbutton ⑪.
- 5) Check display ① for  $\leq 5$ .

**Check of residual distortion**

- 1) Connect the output of the HM8037 to the input ⑨ of HM8027.
  - 2) Calibrate the readout ① of the HM8027 to 100.
  - 3) Check the readout ① of the HM8027 for  $\leq 0.01$  on 10% range according to the frequencies listed below.
- | Range  | Frequencies to be checked |
|--------|---------------------------|
| 200 Hz | 20 Hz 200 Hz              |
| 2 kHz  | 200 Hz 2 kHz              |
| 20 kHz | 2 kHz 10 kHz              |

**Check of distortion measurement ranges**

- 1) Adjust both Sine Wave Generators HM8037 for an output of 1 V. Verify with HM8012. Frequency setting 200 Hz and 1600 Hz is recommended.
- 2) Connect both generators to the input ⑨ of the HM8027 according to the circuit below.



- 3) Setting: ② ⑤ ⑥ ⑧ ⑪ ⑩  
 2k tuned 100% 100% Cal released

- 4) Reading ① on HM8027 should be  $10.0 \pm 5\%$ .
- 5) Change the output voltage of Generator 2 to 100 mV (-20 dB). Verify with HM8012.
- 6) Change the setting of the distortion measurement range to 10% by pushing ⑥.
- 7) Check readout ① of HM8027 for  $1.00 \pm 5\%$ .
- 8) In this case it must be possible to measure a signal of 1.6 kHz with an amplitude of 100 mV at output ⑤ of HM8027.

**Control range of automatic frequency tuning**

Setting: ② ⑦ ⑧ ⑪ ⑩  
 2k Cal. 100% Cal. released

- 1) Connect the output of HM8037 to input ⑨ of HM8027. Set the frequency to 1 kHz.
- 2) Calibrate the HM8027 to 100% and align the frequency by means of the control knob ⑤.
- 3) Adjust the frequency control of HM8027 by means of the control knob ⑤ so, that the right LED ④ just lights.
- 4) Adjust the frequency of HM8037 until the left LED lights.
- 5) The frequency setting of HM8037 should now be approx. 1.15 kHz. This corresponds to the specified 15% automatic tuning range.

**Adjustment****Display zero adjustment**

Setting: ② ⑦ ⑧ ⑪  
 2k Cal. mid posit. 0dB

**Gain adjustment**

Setting: ② ⑦ ⑪  
 2k Cal. -10dB

- 1) Adjust both sine wave generators HM8037 to an output of 1 V. Verify with HM8012. Frequency setting 200 Hz and 1600 Hz is recommended.
- 2) Connect both generators to the input ⑨ of HM8027 according to the circuit in the section operational check.
- 3) Connect the HM8012 (setting  $2V_{AC}$ ) to test point E on the test connector CN101.
- 4) Adjust the measured value to 300 mV by means of the amplitude control (A).
- 5) Tune the frequency control ⑤ until the LEDs ④ extinguish.
- 6) Select the 100% measurement range with ⑥.
- 7) Adjust the readout ① for 10.0 by means of VR103.

**Calibration adjustment**

- 1) Same settings and connections as **Gain adjustment**.
- 2) Select the calibration mode by means of pushbutton ⑦.
- 3) Adjust VR301 for 100% readout ①.

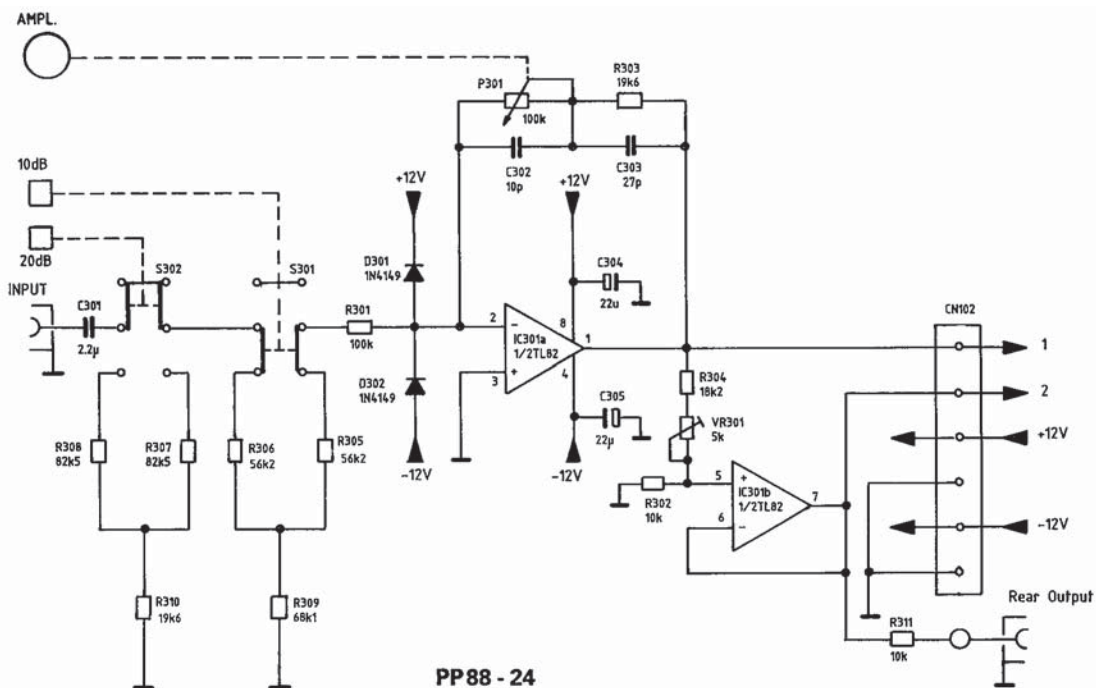
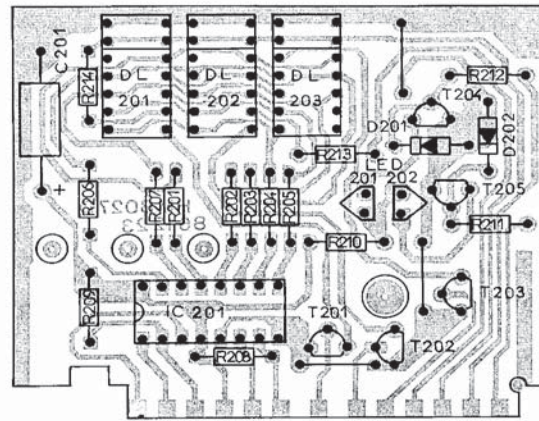
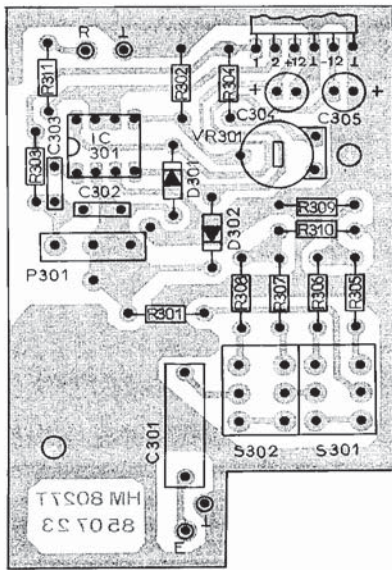
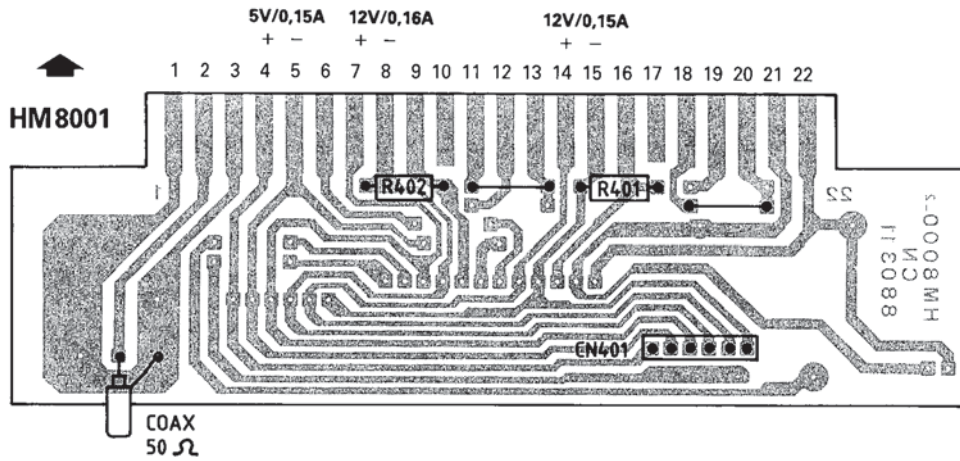
**Adjustment of frequency control circuit**

Setting: ② ⑦ ⑪ ⑧  
 2k Cal. -10dB 100%Cal.

- 1) Connect the output of HM8037 to the input ⑨ of HM8027 (output voltage 1 V, 1 kHz).
- 2) Adjust the display ① for 100 by means of the level control knob ⑥.
- 3) Tune the frequency control ⑤ until the LEDs ④ extinguish.
- 4) Adjust the frequency control ⑤ of HM8027 so that the right LED ④ lights.
- 5) Set the frequency of HM8037 to 1150 Hz.
- 6) Adjust VR101 so that the left LED ④ lights.

**Frequency compensation**

- 1) Connect the output of HM8037 to the input ⑨ of HM8027.
- 2) Tune the HM8027 for correct distortion reading.
- 3) Measure and take note of DC-voltage at the point A of the test connector CN101 (-5V<sub>DC</sub> typ.).
- 4) Adjust the frequency of HM8037 to 20 kHz.
- 5) Recalibrate and readjust the HM8027.
- 6) Adjust VC101 to obtain a DC-Voltage same as 3)  $\pm 100\text{ mV}$ .

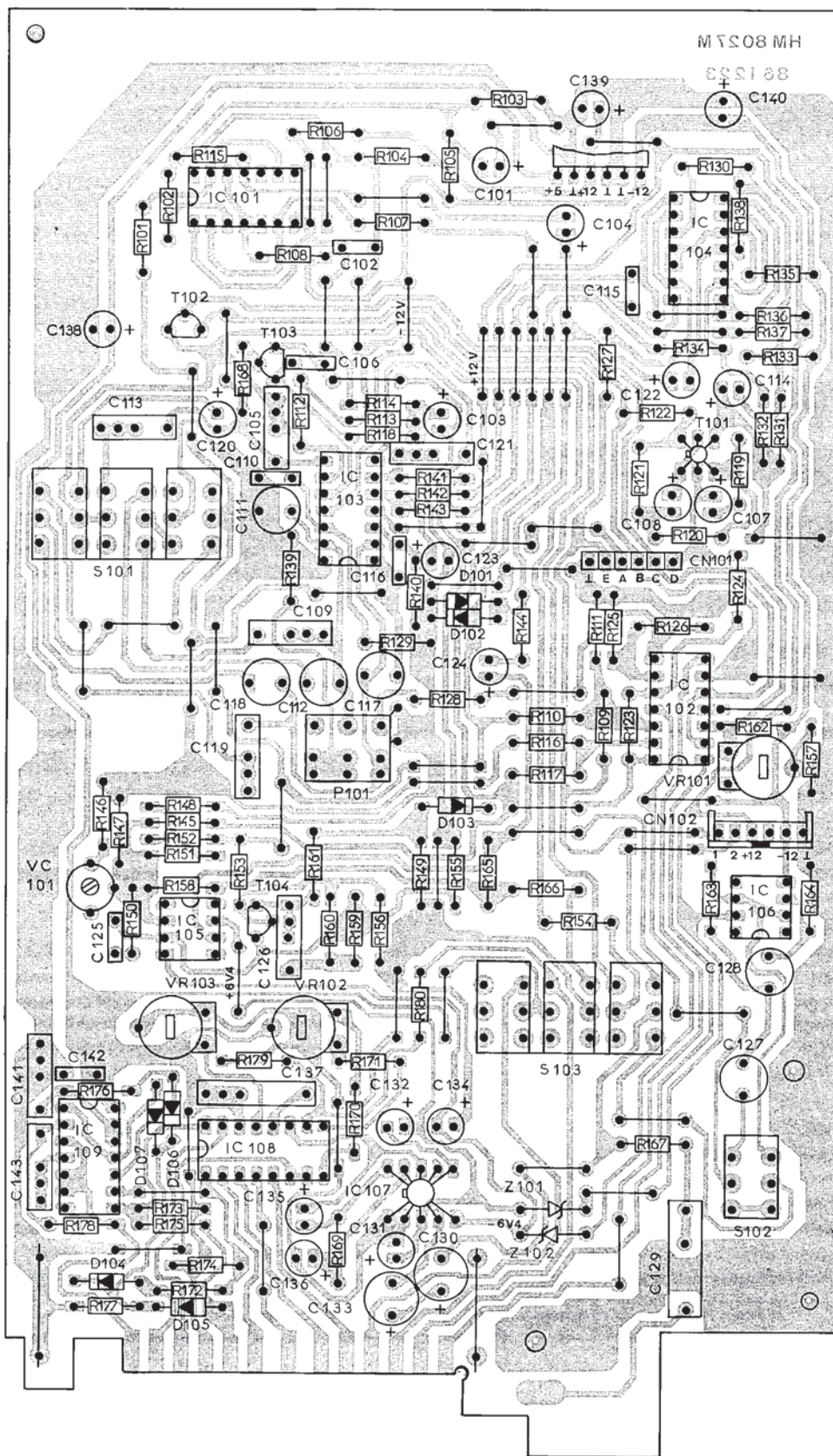


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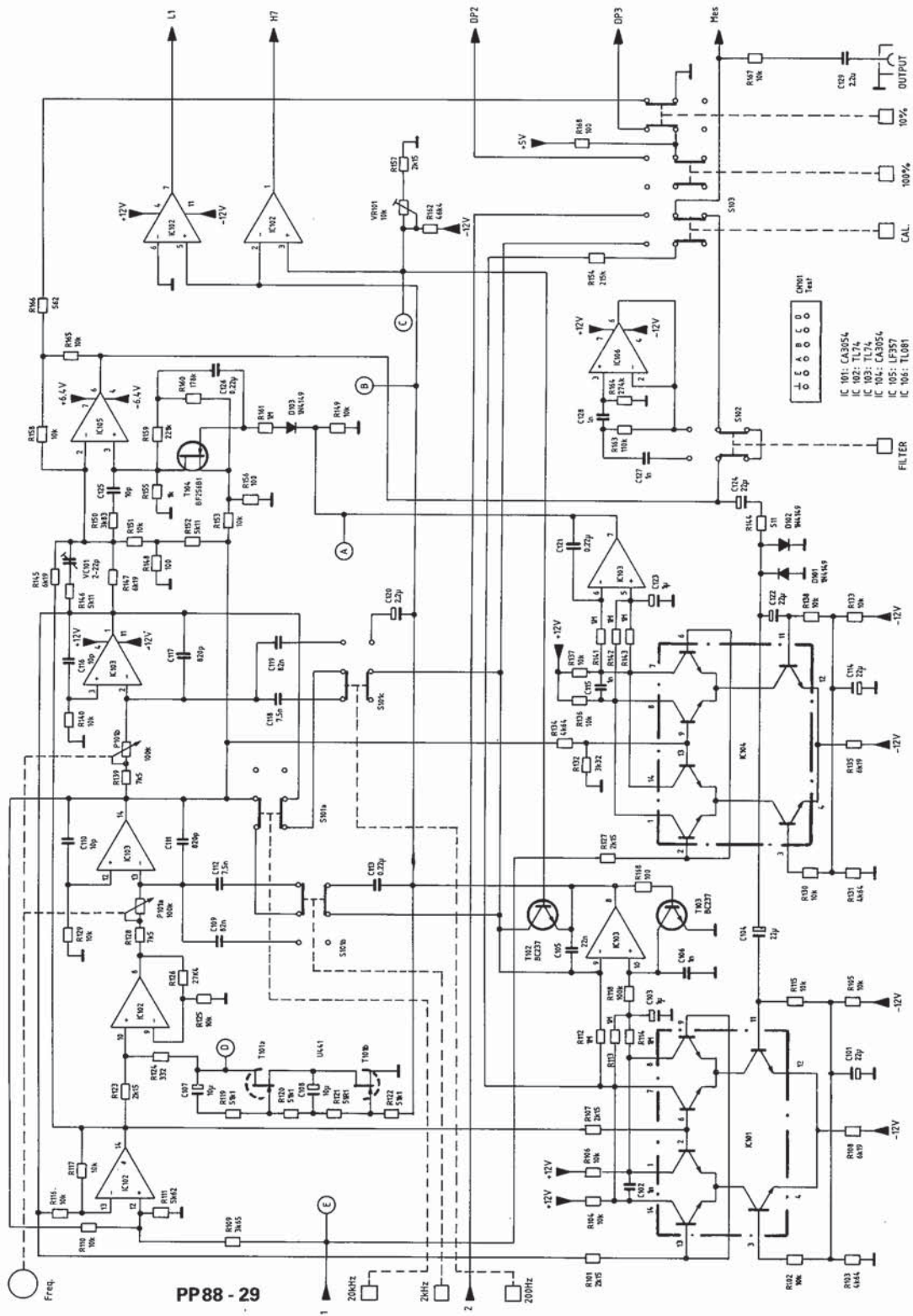
Component Locations  
Localizacion de componentes

Bestückungsplan  
Implantation des composants



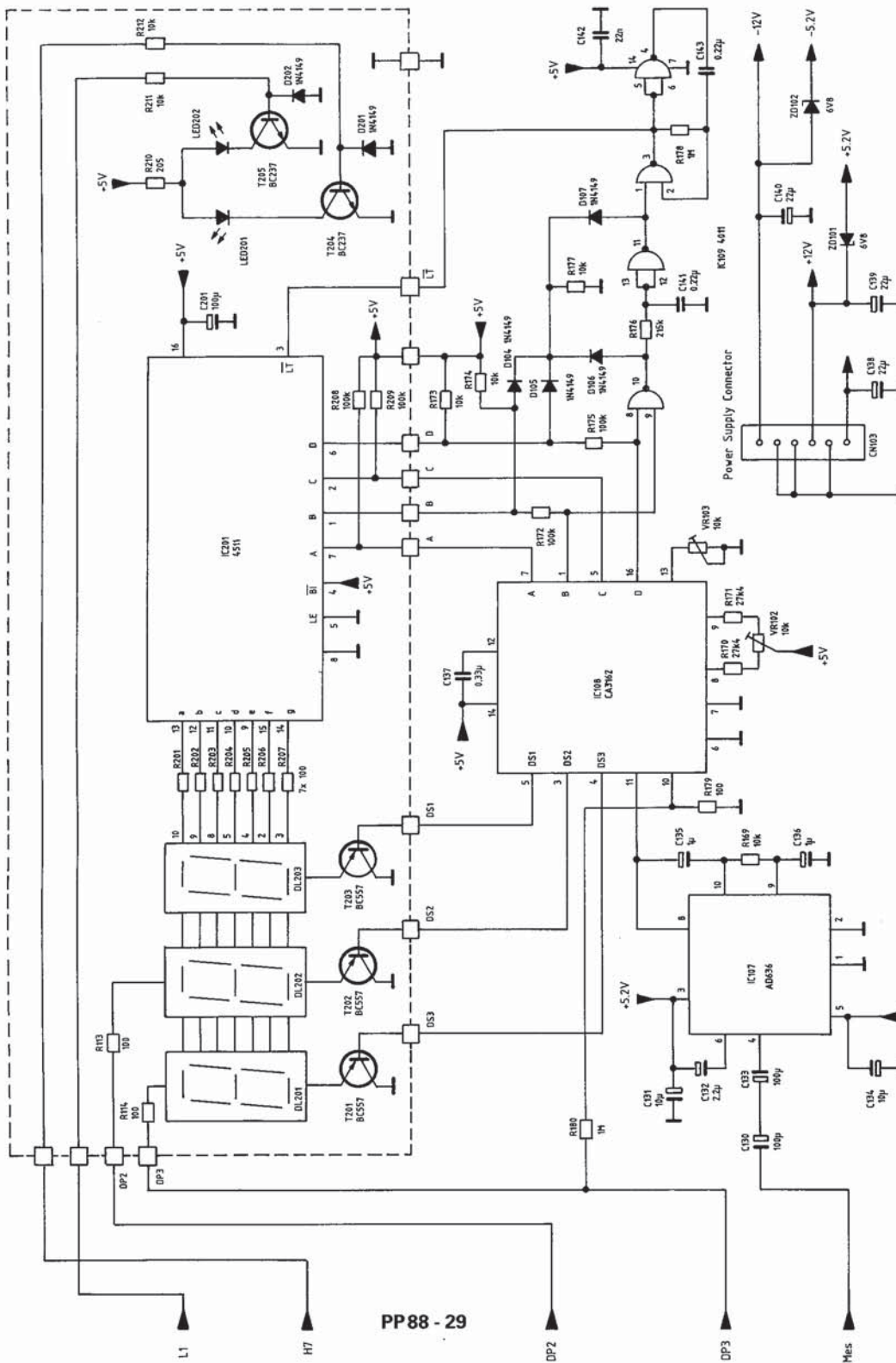
**Filterschaltung, Signalaufbereitung**  
**Mise en forme des signaux**

**Active Filter, Signal Shaping**  
**Preparación de señales**



**Digitalanzeige**  
**Affichage numerique**

**Digital Display**  
**Indicator digital**



Oscilloscopes



Spectrum Analyzer



Power Supplies



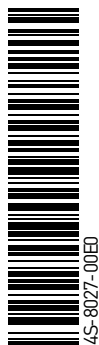
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Reg.-Nr.: 071040 QM

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