HAMEG Instruments
A Rohde&Schwarz Company

# 25/50 MHz Arbitrary Function Generator HMF2525/2550

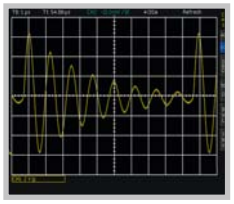
## Handbuch / Manual

Deutsch / English

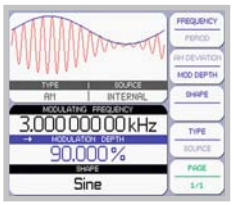
# 25/50MHz Arbitrary Function Generator HMF2525/HMF2550


USB · RS-232 · USB Stick · optional TCP/IP · optional IEEE-488 · inclusive

Generation of complex waveforms with 256 kpts in 14 Bit



All parameters at a glance on the 3.5" TFT and interactive softkeys




Ethernet/USB-interface HO730 for industrial use (Option)

- ☑ Frequency range 10µHz...25MHz/50MHz
- ☑ Output voltage $5mV_{pp}$...$10V_{pp}$ (into 50Ω) DC Offset ± 5mV...5V
- ☑ Arbitrary waveform generator: 250MSa/s, 14Bit, 256kPts
- ☑ Sine, Square, Pulse, Triangle, Ramp, Arbitrary waveforms incl. standard curves (white, pink noise etc.)
- ☑ Total harmonic distortion 0.04% (f‹100kHz)
- ☑ Burst, Sweep, Gating, external Trigger
- ☑ Rise time ‹8ns, in pulse mode 8...500ns variable-edge-time
- ☑ Pulse mode: Frequency range 100µHz...12.5MHz/25MHz, pulse width 10ns...999s, resolution 5ns
- ☑ Modulation modes AM, FM, PM, PWM, FSK (int. and ext.)
- ☑ 10MHz Timebase: ± 1ppm TCXO, rear I/O BNC connector
- ☑ Front USB connector: save & recall of set-ups and waveforms
- ☑ 8.9cm (3.5") TFT: crisp representation of the waveform and all parameters
- ☑ USB/RS-232 Dual-Interface, optional Ethernet/USB or IEEE-488

# 25 MHz Arbitrary Function Generator HMF2525
# 50 MHz Arbitrary Function Generator HMF2550

All data valid at 23 °C after 30 minute warm-up

| | |
|---|---|
| **Frequency** | |
| **HMF2525:** | 10µHz...25MHz |
| **HMF2550:** | 10µHz...50MHz |
| **Temperature stability:** | 1ppm (18°C...28°C) |
| **Aging** (after 1 year): | ± 1ppm (25°C) |
| **Amplitude** | |
| **Output voltage:** | $5mV_{pp}$...$10V_{pp}$ (into 50Ω)<br>$10mV_{pp}$...$20V_{pp}$ (open circuit) |
| **Resolution:** | 1mV (into 50Ω) |
| **Setting accuracy:** | ± (1% of control + $1mV_{pp}$) at 1kHz |
| **Frequency response:** | f ‹ 10MHz: ‹ ± 0.1dB<br>10MHz ≤ f ‹ 25MHz: ‹ ± 0.2dB<br>25MHz ≤ f ‹ 50MHz: ‹ ± 0.4dB (Sine) |
| **DC offset:** | |
| **Voltage range (AC + DC)** | ± 5mV...5V (into 50Ω)<br>± 10mV...10V (open circuit) |
| **Accuracy** | ± 2% of offset<br>± 0.5% of signal level<br>± 2mV |
| **Units:** | $V_{pp}$, $V_{rms}$, dBm |
| **Waveform Sine Wave** | |
| **Total harmonic distortion** ($1V_{pp}$): | |
| f ‹100kHz: | ‹ -70dBc |
| 100kHz ≤ f ‹10MHz | ‹ -55dBc |
| 10MHz ≤ f ‹25MHz | ‹ -40dBc |
| f ≥ 25 MHz | ‹ -37dBc |
| **Spurious:** (Non-harmonics $1V_{pp}$) | |
| f ‹ 1MHz: | -70dBc |
| 1MHz ‹ f ‹ 50MHz | -70dBc + 6dB/Octave |
| **Total Harmonic Distortion** (f ≤ 100kHz): 0.04% typ. | |
| **Phase noise:** | |
| (10MHz, 10kHz Offset, $1V_{pp}$) ‹-115dBc/Hz typ. | |
| **Waveform Rectangle** | |
| **Rise/fall time:** | ‹8ns |
| **Overshoot:** | ‹3% typ. |
| **Symmetry** (50% duty): | 1% + 5ns |
| **Jitter (RMS):** | ‹1ns typ. |
| **Waveform Pulse** | |
| **Frequency range:** | |
| **HMF2525** | 100µHz...12.5MHz |
| **HMF2550** | 100µHz...25MHz |
| **Amplitude:** | 5mV...+5V respectively -5mV...-5V (into 50Ω) |
| **Rise/fall time:** | ‹8ns, variable up to 500ns |
| **Pulse width:** | 10ns...999s |
| **Resolution:** | 5ns |
| **Jitter (RMS):** | ‹500ps typ. |
| **Overshoot:** | ‹3% typ. |
| **Waveform Rampe, Triangle** | |
| **Frequency range:** | |
| **HMF2525** | 10µHz...5MHz |
| **HMF2550** | 10µHz...10MHz |
| **Symmetry:** | 0...100% |
| **Linearity:** | |
| f ‹ 250kHz | ‹0,1% typ. |
| f ≥ 250 kHz | ‹2% typ. |
| **Waveform Arbitrary** | |
| **Frequency range:** | |
| **HMF2525** | 10µHz...12.5MHz |
| **HMF2550** | 10µHz...25MHz |
| **Sample rate:** | 250MSa/s |
| **Amplitude resolution:** | 14Bit |
| **Bandwidth** (- 3dB): | ›50MHz |
| **Signal length:** | Up to 256kPts |
| **Non-volatile memory:** | |
| **HMF2525** | 512kPts |
| **HMF2550** | 1MPts |
| **Predefined waveforms:** | Exponential rise/fall, Sin(x)/x, Cardiac, white/pink noise |
| **Inputs and Outputs** | |
| **Signal output:** | BNC socket (frontside), short-circuit-proof, ext. voltage ± 15V max. |
| **Impedance** | 50Ω |
| **Gate / Trigger input:** | BNC socket (frontside) |
| **Impedance** | 5kΩ \|\| 100pF |
| **Level** | TTL (protected up to ± 30V) |
| **Edge** | Positive/negative (selectable) |
| **Pulse width** | Min. 100ns |
| **Trigger output:** | BNC socket (frontside) |
| **Impedance** | 50Ω |
| **Edge** | Positive TTL level impulse |
| **Frequency** | 10MHz max. |
| **Modulation input:** | BNC socket (rear side) |
| **Impedance** | 10kΩ |
| **Max. input voltage** | ± 5V for full scale |
| **Bandwidth** (- 3dB) | DC...50kHz (sample with 250kSa/s) |
| **Reference input:** | BNC socket (rear side) |
| **Impedance** | 1kΩ |
| **Frequency** | 10MHz ± 100kHz |
| **Input voltage** | TTL |
| **Reference output:** | BNC socket (rear side) |
| **Impedance** | 50Ω |
| **Frequency** | 10MHz |
| **Output voltage** | $1,65V_{pp}$ (into 50Ω) |
| **Ramp output:** | BNC socket (rear side) |
| **Impedance** | 200Ω |
| **Output voltage** | 0...5V, synchronous with sweep |
| **Sweep** | |
| **Signals:** | All |
| **Type:** | linear/log. |
| **Direction:** | up/down |
| **Sweep time:** | 1ms...500s |
| **Burst** | |
| **Signals:** | All |
| **Type:** | Triggered, 1...50.000 cycles, endless or Gate controlled |
| **Start / stop phase:** | -360...+360° |
| **Trigger source:** | Manual, internal or external via Trigger source or interface |
| **Internal Trigger period:** | 1µs...500s |
| **Modulation** | |
| **Waveform modulation:** | AM, FM, PM, PWM, FSK |
| **Waveform carrier:** | All (without pulse) |
| **Internal modulation (ripple):** | Sine, Rectangle, Triangle, Ramp, Arbitrary with up to 4096Pts. |
| **Internal modulation frequency:** | 10µHz...50kHz |
| **Ext. modulation bandwidth** (-3dB): | DC...50kHz (sampled with 250kSa/s) |
| **Amplitude modulation:** | |
| **Modulation depth** | 0...100% |
| **Frequency modulation:** | |
| **Frequency deviation** | Max. 10MHz |
| **Phase modulation:** | |
| **Phase deviation** | -180...+180° |
| **Pulse width modulation:** | |
| **Deviation** | 0...100% of the pulse width |
| **Miscellaneous** | |
| **Display:** | 3,5" color TFT QVGA 65k colors |
| **Interface:** | Dual-Interface USB/RS-232 (HO720) |
| **Save / Recall memory:** | 10 complete set-ups |
| **Protection class:** | Safety class I (EN61010-1) |
| **Power supply:** | 105...253V, 50/60Hz, CAT II |
| **Power consumption:** | approx. 30Watt |
| **Operating temperature:** | +5...+40°C |
| **Storage temperature:** | -20...+70°C |
| **Rel. humidity:** | 5...80% (non condensing) |
| **Dimensions** (W x H x D): | 285 x 75 x 365mm |
| **Weight:** | 3,4kg |

**Accessories supplied:** Line cord, Operating manual, USB/RS-232 Interface (HO720), CD

**Optional accessories:**

| | |
|---|---|
| HO730 | Dual-Interface Ethernet/USB |
| HO740 | Interface IEEE-488 (GPIB), galvanically isolated |
| HZ13 | Interface cable (USB) 1,8m |
| HZ14 | Interface cable (serial) 1:1 |
| HZ20 | Adapter plug BNC plug - 4mm safety sockets |
| HZ24 | Attenuators 3/6/10 and 20dB |
| HZ33 | Test cable BNC plug - BNC plug 0,5m |
| HZ34 | Test cable BNC plug - BNC plug 1,0m |
| HZ42 | 19" Rackmount kit 2RU |
| HZ72 | GPIB-Cable 2m |

# 1 Important hints


(1) (2) (3) (4) (5)

## 1.1 Symbols

Symbol 1: Attention, please consult manual
Symbol 2: Danger! High voltage!
Symbol 3: Ground connection
Symbol 4: Important note
Symbol 5: Stop! Possible instrument damage!

## 1.2 Unpacking

Please check for completeness of parts while unpacking. Also check for any mechanical damage or loose parts, due to transportation. In case of transport damage inform the supplier immediately and do not operate the instrument.

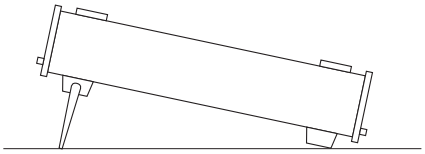
## 1.3 Positioning

Two positions are possible: According to picture 1 the front feet are folded down and are used to lift the instrument so its front points slightly upward. (Appr. 10 degrees)

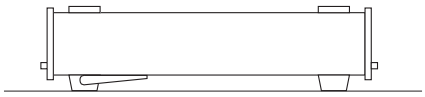
If the feet are not used (picture 2) the instrument can be stacked safely with many other HAMEG instruments.

In case several instruments are stacked (picture 3) the feet rest in the recesses of the instrument below so the instruments can not be inadvertently moved. Please do not stack more than 3 instruments. A higher stack will become unstable, also heat dissipation may be impaired.

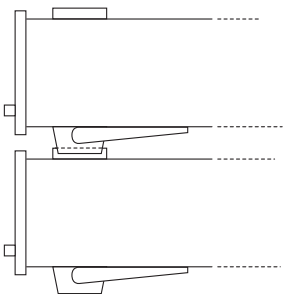
picture 1



picture 2



picture 3



## 1.4 Transport

Please keep the shipping carton in case the instrument may require later shipment for repair. Losses and damages during transport as a result of improper packaging are excluded from warranty!

## 1.5 Storage

Dry indoors storage is required. After exposure to extreme temperatures 2 h for accomodation to ambient temperature before turning the instrument on.

## 1.6 Safety instructions

The instrument conforms to VDE 0411/1 safety standards applicable to measuring instruments and left the factory in proper condition according to this standard. Hence it conforms also to the European standard EN 61010-1 resp. to the international standard IEC 61010-1. Please observe all warnings in this manual in order to preserve safety and guarantee operation without any danger to the operator. According to safety class 1 requirements all parts of the housing and the chassis are connected to the safety ground terminal of the power connector. In case of doubt the power connector should be checked according to DIN VDE 0100/610.

**Do not disconnect the safety ground either inside or outside of the instrument!**

- The line voltage of the instrument as shown on the type label must correspond to the line voltage used.
- Only qualified personnel may open the instrument
- Prior to opening the instrument must be disconnected from the line and all other inputs/outputs.

In any of the following cases the instrument must be taken out of service and locked away from unauthorized use:

- Visible damages
- Damage to the power cord
- Damage to the fuse holder
- Loose parts
- No operation
- After longterm storage in an inappropriate environment , e.g. open air or high humidity.
- Excessive transport stress

## 1.7 Proper operating conditions

The instruments are destined for use in dry clean rooms. Operation in an environment with high dust content, high humidity, danger of explosion or chemical vapors is prohibited. Operating temperature is +5 ... +40 °C. Storage or transport limits are –20 ... +70 °C. In case of condensation 2 hours for accomodation to ambient temperature before turning the instrument on. For safety reasons operation is only allowed from 3 terminal connectors with a safety ground connection or via isolation transformers of class 2. The instrument may be used in any position, however, sufficient ventilation must be assured as convection cooling is used. For continuous operation prefer a horizontal or slightly upward position using the feet.

## 1.8 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 where the instrument was purchased.

**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 (see RMA).

**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 (+49 (0) 6182 800 500) . If you do not have an original shipping carton, you may obtain one by calling the HAMEG service dept (+49 (0) 6182 800 500) or by sending an email to service@hameg.com.**

## 1.9 Maintenance

The instrument does not require any maintenance. Dirt may be removed by a soft moist cloth, if necessary adding a mild detergent. (Water and 1 %.) Grease may be removed with benzine (petrol ether). Displays and windows may only be cleaned with a moist cloth.


**Under no circumstances any fluid should be allowed to get into the instrument. If other cleaning fluids are used damage to the lacquered or plastic surfaces is possible.**

## 1.10 Power switch

The instrument has a wide range power supply from 105 V to 253 V, 50 Hz or 60 Hz ±10 %. There is hence no line voltage selector.

## 1.11 Line fuse

The instrument has 2 internal line fuses: T 0.8 A. In case of a blown fuse the instrument has to be sent in for repair. A change of the line fuse by the customer is not permitted.

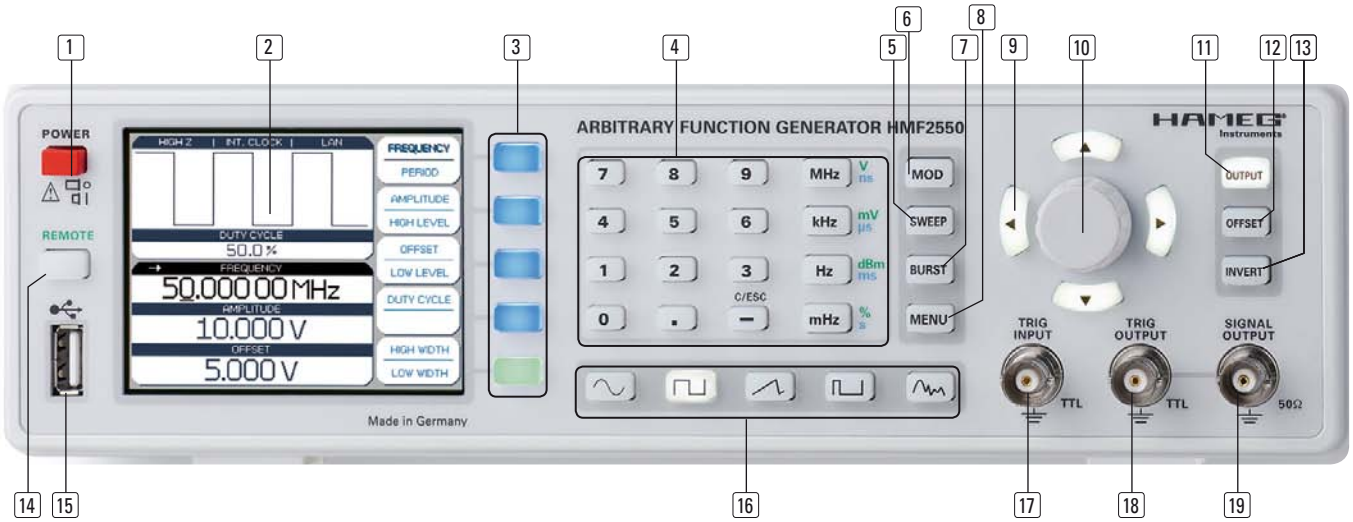



Fig. 2.1: Frontpanel of the HMF2550 / HMF2525

## 2 Controls and display

### Front panel

1 **POWER** (pushbutton)
Power switch turns the instrument on/off

2 **Display** (TFT)
All parameters including the current waveform are shown concurrently

3 **Interaktive Softkeys** (illuminated buttons)
Direct access of all relevant functions

4 **Numerical keyboard** (buttons)
Setting of all operating parameters with respective units

5 **SWEEP** (illuminated button)
Selection of the parameters for sweep mode

6 **MOD** (illuminated button)
Modulation modes

7 **BURST (illuminated button)**
Add user defined period to the waveform depending on internal or external trigger signal

8 **MENU** (illuminated button)
Open the menu options

9 **Arrow buttons** ◀ ▼ ▲ ▶ (illuminated buttons)
Cursor keys for shifting the cursor to the position to be changed, increase/decrease value of the selected parameter

10 **Rotary knob**
Knob to adjust the values

11 **OUTPUT** (illuminated button)
Turn on/off the output

12 **OFFSET** (illuminated button)
Add a user defined DC voltage to the signal output

13 **INVERT** (illuminated button)
Inverses the pulse signal output

14 **REMOTE** (illuminated button)
Toggling between front panel and remote operation

15 **USB port**
Front USB port for storing parameters and load available waveforms

16 **Signal functions** (illuminated buttons)
Selection of the signal: sine wave ∿ , square wave ⎍, triangle ⩘, pulse ⎍, arbitrary ⩙

17 **TRIG INPUT** (BNC socket)
Input for trigger signals

18 **TRIG OUTPUT** (BNC socket)
Output for trigger signals (TTL)

19 **SIGNAL OUTPUT** (BNC socket)
Signal output (50 Ω)

### Rear panel

20 **Interface**
HO720 Dual Interface USB/RS-232 is provided as standard

21 **MODULATION INPUT** (BNC socket)
Input for amplitude modulation, max. ±5 V, 50 kHz

22 **SWEEP OUT** (BNC socket)
Sawtooth output (sweep mode)

23 **10 MHz REF OUT** (BNC socket)
Reference output

24 **10 MHz REF IN** (BNC socket)
Reference input

25 **POWER INPUT** (Power Cord Receptacle)

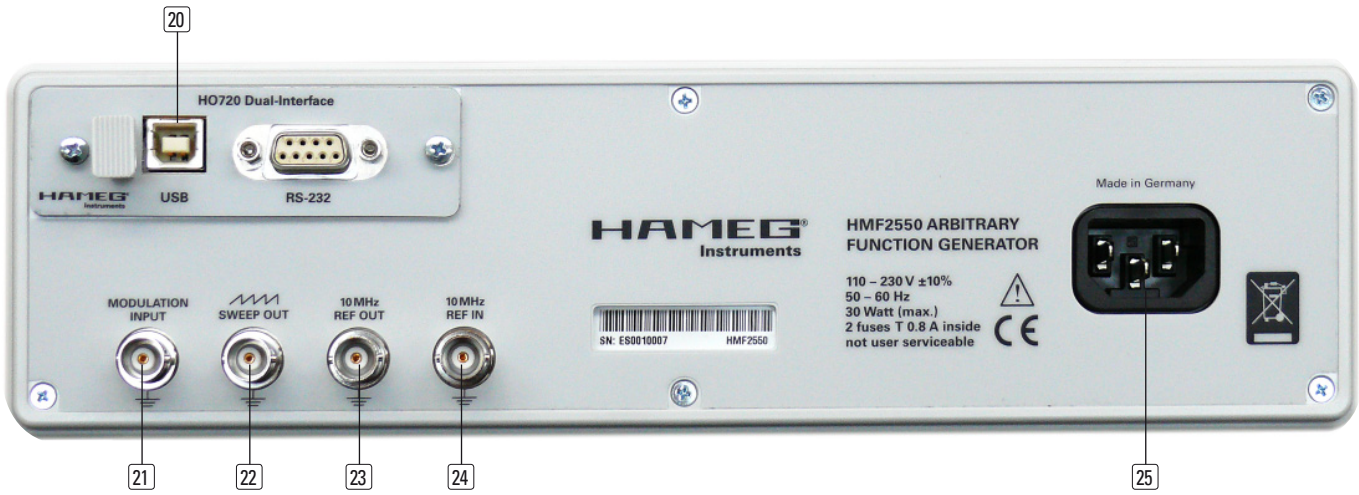



Fig. 2.2: Rear panel of the HMF2550 / HMF2525

## 3 Short description HMF2525 / HMF2550

The new HMF series arbitrary function generators with 25 MHz and 50 MHz respectively at 250 MSample/s provide 14 bit resolution. Featuring a 9 cm QVGA-TFT display and 8 ns rise time the new instruments from Hameg set the standard in their class.

Besides standard waveforms like sine, rectangle and triangle (symmetry 0 ... 100%), the HFM2525 and HFM2550 provide users with powerful arbitrary signal functionality. On the one hand users can choose among numerous pre-defined signal shapes like sin(x)/x, cardiac, white or pink noise; on the other hand they can take advantage of customer specific, arbitrary curve shapes with a bandwidth of more than 50 MHz and a signal length of up to 256 kPts. Arbitrary waveforms can be developed using the comfortable built in editor or by using the included PC software, whose results can be stored in the internal, generously sized non volatile memory. Moreover, stored waveforms, derived e.g. from an oscilloscope, can be loaded via front USB port from an USB memory stick or can imported via the complimentary HMArb software (available for download at http://www.hameg.com).

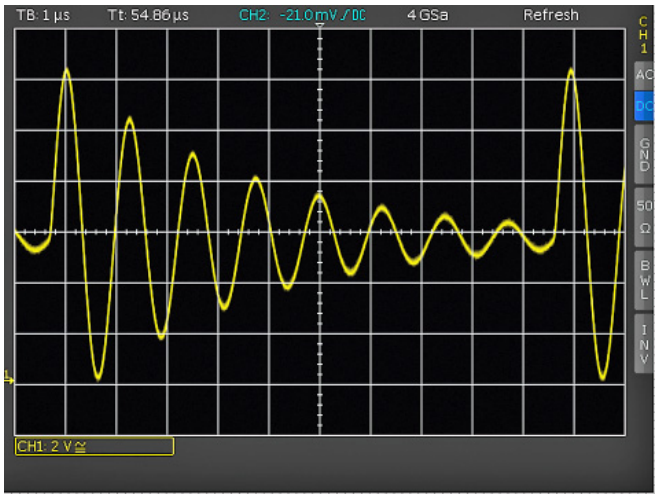



Fig. 3.1: Example for an oscilloscope signal which can be imported to the HMF

The operation modes burst, wobble, gating, ext. triggering and the modulation functions AM, FM, PM, PWM and FSK (int. and ext.) can be applied on all above mentioned signal shapes.

Particular emphasis has also been put on a powerful and practice oriented pulse generator. Providing pulses with a recurrence rate of up to 25 MHz (12,5MHz for the HMF2525), a pulse width can be chosen in the range of 10ns (20ns for the HMF2525) up to 10000s with a resolution of 5ns. Rise time can be selected in the range from 8 ns to 500 ns – a very useful feature when characterising input hysteresis of semiconductor devices.

All parameters, including the current waveform are shown concurrently on the high-contrast TFT display. Interactive, illuminated soft keys and the direct access of all relevant functions ensure the typical Hameg easy operability. The HMF series is equipped with an USB/RS-232 dual interface. Optionally, an Ethernet/USB or GPIB (IEEE-488) interface is available.

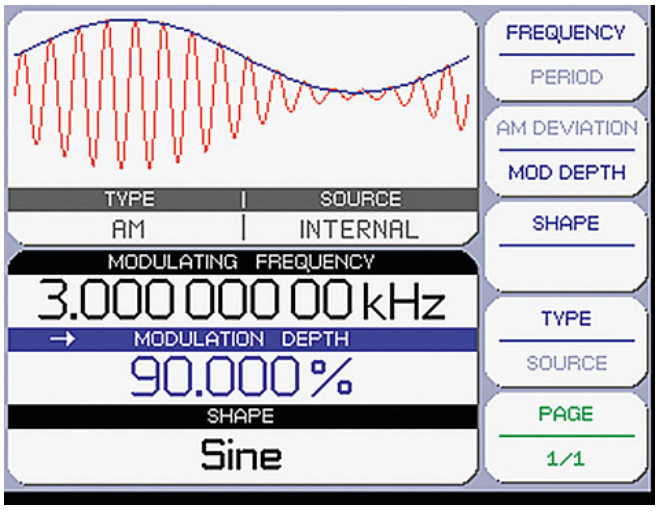



Fig. 3.2: Display of the HMF 2550 /2525

# 4 Operation of the HMF2525 / HMF2550

## 4.1 First time operation

Prior to the first time operation please note and observe the safety instructions given before!

## 4.2 Switching on

Turn the instrument on by pushing the POWER button [1]. Upon turn-on of the HMF2550 / HMF2525 the display will first show the type of instrument and the versions of the hardware and software. The instrument will resume the operational settings which were active before turn-off. All settings are stored in a nonvolatile memory and are recalled when the instrument is switched on. However, the output signals (OUTPUT), the BURST mode, the SWEEP function, the OFFSET and INVERT functions will always be deactivated upon turn-on.

**Factory settings**

| | |
|---|---|
| Wave form: | Sinus |
| Frequency: | 50 kHz |
| Amplitude: | 5.000 $V_{ss}$ at a load of 50 Ω |
| Pulse width: | 20 µs |
| Offset: | 0 mV |
| Sweep time: | 1 s |
| Sweep start frequency: | 1 Hz |
| Sweep stop frequency: | 10 Hz |

## 4.3 Supported signal waveforms with parameter inputs

The HMF2550 / HMF2525 offers five different waveforms with a wide selection of parameters:
(all values in parenthesis are valid for the HMF2525)

1. **Sine**
   Frequency 0.01 mHz ... 50 MHz (25 MHz)
   Period 20 ns (40ns)...100000 s
   Amplitude 0 ... 20V (high impedance)
   High Level -10 V ... +10 V
   Offset -10V ... +10 V
   Low Level -10 V ... +10 V

2. **Square**
   Frequency 0.01 mHz ... 50 MHz (25 MHz)
   Period 20 ns (40ns) ... 100000 s
   Amplitude 0 ... 20V (high impedance)
   High Level -10 V ... +10 V
   Offset -10V ... +10 V
   Low Level -10 V ... +10 V
   Duty Cycle 20% ... 80%
   High Width (dependant on adjusted periodic time) 4ns (8ns) ... 80000 s
   Low Width (dependant on adjusted periodic time) 4ns (8ns) ... 80000 s

3. **Triangle**
   Frequency 0.01 mHz ... 10 MHz (5MHz)
   Period 100 ns ... 100000 s
   Amplitude 0 ... 20V (high impedance)
   High Level -10V ... +10 V
   Offset -10V ... +10 V
   Low Level -10 V ... +10 V
   Symmetry 0% ... 100%
   Rising Time 4ns (8ns) ... 100000 s (dependant on adjusted the frequency)
   Falling Time 4ns (8ns) ... 100000s (dependant on adjusted the frequency)

4. **Pulse**
   Frequency 0.10 mHz ... 25 MHz (12,5 MHz)
   Period 40 ns (80ns) ... 10000 s
   Amplitude 0 ... 20 V (high impedance)
   High Level -10V ... +10 V
   Offset -10 V ... +10V
   Low Level -10 V ... +10V
   Duty Cycle 0.1% ... 99.9%
   High Width (dependant on adjusted periodic time)
   0 ... 10000 s
   Low Width (dependant on adjusted periodic time)
   0...10000 s
   Edging Time 5 ns ... 500 ns

5. **Arbitrary**
   Frequency 0.01 mHz ... 25 MHz (12,5 MHz)
   Period 40 ns (80ns) ... 100000 s
   Amplitude 0 ... 20V (high impedance)
   High Level -10V ... +10 V
   Offset -10 V ... +10 V
   Low Level -10 V ... +10 V

## 4.4 Quick introduction

First select the desired basic waveform (sine, square etc.) by pushing the respective key. In order to edit the parameters of the waveform selected choose from the soft keys [3] to the right of the function generator display.

**Fig. 4.1: Panel key's for chosing basic waveforms**

The signal parameters can be set either directly via the numerical keyboard [4], with the knob [10] or the arrow keys [9]. The latter are also used to select the decimal position which is to be changed. Turning the knob CW will increase the value, turning it CCW will decrease it. The unit is selected with the unit keys of the keyboard. Wrong inputs (e.g. illegal frequency range) will be indicated by an acoustical warning signal and will not be accepted. The display will show a red error field.

**The ESC key [–] is used to correct an input via the numerical keyboard.**


**Fig. 4.2: numeric keypad and key's for unit's and escape**

It is possible to only use the knob [10] for all settings. Pushing the knob will activate the cursor in the display, the soft keys [3] are thus deactivated. The desired position is selected by

turning the knob CW resp. CCW. The parameter selected can the set after pushing the knob. The value set will be accepted by pushing the knob again.

**Examples of setting parameters:**
The following examples demonstrate the setting of parameters for the square wave function. First push the square wave key below the keyboard. You will see the following display:


**Fig. 4.3: Front view including display of the settings**

In this case the signal frequency was set to 50.0000000 kHz.

The simplest method of entering parameters quickly and exactly is the entry via the numerical keyboard 4. When entering parameters via the keyboard the value will be accepted upon pushing the respective unit key MHz, kHz, Hz or mHz. Prior to pushing any such key an entry may be deleted by pushing the key – (C/ESC). If an illegal value was entered, this will be indicated by a warning tone (provided this had been activated), a red error field will be shown in the display, the instrument will return to the former parameter unit.

In order to clarify this, enter a frequency of 20.56 kHz. Setting the frequency is possible if the respective key of the softkey menu lights up blue. Push the keys 2, 0, ., 5 and 6 in proper sequence. The value entered will be accepted by pushing the key kHz to the side of the numerical keyboard. The following display will be shown:


**Fig. 4.4: Front view including display of the settings changed**

Alternative methods of parameter entry are with the knob 10 and the arrow keys 9.

Now push the second soft key (its blue LED will light up if it is active) in order to set the amplitude. Use the left cursor key to select the first decimal position of the numerical value. Use the knob 10 to set 2.000 V. The display will show:


**Fig. 4.5: Front view including display of the amplitude change**

The entries of Sweep, Offset etc. are performed following the same procedure.
If the signal output of the function generator is connected e.g. to an oscilloscope, the signal may be shown on the display of the oscilloscope. The key OUTPUT is active if its white LED is lighted.

## 4.5 Display

Depending on the type of function selected, the HMF2550 / HMF2525 will display a preview of the waveform of the signal. When the signal parameters are changed, the preview will be adapted accordingly. This allows to see immediately how the signal reacts to the entries. Above this display the setting of the impedance (50Ω or open circuit), the selection of the external or internal clock, and the selected interface will be shown.

The right portion of the display shows the variable parameters in the soft key menu. This menu will be adapted to the waveform selected. The setting of the parameters will be explained in the following section „Setting of parameters". Most of the soft keys are dual function: the active function will be shown in blue and the inactive one in grey letters. Pushing the key will alternate between functions.

The frequency display is a 9 digit one with a maximum resolution of 10µHz. The peak-to-peak values of amplitude, High/Low level, and offset are displayed with a maximum of 5 digits and a maximum resolution of 1mV.

**Please note that the maximum output amplitude which can be set will depend upon the impedance selected (50 Ω or open circuit), it will be 10 V maximum with 50 Ω and 20 V maximum open circuit.**

## 4.6 Setting of parameters

The soft keys allow to use the menu field displayed. E.g. for the waveform sine the parameters frequency, amplitude, and offset can be varied. The amplitude may be also defined by setting the upper (High level) and lower (Low level) levels. The selection can be performed via the numerical keyboard, with the knob 10 or the arrow keys 9. In addition to the parameters frequency, amplitude, and offset also the duty cycle and the pulse width (High/Low width) of square waves and pulses can be defined. If the output was activated (the LED of the OUTPUT key lights up white), any parameter changes will be immediately available at the output of the function generator. The waveforms triangle and pulse allow to define the rise and fall times (Edging time). With the waveform triangle also the symmetry (percentage of the rise time to the period) may be adjusted.

If a selection menu offers several pages (e.g. with the waveform pulse), the lowest soft key will light up green, this will be indicated in the display as page 1/2. Pushing the green key will advance to the second page, pushing it again will return to the first page.

## 4.7 Defining an arbitrary function

In addition to the predefined waveforms the HMF2525 / HMF2550 allows to generate user-defined waveforms. However, there are some rules and specification limits to be observed which will be described.

The arbitrary signals are digitally generated and can hence be defined with great accuracy. The frequency and amplitude of the waveform thus generated can be varied.

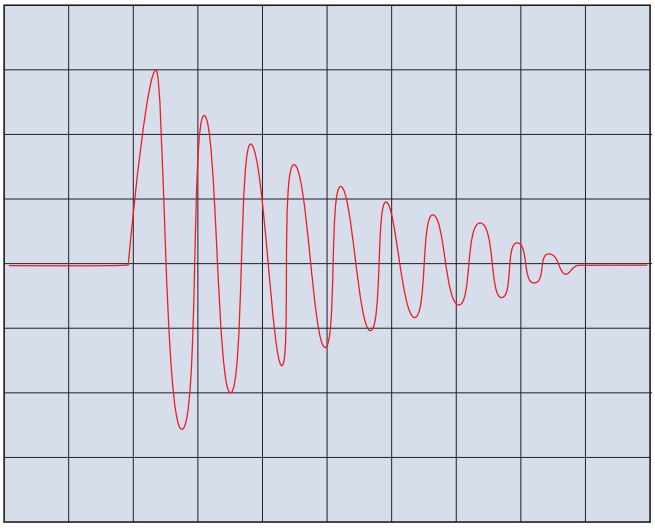


Fig. 4.6: Arbitrary signal

Apart from the limitations given by the specifications it should be kept in mind that waveforms freely defined and digitally generated may contain high frequency harmonics far above the signal frequency. When using arbitrarily defined signals their possible effects on the circuits tested should be evaluated.

The parameters frequency, amplitude, and offset can be set as described above, by using the SELECT functions waveforms can also be recalled from RAM (**r**andom **a**ccess **m**emory), ROM (**r**ead-**o**nly **m**emory) or via USB. The menu item ROM offers these signal waveforms:
- Sine Function
- Square Function
- Positive Ramp Function
- Negative Ramp Function
- Triangle Function
- Noise Function
- Cardinal Sine Function
- Exponential Rise Function
- Exponential Fall Function

The arbitrary waveforms for the HMF2525/2550 can only be defined via the interface (USB/RS-232, GPIB, LAN). Once a waveform has been defined it can be stored in an EEPROM (nonvolatile memory) and used like any predefined one. Additionally, stored waveforms will be available in the listing of predefined waveforms. Please refer to the section „Remote Operation".

The HMF2550 / HMF2525 offers a memory of 1 Mpoints resp. 512 kpoints for arbitrary signals. The Y axis represents the amplitude and the X axis the time or phase values.

When defining a new waveform, it is not always necessary to erase old data fully. The soft key menu EDIT offers the possibility of modifying existing waveforms or to use a portion of an old waveform. (The internal EDIT function nwill work from firmware 1.2)

# 5 Extended operating modes

## 5.1 Available modulation types (MOD)


Fig. 5.1: Key's for additional functions

A modulated signal consists of a carrier signal and a superimposed modulation signal. The HMF2525 / HMF2550 offers the following types of modulation: AM (amplitude modulation), FM (frequency modulation), PM (phase modulation), PWM (pulse width modulation), and FSK (frequency shift keying). The type of modulation is selected by pushing the MOD key and choosing it in the soft key menu TYPE. Only one type of modulation may be active at any time.

With AM the amplitude of the carrier signal will be changed by the amplitude of the modulating signal. After selecting AM in the soft key menu TYPE the modulation depth can be set from 0 to 100 % in 0.1 % increments (AM DEPTH). Internal or external modulation can be chosen. When external modulation was selected, the carrier will be modulated with this external signal.

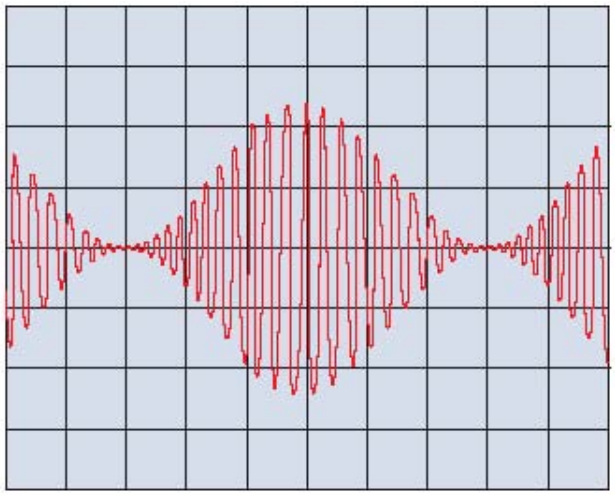


Fig. 5.2: Sine wave with amplitude modulation

External modulation signals are connected to the rear panel connector MODULATION INPUT.

With FM the frequency of the carrier signal will be varied according to the instantaneous value of the modulating signal, the amplitude remains unaffected.

With phase modulation the phase of the carrier signal will be shifted according to the instantaneous value of the modulating signal.

The socalled pulse width modulation (PWM) is only available with the pulse waveform; it will be automatically chosen when the waveform „pulse" is selected.

The soft key menu item SHAPE offers the following modulation waveforms, available for the modulation types AM, FM, PM, and PWM:
- Sine Function
- Square Function
- Positive / Negative Ramp Function
- Triangle Function
- Noise Function
- Arbitrary function

The selected function will be indicated in the lower menu field. The values of the parameters are set using the numerical keyboard [4], the knob [10] or the arrow keys [9].

The modulation type frequency shift keying (FSK) generates a signal which alternates between two predefined frequencies: the carrier and the leap frequency. The alternation will depend on the FSK rate set in the internal source mode or on the signal at the trigger input TRIG INPUT in the external source mode. Both carrier and leap frequencies may be set entirely independent of each other. The setting of the individual parameters is performed via the numerical keyboard, the knob or the arrow keys.

## 5.2 Sweep mode (SWEEP)

In the sweep mode the start frequency will be increased in steps within a given sweep time (SWEEP time) up to a preset stop frequency. In case the stop frequency was chosen higher than the start frequency the sweep will run from the higher to the lower frequency. The center frequency and the span are directly related to the start and stop frequencies. Additionally, linear or exponential sweep can be chosen. The socalled marker frequency must be set between the start and stop frequencies. If the signal frequency reaches the marker frequency a signal will be generated available at the TRIG OUTPUT connector.

**The sweep function can not be combined with the gating function.**

The sweep mode is selected by pushing the SWEEP key which will light up. The parameters sweep time, start and stop frequency can be set independently.

The sweep parameters are set via the numerical keyboard, the knob or the arrow keys. Setting or changing of parameters are also possible during a sweep, any changes will be immediately apparent. The sweep actually running will be terminated and a new one started; the display will show the parameters activated.

**The sweep function will be left by pushing the SWEEP key again.**

The sweep time is selectable from 1 ms to 500 s. A sweep signal may also be triggered, this can be selected with the soft keys. In trigger mode the HMF2525 / HMF2550 will generate the start frequency and wait for the trigger in order to start a sweep. The sweep will run with the parameters selected and stop, waiting for the next trigger.

## 5.3 BURST mode (BURST)

The BURST mode is available for each waveform, also for any symmetry setting. If this mode is chosen the white LED of the BURST key will light up. In BURST mode these selections are available:

- triggered (internal/external)
- gated (GATED externally)

In the triggered BURST mode a trigger will generate a burst with a predefined number of cycles. Such a n-cycle burst begins and ends at the same point of the signal which is called start phase. A start phase 0° equals the beginning and 360° the end of the waveform defined. If the burst counter was set to infinity, a continuous waveform will be generated upon a trigger. The trigger source may be an external signal, an internal clock signal or a remote command. The trigger input for an external signal is the TRIG INPUT [17] connector on the front panel. The

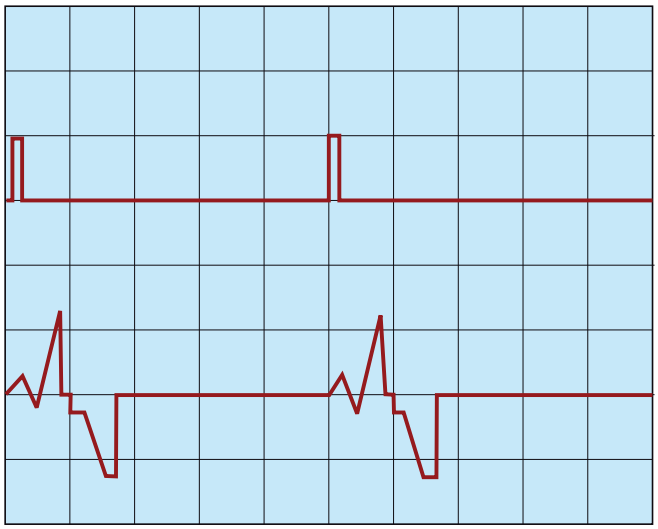


**Fig. 5.3: Example for burst mode**

logic signal applied is referenced to the instrument case which is ground potential.

In gated BURST mode (GATED), the signal will be either on or off, depending on the level of the external signal at the „Trigger input/ouput" connector. If the gate signal is „true", the function generator will deliver a continuous signal, if the signal is „false", the output signal will stop as the function generator will stop generation. The output level will correspond to the start level of the waveform selected.

The soft keys are used for the BURST mode settings, if they are active their blue LEDs will light up.

## 5.4 Menu options (MENU)

The menu will be called by pushing the MENU key [8] which will light up white. The interactive soft keys [3] allow to select the following options. After selecting a menu option the knob [10] or the arrow keys [9] are used to move around in the submenu. A selection is performed resp. confirmed by pushing the knob. If the respective soft keys of the option are active, their blue LEDs will light up.

**System settings**
These are general informations about the instrument such as firmware version, date of the last update, date of the last calibration. RESET will revert all settings to the factory settings, hence all settings by the customer will be erased. Here also the impedance of the output (50 ohms or open circuit) and internal or external clock can be selected.

**Firmware update**
A Firmware-Update can be done with an USB-Stick:

1. Please download the latest firmware from our website http://www.hameg.com and save this file on a USB-Stick into the root folder.
2. Plug the FAT or FAT32 formatted USB-Stick into the USB-interface in front of the HMF.
3. Please press the key MENU [8] and choose with the knob [10] or with the arrow key's [9] the menuepoint UPDATE. The update process starts with pressing the knob.

**Attention! At the time of the update the unit will not respond on any inputs and the display will be resettet. Does not switch off the unit during the update process. A interruption of power supply can destroy the unit!**

**If the instrument starts not properly, please press directly the button REMOTE [14] and OFFSET [12] after switching-on till the start sequence is completed. Therefore the instrument is set to default settings.**

### Interface settings

This menu item is used for the settings of the diverse interfaces:

1. The dual interface HO720 USB/RS-232 (Baud rate, number of stop bits, parity, handshake on/off).
2. LAN interface HO730 (IP address, sub net mask etc., see the HO730 manual).
3. IEEE-488 GPIB interface HO740 (GPIB address).

In order to select the suitable interface in this menu item, please act as follows:

1. Push the knob [10].
2. Choose the suitable interface with the knob [10].
3. To confirm the selection please push the knob [10] again.

### STORE/RECALL

The actual instrument settings can be stored in the memory locations 1 to 9. By pushing the knob [10] the pertinent selection line can be accessed. The knob is used for the selection of the location 1 to 9, the selection is confirmed by pushing the knob. RECALL allows to recall the settings. It is possible to also store a date.

## 6 Control of the signal output

The key OUTPUT [11] is used to turn the output on or off at any time. Prior to turning the output on, all parameters can be set comfortably. If the output is activated, the white LED of the key will light up.


**Fig. 6.1: Controls for output, offset and invert function**

A positive or negative DC offset may be added to the output signal. If an offset was selected it will be added by pushing the key OFFSET [12] which will light up.

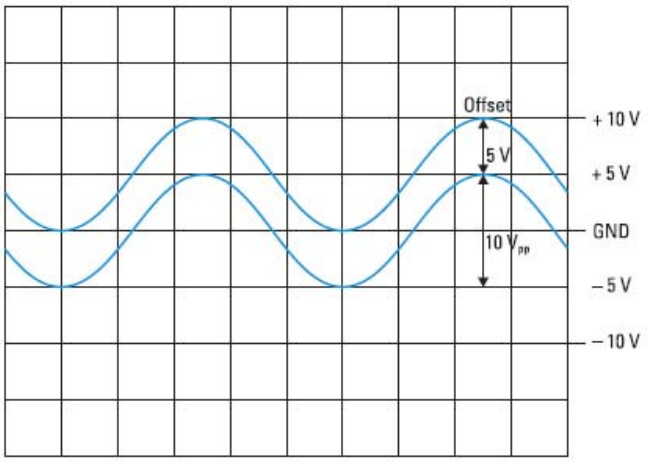



**Fig. 6.2: Explanation for offset function**

The diagram shows two signals. The lower curve without offset is referenced to ground with an amplitude of $10V_{pp}$. The limits of the output stage are shown from –10 V to +10 V which equals $20V_{pp}$. The second upper curve has an offset of +5 V, it reaches the upper limit of +10 V, hence it is not possible to increase the offset further, e.g. to +6 V. The amplitude will then be automatically decreased. The signal amplitude can not be increased if the offset is already +5 V as this would also violate the limit.

**If the offset is decreased to +4 V, the amplitude can be increased to $12V_{pp}$.**

The output signal polarity can be inverted by pushing the key INVERT [13] which will light up white.

**Any offset will be also be affected by a signal inversion. Inversion is only possible for the waveform pulse which is the only one not symmetrical to ground.**

As mentioned the maximum output voltage including an offset can not be increased beyond $20V_{pp}$ open circuit. Hence, for an amplitude of $8V_{pp}$ e.g. the maximum offset possible is 6 V. Within this range the offset voltage can be varied continuously from negative to positive values. The same conditions are valid if the sweep function is used with offset.

## 7 Front panel connections

### 7.1 Signal Output


**Fig. 7.1: Outputs on the front panel**

The signal output of the HMF2525 / HMF2550 has an impedance of 50Ω and can be turned on or off with the key OUTPUT [11]. The output is short-circuit proof and protected against short-term applied voltages of up to ±15 V (DC and AC peak).

### 7.2 Trigger Input

The HMF2525/2550 offers different operating modes. In addition to the standard mode „free-running" (continuous), signals may be generated triggered or gated. The selection is performed in the BURST or SWEEP modes. After turn-on the instrument will be in the free-running mode.

In gated mode the output signal will be gated by a signal applied to the TRIG INPUT connector [17] on the front panel. This operating mode is asynchronous. The phase of the output signal can be any when gated because the signal will be continuously

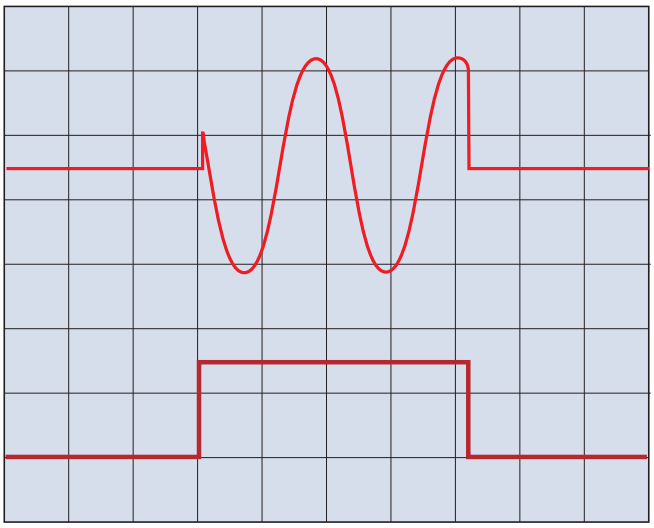


Fig. 7.2: Output signal controlled by a GATE signal

generated. If the gate signal is HIGH (TTL) the output will be activated, if it is LOW it will be off.

In trigger mode the trigger is also applied to the TRIG INPUT connector [17]. A trigger signal may be also a command TRG sent via the interface. This operating mode is synchronous, i.e. the triggered signal will start at its beginning i.e. at zero. One or several periods will be generated depending on the length of the trigger signal. This way bursts may be generated, but the number of cycles per burst is not programmable.

In case the sweep function is activated, a trigger will generate just one sweep, after completion the function generator will wait for the next trigger. During the waiting period the signal frequency will be equal to the start frequency.

### 7.3 Trigger output

The HMF2525/2550 can also generate a trigger signal in sweep mode when the swept frequency reaches a preset marker frequency, this trigger is available at the TRIG OUTPUT connector [18].

### 7.4 USB connector

The USB connector on the front allows software updates of the HMF2525 / HMF2550 firmware via an FAT or FAT32 formatted USB stick as well as entering arbitrary functions in the CSV format.

## 8 Rear panel connections

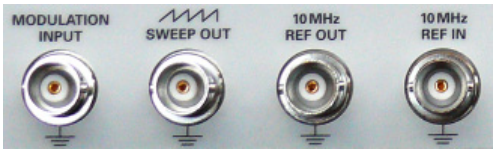



Fig. 8.1: Signalinputs and –outputs including modulation input at the rear panel

### 8.1 Modulation input

The HMF2525 / HMF2550 allows to control the amplitude of the output signal by an externally applied dc voltage to the MODULATION INPUT connector [21]: a voltage from 0 to +5 V will reduce the output amplitude to zero.

### 8.2 Sweep out

The sweep sawtooth is available at the BNC connector SWEEP OUT [22] on the rear panel, the signal runs from 0 V (start frequency) to +5 V (stop frequency). For further information about the SWEEP function consult the section „Extended operating functions".

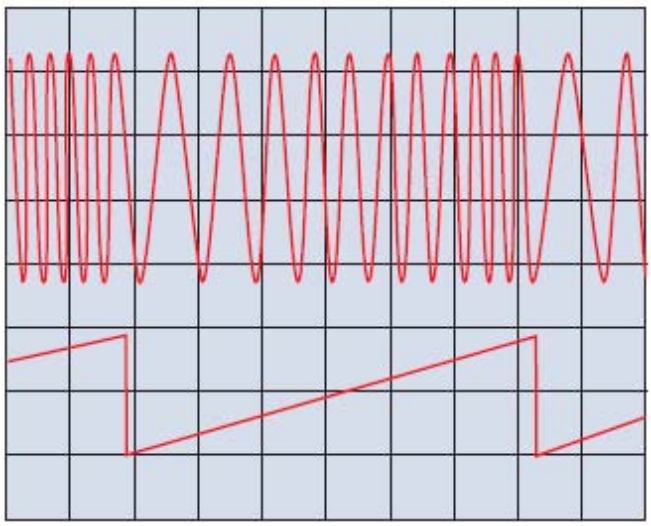


Fig. 8.2: Swept sine wave; sawtooth output

### 8.3 REF OUT/REF IN

In order to further increase the frequency stability, the internal oscillator may be replaced by an external one which can be connected to the „10 MHz REF IN/REF OUT" connectors [23]/[24] on the rear panel. The external reference frequency signal must comply with the specifications given with respect to frequency accuracy and amplitude.

Push the MENU key [8] and select System Settings and CLOCK in order to select an external reference.

# 9 Remote Control

The HMF series is basically supplied with an USB/RS-232 interface. The respective drivers are available on the enclosed Product CD or can be downloaded at http://www.hameg.com.

To establish a basic communication a serial cable (1:1) as well as a terminal program like Windows HyperTerminal is required. The Windows HyperTerminal program is part of any Windows operating system (Windows Vista not). A detailed instruction how to setup a basic communication using HyperTerminal is available at the HAMEG Knowledge Base at http://www.hameg.com/hyperterminal.

If the instrument is being addressed via the interface (remote control), the LED of the Remote button [14] will light up white. Press the Remote button in order to return to local control.

The HMF2525 / HMF2550 uses SCPI (= **S**tandard **C**ommands for **P**rogrammable **I**nstruments) for remote control. Remote control is possible via the built-in dual interface USB/RS-232 (options: Ethernet/USB, IEEE-488). This allow access to nearly all functions which are available on the front panel. A detailed dokument about the provided SCPI commands is available at http://www.hameg.com.

# 10 Appendix

## Table of figures



## Glossary

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