

**FLUKE®**

# **PM5139**

Function Generator 0.1 mHz - 20 MHz

Users Manual

Gebrauchsanleitung

Mode d'emploi

4822 872 10203

March 1997, Rev. 2, 2/99

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## **Limited Warranty & Limitation of Liability**

Each Fluke product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer of a Fluke authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Fluke's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling. Fluke warrants that software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Fluke does not warrant that software will be error free or operate without interruption.

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**FLUKE®**

**DECLARATION OF CONFORMITY**

for

**FLUKE**  
**Function Generator 20 MHz**  
**PM 5139**

**Manufacturer**

Fluke Industrial B.V.  
Lelyweg 1  
7602 EA Almelo  
The Netherlands

**Statement of Conformity**

Based on test results using appropriate standards, the product is in conformity with  
Electromagnetic Compatibility Directive 89/336/EEC  
Low Voltage Directive 73/23/EEC

**Sample tests**

Standards used:

EN 50081-1 (1992)  
Electromagnetic Compatibility Generic Emission Standard:  
EN 55011 Group I Class B

EN 50082-1 (1992)  
Electromagnetic Compatibility; Generic Immunity Standard:  
EN 61000-4-2, -3 and -4

EN 61010 – (1994) CAT II Pollution Degree 2  
Safety Requirements for Electronic Equipment for Measurement,  
Control, and Laboratory Use.

The tests have been performed in a typical configuration.

This Conformity is indicated by the symbol **CE**, i.e. “Conformité européenne”.

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## SHIPMENT NOTE

The following parts should be included in the shipment:

- 1 PM5139 function generator 0.1 MHz – 20 MHz
- 1 Users Manual 4822 872 10203
- 1 Power Cable
- 2 Fuses

For built-in options, see type plate on the rear panel:

Type plate

	<b>FLUKE.</b>	
Type number	TYPE : PM5139/x	77VA
Code number	NC : 9445 051 39xx	
Serial number	NO : L0	50-60Hz

Code number  
9445 051 390xx

Power cable (see Section 1.1.4)

**Options built-in:**

- 0 No interface
- 2 IEEE-488 interface
- 3 RS-232 interface

## INITIAL INSPECTION

Check that the shipment is complete and note whether any damage has occurred during transport. If the contents are incomplete or there is damage, file a claim with the carrier immediately, and notify the Fluke Service organization to facilitate the repair or replacement of the instrument. Fluke addresses are listed in the back of this manual.



# 1 INSTALLATION AND SAFETY INSTRUCTIONS

## 1.1 SAFETY INSTRUCTIONS

Upon delivery from the factory the instrument complies with the required safety regulations, see Chapter 4. To maintain this condition and to ensure safe operation, carefully follow the instructions below.

### 1.1.1 Maintenance and Repair

#### **Failure and excessive stress:**

If the instrument is suspected of being unsafe, remove it from operation immediately and secure it against any unintended operation. The instrument considered to be unsafe when any of the following conditions exist:

- It shows physical damage.
- No longer functions.
- Has been stressed beyond the tolerable limits (e.g., during storage and transportation).

#### **Disassembling the Instrument:**

#### **WARNING**

**Calibration, maintenance, and repair of the instrument must be performed only by trained personnel who are aware of the hazards involved. To avoid electric shock, do not remove the cover unless you are qualified to do so.**

**Before removing the cover, disconnect the instrument from all power sources. The capacitors in the instrument may remain charged for several seconds after all power has been disconnected.**

### 1.1.2 Grounding

Before any other connection is made the instrument must be connected to a protective ground conductor via the three-wire power plug.

The power plug shall be inserted only into a grounded connector outlet with a protective ground contact.

Do not defeat the protective action by using an extension cord without a grounded conductor.

The external contacts of the BNC sockets must not be used to connect a protective conductor.

#### **WARNING**

**Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective ground terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

### 1.1.3 Connections

The circuit ground potential is applied to the external contacts of the BNC sockets and is connected to the cabinet by means of parallel-connected resistors and capacitors. This method ensures that ground loops are avoided and a clear RF grounding is obtained.

If the circuit ground potential in a measurement setup is different from the protective ground potential, it must be noticed,

- that the BNC sockets can be touched and that it must not be live (see the safety regulations on the subject).
- that all sockets marked with the sign  $\perp$  are internally interconnected.

### 1.1.4 Line Voltage Setting and Fuses

Before plugging in the line cord, make sure that the instrument is set to the correct line voltage.

#### WARNING

**Changing fuses and modifying power cables to local power must be done by qualified service personnel who are aware of the hazards involved.**

On delivery from the factory the instrument is set to one of the following line voltages.

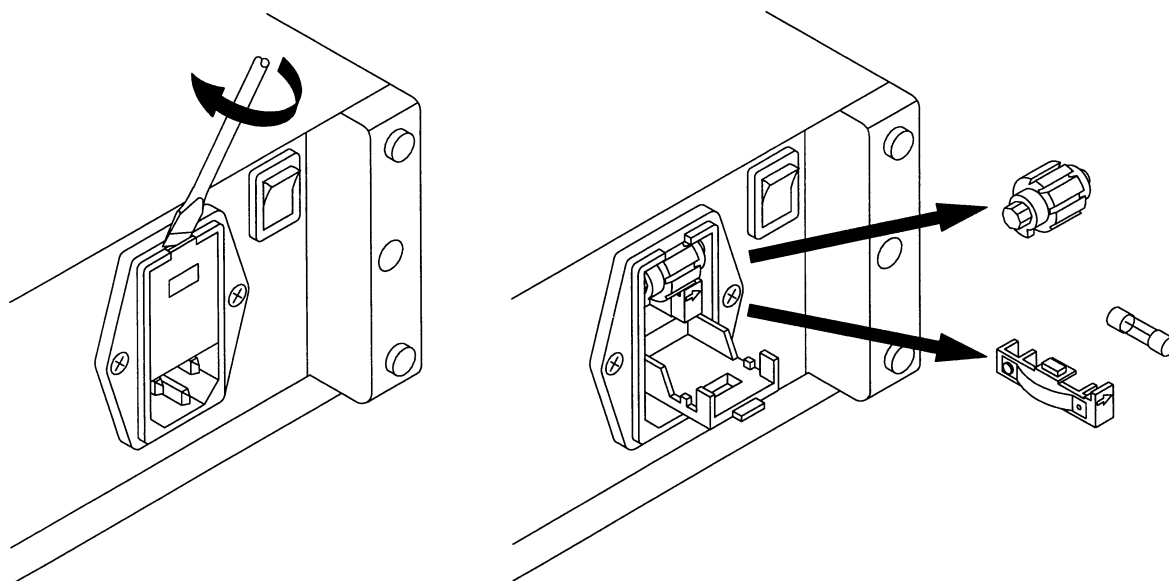
Instrument Version	Instrument Code No.	Line Voltage Setting	Delivered Power Cord
PM5139/0x1	9445 051 390x1	220 V	Universal Europe
PM5139/0x3	9445 051 390x3	120 V	North America
PM5139/0x4	9445 051 390x4	240 V	England (U.K.)
PM5139/0x5	9445 051 390x5	220 V	Switzerland
PM5139/0x8	9445 051 390x8	240 V	Australia

The voltage setting and the corresponding fuse are indicated on the rear panel.

Make sure that replacement fuses are of the specified type and current rating. The use of repaired fuses, and/or the short circuiting of the fuse holders are prohibited.

The instrument can be set to the following line voltages: 100 V, 120 V, 220 V and 240 V ac. These nominal voltages are selected by means of the voltage selector, located on the rear panel, next to the line voltage connector. The fuse is located in a holder at the same place. To select line voltage or replace the fuse, remove the power cord and pry open the compartment with a small screwdriver (see illustration).

Turn the selector to select the appropriate voltage range. If necessary, insert the specified fuse (T0.4A or T0.8A according to IEC127 or T0.5A or T1.0A according to CSA/UL198G) that matches the line voltage setting into the fuse holder.



## 1.2 OPERATING POSITION OF THE INSTRUMENT

The instrument can be used in the position indicated in Chapter 4. With the handle folded down, the instrument may be used in a sloping position. The characteristics mentioned in Chapter 4 are guaranteed for the specified positions. Ensure that the ventilation holes in the cover are free of obstruction. Do not position the instrument in direct sunlight or on any surface that produces or radiates heat.

## 1.3 RADIO INTERFERENCE SUPPRESSION

Radio interference of the instrument is suppressed and checked carefully. If radio frequency interference occurs in connection with other deficient suppressed instruments, further suppression activities may be required.





## 2 MAIN CAPABILITIES

### 2.1 INTRODUCTION

The PM5139 function generator introduces a new concept of menu-driven operation to waveform generation and frequency synthesis.

Microprocessor control enables simple and rapid operation and allows you to set parameters by stepping through the menu offered. One single control rotary knob allows you to make precise settings of all numeric values.

The large backlit LCD clearly displays the selected signal and gives a readout of vital parameters, such as frequency, waveform, amplitude, and modulation. Any invalid parameter selections are ignored and an error message shows the incorrect settings that have been made.

The PM5139 frequency range covers 11½ decades, from 0.1 mHz to 20 MHz. Ten waveforms are selectable, including standard functions, such as sine, triangle, square, as well as positive and negative sawtooth, different pulses, and haversine.

Seven modulation modes are available:

- Amplitude modulation (AM)
- Frequency modulation (FM)
- Phase Shift Keying (PSK)
- GATE
- Linear SWEEP
- Logarithmic SWEEP
- BURST

The 10-key section on the right of the front panel permits a versatile activation and control of such functions as single or continuous sweep or burst, sweep hold, and switching from internal to external modulation or trigger source; further asymmetrical waveforms with variable duty cycle, key for instant return to symmetrical waveform, store and recall keys for up to nine complete instrument settings, a DIAL LOCK key to disable the rotary control, and a key for switching the signal output impedance.

AC or DC amplitudes can be precisely set using the numeric setting rotary knob. DC offset is set independently of the AC output amplitude. The output signals phase noise and residual FM are very low, ensuring a clean and stable signal.

The instrument is optionally available under type number PM5139/02 with a built-in GPIB (IEEE bus) interface and under number PM5139/03 with built-in RS-232 interface. All instrument functions can be remotely activated from a PC or test system controller. It is also possible to upload settings and status data from the instrument for storage in the controller and later recall at any time. The facility IEEE bus makes PM5139 an integral part of an automated test system.

The PM5139 with interface also offers a user-definable "arbitrary" waveform ARB: the desired waveform may be programmed on the PC, and then downloaded to the generator via interface. Twenty-four arbitrary waveforms can be stored separately.

A test program is built in to provide customer support and to facilitate servicing.

The PM5139 is very much suited for applications in research and development, production monitoring, quality assurance, and for service purposes.

## 3 OPERATING INSTRUCTIONS

### 3.1 GENERAL INFORMATION

This chapter outlines the procedures and precautions necessary for operation. It identifies and briefly describes the functions of the front and rear panel controls and the display, and explains the practical aspects of operation to enable an operator to quickly evaluate the instrument's main functions.

### 3.2 TURNING THE INSTRUMENT ON

After the instrument is connected to the line voltage as described in Section 2.2.4, press POWER on the rear panel to ON.

With normal installation in accordance with Section 2.3 and after a warm-up time of 30 minutes, the characteristics specified in Chapter 4 are valid.

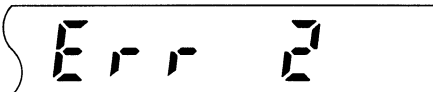
After turning the power off, allow at least 5 seconds before turning it on again. This allows all power to completely discharge and the instrument to reset.

### 3.3 SELF-TEST ROUTINE

After POWER ON, the instrument performs a self-test routine that tests the PROMs, RAMs, and EEPROMs. After this the software version is indicated in the upper line of the display for about 1 second. All segments of the display field are shown for about 2 seconds, and the instrument is set to the operating mode to which it was set before POWER OFF.

The output signal with the corresponding parameters is now at the OUTPUT socket.

A possible fault is indicated as follows:

e.g. 

The digits mean:

- 1 program memory checksum
- 2 RAM processor
- 3 memory of actual settings
- 4 memory registers 1 to 9
- 5 reverse power protection at signal output
- 6 no frequency generation

For detailed information, see Section 3.5.9.

## 3.4 BRIEF CHECKING PROCEDURE

### 3.4.1 General Information

This procedure is intended to check the instrument's functions with a minimum of test steps and actions. It is assumed that the operator doing this test is familiar with the instrument and its characteristics.

If this test is started within a short period after switching on, test steps may be out of specification, due to insufficient warm-up time.

### WARNING

**Before turning the instrument on, ensure that it has been installed in accordance with the instructions mentioned in Chapter 1.**

### 3.4.2 Functional Test

Immediately after power-on a self-test routine is performed (see Section 3.3). After that the instrument automatically recalls operating settings prior to the last power off.

If you prefer different operating settings, set new parameters now.

#### Example:

Prepare frequency setting.

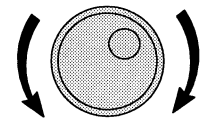
input sequence



Coarse setting about 20 kHz.



Fine setting to 20 kHz;  
if **DIAL LOCKED** lights up,  
push **DIAL LOCK** key.



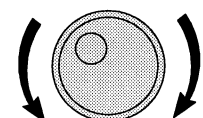
Select waveform (until e.g.  $\sim$  symbol flashes);  
if **VAR SYMMETRY** lights up, push 50 % key.



Select output amplitude.



Set amplitude to 1 V.



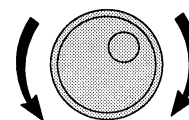
input sequence

Select modulation frequency (until **fMOD** symbol flashes).

MOD PARAMETER



Set modulation frequency to e.g. 1 kHz.

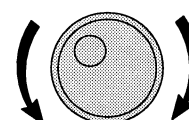


Select modulation depth (until **m** symbol flashes).

MOD PARAMETER



Set modulation depth to 50 %.



Select modulation mode (until **AM** symbol flashes).

MOD MODE



Connect oscilloscope to socket OUTPUT ( $Z_0$  50  $\Omega$ ) and check the signal. If it is correct the test is finished. If not, repeat the procedure with other settings. For input examples, see Section 3.5.

## 3.5 OPERATION

### 3.5.1 Design of Display Field and Keyboard (see section figures, Figure 1)

The display field consists of six horizontal sections for the following displays:

- frequency, max. 4½ digits
- start frequency for sweep
- unit **MHz, kHz, Hz**
- **REMOTE** for identification of remote operation
- **DIAL LOCKED** points to inhibited rotary knob
- waveform symbols  
 ( = ~ ^ □ ▭ ▮ / \ ^ ^ ^ **ARB** ★)    ★ instruments with interface only
- output amplitude, peak value (**ACPP**) in Volt, max. 2½ digits
- DC offset voltage (**DC OFFSET**) in Volt, max. 2½ digits
- output impedance (**LOW Z<sub>o</sub>**)

- modulation parameter:
  - modulation frequency (**fMOD**), 2½ digits in Hz or kHz
  - modulation depth (**m**), 2½ digits in %
  - frequency deviation (**DEV**), 2½ digits in %, related to carrier
  - sweep stop frequency (**fSTOP**), 3½ digits in MHz, kHz, Hz
  - sweep time (**T**), 3½ digits in seconds
  - sweep modes, –1–, –2–, –3–
  - ON periods (**N**) for burst mode, 3½ digits
  - start-stop phase ( $\varphi$ ) for burst mode, 2½ digits in degrees (**DEG**)
- duty cycle (**SYMMETRY**), 2 digits in %
- storage register number (**REG**), 1 ... 9
- device address for IEEE-488 (**ADDR**) or interface configuration for RS-232
- modulation mode (**MOD-OFF, AM, FM, PSK, GATE, LIN-SWP-LOG, BURST**)
- trigger state (**INT, EXT-TRIG, CONT, SGLE, NOT TRIG'D**)
- sweep and burst control (**CONT, SGLE**), signal interruption (**HOLD**)
- duty cycle not 50 % (**VAR SYMMETRY**)
- DC offset voltage (**VAR DC OFFSET**)










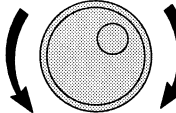
The symbol "▶" in front of the upper five sections shows that this section is ready for input or selection of data respectively parameters.











The keyboard is divided into four sections:

- keys for operation via interface (**LOCAL, ADDR**)
- special key for processor reset (**RESET**)
- selection for frequency input (**FREQUENCY**)
- selection of signal waveform (**WAVEFORM**)
- preparation for input of DC offset and output amplitude (**DC** and **AC**)
- selection for input of modulation parameter (**MOD PARAMETER**)
- selection of modulation mode (**MOD MODE**)
- keys to change numerical values in decade steps and for subrange selection (**±10 RANGE x10**)
- rotary knob to set values for:
  - frequency
  - DC offset voltage
  - output amplitude
  - modulation parameter
  - duty cycle
  - storage register number
  - device address for remote control (IEEE-488)
  - communication parameters (RS-232)
- keys to control sweep and burst (**SINGLE, CONT, HOLD**)
- key to select modulation or trigger signal source (**EXT**)
- keys to select duty cycle (**ASYM, 50%**)
- keys for storage registers (**STORE, RECALL**)
- key to inhibit and release the rotary knob (**DIAL LOCK**)
- key to select the output impedance (**LOW Zo**)

### 3.5.2 Control Elements, Display and Connectors

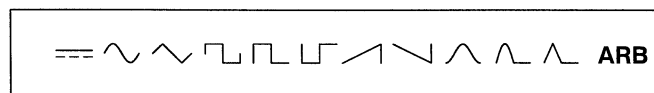
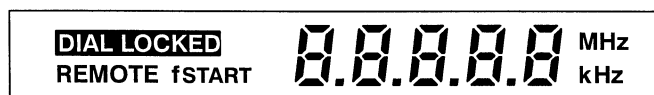
#### 3.5.2.1 Front Panel












Description	Function
<p><b>LOCAL</b></p> 	<p>Key to switch from remote control to keyboard operation.</p>
<p><b>ADDR</b></p> 	<p>Display and input of device address for remote control.</p>
<p><b>RESET</b></p> 	<p>Processor reset to initial state (use e.g. ball point pen).</p>
<p><b>FREQUENCY</b></p> 	<p>Keys to select frequency section and to select that digit which is to be altered by the rotary knob (resolution).</p>
<p><b>WAVEFORM</b></p> 	<p>Keys to select the signal waveform.</p>
<p><b>DC</b>      <b>AC</b></p> 	<p>Key to prepare input of DC offset voltage respectively AC output amplitude. Pressing the same key twice sets the value to zero.</p>
<p><b>MOD PARAMETER</b></p> 	<p>Keys to select modulation parameter.</p>
<p><b>MOD MODE</b></p> 	<p>Keys to select modulation mode.</p>
<p><b>÷10</b>      <b>x10</b></p> 	<p>Keys for altering numerical values in decades, e.g., for frequency or output amplitude.</p>
	<p>Rotary knob for setting and alteration of values for:</p> <ul style="list-style-type: none"> <li>– frequency</li> <li>– output amplitude</li> <li>– DC offset voltage</li> <li>– modulation parameter</li> <li>– stop frequency for sweep</li> <li>– duty cycle</li> <li>– storage register number</li> <li>– device address (IEEE-488), interface configuration (RS-232)</li> </ul>

Description	Function
<p><b>SINGLE</b>      <b>CONT</b></p>   <p><b>HOLD</b></p> 	<p>Keys to start a sweep or burst, pressing the same key once more resets the sweep respectively burst.</p> <p>Key to stop a sweep at the present frequency. In MOD-OFF the key also serves</p> <ul style="list-style-type: none"> <li>– to stop and to release the output amplitude at its present value in the frequency range from 0.1 mHz to 1 Hz</li> <li>– to set the output amplitude to zero and back again in the frequency range from 1 Hz to 20 kHz.</li> </ul>
<p><b>EXT</b></p>  <p><b>ASYM</b>      <b>50%</b></p>   <p><b>STORE</b>      <b>RECALL</b></p>   <p><b>DIAL LOCK</b></p>  <p><b>LOW Zo</b></p> 	<p>Key to switch to external modulation or trigger source, pressing the key once more switches back to internal signal.</p> <p>Key for selection of duty cycle.</p> <p>Keys to store and to recall complete instrument settings (9 storage registers).</p> <p>Key to inhibit and to release the rotary knob.</p> <p>Key to select the output impedance (50 Ω or LOW Zo for amplitudes ≥ 2.0 V).</p>

**Display Section**

"▶" points to the selected display section



- **fSTART**: carrier frequency (also sweep start frequency) in MHz, kHz or Hz
- **DIAL LOCKED**: rotary knob inhibited
- **REMOTE**: remote control via interface
  
- signal waveforms
  -  DC voltage
  -  sine
  -  triangle
  -  square
  -  positive pulse
  -  negative pulse
  -  positive sawtooth
  -  negative sawtooth
  -  haversine
  -  sine pulse
  -  triangle pulse
  - ARB** freely programmable (instruments with IEEE-488 or RS-232 only)



Description

Function

DC OFFSET ACPP LOW Zo **-0.00** V

- **DC OFFSET** : DC offset voltage in volts
- **ACPP** : output amplitude in volts
- **LOW Zo** : output impedance

f MOD m DEV fSTOP T N φ **0.000** msDEG  
 SYMMETRY REG ADDR **%MkHz**

- Modulation parameter:
  - fMOD** : modulation frequency in Hz or kHz
  - m** : modulation depth AM in %
  - DEV** : frequency deviation FM in %
  - fSTOP** : stop frequency for sweep
  - T** : sweep time in seconds sweep mode -1-, -2-, -3-
  - N** : carrier periods per burst
  - φ** : start and stop phase for burst
- **SYMMETRY** : duty cycle 50 %
- **REG** : storage register
- **ADDR** : device address

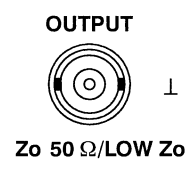
MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST  
 INT EXT-TRIG CONT SGLE **NOT TRIG'D HOLD**

- Modulation modes:
  - MOD-OFF** : modulation switched off
  - AM** : amplitude modulation
  - FM** : frequency modulation
  - PSK** : phase shift keying
  - GATE** : gating
  - LIN-SWP** : linear sweep
  - SWP-LOG** : logarithmic sweep
  - BURST** : burst
  - INT** : internal modulation
  - EXT-TRIG** : external modulation or trigger signal source
  - CONT** : continuous sweep or burst
  - SGLE** : single sweep or burst
- **NOT TRIG'D** : trigger status
- **HOLD** : HOLD key pressed

VAR SYMMETRY VAR DC OFFSET




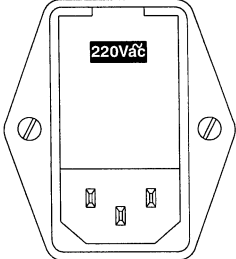
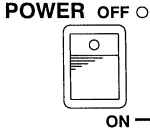





- **VAR SYMMETRY** : duty cycle not 50 %
- **VAR DC OFFSET** : DC voltage added to output signal

Connectors:



Signal output:  
 short-circuit proof, max. external voltage:  
 ±15 V up to 3 min, Zo 50 Ω  
 ±12 V up to 3 min, LOW Zo

### 3.5.2.2 Rear Panel

Description	Function
<b>INPUTS</b>	
<b>REFERENCE</b>	
	External reference frequency input.
<b>MOD/TRIG</b>	
	External modulation or trigger signal input.
	IEEE-488 or RS-232 connector for remote control.
	Mains input socket with fuse and voltage selector.
	Power switch
<b>OUTPUTS</b>	
<b>10MHz</b>	
	10 MHz internal reference frequency output for synchronization purposes
<b>MOD</b>	
	Internal modulation or keying signal output.
<b>PEN LIFT</b>	
	Signal output, e.g. to control a plotter pen during sweep.
<b>SWEEP</b>	
	Sweep voltage output (0 – 10 V, proportional to sweep frequency).
<b>TTL</b>	
	TTL signal output (frequency as output signal).

**3.5.3 Keyboard Input**

The instrument can be controlled via the keyboard or via remote control. When you are working via the remote control, the keyboard is inhibited and REMOTE lights up on the display.

Operational errors will not cause damage to the instrument. Set values are carried out immediately. The instrument does not have an ENTER key. The signal output is short-circuit proof and is protected for up to 3 minutes against external voltages up to ±15 V. Any illegal input values or combinations are shown by the illegal parameters flashing on the display. The instrument automatically returns to the last valid setting.

Data can be input in any order. Values that have been input earlier and don't need to be changed do not need to be input again.

**3.5.3.1 Input Formats**

**Frequency**

Frequency Subranges	Maximum Resolution	Display
0.1 mHz ... 0.2 Hz	0.1 mHz	0 . X X X X Hz
1 mHz ... 2 Hz	1 mHz	★ . X X X Hz
10 mHz ... 20 Hz	10 mHz	★ X . X X Hz
100 mHz ... 200 Hz	100 mHz	★ X X . X Hz
1 Hz ... 2 kHz	1 Hz	★ . X X X kHz
10 Hz ... 200 kHz	10 Hz	★ X X . X X kHz
100 Hz ... 2 MHz	100 Hz	★ . X X X X MHz
1 kHz ... 20 MHz	1 kHz	(#) X . X X X MHz

**Output Amplitude** (Zo 50 Ω, open circuit)

Subranges	Resolution	Display
0 V ... 0.2 V	1 mV	. ★ X X V
0.2 V ... 2 V	10 mV	★ . X X V
2 V ... 20 V	100 mV	★ X . X V

**DC offset voltage** (Zo 50 Ω, open circuit)

Range	Resolution	Display
- 10.0 V ... + 10.0 V	0.1 V	(-)(1) X . X V

"★" = digits 0, 1, 2  
 "X" = digits 0 to 9  
 "#" = digits 1 or 2

The ranges of the modulation parameters are listed together with the examples of the modulation modes.

### 3.5.4 Frequency Setting

WAVEFORM	Symbol	Frequency Range	Amplitude Range (Zo 50 Ω, open circuit) max. resol. 1 mV
sine		0.1 MHz – 20 MHz	0 – 20 V
triangle		0.1 MHz – 500 kHz	0 – 20 V
square		0.1 MHz – 20 MHz	0 – 20 V
pos. pulse 1)		0.1 MHz – 20 MHz	0 – 10 V
neg. pulse 1)		0.1 MHz – 20 MHz	0 – 10 V
pos. sawtooth		0.1 MHz – 50 kHz	0 – 10 V
neg. sawtooth		0.1 MHz – 50 kHz	0 – 10 V
haversine		0.1 MHz – 50 kHz	0 – 10 V
sine pulse		0.1 MHz – 50 kHz	0 – 10 V
triangle pulse		0.1 MHz – 50 kHz	0 – 10 V
arbitrary 2)	<b>ARB</b>	0.1 MHz – 20 kHz	0 – 20 V
<b>MODULATION</b>			
amplitude modulation	<b>AM</b>	0.1 MHz – 20 MHz	0 – 20 V 3)
frequency modulation	<b>FM</b>	0.1 MHz – 20 MHz	0 – 20 V
phase shift keying	<b>PSK</b>	0.1 MHz – 20 MHz	0 – 20 V
gate	<b>GATE</b>	0.1 MHz – 20 MHz	0 – 20 V
sweep	<b>SWP</b>	1 MHz – 10 MHz 50 kHz – 20 MHz	0 – 20 V
burst 4)	<b>BURST</b>	0.1 MHz – 2 MHz	0 – 20 V

1) 10 MHz for LOW Zo

2) instruments with IEEE-488 or RS-232 only

3) carrier amplitude reduced by 6 dB

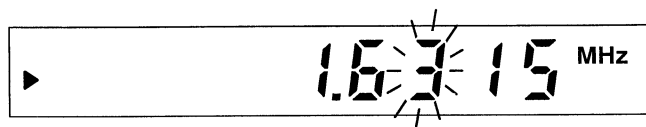
4) the lower frequency in continuous burst mode depends on ON-periods and repetition frequency

The frequency can be input when the symbol "►" appears at the front of the frequency display section. If it is at the front of another field, press one of the FREQUENCY ◀▶ keys.

#### Example:

Key Operation

Display Shows



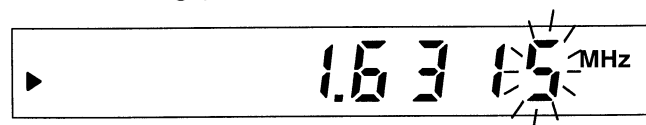
When the "3" flashes, the rotary knob can be used to change the frequency at a resolution of 0.01 MHz within this frequency subrange.

If a different resolution is required, press one of the FREQUENCY ◀▶ keys until the digit in the required decimal place flashes,

for example resolution 100 Hz (max. resolution in this range)



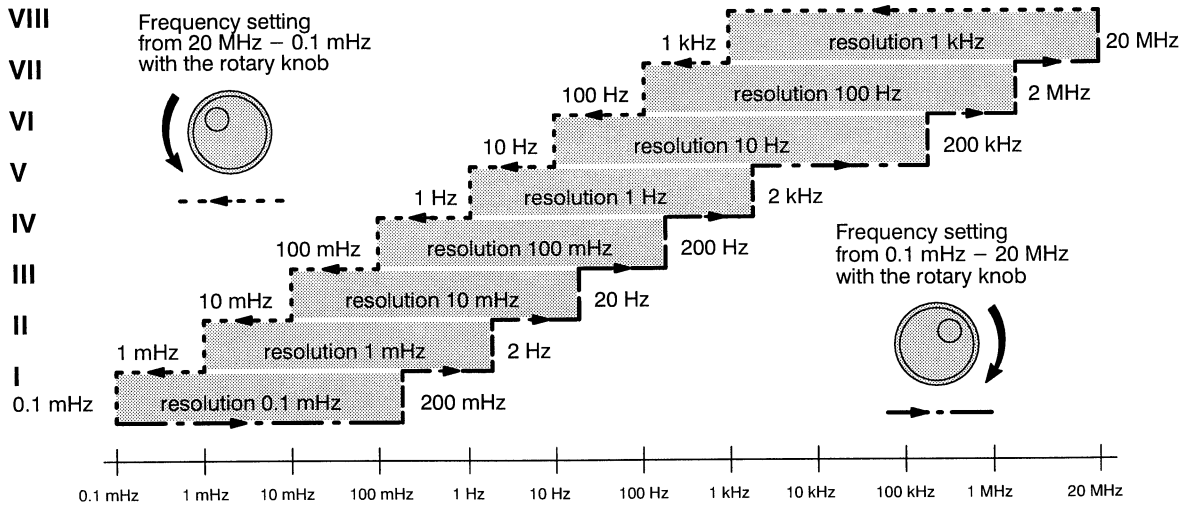
▶ 3 times



The subrange in which the instrument is operating is shown by the digits behind the decimal point in conjunction with the unit of measure. In this example it is the range 100 Hz to 2 MHz. See the Frequency Table under Section 3.5.3.1.

**Frequency range 0.1 mHz – 20 MHz**

Subranges:



If in a subrange the maximum resolution is chosen, e.g., 0.1 mHz (rightmost digit) in subrange I, the instrument automatically selects the maximum resolution of the next range when passing the limits to the next range.

Press the RANGE keys  $\pm 10 \times 10$  to divide or multiply the frequency by the factor 10. Use the rotary knob for fine frequency settings.

**Example: 125.5 Hz**

Key Operation	Display Shows
	e.g.
$\pm 10$	
4 times	
<b>FREQUENCY</b> 	
press until the rightmost "0" flashes (max. resolution)	
fast	
slow	
stepwise	




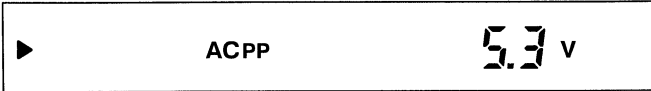
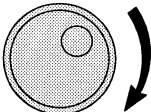
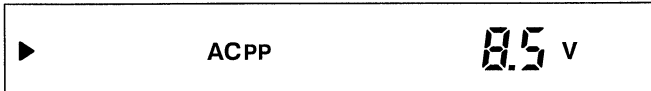
The key DIAL LOCK prevents the set value from being incidentally altered if the rotary knob is touched. The text DIAL LOCKED will appear in the display. Pressing the key DIAL LOCK once more will release the knob again.

### 3.5.5 Setting Output Amplitude

Pressing the key AC will set the symbol "▶" in the third section of the display, and the present value will appear. The rotary knob can now be used to set another value.

The coarse setting is done as for the frequency setting using the keys  $\div 10$   $\times 10$ .

**Example:** Output amplitude 8.5 V

Key Operation	Display Shows
<p>AC</p> 	
<p>x10</p>  (if required)	
	

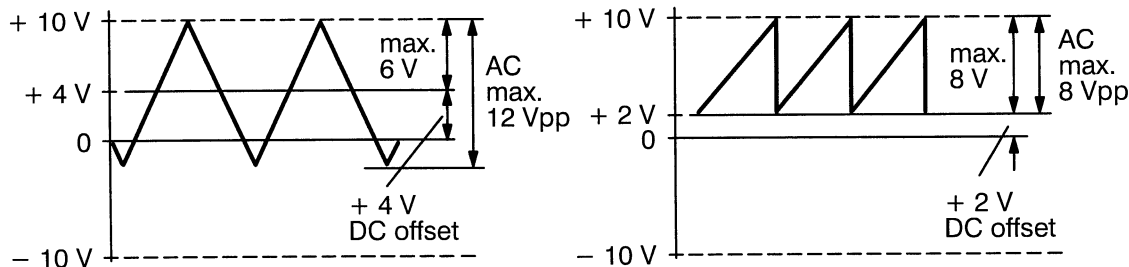
Operating the AC key several times sets the value to zero and back again to the value set; this corresponds with the function "AC OFF".

### 3.5.5.1 Input of the DC Offset Voltage

A DC voltage of  $-10\text{ V}$  to  $+10\text{ V}$  ( $Z_o$   $50\ \Omega$ , open circuit) can be added to the AC signal.

The text VAR DC OFFSET appears in the display.

Please note that the total output voltage (AC and DC) cannot exceed  $\pm 10\text{ V}$ .


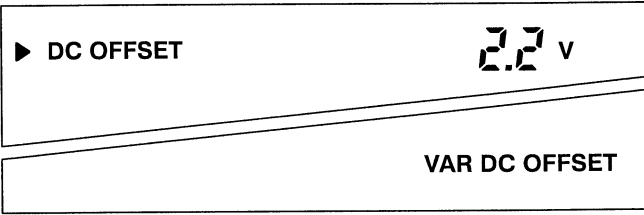
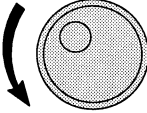
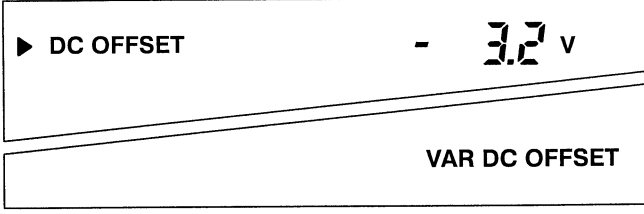

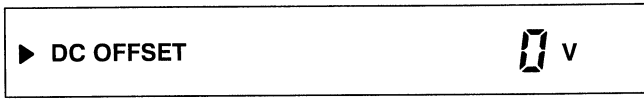

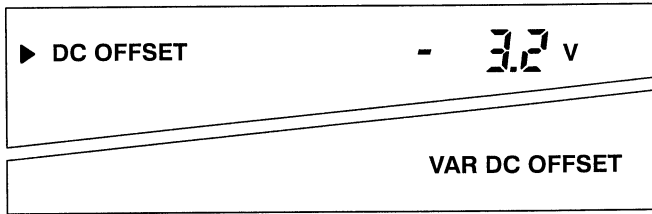


If the permissible setting range is exceeded, "DC OFFSET" and "ACPP" will flash in the display. The instrument will automatically return to the last permissible setting.

The offset is input with the key DC in the same way as the output amplitude has been input (Section 3.5.5).

Pressing the DC key again sets the previously selected offset value to zero.

#### Example:

Key Operation	Display Shows
<p>DC</p> 	
	
<p>DC</p> 	
<p>DC</p> 	

### 3.5.6 Selection of the Signal Waveform


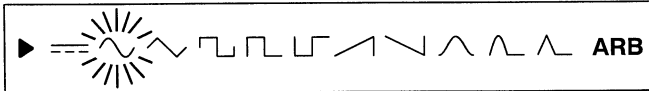

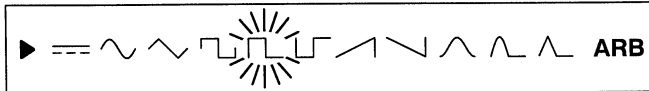
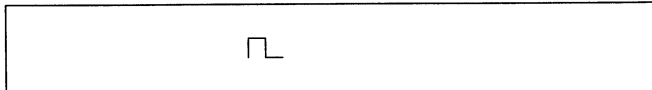
Press WAVEFORM ◀ ▶ keys to set the symbol "▶" to the second section of the display; the symbols of the selectable waveforms appear, the waveform that is currently set flashes.

Continue to press the WAVEFORM ◀ ▶ key to select the required waveform. During selection the flashing waveform is available at the signal output.

The waveform flashes 10 times, then the display only shows the symbol of the selected waveform.

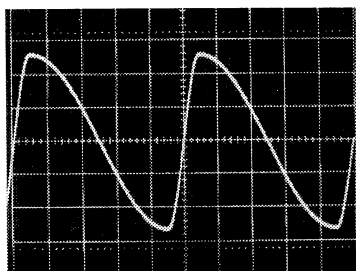
Note the frequency and amplitude limits of the waveforms in the tables in Section 3.5.3.1. Unallowed combinations are shown by flashing of the respective settings. The instrument then automatically returns to the last permissible selected waveform.

#### Example: Selection of positive pulses

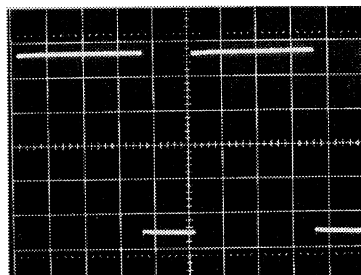
Key Operation	Display Shows
<p>WAVEFORM</p> 	
<p>WAVEFORM</p> <p>▶  3 times</p>	
<p>after 10 flashes</p>	

After pressing the ASYM key, the asymmetry (duty cycle) of all waveforms shown below can be set by the rotary knob.

sine	1 % to 99 %	up to 20 kHz
triangle	1 % to 99 %	up to 20 kHz
square	1 % to 99 %	up to 20 kHz
square pulse	1 % to 99 %	up to 20 kHz
additionally: square	20 % to 80 %	20 kHz to 5 MHz
square pulse	20 % to 80 %	20 kHz to 5 MHz



sine, 10 kHz, 20 %



square, 1 MHz, 70 %

Reset to symmetrical waveform is done by the key 50 %.



### 3.5.7 Modulation Modes

The frequency and amplitude range limits of the modulated signal also apply to all modulation modes, except sweep and burst (see Section 3.5.4).

The operation is similar to that for the waveform selection.

Press the MOD MODE ◀ ▶ key to move the symbol "▶" to the fifth section of the display. The abbreviations of the selectable modulation modes appear. The present one set or MOD-OFF flashes.

Continue to press the MOD MODE ◀ ▶ key to set the required mode; during selection the flashing mode is available at the signal output.

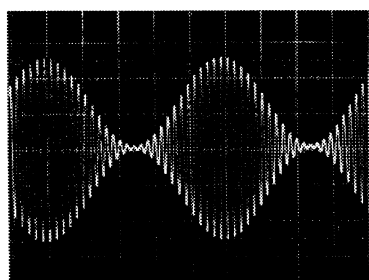
The symbol flashes 10 times, then the display shows the selected modulation mode.

The MOD PARAMETER ◀ ▶ keys are used to set the modulation parameters shown in the section above, which can be set to the required value by turning the rotary knob.

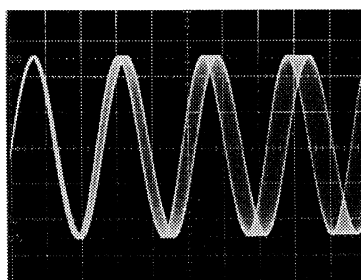
Modulation frequency range: 10 Hz – 100 kHz for AM, FM, PSK, GATE, BURST

Subranges:	100 kHz – 1 kHz,	resolution	100 Hz
	1 kHz – 100 Hz,	resolution	10 Hz
	100 Hz – 10 Hz,	resolution	1 Hz

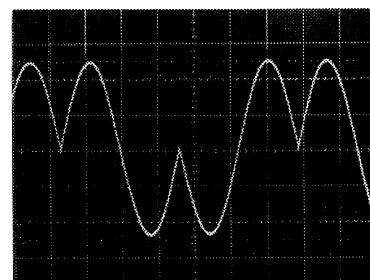
Additional for BURST:	10 Hz – 1 Hz,	resolution	0.1 Hz
	1 Hz – 0.1 Hz,	resolution	0.01 Hz
	0.1 Hz – 0.001 Hz,	resolution	0.001 Hz



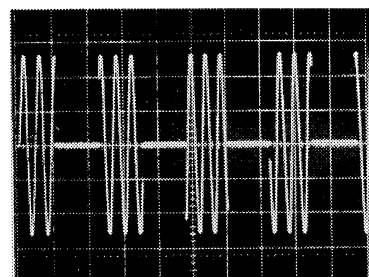
AM



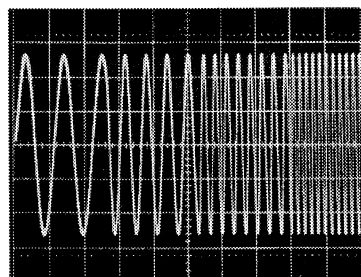
FM



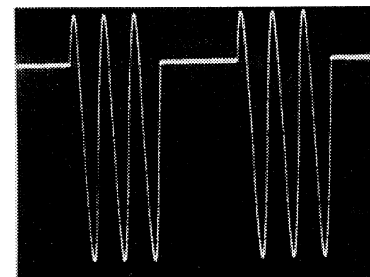
PSK



GATE



LIN SWEEP



BURST

**3.5.7.1 Amplitude Modulation (AM)**

internal:	modulation frequency	10 Hz – 100 kHz
	modulation depth (m)	0 – 100 %, resolution 1 %
external:	modulation frequency	0 – 200 kHz
	modulation depth	0 – 100 %
		( $\Delta$ external voltage 0 – 1 V)

**Example:** Amplitude modulation, internal, modulation frequency 2 kHz, mod. depth 30 %.  
 For frequency, waveform, and output amplitude settings, see Sections 3.5.4 to 3.5.6.

Key Operation	Display Shows
e.g.	MOD-OFF
	▶ MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST
	▶ MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST INT
	▶ f MOD m DEV fSTOP T N $\phi$ 10 kHz
	▶ f MOD 2.0 kHz
	▶ f MOD m DEV fSTOP T N $\phi$ 85 %
	▶ m 30 %
Turn off the modulation mode:	
	▶ MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST INT
	▶ MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST
	MOD-OFF

To modulate the carrier by an external modulation signal, select AM, press the EXT key, and feed a signal via the MOD/TRIG socket on the rear panel.







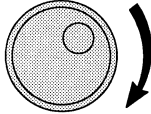


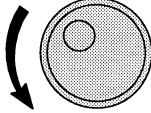




Press the EXT key once more to switch the instrument back to the internal modulation signal source.

**3.5.7.2 Frequency Modulation (FM)**

Internal: modulation frequency 10 Hz – 100 kHz  
 frequency deviation (DEV) 0 – 2 %, resolution 0.01 %

External: modulation frequency 10 Hz – 200 kHz  
 frequency deviation 0 – 2 %  
 (Δ external voltage 0 – 1 V)

**Example:** Frequency modulation, modulation frequency 150 Hz, internal, deviation 1.5 %.  
 For frequency, waveform, and output amplitude settings, see Sections 3.5.4 to 3.5.6.

Key Operation	Display Shows
e.g.	<div style="border: 1px solid black; padding: 5px; text-align: center;">MOD-OFF</div>
<p><b>MOD MODE</b></p> 	<div style="border: 1px solid black; padding: 5px; text-align: center;">  MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST                 </div>
<p><b>MOD MODE</b></p>  2 times	<div style="border: 1px solid black; padding: 5px; text-align: center;">  MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST INT                 </div>
<p><b>MOD PARAMETER</b></p> 	<div style="border: 1px solid black; padding: 5px; text-align: center;">  f MOD m DEV fSTOP T N φ <span style="float: right;">2.0 kHz</span> </div>
	<div style="border: 1px solid black; padding: 5px; text-align: center;">                     f MOD <span style="float: right;">0.15 kHz</span> </div>
<p><b>MOD PARAMETER</b></p>  2 times	<div style="border: 1px solid black; padding: 5px; text-align: center;">  f MOD m DEV fSTOP T N φ <span style="float: right;">2.00 %</span> </div>
	<div style="border: 1px solid black; padding: 5px; text-align: center;">                     DEV <span style="float: right;">1.50 %</span> </div>
<p>Turn off the modulation mode:</p> <p><b>MOD MODE</b></p> 	<div style="border: 1px solid black; padding: 5px; text-align: center;">  MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST INT                 </div>
<p><b>MOD MODE</b></p>  2 times	<div style="border: 1px solid black; padding: 5px; text-align: center;">  MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST                 </div>
	<div style="border: 1px solid black; padding: 5px; text-align: center;">MOD-OFF</div>

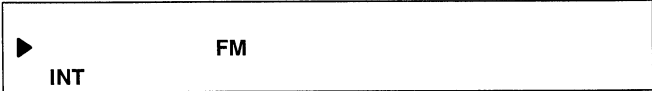

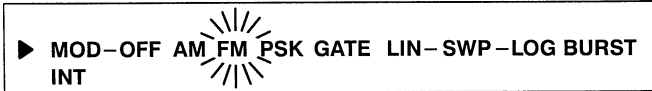



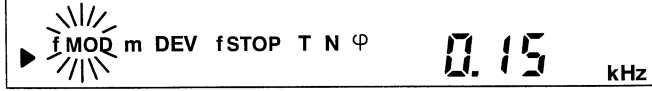
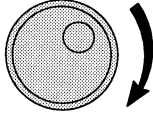
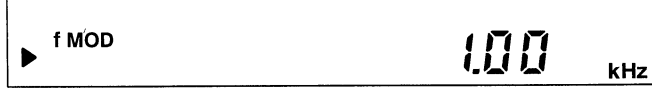

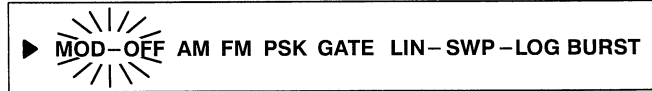

To modulate the carrier by an external modulation signal, select FM, press the EXT key, and feed a signal via the MOD/TRIG socket on the rear panel.

Press the EXT key once more to switch the instrument back to the internal modulation signal source.

### 3.5.7.3 Phase Shift Keying (PSK)

Signal waveforms:	sine, triangle, square
Internal: Keying frequency (f <sub>MOD</sub> ) duty cycle	10 Hz – 100 kHz 50 %, fixed
External: Keying frequency duty cycle	0 – 200 kHz depends on external signal

**Example:** Carrier frequency 32 kHz, sine, with phase shift keying, keying frequency 1 kHz.  
For frequency, waveform, and output amplitude settings, see Sections 3.5.4 to 3.5.6.

Key Operation	Display Shows
e.g.	
	
	
	
	
Turn off the modulation mode: 	
Press and release until MOD-OFF flashes	

For external signal keying select PSK, press the EXT key, and feed a TTL signal via the MOD/TRIG socket on the rear panel.

Press the EXT key once more to switch the instrument back to the internal keying signal source.

3.5.7.4 Modulation Mode GATE

Internal:	Keying frequency (f <sub>MOD</sub> ) duty cycle	10 Hz – 100 kHz 50 %, fixed
External:	Keying frequency duty cycle	0 – 200 kHz depends on external signal

**Example:** Carrier frequency 30 kHz, sine, with on/off keying, keying frequency 10 kHz.  
For frequency, waveform, and output amplitude settings, see Sections 3.5.4 to 3.5.6.

Key Operation	Display Shows
e.g.	
Turn off the modulation mode:	
Press and release until MOD-OFF flashes	

For external signal keying select GATE, press the EXT key, and feed a TTL signal via the MOD/TRIG socket on the rear panel.

Press the EXT key once more to switch the instrument back to the internal keying signal source.

**3.5.7.5 Modulation Mode SWEEP**

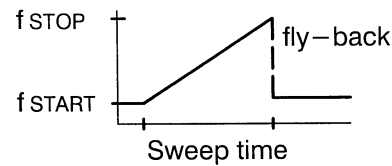
Max. sweep ranges: 1 mHz – 10 MHz  
(f<sub>START</sub> to f<sub>STOP</sub>) 50 kHz – 20 MHz

Sweep time: 10 ms – 1000 s

Subranges: 10 ms – 10.00 s resolution 0.01 s  
10 s – 100.0 s resolution 0.1 s  
100 s – 1000 s resolution 1 s

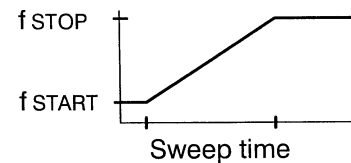
Sweep characteristic: linear (LIN-SWP)  
logarithmic (SWP-LOG)

Modes:



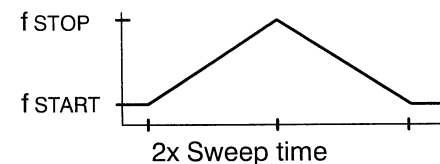
– 1 –

Sweep runs from f<sub>START</sub> to f<sub>STOP</sub>  
fly-back to f<sub>START</sub>.



– 2 –

A single sweep runs from f<sub>START</sub>  
to f<sub>STOP</sub> and remains at f<sub>STOP</sub>.  
Pressing key SINGLE, CONT or HOLD  
resets the sweep to f<sub>START</sub>.



– 3 –

Sweep runs from f<sub>START</sub> to f<sub>STOP</sub>  
and back to f<sub>START</sub>.

The start frequency is shown in the upper display section and set as explained in Section 3.5.4 (Frequency Setting).

The stop frequency is selected in the modulation parameter row using the MOD PARAMETER ◀▶ keys, then it is set by the rotary knob.

Frequency Subranges	Maximum Resolution	Display
1 mHz to 2 Hz	1 mHz	★ . X X X Hz
2 Hz to 20 Hz	10 mHz	★ X . X X Hz
20 Hz to 200 Hz	100 mHz	★ X X . X Hz
200 Hz to 2 kHz	1 Hz	★ . X X X Hz
2 kHz to 20 kHz	10 Hz	★ X . X X kHz
20 kHz to 200 kHz	100 Hz	★ X X . X kHz
200 kHz to 2 MHz	1 kHz	★ . X X X kHz
2 MHz to 20 MHz	10 kHz	# X . X X MHz

”★” = digits 0, 1, 2  
”X” = digits 0 to 9  
”#” = digits 1 or 2

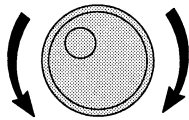
The MOD PARAMETER ▶ key allows the sweep time (T) to be selected in the same row, then set by the rotary knob.

The MOD MODE ◀▶ keys allow the sweep characteristic to be selected in the lower section (LIN-SWP or SWP-LOG). The set sweep mode – 1 –, – 2 – or, – 3 – appears in the row above for about 5 seconds. It can be changed while being displayed using the rotary knob.

**Example:** fSTART 200 kHz, fSTOP 2 MHz, sweep time 3 s, linear, mode – 3 –



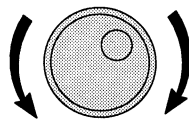
Prepare frequency input, select resolution.



Set start frequency (200 kHz).



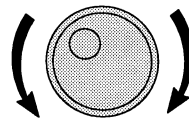
Select fSTOP.



Set stop frequency (2 MHz).



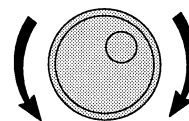
Select sweep time (T).



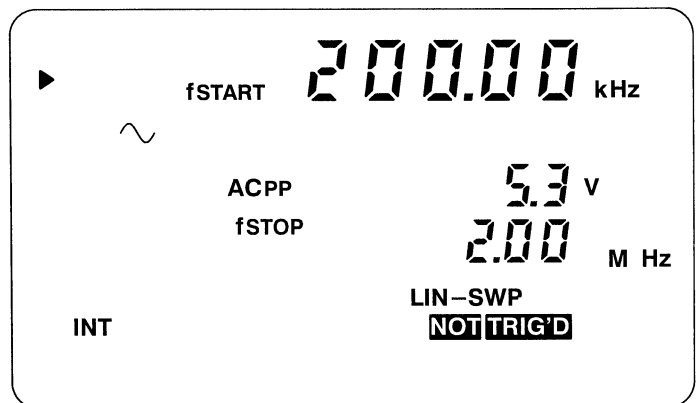
Set sweep time (3 s).



Select sweep characteristic (LIN-SWP) and set sweep mode (– 3 –).



The display now shows:



Start the sweep with the SINGLE key for a single sweep, or with the CONT key for a continuous sweep. The keyboard is inhibited during sweep so that no further input is possible. Pressing the SINGLE or CONT keys once more resets the running sweep. The letters "NOT TRIG'D" appear again. To leave Sweep modulation mode, select MOD-OFF.

If the SINGLE key is pressed **during continuous sweep**, the frequency is reset to  $f_{START}$ , and a single sweep is started.

If the CONT key is pressed **during a single sweep**, the frequency will also be reset to  $f_{START}$ , and a continuous sweep is started.

The HOLD key stops the sweep at its present frequency.  
This frequency is shown in the upper display section.  
Press the HOLD key once more and the sweep continues.

For external triggering of the sweep, press the EXT key and feed a TTL signal via the MOD/TRIG socket at the rear panel.

The positive-going edge of the signal starts the sweep. When sweep is running, the external signal is ignored.

In **sweep mode – 2 –**, the sweep remains at the stop frequency after the sweep time has elapsed. The next positive-going edge of the signal sets the sweep back to the start frequency, and the following positive-going edge starts the sweep again.

If the TTL-signal is 'high' when the sweep reaches the stop frequency, the sweep is immediately reset.

Pressing the SINGLE or CONT keys switches the instrument to the internal trigger signal source.

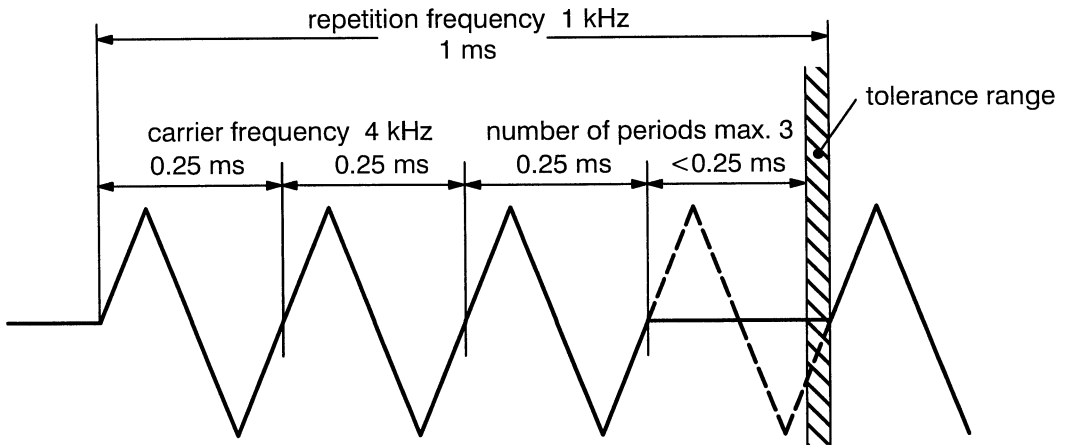
### 3.5.7.6 Modulation Mode BURST

Carrier frequency:	max. 2 MHz	
Start/stop phase:	– 180° to + 180°, resol. 1°; 0°	sine and triangle, ≤ 20 kHz general
Carrier periods per burst:	1 – 2000	
Repetition frequency ( $f_{MOD}$ )		
– internal:	1 MHz – 100 kHz	
– external:	0 – 200 kHz	

Note that when setting the carrier frequency respectively the repetition frequency for a continuous burst the last period of the burst packet must have come to an end before the next burst packet starts.

e.g.:	repetition frequency	500 Hz	(2 ms per burst)
	periods per burst	1000	(2 μs per period), i.e.
	carrier frequency	>500 kHz	(one period < 2 μs)
or	repetition frequency	1 kHz	(1 ms per burst)
	carrier frequency	4 kHz	(0.25 ms per period)
	number of periods	max. 3	(duration of a burst packet < 1 ms)





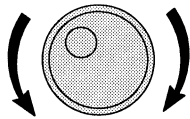
**Example:** carrier frequency 18 kHz, sine, repetition frequency (fMOD) 1 kHz, periods per burst (N) 10, start-/stop phase ( $\phi$ ) 45 degrees.

For frequency, waveform, and output amplitude settings, see Sections 3.5.4 to 3.5.6.

**MOD PARAMETER**



Select repetition frequency (fMOD)

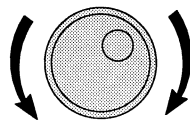


and set to 1 kHz.

**MOD PARAMETER**



Select periods per burst (N)

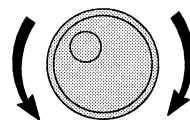


and set to 10.

**MOD PARAMETER**



Select start-/stop phase ( $\phi$ )



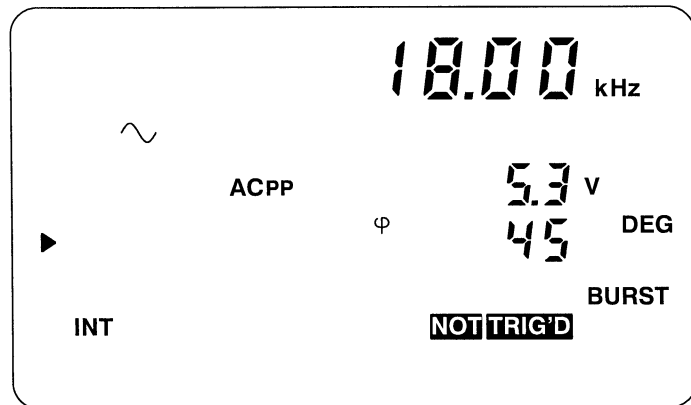
and set to 45 degrees (DEG).

**MOD MODE**



Select BURST

The display now shows:



The SINGLE key starts a single and the CONT key starts a continuous burst.

Parameters can be changed within the allowed ranges during running burst.

Pressing the SINGLE or CONT keys once more switches the burst off.

To leave the modulation mode burst, select MOD-OFF.

For external triggering select BURST, press the EXT key and feed a TTL signal via the MOD/TRIG socket at the rear panel. The negative-going edge starts the burst.

During running burst packets external trigger pulses are ignored.

Pressing the SINGLE, CONT, or EXT keys switches the instrument back to the internal trigger signal source.

### 3.5.8 Store and Recall of Instrument Settings

Nine complete instrument settings can be stored into storage registers 1 to 9. The actual operating mode is automatically stored separately. The registers are battery-buffered so that the settings are not lost when the instrument is turned off.

When the instrument is turned on again, it will run through its self-test routine, then return to the operating mode it was set to before it was turned off.

#### Store

Storage is done by pressing the STORE key. REG will appear in the display together with a digit from 1 to 9 for the storage register number. The rotary knob can now be used to select the register number where the displayed settings are to be stored.

Pressing the STORE key once more stores the settings into the selected register. Previous settings in that register are written over and thus are lost.

#### Recall

Stored settings are recalled by pressing the RECALL key. REG appears in the display with a register number. The entire display starts to flash. The settings stored in this register are shown but not yet carried out.

The rotary knob selects the register 1 to 9 and thus shows its contents. Press the RECALL key once more to activate the settings shown.

### 3.5.9 Error Messages, Operating Errors

When the instrument has been switched on it will automatically check the program memory, the processor RAM, the memory of actual settings and the storage registers 1 to 9 for the instrument settings. The data in the registers remain intact.

Next follows a test of the overload protection.

In instrument versions with the IEEE bus, the memory registers for the arbitrary waveforms (ARB) are also tested.

During operation the instrument checks the input of settings for their validity and range limits.

#### 3.5.9.1 Error Messages when Switching on

Errors the instrument detects after power-on are shown in the upper display section by "Err" followed by one digit.

The messages mean as follows:

<i>E r r</i> 1	checksum error, program memory (PROM)
<i>E r r</i> 2	RAM error, processor
<i>E r r</i> 3	defective memory of actual settings
<i>E r r</i> 4	defective storage registers 1 to 9
<i>E r r</i> 5	overload protection
<i>E r r</i> 6	frequency generation does not work
<i>E r r</i> 8	defective memory for arbitrary waveforms (ARB)
<i>E r r</i> 9	error during data transfer scope – generator

Errors 1 and 2 do not permit further operation. For errors 3, 4, or 8 operation is possible after the error message has been reset by pressing any key except LOCAL. In this case, however, it is no longer possible to store data into the respective register.

#### 3.5.9.2 Operating Hints, Operating Errors

Settings exceeding the permissible limits are shown by the respective parameters flashing. The instrument automatically returns to the last valid setting.

The error message "Err 5" during operation shows that the overload protection of the signal output has been activated. In this case remove the BNC cable from the output socket and check the measurement assembly.

Pressing any key except LOCAL resets the error message and releases the signal output again.

The error message "Err 9" shows data error in the data transfer from the storage oscilloscope to the generator for the arbitrary waveform (instruments with IEEE-488 or RS-232 only).

### 3.6 SPECIAL APPLICATION

Function generators with an IEEE-488 interface (PM5139/02) or RS-232 interface (PM5139/03) are able to read in a stored signal of a digital storage oscilloscope (DSO), store these in an internal EEPROM, and generate this signal as an output signal itself. Twenty-four different signals can be stored.

This allows you use the generator to reproduce single signals, such as spikes or contact bouncing when required for testing and measuring. You can also vary the frequency and / or the amplitude of the signal.

All that is needed for signal transfer is for the oscilloscope and the PM5139/02 or PM5139/03 to be connected together via an IEEE bus or a RS-232 cable. The transfer is carried out in the plotter language HPGL. A Fast Transfer Mode, depending on the oscilloscope, is possible via IEEE-488 interface. The DSOs PM 3382A, PM 3384A, PM 3392A, and PM 3394A also provide the Fast Transfer Mode via the RS-232 interface. You do not need a computer, nor do you need to set up programs or know special programming commands.

**Example:** Transfer of waveform data from a digital storage oscilloscope (PM 3350) to the PM 5139/02 via IEEE-488 bus.

Connect both instruments together using an IEEE bus cable and connect them to line power.

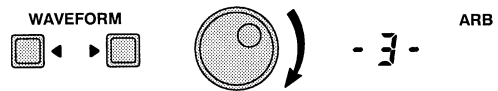
The oscilloscope as the Talker in the digital plot mode must be set to transfer the signal to plotter type PM 8153\_6 via the IEEE interface.

Set the generator to the ARB waveform, and use the rotary knob to select the memory location (1 to 24) where the signal will be stored.

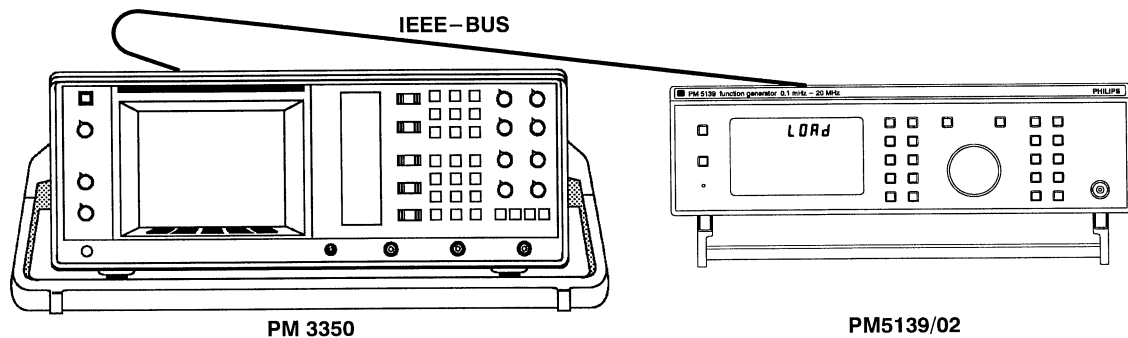
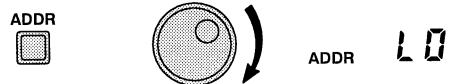
Set the generator to Listener Only by pressing the ADDR key and setting LO in the display.

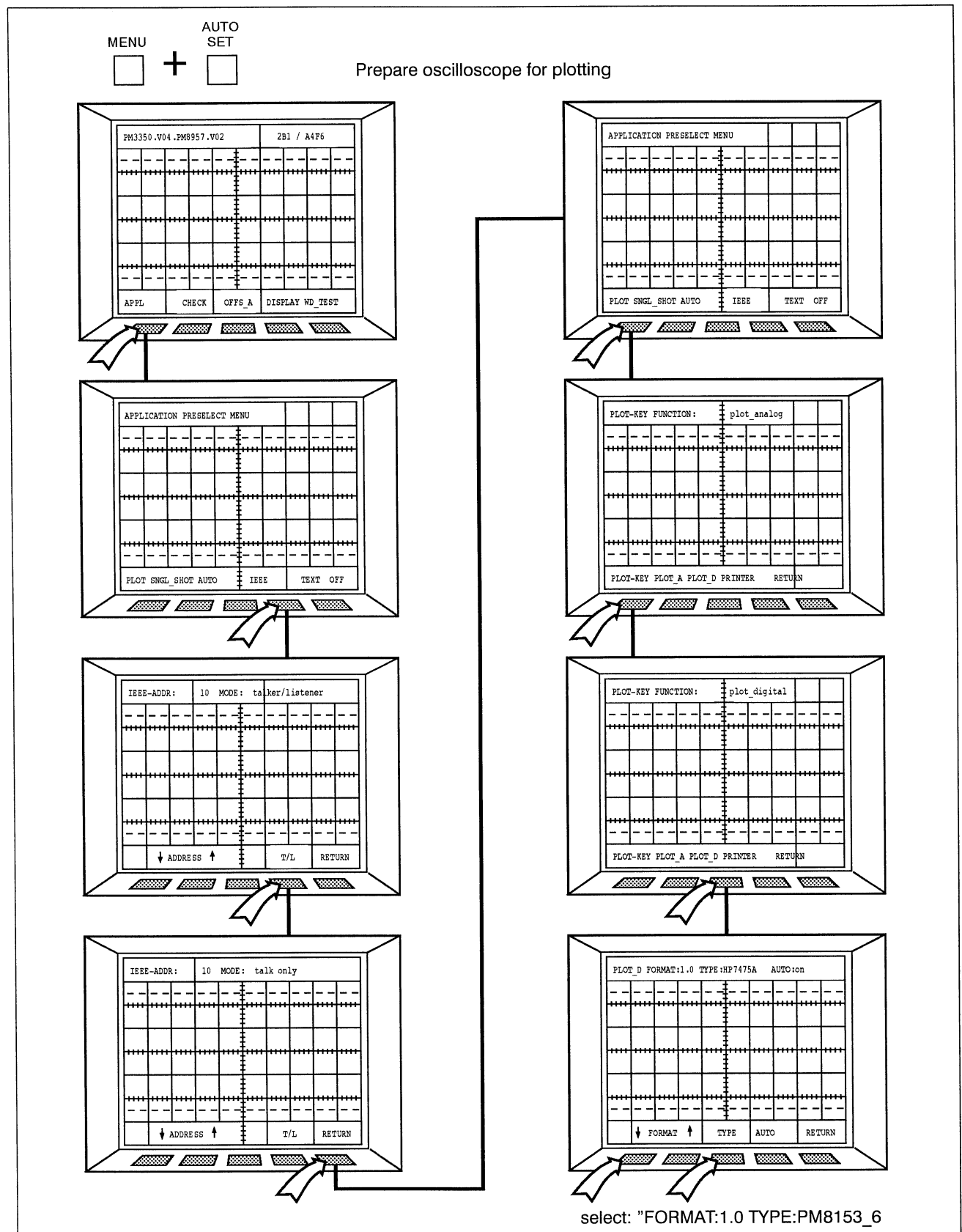
At the start of plotting (PLOT key on the scope), the generator shows the letters "LOAD" in the display as an indication that the transfer of data is in process. When the transfer of data is complete, the transferred signal is now available at the output of the generator. The amplitude and frequency of this signal can be altered within the permissible limits, whereby the relation of the maximum amplitude is proportional to the signal received from the screen of the scope. The full vertical range of the screen corresponds to the maximum voltage of 20 Vpp (open circuit voltage).

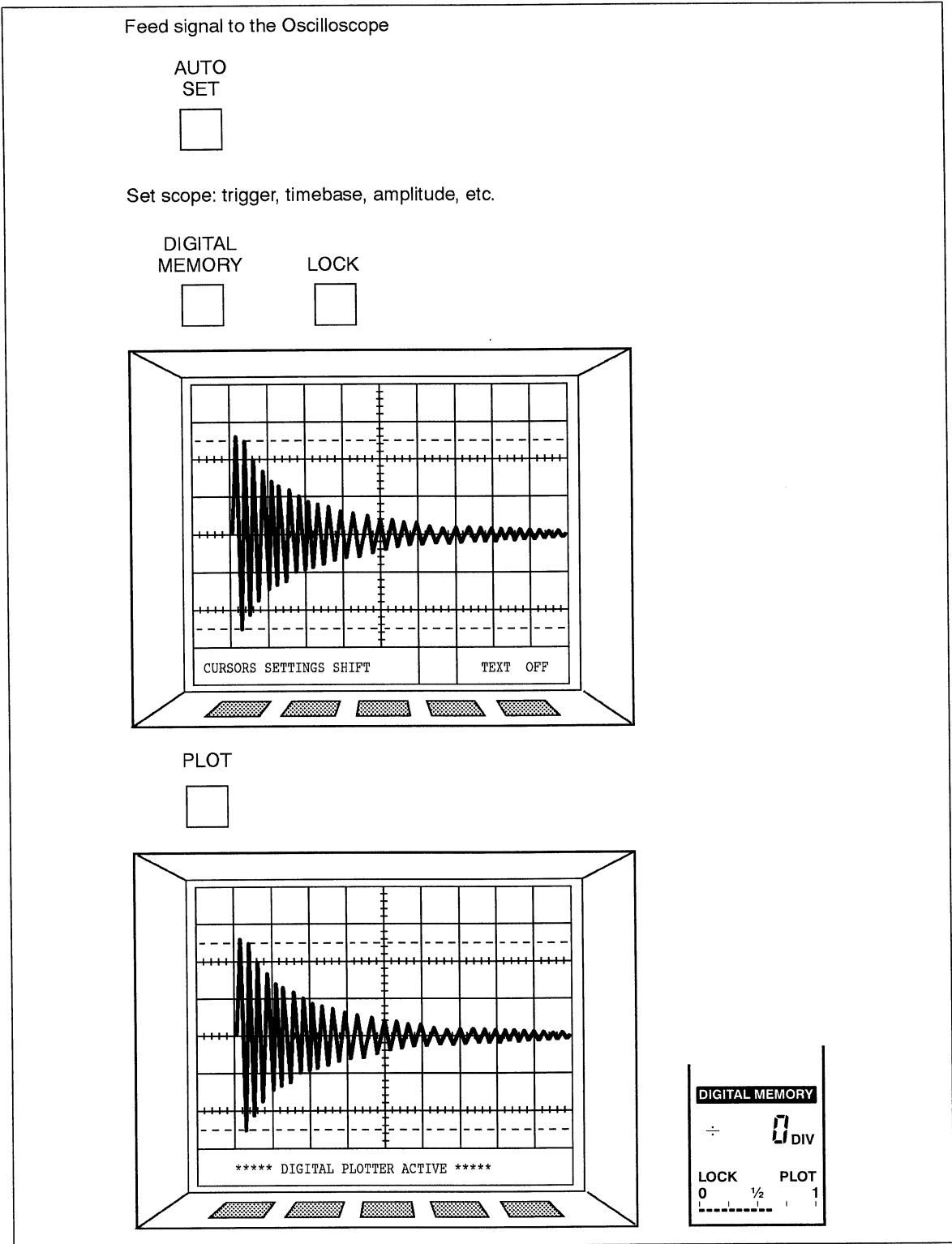
Select memory location:



Set device address of the generator to "LO":







The bargraph in the display of the oscilloscope shows the course of plotting, which in this case is the transfer of data to the generator. The display of the generator shows "LOAD" while the transfer is running. Once all data has been transferred, these letters are switched off and the generator returns to display the last setting. If the waveform ARB is selected now, the instrument will generate the signal transferred.

### 3.7 REMOTE CONTROL OF THE INSTRUMENT

#### 3.7.1 Introduction

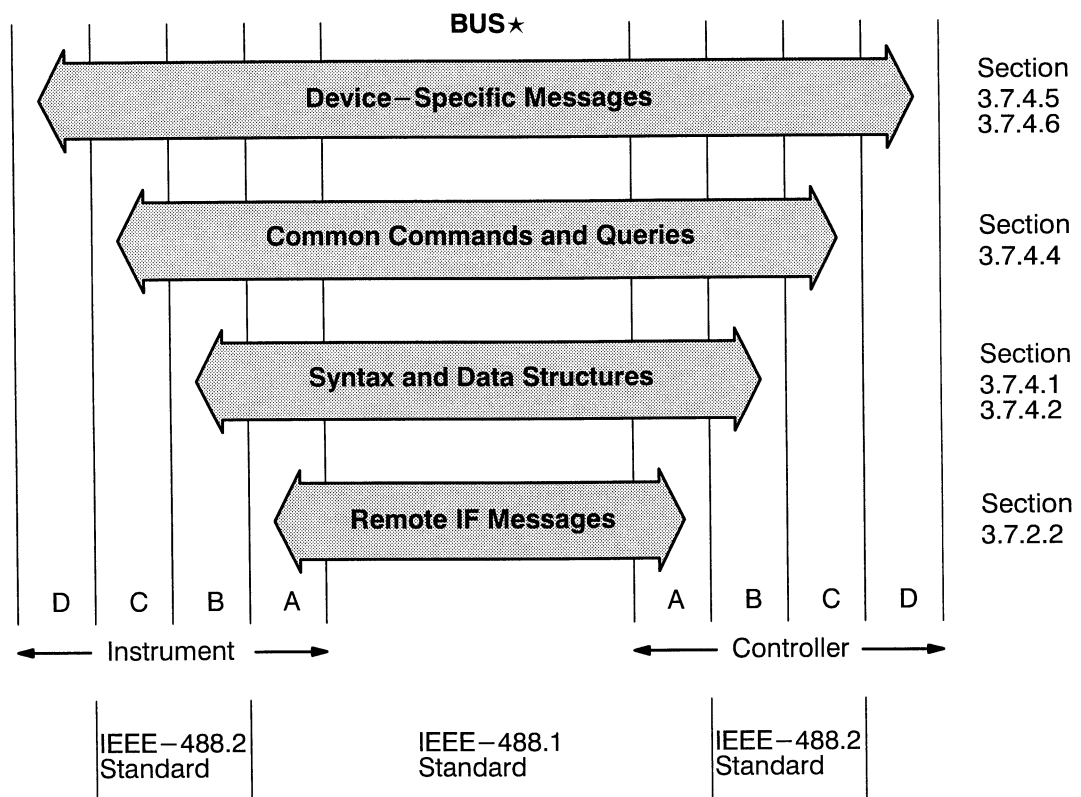
All instrument functions can be controlled via the IEEE-488 or RS-232 interface.

The information in this section assumes that you are acquainted with the operation of the instrument, modulation facilities, parameters, and limits. A detailed description with examples is included in Section 3.5.

In addition, data for a maximum of twenty-four arbitrary waveforms (ARB) can be sent to the generator by a controller, stored in EEPROMs. The arbitrary waveforms can be activated via remote control as well as directly via the generator keyboard.

#### 3.7.2 IEEE-488 Interface

In the following section the functions of the IEEE-488 bus interface are described. For commands, queries, syntax, and terminators, see Section 3.7.4.



- A = Interface functions
- B = Message communication functions
- C = Common system functions
- D = Device functions

\* This figure is in accordance with "IEEE Standard Codes, Formats, Protocols, and Common Commands" (ANSI/IEEE Std 488.2-1987).

### 3.7.2.1 Instrument Address

Remote control of the generator requires the instrument address to be known. Press the ADDR key to display the set address, and if necessary turn the rotary knob to select an address from 1 to 30 for remote control or LO for the "Listener Only mode" to transfer data from a Digital Storage Oscilloscope (DSO) directly to the generator without any PC or controller.

When the instrument is turned on, it is in 'local' mode (input via keyboard). When addressed as a listener by a controller, the text REMOTE appears in the display field. The rotary knob and all keys except LOCAL are locked and the instrument can now be operated in remote control. Return to local operation is done by the addressed command GTL (go to local) or by the LOCAL key. In order to avoid unintended return the LOCAL key can be disabled by the universal command LLO (local lockout).

### 3.7.2.2 Interface Functions

The following interface functions are implemented:

AH1: acceptor handshake	SR1: service request SRQ
SH1: source handshake	DC1: device clear function
L3: listener function	DT1: device trigger function
L1: listener only	PP0: no parallel poll
T6: talker function	C0: no control function
RL1: local/remote with local lockout	E2: tri-state drivers

Hardware, connections, and handshake procedure are in accordance with IEEE-488.1.



**3.7.3 RS-232 Interface**

**3.7.3.1 Instrument Configuration**

In the following section the functions of the RS-232 interface are described.

For commands, queries, syntax, and terminators, see Section 3.7.4.


In addition you can send data from a Digital Storage Oscilloscope (DSO) directly to the generator without any PC or controller.

Remote control of the instrument requires an interface communication configuration that matches that of your PC.

With the **ADDR** key, the current configuration can be displayed and altered by the rotary knob.

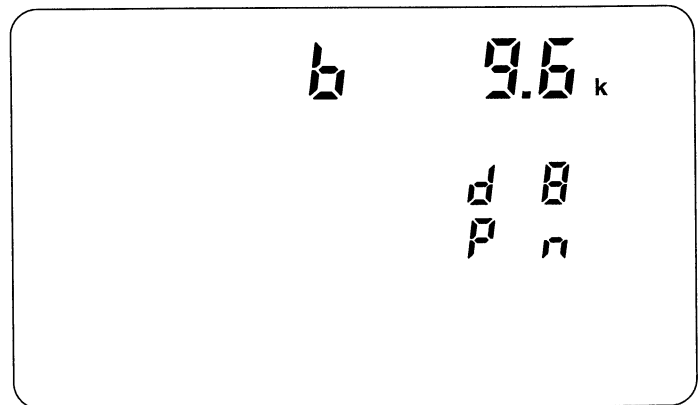
If you use the Fast Transfer Mode for data transfer from an oscilloscope 8 data bits must be set.

Pressing the **ADDR** key shows the current configuration:

Key Operation	Display shows
<p><b>ADDR</b></p> 	<p>Communication Mode (<b>Co</b>) or Listener Only Mode (<b>Lo</b>).</p>

With the rotary knob you can switch from Lo to Co.  
From Co to Lo you can only switch if 8 data bits are selected.

After two seconds the selected settings are displayed.

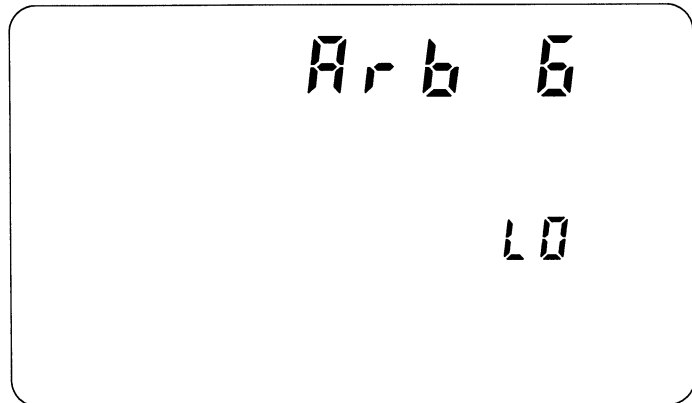


That means:  
**baud rate 9600, data bits 8, parity no.**

Key Operation

Display shows

In **Listener Only Mode** the display shows after three seconds:

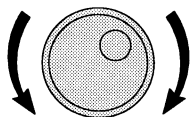
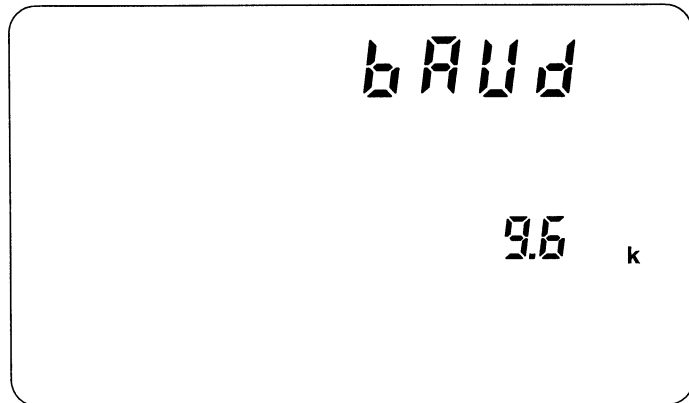


**Arb 6** means data transferred will be stored in ARB memory number six.

The instrument remains in this mode until the data transfer has been finished or any key (except ADDR and LOCAL) has been pressed.

In Communication Mode the instrument shows the current settings and returns to normal display after three seconds.

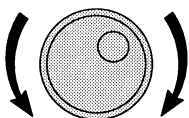
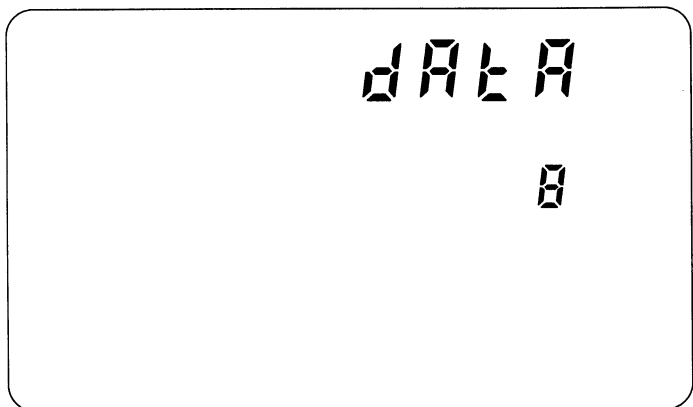
If you want different settings press the **ADDR** key again during display:



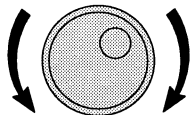
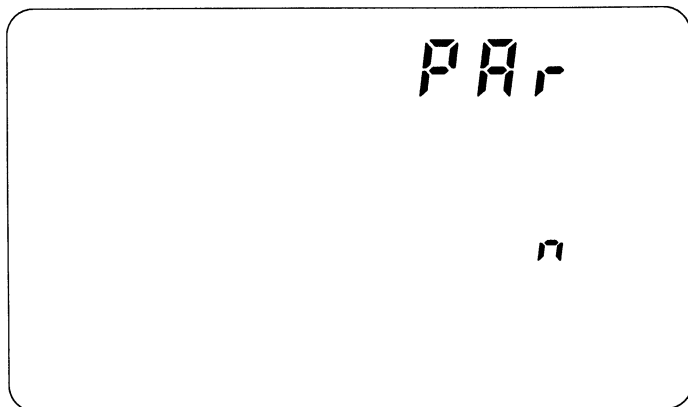
Select **baud** rate  
**110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200**  
for 110 baud 2 stop bits are set, otherwise 1 stop bit.

Key Operation

Display shows



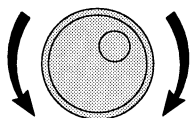
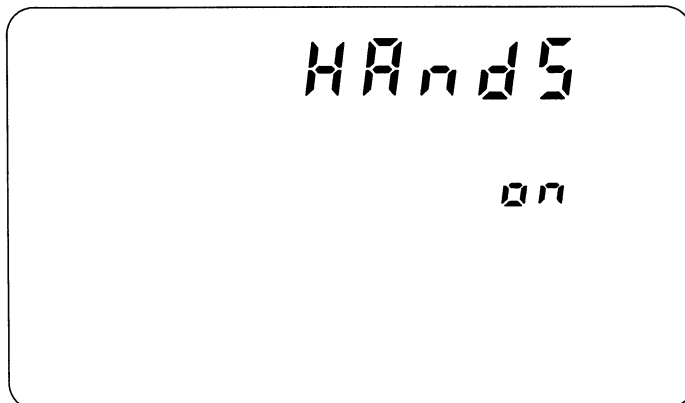
Select **data** bits **7** or **8**  
7 bits for parity **Even** or **Odd**.  
Fast Transfer Mode needs 8 data bits.



Select **parity Even**, **Odd** or **no**  
(parity **no** for 8 data bits only).

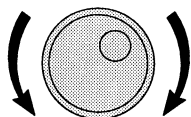
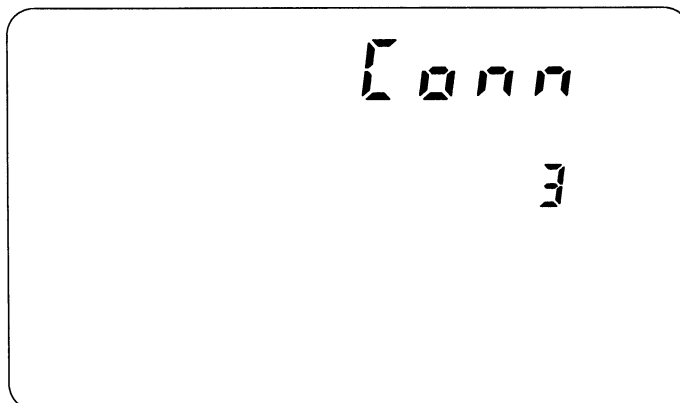
Key Operation

Display shows



Select Xon/Xoff **handshake on** or **off**.

For data transfer of more than 64 byte the handshake Xon/Xoff should be set to **on**.



Select **3** or **7** wire **connection**.

Press the **ADDR** key again to leave the mode.

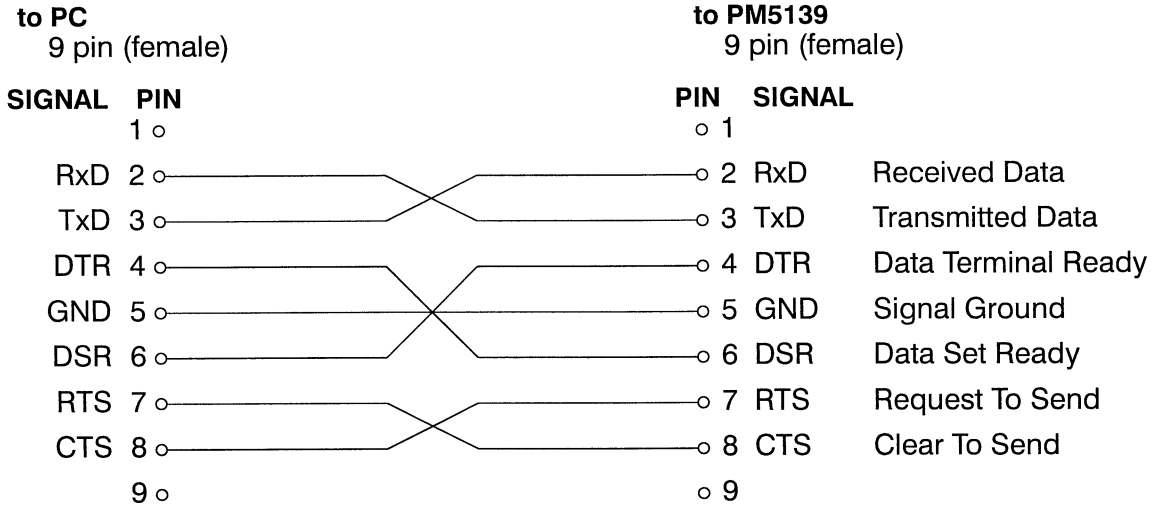
If no key is pressed within 3 seconds during configuration the instrument returns automatically to normal mode; the altered configurations are not stored.

On power up, the instrument is in 'local' mode (input via keyboard). When set to listener by PC with the command **ESC 2** the text REMOTE appears in the display field. All keys except LOCAL are locked and the instrument can now be operated in remote control. Return to local operation is done by the command **ESC 1** or by the LOCAL key. In order to avoid unintended local control the LOCAL key can be disabled by the command **ESC 5**.

### 3.7.3.2 Interface Functions and Wiring

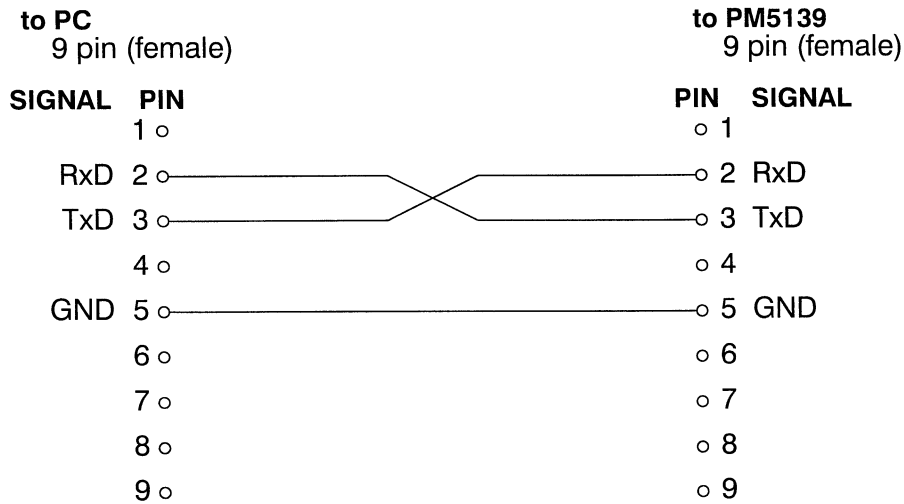
Operating modes:	Communication Mode (Co) / Listener Only Mode (LO)
Baud rates:	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200
Data bits:	7 or 8
Stop bits:	1 (2 for 110 baud only)
Parity:	ODD EVEN NO (with 8 data bits)
Xon/Xoff Handshake:	ON or OFF
Hardware connection:	3 wires, no hardware handshake 7 wires, with hardware handshake
Hardware handshake:	DSR/DTR and CTS/RTS
Connector:	9-pin D-connector (male)

Because the PC as well the PM5139 are DTE (Data Terminal Equipment) following pin configuration for the RS-232 connection cable should be used. In general it is recommended to use a well shielded cable for adequate radio interference suppression.



This cable can be purchased from your local Fluke Organization, order number PM9536/041.

If you use a 3 wire connection set the PM5139 to software handshake.



### 3.7.3.3 Special Interface Functions

For communication with the RS-232 interface following commands are used (similar to the addressed and unaddressed interface commands for IEEE-488):

RS-232	Function	similar to IEEE-488
ESC 1	go to local	GTL
ESC 2	go to remote control	GTR
ESC 4	device clear	DCL
ESC 5	local lock out	LLO
ESC 7	asks for status byte	★ STB?
ESC 8	device trigger	DTR

These commands should be implemented in a application program, so they can be sent to the instrument by a PC.

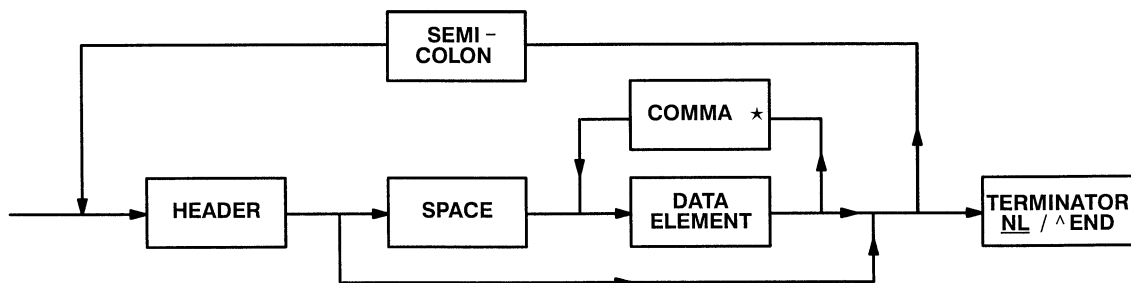
### 3.7.4 Remote Control Commands

In this section the commands are described related to the instrument functions and front panel keys, which are listed in Section 3.5. If not stated otherwise, following commands are used for IEEE-488 as well as for RS-232.

#### 3.7.4.1 Program Message Syntax

Several commands can be combined in a message and sent to the generator, using the semicolon ";" as a separator between the commands.

Header and data element must be separated by a space; the end of a message must be terminated by NL (new line), ^ END or both for the IEEE-488 interface and by NL for the RS-232 interface.



★ for arbitrary waveform data

### 3.7.4.2 Message Terminator

The instrument accepts ^ END or NL (ASCII 10 dec.) or both as the terminator for a program message via IEEE-488 interface.

The instrument also sets ^ END and NL as the terminator for a response message. To get compatibility to earlier controllers you can program terminators which depart from the IEEE-488.2 standard. Use the command TRM followed by the decimal value of the required ASCII character.

Example: **TRM 13,10** sets CR NL as terminator for a response message

The command TRM without decimal value, \*RST or the interface functions SDC/DCL sets the initial terminator again. The initial terminator is also set after power on.

Programming via RS-232 interface uses only NL as the terminator.

### 3.7.4.3 Service Request (SRQ) and Status Registers

Service Request will be generated if one or more bits of the 'Status Byte Register' are set to 1 and if the corresponding bits are enabled by the 'Service Request Enable Register' (IEEE-488 interface only). The controller asks the contents of the 'Status Byte Register' in 'Serial Poll Mode'.

PM5139 'Status Byte Register':

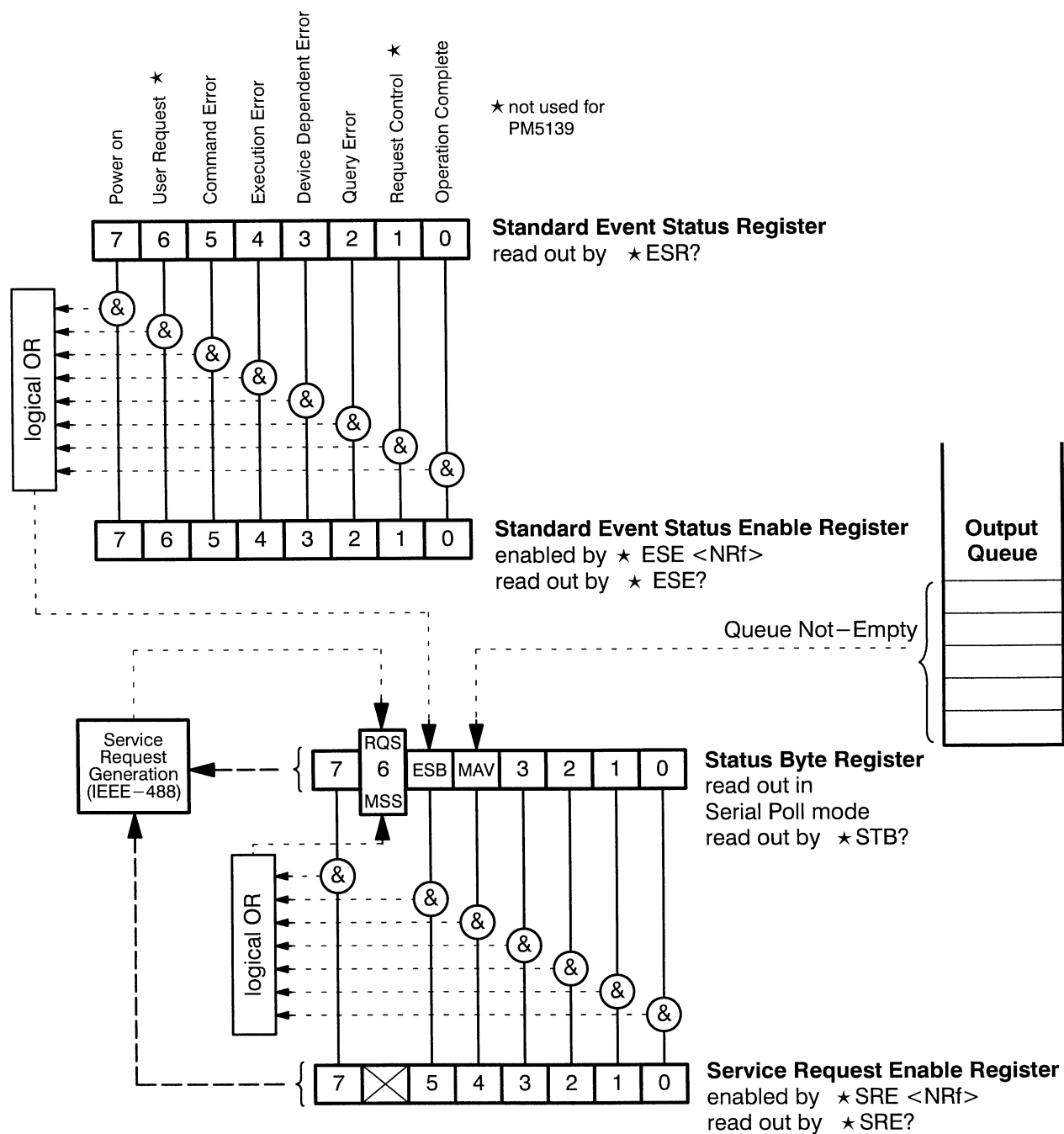
Bit	Function	Decimal value
0	power protection	1
1	} not used	2
2		4
3		8
4	message available (MAV)	16
5	bit of the 'Standard Event Status Register' high	32
6	request for service (RQS)	64
7	not used	128

To get the information via Service Request that bits of the 'Standard Event Status Register' are set, those bits must have been enabled by \*ESE, **and** bit 5 of the 'Status Byte Register' must have been enabled by \*SRE.

Direct readout without Service Request is possible for the IEEE-488 as well as for the RS-232 interface by using the \*ESR? query for the 'Standard Event Status Register' and by the \*STB? query for the 'Status Byte Register'.



**'Standard Event Status Register'**



<NRf> represents a decimal value whose binary pattern sets the corresponding bits of the 'Enable Register' to 1. By this the assigned bits of the 'Standard Event Status Register' respectively the bits of the 'Status Byte Register' are enabled.

All bits of the 'Standard Event Status Enable Register' and of the 'Service Request Enable Register' are set to 0 when the instrument is turned on. Therefore, in a user program where Service Request is required, the required bits must be set to 1 after power on.



**★TST? Self-test Query**

The instrument automatically checks the memory for the current settings, the storage registers 1 to 9, the memory for the arbitrary waveforms. The contents of the registers will not be destroyed, instrument settings remain unchanged. The test lasts approximately 1 second.

A zero in the response indicates that the self-test has completed without any errors detected.

- 1 means error during test of backup memory
- 2 means error during test of storage registers 1 to 9
- 4 means error during test of memory for ARB

**Synchronization:****★OPC Operation Complete Command**

For PM5139 this command is suggested for single sweep or burst. Selecting single sweep or burst via the interface, followed by the command ★OPC, sets bit 0 (operation complete) of the 'Standard Event Status Register' to 1 when the sweep or burst is finished. This bit activates bit 5 of the 'Status Byte Register' (event status bit); this generates Service Request (IEEE-488 interface only). This allows the controller to realize that the function is finished. Service Request, however, will be generated when the respective bits are enabled, see Section 3.7.4.3.

**★OPC? Operation Complete Query**

This command is also suggested for single sweep or burst. Sending the ★OPC? query to the generator during single sweep or burst causes the instrument to wait until the function is finished and to set a 1 into the output queue. The register can be read out by the controller without Service Request to continue in its user program.

Data in the output queue generally activate bit 4 of the 'Status Byte Register' (MAV, message available); this may generate a Service Request (IEEE-488 interface). To avoid this, bit 4 must not be enabled. Bit 0 (operation complete) of the 'Standard Event Status Register' is not affected by ★OPC?.

**★WAI Wait-to-Continue Command**

This command sent to the instrument in a message with further commands causes the generator to execute the command behind ★WAI only when the previous command is completed. This command acts as a terminator for the PM5139.

**★TRG Trigger Command**

When receiving this command the generator starts burst respectively sweep if one of these functions was selected before.

**Status and event:****★CLS Clear Status Command**

Sets the bits of the 'Standard Event Status Register' and of the 'Status Byte Register' to zero. Sending ★CLS as a single command or as the first command of a string additionally clears the contents of the Output Queue.

**★ESE Standard Event Status Enable Command**

★ESE, followed by a decimal value, sets the bits of the 'Standard Event Status Enable Register' which correspond to that decimal value to 1. This enables the assigned bits of the 'Standard Event Status Register', see Section 3.7.4.3.

**★ESE? Standard Event Status Enable Query**

This query asks for the contents of the 'Standard Event Status Enable Register'. The response is a decimal value.

Example: "255" = all bits are set to 1, that means all events of the 'Standard Event Status Register' are enabled.

**★ESR? Standard Event Status Register Query**

Asks for the contents of the 'Standard Event Status Register'. The response is a decimal value. This query clears the register contents.

**★SRE Service Request Enable Command**

★SRE, followed by a decimal value, sets the bits of the 'Service Request Enable Register' which correspond to that decimal value to 1, except bit 6. This enables the assigned bits of the 'Status Byte Register', see Section 3.7.4.3.

**★SRE? Service Request Enable Query**

Asks for the contents of the 'Service Request Enable Register'. The response is a decimal value.

**★STB? Read Status Byte Query**

Asks for the contents of the 'Status Byte Register'. The response is a decimal value.

**Stored settings:****★SAV Save Command**

This command followed by a decimal value from 1 to 9 stores the current instrument setting into the corresponding memory location. The memory contents are not affected by the ★RST command or by the instrument being turned off.

**★RCL Recall Command**

This command followed by a decimal value from 1 to 9 for the memory location calls up and executes the instruments settings stored in that memory location.

### 3.7.4.5 Device-Specific Messages

The following examples show which remote control commands are necessary to select operation modes and parameters and to set values.

"|" separates expressions which can be used by choice.

"NRf" (flexible numeric representation) value within the allowed range as integer, real or exponential value (NRf 1, 2 or 3 according to IEEE-488.2), whereby the number of digits is limited to 10 and to 1 for the exponent. The dimension is automatically set by the generator to **Hz**, **V**, **s**, **%** or **DEG** (degree). Numerical values exceeding the maximum resolution of a sub-range are internally rounded.

Different from the keyboard input the resolution in the frequency range from 100 Hz to 10 MHz is 10 Hz in remote control, except for SWEEP. These high resolution digits are not displayed.

"," serves as separator between several data elements in the program data, when programming an arbitrary waveform.

Some headers can be sent as command headers to program the generator and they can also be sent as queries with a question mark. The instrument then generates an answer with its actual value.

Example:           **FREQ 10e6**                   sets the frequency to 10 MHz  
                           **FREQ?**                        answer: FREQ 10.000E6

In the following table the question mark of these headers is set into brackets, e.g., FREQ(?).

Most headers can be used in short form, marked with bold letters in the table.

Example:           **SYMMETRY ON** in short form **SYM ON**

#### ■ Frequency Setting

Header/Query:	<b>FREQ(?)</b>	Frequency, carrier frequency (also start frequency for sweep)
	<b>STARTFREQ(?)   STFREQ(?)</b>	Start frequency for sweep
	<b>STOPFREQ(?)</b>	Stop frequency for sweep
Data element:	NRf	
Remark:	Max. frequency depends on waveform.	
	Frequency ranges for sweep:	1 mHz – 10 MHz 50 kHz – 20 MHz
Example:	<b>FREQ 10E6</b>	Sets the frequency to 10 MHz

■ **Waveform Setting**

Query:           **WAVEFORM?**

Header:           **SINE**                           sine  
                       **TRNGLE**                       triangle  
                       **SQUARE|SQR**                   square  
                       **POSPULSE|PULSE**               positive pulse  
                       **NEGPULSE**                   negative pulse  
                       **POSSAWTOOTH|SAWTOOTH**       positive sawtooth  
                       **NEGSAWTOOTH**               negative sawtooth  
                       **HAVERSINE**                   haversine  
                       **SINEPULSE**                   sine pulse  
                       **TRNGLPULSE**               triangle pulse  
                       **ARBITRARY|ARBITRARY**       free programmable (see Section 3.7.4.6)

Data element:    none

Example:          **TRNGLE** or **TRNG** sets the waveform to triangle

Remark:           Apart from keyboard operation the amplitude value is not automatically set to half the value when selecting unipolar signals.

■ **Waveform Asymmetry Setting**

Header/Query:    **DUTYCYCLE(?)**                   Sets the asymmetry

Data element:    NRf

Remark:           NRf for:  
                       sine, square, square pulses       ≤ 20 kHz:           1 to 99  
                       square, square pulses            > 20 kHz to 5 MHz: 20 to 80

Header/Query:    **SYMMETRY(?)**                   Switches asymmetry on or off

Data element:    **ON|OFF**

Remark:           **SYM ON** means duty cycle 50 %

Example:          **SQR;DUTYC 20;SYM OFF** sets square wave to 20 % duty cycle

■ **Output Amplitude Setting**

Header/Query:    **AMPLTUDE(?)**                   AC setting  
                       **DCOFFSET(?)**                   DC setting

Data element:    NRf

Remark:           AC plus DC may not exceed a window of ±10 V

Header:           **AC|DC**                           Switch AC or DC on or off

Data element:    **ON|OFF**

Remark:           **DCON|DCOFF** respectively **ACON|ACOFF** can also be used

■ **Modulation Mode Setting**

Header/Query:	<b>MODLN(?)</b>	No header for sweep
Data element:	<b>AM FM PSK GATE BURST OFF</b>	
Remark:	<b>AM FM PSK GATE BURST</b>	Can be used as header alone
Header:	<b>MODOFF</b>	Can be used to switch modulation off
Data element:	none	
Header:	<b>BURST</b>	Starts burst if burst is selected (ON) or sets burst to not triggered (OFF)
Data element:	<b>ON OFF</b>	
Header/Query:	<b>SWEEP(?)</b>	
Data element:	<b>LOG LIN ON OFF</b>	LOG = logarithmic sweep LIN = linear sweep OFF = sweep not triggered ON = starts sweep, if sweep selected
Remark:	During running sweep, no device-specific message is accepted, except MODOFF, MODLN OFF, and SWEEP OFF. These commands also serve to reset a single sweep in mode – 2 – to fSTART.	
Header:	<b>SINGLE CONTINUOUS</b>	Starts a single or continuous burst or sweep
Data element:	none	
Header:	<b>AMSWEEP</b>	Combines AM with sweep
Data element:	<b>LIN LOG</b>	
Examples:	<b>MODLN AM</b> or <b>AM</b> <b>MODLN FM</b> or <b>FM</b> <b>SWEEP LIN;CONT</b> <b>BURST;BURST ON</b> <b>BURST OFF</b>	Sets amplitude modulation Sets frequency modulation Linear sweep, continuous Burst, continuous Burst not triggered

### ■ Modulation Parameter Setting

Header/Query:	<b>MODFREQ(?)   MODLNFREQ(?)</b>	Modulation/repetition frequency
	<b>AMDEPTH(?)</b>	Modulation depth for AM in %
	<b>FMDEVIATION(?)</b>	Frequency deviation for FM in %
	<b>SWEEPTIME(?)</b>	Sweeptime in seconds
	<b>SWEEPMODE(?)</b>	Sweepmode – 1 –, – 2 – or – 3 –
	<b>ONPERIODS(?)</b>	ON-periods per burst
	<b>STARTPHASE(?)   STPHASE(?)</b>	Start/stop phase for burst

Data element: NRf

Remark: For these settings, the ranges and limits stated in Section 3.5 are valid.

### ■ Modulation/Trigger Signal Setting

Header/Query:	<b>MODSRC(?)   TRIGSRC(?)   TRGSRC(?)</b>	Modulation/trigger signal source
---------------	---	----------------------------------

Data element: INT | EXT

Header/Query:	<b>TRIGFUNCTION(?)   TRGFUNCTION(?)</b>	Trigger function
---------------	---	------------------

Data element: SINGLE | CONTINUOUS

Remark: This command determines whether the command '★TRG' or an interface trigger function, for example, GET, starts a single or continuous burst respectively sweep.

### ■ Additional Commands

Header:	<b>HOLD</b>	Stops the output signal at its present amplitude value (frequency 0.1 mHz ... 1 Hz). Sets the output amplitude to zero (frequency 1 Hz ... 20 kHz). Different from the 'HOLD' key, the command 'HOLD' is not effective during sweep.
	<b>RELEASE</b>	Releases the HOLD function
	<b>ENABLE</b>	Resets tripped power protection (RPP)
Query:	<b>OUTPUT?</b>	Output status query
Header/Query:	<b>LOWIMP(?)   LOIMP(?)</b>	Output impedance 50 Ω or LOW Zo
Data element:	<b>ON   OFF</b>	
Remark:	LOW Zo for amplitudes $\geq 2.0$ V.	



**Examples:**

Internal amplitude modulation:

frequency 150 kHz	<b>FREQ 150E3</b>
waveform sine	<b>SINE</b>
output amplitude 4.5 V	<b>AMPLT 4.5</b>
amplitude modulation	<b>AM</b>
modulation frequency 1.5 kHz	<b>MODFRE 1.5E3</b>
internal modulation signal	<b>MODSRC INT</b>
modulation depth 50 %	<b>AMDEP 50</b>

Linear sweep with same start frequency and amplitude as above:

amplitude modulation off	<b>MODOFF</b>
linear sweep	<b>SWEEP LIN</b>
stop frequency 5 MHz	<b>STOPF 5E6</b>
sweep time 5 seconds	<b>SWEEPT 5</b>
mode – 3 –	<b>SWEEPM 3</b>
continuous sweep	<b>CONT</b>

Burst with 5 periods, carrier frequency 15 kHz, amplitude 5 V:  
 repetition frequency (fMOD) 500 Hz, start-/stop phase 45°:

modulation off	<b>MODOFF</b>
frequency 15 kHz	<b>FREQ 15E3</b>
amplitude 5 V	<b>AMPLT 5</b>
modulation mode BURST	<b>BUR</b>
repetition frequency (fMOD) 500 Hz	<b>MODFRE 500</b>
periods 5	<b>ONPER 5</b>
start-/stop phase 45°	<b>STPHA 45</b>
continuous burst	<b>CONT</b>

The commands in the examples can also be sent to the generator in a combined message:

<b>FREQ 150E3;SINE;AMPLT 4.5;AM;MODFRE 1.5E3;MODSRC INT;AMDEP 50</b>	(AM)
<b>MODOFF;SWEEP LIN;STOPF 5E6;SWEEPT 5;SWEEPM 3;CONT</b>	(sweep)
<b>MODOFF;FREQ 15E3;AMPLT 5;BUR;MODFRE 500;ONPER 5;STPHA 45;CONT</b>	(burst)

### 3.7.4.6 Arbitrary Waveform (ARB)

Data for twenty-four free programmable waveforms can be sent to the generator via the IEEE-488 or via the RS-232 interface. These data are stored in an EEPROM and can be recalled at any time or overwritten by new data. Values for the amplitude Y are assigned to the storage addresses on the time axis X of a system of coordinates.

When generating the arbitrary waveform, the instrument recalls the addresses and sets the output signal to the value corresponding to the storage contents.

The total signal can be repeated at a frequency up to 20 kHz; this means a maximum sample rate of the single addresses of 20.48 MS/s (mega samples per second).

#### Commands to select, program, and recall the arbitrary waveform

Header:	<b>ARBSELECT(?)</b>	Selects the memory location 1 to 24 to store data for an arbitrary waveform during a different signal is present at the output.
Data element:	<b>1 to 24</b>	
Header:	<b>ARBITRARY(?)   ARB(?)</b>	Activates the programmed signal of the memory place 1 to 24, 'ARB' without a decimal value activates the signal of the memory place last selected.
Data element:	<b>1 to 24</b>	
Note:	If the command 'ARBSEL..' is sent to the generator in a combined message after 'ARB..' (e.g., ARB 2;ARBSEL 5;...), the waveform selected by 'ARBSEL..' is activated.	
Header:	<b>BEGIN(?)</b>	Defines the start address on the x-axis (0 to 1023) of the data for the amplitude; if this command is not sent, programming will start at the next free address.
Data element:	<b>0 to 1023</b>	
Header:	<b>COUNT(?)   CNT(?)</b>	Address increment (1 to 255) on the X-axis; if this command is not sent, the increment will be 1.
Data element:	<b>1 to 255</b>	
Header:	<b>DATA</b>	yy = number of subsequent data elements xx = amplitude data on Y-axis (-511..0..+511); the range -511 to +511 corresponds to 20 Vpp.
Data element:	<b>yy,xx,xx...</b>	
Header:	<b>FILL</b>	Sets all addresses from 0 to 1023 to the programmed value.
Data element:	<b>-511 to 0 to +511</b>	
Header:	<b>CLEAR</b>	Erases the selected arbitrary waveform (corresponds to FILL 0).
Data element:	<b>ARBIT</b>	

The command FILL supports programming a wave form with DC component.

You can program a DC voltage, in which you can program a desired waveform in segments.

When you only program one value by FILL, this corresponds to a DC voltage. This voltage is present at the generator output. The display shows "AC 0".

It is not possible to make changes within the amplitude subranges.

When programming the maximum output amplitude  $V_{max}$  the programmed Y-values are converted by the generator into volts.

for example:  $Y_{max} = 8, Y_{min} = -6$

$$U_{max} = \frac{Y_{max} - Y_{min}}{1022} \times 20 \text{ V} = \frac{8 - (-6)}{1022} \times 20 \text{ V} = 0.2739 \text{ V}$$

Digits behind the 1. position behind the decimal point are ignored as they surpass the resolution of 100 mV of this range (see Section 4.10);

i.e. Output amplitude and display:  $AC_{pp} 0.2 \text{ V}$

When you switch from a standard waveform to an "ARB" which doesn't cover the full amplitude range (-511 to +511), it is recommended to set the output amplitude to zero (AMPLT 0). This avoids range respectively subrange exceeding.

You use the following commands to select whether the arbitrary waveform is executed after data transmission or after sending the command 'ARB'.

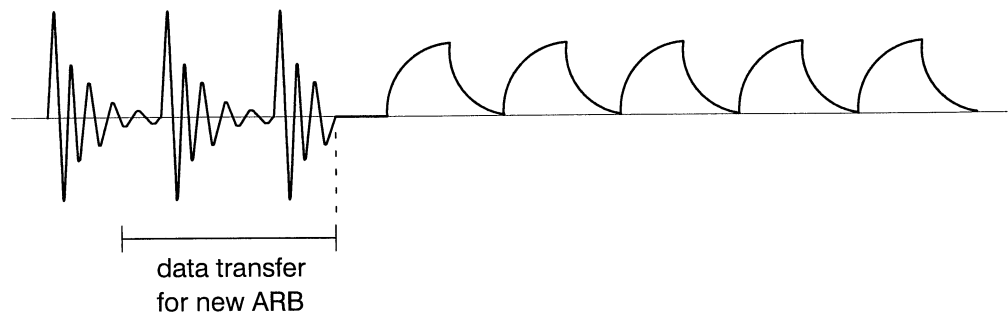
Header: **ARBITEXECUTE(?) | ARBEXECUTE(?)**

Data element: **ON | OFF**

The initial state of the instrument is 'ARBE ON'. The same applies after '\*RST', power-on or after receiving the command 'CLEAR ARBIT'.

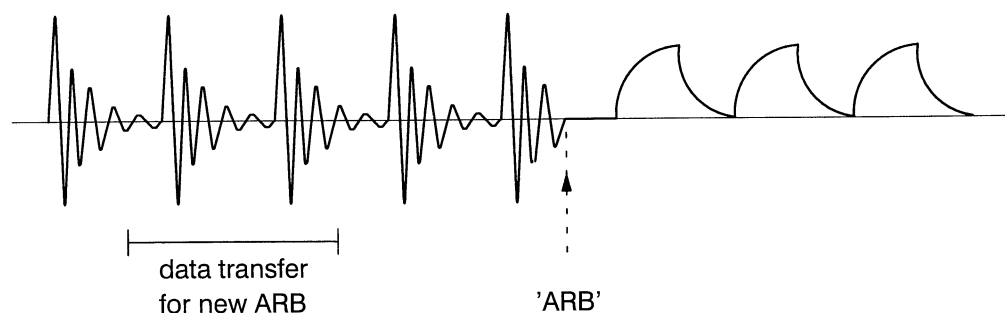
After receiving the 'ARBE ON' command, the instrument immediately generates a new arbitrary waveform and feeds it to the output after data transmission is finished.

waveform ARB



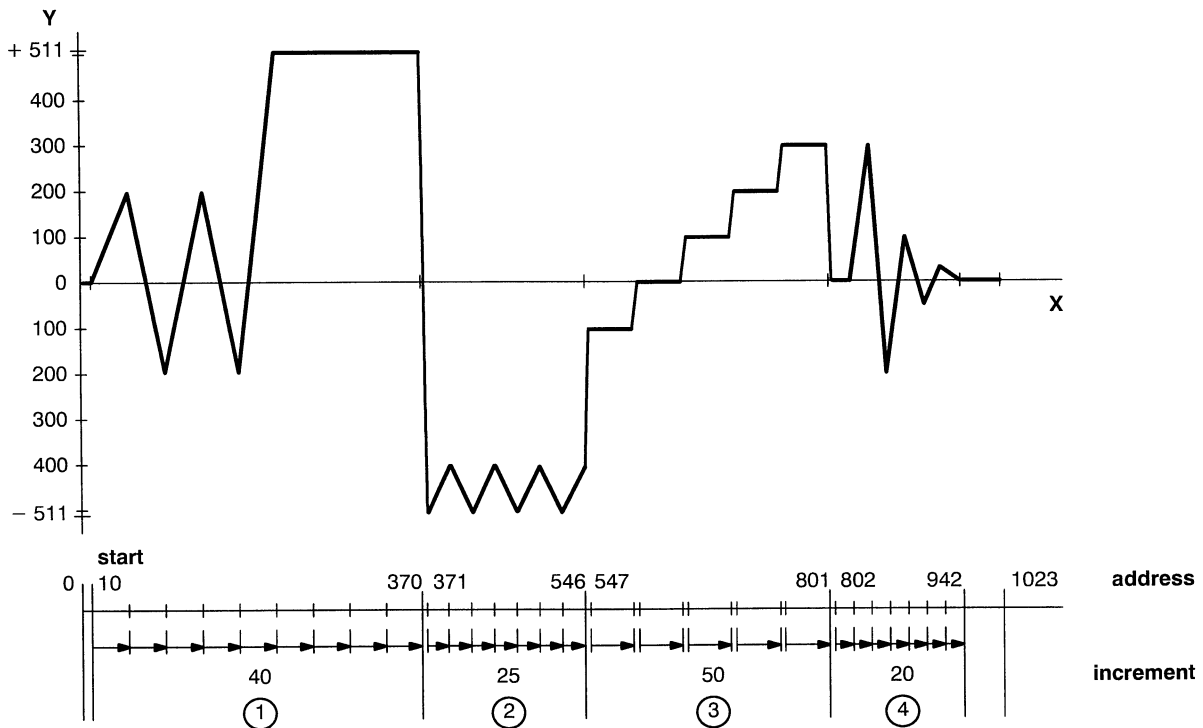
When the generator is programmed with 'ARBE OFF', the previous ARB waveform is still present at the output after data transfer of the new one until the 'ARB' command is sent.

waveform ARB



**Example:** Programming a waveform in four sections with different address increments

	CLEAR ARBIT	Erases the selected memory location of the EEPROM
	BEGIN 10	Start address 10
1	CNT 40 DATA 10,0,200,-200,200,-200, 511,511,511,511,511	Increment 40 Number of data (DATA 10,) and data input (0,200,...)
2	CNT 25 DATA 8,-511,-400,-511,-400, -511,-400,-511,-400	Increment 25 Number of data (DATA 8,) and data input (-511,-400,...)
3	CNT 50 DATA 2,-100,-100 DATA 2,0,0 DATA 2,100,100 DATA 2,200,200 DATA 2,300,300	Increment 50 Input of 2 data per group
4	CNT 20 DATA 8,0,0,300,-200,100,-50,25,0	Increment 20 Input of 8 data



Samples within the count-steps are automatically interpolated and stored by the generator.

**Programming in 16-Bit Hex Format** (IEEE-488 interface only)

In addition to the programming with decimal values, values can also be sent in 16-bit hex format. This speeds up the transfer time.

The commands 'CNT' and 'BEGIN' remain unchanged. Instead of the decimal values 'DATA .....' in the message hexadecimal coded amplitude values are sent.

Positive values: 0 to +511 dec = 0000 to 01FF hex

Negative values: -1 to -511 dec = FFFF to FE01 hex

Before hexadecimal values are sent, the generator must get the information on how many bytes will be sent; this is similar to the information 'DATA yy,...' for the decimal transfer. At the end, the checksum (sum of the contents of all data bytes) is sent.

**DATA #ZXXXX<Hy><Ly><Hy><Ly><Hy><Ly>.....<Hy><Ly><CHKS>**

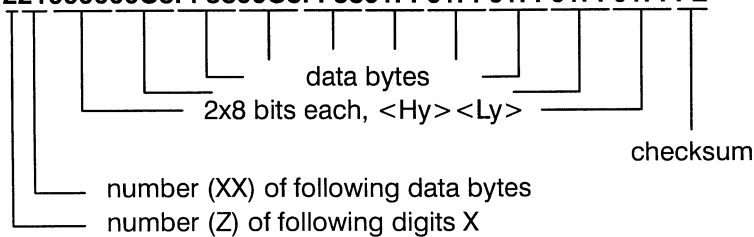
- # = symbol to identify the data transfer in binary format
- Z = number of following digits X
- X = number of following data bytes including byte of the checksum
- <Hy> = upper byte of the 16-bit data
- <Ly> = lower byte of the 16-bit data
- <CHKS> = checksum

The following example shows the first data set of the example on the previous page in decimal format:

**DATA 10,0,200,-200,200,-200,511,511,511,511,511**

16-bit hex format:

**DATA #22100000C8FF3800C8FF3801FF01FF01FF01FF01FFFE**



Contents of the data bytes:

Hex	Decimal	
0000	= 0	FE = lower byte of the sum of the contents
00C8	= 200	of all single bytes (08FE)
FF38	= -200	
01FF	= 511	

### 3.7.5 Program Examples

The following examples are related to an IBM compatible PC. The first one uses a built-in IEEE-488 interface, the second one uses the standard serial port of the controller and the RS-232 interface. You should have a basic knowledge of the operating system MS-DOS of the controller and the programming language QuickBasic (version 4.0 and onwards) in order to understand the examples that follow.

The programs allows to input commands via the controller keyboard and to send them via the interface to the generator.

#### ■ Example for the IEEE-488 interface:

```

DECLARE SUB SendCmd (WR$)
DECLARE SUB SendStr (WR$)
DECLARE SUB ErrChk (Cs!, Sts%)
REM $INCLUDE: 'qbdecl4.bas'

CLS
PRINT " "
PRINT " "
PRINT "          ***** DEMO PROGRAMM FOR PM5139 *****"
PRINT
PRINT "          PRESS 'RETURN' TO CONTINUE  "
PRINT
PRINT "          To leave running program type 'END' or 'end' "
BEEP
PRINT
DO          'waiting for 'RETURN'
    B$ = ""
    DO UNTIL B$ <> ""
        B$ = INKEY$
    LOOP
LOOP UNTIL B$ = CHR$(13)

CLS          'clears screen
Stp = 0
BDNAME$ = "GEN1"          'name of the device on the conf.table
CALL IBFIND(BDNAME$, GEN%)          'open device
CALL ErrChk(1, GEN%)          'check error

IF Stp = 0 THEN
    CALL IBCLR(GEN%)          'send interface clear
    CALL ErrChk(2, IBSTA%)          'check error
END IF

```

```

IF Stp = 0 THEN
  A$ = "**ese 255"           'initialize ESR register
  CALL SendCmd(A$)         'send command

  A$ = "**cls"              'clear status register
  CALL SendCmd(A$)         'send command

  A$ = "**IDN?"             'ask for identity
  CALL SendStr(A$)         'send command string

  WHILE Stp = 0
    LINE INPUT "COMMAND :  ", A$ 'reading keyboard input
    IF A$ = "END" OR A$ = "end" THEN
      CALL IBLOC(GEN%)         'set instrument to 'LOCAL'
      CLS                     'clear screen
      Stp = 1
    ELSE
      CALL SendStr(A$)         'send command string
    END IF
    PRINT
    PRINT
  WEND
END IF
END

SUB ErrChk (Cs, Sts%)      'Error handler
  SHARED Stp
  SELECT CASE Cs
    CASE 1
      IF Sts% < 0 THEN
        PRINT
        PRINT
        PRINT "IBFIND ERROR"
        PRINT "Check the configuration of the bus interface with IBCONF.EXE"
        PRINT
        Stp = 1           'terminate program
      END IF
    CASE 2
      IF Sts% < 0 THEN
        PRINT
        PRINT
        PRINT "      BUS ERROR!"
        PRINT
        PRINT "      Please check connections and start program again"
        PRINT
        Stp = 1           'terminate the program
      END IF
    CASE 3
      IF Sts% < 0 THEN
        PRINT
        PRINT
        PRINT "GPIB ERROR"
        PRINT
      END IF
      IF Sts% > 16383 THEN
        PRINT
        PRINT
        PRINT "TIME OUT ERROR"
        PRINT
      END IF
    END SELECT
  END SUB
END SUB

```

```

SUB SendCmd (WR$)
  'Send command string to instrument via GPIB without response
  SHARED GEN%
  CALL IBWRT(GEN%, WR$)          'output command string
  CALL ErrChk(3, IBSTA%)        'check error
END SUB

SUB SendStr (WR$)
  'Send command string to instrument via GPIB with response
  SHARED GEN%
  qry = 0                        'query flag
  qer = 0                        'error query flag
  CALL IBWRT(GEN%, WR$)        'output command string

  IF IBSTA% < 0 THEN
    CALL ErrChk(3, IBSTA%)      'check error
  ELSE
    Stat = 0
    CALL IBRSP(GEN%, Stat%)     'get status byte from instrument
    CALL ErrChk(3, IBSTA%)      'check error
    IF (Stat% AND 16) THEN      'checks whether MAV is set
      qry = 1
    END IF
    IF (Stat% AND 32) THEN      'checks whether ESB is set
      BEEP
      WR$ = "err?"              'error query
      CALL IBWRT(GEN%, WR$)    'output command string
      qry = 1
      qer = 1
    END IF
  END IF

  IF INSTR(WR$, "?") > 0 OR qry = 1 THEN 'check if query command
    MaxLen = 164                'max. length of response string
    RD$ = SPACE$(MaxLen)        'clear response string
    CALL IBRD(GEN%, RD$)        'get response string
    IF IBSTA% < 0 THEN
      CALL ErrChk(3, IBSTA%)    'check error
    ELSE
      PRINT
      PRINT "RESPONSE : " + RD$ 'response string
      IF qer = 1 THEN
        WR$ = "**cls"           'clear status register
        CALL IBWRT(GEN%, WR$)  'output command string
      END IF
    END IF
  END IF
END SUB

```



■ Example for the RS-232 interface:

```

DECLARE FUNCTION TestCmd! (A$)
DECLARE SUB RecDat (St%)
DECLARE SUB SendCmd (Cmd%, Rsp%)
DECLARE SUB SendStr (WR$)
DECLARE SUB InitCom ()

CLS
PRINT " "
PRINT " "
PRINT "          ***** Demonstration Program for PM5139 *****"
PRINT "          ***** with RS-232 Interface *****"
PRINT
'          Enviroment : IBM AT or Compatible with Quick Basic 4.5
Stp = 0
A$ = ""
CALL InitCom          'open device

ErrSts% = 0
CALL SendCmd(4, 0)    'send interface clear

CALL SendCmd(2, 0)    'sets instrument to remote

A$ = "*ese 255"       'initialize ESR register
CALL SendStr(A$)      'send command

IF ErrSts% > 0 THEN   'if no answer
  PRINT "Please check the connection and setting!"
ELSE
  CLS                  'clears screen
  A$ = "*cls"          'clear status register
  CALL SendStr(A$)     'send command

  A$ = "*IDN?"         'ask for identity
  CALL SendStr(A$)     'send command string

  WHILE Stp = 0
    LINE INPUT "COMMAND : ", A$ 'reading keyboard input
    Cmd% = TestCmd(A$) 'test command
    SELECT CASE Cmd%
      CASE 0
        CALL SendCmd(1, 1) 'set instrument to 'LOCAL'
        CLOSE #1
        CLS                  'clear screen
        Stp = 1
      CASE 1 TO 8
        CALL SendCmd(Cmd%, 1) 'send command
      CASE IS > 8
        CALL SendStr(A$) 'send command string
    END SELECT
    PRINT
    PRINT
  WEND
END IF
END

```

```

DATA END,end,GTL,gtl,GTR,gtr,GTR,gtr,DCL,dcl,LLO,llo,LLO,llo,STB,stb,DTR,dtr

SUB InitCom
  'Initalize serial communication channel
  PRINT "Please set the RS-232 parameters of the PM5139 to : "
  PRINT "      Baudrate : 9600"
  PRINT "      Parity    : n"
  PRINT "      Data       : 8"
  PRINT "      Handshake  : on"
  PRINT "      Wire       : 3"
  PRINT
  PRINT "Which communication port of the PC do You use ? "
  PRINT "      COM1      [1]"
  PRINT "      COM2      [2]           please select : ";
  C$ = ""
  DO UNTIL (C$ = "1" OR C$ = "2")
    C$ = INKEY$
  LOOP
  PRINT C$
  ComStr$ = "COM" + C$ + ":9600,N,8,1,CS,DS,LF"
  PRINT
  OPEN ComStr$ FOR RANDOM AS #1
  PRINT "Special commands :      GTL : go to local"
  PRINT "                        GTR : go to remote"
  PRINT "                        DCL : device clear"
  PRINT "                        LLO : local lock out"
  PRINT "                        STB : get status byte"
  PRINT "                        DTR : device trigger"
  PRINT
  PRINT
  PRINT "To leave running program type 'END' or 'end'.      Press a key to continue ";
  PRINT
  BEEP
  C$ = ""
  DO WHILE C$ = ""
    C$ = INKEY$
    'waiting for a key
  LOOP
  PRINT
  PRINT
END SUB

SUB RecDat (Rsp%)
  SHARED stb%, ErrSts%
  Tr = TIMER
  RD$ = ""
  C$ = ""
  DO UNTIL (C$ = CHR$(10) OR (TIMER - Tr > 3))
    IF LOC(1) > 0 THEN
      C$ = INPUT$(1, #1)
      IF C$ <> CHR$(10) THEN
        RD$ = RD$ + C$
        C$ = ""
      END IF
    END IF
  END IF
END SUB

```

```

LOOP
IF (TIMER - Tr > 3) THEN
  ErrSts% = 1
  PRINT "**** receive timeout ****"
  PRINT
ELSE
  ErrSts% = 0
  IF Rsp% = 0 THEN
    stb% = VAL(RD$)
  ELSE
    PRINT
    PRINT "RESPONSE : " + RD$ 'response string
    PRINT
  END IF
END IF
END SUB

SUB SendCmd (Cmd%, Rsp%)
'Send command string to instrument via serial bus without response
WR$ = CHR$(27) + CHR$(Cmd% + 48)
PRINT #1, WR$ 'output command string
IF Cmd% = 7 THEN 'if statusbyte requested
  CALL RecDat(Rsp%) 'get status byte
END IF
END SUB

SUB SendStr (WR$)
'Send command string to instrument via serial bus with response
SHARED stb%
qry = 0 'query flag
WR$ = WR$ + CHR$(10) 'append LF
PRINT #1, WR$ 'output command string

IF INSTR(WR$, "?") > 0 THEN 'check if query command
  MaxLen = 164 'max. length of response string
  RD$ = SPACE$(MaxLen) 'clear response string
  CALL RecDat(1) 'get response string
END IF

stb% = 0
CALL SendCmd(7, 0) 'ask for status byte
IF (stb% AND 16) THEN 'checks whether MAV is set
  qry = 1
END IF
IF (stb% AND 32) THEN 'checks whether ESB is set
  BEEP
  WR$ = "err?" + CHR$(10) 'error query
  PRINT #1, WR$ 'output command string
  qry = 1
END IF

```

```
IF qry = 1 THEN
    CALL RecDat(1)
    WR$ = "*cls" + CHR$(10)
    PRINT #1, WR$
END IF
END SUB

FUNCTION TestCmd (A$)
    RESTORE
    Cmd% = 100
    i% = 0
    DO UNTIL Cmd% < 100 OR i% > 17
        READ b$
        IF A$ = b$ THEN
            Cmd% = i% \ 2
        END IF
        i% = i% + 1
    LOOP
    TestCmd = Cmd%
END FUNCTION
```

3.7.6 Error Messages

After receiving the query 'ERR?' the PM5139 generates a response message with an error number and an error description in clear text, which can be read in by the controller.

<b>Error Message</b>	<b>See Section</b>
ERROR 0/NO ERROR	
ERROR 101/SYNTAX ERROR	3.7.4 / 3.7.7
ERROR 102/ILLEGAL HEADER	3.7.4 / 3.7.7
ERROR 103/BODY SYNTAX ERROR	3.7.4 / 3.7.7
ERROR 104/DATA OUT OF RANGE	3.7.4 / 3.7.7
ERROR 105/NO QUERY HEADER	3.7.4 / 3.7.7
ERROR 107/FREQUENCY OUT OF RANGE	3.5.4
ERROR 108/STOP FREQUENCY OUT OF RANGE	3.5.7.5
ERROR 109/AMPLITUDE OUT OF RANGE	3.5.5
ERROR 110/DC OFFSET OUT OF RANGE	3.5.5.1
ERROR 111/MOD.FREQUENCY OUT OF RANGE	3.5.7
ERROR 112/AM DEPTH OUT OF RANGE	3.5.7.1
ERROR 113/FM DEVIATION OUT OF RANGE	3.5.7.2
ERROR 114/SWEEP TIME OUT OF RANGE	3.5.7.5
ERROR 115/BURST PERIOD OUT OF RANGE	3.5.7.6
ERROR 116/BURST PHASE OUT OF RANGE	3.5.7.6
ERROR 117/DUTY CYCLE OUT OF RANGE	3.5.6
ERROR 118/ILLEGAL SWEEP MODE	3.5.7.5
ERROR 119/AMPLITUDE+DC OFFSET OUT OF RANGE	3.5.5.1
ERROR 120/INCOMPATIBLE FREQUENCY / WAVEFORM	3.5.4
ERROR 121/INCOMPATIBLE AMPLITUDE / WAVEFORM	3.5.4
ERROR 122/INCOMPATIBLE DUTY CYCLE / WAVEFORM	3.5.6
ERROR 123/INCOMPATIBLE DUTY CYCLE / FREQUENCY	3.5.6
ERROR 124/INCOMPATIBLE FREQUENCY / BURST PARAMETERS	3.5.7.6
ERROR 125/NO EXTERNAL MODULATION POSSIBLE	3.7.4.5
ERROR 127/NO EXTERNAL TRIGGER POSSIBLE	3.7.4.5
ERROR 128/ILLEGAL REGISTER ADDRESS	3.5.8 / 3.7.4.4
ERROR 129/NO DATA STORED	3.5.8
ERROR 130/OUTPUT OVERLOADED	3.5.9 / 3.7.4.5 / 4.7
ERROR 131/NO ARBITRARY DATA	3.7.4.6
ERROR 132/CHECKSUM ERROR	3.7.4.6
ERROR 133/VALUE OUT OF RANGE	3.7.4.6
ERROR 134/ADDRESS OUT OF RANGE	3.7.4.6
ERROR 135/TIME OUT	
ERROR 136/STOP SWEEP FIRST	3.7.4.5
ERROR 137/EEPROM ERROR	3.5.9.1
ERROR 138/AMPLITUDE OF ARBITRARY OUT OF RANGE	3.7.4.6 / 4.10.4
ERROR 139/AMPLITUDE CORRECTED	3.7.4.6 / 4.10.4
ERROR 140/HOLD NOT POSSIBLE	3.7.4.5
ERROR 141/NO SWEEP SELECTED	3.7.4.5
ERROR 142/NO BURST SELECTED	3.7.4.5
ERROR 143/EXTERNAL RAM ERROR	3.5.9
ERROR 144/BACKUP ERROR	3.5.9
ERROR 145/NO TRIGGER POSSIBLE	3.7.4.5
ERROR 146/NO OUTPUT DATA AVAILABLE	3.7.4.3
ERROR 147/OUTPUT DATA DESTROYED	3.7.4.3
ERROR 148/INCOMPATIBLE WAVEFORM / MODULATION	3.5.4
ERROR 149/INCOMPATIBLE MOD.FREQUENCY / MODULATION	3.5.4
ERROR 150/INCOMPATIBLE STOP FREQUENCY / WAVEFORM	3.5.7.5
ERROR 151/INCOMPATIBLE FREQUENCY / FM-DEVIATION	3.5.4
ERROR 152/INCOMPATIBLE FREQUENCY / STOP FREQUENCY	3.5.7.5
ERROR 153/ILLEGAL MEMORY ADDRESS	3.7.4.6
ERROR 199/UNKNOWN ERROR	

### 3.7.7 Commands in Alphabetic Order

Allowed abbreviations are printed in bold letters

#### 3.7.7.1 Common Commands and Queries (IEEE-488.2):

Command/Query	Description	Page
★CLS	Sets 'Standard Event Status Register' and 'Status Byte Register' to zero	3 – 41
★ESE <NRf>	'Standard Event Status Enable' command	3 – 42
★ESE?	'Standard Event Status Enable' query	3 – 42
★ESR?	Reads 'Standard Event Status Register'	3 – 42
★IDN?	Identification query	3 – 40
★LRN?	Asks for instrument settings	3 – 40
★OPC	'Operation Complete' command	3 – 41
★OPC?	'Operation Complete' query	3 – 41
★RCL 1 to 9	Recall command	3 – 42
★RST	Reset command	3 – 40
★SAV 1 to 9	Save command	3 – 42
★SRE <NRf>	'Service Request Enable' command	3 – 42
★SRE?	'Service Request Enable' query	3 – 42
★STB?	Read status byte query	3 – 42
★TRG	Trigger command	3 – 41
★TST?	Self-test query	3 – 41
★WAI	Wait-to-Continue command	3 – 41

#### 3.7.7.2 Device-Specific Commands:

Command/Query	Description	Page
AC ON OFF	AC amplitude on/off	3 – 44
ACON	AC amplitude on	3 – 44
ACOFF	AC amplitude off	3 – 44
AM	Amplitude modulation	3 – 45
AMDEPTH(?) <NRf>	Modulation depth for AM	3 – 46
AMPLTUDE(?) <NRf>	Output amplitude	3 – 44
AMSWEEP LIN LOG	AM combined with sweep	3 – 45
ARB(?) 1 to 24	Free programmable waveform	3 – 48
ARBITRARY(?) 1 to 24	Free programmable waveform	3 – 48
ARBTEXCUTE(?) ON OFF	Execution of arbitrary waveform	3 – 49
ARBEXECUTE(?) ON OFF	Execution of arbitrary waveform	3 – 49
ARBSELECT(?) 1 to 24	Memory place 1 to 24 for ARB waveform	3 – 48
BEGIN(?) 0 to 1023	Start address for ARB programming	3 – 48
BURST	Selects modulation mode burst	3 – 45
BURST ON OFF	Starts burst respectively sets to not triggered	3 – 45

<b>Command/Query</b>	<b>Description</b>	<b>Page</b>
<b>CLEAR ARBIT</b>	Erases data of selected arbitrary waveform	3 – 48
<b>CNT(?) 1 to 255</b>	Address increment for ARB programming	3 – 48
<b>COUNT(?) 1 to 255</b>	Address increment for ARB programming	3 – 48
<b>CONTINUOUS</b>	Starts continuous burst respectively sweep	3 – 45
<b>DATA .....</b>	Data for free programmable waveform ARB	3 – 48
<b>DUTYCYCLE(?) &lt;NRf&gt;</b>	Asymmetry of output signal	3 – 44
<b>DCOFFSET(?) &lt;NRf&gt;</b>	DC offset	3 – 44
<b>DC ON OFF</b>	DC offset on/off	3 – 44
<b>DCON</b>	DC offset on	3 – 44
<b>DCOFF</b>	DC offset off	3 – 44
<b>ENABLE</b>	Resets tripped power protection (RPP)	3 – 46
<b>ERROR?</b>	Error query	3 – 59
<b>FILL –511 to +511</b>	Sets all data of ARB to the same value	3 – 48
<b>FM</b>	Frequency modulation	3 – 45
<b>FMDEVIATION(?) &lt;NRf&gt;</b>	Deviation for frequency modulation	3 – 46
<b>FREQ(?) &lt;NRf&gt;</b>	Carrier frequency	3 – 43
<b>GATE</b>	Gating	3 – 45
<b>HAVERSINE</b>	Haversine	3 – 44
<b>HOLD</b>	Stops amplitude at its present value	3 – 46
<b>LOWIMP(?) ON OFF</b>	Output impedance 50 Ω or LOW Zo	3 – 46
<b>LOIMP(?) ON OFF</b>	Output impedance 50 Ω or LOW Zo	3 – 46
<b>MODOFF</b>	Modulation off	3 – 45
<b>MODFREQ(?) &lt;NRf&gt;</b>	Modulation frequency	3 – 46
<b>MODLNFREQ(?) &lt;NRf&gt;</b>	Modulation frequency	3 – 46
<b>MODLN(?) AM FM PSK GATE BURST OFF</b>	Modulation mode	3 – 45
<b>MODSRC(?) INT EXT</b>	Modulation signal source	3 – 46
<b>NEGPULSE</b>	Negative square pulse	3 – 44
<b>NEGSAWTOOTH</b>	Negative sawtooth	3 – 44
<b>ONPERIODS(?) &lt;NRf&gt;</b>	Periods per burst	3 – 46
<b>OUTPUT?</b>	Output status query	3 – 46
<b>POSPULSE</b>	Positive square pulse	3 – 44
<b>PULSE</b>	Positive square pulse	3 – 44
<b>POSSAWTOOTH</b>	Positive sawtooth	3 – 44
<b>PSK</b>	Phase shift keying	3 – 45
<b>RELEASE</b>	Releases the HOLD function	3 – 46

<b>Command/Query</b>	<b>Description</b>	<b>Page</b>
<b>SAWTOOTH</b>	Positive sawtooth	3 – 44
<b>SINE</b>	Sine wave	3 – 44
<b>SINEPULSE</b>	Sine pulse	3 – 44
<b>SINGLE</b>	Starts single burst respectively sweep	3 – 45
<b>SQUARE</b>	Square wave	3 – 44
<b>SQR</b>	Square wave	3 – 44
<b>STARTPHASE(?) –180 to +180</b>	Start/stop phase for burst	3 – 46
<b>STPHASE(?) –180 to +180</b>	Start/stop phase for burst	3 – 46
<b>STARTFREQ(?) &lt;NRf&gt;</b>	Start frequency for sweep	3 – 43
<b>STFREQ(?) &lt;NRf&gt;</b>	Start frequency for sweep	3 – 43
<b>STOPFREQ(?) &lt;NRf&gt;</b>	Stop frequency for sweep	3 – 43
<b>SWEEP(?) LIN LOG ON OFF</b>	Sweep selection	3 – 45
<b>SWEEPTIME(?) &lt;NRF&gt;</b>	Sweeptime	3 – 46
<b>SWEEPMODE(?) 1 to 3</b>	Sweep mode	3 – 46
<b>SYMMETRY(?) ON OFF</b>	Symmetry on or off	3 – 44
<b>TRIGFUNCTION(?) CONT SINGL</b>	Trigger function	3 – 46
<b>TRGFUNCTION(?) CONT SINGL</b>	Trigger function	3 – 46
<b>TRIGSRC(?) INT EXT</b>	Trigger signal source	3 – 46
<b>TRGSRC(?) INT EXT</b>	Trigger signal source	3 – 46
<b>TRM &lt;NRf&gt;</b>	Sets message terminator	3 – 38
<b>TRNGLE</b>	Triangle wave	3 – 44
<b>TRNGLPULSE</b>	Triangle pulse	3 – 44
<b>WAVEFORM?</b>	Waveform query	3 – 44

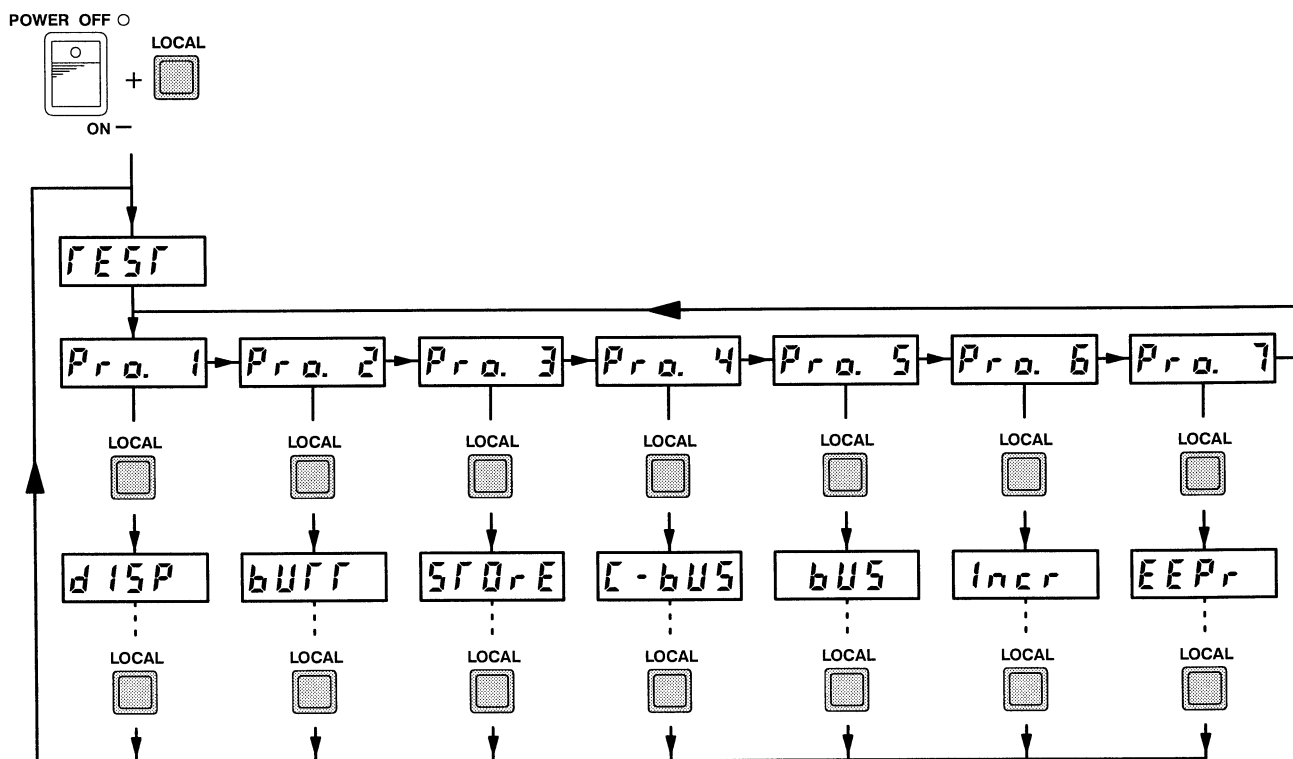


### 3.8 TEST PROGRAM

The test program of the PM5139 contains the following seven subprograms:

- 1. Display test
- 2. Keyboard test
- 3. Memory register test
- 4. Strobe test (test of the internal interfaces)
- 5. Interface test (RS-232 or IEEE-488)
- 6. Rotary knob test
- 7. EEPROM test (PM5139/02 and PM5139/03 only)

The test program is activated by pressing the LOCAL key for about 3 seconds, while the instrument is being switched on, or by pressing the LOCAL key and pressing the concealed RESET key. The self-test routine is followed by the word "TEST" in the display followed by the menu of subprograms 1 to 7. Press the LOCAL key briefly to select and carry out the test required. Press LOCAL again for about 1 second to return to the subprogram menu. To leave the test program, either press RESET or turn off the instrument.



### Program 1: Display Test

This test checks the operation of the liquid crystal display and the respective decoders/drivers.

When the text "Pro. 1" appears in the subprogram menu, press the LOCAL key to select the display test. The letters "dISP" appear in the display, whereupon each segment of the display is switched on one after the other. The generator waits with its total display lit up until either you press LOCAL to take it back to the program menu or until you leave the test program.

### Program 2: Keyboard Test

This test checks the function of each key as well as those of the keyboard decoder.

Select this test and the letters "bUTT" (button) appear in the display. Press any key at random, except LOCAL, and the current number of this key will appear in the display together with a control number, e.g., 12-2 when key DC is pressed. This control number is generated by the keyboard decoder and can be changed to 0, 1, 2, or 3 by pressing this key again. The keys are numbered row by row from left to right. Thus, for example, the key SINGLE has the number 5 and the key ADDR the number 11. To return to the program menu, press LOCAL.

### Program 3: Memory Register Test

This test checks the memory registers 1 to 9 for the storage of the generator settings and register 0 which stores the last setting before the instrument is switched off. The contents of these registers are not written over or deleted during the test and can be used as normal when the test has been completed.

This test runs automatically. The display continually shows the numbers of the registers being tested. If the test is finished without detecting any errors, the display will read "PASS"; if it finds an error, then it will read "Error".

To return to the program menu, press the LOCAL key.

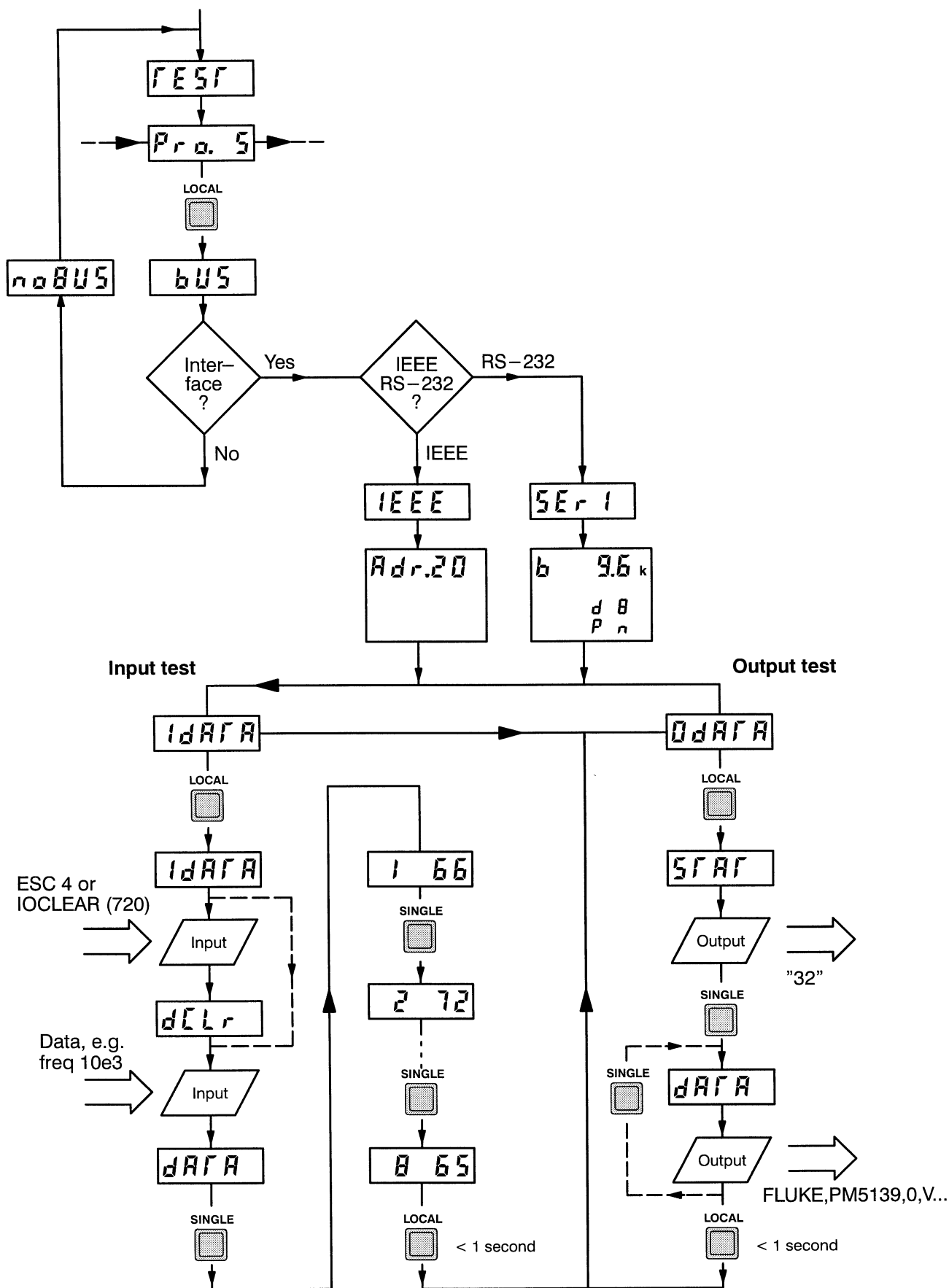
### Program 4: Strobe Test (Test of the internal interfaces)

This test serves to test the internal data transfer to the shift registers whose outputs can be set to "High" or "Low" at the touch of a key. The purpose of the test is to help the Service Technician locate an error. Details are given in the Service Manual.

### Program 5: Interface Test (RS-232 or IEEE-488)

This test checks the built-in interface, its input and output buffers, and the correct coding and decoding of the data transferred.

The test automatically checks which interface is actually available; if none, "noBUS" will appear in the display and the instrument returns to the program menu. In instruments with an interface, there is a choice between an input test ("IdATA") and an output test ("OdATA"). Selection is done by pressing the LOCAL key. For the IEEE-488 interface the device address is set to 20. The configuration for the RS-232 interface is: Baud rate 9600, data bits 8, parity no. Using the RS-232 Interface the instrument must be set with ESC 2 to remote.



#### Input test:

The display shows "dCLr" when the interface command "IOCLEAR(720)" or "ESC 4" has been received. When data to set the instrument are received, the display will show "dATA", and the first eight figures of the string can be shown individually in hexadecimal form by pressing the SINGLE or CONT keys. The data input can be repeated as often as desired.

Press LOCAL for less than 1 second and the program will return to the selection between input and output test.

#### Output test:

The letters "STAT" appear. All bits of the Standard Event Status Register are set to "1". If the bits of the Standard Event Status Enable Register were set to "1" with the command \*ESE 255 the MAV bit of the Status Byte Registers will be set to "1". The controller can ask for the contents of the Status Byte with serial poll or with the query \*STB? (IEEE-488) respectively with ESC 7 for the RS-232 interface. The Standard Event Status Register can also be read out by a controller with query \*ESR?. The SINGLE or CONT keys set the bits to "0", the letters "dATA" appear in the display, and the controller can read in the identification string "FLUKE,PM5139,0,Vx.x" (x.x = software version).

Press LOCAL for less than 1 second and the program returns to the selection between the input and output test; press LOCAL longer, and the program returns to the test program menu.

### Program 6: Rotary Knob Test

This test checks whether the direction of rotation is recognized (display "L" or "r"). The display also shows a number of pulses, dependent on the speed of rotation. "Error" shows that there may be an error.

### Program 7: EEPROMs Test (PM5139/02 and PM5139/03 only)

This test checks the memory registers for the arbitrary waveforms. The contents of these registers are not written over or deleted during the test. If the test finishes without detecting any errors, the display reads "PASS"; if the test finds an error, the display reads "Error".

To return to the program menu, press the LOCAL key.

## 4 CHARACTERISTICS

### 4.1 SAFETY AND EMC REQUIREMENTS

The PM5139 Function Generator 0.1 mHz – 20 MHz is

**in accordance with EN 61010-1 (safety requirements),**

an instrument for measurement and test including accessories

- intended for professional, industrial process, and educational use.
- Overvoltage Category II, Pollution Degree 2.

**in accordance with EN 55011 (radio interference suppression),**

an ISM equipment (industrial, scientific, and medical RF-equipment)

- of Group I,  
which intentionally generates and/or uses conductively coupled radio frequency energy which is necessary for the internal functioning of the equipment itself.
- of Class B,  
suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

**in accordance with EN 50082-1 (radio frequency immunity)**

an instrument for use in all locations which

- are characterized by being supplied directly at low voltage from the public mains.
- are considered to be residential, commercial or light-industrial, both indoor and outdoor.

### 4.2 PERFORMANCE CHARACTERISTICS, SPECIFICATIONS

Properties expressed in numerical values with stated tolerances are guaranteed by the manufacturer. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.

This specification is valid after the instrument has warmed up for 30 minutes and the generator output terminated with a 50 ohm load. For reference conditions see Sections 4.14 and 4.15. If not stated otherwise, relative or absolute tolerances relate to the set value.

### 4.3 FREQUENCY, RESOLUTION

Frequency range	0.1 mHz – 20 MHz	Depending on function and waveform
Subranges		Resolution
I	0.1 mHz – 0.2 Hz	0.1 mHz
II	1 mHz – 2 Hz	1 mHz
III	10 mHz – 20 Hz	10 mHz
IV	100 mHz – 200 Hz	100 mHz
V	1 Hz – 2 kHz	1 Hz
VI	10 Hz – 200 kHz	10 Hz
VII	100 Hz – 2 MHz	100 Hz
VIII	1 kHz – 20 MHz	1 kHz

Display	LCD: liquid crystal backlit display	
Setting	2 step keys, rotary knob	÷ 10    x10
Setting error limit	±2 ppm	
Temperature Coefficient limit	±0.2 ppm/K	
Short-term drift	±0.25 ppm	Within 15 min
Long-term drift	±0.3 ppm	Within 7 hours
Aging rate	±1 ppm	Within 1 year
Frequency noise rms deviation	<10 ppm, typ. 1 ppm <100 Hz, typ. 13 Hz	f ≤ 10 MHz } meas. bandwidth f > 10 MHz } 10 Hz – 20 kHz

#### 4.4 SYNCHRONIZATION

External frequency	10 MHz/N	N = 1, 2, 3 ... 10
Capture range	±0.2 %	
Lock-in time	<2 s	
Input terminal	REFERENCE INPUT	BNC connector
– Input impedance	50 Ω	
– Input waveform	Sine, square	
– Input level	0 – 20 dBm	
Output terminal	10 MHz OUTPUT	Short-circuit proof at 50 Ω load
– Output level	2 dBm, >0 dBm	
– Output impedance	50 Ω	
– Output frequency	10 MHz	Error limits and temperature coefficient as output frequency; several instruments can be synchronized by a single reference

#### 4.5 WAVEFORMS

Selectable waveforms	Sine	Frequency range 0.1 mHz – 20 MHz
	Triangle	0.1 mHz – 0.5 MHz
	Square	0.1 mHz – 20 MHz
	Pos. pulse	0.1 mHz – 20 MHz } 10 MHz for LOW Zo
	Neg. pulse	
	Pos. sawtooth	0.1 mHz – 50 kHz
	Neg. sawtooth	0.1 mHz – 50 kHz
	Haversine	0.1 mHz – 50 kHz
	Sine pulse	0.1 mHz – 50 kHz
	Triangle pulse	0.1 mHz – 50 kHz
	Arbitrary (ARB)	0.1 mHz – 20 kHz (see Sect. 4.10)

Asymmetry	1 % – 99 % Resolution 1 %	≤ 20 kHz; sine, square, triangle, pos./neg. pulses
	20 % – 80 % Resolution 1 %	20 kHz – 5 MHz; square, pos./neg. pulses
Asymmetry	±0.1 %	< 20 kHz
Absolute error limits	±1.0 % ±2.0 % ±5.0 %	20 kHz – 1 MHz > 1 MHz – 2 MHz > 2 MHz – 5 MHz

## 4.6 WAVEFORM CHARACTERISTICS

### 4.6.1 Sine Wave

	1 Hz – 0.5 MHz	> 0.5 – 5 MHz	> 5 MHz	> 10 MHz	Amplitude > 20 mV, MOD OFF
THD	< 0.4 %	–	–	–	Amplitude < 70 % of subrange maximum
Harmonics *	< –48 dBc	< –40 dBc	< –36 dBc	< –34 dBc	Amplitude < 70 % of subrange maximum
Sub-harmonics	< –60 dBc	< –60 dBc	< –38 dBc	< –38 dBc	–
Non-harmonics	< –37 dBc	< –37 dBc	< –37 dBc	< –37 dBc	30 kHz band centered on carrier and frequencies > 100 MHz excluded
Phase noise	< –80 dBc/Hz	< –80 dBc/Hz	< –80 dBc/Hz	< –80 dBc/Hz	At 1 kHz distance from carrier

\* Add +6 dBc for amplitudes higher than 70 % of subrange maximum

### 4.6.2 Square Wave and Rectangular Pulses

Rise/fall time		For MOD OFF and 50 % symmetry setting
	≤ 30 ns	f ≤ 500 kHz
	≤ 20 ns	f > 500 kHz
Aberration (overshoot, ringing, tilt)	± 2 %	Amplitude > 100 mV

### 4.6.3 Triangle and Sawtooth

Linearity error	< 0.2 %	f < 20 kHz
-----------------	---------	------------

## 4.7 SIGNAL OUTPUT

**Output Impedance** 50 Ω  
LOW Zo

LOW Zo AC amplitude ≥ 2.0 V  
Impedance  $Z_o = 0.36 \Omega + 32 \Omega \times (f/20 \text{ MHz})$   
Max. current range -250 mA ... +250 mA  
Min. load resistor 40 Ω AC amplitude ≥ 10 V  
V/250 mA AC amplitude < 10 V  
( $\Delta$  40 Ω for 10 V)

**AC Output Amplitude** 0 - 20 V pp, open circuit voltage

Subrange I 0 - 0.200 V Resolution 1 mV  
II 0.20 - 2.00 V 10 mV  
III 2.0 - 20.0 V 100 mV  
Half the amplitude values for pulses, sawtooth, haversine

	<0.2 MHz	0.2 - 5 MHz	5 - 10 MHz	>10 MHz	Amplitude
Error limits for MOD OFF, FM, SWEEP	±2.0 %	±2.5 %	±4.0 %	±6 %	0.01 - 20 V
Amplitude flatness for MOD OFF, FM, SWEEP	±0.1 dB	±0.2 dB	±0.25 dB	±0.5 dB	} 0.01 - 20 V
	±0.03 dB typ.	±0.07 dB typ.	0.1 dB typ.	±0.4 dB typ. ±0.15 dB typ.	

Temp. coeff. limits for ±0.1 %/K ≤ 5 MHz  
MOD OFF, FM, SWEEP ±0.15 %/K > 5 MHz

**DC Offset Voltage** -10.0 V ... +10.0 V Open circuit; resolution 0.1 V, can be set independently on the ac amplitude within a ±10 V window

Error limits ±2 % ±50 mV

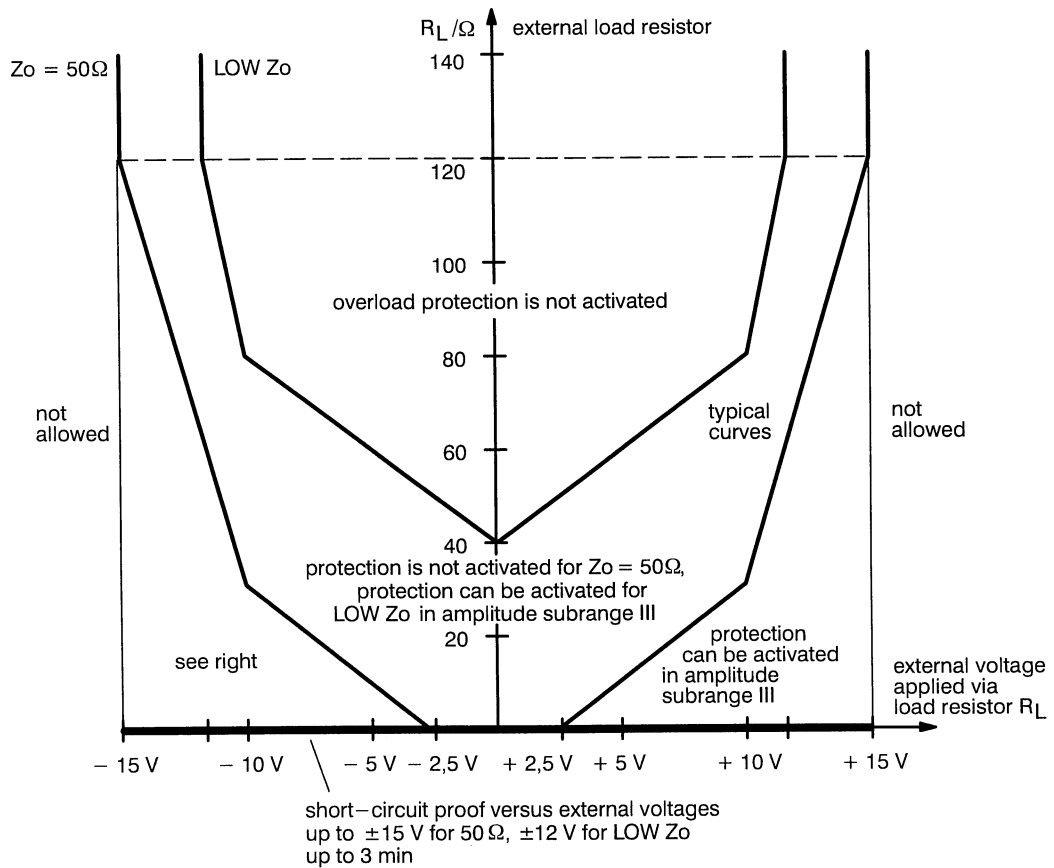
Temperature coeff. ±2.0 mV/K For MOD OFF, FM, SWEEP  
±2.5 mV/K For AM, PSK, GATE, BURST

**Output Load Capability** Short-circuit proof Max. external voltage  
±15 V for Zo 50 Ω,  
±12 V for LOW Zo, up to 3 min

Max. capacitive load, 100 nF Zo 50 Ω  
not activating the 0.5 nF LOW Zo, pos./neg. pulse  
protector 1.0 nF LOW Zo, other waveforms



**Overload Protection** Can be activated in amplitude subrange III with respect to the conditions shown in the diagram; it protects the instrument



See also Section 3.5.9.2: Error 5

## 4.8 MODULATION

Carrier waveforms	all	Except PSK, see Section 4.8.3
Internal modulation frequency	10 Hz – 100 kHz	Sine wave for AM, FM TTL signal for PSK, GATE, BURST
Subranges	10 Hz – 100 Hz 100 Hz – 1 kHz 1 kHz – 100 kHz	Resolution 1 Hz 10 Hz 100 Hz
Additional for BURST	0.001 Hz – 0.1 Hz 0.1 Hz – 1 Hz 1 Hz – 10 Hz	0.001 Hz 0.01 Hz 0.1 Hz
Error limits	±0.1 %	

**4.8.1 Amplitude Modulation (AM)**

Carrier frequency range	Total range	Related to waveform
Carrier amplitude pp for $m = 0$	Reduced by 6 dB	
Envelope THD for $m \leq 90\%$	$<0.7\%$ $<0.5\%$ ; typ. $0.15\%$	$f \leq 15\text{ MHz}$

**Amplitude Modulation, Internal**

Modulation depth	$m = 0 - 100\%$	Resolution $1\%$
Absolute error limits	$\pm 1\%$ $\pm 2\%$ $\pm 4\%$	Mod. freq. $\leq 20\text{ kHz}$ , carrier $\leq 2\text{ MHz}$ Mod. freq. $\leq 20\text{ kHz}$ , carrier $\leq 5\text{ MHz}$ General

**Amplitude Modulation, External**

Mod. frequency range	$0 - 200\text{ kHz}$	
Modulation depth	$m = 0 - 100\%$	
Mod. input voltage, pp	$1\text{ V}$ for $m = 100\%$	$+0.5\text{ V}$ DC: $0\%$ of AC display $0\text{ V}$ DC: $50\%$ of AC display $-0.5\text{ V}$ DC: $100\%$ of AC display

**4.8.2 Frequency Modulation (FM)**

Carrier freq. range	Complete ranges	Related to waveform
Modulation THD	$<0.4\%$ , typ. $0.12\%$	For $1\%$ deviation
Residual FM		As unwanted FM deviation, see Section 4.3

**Frequency Modulation, Internal**

Frequency deviation	$0 - 2\%$	Resolution $0.01\%$
Absolute error limits	$\pm 0.03\%$ $\pm 0.2\%$	Mod. freq. $\leq 20\text{ kHz}$ General

**Frequency Modulation, External**

Mod. freq. range	$10\text{ Hz} - 200\text{ kHz}$	
Frequency deviation	$0 - 2\%$	
Mod. input voltage, pp	$1\text{ V}$	For $2\%$ frequency deviation

**4.8.3 Phase Shift Keying (PSK)**

The carrier phase is keyed between  $0^\circ$  and  $180^\circ$  ( $\pi$ ); non-coherent

Carrier waveforms      Sine, triangle, square

Carrier freq. range      Total range      Related to waveform

**Phase Shift Keying, Internal**

Keying frequency      10 Hz – 100 kHz

Duty cycle      50 %

**Phase Shift Keying, External**

Keying frequency      0 – 200 kHz      TTL signal

Phase difference OUT-       $0^\circ$  for  $f \leq 20$  kHz      MOD IN high  
PUT to TTL OUTPUT       $180^\circ$  for  $f > 20$  kHz      MOD IN high

**4.8.4 Gate**

The modulating signal switches the carrier on and off; non-coherent

Carrier freq. range      Total range      Related to waveform

**Gate, Internal**

Keying frequency      10 Hz – 100 kHz

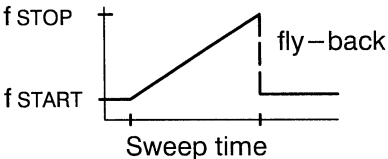
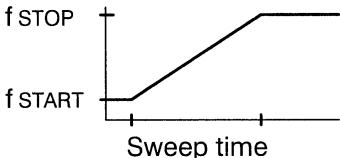
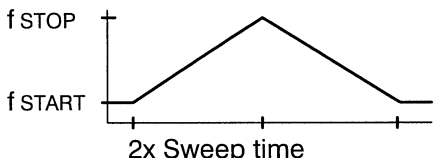
Duty cycle      50 %

**Gate, External**

Keying frequency      0 – 200 kHz      TTL signal

Relation OUTPUT/      Output signal blanked      For MOD INPUT high  
MOD INPUT

**4.8.5 Sweep**

Sweep operating modes	SINGLE sweep CONTInuous sweep	
	HOLD/release	Stops and releases the sweep
	Reset to fSTART	By pressing SINGLE respectively CONT once more
Sweep characteristic	Linear Logarithmic	
	Up Down	fSTART < fSTOP fSTART > fSTOP
Mode – 1 –	Sweep runs from fSTART to fSTOP, fly-back to fSTART	
Mode – 2 –	Sweep runs from fSTART to fSTOP and remains at fSTOP	
		For CONT mode 1 and mode 2 are identical
Mode – 3 –	Sweep runs from fSTART to fSTOP and back to fSTART	
Carrier waveforms	all	
Max. sweep range	1 MHz – 10 MHz 50 kHz – 20 MHz	If fSTART or fSTOP > 10 MHz
Sweep time T	10 ms – 1000 s	
Resolution for Sweep time	10 ms 100 ms 1 s	10 ms – 10 s 10 s – 100 s 100 s – 1000 s
Number of frequency steps	1000 per second = 1 step per 1 ms	



## 4.9 STORAGE AND RECALL OF INSTRUMENT SETTINGS

Number of storage registers	10	Nonvolatile; in register 0 the actual setting is automatically stored
Storage time	Approximately 7 years (depends on the age of the battery)	
Battery	Lithium battery	

## 4.10 REMOTE CONTROL

All instrument functions can be remotely controlled except the sweep function HOLD. Additionally the instrument has twenty-four arbitrary waveform facilities.

The commands consists of header and data element, command set see Section 3.7.4.

Digits exceeding the resolution of the subranges are internally rounded. For frequency settings >200 kHz increased resolution of 10 Hz can be used; not for sweep.

### 4.10.1 IEEE-488 Interface (PM5139/02)

Galvanical insulation	opto-electronical	
Interface functions	AH1: acceptor handshake SH1: source handshake L3: listener function L1: listener only T6: talker function RL1: remote/local with local lockout	SR1: service request SRQ C0: no control function DC1: device clear function DT1: device trigger function PP0: no parallel poll E2: tri-state drivers
Device address	1 – 30, LO	LO (= 31) is reserved for listener only mode (L1)
Remote lock-out	LOCAL key	Can be disabled by LLO
Service request	Error messages, end message for single sweep or burst; Service request asks for operating by the controller	

**4.10.2 RS-232 Interface (PM5139/03)**

Galvanical insulation	opto-electronical
Operating modes	Communication Mode / Listener Only Mode
Baud rate	110, 150, 300, 600, 1200, 2400, 4800, 9600, or 19200 baud
Data bits	7 or 8
Stop bits	1, 2 for 110 baud
Parity check	odd, even or none (none for 8 data bits only)
X <sub>ON</sub> /X <sub>OFF</sub> handshake	on or off
Hardware handshake	DSR/DTR and CTS/RTS
Connector	9-pin D-connector (male)

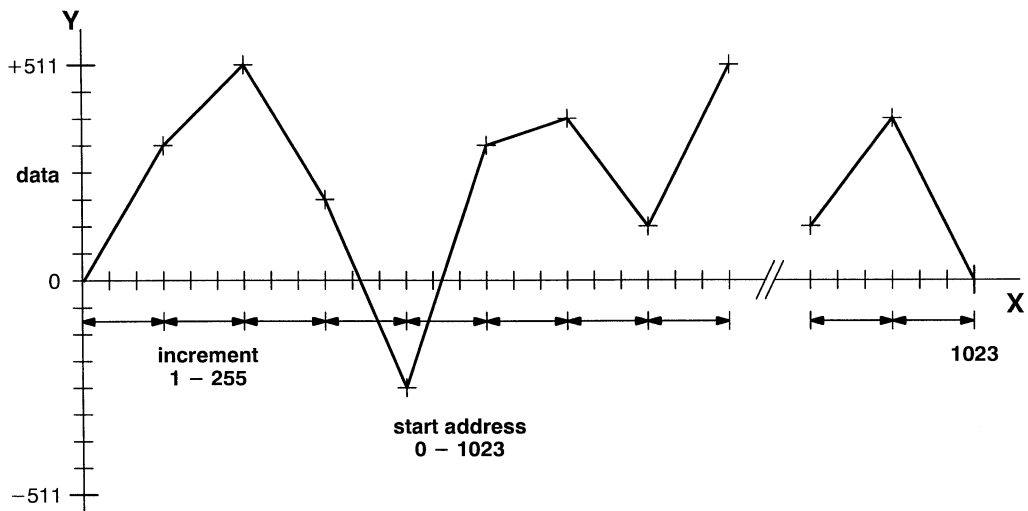
**4.10.3 Timing**

Generator response time (approximately):		Transfer time:	
Frequency	7 ms	Per byte IEEE-488	0.56 ms
Amplitude	7 ms	RS-232	depends on baud rate
Waveform	39 to 51 ms	Learn string	160 to 250 ms
Modulation mode	5 to 6 ms	Identification string	<52 ms

**4.10.4 Arbitrary Waveforms**

Up to twenty-four different arbitrary waveforms are defined by sample addresses (X-axis) with assigned waveform data (Y-value) which are sent as programming data to the internal generator RAM. This can be done by a controller via IEEE-488 or RS-232 interface. It can also directly be done in listener only mode by a digital storage oscilloscope using the graphic language HPGL or the Fast Transfer Mode, depending on the Philips/Fluke oscilloscope.

Start address	0 – 1023	
Address increment	1 – 255	Interval between two addresses
Waveform data	–511 to 0 to +511	Y-value
Frequency range	0.1 mHz – 20 kHz	Repetition rate of a complete ARB waveform
Max. sample rate	20.48 MS/s	For 20 kHz output frequency (MS/s = mega samples per second)
Max. output Amplitude pp, Vmax (open circuit)	$\left\{ \frac{(Y_{max} - Y_{min})}{1022} \times 20 \text{ V} \right.$	Ymax – Ymin ≥ 6 For conversion to Vpp all digits behind the 1st position behind the decimal point are ignored.
Subrange		Resolution
I	0 – Vmax/100	1 mV
II	Vmax/100 – Vmax/10	10 mV
III	Vmax/10 – Vmax	100 mV
Error limits	±2.0 % ±0.7 mV ±1.75 % ± 7 mV ±1.5 % ± 70 mV	Subrange I II III





## 4.11 CONNECTORS

Front panel	OUTPUT	BNC connector, signal output $Z_o$ 50 $\Omega$ or LOW $Z_o$
Rear panel	REFERENCE INPUT	BNC connector, for external synchronization, see Section 4.4.
	MOD/TRIG INPUT	BNC connector, for external modulation or trigger signal, see Section 4.8.
	10 MHz OUTPUT	BNC connector, reference output, Section 4.4.
	MODULATION OUTPUT	BNC connector, $Z_o = 600 \Omega$ (1 k $\Omega$ for AM or FM int.), internal modulation signal 1 V(pp) sine wave for AM and FM INT; TTL signal for PSK, GATE and BURST, or feedthrough of MOD INPUT signal, see Section 4.8.
	PEN LIFT OUTPUT	BNC connector, electronic switch: closed 0 V / $Z_o = 200 \Omega$ open +5 V / $Z_o = 20 \text{ k}\Omega$
	SWEEP OUTPUT	BNC connector, sweep voltage proportional to frequency, 0 – 10 V ( $f_{\text{START}} - f_{\text{STOP}}$ ), $Z_o = 10 \text{ k}\Omega$
	TTL OUTPUT	BNC connector, $Z_o = 50 \Omega$ , fan out 4 TTL inputs, in-phase with OUTPUT signal $f > 20 \text{ kHz}$ , antiphase for $f \leq 20 \text{ kHz}$
	IEEE-488/RS-232	IEEE-488 interface connector, PM5139/02; 9-pin D-connector (male), PM5139/03

## 4.12 ERROR MESSAGES

Unallowed settings are indicated by flashing of the incompatible settings or their combinations.

## 4.13 SELF-TEST ROUTINE, DIAGNOSTIC PROGRAM

After POWER ON the instrument performs a self-test routine, which tests the PROMs, RAMs, and EEPROMs. After this the software version is indicated on the display. All segments of the display field are shown for a moment.

This program also contains a detailed diagnostic part for fault finding.

## 4.14 POWER SUPPLY

### AC line voltage

Nominal values	100/120/220/240 V	Selectable at mains input connector
Reference Value	220 V $\pm$ 2 %	
Nom. operating range	$\pm$ 10 %	Of nominal value
Operating limits	$\pm$ 10 %	Of nominal value
Nom. frequency range	50 – 60 Hz	
– operating limits	47.5 Hz, 63 Hz	
Power consumption	77 VA	

## 4.15 ENVIRONMENTAL CONDITIONS

The following environmental data are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the Fluke organization in your country.

### Ambient temperature:

Reference value	+23 °C $\pm$ 1 K
Nominal working range	+ 5 °C ... +40 °C
Non-operating range	–40 °C ... +70 °C

### Relative humidity:

Reference range	45 % ... 75 %
Nominal working range	20 % ... 80 %
Limit range of use	10 % ... 90 %
Non-operating range	0 % ... 90 %

### Air pressure:

Reference value	1013 hPa
Nominal working range	800 ... 1060 hPa

### Air speed:

Reference range	0 ... 0.2 m/s
Nominal working range	0 ... 0.5 m/s

Heat radiation: Direct sunlight radiation not allowed

### Vibration:

Limits for storage and Transport	Max. amplitude 0.35 mm (10 to 150 Hz), Max. 5 g
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Bump acceleration limit: 10 g

Operating position: Normally upright on feet or with bow fold down

Warm-up time: 30 min

## 4.16 SAFETY- AND QUALITY DATA; CABINET

Safety	According to Low Voltage Directive 73/23/EEC, EN 61010–1 CAT II Pollution Degree 2 CSA 22.2 no. 231
Protection type	IP 20 (IEC 529)
EMC	According to Electromagnetic Compatibility Directive 89/336/EEC. Emission according to EN 55 011, Group 1, Class B. Immunity according to EN 50 082-1, inclusive EN 61000–4–2, –3 and –4.
Call rate	<0.10 units per year
MTBF (calculated)	25,000 hours
Cabinet dimensions	– Width 315 mm (12.4") – Height 105 mm (4.13") – Depth 405 mm (15.9") – Weight 6.8 kg (15.2 lb)

## 4.17 ACCESSORIES

### 4.17.1 Standard

Users Manual	4822 872 10203
Power cord	
Fuses	

### 4.17.2 Optional

Service Manual	4822 872 15206
PM9074	Coax cable BNC – BNC, 50 $\Omega$ , 1 m
PM9051	Adapter BNC (male) / banana jack (female)
PM9585	50 $\Omega$ termination, 1 W
PM9581	50 $\Omega$ termination, 3 W
PM9563	19 inch rack mount adapter (3 E high)
PM9564	19 inch rack mount adapter (2 E high)
PM2295/10	IEEE bus cable, 1 m
PM2295/20	IEEE bus cable, 2 m
PM9536/041	RS-232 cable, 3 m



## 5 PERFORMANCE TEST

### 5.1 INTRODUCTION

The information in the following paragraphs describes the performance tests for the key parameters of the PM5139 Function Generator using the instrument specifications (Chapter 4) as the performance standard.

These performance tests may be used as an acceptance test upon receipt of the instrument, as an indication that repair and/or adjustment is required, or as a performance verification after repairs or adjustment of the instrument. The PM5139 must be warmed up with all covers in place for at least 30 minutes before starting the performance tests. For reference conditions, see Sections 4.14 and 4.15. The test result requirements in the tables of the following sections do not take into account the tolerances of the measuring equipment.

If not stated otherwise the output impedance of the generator must be set to  $Z_0$  50  $\Omega$ .

### 5.2 RECOMMENDED TEST EQUIPMENT

- 50  $\Omega$  feedthrough termination
- Wideband oscilloscope ( $t_r < 3.5$  ns); PM 3295
- DC voltmeter, resolution  $< 100$   $\mu$ V; PM 2535
- Counter/timer; PM 6654
- Spectrum analyzer; HP 8590 A
- RMS voltmeter; Fluke 8920 A
- Distortion meter, resolution 0.01 %; PM 6309
- Power meter; HP 436A with power sensor HP 8482A
- Modulation analyzer; Rohde & Schwarz FAM
- Reference synthesizer, accuracy  $\pm 10^{-6}$ ; PM 5192

### 5.3 SELF-TEST ROUTINE

When turned on, the instrument performs a self-test that checks the PROMs, RAMs, and EEPROMs. After this the software version is indicated in the upper line of the display for about 1 second. All segments of the display field are shown for about 2 seconds and the instrument is set to that operating mode to which it was set before POWER OFF.

The output signal with the corresponding parameters is now available at the OUTPUT socket.

A possible fault is indicated by "Err" followed by a digit.  
For detailed information, see Section 3.5.9.

## 5.4 PERFORMANCE VERIFICATION

### 5.4.1 Frequency

#### 5.4.1.1 Frequency Accuracy Test




**Test Equipment:**

- Frequency counter

**Procedure:**

- Connect the PM5139 OUTPUT to the frequency counter.
- Set the counter to 10 seconds gate time.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	1 MHz	OFF	10 V	0	0.999998 MHz to 1.000002 MHz
	1 MHz	OFF	10 V	0	9.99998 MHz to 10.00002 MHz
	1 MHz	OFF	10 V	0	19.99996 MHz to 20.00004 MHz

#### 5.4.1.2 Frequency Noise RMS Deviation


**Test Equipment:**

- Modulation analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the modulation analyzer.
- Set the modulation analyzer to the RMS measuring mode and LF-measuring bandwidth to 10 Hz to 20 kHz.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	5.000 MHz	OFF	10 V	0	<35 Hz
	10.000 MHz	OFF	10 V	0	<71 Hz
	10.199 MHz	OFF	10 V	0	<71 Hz
	15.715 MHz	OFF	10 V	0	<71 Hz
	20.000 MHz	OFF	10 V	0	<71 Hz

## 5.4.2 10 MHz Synchronization



### 5.4.2.1 Synchronization Capture Range

#### Test Equipment:

- Reference synthesizer
- Counter

#### Procedure:

- Connect the TTL-output of the reference synthesizer to REF INPUT of PM5139.
- Connect the PM5139 OUTPUT to the counter.
- Set the counter to 1 second gate time.
- Set the reference synthesizer to the frequencies in the following table.

Waveform	Frequency	Modulation Mode	Output Voltage		Reference Frequency	Test Result Requirement
			ACpp	DC		
	1 MHz	OFF	10 V	0	0.998 MHz	0.998 MHz
	1 MHz	OFF	10 V	0	1.002 MHz	1.002 MHz

### 5.4.2.2 10 MHz OUTPUT Level

#### Test Equipment:

- RMS voltmeter
- 50  $\Omega$  feedthrough termination

#### Procedure:

- Connect RMS voltmeter to the 10 MHz OUTPUT of PM5139.
- Set RMS voltmeter to dBm and 50  $\Omega$  reference via 50  $\Omega$  feedthrough termination.



**Test Result Requirement:** 0 to 5 dBm





**5.4.3 Waveform Asymmetry**

**Test Equipment:**

- Counter/timer

**Procedure:**

- Connect the PM5139 OUTPUT to the counter input.
- Set the counter to 1 second gate time and time interval measurement (   ).

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Asymmetrie	Test Result Requirement
			ACpp	DC		
	1 kHz	OFF	10 V	0	10 %	99 to 101 μs
	1 kHz	OFF	10 V	0	50 %	499 to 501 μs
	1 kHz	OFF	10 V	0	90 %	899 to 901 μs
	1 MHz	OFF	10 V	0	20 %	190 to 210 ns
	1 MHz	OFF	10 V	0	50 %	490 to 510 ns
	1 MHz	OFF	10 V	0	80 %	790 to 810 ns
	2 MHz	OFF	10 V	0	20 %	90 to 110 ns
	2 MHz	OFF	10 V	0	50 %	240 to 260 ns
	2 MHz	OFF	10 V	0	80 %	390 to 410 ns
	5 MHz	OFF	10 V	0	20 %	30 to 50 ns
	5 MHz	OFF	10 V	0	50 %	90 to 110 ns
	5 MHz	OFF	10 V	0	80 %	150 to 170 ns

**5.4.4 Sine Wave**

**5.4.4.1 Total Harmonic Distortion Test at 1 kHz**


**Test Equipment:**

- Distortion meter

**Procedure:**

- Connect the PM5139 OUTPUT to 50 Ω feedthrough termination at the distortion meter input.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	1 kHz	OFF	14 V	0	<0.4 %



**5.4.4.2 Harmonic Components**

**Test Equipment:**

- Spectrum analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the spectrum analyzer; be careful not to overload the analyzer input. Overloading the analyzer causes it to generate harmonics, thus invalidating the test.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
~	0.5 MHz	OFF	14 V	0	< -48 dBc
	0.5 MHz	OFF	20 V	0	< -42 dBc
~	5 MHz	OFF	14 V	0	< -40 dBc
	5 MHz	OFF	20 V	0	< -34 dBc
~	10 MHz	OFF	14 V	0	< -36 dBc
	10 MHz	OFF	20 V	0	< -30 dBc
~	20 MHz	OFF	14 V	0	< -34 dBc
	20 MHz	OFF	20 V	0	< -28 dBc

**5.4.4.3 Subharmonic Components (level at 1/2 of carrier frequency)**

**Test Equipment:**

- Spectrum analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the spectrum analyzer.

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
~	10 MHz	OFF	20 V	0	< -60 dBc
	11 MHz	OFF	20 V	0	< -38 dBc
	18 MHz	OFF	20 V	0	< -38 dBc
	20 MHz	OFF	20 V	0	< -38 dBc

**5.4.4.4 Non Harmonic Components**






**Test Equipment:**

- Spectrum analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω input of the spectrum analyzer.
- Measure the relative level of the non-harmonic components, >15 kHz distanced from the carrier.
- Measuring frequency range 0 to 100 MHz.

**Generator settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	500 kHz	OFF	10 V	0	< -37 dBc
	500 kHz	OFF	20 mV	0	< -37 dBc
	5 MHz	OFF	10 V	0	< -37 dBc
	5 MHz	OFF	20 mV	0	< -37 dBc
	10 MHz	OFF	10 V	0	< -37 dBc
	10 MHz	OFF	20 mV	0	< -37 dBc
	18 MHz	OFF	10 V	0	< -37 dBc
	18 MHz	OFF	20 mV	0	< -37 dBc
	20 MHz	OFF	10 V	0	< -37 dBc
	20 MHz	OFF	20 mV	0	< -37 dBc

**5.4.5 Square Wave and Rectangular Pulses**

**5.4.5.1 Rise and Fall Times**

**Test Equipment:**

- Wideband scope; tr <3.5 ns

**Procedure:**

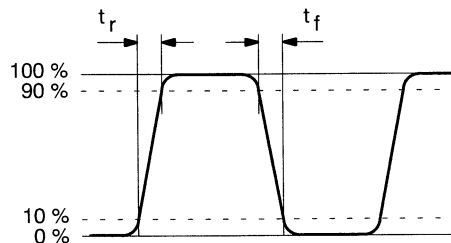
- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the scope.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
□	20 kHz	OFF	20 V	0	tr,tf ★ < 30 ns
	20 kHz	OFF	100 mV	0	
□	20.01 kHz	OFF	20 V	0	< 30 ns
	20.01 kHz	OFF	100 mV	0	< 30 ns
□	50 kHz	OFF	20 V	0	< 30 ns
	50 kHz	OFF	100 mV	0	< 30 ns
□	100 kHz	OFF	20 V	0	< 30 ns
	100 kHz	OFF	100 mV	0	< 30 ns
□	200 kHz	OFF	20 V	0	< 30 ns
	200 kHz	OFF	100 mV	0	< 30 ns
□	500 kHz	OFF	20 V	0	< 30 ns
	500 kHz	OFF	100 mV	0	< 30 ns
□	501 kHz	OFF	20 V	0	< 20 ns
	501 kHz	OFF	100 mV	0	< 20 ns

Repeat these steps with positive and negative pulses, □ □, AC pp 10 V and 50 mV.

★ tr = rise time  
 tf = fall time  
 for 50 % symmetry  
 setting



**5.4.5.2 Overshoot, Ringing, Tilt**


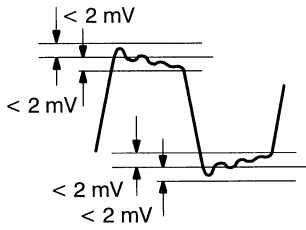

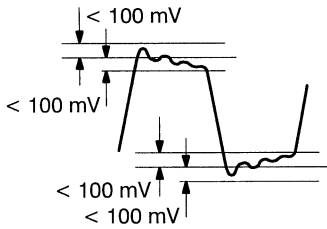

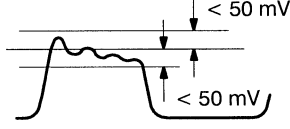

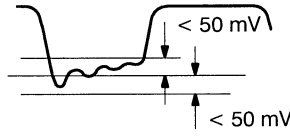
**Test Equipment:**

- Wideband scope

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the scope.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	2 MHz	OFF	0.199 V	0	
	2 MHz	OFF	10 V	0	
	2 MHz	OFF	5 V	0	
	2 MHz	OFF	5 V	0	

**5.4.6 AC Output Amplitude**

**5.4.6.1 AC Voltage Accuracy Test in the Frequency Range  $\leq 200$  kHz**





**Test Equipment:**

- RMS voltmeter

**Procedure:**

- Connect the PM5139 OUTPUT to the 50  $\Omega$  feedthrough termination at the RMS voltmeter input.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
	10 kHz	OFF	150 mV	0	26.0 to 27.0 mV
	10 kHz	OFF	0.21 V	0	36.4 to 37.9 mV
	10 kHz	OFF	1.50 V	0	0.260 to 0.270 V
	10 kHz	OFF	2.00 V	0	0.347 to 0.360 V
	10 kHz	OFF	2.1 V	0	0.364 to 0.378 V
	10 kHz	OFF	10 V	0	1.733 to 1.803 V
	10 kHz	OFF	20 V	0	3.465 to 3.606 V
	200 kHz	OFF	150 mV	0	25.9 to 27.2 mV
	200 kHz	OFF	0.21 V	0	36.2 to 38.0 mV
	200 kHz	OFF	1.50 V	0	0.259 to 0.272 V
	200 kHz	OFF	2.00 V	0	0.345 to 0.362 V
	200 kHz	OFF	2.1 V	0	0.362 to 0.380 V
	200 kHz	OFF	10 V	0	1.725 to 1.812 V
	200 kHz	OFF	20 V	0	3.449 to 3.624 V
	10 kHz	OFF	150 mV	0	36.8 to 38.2 mV
	10 kHz	OFF	0.21 V	0	51.5 to 53.5 mV
	10 kHz	OFF	1.50 V	0	0.368 to 0.382 V
	10 kHz	OFF	2.00 V	0	0.490 to 0.510 V
	10 kHz	OFF	2.1 V	0	0.515 to 0.535 V
	10 kHz	OFF	10 V	0	2.450 to 2.550 V
	10 kHz	OFF	20 V	0	4.900 to 5.100 V
	10 kHz	OFF	150 mV	0	36.8 to 38.2 mV
	10 kHz	OFF	0.21 V	0	51.5 to 53.5 mV
	10 kHz	OFF	1.50 V	0	0.368 to 0.382 V
	10 kHz	OFF	2.00 V	0	0.490 to 0.510 V
	10 kHz	OFF	2.1 V	0	0.515 to 0.535 V
	10 kHz	OFF	10 V	0	2.450 to 2.550 V

**5.4.6.2 AC Voltage Accuracy Test in the Frequency Range >200 kHz**

**Test Equipment:**

- Power meter with power sensor
- 20-dB attenuator

**Procedure:**

- Calibrate and zero the power meter.
- Connect the probe to the PM5139 OUTPUT.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
~	5 MHz	OFF	1.50 V	0	1.34 to 1.48 mW
	5 MHz	OFF	2.00 V	0	2.38 to 2.63 mW
	5 MHz	OFF	2.1 V	0	2.63 to 2.89 mW
	5 MHz	OFF	10 V	0	59.5 to 65.6 mW
	5 MHz	OFF	20 V ★	0	237.5 to 262.6 mW
~	10 MHz	OFF	1.00 V	0	0.58 to 0.68 mW
	10 MHz	OFF	1.50 V	0	1.30 to 1.52 mW
	10 MHz	OFF	2.00 V	0	2.30 to 2.70 mW
	10 MHz	OFF	2.1 V	0	2.55 to 2.98 mW
	10 MHz	OFF	10 V	0	57.8 to 67.6 mW
	10 MHz	OFF	20 V ★	0	231.2 to 270.4 mW
~	20 MHz	OFF	1.00 V	0	0.56 to 0.70 mW
	20 MHz	OFF	1.50 V	0	1.25 to 1.58 mW
	20 MHz	OFF	2.00 V	0	2.23 to 2.80 mW
	20 MHz	OFF	2.1 V	0	2.46 to 3.01 mW
	20 MHz	OFF	10 V	0	55.7 to 70.2 mW
	20 MHz	OFF	20 V ★	0	222.5 to 280.9 mW

★ **Note:** To avoid damage to the power meter, insert a 20-dB attenuator and take into account a power factor of 0.01.

**5.4.7 DC Voltage**

**5.4.7.1 DC Voltage Accuracy Test at AC OFF**

**Test Equipment:**

- DC voltmeter

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the DC voltmeter input.

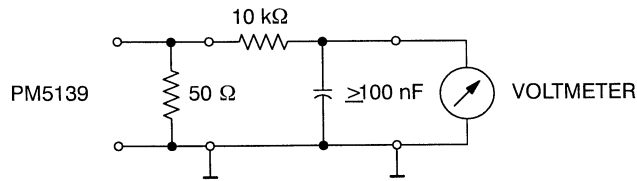
**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
===	1 kHz	OFF	1 V	-10 V	-4.850 to -5.150 V
	1 kHz	OFF	1 V	-9 V	-4.360 to -4.640 V
	1 kHz	OFF	1 V	-8 V	-3.870 to -4.130 V
	1 kHz	OFF	1 V	-7 V	-3.380 to -3.620 V
	1 kHz	OFF	1 V	-6 V	-2.890 to -3.110 V
	1 kHz	OFF	1 V	-5 V	-2.400 to -2.600 V
	1 kHz	OFF	1 V	-4 V	-1.910 to -2.090 V
	1 kHz	OFF	1 V	-3 V	-1.420 to -1.580 V
	1 kHz	OFF	1 V	-2 V	-0.930 to -1.070 V
	1 kHz	OFF	1 V	-1 V	-0.440 to -0.560 V
===	1 kHz	OFF	1 V	-0.1 V	+0.001 to -0.101 V
	1 kHz	OFF	1 V	0 V	-50 to +50 mV
===	1 kHz	OFF	1 V	+0.1 V	-0.001 to +0.101 V
	1 kHz	OFF	1 V	+1 V	+0.440 to +0.560 V
	1 kHz	OFF	1 V	+2 V	+0.930 to +1.070 V
	1 kHz	OFF	1 V	+3 V	+1.420 to +1.580 V
	1 kHz	OFF	1 V	+4 V	+1.910 to +2.090 V
	1 kHz	OFF	1 V	+5 V	+2.400 to +2.600 V
	1 kHz	OFF	1 V	+6 V	+2.890 to +3.110 V
	1 kHz	OFF	1 V	+7 V	+3.380 to +3.620 V
	1 kHz	OFF	1 V	+8 V	+3.870 to +4.130 V
	1 kHz	OFF	1 V	+9 V	+4.360 to +4.640 V
1 kHz	OFF	1 V	+10 V	+4.850 to +5.150 V	

**5.4.7.2 DC Voltage Offset Error Test**

**Test Equipment:**

- DC voltmeter
- Low-pass filter



**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the DC voltmeter input.

Note: Take care that the DC voltmeter does not respond on the AC portion of the tested voltage. If necessary, insert a low-pass filter.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
~	1 MHz	OFF	10 V	0	-50 to +50 mV
	2 MHz	OFF	10 V	0	-50 to +50 mV
	1 MHz steps	.	.	.	.
~	19 MHz	OFF	10 V	0	-50 to +50 mV
	20 MHz	OFF	10 V	0	-50 to +50 mV

Repeat with ACpp = 20 V, test result requirement as above

**5.4.8 Modulation**

**5.4.8.1 Modulation Frequency Accuracy Test**

**Test Equipment:**

- Frequency counter

**Procedure:**

- Connect the PM5139 MODULATION OUTPUT (at the rear of the instrument) to the frequency counter.
- Set the counter to >1 second gate time.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			f <sub>MOD</sub>	m %	
~	1 kHz	AM INT	11 Hz	50	10.989 to 11.011 Hz
~	1 kHz	AM INT	1 kHz	50	999 to 1001 Hz



**5.4.8.2 AM Envelope Distortion Test**

**Test Equipment:**

- Modulation analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the modulation analyzer RF input.
- Set the analyzer to AM, DIST, and the filter to 30 Hz to 20 kHz.

Note: The modulation depth  $m$  of 90 % must be checked with the modulation analyzer. If necessary, change the generator setting.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Modulation Parameter		Output Voltage		Test Result Requirement
			$f_{MOD}$	$m$ %	ACpp	DC	
~	5 MHz	AM INT	1 kHz	90	5 V	0	<0.5 %
	10 MHz	AM INT	1 kHz	90	5 V	0	<0.5 %
	15 MHz	AM INT	1 kHz	90	5 V	0	<0.5 %
	20 MHz	AM INT	1 kHz	90	5 V	0	<0.7 %

**5.4.8.3 Internal AM Modulation Depth ( $m$ ) Accuracy Test**

**Test Equipment:**

- Modulation analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the modulation analyzer.
- Set the analyzer to  $\frac{P+P}{2}$  and the filter to 30 Hz to 200 kHz.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Modulation Parameter		Output Voltage		Test Result Requirement
			$f_{MOD}$	$m$ %	ACpp	DC	
~	2 MHz	AM INT	20 kHz	10	5 V	0	9 to 11 %
	2 MHz	AM INT	.	50	5 V	0	49 to 51 %
	2 MHz	AM INT	.	90	5 V	0	89 to 91 %
~	5 MHz	AM INT	.	10	5 V	0	8 to 12 %
	5 MHz	AM INT	.	50	5 V	0	48 to 52 %
	5 MHz	AM INT	.	90	5 V	0	88 to 92 %
~	20 MHz	AM INT	.	10	5 V	0	6 to 14 %
	20 MHz	AM INT	.	50	5 V	0	46 to 54 %
	20 MHz	AM INT	20 kHz	90	5 V	0	86 to 94 %

Note: Take into account the tolerances of the used modulation analyzer.

**5.4.8.4 FM Distortion Test**


**Test Equipment:**

- Modulation analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the modulation analyzer RF input.
- Set the modulation analyzer to FM, DIST,  $\frac{P+P}{2}$ , and the filter to 30 Hz to 20 kHz.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Modulation Parameter		Output Voltage		Test Result Requirement
			f <sub>MOD</sub>	DEV	ACpp	DC	
	10 MHz	FM INT	1 kHz	1.00 %	5 V	0	<0.4 %

**5.4.8.5 FM Deviation Accuracy Test**



**Test Equipment:**

- Modulation analyzer

**Procedure:**

- Connect the PM5139 OUTPUT to the modulation analyzer.
- Set analyzer to FM,  $\frac{P+P}{2}$ , and the filter to 30 Hz to 200 kHz.

**Generator Settings:**

Waveform (for all)	Frequency	Modulation Mode	Modulation Parameter		Output Voltage		Test Result Requirement
			f <sub>MOD</sub>	DEV	ACpp	DC	
	10 MHz	FM INT	1 kHz	2 %	5 V	0	197 to 203 kHz
	10 MHz	FM INT	·	1.8 %	5 V	0	177 to 183 kHz
	10 MHz	FM INT	·	1.6 %	5 V	0	157 to 163 kHz
	10 MHz	FM INT	·	1.4 %	5 V	0	137 to 143 kHz
	10 MHz	FM INT	·	1.2 %	5 V	0	117 to 123 kHz
	10 MHz	FM INT	·	1.0 %	5 V	0	97 to 103 kHz
	10 MHz	FM INT	·	0.8 %	5 V	0	77 to 83 kHz
	10 MHz	FM INT	·	0.6 %	5 V	0	57 to 63 kHz
	10 MHz	FM INT	·	0.4 %	5 V	0	37 to 43 kHz
	10 MHz	FM INT	1 kHz	0.2 %	5 V	0	17 to 23 kHz
	10 MHz	FM INT	100 kHz	2 %	5 V	0	180 to 220 kHz
	10 MHz	FM INT	·	1.8 %	5 V	0	160 to 200 kHz
	10 MHz	FM INT	·	1.6 %	5 V	0	140 to 180 kHz
	10 MHz	FM INT	·	1.4 %	5 V	0	120 to 160 kHz
	10 MHz	FM INT	·	1.2 %	5 V	0	100 to 140 kHz
	10 MHz	FM INT	·	1.0 %	5 V	0	80 to 120 kHz
	10 MHz	FM INT	·	0.8 %	5 V	0	60 to 100 kHz
	10 MHz	FM INT	·	0.6 %	5 V	0	40 to 80 kHz
	10 MHz	FM INT	·	0.4 %	5 V	0	20 to 60 kHz
	10 MHz	FM INT	100 kHz	0.2 %	5 V	0	0 to 40 kHz

**5.4.8.6 Phase Shift Keying (PSK) Functional Test**


**Test Equipment:**

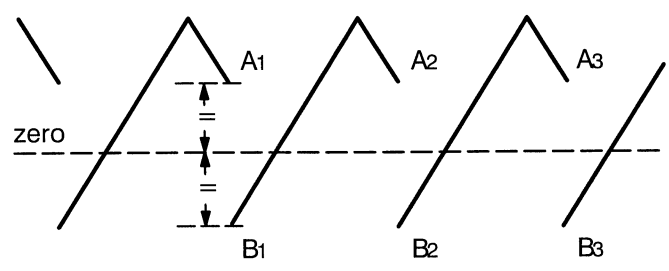
- Scope

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the scope.
- Connect the PM5139 MODULATION OUTPUT to the external trigger input of the scope.
- Set the scope to external trigger and set the trace to the zero voltage line.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Modulation Parameter	Output Voltage		Test Result Requirement
				ACpp	DC	
	1 kHz	PSK INT	$f_{MOD}$ 1 kHz	5 V	0	See drawing



The pairs A,B of the transition points (showing varying distances A – B) must be symmetrical to the zero voltage line.

**5.4.8.7 Gate Functional Test**


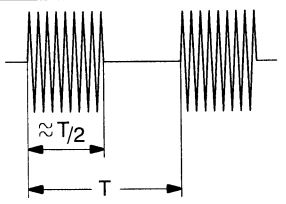
**Test Equipment:**

- Scope

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the scope.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Modulation Parameter	Output Voltage		Test Result Requirement
				ACpp	DC	
	100 kHz	GATE INT	$f_{MOD}$ 1 kHz	5 V	0	

Note: Check the duty cycle of the gated output signal: approximately 50 % and voltage pp 2.5 V.

**5.4.8.8 Sweep Functional Test**


**Test Equipment:**

- Dual channel scope

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at the scope input channel A.
- Connect the PM5139 SWEEP OUT (at the rear of the instrument) to channel B of the scope.
- Set channel B to DC-coupling.
- Set the trigger to channel A.
- Set the scope to chopped mode.

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Modulation Parameter	Output Voltage		Test Result Requirement
				ACpp	DC	
	f <sub>START</sub> 1 kHz  f <sub>STOP</sub> 10 kHz	LIN SWEEP CONT	T = 5 s mode 1	5 V	0	See following text

During the 5-second sweep period, the output frequency is swept from start to stop (channel A), and the SWEEP OUTPUT (channel B) is rising from 0 to +10 V open loop.

- Connect channel B to the PM5139 PEN LIFT OUTPUT (rear).
- Start single sweep by pressing the SINGLE key.

When sweep is running the PEN LIFT voltage (channel B) must be approximately 0 V; at the end of the sweep the PEN LIFT voltage is switched to approximately +5 V.

**5.4.8.9 Burst Functional Test**


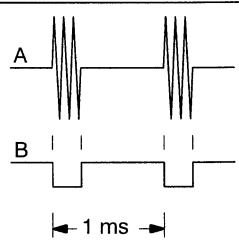


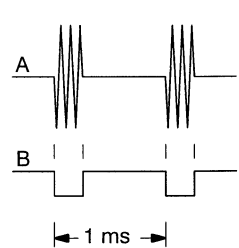

**Test Equipment:**

- Dual channel scope
- External TTL source of 1 kHz

**Procedure:**

- Connect the PM5139 OUTPUT to the 50 Ω feedthrough termination at scope channel A.
- Connect the PM5139 MODULATION OUTPUT (at the rear of the instrument) to channel B of the scope.
- Connect the external 1 kHz-TTL source to the PM5139 MODULATION INPUT (rear).

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Modulation Parameter	Output Voltage		Test Result Requirement
				ACpp	DC	
	10 kHz	BURST INT CONT Repetition frequency (f <sub>MOD</sub> ) 1 kHz φ = 0°	3 ON cycles	5 V	0	
	10 kHz	BURST EXT	3 ON cycles	5 V	0	Must be the same display
	10 kHz	BURST INT CONT Repetition frequency (f <sub>MOD</sub> ) 1 kHz φ = -180° φ = +180°	3 ON cycles	5 V	0	
	10 kHz	BURST EXT	3 ON cycles	5 V	0	Must be the same display

**5.4.9 TTL OUTPUT Level Test**

**Test Equipment:**

- Scope

**Procedure:**

- Connect the PM5139 TTL OUT to the scope (without 50 Ω termination).

**Generator Settings:**

Waveform	Frequency	Modulation Mode	Output Voltage		Test Result Requirement
			ACpp	DC	
–	1 kHz	OFF	–	–	low level: –0.3 to +0.3 V  high level: +4.7 to +5.3 V

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## **FIGURES**

Front View / Rear View

Frontansicht / Rückansicht

Vue avant / vue arrière









**FLUKE PM5139** FUNCTION GENERATOR

0.1 mHz – 20 MHz











**DIAL LOCKED**  
 REMOTE f START  
 ARB  
 DC OFFSET AC PP LOW Z<sub>0</sub>  
 fMOD m DEV f STOP T N φ  
 SYMMETRY REG ADDR  
 MOD-OFF AM FM PSK GATE LIN-SWP-LOG BURST  
 INT EXT-TRIG CONT SGLE **NOT TRIGD HOLD**  
 VAR SYMMETRY VAR DC OFFSET

8.8.8.8.8 MHz  
 kHz  
 -8.8.8 V  
 8.8.8.8 ms DEG  
 % MHz

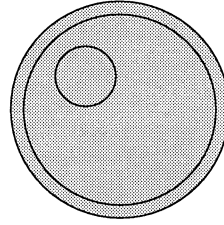
LOCAL  ADDR  RESET 



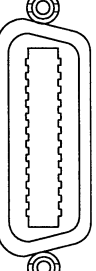
FREQUENCY  WAVEFORM  AC  DC  MOD PARAMETER  MOD MODE 






RANGE  x10  -10 

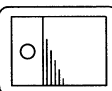

SINGLE  SINGLE  ASYM  STORE  DIAL LOCK  CONT  CONT  50%  RECALL  LOW Z<sub>0</sub> 

OUTPUT  Z<sub>0</sub> 50 Ω / LOW Z<sub>0</sub>



**INPUTS**  
 REFERENCE  MOD/TRIG  IEEE488 / RS232 

**OUTPUTS**  
 10MHz  MOD  PEN LIFT  SWEEP  TTL 


POWER OFF  ON - 

FLUKE  
 TYPE : PM5139/X  
 NC : 9445 051 39xx  
 NO : L0  
 50-60Hz  
 77VA

CAUTION:  
 FOR CONTINUED FIRE PROTECTION  
 REPLACE ONLY WITH FUSE OF SAME  
 TYPE AND RATINGS

220VAC

CE

LR 81436C 

FUSE  
 FOR 100V FOR 220V  
 AND 120V AND 240V  
 IEC127 T 0.4A  
 CSA/UL1986 T 1.0A T 0.5A

Fig. 1 Front View / Rear View  
 Frontansicht / Rückansicht  
 Vue avant / vue arrière



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+31-402-678-200 in Europe

+1-425-356-5500 from other countries

## **SERVICE-ZENTREN**

Wenn Sie die Adresse eines autorisierten Fluke-Servicezentrums brauchen,

besuchen Sie uns doch bitte auf dem World Wide Web:

**<http://www.fluke.com>**

oder rufen Sie uns unter einer der nachstehenden Telefonnummern an:

+1-888-993-5853 in den USA und Canada

+31-402-678-200 in Europa

+1-425-356-5500 von anderen Ländern aus

## **CENTRES DE SERVICE APRES-VENTE**

Pour localiser un centre de service, visitez-nous sur le World Wide Web:

**<http://www.fluke.com>**

ou téléphonez à Fluke:

+1-888-993-5853 aux U.S.A. et au Canada

+31-402-678-200 en Europe

+1-425-356-5500 pour les autres pays

