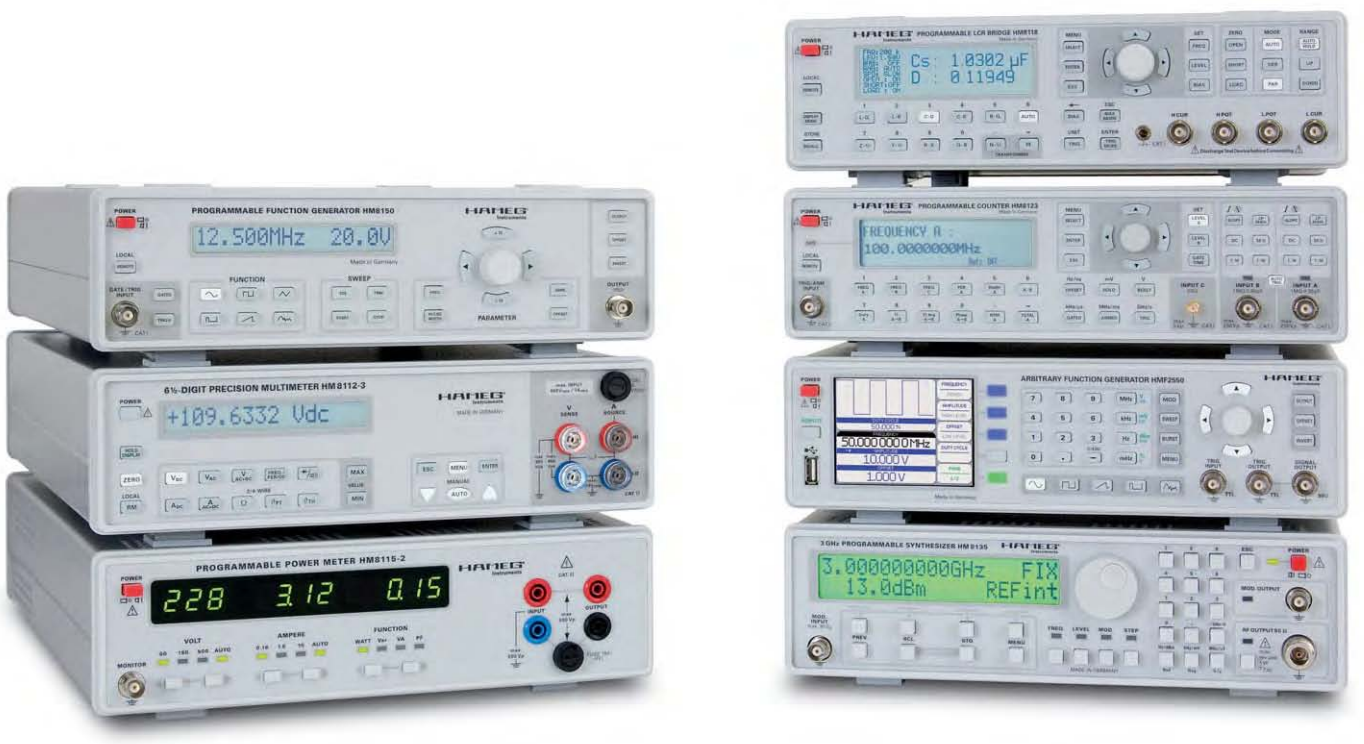
HAMEG
Programmable Measuring Instruments Series 8100

HAMEG Programmable Measuring Instruments Series 8100 are ideally suited for test installations in production and automated tests in laboratories. They support either a RS-232, an USB or an IEEE-488 interface and thus may be easily integrated in any test system.

In combination with other HAMEG measuring instruments which have an interface high performance test systems may be easily and cost effectively set up. Of course, any of these instruments can be operated manually and used in laboratories.



Multimeter

The **6½ digit multimeter HM8112-3** is a high performance precision measuring instrument für research and development labs, industry, universities, test and production facilities as well as for the service. The extensive and practical functions include DC and AC voltages and currents, resistance, temperature and frequency measurements. Additionally, a continuity and diode test function is provided.

For AC measurements the HM8112-3 is equipped with a true rms converter which allows precise measurements also of non-sinusoidal waveforms. The HM8112-3 excels by a basic DC accuracy of 0.003 % and a high resolution of 100 pA with current measurements. Offset correction allows for compensation of cable and contact resistances and also of thermal voltages at

Multimeter HM8112-3

the joints of two different metals. The HM8112-3 is designed for temperature measurements with platinum (Pt100/Pt 1000) and Ni (K and J types) sensors; the display is either in degrees centigrade or Fahrenheit.

The sampling rate, i.e. the time interval after which the result is transferred to the display or the memory, may be selected from 10 ms to 60 s, depending on the function and the resolution. A digital filter which calculates the average of 1, 2, 4, 8, 16 (selectable) measurements can be activated in order to reduce the noise in signals.

The limit test function automatically indicates if results exceed a high or low limit set. The features are completed by additional mathematical functions like min/max, averaging, and offset compensation. In continuous tests up to 100 measurements per second may be stored in the memory or output through the RS-232, USB, or GPIB

Scanner Card HO112

Precise temperature measurement with sensor

interfaces. The integrated data logger stores up to 32,000 results and is hence able to store the results of tests lasting days by proper selection of the variable sampling interval (up to 60 s).

With the optional channel selector HO112 a 9 channel measurement system is available; 8 rear panel inputs add to the front panel inputs. Channels may be selected either on the front panel or via the interface.

Function Generators

The **HM8131-2** function generator is a good and cost effective signal generator which should belong to the standard equipment of every laboratory. The frequency range is 10 mHz to 15 MHz. The signal frequency selected may be read from the digital display of the instrument with the accuracy of a frequency counter. The HM8131-2 generator features arbitrary waveform generation, frequency sweep, external triggering and external gating. In spite of its many features the instrument may be easily and intuitively operated.

The output delivers a voltage of up to 20 V_{pp} and is short circuit proof. It is also protected against external sources up to ± 15 V. The rise time of square wave signals is below 10 ns with little overshoot .

Function Generator HM8131-2

Besides the basic functions the HM8131-2 additionally offers white and pink noise, FSK and PSK modulation. The signals are generated by DDS (direct digital synthesis) and thus have the high accuracy and stability of a synthesizer.

Arbitrary signals are available up to 10 MHz, the vertical resolution is 12 bits. The waveforms are read out at 40 MS/s. The memory depth is either 4 K words or 16 K words. Waveform data and instrument control settings may be stored on an S-RAM card. The HM8131-2 features an integrated arbitrary editor which allows to manipulate each individual point of an arbitrary function.

The HM8131-2 may be externally triggered or gated. It is also possible to connect an external reference signal in order to increase the accuracy of the internal precision oscillator. The master slave function provided allows to synchronise up to three generators.

The HM8131-2 has a very fast output stage with high bandwidth, low noise and little overshoot.

The function generator **HM8150** uses direct digital frequency synthesis (DDS) for the generation of stable low distortion signals and guarantees optimum performance. The frequency range extends from 10 mHz to 12.5 MHz; amplitude and frequency of the selected signal can be read from the high contrast LC display. The HM8150 allows direct access to standard signals like sine wave, square wave, triangle, sawtooth and pulse by just pushing a button. Sine wave and square wave signals can be generated up to 12.5 MHz. The fast rise time of ‹ 10 ns and the minimum overshoot of the HM8150 are proof of the high signal quality of the HM8150, outstanding in its price class.

The additional arbitrary function with a sampling rate of 40 MS/s allows the user to generate his own waveforms. In pulse mode positive or negative pulses of variable width from 100 ns with a maximum repetition rate of 5 MHz can be generated.

The output delivers up to 20 V_{pp} (open circuit), it is short circuit - proof and protected against external voltages up to ±15 V.

Arbitrary Function Generator HM8150

The modulation input allows the amplitude modulation of the synthesized signal from 0 to 100 % with a bandwidth of 20 kHz.

The list of functions is completed by the sweep function which is easily configured, the external triggering and gating.

In spite of these many features the instrument can be intuitively and easily operated.

The **HM8143** power supply should be mentioned here as it also is a function generator. User defined waveforms may be generated with currents up to 2 A. The frequency range is 50 kHz. The arbitrary waveform can be defined by 1024 points.

The RF signal generators **HM8134-3** and **HM8135** are high precision synthesisers with a frequency range of 1 Hz to 1.2 GHz respectively 3 GHz.

Operating Modes and Functions

Trigger

In the operating mode "triggered" the trigger signal is connected to the trigger signal input of the function generator. In this operating mode the external trigger signal will be synchronised. That means that the trigger signal prepares the generator for the next waveform period which always starts at zero. Depending on the length of the trigger signal one or several complete periods of the signal will be generated. Once a signal period was started it will be completed even if the trigger signal disappeared in the meantime.

The sine wave starts at zero with the positive slope of the trigger signal. Generation of the sine wave signal will stop after com-

Arbitrary Power Supply HM8143

pletion of the last full period following the negative slope of the trigger signal.

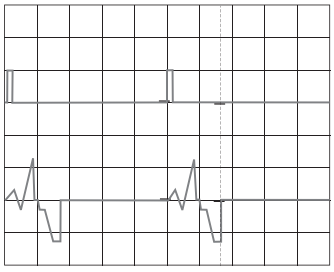
Burst Mode

Burst signals may be generated by an external trigger signal. This trigger signal may either come via the serial interface or

RF-Synthesizer HM8135

from an external generator.

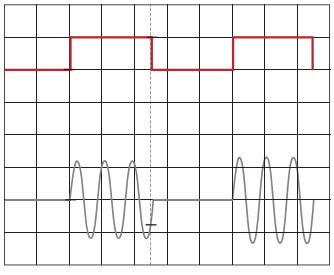
A burst signal in the arbitrary mode will be generated by a short trigger pulse. As the trigger signal is shorter than the period of the burst, only one full period of the burst signal will be generated.



Positive trigger slope generates burst signal

Gate Mode

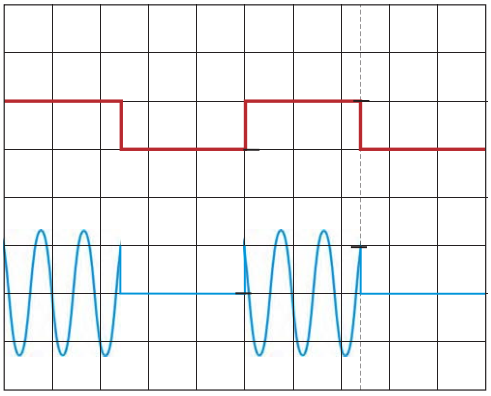
Also in gated mode the output signal of the generator will be controlled by a signal fed into the external trigger input. The gated mode is asynchronous, that means, that the gate signal just gates the internal signal to the output. In contrast to this in the trigger mode the output signal will always start at zero. In the gated mode there is no correlation between the gate signal and the signal generated. The signal will start anywhere in its period upon the positive slope of the gate signal and will end anywhere in its period with the negative slope of the gate signal.
The output signal is hence always present as long as the gate signal is high. The signal will disappear as soon as the gate input is pulled low. This is visible in the picture beside.



Gated output signal

Sweep Mode

If the sweep mode is activated an LED will light up. The parameters sweep time, start frequency and stop frequency are independently selectable and may be changed during operation. If a parameter is changed during operation the sweep will be stopped immediately and a new sweep will be started. The display will show the actual parameter setting. This ability of parameter change online allows to judge the influence of different parameters directly at the signal output. If

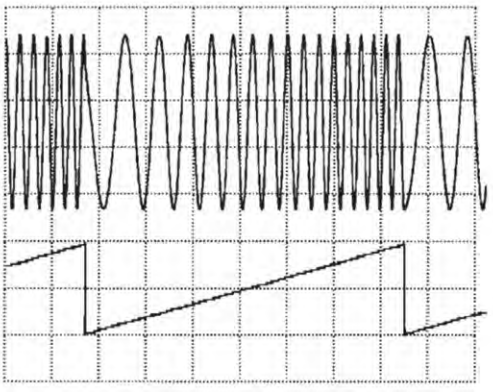


positive slope triggering

the start frequency is set to a lower value than the stop frequency the sweep will run from the lower to the higher frequency. If the start frequency is selected to be higher than the stop frequency the sweep will go from the higher to the lower frequency. With the HM8131-2 the sweep may be either linear or logarithmic, the sweep time is selectable. The frequency of the output signal will be changed in steps. Depending on the sweep time selected the number of steps will be different.

AM Amplitude Modulation

With AM a high frequency carrier signal will be modulated by a low frequency signal. The modulation degree or depth indicates the percentage of modulation of the carrier signal. The picture to the right shows a carrier signal 100 % modulated. The second picture shows a modulation depth of 50 %.



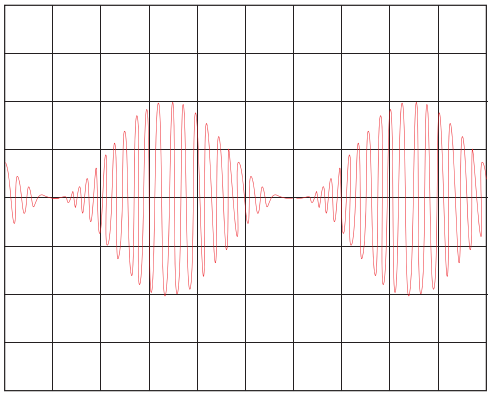
Swept Output Signal

FSK Frequency Shift Keying

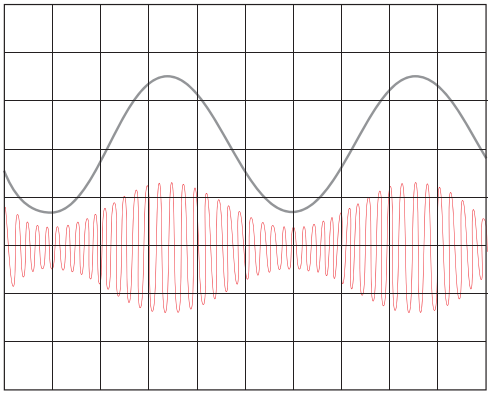
In FSK mode the signal alternates between two frequencies individually selectable. The first frequency "f_0" is also called the carrier frequency, the second frequency "f_1" is called the hop frequency. The frequency change depends on the signal fed to the external trigger input. The frequencies of the carrier and the hop signal may be selected independently of each other.

PSK Phase Shift Keying

In the modulation mode PSK the signal changes its phase upon a trigger signal. The picture shows a square wave signal with 5 V TTL-level. Also a sine wave signal is shown the zero crossings of which coincide with the slopes of the square wave signal. This is the sine wave signal not yet shifted in phase. The second sine wave signal shown which is cut off is the PSK signal. This signal was shifted by Ph0=70° during the high



Internal signal source HM8131-2: V_o=10 V_{pp}, 20 kHz, 5 V/cm ; generator set to 100 % modulation depth.



Generator1: V_e= 1,40 V_p, 1 kHz, 1 V/div; HM8131-2: U_a= 10 V_{pp}, 20 kHz, 5 V/div; generator set to 50 % modulation depth.

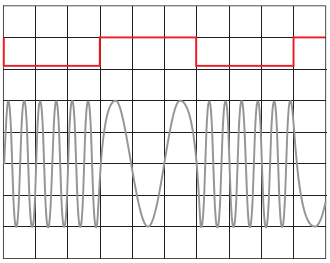
level of the trigger signal and returns to Ph1=0° during the low level.

Arbitrary Mode

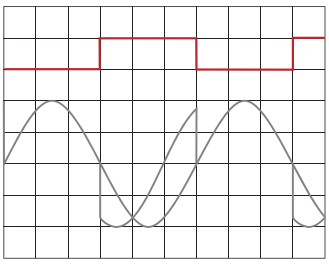
The arbitrary signals are generated digitally and may be simply defined. In general, an arbitrary signal is defined by a certain number of amplitudes which define the shape of the signal during one period. Within the instrument's specifications the user is free to define the signals which will be stored in the instrument. As soon as an arbitrary signal was defined, it may be called from the memory like any other waveform. There are several ways to define arbitrary signals. One method is to use the front panel key board and the arbitrary editor contained in the firmware of the HM8131-2. Definition is also possible via the standard built-in RS-232 interface or the optional interfaces USB or IEEE-488. It also possible to take the waveform over from an oscilloscope, the software necessary for the data transmission via the serial interface is available on the HAMEG website. Please note that freely defined and digitally generated waveforms will contain harmonics far above the frequency of the waveform itself. Watch out for possible effects of those harmonics on the circuits to be tested.

Noise

The HM8131-2 also offers white and pink noise. White noise contains all frequencies from zero to infinity. As infinity has not been



FSK signal 500 Hz/2 kHz

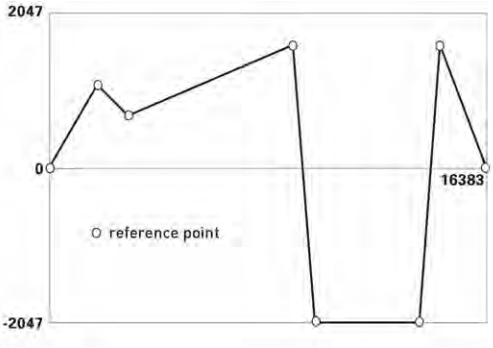


PSK signal, Ph0=70°; Ph1=0° phase shift

realised yet (we work on it), the HM8131-2 offers a bandwidth for white noise of 10 MHz. Pink noise means that the frequency spectrum will be reduced to 100 kHz.

Offset Voltage

It is possible to add a negative or positive offset to the output signal. The selection of the offset voltage is quite simple. It is either



possible by using the keyboard or the knob. If the output signal contains an offset this will be indicated by a LED. The picture below shows two signals. The lower curve has no offset and is referred to ground. Its amplitude is 10 V_{pp}. The upper curve was offset by +5 V. This means that the signal was shifted by +5 V in positive direction.

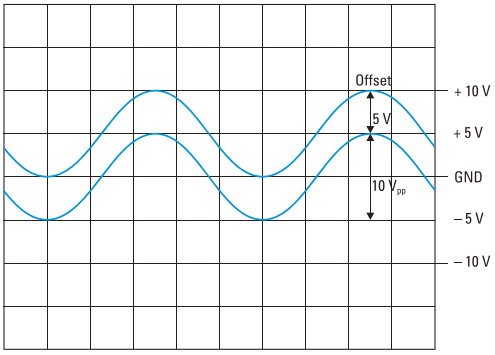
Universal Counter

The **universal counter HM8123** features three high sensitivity inputs and allows the measurement of signals in the frequency range between DC and 3 GHz.

Due to the high frequency of the internal oscillator of 200 MHz the time resolution is 10 ns. Additional control and trigger functions are available via inputs on the rear of the instrument. There are inputs for arming, gate and trigger and outputs for gate and trigger signals.

Frequency measurements

A high input sensitivity is not always desirable for frequency measurements. The counter becomes sensitive to noise. Therefore frequency measurements should be made with as much attenuation as possible.



Maximum offset: chart with two sine waves

If signals have a DC content this should be blocked by a capacitor. Such AC-coupling may be disadvantageous when measuring low frequencies. A low pass filter may be switched in if a low frequency signal is superimposed by high frequency interference.

Time Interval Measurements

In the operating mode time interval A/B the time between the start pulse at input A and a stop pulse at input B is measured. If the pulsewidth is to be measured the signal will be only connected to input A.

Pulse Width Measurement

Pulsewidth measurement is a special case of time interval measurement. The signal will be connected to input A, internally it is connected to input B. By suitable selection of the trigger slope for inputs A and B the pulsewidth may be measured. The measurement will be started at input A and stopped at input B.

Arming

Arming prevents that a counting sequence can be started by interference. The arming

Universal counter HM8123

input is nothing else but an additional trigger. As long as there is a low level at this input the counter cannot start a new measurement. However, the counter will be prepared for a new measurement. The measurement will start after the arming signal went high, and the trigger condition was fulfilled and the synchronisation time expired.

Gated Mode

The gate input allows full control of start and stop of the counter. When this function is selected and there is a low level at the gate input the counter will prepare for a measurement.

The measurement will start when the gate input goes high and the triggering of the input signal after the expiration of the synchronising time. The measurement will be terminated as soon as the gate input goes low. The external gate signal has a higher priority than the gate time selected.