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HAMEG®
Instruments

A Rohde & Schwarz Company

1.2 GHz RF-Synthesizer HM8134-3

Manual / English



	<p>Hersteller Manufacturer Fabricant</p> <p>HAMEG Instruments GmbH Industriestraße 6 D-63533 Mainhausen</p>	<p>KONFORMITÄTSERKLÄRUNG DECLARATION OF CONFORMITY DECLARATION DE CONFORMITE</p>	
<p>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</p>		<p>Sicherheit / Safety / Sécurité</p> <p>Sicherheit / Safety / Sécurité: EN 61010-1:2001 (IEC 61010-1:2001) Überspannungskategorie / Overvoltage category / Catégorie de surtension: II Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2</p>	
<p>Bezeichnung / Product name / Designation: HF-Synthesizer RF-Synthesizer HF-Synthesizer</p>		<p>Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique</p> <p>EN 61326-1/A1 Störaussendung / Radiation / Emission: Tabelle / table / tableau 4, Klasse / Class / Classe B. Störfestigkeit / Immunity / Imunitee: Tabelle / table / tableau A1.</p>	
<p>Typ / Type / Type: HM8134-3</p> <p>mit / with / avec: -</p> <p>Optionen / Options / Options:</p> <p>mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes</p>		<p>EN 61000-3-2/A14 Oberschwingungsströme / Harmonic current emissions / Émissions de courant harmonique: Klasse / Class / Classe D.</p> <p>EN 61000-3-3 Spannungsschwankungen u. Flicker / Voltage fluctuations and flicker / Fluctuations de tension et du flicker.</p>	
<p>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</p>		<p>Datum/Date/Date 15.04.2005</p>	
<p>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</p>		<p>Unterschrift / Signature / Signatur</p>  <p>G. Hübenett Technical Manager Directeur Technique</p>	
<p>Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées</p>			

General remarks regarding the CE marking

HAMEG measuring instruments comply with the EMI norms. Our tests for conformity are based upon the relevant norms. Whenever different maximum limits are optional HAMEG will select the most stringent ones. As regards emissions class 1B limits for small business will be applied. As regards susceptibility the limits for industrial environments will be applied.

All connecting cables will influence emissions as well as susceptibility considerably. The cables used will differ substantially depending on the application. During practical operation the following guidelines should be absolutely observed in order to minimize EMI:

1. Data connections

Measuring instruments may only be connected to external associated equipment (printers, computers etc.) by using well shielded cables. Unless shorter lengths are prescribed a maximum length of 3 m must not be exceeded for all data interconnections (input, output, signals, control). In case an instrument interface would allow connecting several cables only one may be connected.

In general, data connections should be made using double-shielded cables. For IEEE-bus purposes the double screened cable HZ72 from HAMEG is suitable.

2. Signal connections

In general, all connections between a measuring instrument and the device under test should be made as short as possible. Unless a shorter length is prescribed a maximum length of 3 m must not be exceeded, also, such connections must not leave the premises.

All signal connections must be shielded (e.g. coax such as RG58/U). With signal generators double-shielded cables are mandatory. It is especially important to establish good ground connections.

3. External influences

In the vicinity of strong magnetic or/and electric fields even a careful measuring set-up may not be sufficient to guard against the intrusion of undesired signals. This will not cause destruction or malfunction of HAMEG instruments, however, small deviations from the guaranteed specifications may occur under such conditions.

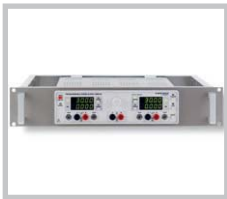
HAMEG Instruments GmbH

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1.2 GHz RF-Synthesizer HM8134-3



HZ42 19" Rackmount kit 2 RU



Outstanding Frequency range from 1 Hz to 1.2 GHz

Output power from -127 dBm to +13 dBm

Frequency resolution 1 Hz
(accuracy 0.5 ppm)

Input for external time base (10 MHz)

Modulation modes: AM, FM, Pulse, Φ , FSK, PSK

Rapid pulse modulation: typ. 200 ns

Internal modulator (sine wave, square wave, triangle, sawtooth)
from 10 Hz to 150 kHz

High spectral purity

10 configuration memories including turn-on configuration

Standard: TCXO (temperature stability: $\pm 0,5 \times 10^{-6}$)

Optional: OCXO (temperature stability: $\pm 1 \times 10^{-8}$)

RS-232 Interface, optional: USB, IEEE-488

H0870 USB Interface



H0880 IEEE-488
(GPIB) Interface



1.2 GHz HF Synthesizer HM8134-3
Valid at 23 °C after a 30 minute warm-up period

Frequency

Range:	1 Hz to 1200 MHz
Resolution:	1 Hz
Settling time:	< 10 ms

Frequency Reference 10 MHz

Standard: TCXO

Temperature stability (0 to 50 °C):	≤ ±0.5 ppm
Aging:	≤ ±1 ppm/year

Option: OCXO (Type HM8134-3X)

Temperature stability (0 bis 50 °C):	≤ ±1x10 ⁻⁸
Aging:	≤ ±1x10 ⁻⁹ /day

Internal reference output: (rear panel)

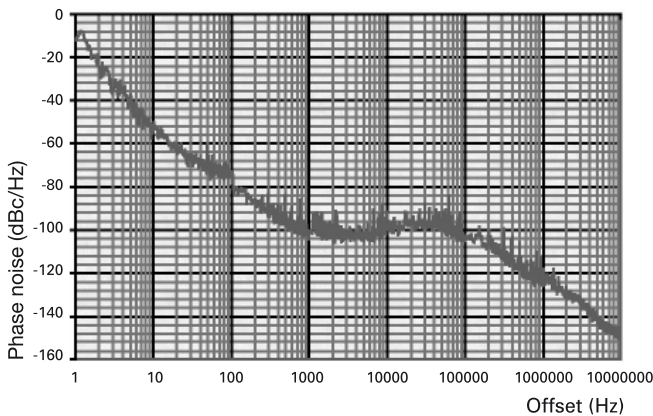
Level:	TTL
--------	-----

External reference input: (rear panel)

Level:	> 0 dBm
Frequency:	10 MHz ± 20 ppm

Spectral purity (without modulation)

Harmonics:	≤ -35 dBc
Non-harmonics:	≤ -55 dBc (> 15 kHz from carrier)
Phase noise:	(at 20 kHz from carrier)
f < 16 MHz:	≤ -120 dBc/Hz
16 MHz ≤ f < 250 MHz:	≤ -94 dBc/Hz
250 MHz ≤ f < 500 MHz:	≤ -105 dBc/Hz
500 MHz ≤ f < 1000 MHz:	≤ -100 dBc/Hz
1000 MHz ≤ f < 1200 MHz:	≤ -95 dBc/Hz
Residual FM:	≤ 6.5 Hz (at 1 GHz in 300 Hz – 3 kHz bandwidth)
Residual AM:	typ. < 0.06 % (in 0.03 – 20 kHz bandwidth)



[Typical phase noise at 1 GHz]

Output level

Range:	-127 to + 13 dBm
Resolution:	0.1 dB
Precision:	for level > - 57 dBm: ≤ ± 0.5 dB for level < - 57 dBm: ≤ ± [0.5 dB + (0.2 x (-57 dBm – level))/10]
Impedance:	50 Ω
V.S.W.R.:	≤ 2

Modulation sources

Internal:	10 Hz – 150 kHz sine wave, 10 Hz – 20 kHz square wave, triangle, sawtooth
Resolution:	10 Hz
External:	(input on front panel)
Impedance:	10 kΩ 50 pF
Input level:	2 V _{pp} for full scale
Coupling:	AC or DC
Output:	(on front panel)
Level:	2 V _{pp}
Impedance:	1 kΩ

Amplitude modulation (Level ≤ +7 dBm)

Source:	internal or external
Modulation depth:	0 to 100 %
Resolution:	0.1 %

Ext. frequency resp. (to - 1 dB):	10 Hz to 50 kHz for AC
Distortion:	< 2 % (AM-depth ≤ 60 %, f _{mod} ≤ 1 kHz) < 6 % (AM-depth ≤ 80 %, f _{mod} < 20 kHz)

Frequency modulation

Source:	internal or external
Deviation:	± 200 Hz to 400 kHz (depending on frequency band)
Resolution:	100 Hz
Accuracy:	± 3 % + res. FM (f _{mod} ≤ 5 kHz) ± 7 % + res. FM (5 kHz < f _{mod} < 100 kHz)

Ext. frequency response: (to - 1 dB)

DC coupling:	0 to 100 kHz
AC coupling:	10 Hz to 100 kHz
Distortion:	< 1 % for deviation ≥ 50 kHz at 1 kHz < 3 % for deviation ≥ 10 kHz at 1 kHz

Phase modulation

Source:	internal or external
Deviation:	< 16 MHz: 0 to 3.14 rad > 16 MHz: 0 to 10 rad
Resolution:	0.01 rad
Accuracy:	± 5 % to 1 kHz + residual PM

Ext. frequency response : (to - 1 dB)

DC coupling:	0 to 100 kHz
AC coupling:	10 Hz to 100 kHz
Distortion:	< 3 % for f _{mod} = 1 kHz and deviation = 10 rad

FSK modulation

Range (F0 - F1):	16 to 1200 MHz
Mode:	2 FSK levels
Data source:	external
Max. rate:	10 kbit/s
Shift (F1 - F0):	0 to 10 MHz
Resolution:	100 Hz
Accuracy:	see under FM

PSK modulation

Mode:	2 PSK levels
Data source:	external
Max. rate:	10 kbit/s
Shift (Ph1 - Ph0):	< 16 MHz: 0 to ± 3.14 rad > 16 MHz: 0 to ± 10 rad
Resolution:	0.01 rad
Accuracy:	see under PM

Pulse modulation

Source:	external (rear panel)
Dynamic range:	> 80 dB
Rise/fall times:	< 50 ns
Delay:	< 100 ns
Max. frequency:	2.5 MHz
Input level:	TTL

Sweep mode

Range:	1 MHz to 1200 MHz
Depth:	500 Hz to 1199 MHz
Sweep time:	20 ms to 5 s
Trigger:	internal

Protective functions

The synthesizer is protected against reverse power applied on RF output up to 1 W for a 50 Ω source and against any DC source up to ± 7V. The protection disconnects the output until manually rearmed by operator.

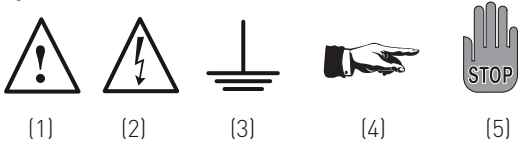
Miscellaneous

Interface:	RS-232 (standard), IEEE-488 (optional), USB (optional)
Configuration memories:	10
Safety class:	Safety Class I (EN61010-1)
Power supply:	115/230 V ± 10 %, 50/60 Hz
Power consumption:	approx. 40 VA
Operating temperature:	+10 to +40 °C
Max. relative humidity:	10 to 90 % (without condensation)
Dimensions (W x H x D):	285 x 75 x 365 mm
Weight:	approx. 5 kg

Accessories supplied: Operator's manual, power cable
Optional accessories: HZ33/HZ34 Test Cable 50 Ω (BNC-BNC), HZ21 Adapter plug, HZ42 19" Rackmount kit 2RU, HO870 USB Interface, HO880 IEEE-488 (GPIB) Interface, HO890 RS-232 Interface, OCXO (Type HM8134-3X)

Important hints

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!

Unpacking

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

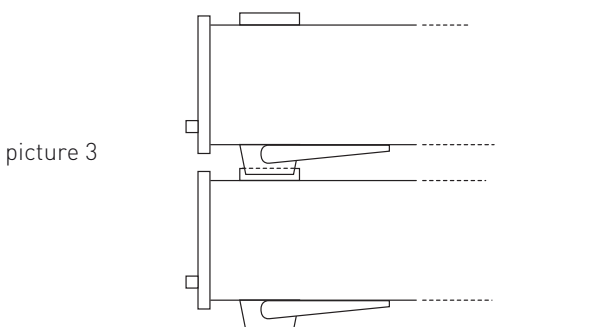
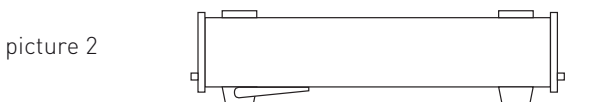
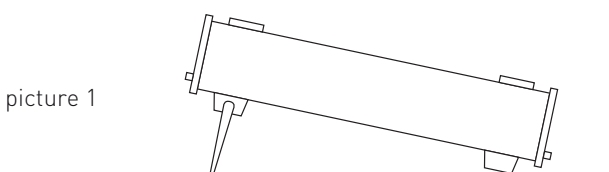
Check setting of line voltage selector whether it corresponds to the actual line voltage.

Positioning

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

If the feet are not used the instrument can be combined with many other Hameg instruments.

In case several instruments are stacked 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.



Transport

Please keep the carton in case the instrument may require later shipment for repair. Improper packaging may void the warranty!

Storage

Dry indoors storage is required. After exposure to extreme temperatures 2 h should be allowed before the instrument is turned on.

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. For safety reasons the instrument must only be operated from 3 terminal power connectors or via isolation transformers. In case of doubt the power connector should be checked according to DIN VDE 0100/610.



Disconnecting the protective earth internally or externally is absolutely prohibited!

- The line voltage selector must be properly set for the line voltage used.
- Opening of the instrument is allowed only to qualified personnel
- 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

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 0 .. +40 degrees C. Storage or transport limits are -20 .. +55 degrees C. In case of condensation two hours are to be allowed for drying prior to operation.

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.

 **Do not cover either the holes of the case nor the cooling fins.**

Nominal specs are valid after a warm-up period of min. 20 min. in the interval of +15 to +30 degrees C. Values without a tolerance are typical of an average production instrument.

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.

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.



Do not use alcohol, solvents or paste. 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.

Line voltage selector

The instrument is destined for operation on 115 or 230 V mains, 50/60 Hz. The proper line voltage is selected with the line voltage selector. It is necessary to change the fuse observing the proper values printed on the back panel.



**Please note:
After changing the main volage, the line fuse has to be changed. Otherwise the instrument may be destroyed.**

Change of fuse

The mains fuse is accessible on the back panel. A change of the fuse is only allowed after the instrument was disconnected from the line and the power cord removed. Fuse holder and power cord must not show any sign of damage. Use a screw



driver to loosen the fuse holder screw counterclockwise while pressing the top of the fuse holder down. The top holding the fuse will then come off. Exchange the defective fuse against a correct new one.



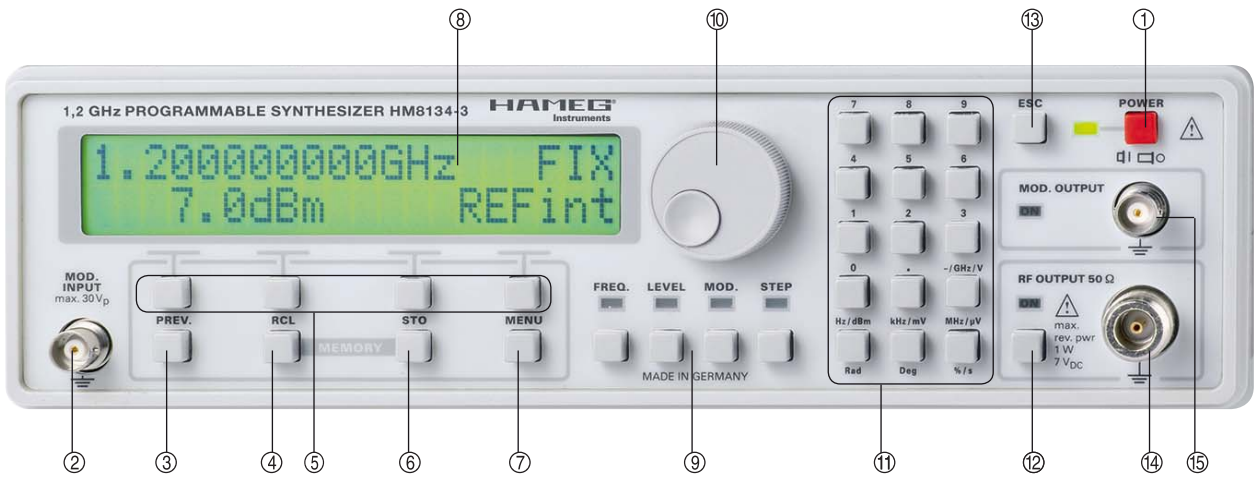
It is forbidden to repair defective fuses or to bridge them by any means. Any damage caused this way will void the warranty.

Type of fuse:

5 x 20 mm; 250V~, C;
IEC 127/III; DIN 41662
(DIN 41571/3).

Value

115 V: 0.5 A slow blow
230 V: 1.0 A slow blow



Designation of Operating controls

Front panel

- ① **POWER (button)**
Power switch and led
- ② **MOD. INPUT (Modulation input)**
Input of external modulation
- ③ **PREV. (Previous)**
Selection of previous menu
- ④ **MEMORY RCL (Memory Recall)**
Key for recalling one of 10 memories for instrument settings
- ⑤ **CONTEXT SENSITIVE KEYS**
Function depending on the context display
- ⑥ **MEMORY STO (Memory Store)**
Key for storing one of 10 memories for instrument settings
- ⑦ **MENU**
Input key in the configuration menu
- ⑧ **DISPLAY**
Two lines of 20 characters each on a backlight LCD
- ⑨ **FUNCTIONS**
Functions keys and LEDs
- ⑩ **Rotary knob**
Dial for setting all parameters
- ⑪ **NUMERIC KEYPAD**
Input parameters with unit validation

- ⑫ **ON**
Key for activation the output
- ⑬ **ESC (Escape)**
Cancels the current display
- ⑭ **RF OUTPUT 50 Ω (Radio Frequency Output)**
Signal output
- ⑮ **MOD. OUTPUT (Modulation Output)**
Output for modulation signal

Rear panel

- ⑯ **Power receptacle**
- ⑰ **VOLTAGE SELECTOR**
Selection of the line voltage
- ⑱ **F1 (FUSE)**
Mains fuse
- ⑲ **GATE INPUT**
TTL-compatible
- ⑳ **REF. 10 MHz OUTPUT**
Output for reference signal
- ㉑ **REF. 10 MHz INPUT**
Input for reference signal
- ㉒ **RS-232**
Serial port (included in delivery)
- ㉓ **INTERFACE**
Interface slot (optional)



Introduction of the HM8134-3

First time operation

Before starting the instrument the first time, please check the following:

- The line voltage indicated on the rear panel corresponds to the available line voltage, also, the correct fuses for this line voltage are installed. The fuses are contained in the line voltage connector housing.
- The connection to the mains is either by plugging into a socket with safety ground terminal or via an isolation transformer of protection class II.
- No visible damage to the instrument.
- No visible damage to the line cord.
- No loose parts floating around in the instrument.

Switch-on

After depressing the red power key ①, the display of the HM8134-3 will successively show the following messages:

- the type (SYNTHESIZER) and the version of the instrument (HM8134-3)
- the self-test messages "RAM checking" and "DDS loading" (RAM = Random Access Memory; DDS = Direct Digital Synthesis)
- Optional interface:
SECOND COM INTERFACE: NONE, RS-232 (HO890), IEEE488 (HO880), USB (HO870)
- Optional OCXO:
FREQUENCY REFERENCE
OCXO OPTION > NO (YES)
- the reference source in progress (internal or external):
FREQUENCY REFERENCE
Internal (External)

After switch-on the HM8134-3 has the configuration stored in the configuration memory 0. The output signal is disabled after switch-on by default.

Factory configuration

At delivery the instrument is adjusted for a basic set-up:

- Frequency: 1200 MHz
- Level: +7 dBm
- No modulation
- Reference source: internal
- Fmod: 1 kHz, Shape: sine (for all modulations)
- Dev: 20 kHz (FM), Dev: 1 rad (PM), Depth: 50% (AM)
- Contrast: maximum
- Sound indicator: none
- Interface parameters: 4800 baud / 1 stopbit / 8 data bits

This basic adjustment can be recalled at any time as follows:

- Switch off the unit.
- Switch on the unit and hold the ESC key until you hear several beeps. This procedure is especially suited in case of doubt.



Caution:

The 10 memories storing configurations are erased and replaced by the previous basic adjustments.

Operating the instrument

Main display

This display shows the frequency and the level of the RF output signal and the reference in use (INTERNAL or EXTERNAL). If no modulation (AM, FM, PM) is turned on, the display shows:

```
1200.000000MHz  NoMod
+13.0dBm        REFint
```

Moreover, it contains some modulation parameters (for example in case of AM modulation, shape SQR and Fmod = 1 kHz).

```
1200.000000MHz  AMsqr
+7.0dBm         1.0kHz
```

This state is left by pressing one of the function keys ⑨ or the MENU key ⑦.

ESC key ⑬

The ESC key ⑬ allows the user to return to the main display, to unselect the current function ⑨ or to cancel the numeric keypad input.

Setting parameters

```
Frq: 1200.000000 MHz
- stp +      ◀ cur ▶
```

Once a parameter is selected (for example FREQ.) with a function key ⑨, a new value for this parameter can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤ below the displayed marks - and +.

The operation of the data keypad is conventional. Depress successively the numeric keys representing the parameter value and at the end the unit key (for example MHz or dBm). Note that it is not necessary to enter any leading zeros. The instrument always displays at least one digit on the left of the comma. Before the unit selection, it is possible to cancel the value by pressing the ESC key ⑬. In this case the previous value is restored.

The encoder ⑩ modifies the value of the digit underlined by the cursor (if the cursor underlines a blank position, it is considered as 0). The cursor is shifted to another position by pressing the keys below the 2 arrows ⑤ and the value can be increased or decreased by operating - or +. An improper value is announced by a warning message and the sound indicator if activated (except for out of range of encoder ⑩ and steps).

Selecting frequency

After pressing the FREQ. key ⑨, the display shows:

```
Frq: 1200.000000 MHz
- stp +      ◀ cur ▶
```

A new value can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters". The frequency range is 1 Hz to 1200 MHz.

The resolution is 1 Hz. If a value is entered with a higher resolution, the instrument makes a truncation keeping 1 Hz resolution.

Selecting level

After pressing the LEVEL key ⑨, the display shows:

```
Level: -127.0 dBm
- stp + ◀ cur ▶
```

A new value of the level can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

The level range is:

- -127 dBm to +13 dBm without amplitude modulation
- -127 dBm to +7 dBm with amplitude modulation
- The resolution is 0.1 dBm.

The level displayed is specified for a load of 50 Ω. The choice of the unit is made by the keys dBm, mV or μV ⑩. For the volt unit the instrument performs a three digits resolution according to the range (mV/μV/nV).

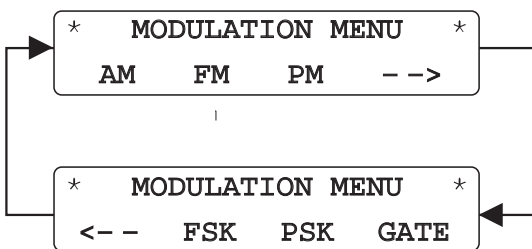


Caution:

If the AM modulation is activated, the instrument automatically limits the level to +7 dBm in order to avoid an excess of the dynamic of the output amplifier.

Selecting modulations

After pressing the MOD. key ⑨, the display shows:



The modulation type is selected by pressing one of the four context sensitive keys ⑤ corresponding to:

- AM (Amplitude modulation)
- FM (Frequency modulation)
- PM (Phase modulation)
- FSK (Frequency shift keying)
- PSK (Phase shift keying)
- GATE (Gate modulation)

The return to the previous display is possible by pressing the PREV. key ③.

After selecting the type of modulation (FM MENU), the display shows:

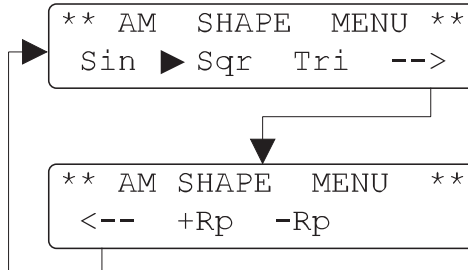
```
***** FM MENU *****
Shape Fmod Dev ▶Off
```

The selection of the parameters for AM/FM/PM is made by pressing one of the four context sensitive keys ⑤ corresponding to:

- The shape of internal modulation signal
- The frequency of the internal modulation signal
- The deviation (or depth in AM)
- The modulation state

The return to the previous display is possible by pressing the PREV. key ③.

After selecting the SHAPE option (AM SHAPE MENU), the display shows:



The shape of the internal modulation signal may be modified by the context sensitive keys ⑤. The active signal is pointed out by a triangle ▶.

The return to the previous menu is possible by pressing the PREV. key ③.

After selecting the Fmod option (AM MENU), the display shows:

```
AM Fmod: 1.000 kHz
- stp + ◀ cur ▶
```

The frequency of the internal modulation signal may be directly changed by the numeric keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤.

The return to the previous menu is possible by pressing the PREV. key ③.

The frequency range is:

- 10 Hz to 150 kHz: Sine (Step 10 Hz)
- 10 Hz to 20 kHz: Triangle, Square, Sawtooth (Step 10 Hz)

The modulation is turned on by pressing the context sensitive key ⑤ below the string OFF. One time for turning the internal source on (INT) and a second time for turning the external source on (EXT). The active source is pointed out by a triangle ▶ beside the option. The indicator LED of the MOD.OUTPUT is lighting.

```
***** FM MENU *****
Shape Fmod Dev ▶Int
```

Pressing the context sensitive key ⑤ once again, the modulation will be deactivated (OFF).

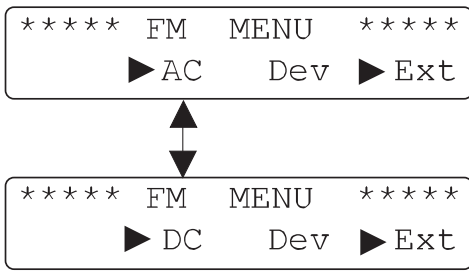
The return to the previous menu is possible by pressing the PREV. key ③.

With external AM activated, the only modifiable option is the modulation depth (see paragraph "Amplitude modulation"). The external modulation frequency for AM must be in the range:

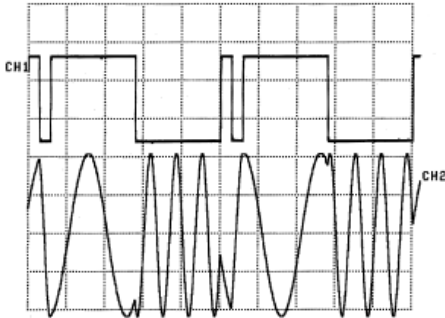
- 10 Hz to 50 kHz

With external FM or PM activated, several cases are possible:

- DC coupled (DC - 150 kHz)
- AC coupled (10 Hz - 150 kHz)
- Deviation (see corresponding paragraph)

**Example 1:**

1.000kHz FMext
+ 0.0dBm



CH1 → modulation: first pulse width 150s
second pulse width 1.1 ms
period 2.5 ms (Fmod: 400 Hz)
CH2 → modulated signal (deviation: 2 kHz)

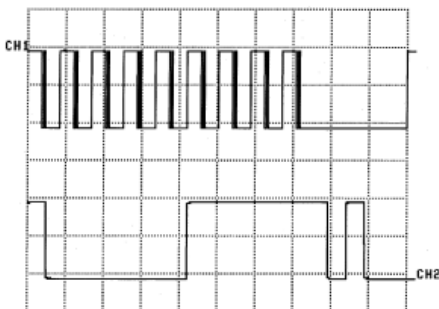
Example 2:

400.000000MHz FMext
+ 0.0dBm

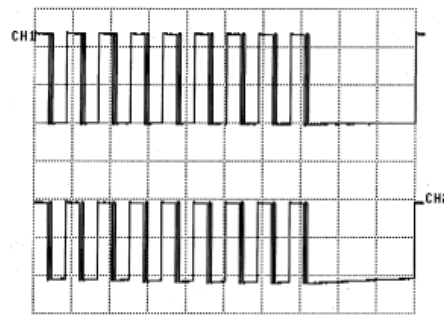
In this example, the external modulation signal is a "trinary" code composed of 9 bits. One bit is composed of 2 narrow and / or wide pulses, depending on the combination expected:

- A bit composed of 1 wide and 1 narrow pulses is called OPEN.
- A bit composed of 2 narrow pulses is called LOW.
- A bit composed of 2 wide pulses is called HIGH.

For detecting the first bit, a synchronisation bit (long low level) is present. The modulation frequency is 20 Hz.



CH1 → modulation: narrow pulse of 200 μs
wide pulse of 1.8ms
synchronisation bit of 14ms
CH2 → zoom of CH1



CH1 → demodulated signal: DC coupled
CH2 → demodulated signal: AC coupled

The return to the modulation menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

The external modulation input is on the front panel (MOD. INPUT ②). The signal can be of any shape, however the AM-depth and FM/PM deviation programmed is calibrated only for a 2 V_{RMS} signal at the input.

Types of Modulation

Amplitude modulation (AM)

After selecting D% (AM MEMU) using the context sensitive keys ⑤, the display shows:

AM Depth: 100.0 %
- stp + ◀ cur ▶

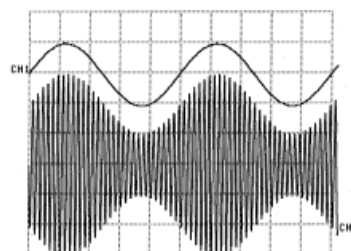
A new value of the modulation depth can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤.

The modulation depth may be changed from 0 to 100% with a resolution of 0.1%.

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

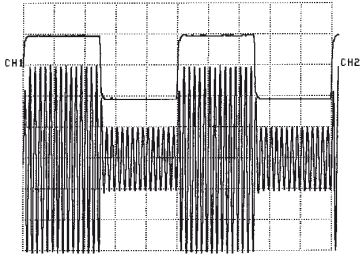
Example 3: For AM sine (depth: 50%), the display shows:

300.000kHz AMsin
+ 7.0dBm 10.0kHz



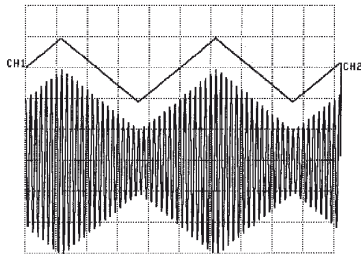
Example 4: For AM square (depth: 50%), the display shows:

```
300.000kHz  AMsq
+ 7.0dBm    10.0kHz
```



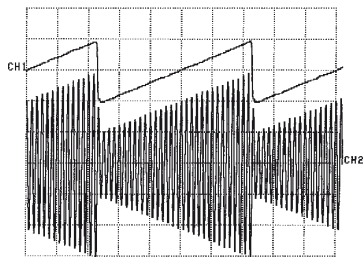
Example 5: For AM triangle (depth: 50%), the display shows:

```
300.000kHz  AMtri
+ 7.0dBm    10.0kHz
```



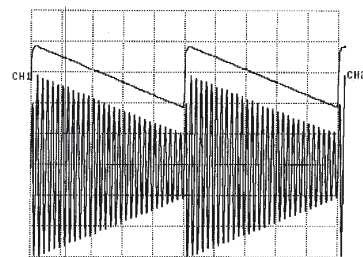
Example 6: For AM positive ramp (depth: 50%), the display shows:

```
300.000kHz  AM+rp
+ 7.0dBm    10.0kHz
```



Example 7: For AM negative ramp (depth: 50%), the display shows:

```
300.000kHz  AM-rp
+ 7.0dBm    10.0kHz
```



Frequency modulation (FM)

After selecting DEV (FM MEMU) using the context sensitive keys ⑤, the display shows:

```
1200.000000MHz  FMsin
+ 0.0dBm        1.0kHz
```

A new value of the deviation can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

The deviation (step 100 Hz) may be changed from:

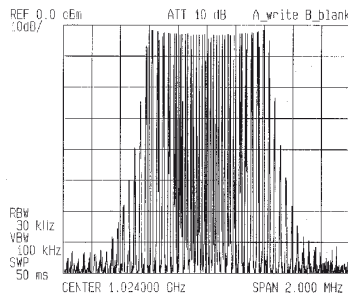
- ±200 Hz to ±150 kHz (<16 MHz)
- ± 2 kHz to ±400 kHz (16 - 250 MHz)
- ± 1 kHz to ±100 kHz (250 - 500 MHz)
- ± 1 kHz to ±200 kHz (500 - 1000 MHz)
- ± 2 kHz to ±400 kHz (1000 - 1200 MHz)

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

Example 8: For FM sine, the display shows:

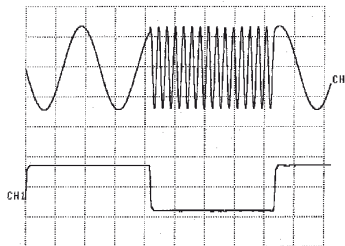
```
1200.000000MHz  FMsin
+ 0.0dBm        1.0kHz
```

(deviation: 400 kHz)



Example 9: For FM square, the display shows:

```
100.000kHz  FMsq
+10.0dBm    6.0kHz
```



CH1 → modulation signal
CH2 → modulated signal (deviation: 80 kHz)

Phase modulation (PM)

After selecting DEV (PM MEMU) using the context sensitive keys ⑤, the display shows:

```
PM DEV:      10.00 rad
- stp + ◀ cur ▶
```

A new value of this deviation can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

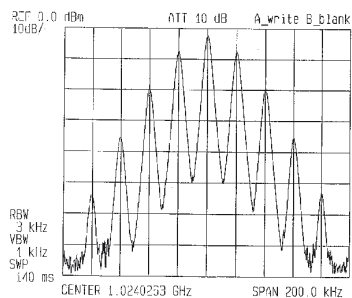
The deviation range may be set from:

- 0 to 3.14 rad (<16MHz)
- 0 to 10 rad (16 – 1200MHz)
- Setting with a step of 0.01 rad.

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

Example 10: For PM sine (deviation: 1 rad), the display shows:

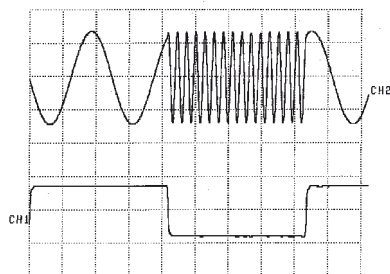
```
1200.000000MHz PMSin
+ 0.0dBm      20.0kHz
```



Example 11:

For PM square, the display shows:

```
50.000kHz PMSqr
+10.0dBm   6.0kHz
```



CH1 → modulation signal
CH2 → modulated signal (deviation: 1 rad)

FSK modulation

After selecting F0 or F1 (FSK MENU) with the context sensitive key ⑤, the display shows:

```
Fsk0: 512.000000 MHz
- stp + ◀ cur ▶
```

```
Fsk1: 522.000000 MHz
- stp + ◀ cur ▶
```

A new value of Fsk0 or Fsk1 can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

The skip frequency Fsk0 → Fsk1 or Fsk1 → Fsk0 may be set from:

- 0 to 10 MHz (16 MHz - 1200 MHz)
- step 1 Hz

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

Example 12: For modulation FSK, the display shows:

```
1190.000000 MHz FSK
1200.000000 MHz Ext
```

Fsk0: 1190.000000 MHz
Fsk1: 1200.000000 MHz

PSK Modulation

After selecting PH0 or PH1 (PSK MENU) with the context sensitive key ⑤, the display shows:

```
Psk0:      -10.00rad
- stp + ◀ cur ▶
```

```
Psk1:      10.00rad
- stp + ◀ cur ▶
```

A new value of Psk0 or Psk1 can be entered from the data keypad ⑪ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

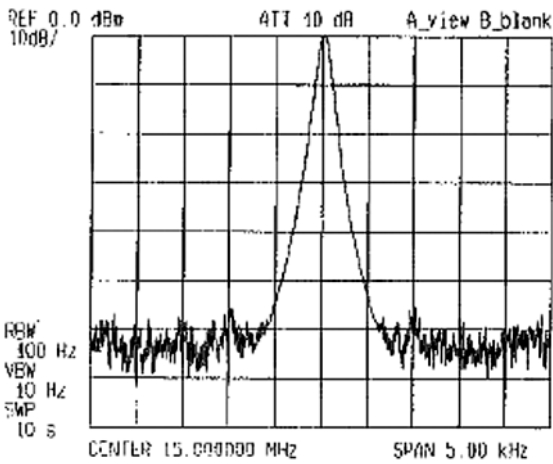
The skip phase Psk0 → Psk1 or Psk1 → Psk0 may be set from:

- -3.14 rad to 3.14rad (<16 MHz)
- -10 rad to 10 rad (16 – 1200 MHz)
- step 0.01 rad

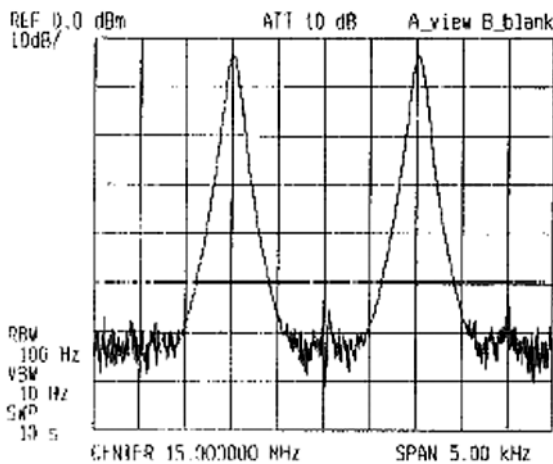
The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑬.

Example 13: For modulation PSK, the display shows:

```
1200.000000 MHz PSK
+13.0dBm      Ext
```



Psk0: -3,14 rad; Psk1: 3,14 rad; Fmod: 1 kHz; Level TTL



Psk0: 0 rad; Psk1: 3,14 rad; Fmod: 1 kHz; Level TTL

GATE modulation

The GATE modulation is made by sampling the output carrier with a logic signal (GATE) and is characterised by:

- Duty cycle
- Rise / Fall time
- Delay time

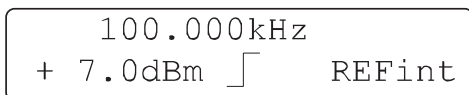
The GATE signal (TTL level) is applied to the GATE INPUT ⑩ at the rear panel. When the GATE signal is at the state ACTIVE (optional level 1 or 0), the carrier is present at the output.

After selecting GATE (MODULATION MENU) with the four context sensitive keys ⑤, the display shows:



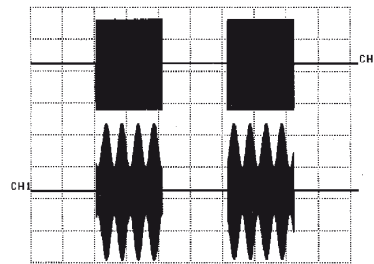
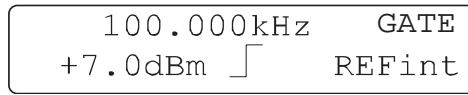
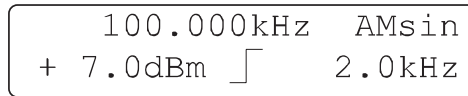
Press one of the four context sensitive keys ⑤ for selecting the active level and for turning the gate ON or OFF. Two triangles ► point out the options , , and ON or OFF.

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑩.



The GATE modulation can be active with another modulation (for example the GATE modulation with AMsin modulation and Fmod = 10 kHz)

Example 14 (Fgate: 250Hz Sqr):

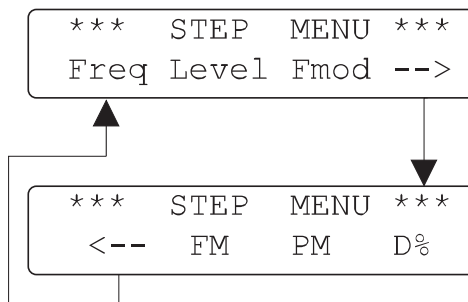


CH1 → AM signal (depth: 50%) and GATE modulation
CH2 → signal with GATE modulation

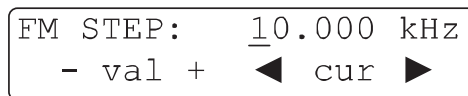
Setting the configuration

Selecting step

After pressing the STEP function key ⑨, the display shows:



Now the step type is selected by pressing one of the four context sensitive keys ⑤. If the parameter is already selected, the step type can directly be modified by pressing the STEP function key ⑨. Press again the STEP key to go back to previous display.






A new value of the step can be entered from the data keypad ⑪ or modified by the digital rotary control ⑩ or by one of the four context sensitive keys ⑤. For more details, refer to the paragraph "Setting parameters".

The step can be modified for:

- FSTEP: (frequency)
- Level STEP: (level)
- Fmod STEP: (modulation frequency)
- AM STEP: (AM-depth)
- FM STEP: (FM-deviation)
- Phi STEP: (PM-deviation)

MENU key


```
*** CONFIG MENU ***
    Ref   Sfc   SWEEP
```

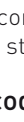
Operating the MENU key  accesses the configuration menu. The options are selected by pressing one of the context sensitive keys . The return to the main display is possible by pressing the ESC key .

Reference REF

```
** FREQUENCY REF **
  Int▶ Ext   Locked
```

The HM8134-3 is basically equipped with a temperature controlled crystal oscillator (TCXO) with a reference frequency of 10 MHz.


With every access to the configuration menu and after selecting the reference source by the context sensitive keys , the phaselock loop of the reference is tested (locked or unlocked). Increased stability for the HM8134-3 may be obtained from an external oscillator. The external reference frequency must be applied to the REF. INPUT 10MHz and the internal reference frequency is available on the REF. OUTPUT 10MHz at the rear panel.

 **Caution:**
If the reference frequency from an external source is not within specifications, the error message ERROR will be displayed. In this case the internal reference will be automatically activated.

Special function SFC

After selecting the SFC option in the configuration menu, the display shows:

```
* SPECIAL FUNCTION *
  Beep  Enco  Com  Lcd
```


The special function can be selected by pressing the context sensitive keys .

Beeper BEEP

The built-in beeper will react to every key stroke and will indicate any operation errors. The activation and the adjustment of the volume is done in the beeper menu:


```
** BEEPER SETUP **
▶ Soft   Loud  None
```


- Soft (soft sound)
- Loud (loud sound)
- None (no sound)

The characteristic of the beeper can be selected by pressing the context sensitive keys . A triangle ▶ points out the current state.

Encoder ENCO


```
** ENCODER SETUP **
    ▶ On   Off
```

In this menu the activation of the rotary control is done by selecting the ON or OFF option with the context sensitive keys . A triangle ▶ points out the current state.

 **Caution:**
Think to check this option in case of no operating of the rotary.


Interface Com

The HM8134-3 is basically equipped with the serial interface. The instrument is prepared for the installation of either an optional RS-232 (H0890), IEEE-488 (H0880) or an USB (H0870) interface (all galvanically isolated). Only the baud rate of the serial interface can be modified. The optional interface is chosen by operating the context sensitive keys. After power-on the serial interface is activated by default. If you want the optional interface to be activated after power-on, store the instruments settings (optional interface activated) in the configuration memory 0.

 **If there is any optional interface installed in your instrument and not displayed in this menu, please contact the HAMEG Service (serciec@hameg.de).**

Serial interface


```
** RS232 (DEFAULT) **
  4800  NONE  8   1
```

It is possible to select the transmission rates 300, 600, 1200, 2400, 4800, 9600 or 19200 baud by pressing the context sensitive key . The other parameters are fixed:

- no parity
- 8 data bits
- 1 stop bit

Display LCD

```
** LCD PARAMETERS **
-Contrast+  -Light+
```

The contrast and the illumination of the display is adjusted by pressing one of the four context sensitive keys , corresponding to + or -.

SWEEP

After selecting the SWEEP option in the configuration menu, the display shows:

```
*** SWEEP MENU ***
Start Stop Time ▶ Off
```

The parameters are selected by pressing one of the four context sensitive keys ⑤.

- START (start frequency)
- STOP (stop frequency)
- TIME (sweep time)
- ON / OFF (state of sweep)

The return to the previous menu is possible by pressing the PREV. key ③.

After selecting START, STOP or TIME with the context sensitive keys ⑤, the display shows:

```
Fstr:  16.000000 MHz
- stp + ◀ cur ▶
```

```
Fstp: 1200.000000 MHz
- stp + ◀ cur ▶
```

```
SweepTime: 5.00 Sec
- val + ◀ cur ▶
```

A new value of Fstr, Fstp or Sweep Time can be entered from the data keypad ⑩ or modified by the digital rotary ⑩ or by one of the four context sensitive keys ⑤.

The frequency hub between Fstr → Fstp may be set from:

- 500Hz to 1199 MHz (1 MHz -1200 MHz)
- step 1Hz

The sweep time may be changed from:

- 20 ms to 5s
- step 10 ms

The return to the previous menu is possible by pressing the PREV. key ③.

The context sensitive keys ⑤ (OFF/ON) can be used to enable the sweep. For sweep time > 1.3 sec, the following message is displayed:

```
Sweep Starting
Initialization ..
```

After initialization, the sweep menu appears automatically with the ON option selected as just below:

```
*** SWEEP MENU ***
Start Stop Time ▶ On
```

The return to the previous menu is possible by pressing the PREV. key ③ and the return to the main display by pressing the ESC key ⑩.

```
16.000000MHz  SWE
1200.000000MHz 1.00s
```

PREV. key (Previous)

The return to the previous menu is possible by pressing the PREV. key ③.

ON key

The output RF OUTPUT ⑭ is only active if the ON key ⑫ is pressed and the corresponding LED is lighted. When the signal is not active, the output is an open circuit.

RCL / STO keys (Recall & Store)

The instrument is equipped with an internal non-volatile memory which stores all parameters in use (frequency, level, modulation ...) when the power is switched off. In addition to this the instrument offers the possibility to store 10 complete configurations.

After pressing the STO key ⑥, the display shows:

```
** STORE MEMORY **
Number : ?
```

The current configuration can be stored by pressing a numeric key from 0 to 9.

After pressing the RCL key ④, the display shows:

```
** RECALL MEMORY **
Number : ?
```

A configuration can be recalled by pressing a numeric key from 0 to 9.

Remote Operation

Interfaces

The serial interface is a 9-pin connector (DB-9, male connector) on the rear panel.

Only three wire lines are connected inside:

- pin 2 = Txd (transmit data)
- pin 3 = Rxd (Receive data)
- pin 7 = Gnd (Ground)

Electric voltage on Rxd must be according to the RS232 hardware standard (+12/-12 V max). This provides the capability to communicate with any PC computer via a COM port. The communication protocol is a Xon/Xoff procedure and operates as follows.

Once the instrument has received a command line (refer to the definition below), it sends the Xoff character (19 dec). After all commands (in the received line) have been computed and executed, it sends the Xon character (17 dec), making the transmission of a new line possible. Commands are the same for all interfaces (For more details concerning the optional interfaces refer to the corresponding manual).



Either an RS-232 (H0890), IEEE- (H0880) or an USB-Interface (H0870) can be built in optionally. ②

With the receipt of a remote command, the display shows:

```
1000.000000MHz  NoMod
▶ REMOTE        LOCAL
```

The user may return to local mode by pressing the context sensitive keys ⑤ below the LOCAL option (all other keys are locked).

By sending the command LK1, the user may lock all keys and in this case the display shows:

```
1000.000000MHz  NoMod
REMOTE:LOCAL    LOCKOUT
```

Commands supported

General

There are two kinds of commands. The first one is the set of old commands which are HM8133-2 compatible. They are normally understood by the instrument without changing existing programs. The second one is a new set with a similar syntax to the SCPI standard. We recommend to use these commands which are the only one described hereafter.

Commands are sent by lines to the instrument, one line being a set of characters in ASCII code between 20 and 127 (dec), and terminated by an end of line terminator (10 dec) or 13 following by 10 (dec). Each line is composed of one or several simple commands (elementary) separated one another by the ";" (semicolon) separator.

Example: :POWER 7 ; :FREQ 500E+6 ; :OUTP ON

The level is at +7 dBm, the frequency at 500 MHz and the output signal ON. The strings of data are not case sensitive. That means

lower case and upper case are the same. A simple command gives an access to a quantity or a function of the instrument. All commands acting on the same quantity are brought together in a tree structure. We are going to detail function by function beginning with the simplest and the most useful.

Commands description

Syntax conventions

The following syntax conventions are valid:

- lower cases in keywords are optional, for example the keyword OUTPUT may be transmitted as OUPt (short writing) or OUTPUT (long writing)
- [] The keyword in brackets is optional
- | Exclusive OR between several parameters
- NR1 A string of digits without decimal point (1234)
- NR2 A string of digits with a decimal point (1234.56)
- NR3 A string representing a decimal number with an exponent (1234.56E+3)

Initialisation

*RST idem key ESC at power on time except beep, display, com and memory config (0 – 9) which are not modified

General commands

*IDN? Identification
 *SAV x Saving the current configuration (x from 0 to 9)
 *RCL x Recall a configuration (x from 0 to 9)
 SNR? Serial number of the instrument
 FAB? Manufacture date of the instrument

Bus commands

LK0 Enable local mode
 LK1 Disable local mode (all buttons locked)
 RM0 Disable remote mode
 RM1 Enable remote mode

Sound commands

BP0 Beep off
 BPS Soft beep
 BPL Loud beep

OUTPUT

Commands in order to activate the RF output signal

Syntax:

```
:OUTPut[:STATe] 0 | OFF | 1 | ON (1)
:OUTPut[STATe]? (2)
```

Sending line (1) activates or deactivates the RF output. The parameters 0 or OFF turn off the RF output (if the output is ON), 1 or ON turn on the RF output. Sending line (2) the instrument returns the output state of the instrument. It sends back 1 for output ON and 0 for output OFF.

Examples:

```
:OUTP ON      Ouput ON
:OUTP 1       Ouput ON
:OUTPUT ON    Ouput ON
:OUTPUT:STATE 1Ouput ON
:OUTP?        Request for state
:OUTPUT:STATE? Request for state
```

POWER

Commands in order to change the level of the RF output signal

Syntax:

```
:POWer[:LEVeL] <NUM>           (1)
:POWer[:LEVeL]?                 (2)
:POWer:UNIT V | DBM             (3)
:POWer:UNIT?                    (4)
```

Sending line (1) modifies the level. The <NUM> parameter is a NR2 number (see paragraph Syntax conventions). No unit has to follow the number, the current unit is assumed. Sending line (2) the instrument returns the current level. The instruments sends back a NR2 number corresponding to the resolution without the unit.

Sending line (3) changes the current unit. Two parameters are possible: V for Volt (mV / μ V included) or DBM for dBm. Sending line (4) the instruments returns the current unit. The instruments sends back the same string as the corresponding command parameters above (e.g. DBM).

Examples:

```
:POW:UNIT DBM           Set the level unit dBm
:POWER:UNIT DBM        Set the level unit dBm
:POW 5.7                Set the level to 5.7 dBm
:POW:LEV 5.7           Set the level to 5.7 dBm
:POWER:UNIT?           Request for unit
```

FREQUENCY

Commands in order to change the frequency

Syntax:

```
:FREQuency[:CW]:FIXed] <NUM>   (1)
:FREQuency[:CW]:FIXed]?       (2)
```

Sending line (1) modifies the carrier frequency. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit has to follow the number, the Hz unit is the default one. The value is rounded (same as the keypad) to the resolution. The CW and FIXed options have no particular effect on the instrument, they are present for compatibility with programs existing in the SCPI standard. Sending line (2) the instrument returns the current (carrier) frequency. The instrument sends back a string representing a NR3 decimal number.

Examples:

```
:FREQ 678E+6           Setting of the frequency to 678 MHz
:FREQUENCY 34000000    Setting of the frequency to 34 MHz
:FREQ?                 Request for frequency
:FREQ:FIX 900E+6       Setting of the frequency to 900 MHz
```

PHASE

Commands in order to select the source of the reference signal

Syntax:

```
:PHASe:SOURce INTern | EXTern  (1)
:PHASe:SOURce?                 (2)
```

Sending line (1) the current reference can be selected. Only one of the 2 parameters must be present: INTern for turning the internal reference on or EXTern for turning the external reference on.

Note:

It is strongly advised to check the current state after the command (1) sent. For example with the query command (2).

Sending line (2) the instruments returns which source is currently selected. The instrument sends back the strings INT or EXT corresponding to the 2 options described above.

Examples:

```
:PHAS:SOURCE EXT          Activating the external reference
:PHASE:SOUR?              Request for current reference
:PHAS:SOUR?               Request for current reference
                          (abbreviated form)
```

PULM (PULse Modulation)

Commands in order to modify the GATE modulation.

Syntax:

```
:PULM:STATe 1 | ON | 0 | OFF  (1)
:PULM:STATe?                  (2)
```

Sending line (1) the GATE modulation can be activated or deactivated. The parameters 1 or ON turn the modulation on and 0 or OFF turn the modulation off (if present). Sending line (2) the instruments returns the state of the GATE modulation. The instrument sends back 0, if the modulation is switched off, and 1, if the modulation is online.

```
:PULM:POLarity NORMal | INVert (3)
:PULM:POLarity?                 (4)
```

Sending line (3) the validation level of the GATE modulation can be set. The parameter NORMal represents high level validation and INVert represents low level validation. Sending line (4) the instrument returns the current level state. The instrument sends back 1 for high level (NORMal) and 0 for low level (INVert).

AM (Amplitude Modulation)

Commands in order to modify AM parameters

Syntax:

```
:AM[:DEPT] <NUM>              (1)
:AM[:DEPT]?                    (2)
```

Sending line (1) the modulation depth can be modified. The <NUM> parameter is a NR2 number (see paragraph Syntax conventions). No unit has to follow the number, % unit is the default one. If the value has an accuracy higher than the resolution (0.1%), the number is rounded to the resolution. Sending line (2) the instrument returns the current depth of modulation. The instruments sends back a NR2 number corresponding to the resolution (one digit after the decimal point) without unit.

```
:AM:SOURce INTern | EXTern    (3)
:AM:SOURce?                   (4)
```

Sending line (3) the modulation source can be selected and the FM will be turned on. Sending line (4) the instrument returns the source modulation. The instrument sends back the strings INT or EXT (not INTERN or EXTERN). If the AM is turned off, the string INT is sent back because this source is the default setting for the command AM:STAT 1 .

```
:AM:INTern:FREQuency <NUM>    (5)
:AM:INTern:FREQuency?         (6)
```

Sending line (5) the frequency of the internal modulation signal can be changed. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit has to follow the number, Hz unit is the default one. The value is rounded to the resolution.

Sending line (6) the instruments returns the current modulation frequency. The instrument sends back a string representing a NR3 decimal number.

```
:AM:INTern:SHAPE SIN | SQU | TRI | +RP | -RP      (7)
:AM:INTern:SHAPE?                               (8)
```

Sending line (7) the shape of the internal modulation signal can be changed. The parameters are: SIN for a sine signal, SQU for square, TRI for triangle, +RP for a positive ramp and -RP for a negative ramp.

Sending line (8) the instrument returns the current shape. The instrument sends back the same strings as the corresponding command parameters above.

```
:AM:STATe 0 | OFF | 1 | ON                      (9)
:AM:STATe?                                     (10)
```

Sending line (9) the AM modulation can be turned on or off. Sending the parameters 1 or ON, AM will be turned on, and sending the parameters 0 or OFF, the modulation will be turned off (if present).

Sending line (10) the instrument returns the current AM state. The instrument sends back 0, if no AM is in progress, and 1, if AM is present.

Example:

```
:AM:INT:FREQ 1200; SHAP SQU; DEPT 60; STAT 1
```

FM (Frequency Modulation)

Commands in order to modify FM parameters

Syntax:

```
:FM[:DEVIation] <NUM>                         (1)
:FM[:DEVIation]?                               (2)
```

Sending line (1) the FM deviation can be modified. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit has to follow the number, Hz unit is the default one. The value is rounded to the resolution. Sending line (2) the instrument returns the current FM deviation. The instrument sends back a string representing a NR3 decimal number.

```
:FM:SOURce INTern | EXTern                     (3)
:FM:SOURce?                                   (4)
```

Sending line (3) the modulation source is set and the FM is turned on at the same time. Sending line (4) the instrument returns the FM source. The instrument sends back the strings INT or EXT (not INTERN or EXTERN).

If the FM is turned off, the string INT is sent back because the internal source is the default setting for the command FM:STAT 1.

```
:FM:INTern:FREQuency <NUM>                    (5)
:FM:INTern:FREQuency?                         (6)
```

Sending line (5) the frequency of the internal modulation signal can be changed. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit has to follow the number, Hz unit is the default one. The value is rounded to the resolution.

Sending line (6) the instrument returns the current modulation frequency. The instrument sends back a string representing a NR3 decimal number.

```
:FM:INTern:SHAPE SIN | SQU                    (7)
:FM:INTern:SHAPE?                             (8)
```

Sending line (7) the shape of the internal modulation signal can be changed. The parameters are: SIN for a sine signal, SQU for square. Sending line (8) the instrument returns the current shape. The instrument sends back the same strings as the corresponding command parameters above.

```
:FM:STATe 0 | OFF | 1 | ON                    (9)
:FM:STATe?                                   (10)
```

Sending line (9) the FM can be turned on or off. The FM is turned on by sending parameters 1 or ON and the parameters 0 or OFF turn the modulation off (if present). Sending line (10) the instrument returns the current FM state. The instrument sends back 0, if no FM is in progress, and 1, if FM is present.

```
:FM:EXTern:COUPLing AC | DC                  (13)
:FM:EXTern:COUPLing?                         (14)
```

Sending line (13) the external FM modulation is set to AC or DC mode. Sending line (14) the instrument returns the current state. The instrument sends back the same strings as the corresponding command parameters above.

Example:

```
FM:INT:FREQ 9E+3; SHAP SIN; DEV 150E+3; STAT ON
```

PM (Phase Modulation)

Commands in order to modify PM parameters

Syntax:

```
:PM[:DEVIation] <NUM>                       (1)
:PM[:DEVIation]?                             (2)
```

Sending line (1) the PM deviation can be modified. The <NUM> parameter is a NR2 number (see paragraph Syntax conventions). No unit has to follow the number, the current unit is the default one. If the value has an accuracy higher than the resolution, the number is rounded to the corresponding digit.

Sending line (2) the instrument returns the current PM deviation. The instrument sends back a string representing a NR2 decimal number (without unit).

```
:PM:UNIT RAD | DEG                           (3)
:PM:UNIT?                                     (4)
```

Sending line (3) the current unit of the phase can be changed. Two parameters are possible: RAD for radian or DEG for degree. Sending line (4) the instrument returns the current unit. The instrument sends back the same strings as the corresponding command parameters above.

```
:PM:SOURce INTern | EXTern                   (5)
:PM:SOURce?                                  (6)
```

Sending line (5) the modulation source can be selected and at the same time the PM is turned on. Sending line (6) the instrument returns the PM source. The instrument sends back the strings INT or EXT (not INTERN or EXTERN). If the PM is turned off, the string INT is sent back because the internal source is the default setting for the PM:STAT 1 command.

```
:PM:INTern:FREQuency <NUM>                   (7)
:PM:INTern:FREQuency?                         (8)
```

Sending line (7) the frequency of the internal modulation signal can be changed. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit has to follow the number, Hz unit is the default one. The value is rounded to the resolution. Sending line (8) the instrument re-

turns the current modulation frequency. The instrument sends back a string representing a NR3 decimal number.

```
:PM:INTern:SHAPE SIN | SQU          (9)
:PM:INTern:SHAPE?                    (10)
```

Sending line (9) the shape of the internal modulation signal can be changed. The parameters are: SIN for a sine signal, SQU for square. Sending line (10) the instrument returns the current shape. The instrument sends back the same strings as the corresponding command parameters above.

```
:PM:STATe 0 | OFF | 1 | ON          (11)
:PM:STATe?                          (12)
```

Sending line (11) the PM can be turned on or off. The PM is turned on by sending the parameters 1 or ON and it is turned off by sending 0 or OFF (if present). Sending line (12) the instrument returns the current PM state. The instrument sends back 0, if no PM is in progress, and 1, if PM is present.

```
:PM:EXTErn:COUPLing AC | DC        (13)
:PM:EXTErn:COUPLing?              (14)
```

Sending line (13) the external PM modulation is set to AC or DC mode. Sending line (14) the instrument returns the current state. The instrument sends back the same strings as the corresponding command parameters above.

Example:

```
:PM:UNIT DEG; DEV 120; INT:FREQ 1E+3;
SHAP SIN; STATE 1
```

FSK

Commands in order to modify FSK parameters

Syntax:

```
:FSKey :SOURce EXT                  (1)
:FSKey :SOURce ?                    (2)
```

Sending line (1) the modulation source can be changed (for this unit version always EXT). Sending line (2) the instrument returns the FSK source. It sends back the string EXT (not EXTERN).

```
:FSKey :F0 <NUM>                   (3)
:FSKey :F0?                         (4)
:FSKey :F1 <NUM>                   (5)
:FSKey :F1?                         (6)
```

Sending line (3) and (5) the two frequencies F0 and F1 can be changed. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit must follow the number, Hz unit is the default one. The value is rounded to the resolution. Sending line (4) and (6) the instrument returns the two frequencies F0 and F1. It sends back a string representing a NR3 decimal number.

```
:FSKey :STATe 0|OFF|1|ON           (7)
:FSKey :STATe?                     (8)
```

Sending line (7) the FSK can be turned on or off. The FSK is turned on by sending the parameters 1 or ON, and it is turned off by sending 0 or OFF (if present). Sending line (8) the instrument returns the current FSK state. The instrument sends back 0, if no FSK is in progress, and 1, if FSK is present.

Example:

```
:FSK:SOUR EXT ; F0 400E+6 ; F1 410E+6 ; STAT ON
```

PSK

Commands in order to modify PSK parameters.

Syntax:

```
:PSKey :SOURce EXT                  (1)
:PSKey :SOURce ?                    (2)
```

Sending line (1) the modulation source can be changed (for this unit version always EXT). Sending line (2) the instrument returns the PSK source. It sends back the string EXT (not EXTERN).

```
:PSKey :PH0 <NUM>                  (3)
:PSKey :PH0?                       (4)
:PSKey :PH1 <NUM>                  (5)
:PSKey :PH1?                       (6)
```

Sending line (3) and (5) the two phases PH0 and PH1 can be changed. The <NUM> parameter is a NR2 number (see paragraph Syntax conventions). No unit must follow the number, the current unit is the default one. If the value has an accuracy higher than the resolution, the number is rounded to the corresponding digit. Sending line (4) and (6) the instrument returns the two phases PH0 and PH1. It sends back a string representing a NR2 decimal number (without unit).

```
:PSKey :UNIT RAD|DEG               (7)
:PSKey :UNIT?                      (8)
```

Sending line (7) the current unit can be changed. Two parameters are possible: RAD for radian or DEG for degree. Sending line (8) the instrument returns the current unit. It sends back the same string as the corresponding command parameters above.

```
:PSKey :STAT 0|OFF|1|ON            (9)
:PSKey :STAT?                      (10)
```

Sending line (9) the PSK can be turned on or off. The PSK is turned on by sending the parameters 1 or ON, and it is turned off by sending 0 or OFF (if present). Sending line (10) the instrument returns the current FSK state. The instrument sends back 0, if no PSK is in progress, and 1, if PSK is present.

Example:

```
:PSK:SOUR EXT ; UNIT RAD ; PH0 0 ; PH1 10 ; STAT ON
```

SWEEP

Commands in order to modify SWEEP parameters.

Syntax :

```
:FREQuency:MODE SWEep              (1)
:FREQuency :MODE FIXEd | CW        (2)
:FREQuency :MODE ?                 (3)
```

Sending line (1) the SWEEP can be turned on. Sending line (2) the SWEEP can be turned off, if SWEEP is present. Sending line (3) the instrument returns the current SWEEP state. It sends back SWE, if SWEEP is in progress, and FIX, if no SWEEP is present.

```
:FREQuency:STARt <NUM>             (4)
:FREQuency:STARt?                  (5)
:FREQuency:STOP <NUM>              (6)
:FREQuency:STOP?                   (7)
```

Sending line (4) and (6) the two frequencies START and STOP can be changed. The <NUM> parameter is a NR1 or NR2 or NR3 number (see paragraph Syntax conventions). No unit must follow the number, Hz unit is the default one. The value is rounded to

the resolution. Sending line (5) and (7) the instrument returns the two frequencies START and STOP. It sends back a string representing a NR3 decimal number.

```
:SWEep :TIME <NUM>           (8)
:SWEep :TIME?                 (9)
```

Sending line (8) the SWEEP TIME can be changed. The <NUM> parameter is a NR2 number (see paragraph Syntax conventions). No unit must follow the number, sec. unit is the default one. The value is rounded to the resolution. Sending line (9) the instrument returns the SWEEP TIME. It sends back a string representing a NR2 decimal number.

Example:

```
:SWE :TIME 5;:FREQ:STAR 16E+6;:FREQ:STOP 1.2E+9;
:FREQ :MODE SWE
```

SYSTEM

Syntax:

```
:SYSTem:ERRor?
```

Sending this line the instrument returns the current error code. This code is the first one recorded even if several errors have occurred. After sending the error number the instrument sets it to zero (it also set it to zero at power on time). Refer to the table of the error codes.

Notes regarding the syntax

As mentioned in some examples above, in each command line the first character ":" is optional. In case of successive commands corresponding to the same tree it is not necessary to repeat all the descriptions of the commands.

Example:

```
FM:INT:FREQ 9E+3; SHAP SIN; DEV 150E+3; STAT ON
```

is the same as:

```
:FM:INT:FREQ 9E+3; :FM:INT:SHAP SIN; :FM:DEV 150E+3;
STAT ON
```

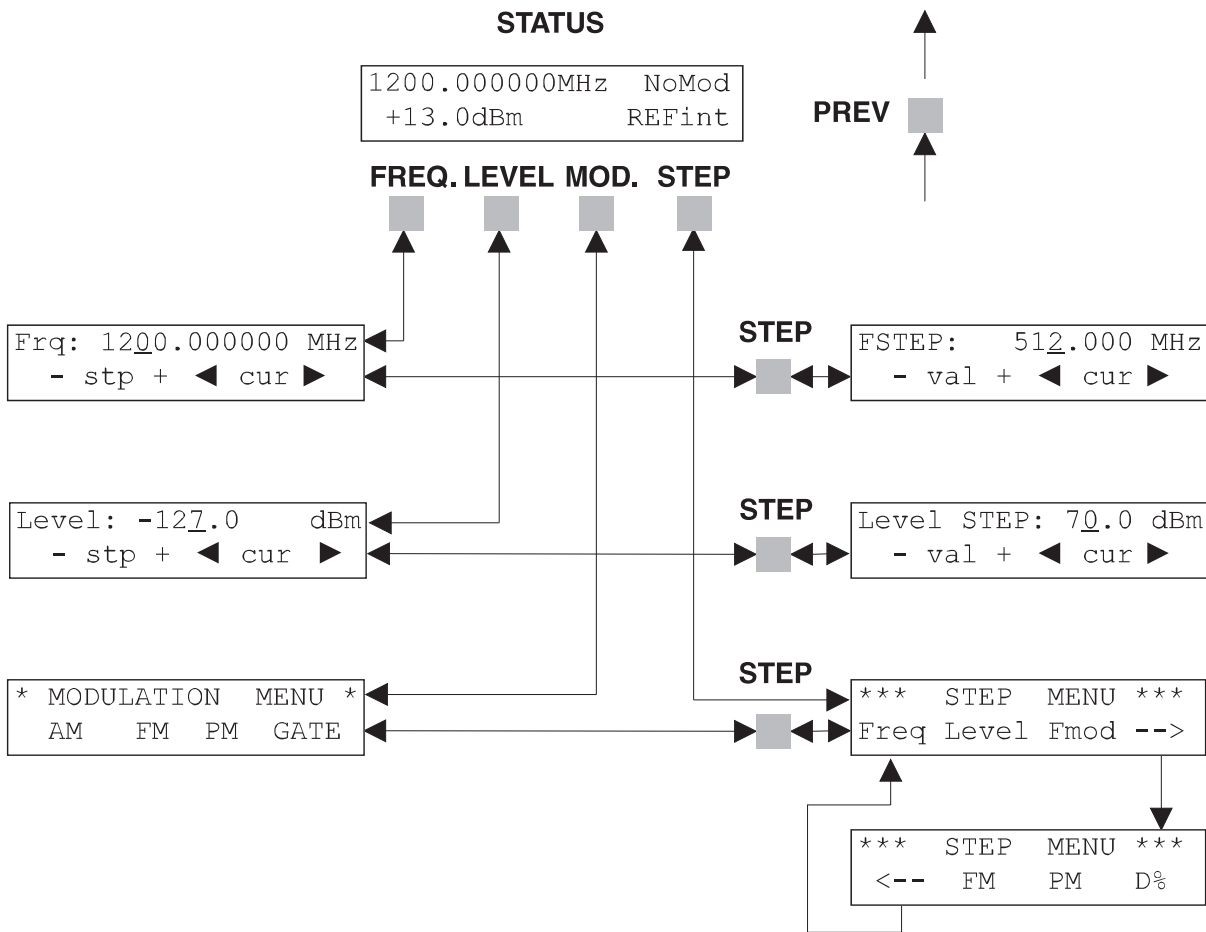
In fact: FM for the first command indicates that we get into the FM tree (group) and the following commands, if they belong to the same group, may be shorter (without repeating all the tree descriptions). If the next command does not belong to the same tree, it is necessary to specify the root.

- 62 FM deviation error (must be in the range 2 kHz - 400 kHz)
- 63 FM deviation error (must be in the range 1 kHz-200 kHz)
- 64 FM deviation error (must be in the range 200 Hz-150 kHz)
- 70 AM frequency modulation error (must be in the range 10 Hz-20 kHz)
- 71 AM frequency modulation error (must be in the range 10 Hz-40 kHz)
- 75 PM deviation error (in remote control, no phase <0)
- 76 frequency error (in remote control, no frequency <0)
- 81 FM or PM frequency modulation error (must be in the range 10 Hz-20 kHz)
- 82 FM or PM frequency modulation error (must be in the range 10 Hz-100 kHz)
- 90 PM deviation error (must be in the range 0 rad - 3.14 rad)
- 91 PM deviation error (must be in the range 0 rad-10.00 rad)
- 92 PM deviation error (must be in the range 0 deg-180.0 deg)
- 93 PM deviation error (must be in the range 0 deg-573.0 deg)
- 102 Syntax or Parameter error (remote control)
- 103 Invalid Separator (remote control)
- 110 Command header error (remote control)
- 120 Numeric data error (remote control)

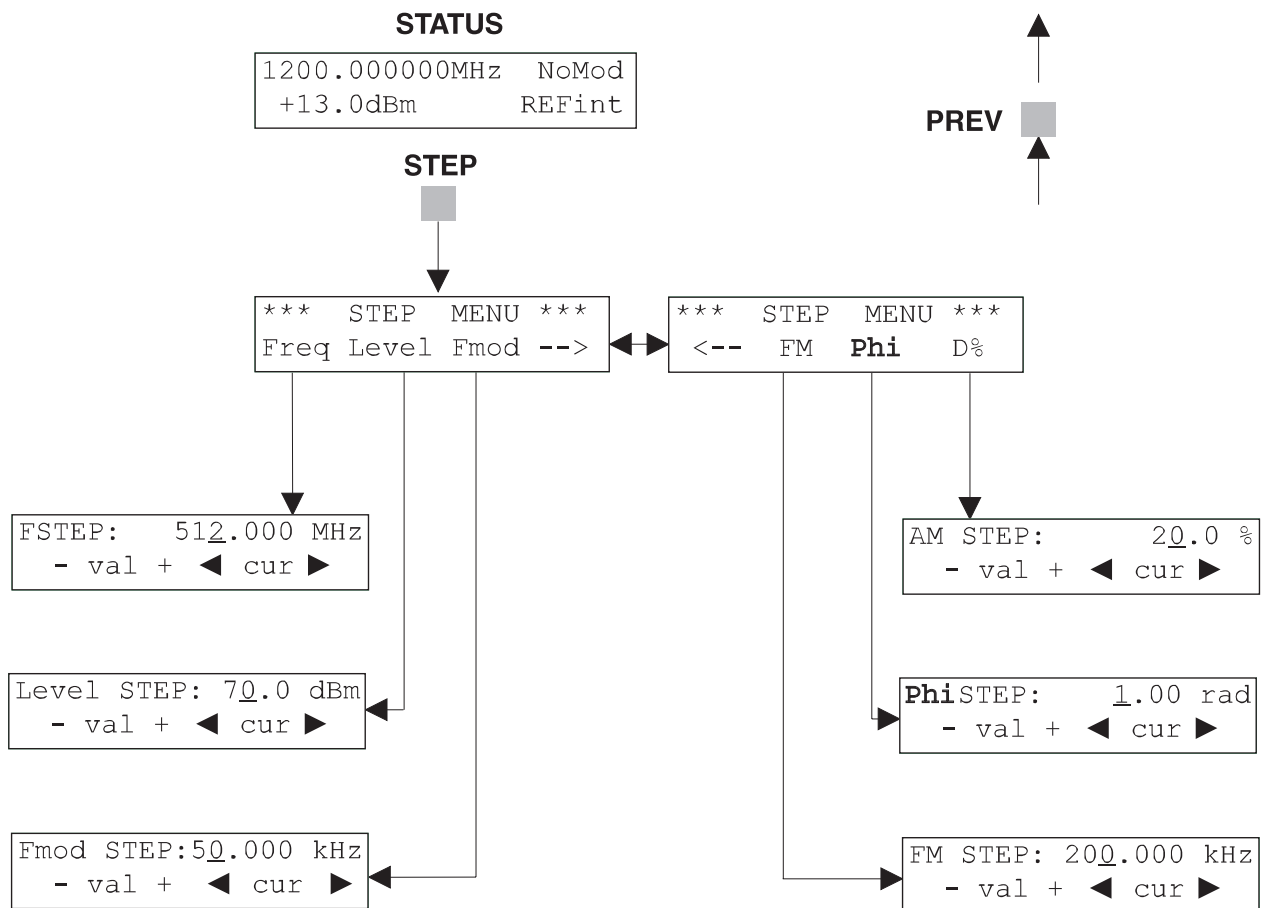
Error codes and their meaning

- 00 No error
- 01 Direct Digital Synthesis error (Hardware)
- 02 Internal reference error (Hardware)
- 03 External reference error (Hardware)
- 04 PLL1 error (Hardware)
- 05 PLL2 error (Hardware)
- 08 Calibration error
- 09 Overload error (Hardware)
- 15 Level error (out of range)
- 16 (Carrier) Frequency error (out of range)
- 21 AM modulation in progress (impossible to turn another modulation on)
- 22 PM modulation in progress (impossible to turn another modulation on)
- 23 FM modulation in progress (impossible to turn another modulation on)
- 25 AM depth error (out of range)

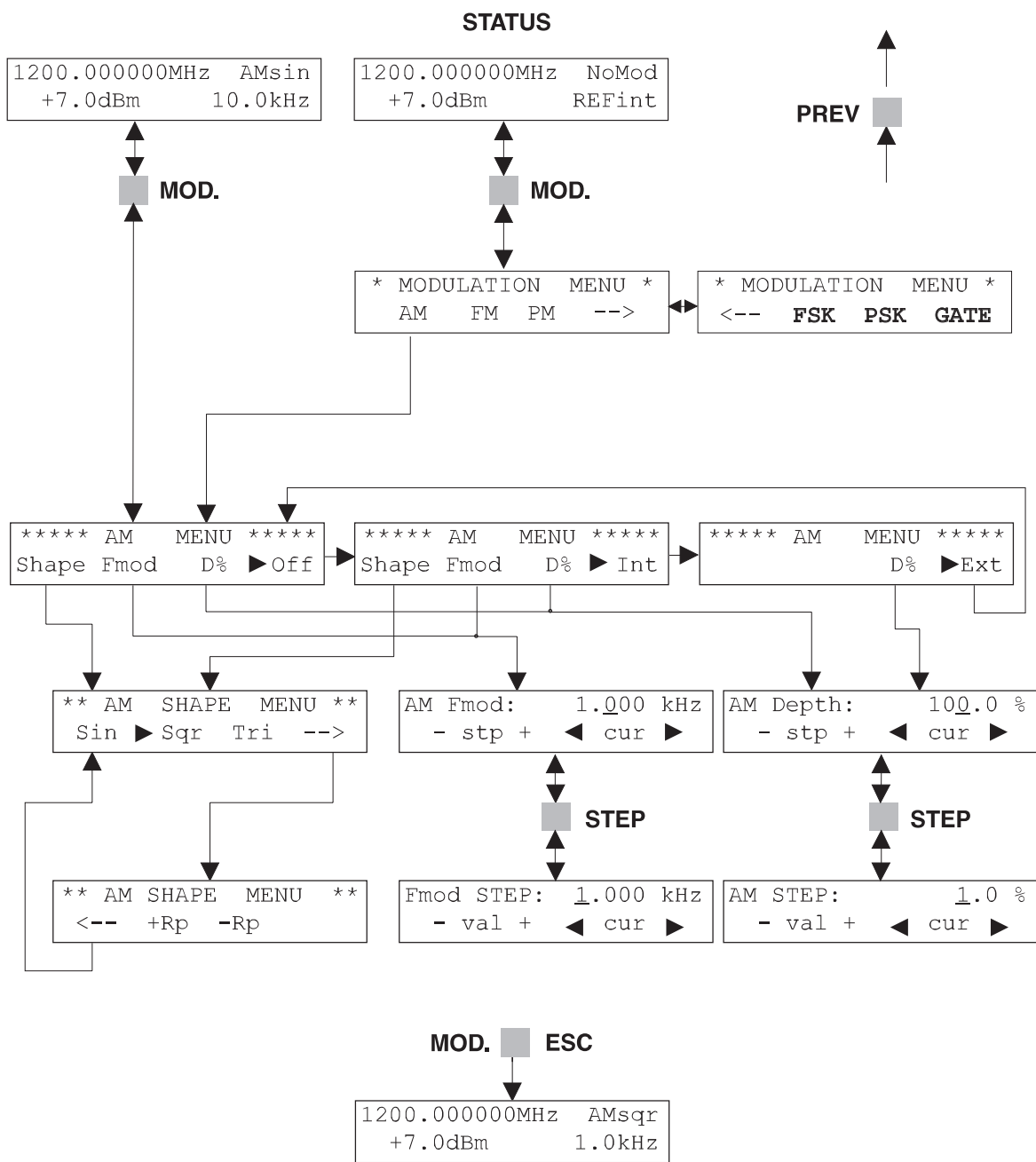
Function selection



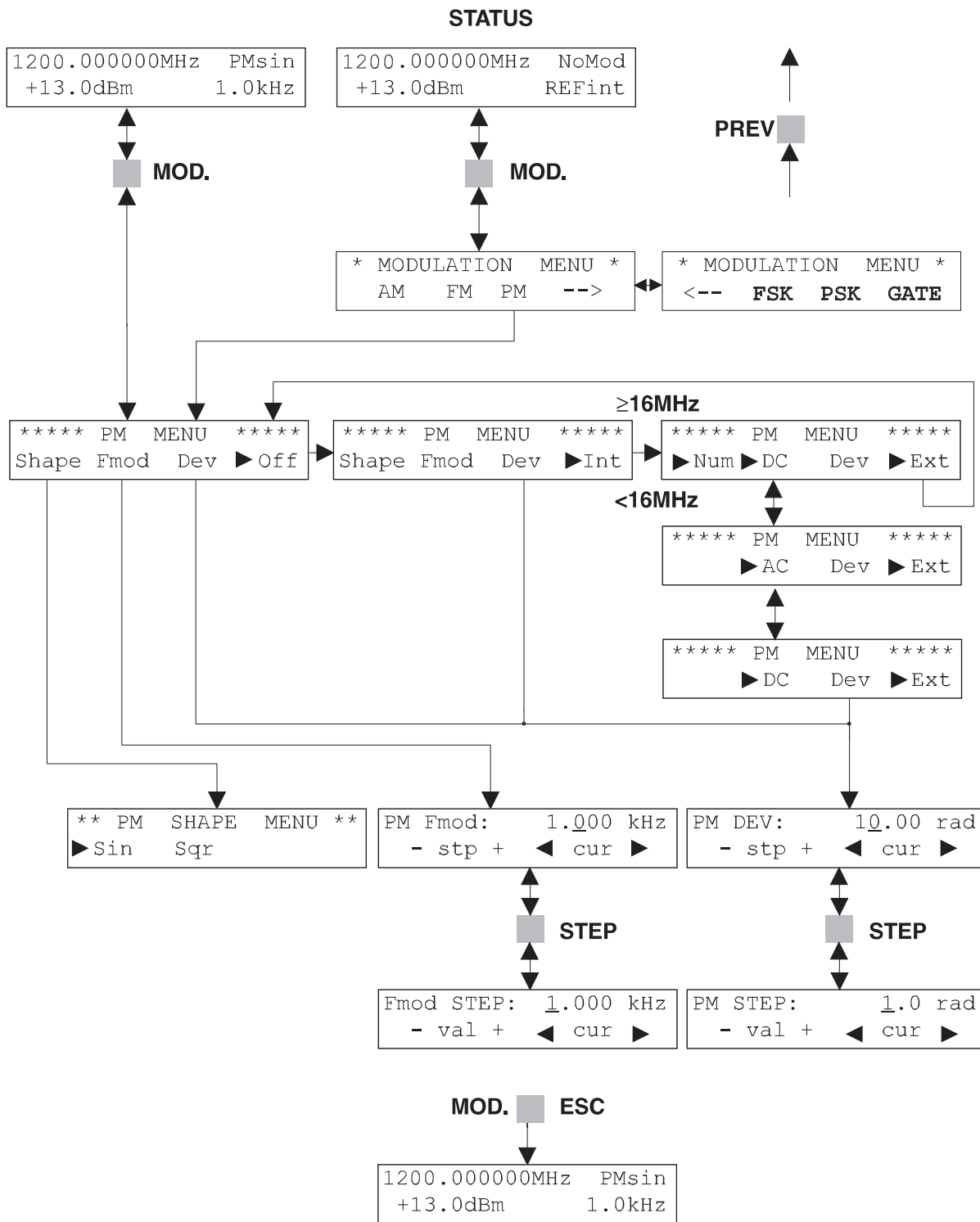
Step control



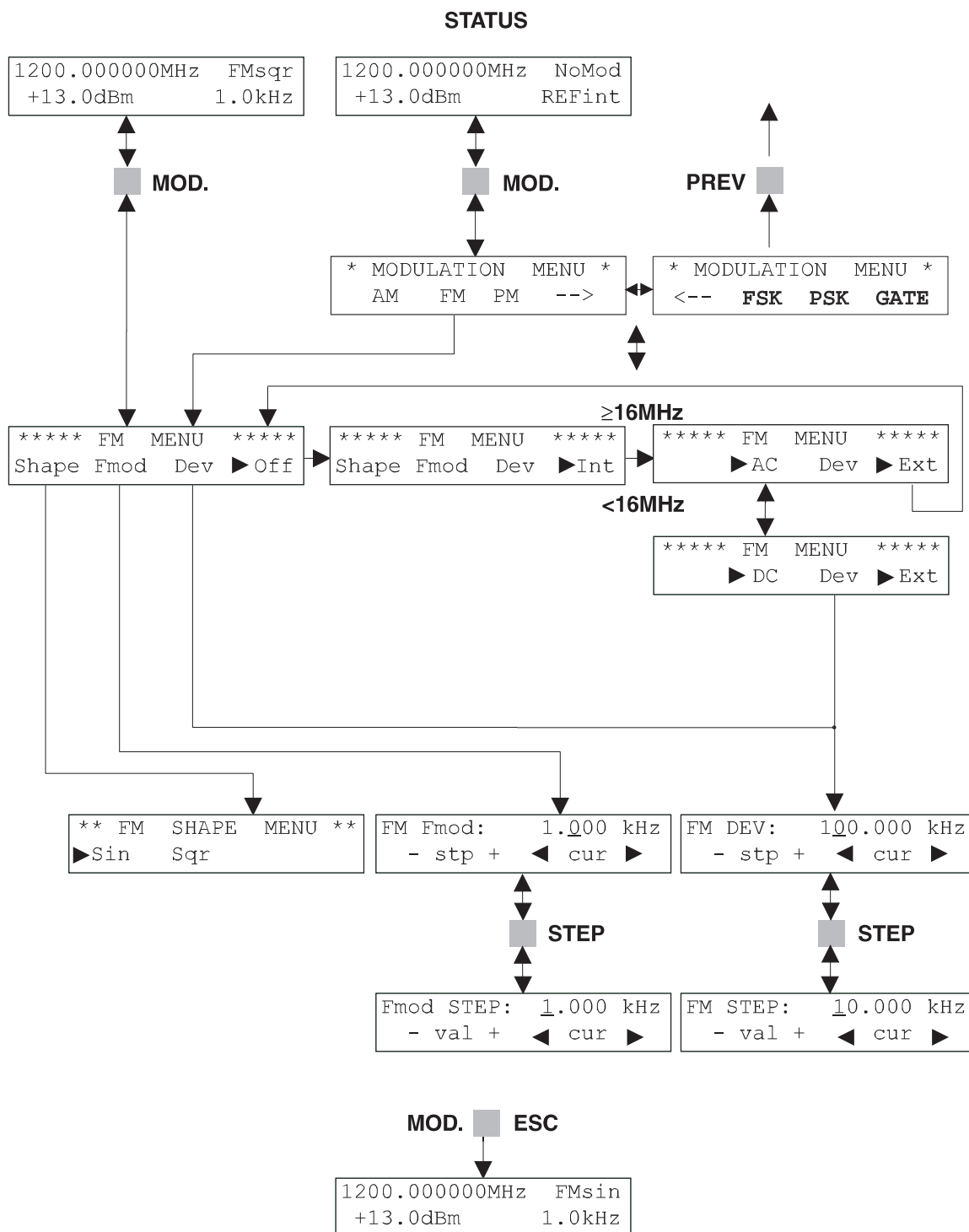
Amplitude Modulation Control



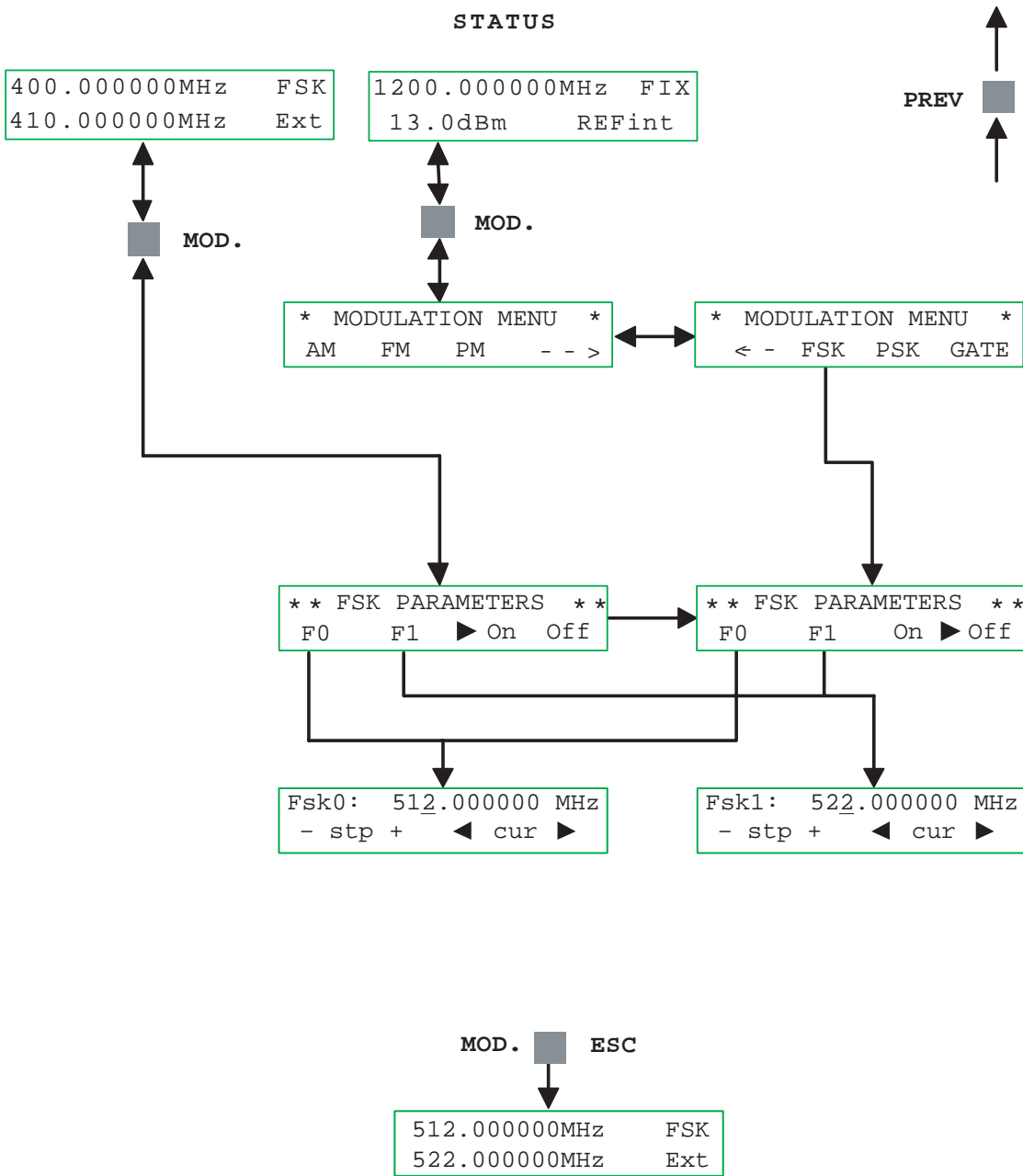
Phase Modulation Control



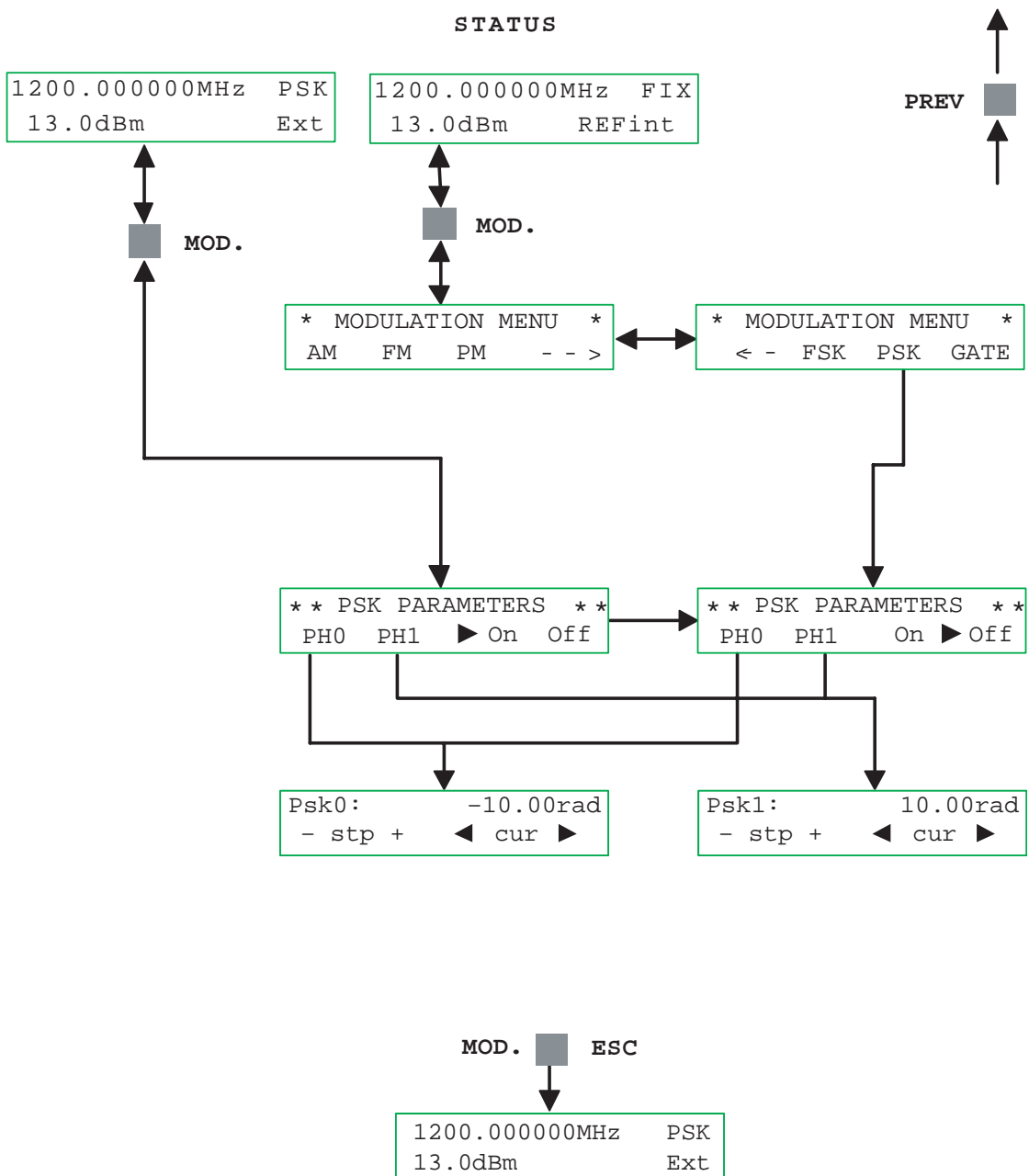
Frequency Modulation Control

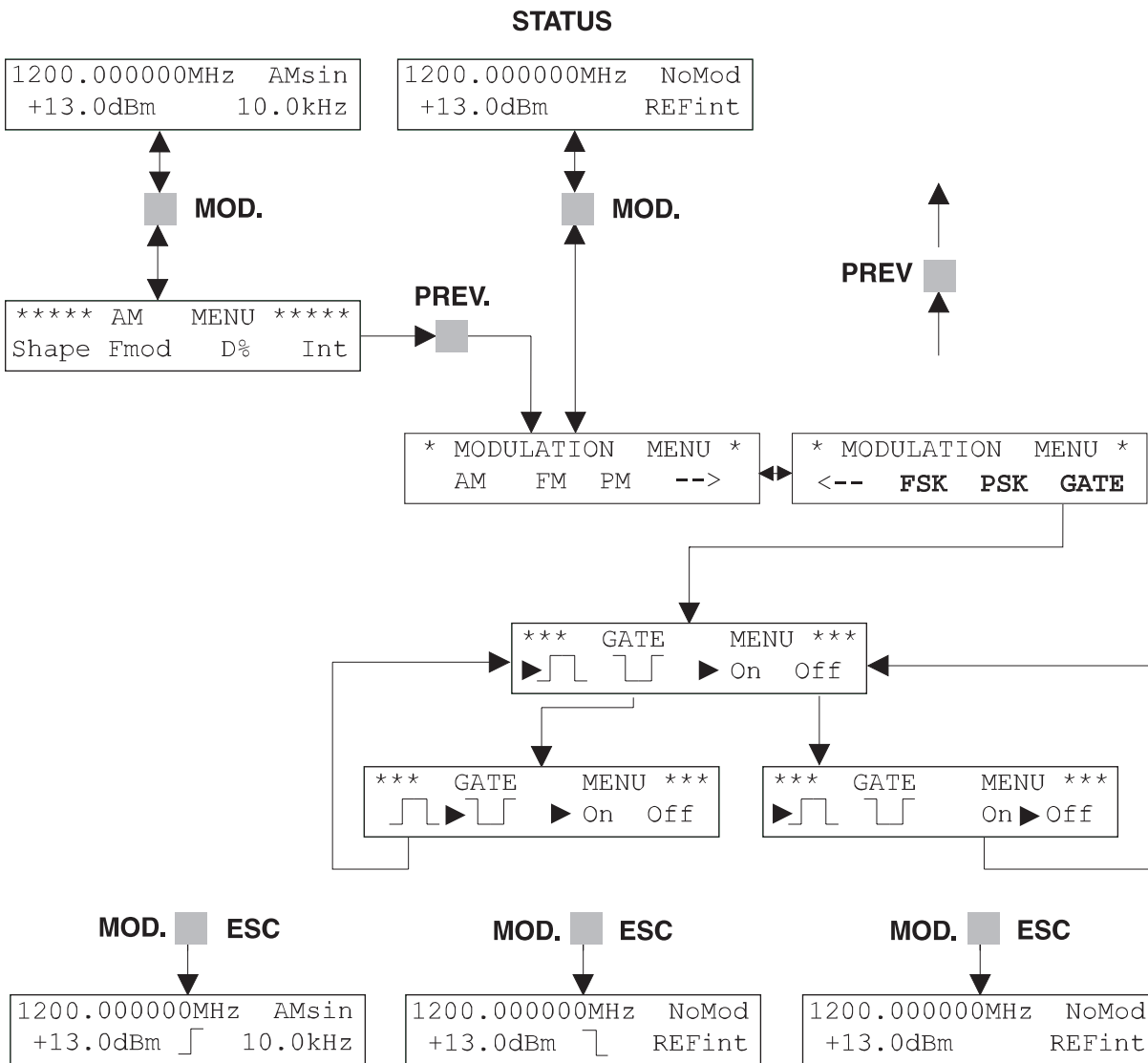


FSK Modulation Control

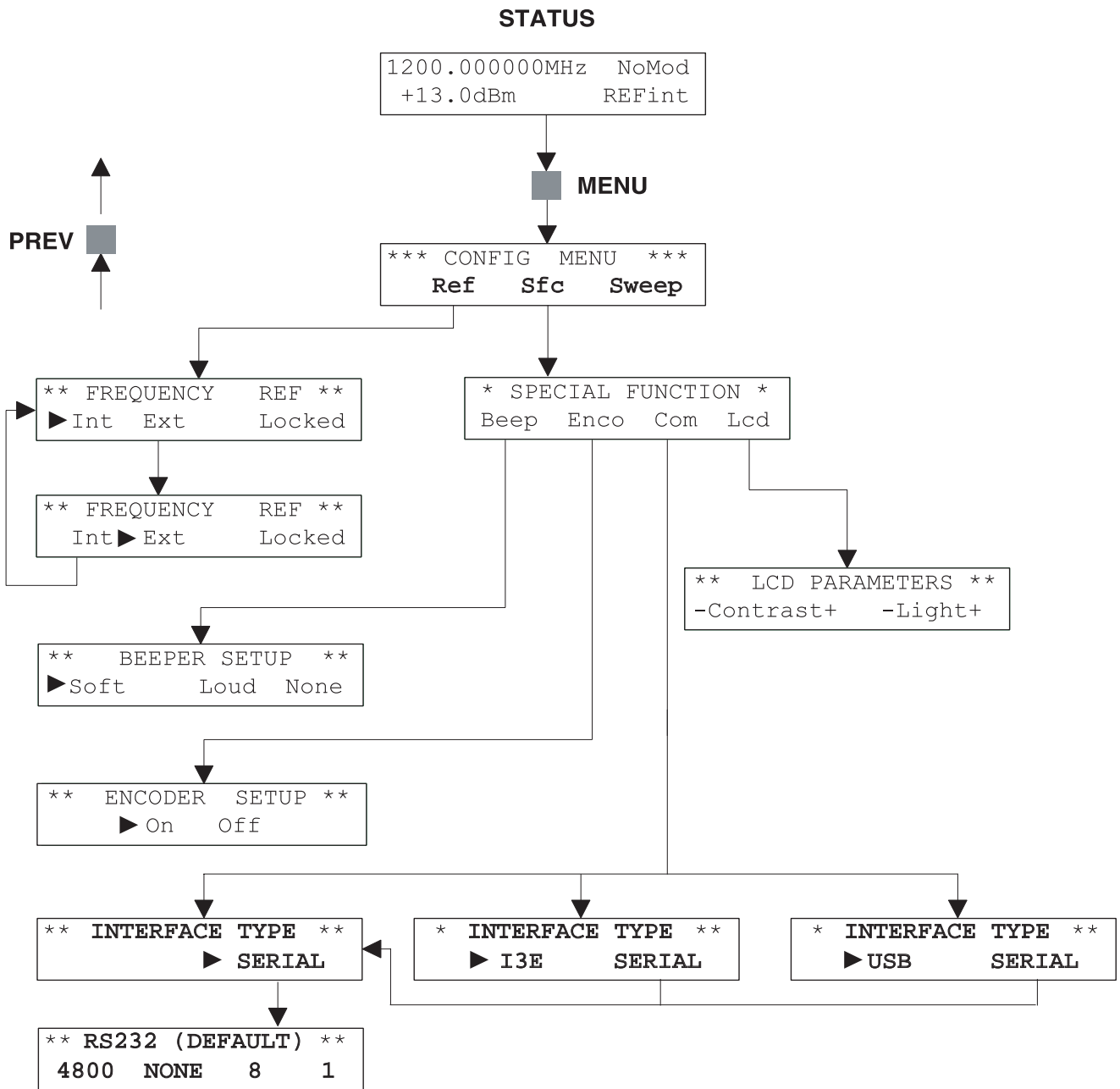


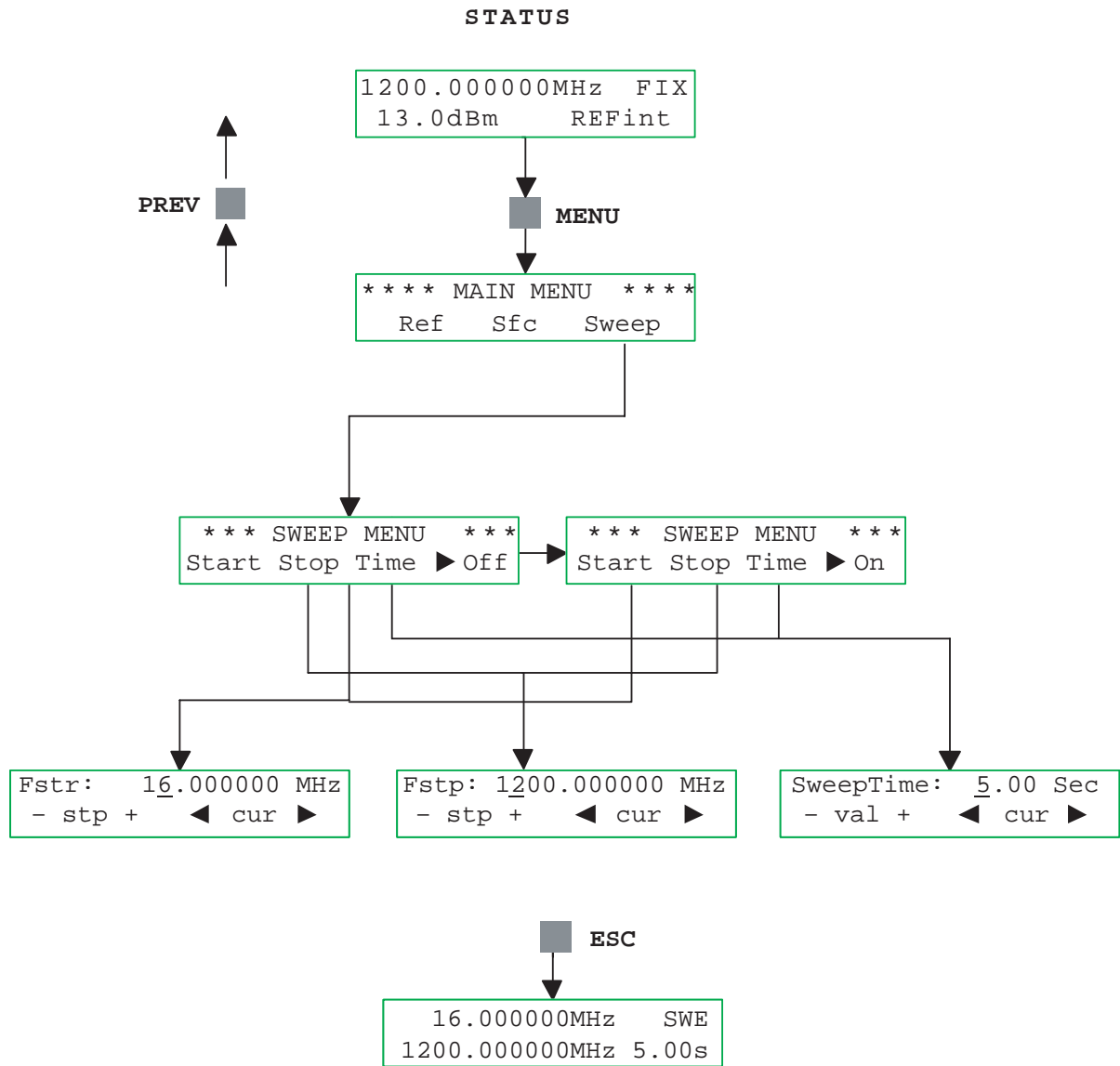
PSK Modulation Control





Main Menu Control





Conversion $\rho \leftrightarrow$ V.S.W.R.

REFLECTED FACTOR

$$\rho = \frac{Z - Z_0}{Z + Z_0}$$

STATIONARY WAVE RATIO

$$VSWR = \frac{1 + |\rho|}{1 - |\rho|}$$

$ \rho $	VSWR	$ \rho $	VSWR	$ \rho $	VSWR	$ \rho $	VSWR
0.00	1.00	0.25	1.67	0.50	3.00	0.75	7.00
0.01	1.02	0.26	1.70	0.51	3.08	0.76	7.33
0.02	1.04	0.27	1.74	0.52	3.17	0.77	7.70
0.03	1.06	0.28	1.78	0.53	3.26	0.78	8.09
0.04	1.08	0.29	1.82	0.54	3.35	0.79	8.52
0.05	1.11	0.30	1.86	0.55	3.44	0.80	9.00
0.06	1.13	0.31	1.90	0.56	3.55	0.81	9.53
0.07	1.15	0.32	1.94	0.57	3.65	0.82	10.11
0.08	1.17	0.33	1.99	0.58	3.76	0.83	10.76
0.09	1.20	0.34	2.03	0.59	3.88	0.84	11.50
0.10	1.22	0.35	2.08	0.60	4.00	0.85	12.33
0.11	1.25	0.36	2.13	0.61	4.13	0.86	13.29
0.12	1.27	0.37	2.17	0.62	4.26	0.87	14.38
0.13	1.30	0.38	2.23	0.63	4.41	0.88	15.67
0.14	1.33	0.39	2.28	0.64	4.56	0.89	17.18
0.15	1.35	0.40	2.33	0.65	4.71	0.90	19.00
0.16	1.38	0.41	2.39	0.66	4.88	0.91	21.22
0.17	1.41	0.42	2.45	0.67	5.06	0.92	24.00
0.18	1.44	0.43	2.51	0.68	5.25	0.93	27.57
0.19	1.47	0.44	2.57	0.69	5.45	0.94	32.33
0.20	1.50	0.45	2.64	0.70	5.67	0.95	39.00
0.21	1.53	0.46	2.70	0.71	5.90	0.96	49.00
0.22	1.56	0.47	2.77	0.72	6.14	0.97	65.67
0.23	1.60	0.48	2.85	0.73	6.41	0.98	99.00
0.24	1.63	0.49	2.92	0.74	6.69	0.99	199.00

Conversion dBm ↔ Volt

CONVERSION dBm → Volt

$$V_0 = \sqrt{R \cdot P_0} \cdot 10^{\frac{P_{dBm}}{20}}$$

CONVERSION Volt → dBm

$$P_{dBm} = 20 \cdot \log \frac{V_0}{\sqrt{R \cdot P_0}}$$

with: $P_0 = 1mW$ and $R = 50\Omega$

dBm	Volt	dBm	Volt	dBm	Volt	dBm	Volt	dBm	Volt
+20.0	2.236	+16.0	1.411	+12.0	0.890	+8.0	0.562	+4.0	0.354
+19.9	2.210	+15.9	1.395	+11.9	0.880	+7.9	0.555	+3.9	0.350
+19.8	2.185	+15.8	1.379	+11.8	0.870	+7.8	0.549	+3.8	0.346
+19.7	2.160	+15.7	1.363	+11.7	0.860	+7.7	0.543	+3.7	0.342
+19.6	2.135	+15.6	1.347	+11.6	0.850	+7.6	0.536	+3.6	0.338
+19.5	2.111	+15.5	1.332	+11.5	0.840	+7.5	0.530	+3.5	0.335
+19.4	2.087	+15.4	1.317	+11.4	0.831	+7.4	0.524	+3.4	0.331
+19.3	2.063	+15.3	1.302	+11.3	0.821	+7.3	0.518	+3.3	0.327
+19.2	2.039	+15.2	1.287	+11.2	0.812	+7.2	0.512	+3.2	0.323
+19.1	2.016	+15.1	1.272	+11.1	0.803	+7.1	0.506	+3.1	0.320
+19.0	1.993	+15.0	1.257	+11.0	0.793	+7.0	0.501	+3.0	0.316
+18.9	1.970	+14.9	1.243	+10.9	0.784	+6.9	0.495	+2.9	0.312
+18.8	1.948	+14.8	1.229	+10.8	0.775	+6.8	0.489	+2.8	0.309
+18.7	1.925	+14.7	1.215	+10.7	0.766	+6.7	0.484	+2.7	0.305
+18.6	1.903	+14.6	1.201	+10.6	0.758	+6.6	0.478	+2.6	0.302
+18.5	1.881	+14.5	1.187	+10.5	0.749	+6.5	0.473	+2.5	0.298
+18.4	1.860	+14.4	1.174	+10.4	0.740	+6.4	0.467	+2.4	0.295
+18.3	1.839	+14.3	1.160	+10.3	0.732	+6.3	0.462	+2.3	0.291
+18.2	1.818	+14.2	1.147	+10.2	0.724	+6.2	0.457	+2.2	0.288
+18.1	1.797	+14.1	1.134	+10.1	0.715	+6.1	0.451	+2.1	0.285
+18.0	1.776	+14.0	1.121	+10.0	0.707	+6.0	0.446	+2.0	0.282
+17.9	1.756	+13.9	1.108	+9.9	0.699	+5.9	0.441	+1.9	0.278
+17.8	1.736	+13.8	1.095	+9.8	0.691	+5.8	0.436	+1.8	0.275
+17.7	1.716	+13.7	1.083	+9.7	0.683	+5.7	0.431	+1.7	0.272
+17.6	1.696	+13.6	1.070	+9.6	0.675	+5.6	0.426	+1.6	0.269
+17.5	1.677	+13.5	1.058	+9.5	0.668	+5.5	0.421	+1.5	0.266
+17.4	1.658	+13.4	1.046	+9.4	0.660	+5.4	0.416	+1.4	0.263
+17.3	1.639	+13.3	1.034	+9.3	0.652	+5.3	0.412	+1.3	0.260
+17.2	1.620	+13.2	1.022	+9.2	0.645	+5.2	0.407	+1.2	0.257
+17.1	1.601	+13.1	1.010	+9.1	0.638	+5.1	0.402	+1.1	0.254
+17.0	1.583	+13.0	0.999	+9.0	0.630	+5.0	0.398	+1.0	0.251
+16.9	1.565	+12.9	0.987	+8.9	0.623	+4.9	0.393	+0.9	0.248
+16.8	1.547	+12.8	0.976	+8.8	0.616	+4.8	0.389	+0.8	0.245
+16.7	1.529	+12.7	0.965	+8.7	0.609	+4.7	0.384	+0.7	0.242
+16.6	1.512	+12.6	0.954	+8.6	0.602	+4.6	0.380	+0.6	0.240
+16.5	1.494	+12.5	0.943	+8.5	0.595	+4.5	0.375	+0.5	0.237
+16.4	1.477	+12.4	0.932	+8.4	0.588	+4.4	0.371	+0.4	0.234
+16.3	1.460	+12.3	0.921	+8.3	0.581	+4.3	0.367	+0.3	0.231
+16.2	1.444	+12.2	0.911	+8.2	0.575	+4.2	0.363	+0.2	0.229
+16.1	1.427	+12.1	0.901	+8.1	0.568	+4.1	0.358	+0.1	0.226

Conversion dBm ↔ mW

CONVERSION mW → dBm

$$P_{dBm} = 10 \cdot \log \frac{P_{mW}}{P_0}$$

CONVERSION dBm → mW

$$P_{mW} = P_0 \cdot 10^{\frac{P_{dBm}}{10}}$$

with: $P_0 = 1mW$

dBm	mW	dBm	mW	dBm	mW	dBm	mW	dBm	mW
+20.0	100.000	+16.0	39.811	+12.0	15.849	+8.0	6.310	+4.0	2.512
+19.9	97.724	+15.9	38.905	+11.9	15.488	+7.9	6.166	+3.9	2.455
+19.8	95.499	+15.8	38.019	+11.8	15.136	+7.8	6.026	+3.8	23.99
+19.7	93.325	+15.7	37.154	+11.7	14.791	+7.7	5.888	+3.7	2.344
+19.6	91.201	+15.6	36.308	+11.6	14.454	+7.6	5.754	+3.6	2.291
+19.5	89.125	+15.5	35.481	+11.5	14.125	+7.5	5.623	+3.5	2.239
+19.4	87.096	+15.4	34.674	+11.4	13.804	+7.4	5.495	+3.4	2.188
+19.3	85.114	+15.3	33.884	+11.3	13.490	+7.3	5.370	+3.3	2.138
+19.2	83.176	+15.2	33.113	+11.2	13.183	+7.2	5.248	+3.2	2.089
+19.1	81.283	+15.1	32.359	+11.1	12.882	+7.1	5.129	+3.1	2.042
+19.0	79.433	+15.0	31.623	+11.0	12.589	+7.0	5.012	+3.0	1.995
+18.9	77.625	+14.9	30.903	+10.9	12.303	+6.9	4.898	+2.9	1.950
+18.8	75.858	+14.8	30.200	+10.8	12.023	+6.8	4.786	+2.8	1.905
+18.7	74.131	+14.7	29.512	+10.7	11.749	+6.7	4.677	+2.7	1.862
+18.6	72.444	+14.6	28.840	+10.6	11.482	+6.6	4.571	+2.6	1.820
+18.5	70.795	+14.5	28.184	+10.5	11.220	+6.5	4.467	+2.5	1.778
+18.4	69.183	+14.4	27.542	+10.4	10.965	+6.4	4.365	+2.4	1.738
+18.3	67.608	+14.3	26.915	+10.3	10.715	+6.3	4.266	+2.3	1.698
+18.2	66.069	+14.2	26.303	+10.2	10.471	+6.2	4.169	+2.2	1.660
+18.1	64.565	+14.1	25.704	+10.1	10.233	+6.1	4.074	+2.1	1.622
+18.0	63.096	+14.0	25.119	+10.0	10.000	+6.0	3.981	+2.0	1.585
+17.9	61.660	+13.9	24.547	+9.9	9.772	+5.9	3.890	+1.9	1.549
+17.8	60.256	+13.8	23.988	+9.8	9.550	+5.8	3.802	+1.8	1.514
+17.7	58.884	+13.7	23.442	+9.7	9.333	+5.7	3.715	+1.7	1.479
+17.6	57.544	+13.6	22.909	+9.6	9.120	+5.6	3.631	+1.6	1.445
+17.5	56.234	+13.5	22.387	+9.5	8.913	+5.5	3.548	+1.5	1.413
+17.4	54.954	+13.4	21.878	+9.4	8.710	+5.4	3.467	+1.4	1.380
+17.3	53.703	+13.3	21.380	+9.3	8.511	+5.3	3.388	+1.3	1.349
+17.2	52.481	+13.2	20.893	+9.2	8.318	+5.2	3.311	+1.2	1.318
+17.1	51.286	+13.1	20.417	+9.1	8.128	+5.1	3.236	+1.1	1.288
+17.0	50.119	+13.0	19.953	+9.0	7.943	+5.0	3.162	+1.0	1.259
+16.9	48.978	+12.9	19.498	+8.9	7.762	+4.9	3.090	+0.9	1.230
+16.8	47.863	+12.8	19.055	+8.8	7.586	+4.8	3.020	+0.8	1.202
+16.7	46.774	+12.7	18.621	+8.7	7.413	+4.7	2.951	+0.7	1.175
+16.6	45.709	+12.6	18.197	+8.6	7.244	+4.6	2.884	+0.6	1.148
+16.5	44.668	+12.5	17.783	+8.5	7.079	+4.5	2.818	+0.5	1.122
+16.4	43.652	+12.4	17.378	+8.4	6.918	+4.4	2.754	+0.4	1.096
+16.3	42.658	+12.3	16.982	+8.3	6.761	+4.3	2.692	+0.3	1.072
+16.2	41.687	+12.2	16.596	+8.2	6.607	+4.2	2.630	+0.2	1.047
+16.1	40.738	+12.1	16.218	+8.1	6.457	+4.1	2.570	+0.1	1.023

Conversion dBm ↔ Ratio

CONVERSION Ratio → dBm

$$P_{dBm} = 20 \cdot \log \frac{U_S}{U_E}$$

CONVERSION dBm → Ratio

$$\frac{U_S}{U_E} = 10^{\frac{P_{dBm}}{20}}$$

dBm	Ratio	dBm	Ratio	dBm	Ratio	dBm	Ratio	dBm	Ratio
0.0	1.000	4.6	1.698	9.2	2.884	13.8	4.898	18.4	8.318
0.1	1.012	4.7	1.718	9.3	2.917	13.9	4.955	18.5	8.414
0.2	1.023	4.8	1.738	9.4	2.951	14.0	5.012	18.6	8.511
0.3	1.035	4.9	1.758	9.5	2.985	14.1	5.070	18.7	8.610
0.4	1.047	5.0	1.778	9.6	3.020	14.2	5.129	18.8	8.710
0.5	1.059	5.1	1.799	9.7	3.055	14.3	5.188	18.9	8.810
0.6	1.072	5.2	1.820	9.8	3.090	14.4	5.248	19.0	8.913
0.7	1.084	5.3	1.841	9.9	3.126	14.5	5.309	19.1	9.016
0.8	1.096	5.4	1.862	10.0	3.162	14.6	5.370	19.2	9.120
0.9	1.109	5.5	1.884	10.1	3.199	14.7	5.433	19.3	9.226
1.0	1.122	5.6	1.905	10.2	3.236	14.8	5.495	19.4	9.333
1.1	1.135	5.7	1.928	10.3	3.273	14.9	5.559	19.5	9.441
1.2	1.148	5.8	1.950	10.4	3.311	15.0	5.623	19.6	9.550
1.3	1.161	5.9	1.972	10.5	3.350	15.1	5.689	19.7	9.661
1.4	1.175	6.0	1.995	10.6	3.388	15.2	5.754	19.8	9.772
1.5	1.189	6.1	2.018	10.7	3.428	15.3	5.821	19.9	9.886
1.6	1.202	6.2	2.042	10.8	3.467	15.4	5.888	20	10.000
1.7	1.216	6.3	2.065	10.9	3.508	15.5	5.957	20.1	10.116
1.8	1.230	6.4	2.089	11.0	3.548	15.6	6.026	20.2	10.233
1.9	1.245	6.5	2.113	11.1	3.589	15.7	6.095	20.3	10.351
2.0	1.259	6.6	2.138	11.2	3.631	15.8	6.166	20.4	10.471
2.1	1.274	6.7	2.163	11.3	3.673	15.9	6.237	20.5	10.593
2.2	1.288	6.8	2.188	11.4	3.715	16.0	6.310	20.6	10.715
2.3	1.303	6.9	2.213	11.5	3.758	16.1	6.383	20.7	10.839
2.4	1.318	7.0	2.239	11.6	3.802	16.2	6.457	20.8	10.965
2.5	1.334	7.1	2.265	11.7	3.846	16.3	6.531	20.9	11.092
2.6	1.349	7.2	2.291	11.8	3.890	16.4	6.607	21	11.220
2.7	1.365	7.3	2.317	11.9	3.936	16.5	6.683	21.1	11.350
2.8	1.380	7.4	2.344	12.0	3.981	16.6	6.761	21.2	11.482
2.9	1.396	7.5	2.371	12.1	4.027	16.7	6.839	21.3	11.614
3.0	1.413	7.6	2.399	12.2	4.074	16.8	6.918	21.4	11.749
3.1	1.429	7.7	2.427	12.3	4.121	16.9	6.998	21.5	11.885
3.2	1.445	7.8	2.455	12.4	4.169	17.0	7.079	21.6	12.023
3.3	1.462	7.9	2.483	12.5	4.217	17.1	7.161	21.7	12.162
3.4	1.479	8.0	2.512	12.6	4.266	17.2	7.244	21.8	12.303
3.5	1.496	8.1	2.541	12.7	4.315	17.3	7.328	21.9	12.445
3.6	1.514	8.2	2.570	12.8	4.365	17.4	7.413	22	12.589
3.7	1.531	8.3	2.600	12.9	4.416	17.5	7.499	22.1	12.735
3.8	1.549	8.4	2.630	13.0	4.467	17.6	7.586	22.2	12.882
3.9	1.567	8.5	2.661	13.1	4.519	17.7	7.674	22.3	13.032
4.0	1.585	8.6	2.692	13.2	4.571	17.8	7.762	22.4	13.183
4.1	1.603	8.7	2.723	13.3	4.624	17.9	7.852	22.5	13.335
4.2	1.622	8.8	2.754	13.4	4.677	18.0	7.943	22.6	13.490
4.3	1.641	8.9	2.786	13.5	4.732	18.1	8.035	22.7	13.646
4.4	1.660	9.0	2.818	13.6	4.786	18.2	8.128	22.8	13.804
4.5	1.679	9.1	2.851	13.7	4.842	18.3	8.222	22.9	13.964

Conversion dB μ V \leftrightarrow Volt

CONVERSION Volt \rightarrow dB μ V

CONVERSION dB μ V \rightarrow Volt

$$P_{dB\mu V} = 20 \cdot \log \frac{U}{U_0}$$

$$U = U_0 \cdot 10^{\frac{P_{dB\mu V}}{20}}$$

with: $U_0 = 1\mu V$

dB μ V	μ Volt	dB μ V	μ Volt	dB μ V	mVolt	dB μ V	mVolt	dB μ V	Volt
0	1.00	40	100	60	1.00	100	100	120	1.00
1	1.12	41	112	61	1.12	101	112	121	1.12
2	1.26	42	126	62	1.26	102	126	122	1.26
3	1.41	43	141	63	1.41	103	141	123	1.41
4	1.58	44	158	64	1.58	104	158	124	1.58
5	1.78	45	178	65	1.78	105	178	125	1.78
6	2.00	46	200	66	2.00	106	200	126	2.00
7	2.24	47	224	67	2.24	107	224	127	2.24
8	2.51	48	251	68	2.51	108	251	128	2.51
9	2.82	49	282	69	2.82	109	282	129	2.82
10	3.16	50	316	70	3.16	110	316		
11	3.55	51	355	71	3.55	111	355		
12	3.98	52	398	72	3.98	112	398		
13	4.47	53	447	73	4.47	113	447		
14	5.01	54	501	74	5.01	114	501		
15	5.62	55	562	75	5.62	115	562		
16	6.31	56	631	76	6.31	116	631		
17	7.08	57	708	77	7.08	117	708		
18	7.94	58	794	78	7.94	118	794		
19	8.91	59	891	79	8.91	119	891		
20	10.0			80	10.0				
21	11.2			81	11.2				
22	12.6			82	12.6				
23	14.1			83	14.1				
24	15.8			84	15.8				
25	17.8			85	17.8				
26	20.0			86	20.0				
27	22.4			87	22.4				
28	25.1			88	25.1				
29	28.2			89	28.2				
30	31.6			90	31.6				
31	35.5			91	35.5				
32	39.8			92	39.8				
33	44.7			93	44.7				
34	50.1			94	50.1				
35	56.2			95	56.2				
36	63.1			96	63.1				
37	70.8			97	70.8				
38	79.4			98	79.4				
39	89.1			99	89.1				
40	100								