

## 10 MHz Function Generator HM8030-6



Option H0801



HZ33, HZ34  
 Test cable BNC/BNC



HZ20 BNC to 4mm  
 binding post



- Frequency range 50 MHz to 10 MHz
- High signal purity and amplitude stability
- Distortion factor <math><0.5\%</math> up to 1 MHz
- Output voltage 20 V<sub>pp</sub> (10 V<sub>pp</sub> into 50 Ω)
- Surge- and short-circuit-proof output
- Rise and fall time typ. 15 ns
- Internal and external sweep
- Pulse width adjustment
- Highly accurate digital frequency display
- Mainframe HM8001-2 required for operation

## SPECIFICATIONS

Valid at 23 degrees C after a 30 minute warm-up

### Operating Modes

Sine - Square - Triangle - DC - Pulse

free running, internal sweep, or external frequency modulation, with or without DC Offset

### Frequency Range

Total Range: 0.05Hz to 10MHz  
(8 Decade Steps)

#### Variable Frequency

**Adjustment:** x0.09 to x1.1 (12:1)  
Frequency Stability: <0.5%/h or 0.8%/day  
at constant ambient temperature  
(medium frequency control position)

### Waveform Characteristics

Sine Wave Distortion

0.05 Hz to 1 MHz: max. 0.5%  
1 MHz to 10MHz: max. 5%

**Square Wave Risettime:** typ. 15ns

Overshoot: <5%  
(when output is terminated with 50Ω)

**Triangle Non-Linearity:** <1% (up to 100 kHz)

### Display

Frequency: 5 digit, 7 segment LED;  
8 x 5mm each

#### Accuracy:

up to 5 Hz: ±(1% + 3 digit)  
5 Hz to 10MHz: ±[5 x 10<sup>-5</sup> + 1 digit]  
LED-Indicator for: mHz, Hz, kHz and sec

### Outputs

**Signal Output:** short-circuit proof

**Impedance:** 50Ω

#### Output Voltage

into 50Ω 10V<sub>pp</sub>  
open circuit 20V<sub>pp</sub>

#### Pulse Output Voltage

into 50Ω: 5V<sub>pp</sub>  
open circuit: 10V<sub>pp</sub>

#### Attenuation:

max. 60dB  
2 steps: 20dB ±0.2dB each  
variable: 0 to 20dB

#### Amplitude Flatness: (sine/triangle)

0.05Hz to 0.5MHz: max. 0.2dB  
0.5MHz to 10MHz: max. 2.0dB

**DC-Offset:** variable (on/off, except impulse function)

#### Offset range:

into 50Ω max. ± 2.5V  
open circuit max. ± 5V

#### Trigger Output:

square wave synchronous  
to signal outputs +5V / TTL

### FM Input

(VCF, BNC-connector on rear panel of HM8001-2 and Opt. HO801)

**Frequency change:** approx. 1:100

**Input impedance:** 6 kΩ || 25pF

**Protection voltage:** ± 30V max.

### Internal Sweep

**Sweep speed:** 20ms to 15s

**Sweep range:** approx. 1:100

### General Information

**Operating conditions:** +10°C to +40°C

**max. relative humidity:** 80%

**Supply (from HM8001-2):** +5V/200mA

+16V/300mA;

-16V/250mA

(Σ=9,8W).

**Dimensions** (without 22-pin flat connector)

**W x H x D:** 135 x 68 x 228mm;

Weight: approx. 800g

#### Included in delivery:

Function generator HM8030-6, Operating manual

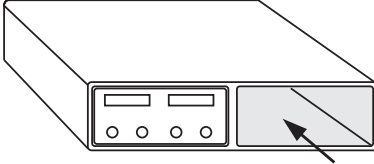
#### Optional Accessories:

BNC test cable HZ33/HZ34

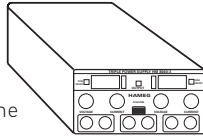
50Ω Through termination HZ22

## Important hints

The operator is requested to carefully read the following instructions and those of the mainframe



me HM8001-2, to avoid any operating errors and mistakes and in order to become acquainted with the module.



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 intended for use in conjunction with the Mainframe HM8001-2. When incorporating it into other systems, the module should only be operated with the specified supply voltages.

### Safety

This instrument has been designed and tested in accordance with IEC Publication 1010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use. It corresponds as well to the the CENELEC regulations EN 61010-1. 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 render the instrument dangerous. Intentional interruption is prohibited.**

The instrument 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 shows 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 necessary on the opened-up instrument, these must only be carried out by qualified personnel acquainted with the danger involved.

Symbols marked on equipment



ATTENTION refer to manual.



DANGER High voltage.



Protective ground (earth) terminal.

### 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 HM8001-2 and on the plug-in modules must not be obstructed.

### Warranty and Repair

HAMEG instruments are subjected to a strict quality control. Prior to leaving the factory, each instrument is burnt-in for 10 hours. By intermittent operation during this period almost all defects are detected. Following the burn-in, each instrument is tested for function and quality, the specifications are checked in all operating modes; the test gear is calibrated to national standards.

The warranty standards applicable are those of the country in which the instrument was sold. Reclamations should be directed to the dealer.

### **Only valid in EU countries**

In order to speed reclamations customers in EU countries may also contact HAMEG directly. Also, after the warranty expired, the HAMEG service will be at your disposal for any repairs.

### **Return material authorization (RMA):**

Prior to returning an instrument to HAMEG ask for a RMA number either by internet (<http://www.hameg.com>) or fax. If you do not have an original shipping carton, you may obtain one by calling the HAMEG sales dept (+49-6182-800-300) or by sending an email to [vertrieb@hameg.com](mailto:vertrieb@hameg.com).

### **Maintenance**

The most important characteristics of the instruments should be periodically checked according to the instructions provided in the sections "Operational check and "Alignment procedure. 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 HM8001-2. 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**

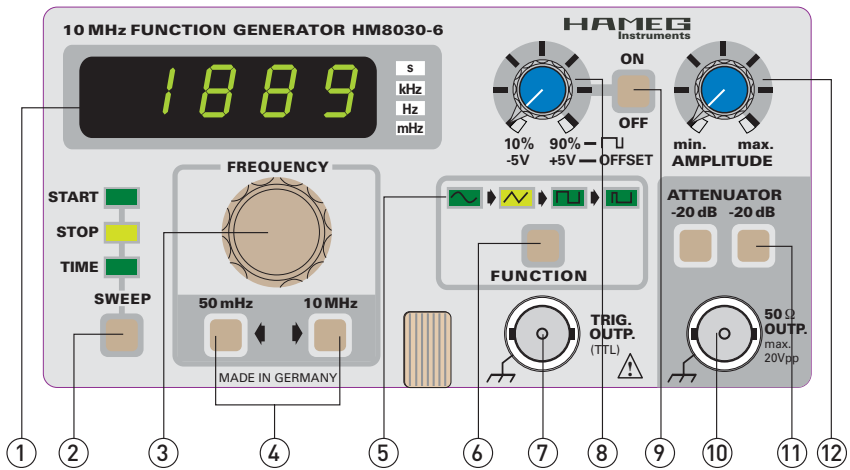
Provided that all hints given in the operating instructions of the HM8001-2 Mainframe were followed especially for the selection of the correct mains voltage start of operation consists practically of inserting the module into the right or left opening of the mainframe. The following pre-cautions should 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 HM8001-2 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 HM8001-2 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 HM8030-6

- ① **DISPLAY (7 segment LED)**  
5-digit frequency meter. LED indicators for mHz, Hz, kHz and s
- ② **SWEEP (push button) and Indication (LEDs)**  
Button activates internal sweep generator. The LEDs indicate the function chosen with the SWEEP-Button. Settings are changed with ③ or ④.
- ③ **FREQUENCY (adjustment knob)**  
Continuous and linear frequency fine adjustment, with the setting range from 0.09 to 1.1 [approx 0.045 to 1.1 in 10MHz-range] overlapping the ranges selected with ④
- ④ **FREQUENCY (2 pushbuttons)**  
Frequency range selection from 50 mHz to 10 MHz in 8 decade steps.
- ⑤  $\sim$   $\wedge$   $\sqcap$   $\square$  (LED s)  
Indication of selected function.
- ⑥  $\sim$   $\wedge$   $\sqcap$   $\square$  (pushbutton)  
Mode selection: Triangle, Sine, Square, Pulse and Off.
- ⑦ **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%.
- ⑧ **OFFSET (adjustment knob)**  
Adjustment of the positive or negative offset voltage. This DC voltage can be super-imposed on the output signal. The max. offset voltage is  $\pm 5V$  (o.c.) or  $\pm 2.5V$  respectively when terminated into  $50\Omega$ . The offset voltage is available to all functions except for pulse and activated by ⑨. In operation mode OFF (no function activated) it can be used separately. In pulse mode the pulse width is set with this control from 10% to 90%.
- ⑨ **ON (pushbutton)**  
Activates the offset function except in pulse mode. If the ON-button is pushed in pulse mode, pulse width is set with the control ⑧ from 10% to 90%. In OFF-position the fixed pulse width amounts to 50%.
- ⑩ **50 $\Omega$  OUTPUT (BNC connector)**  
Short-circuit proof signal output of the generator. The output impedance is  $50\Omega$  and the max. output amplitude is  $20V_{pp}$  (o.c.) or  $10V_{pp}$  respectively when terminated into  $50\Omega$ .
- ⑪ **-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 ⑫, the max. attenuation amounts to 60dB (factor 1000).
- ⑫ **AMPLITUDE (adjustment knob)**  
Continuous adjustment of the output amplitude from 0 to -20dB terminated into  $50\Omega$ .

## Functions

### Function selection

The type of output signal is selected with the function selection switch ⑥. A total number of 4 different waveforms (sine, square, triangle and pulse) are available. The functions are marked with the corresponding symbols. If the ON-pushbutton ⑨ is activated a DC voltage level is supplied by the HM8030-6 (all function LEDs ⑤ off) or superimposed on the output signal, except in pulse mode.

The max. offset voltage is  $\pm 5\text{V}$  with open outputs and is continuously adjustable with the OFFSET control ⑧.

In pulse mode no offset voltage is available. With control ⑧ pulse width is continuously adjustable from 10% to 90%. In position OFF of pushbutton ⑨ a fixed pulse width of 50% is delivered.

### Frequency adjustment

Coarse adjustment is performed with the range keys ④. The desired frequency is selected by turning the FREQUENCY control ③. The selected frequency appears on the 5-digit display ①.

### Output amplitude and signal connection

Adaptation in decade steps to the desired amplitude range is performed by the use of two attenuators with  $-20\text{ dB}$  each, which are activated by pushbuttons ⑩.

Including the continuously adjustable AMPLITUDE control ⑫, the maximum attenuation amounts to  $-60\text{ dB}$ . With the maximum amplitude of  $10\text{V}_{\text{pp}}$ , the minimum signal voltage to be supplied is about  $10\text{ mV}$ . These values are obtained when the generator output is terminated into  $50\Omega$ . In the open-circuit condition, the available signal amplitude is twice as high. Therefore the maximum output voltage of the output socket is specified with  $20\text{V}_{\text{pp}}$ . If exact square-shaped signals are required, care should be taken that only  $50\Omega$  coaxial cables (e.g. HZ34) are used. Furthermore, this cable must be terminated into a  $50\Omega$  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  $50\Omega$  input impedance are connected, this termination is not required. In high signal voltage ranges, it should be noted that the terminating resistor used must be specified for the power dissipated.

**The output terminal of the HM8030-6 is short circuit proof. However, if an external DC-voltage exceeding  $\pm 45\text{V}$  is applied to the output, the output stage is likely to be destructed. It can withstand DC-voltage up to  $\pm 45\text{V}$  for a time of max. 30 seconds.**

If the output of the HM8030-6 unit comes into contact with components of the circuit under test, which are carrying DC voltage, an isolation 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 HM 8030-6 unit.

### Trigger output

In the sine, square and triangle modes, the trigger output ⑦ supplies a square signal in synchronism with the output signal. An offset voltage adjusted at the  $50\Omega$  output has no influence upon the trigger signal. The trigger output is short-circuit-proof and can drive several TTL inputs. If the trigger output is terminated into  $50\Omega$ , the trigger level will fall below TTL specifications. Therefore short or low-capacity cables without a  $50\Omega$  termination are to be used.

### Sweep facilities

#### 1<sup>st</sup> Internal sweep

The internal sweep facility of the HM8030-6 allows checking of filters and equipment in the frequency range from  $3\text{ Hz}$  to  $10\text{ MHz}$ . Operation is very easy and does not require more than setting of the start and stop frequencies and the sweep time. Activation is by simply pressing the SWEEP-pushbutton ② (START-LED lights). Sweep can be combined with all available functions on the HM8030-6. The start frequency is automatically given by the settings of the range selector ④ and the frequency dial ③ and is shown on the 5-digit display. It can be set to any

frequency in the entire frequency range of the HM 8030-6. The stop frequency can be independently set the same way to a frequency which is a maximum of 2 decades apart from the start frequency. Push the SWEEP push button ② again (STOP-LED lights). The max. frequency deviation is given by the difference between start and stop frequencies. This relationship may reach a factor 100. The sweep time can be set when TIME is selected by means of the SWEEP button (TIME-LED lights). The sweep starts immediately when TIME is selected and can be set during operation. Time is set by means of the FREQUENCY potentiometer ③ and ranges from 20ms to 15s. For external frequency modulation please refer to "FM input".

### 2<sup>nd</sup> FM input

If an AC voltage is applied to the FM input on the rear panel of the HM8001-2, the generator frequency is being frequency modulated in time and according to the signal shape of this AC voltage. The frequency deviation depends on the amplitude of the AC voltage.

If a positive DC voltage is applied to the FM input on the rear panel of the HM8001-2, 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 settings. The frequency delivered at 0V input may be freely selected.

Computation:

$$N = N_0 + A \times U \text{ or } U = (N - N_0) : A$$

$N_0$  = digit display at 0V

$N$  = digit display applied voltage U,

$U$  =  $\pm$  voltage at the FM input.

$A$  = approx. 1050 (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  $\cong$  1000 digit). The max. frequency (10 MHz) cannot and "000" should not be exceeded. Any zeros preceding the decimal point are dropped. The stability of the frequency set depends essentially on the stability of the applied voltage U.

The frequency change is linear a function of the voltage U.



In 10 MHz range factor A is approx. 2500!

Examples:

$$N_0 = 500 \text{ (Hz) (range 5k) , } U = +2V:$$

$$N = 500 + 1050 \cdot 2 = 2600$$

$$N_0 = 3000 \text{ (kHz) (range 10M), } U = -2V:$$

$$N = 3000 + 1050 \cdot (-2) = 900$$

$$N_0 = 50.0 \text{ (Hz) (range 500), } N = 190.0 \text{ (Hz):}$$

$$U = (1900 - 500) : 1050 = 1,33V$$

### Sawtooth output

For correct triggering during sweep the HM8030-6 features a sawtooth output. This signal is available at the rear panel of HM8001-2.

## Operational check

### General

This test should help verify, at certain intervals, the functions of HM8030-6. In order to reach thermal balance, the module and the basic instrument, in its case, must be energized for at least 60 minutes before the test begins.

### Measuring equipment required

- 20MHz Oscilloscope: HM303 or similar
- HZ22 50 $\Omega$  Through-Termination or equivalent
- HM8012 Digital Multimeter or similar
- HM8040 Adjustable DC voltage source (max. 30V) or similar
- HM8021 Frequency Counter or similar

### Frequency variation

The adjustment range of the FREQUENCY knob ③ must in any case overlap the selected decade on both sides by min. 2%.

### Amplitude stability

**Setting:** (6) (4) (3) (12)  
 $\wedge$  1k max max

Connect oscilloscope to output ⑩. Use a 50 $\Omega$  through termination. Set oscilloscope to DC coupling. Adjust signal height to 6 div. Check all frequency ranges with ④ and ③. The signal height should not vary by more than 0.2 div.

**Maximum output amplitude**

Setting: (6) (4) (3) (12) (11)  
 $\wedge$  1k max max released

Connect oscilloscope to output ⑩. The signal amplitude should be  $20V_{pp} \pm 500mV_{pp}$ . With a  $50\Omega$  load at the output ⑩, the signal amplitude should be  $10V_{pp} \pm 250mV_{pp}$ .

**Output attenuator function**

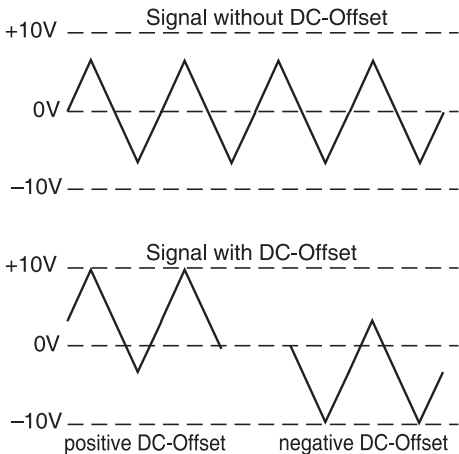
Setting: (6) (4) (3) (12) (11)  
 ~ 100 50Hz max released

Connect digital multimeter ( $V_{AC}$ ) to output ⑩. Set knob ⑫ for 5V display. First depress one button ⑪ (-20dB) only, then both buttons ⑪ (-40dB) simultaneously. The DVM should display 0.5V or  $0.05V \pm 2\%$  respectively.

**Adjustment range of the offset voltage**

Setting: (6) (4) (3) (12)  
 $\wedge$  10k max max

Connect Oscilloscope to the output ⑩. Use a  $50\Omega$  through-termination. Pushbutton ⑨ is active-ted. Adjust signal height to 6 div. Turning OFFSET control ⑧ to the left the output signal should be shifted up to the top of the graticule. Turning the control ⑧ to the right the signal should be shifted to the bottom of the graticule. The DC potential should vary between about +2.5V and -2.5V by use of control .

**Frequency variation by FM input**

Apply an adjustable DC voltage ( $\pm 30V$  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 ⑦. A square wave signal with TTL level and a 50% duty factor will be shown on the screen ("Low": about 0.4V; "High": about 5V). Without any function activated the trigger output supplies +5V.