

OPERATION MANUAL

PULSE - GENERATOR 0,1 / 2000 μ s



PG 01 - 2000

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Warning:

This unit generates high voltages and currents and is inherently dangerous. The local, national and all applicable safety regulations must be obeyed for operation of this unit. The device must only be used by experienced electric technicians, see VDE 0140. People using cardiac pacemakers should be excluded from the test area.

Important: Please read this manual carefully **before** putting the PG 01-2000 into operation and mind the described security instruction.

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1. Introduction

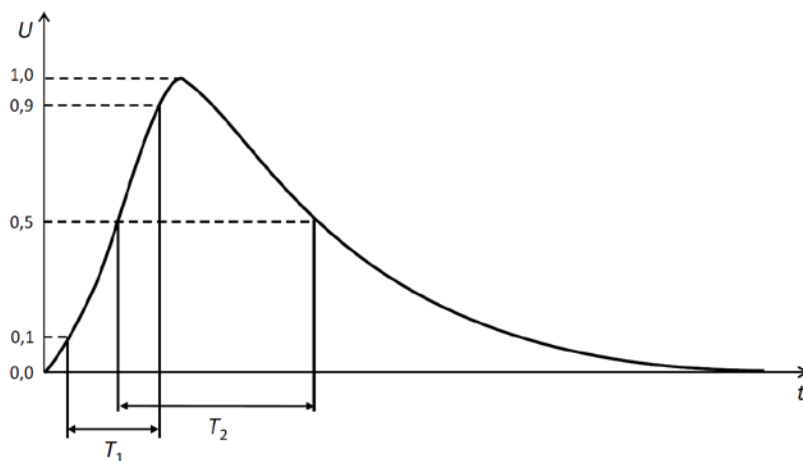
The test generator PG 01 – 2000 is suitable for insulation test and testing of the impulse withstand voltage of electrical and electronic electricity meters.

- The requirements for the test generator PG 01-2000 are described in Chapter 3.7.1 of the FNN "Guidelines for the evaluation of measurement reliability and stability of electricity meters and ancillary equipment"

The generator produce a standard pulse voltage waveform with the 0,1 / 2000 μ s. Using the 1000:1 build-in divider can easily checked the voltage pulse.

With a memory function up to 25 settings can be stored and recalled.

2. Pulse definition



T₁ = Rise time 0,1 μ s
T₂ = Pulse width 2000 μ s

3. Description of functions

3.1. General

The conceptual structure of the PG 01-2000 is shown in the following drawing:

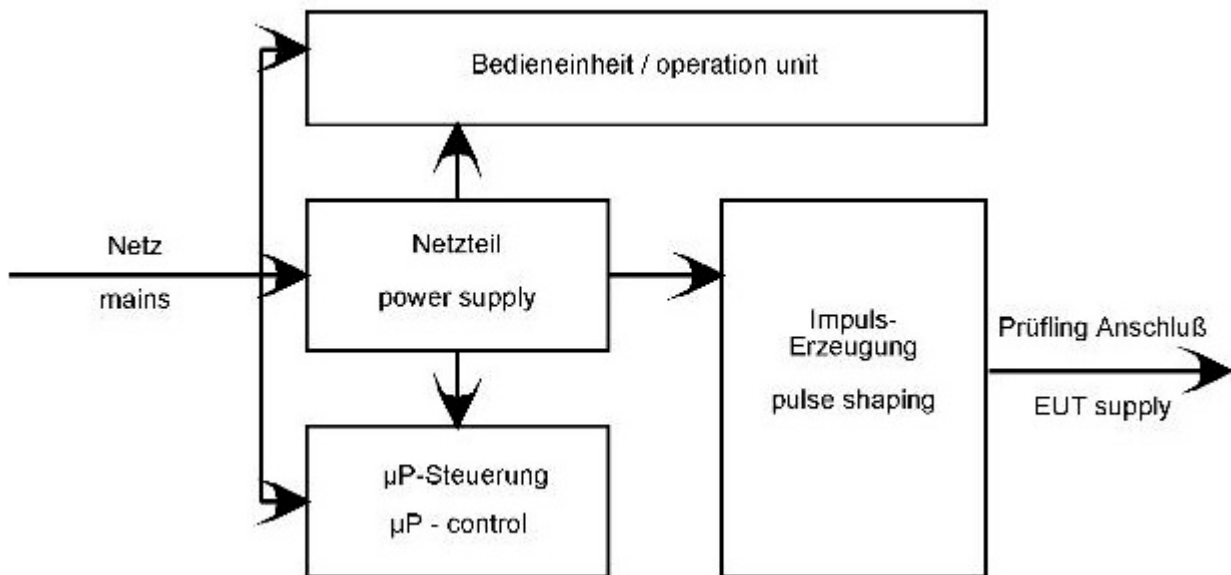


Illustration: Pulse-generator PG 01 - 2000, schematic

3.2. Security instructions

Warning ! This apparatus generates high voltages and currents.

This generator must be operated only with approved protection-earth-power jacks. Cutting the protection-earth-lead may cause seriously danger to life and is therefore forbidden. The unit's enclosure and the grounding jacks are joined to the protection-earth-conductor.

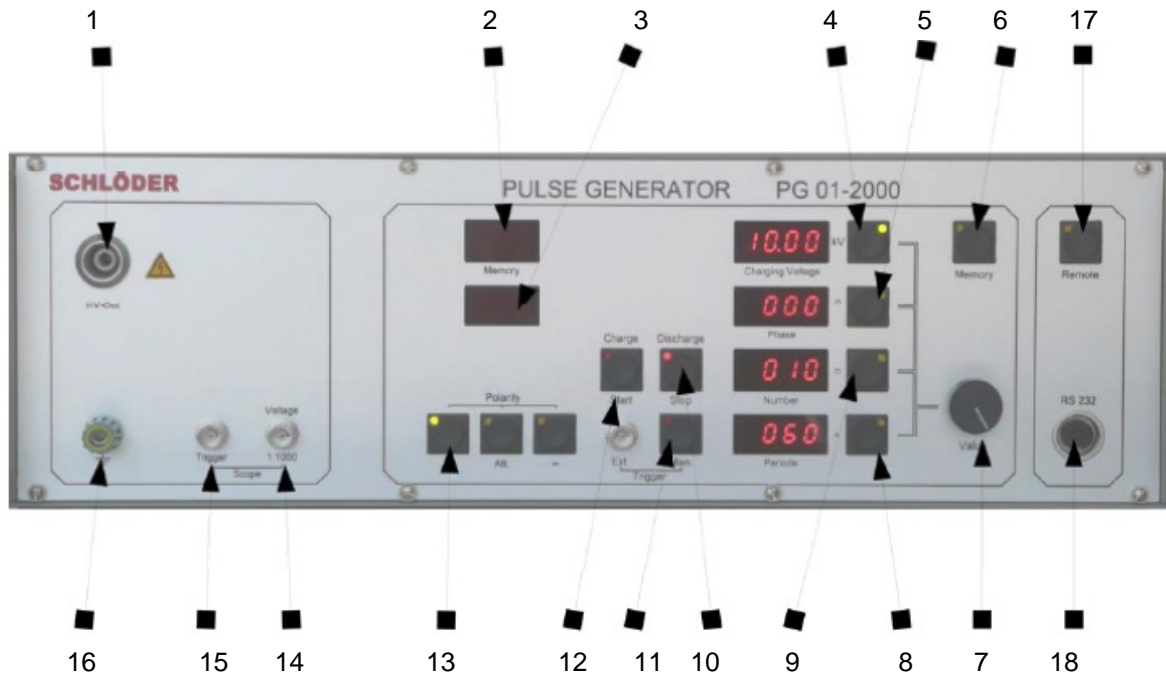
In case the unit shows a damage and a harmless operation is not ensured, it has to be retired from operation and must be protected against unauthorized use.

Also when the mains are disconnected it is possible to have lethal high voltages inside of the test generator (capacities). Servicing this generator should only be done by experienced specialists who has a good knowledge of this generator.

Please mind the specific security instructions described in the individual chapters.

3.3. Unit functions

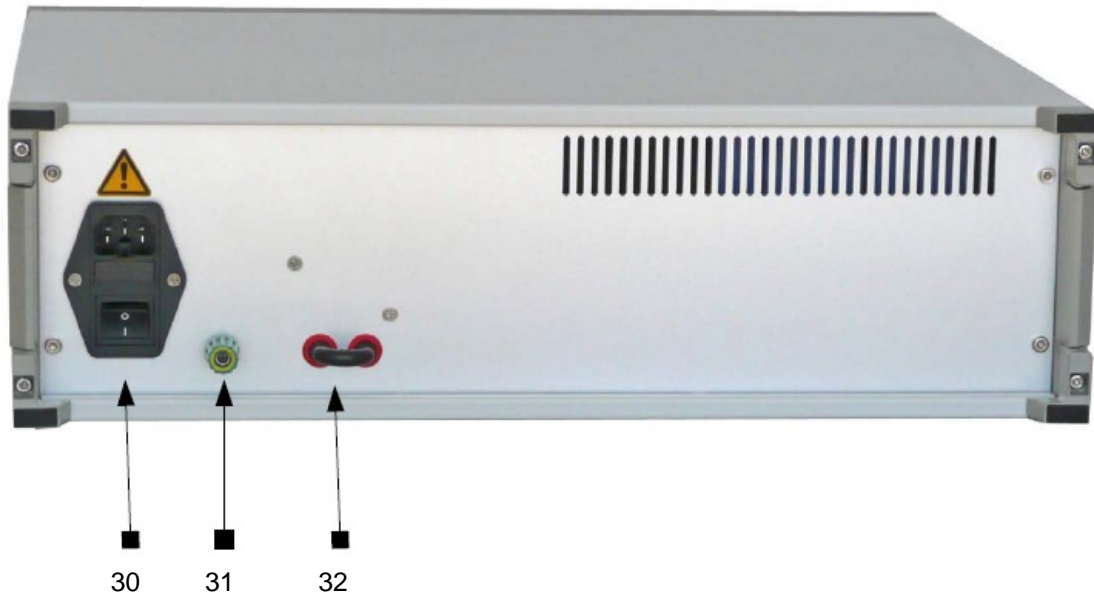
3.3.1. Front panel functions



- [1] High voltage output – connection the EUT (Equipment Under Test) via the HV-cable
- [2] Display Memory request: **>rcl<** (recall) **>Sto<** (store, setting) **>clr<** (clear, delete)
- [3] Display Memory space number: 1 – 25.
- [4] Selection key of the charge voltage with display on the left hand side (voltage in kV), is to be adjusted by revolving the digital potentiometer [7].
- [5] Selection key of the phase angle with display on the left hand side (phase in °), is to be adjusted by revolving the digital potentiometer [7]. The synchronized signal is taken by the 230 VAC input.
- [6] Memory function: up to 25 settings are possible by selecting with the potentiometer [7]
>rcl< (press shortly) **>Sto<** (press and hold on app. 1 sec) **>clr<** (press and hold on app. 2 sec)
- [7] Digital potentiometer to adjust the values in [3], [4], [5], [8] und [9] (LED of the selected parameter is illuminated).
- [8] Selection key of the test period with display on the left hand side (time in s), is to be adjusted by revolving the digital potentiometer [7].
- [9] Selection key for the number of pulses within a test cycle with display on the left hand side (number n), is to be adjusted by revolving the digital potentiometer [7].
- [10] Internal discharge of the energy storage module and interrupt of continuous testing (Test Stop).
- [11] Release of pulse event manually by pressing the key or by remote via BNC jack (see *chapt. 5.2*).
- [12] Charging of the energy storage module and start of the test circle.
- [13] Selection of the polarity of the single pulse: positive, negative or alternating.
- [14] BNC-jack for voltage measurement (1 V = 1000 V test voltage).
- [15] BNC-jack for scope triggering (TTL - level).
- [16] Earth jack for ground connection.
- [17] Release remote control via RS 232
- [18] RS 232 interface

The settable parameters as there are voltage and time functions are displayed on LED-displays. The operation modes of the key functions are displayed by LEDs in the appropriate switch.

3.3.2. Connectors on the rear



[30] Electronic feeding for the PG01-2000 with RF-suppression filter.

[31] Earth jack.

[32] Short-circuit plug-in / jacks for external security circuit. Test can only be done with a closed security-circuit.

4. **Putting into operation**

Check out before testing which charging voltage of the test pulse your EUT can withstand.



For security reasons the generator has to be grounded additionally at the earth jacks

5. Test

5.1. Adjustment of the phase- and time -functions

5.1.1. Charging voltage [4]

The charging voltage is the voltage, which is applied to the high voltage output [1], after triggering the test pulse.

The height of the test pulse depends on the input impedance of the EUT – also the wave form.

First activate the function “charging voltage” by pressing the key [4] and then adjust the parameters by using the digital potentiometer [7].

The values can be changed between 4,0 kV and 10,0 kV in steps of 10 V.

5.1.2. Phase angle φ [5]

Adjustment of the phase angle. First activate the function "phase angle" by pressing the key [5] and then adjust the parameters by using the digital potentiometer [7]. The values can be changed between 0° and 359° in steps of 1°.

5.1.3. Number of the pulses per test cycle [9]

Adjustment of the number of test pulses per test cycle. First activate the function "number" by pressing the key [9] and then adjust the parameters by using the digital potentiometer [7]. The values can be changed between 2 and 999. If the amount of the test pulses is one, the display is switched off - the generator is set in the test-mode "single discharge" (see chapter 5.2.1).

5.1.4. Test period [8]

Adjustment of the temporal distance of the single surge pulses in a test cycle. First activate the function “test period” by pressing the key [8] and then adjust the parameters by using the digital potentiometer [7].

The minimum value depends on the charge characteristic of the storage capacitor. The values can be changed between 5 and 999 s in steps of 1 s. That means the fastest repetition time is 5 second.

5.2. Pulse triggering / discharge

The selection of the test mode depends on the amount of test pulses displayed in [9]. At the mode "single discharge" (one event) the high voltage unit charged to the adjusted voltage. In the mode "automatic operation" (amount 2 and more) the key „Charge“ [12] has the function „Start“.

5.2.1. Single discharge

First the test mode "single discharge" is activated. After choosing the function "number" [9] the digital potentiometer is to be revolved to the left until the display [9] is switched off.

The high voltage unit is charged by pressing the key "charge / start" [12] to the voltage displayed at [4].

The "single event" is activated either by pressing the trigger-key [11] or by switching a low-signal (negative flank) to the BNC-jack [11] for remote control.

If a discharge after a short time is no made, the high voltage unit is discharged automatically after approximately 1 minute - for safety reason.

5.2.2. Automatic operation

After choosing the function "number" [9] the desired amount of test pulses is adjusted by turning the digital potentiometer. The smallest amount of possible pulses to choose is "two".

After pressing the key "charge / start" [14] the test voltage [4] is charged to the adjusted level. As soon as the nominal value is reached, the high voltage unit is discharged automatically. The value in display [9] is decreased by one. Now the following discharges only depend on the amount of the test pulses and the test period [8].

When the value in display [9] reaches zero, the test is finished. The display skips to the value adjusted before starting the automatic test.

The trigger can also be started by a short circuit or a negative signal edge at the BNC socket [11].
New since Nov. 2015 (In the new equipment or remodelling PG01-2000).

5.3. Stop / discharge with the function „discharge“

5.3.1. Single discharge (adjustment as described in chapter 5.2.1)

When the charging voltage as displayed in [4] has reached the pre-selected value the voltage can be discharged internally by pressing the key [10]. This might be important if the charging voltage was pre-selected for example up to 10 kV and the tester now decides to test with a lower voltage. In this case the voltage can be discharged internally without causing damage to the EUT. After the internal discharge a new value can be set.

5.3.2. Automatic test mode (adjustment as described in chapter 5.2.2)

By pressing the key "discharge / stop" [10] while running the automatic test the test-procedure is stopped, the display [9] is blinking. Pressing the key "charge / start" [12] starts the test-procedure again at the stopped status.

If the automatic test shall be stopped finally, the key "discharge / stop" [10] has to be pressed again. In this case the display [9] is set to the value adjusted before starting the automatic test. The test is stopped finally.

6. Security bolt of the trigger function

Because of the possibility of high currents and voltages the CWG 1500 needs the opportunity to be bolted by an external security-circuit. The locking is realized by a low-impedance connection of the jacks "Safety" [34] on the rear. This should not be realized by using the included short-circuit plug but by using external circuits like contacts of test-hoods or security-switches.

While the security-circuit is opened (short circuit plug removed or contact opened) the view on the generators front will show following:

- The lower display of the „memory display“ [3], shows **SRF**
- The values for charging voltage [4], phase relationship [5], number [9] and test period [8] may be changed with the digital potentiometer [7] after the selection.
- The LED "Discharge" [10] is blinking to remind that the discharge relay is activated

As soon as the security-bolt is connected again, all adjusted parameters are activated. Now the high voltage pulses can be released again.

Important: While the **SRF**-information is shown in the display, all parameters can be adjusted on the generator's front

Special function "Memory": If the "Memory"-key [6] is pressed the information **SRF** is effaces. The displays of the memory-function, like they are described in chapter 6, appear. Once the memory-mode is exited, the selected values are displayed and the information **SRF** is shown again.

7. High voltage output

At the high voltage output "HV Out" [1] a high voltage cable can be connected to test the EUT (Equipment Under Test).

Please take care that the HV-connector is completely connected to [1].



Important:

We suggest urgently not to carry out high voltage tests in an open test setup, but only covered under special test hoods with security-contacts.

Because of the high energies by the test pulses devices and components may be destroyed and may even explode. This is valid especially for capacities and varistors

8. Measurement output for oscilloscope

For measurement purpose – a rough check of the pulse - the generator PG 01-2000 includes a high voltage divider. The signal is applied to the BNC-jack [14].

The divider has a transfer-ratio of 1000:1 and this allowed a direct connection to an oscilloscope with an input impedance of 1 MOhm.

Please note the divider has a self-rise time of app. 175ns. At a rise-time of 100 ns of the test pulse the oscilloscope can measure only app. 200ns.

The front panel contains a BNC trigger output [15]. This output generates a positive flank. This signal is present app. 1 ms before the test pulse released.

9. Memory-function

9.1. General description

With the aid of the memory key [6] up to 25 settings can be stored and recalled. All variable parameters and the key positions are fixed for recall.

The first pressing of the memory key activates the memory function. Depend on the holding duration one of three functions can be called up

- a) Recall memory: display [2] shows **rec** => key [6] pressed up to 1 second.
- b) Store setting: display [2] shows **sto** => key [6] pressed between 1 and 2 seconds.
- c) Clear setting: display [2] shows **clr** => key [6] pressed longer than 2 seconds.

The display [3] shows the number of the actual setting, it can be changed by turning the digital potentiometer from 0 until 25. Setting 00 is always equivalent with the unit setting before pressing the memory key

The settings 1 to 25 are random access. An empty memory cell leads to display "- - -" in [4], [5], [8] and [9].

At occupied memory locations as numerical numbers appear charging voltage, phase, number of test pulses and period.

Another pressing of the memory key [6] activates the selected command and leaves the memory function. If setting number "00" was selected, no changes in the memory were made.

9.2. Examples on the usage:

1. Recall data from the memory, e.g. memory cell 3.
 - Activate function „Recall“ by pressing key [6].
 - Shuttle to memory cell 3 shown in the display [2] with the aid of the potentiometer [7]. The desired values are shown in the displays.
 - Press memory key [6] again. You leave the memory mode and the values of memory cell 3 are ready to use.
2. Save data, e.g. memory cell 12.
 - First adjust the desired values at the generator e.g. test voltage, number of pulses and period.
 - Activate function „Store“ by pressing and holding the key [6] for 1 - 2 seconds.
 - Shuttle to memory cell 12 shown in the display [2] with the aid of the potentiometer [7].
 - Press memory key [6] again. You leave the memory mode and the values of memory cell 12 are saved and are shown in the displays.
3. Delete data, e.g. memory cell 20
 - Activate function „Clear“ by pressing and holding the memory key [6] for longer than 2 seconds.
 - Shuttle to memory cell 20 shown in the display [2] with the aid of the potentiometer [7].
 - Press memory key [6] again. You leave the memory mode and the values shown before activating the memory mode are shown again. The memory cell 20 is deleted.

10. Technical data

10.1. Generator

Pulse parameters acc. the FNN rules

Wave form of the pulse	-	0,1/2000 μ s
Charge voltage / Test voltage	-	4,0 – 10 kV in steps of 10V
Source impedance -		50 Ohm
Energy of the source	-	1 Joule at 7 kV
Max. Repetition frequency	-	0,2 Hz

Time function

Phase angle / selected point	-	0 - 359°, in steps of 1° Synchronization by the 230 VAC input
Number of test pulses per test	-	1 - 999
Period / charge time	-	5 - 999 s, steps in 1 s

Trigger

Single event by manual release
 Single event by remote via BNC-jack
 Start of the test circle by charge-key

Connection for device under test (DUT)

HV – Connector on the front panel
 Earth-jacks on front- and rear panel

Measurement output on the front panel

BNC-jack for voltage and trigger

Rear side

Connection for main electronic

10.2. General

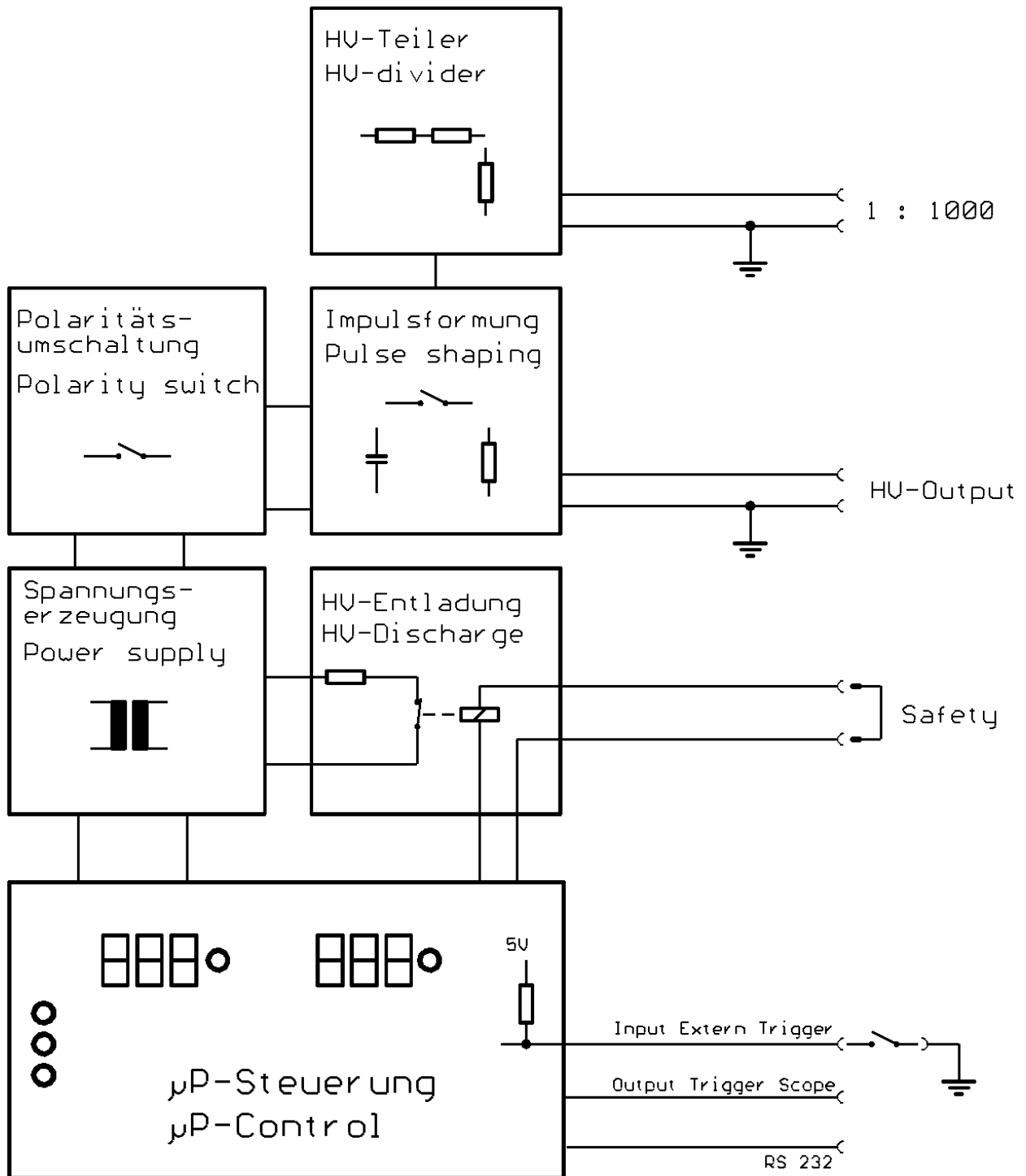
Operation temperature range	-	0 till 40° C
Electronic input	-	230 V / 50 Hz, 100 VA
Dimension	-	19"-housing, 3 HE
Weight	-	app.10 kg

11. Scope of delivery

- Pulse – Generator PG 01 - 2000
- mains cable
- HV-cable 1 m for test object
- This manual

In certain periods mains cable and high voltage cable must be checked carefully on defective insulation.

13. Block schematic diagram PG01-2000



14. Remote control PG01-2000

14.1. Transmission parameters

To use the serial transmission the RS232-interface has to be set up to following parameters:

```

baud rate      :      600
parity         :      none
data bits      :      8
stop bits      :      at least 1
    
```

14.2. Programming

The programming of the PG 01-2000 interface is done by sending orders of one to three bytes length via RS232 interface. At two and three byte orders there must be no gap longer than one word length between each word. Someone byte order make the PG 01-2000 to transmit information.

The number of bytes transferred from the PG 01-2000 is defined in the one-byte command, which is transmitted to the PG 01-2000.

The low transmission rate of 600 baud was chosen because only a few short commands are transmitted, but a higher noise ratio is important.

During the transmission no linefeed (LF), Carriage Return (CR) or any other EOS is transmitted.

To receive data from the PG the "Remote Control" on the front of the PG must not to be enabled. Only for remote control the "Remote Control" of the PG has to be enabled.

The device will react even more on inputs from the front panel.

The NUMBER and PERIOD of pulses can be read only in automatic mode - no programming!

14.3. Command table for PG 01-2000

1 byte command		command bytes	answer bytes	function
Dec.	HEX			
96	60	1		charge
97	61	1		discharge
99	63	1		trigger
103	67	1		reset
105	69	1	8 *	read data: U_{CHARGE} , φ , number, period
106	6A	1	1 *	read data: status
110	6E	1	2 *	read data: unit ID; Version of software; Remote switch (on/off)
111	6F	1	255 *	read data: memory list
112	70	2		set status: polarity
120	78	3		set charging voltage: 400 – 1000 (x 10)
121	79	3		set phase angle: 0 – 359

Table 1: command PG 01-2000

* function even at RS232 off

14.3.1. Description of the commands

1 byte command Dec. HEX	function / programming																																																		
96 60	charge: only possible if Safety = ON																																																		
97 61	discharge: discharge of the high voltage section, may take max. 8 sec.																																																		
99 63	trigger: release of the pulse																																																		
103 67	reset: set up PG 01-2000 to the following parameter: <ul style="list-style-type: none"> • stop / discharge (max. 8 sec) • polarity on positive, not alternating • voltage 4000 V, phase angle 0 ° 																																																		
105 69	read data: "U_{CHARGE}, φ, number, period" <ol style="list-style-type: none"> 1. high byte U_{CHARGE} 0190_{HEX} – 03e8_{HEX} = 4,00 kV - 10,00 kV 2. low byte U_{CHARGE} 1 bit = 0,01 kV 3. high byte φ 0000_{HEX} - 0167_{HEX} = 0 ° - 359 ° 4. low byte φ 1 bit = 1 ° 5. high byte number 0000_{HEX} = manual operation 0002_{HEX} - 03E7_{HEX} = 2 – 999 pulses 6. low byte number 1 bit = 1 pulse 7. high byte period 0005_{HEX} – 03E7_{HEX} = 5 - 999 sec 8. low byte period 1 bit = 1 sec 																																																		
106 6A	read data: "status" <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="text-align: right; padding-right: 5px;">128</td><td style="text-align: right; padding-right: 5px;">64</td><td style="text-align: right; padding-right: 5px;">32</td><td style="text-align: right; padding-right: 5px;">16</td><td style="text-align: right; padding-right: 5px;">8</td><td style="text-align: right; padding-right: 5px;">4</td><td style="text-align: right; padding-right: 5px;">2</td><td style="text-align: right; padding-right: 5px;">1</td><td></td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">0</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td style="border: 1px solid black; text-align: center;">X</td><td></td> </tr> </table> <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="padding-right: 10px;">0 0 0 0</td><td>: discharged manually</td> </tr> <tr> <td style="padding-right: 10px;">0 1 0 1</td><td>: manually during charge</td> </tr> <tr> <td style="padding-right: 10px;">0 1 1 0</td><td>: manually during discharge</td> </tr> <tr> <td style="padding-right: 10px;">0 1 1 1</td><td>: charged manually</td> </tr> <tr> <td style="padding-right: 10px;">1 0 0 0</td><td>: automatically discharged, no operation</td> </tr> <tr> <td style="padding-right: 10px;">1 1 0 1</td><td>: automatic during charge</td> </tr> <tr> <td style="padding-right: 10px;">1 1 1 0</td><td>: automatic during discharge</td> </tr> <tr> <td style="padding-right: 10px;">1 1 1 1</td><td>: charged automatically</td> </tr> <tr> <td style="padding-right: 10px;">1 1 0 0</td><td>: automatically discharged during operation</td> </tr> <tr><td colspan="2"> </td></tr> <tr> <td style="padding-right: 10px;">0 0</td><td>: pos</td> </tr> <tr> <td style="padding-right: 10px;">0 1</td><td>: neg</td> </tr> <tr> <td style="padding-right: 10px;">1 0</td><td>: pos alternate</td> </tr> <tr> <td style="padding-right: 10px;">1 1</td><td>: neg alternate</td> </tr> <tr><td colspan="2"> </td></tr> <tr> <td style="padding-right: 10px;">1</td><td>: safety active</td> </tr> </table>	128	64	32	16	8	4	2	1		0	X	X	X	X	X	X	X		0 0 0 0	: discharged manually	0 1 0 1	: manually during charge	0 1 1 0	: manually during discharge	0 1 1 1	: charged manually	1 0 0 0	: automatically discharged, no operation	1 1 0 1	: automatic during charge	1 1 1 0	: automatic during discharge	1 1 1 1	: charged automatically	1 1 0 0	: automatically discharged during operation			0 0	: pos	0 1	: neg	1 0	: pos alternate	1 1	: neg alternate			1	: safety active
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1 1 1 1	: charged automatically																																																		
1 1 0 0	: automatically discharged during operation																																																		
0 0	: pos																																																		
0 1	: neg																																																		
1 0	: pos alternate																																																		
1 1	: neg alternate																																																		
1	: safety active																																																		

1 byte command Dec. HEX		function / programming																																																																												
110	6E	<p>read: unit-ID, Version of software and -Status of „Remote switch“</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>high byte:</p> <table style="margin: 0 auto; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">128</td><td style="padding: 2px 5px;">64</td><td style="padding: 2px 5px;">32</td><td style="padding: 2px 5px;">16</td><td style="padding: 2px 5px;">8</td><td style="padding: 2px 5px;">4</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">1</td> </tr> <tr> <td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td> </tr> </table> <p style="margin-top: 10px;">Geräte ID</p> </div> <div style="text-align: center;"> <p>low byte:</p> <table style="margin: 0 auto; border-collapse: collapse;"> <tr> <td style="padding: 2px 5px;">128</td><td style="padding: 2px 5px;">64</td><td style="padding: 2px 5px;">32</td><td style="padding: 2px 5px;">16</td><td style="padding: 2px 5px;">8</td><td style="padding: 2px 5px;">4</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">1</td> </tr> <tr> <td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td> </tr> </table> <p style="margin-top: 10px;">Software-Version</p> <p>0 : remote off 1 : remote on</p> </div> </div> <p style="margin-top: 20px;">= 106_{DEZ} 6A_{HEX} 0110 1010 RS232 ON = 131_{DEZ} 83_{HEX} 1000 0011 RS232 OFF = 03_{DEZ} 03_{HEX} 0000 0011</p>	128	64	32	16	8	4	2	1	X	X	X	X	X	X	X	X	128	64	32	16	8	4	2	1	X	X	X	X	X	X	X	X																																												
128	64	32	16	8	4	2	1																																																																							
X	X	X	X	X	X	X	X																																																																							
128	64	32	16	8	4	2	1																																																																							
X	X	X	X	X	X	X	X																																																																							
111	6F	<p>read data:</p> <p>PG send data: memory list of 9 × 25 = 225 Byte corresponding to MEM 1 - MEM 25. On empty memory the first 8 byte are equal FF and byte 9 (status) = F0.</p> <table style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">1</td><td style="border: 1px solid black; padding: 2px 5px;">1</td><td style="border: 1px solid black; padding: 2px 5px;">2</td><td style="border: 1px solid black; padding: 2px 5px;">3</td><td style="border: 1px solid black; padding: 2px 5px;">4</td><td style="border: 1px solid black; padding: 2px 5px;">5</td><td style="border: 1px solid black; padding: 2px 5px;">6</td><td style="border: 1px solid black; padding: 2px 5px;">7</td><td style="border: 1px solid black; padding: 2px 5px;">8</td><td style="border: 1px solid black; padding: 2px 5px;">9</td> </tr> <tr> <td style="padding: 2px 5px;">2</td><td style="border: 1px solid black; padding: 2px 5px;">10</td><td style="border: 1px solid black; padding: 2px 5px;">11</td><td style="border: 1px solid black; padding: 2px 5px;">12</td><td style="border: 1px solid black; padding: 2px 5px;">13</td><td style="border: 1px solid black; padding: 2px 5px;">14</td><td style="border: 1px solid black; padding: 2px 5px;">15</td><td style="border: 1px solid black; padding: 2px 5px;">16</td><td style="border: 1px solid black; padding: 2px 5px;">17</td><td style="border: 1px solid black; padding: 2px 5px;">18</td> </tr> <tr> <td style="padding: 2px 5px;">3</td><td style="border: 1px solid black; padding: 2px 5px;">19</td><td style="border: 1px solid black; padding: 2px 5px;">20</td><td style="border: 1px solid black; padding: 2px 5px;">21</td><td style="border: 1px solid black; padding: 2px 5px;">22</td><td style="border: 1px solid black; padding: 2px 5px;">23</td><td style="border: 1px solid black; padding: 2px 5px;">24</td><td style="border: 1px solid black; padding: 2px 5px;">25</td><td style="border: 1px solid black; padding: 2px 5px;">26</td><td style="border: 1px solid black; padding: 2px 5px;">27</td> </tr> <tr> <td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td><td style="padding: 2px 5px;">⋮</td> </tr> <tr> <td style="padding: 2px 5px;">25</td><td style="border: 1px solid black; padding: 2px 5px;">217</td><td style="border: 1px solid black; padding: 2px 5px;">218</td><td style="border: 1px solid black; padding: 2px 5px;">219</td><td style="border: 1px solid black; padding: 2px 5px;">220</td><td style="border: 1px solid black; padding: 2px 5px;">221</td><td style="border: 1px solid black; padding: 2px 5px;">222</td><td style="border: 1px solid black; padding: 2px 5px;">223</td><td style="border: 1px solid black; padding: 2px 5px;">224</td><td style="border: 1px solid black; padding: 2px 5px;">225</td> </tr> <tr> <td></td><td style="padding: 2px 5px;">H</td><td style="padding: 2px 5px;">L</td><td style="padding: 2px 5px;">H</td><td style="padding: 2px 5px;">L</td><td style="padding: 2px 5px;">H</td><td style="padding: 2px 5px;">L</td><td style="padding: 2px 5px;">H</td><td style="padding: 2px 5px;">L</td><td style="padding: 2px 5px;">byte status</td> </tr> </table> <p style="margin-top: 10px;">byte charge volt. byte phase byte number byte period</p> <p>Status byte 9</p> <table style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">128</td><td style="padding: 2px 5px;">64</td><td style="padding: 2px 5px;">32</td><td style="padding: 2px 5px;">16</td><td style="padding: 2px 5px;">8</td><td style="padding: 2px 5px;">4</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">1</td> </tr> <tr> <td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td> </tr> </table> <p style="margin-top: 10px;">0 0 : polarity pos 0 1 : polarity neg 1 0 : polarity pos alternate 1 1 : polarity neg alternate</p>	1	1	2	3	4	5	6	7	8	9	2	10	11	12	13	14	15	16	17	18	3	19	20	21	22	23	24	25	26	27	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	25	217	218	219	220	221	222	223	224	225		H	L	H	L	H	L	H	L	byte status	128	64	32	16	8	4	2	1	0	0	X	X	0	0	0	0
1	1	2	3	4	5	6	7	8	9																																																																					
2	10	11	12	13	14	15	16	17	18																																																																					
3	19	20	21	22	23	24	25	26	27																																																																					
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	H	L	H	L	H	L	H	L	byte status																																																																					
128	64	32	16	8	4	2	1																																																																							
0	0	X	X	0	0	0	0																																																																							
112	70	<p>write data: „set status“</p> <p>The byte succeeding the command 70 sets up following parameter:</p> <table style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px 5px;">128</td><td style="padding: 2px 5px;">64</td><td style="padding: 2px 5px;">32</td><td style="padding: 2px 5px;">16</td><td style="padding: 2px 5px;">8</td><td style="padding: 2px 5px;">4</td><td style="padding: 2px 5px;">2</td><td style="padding: 2px 5px;">1</td> </tr> <tr> <td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">X</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td><td style="padding: 2px 5px; border: 1px solid black;">0</td> </tr> </table> <p style="margin-top: 10px;">0 0 : polarity pos 0 1 : polarity neg 1 0 : polarity pos alternate 1 1 : polarity neg alternate</p>	128	64	32	16	8	4	2	1	0	0	X	X	0	0	0	0																																																												
128	64	32	16	8	4	2	1																																																																							
0	0	X	X	0	0	0	0																																																																							

1 byte command		function / programming																								
Dec.	HEX																									
120	78	<p>write data: „set charging voltage“ The 2 byte succeeding the command 78 set up following parameter:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">512</td> <td style="text-align: center;">256</td> <td style="text-align: center;">128</td> <td style="text-align: center;">64</td> <td style="text-align: center;">32</td> <td style="text-align: center;">16</td> <td style="text-align: center;">8</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> </tr> </table> <p>The decimal value 400 -1000 correspond to the charging voltage 4,0 kV - 10,0 kV All other values become ignored.</p>	512	256	128	64	32	16	8	4	2	1	0	0	0	0	0	0	x	x	x	x	x	x	x	x
512	256	128	64	32	16	8	4	2	1																	
0	0	0	0	0	0	x	x	x	x	x	x	x	x													
121	79	<p>write data: „phase angle“ The 2 byte succeeding the command 79 set up the phase angle:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">256</td> <td style="text-align: center;">128</td> <td style="text-align: center;">64</td> <td style="text-align: center;">32</td> <td style="text-align: center;">16</td> <td style="text-align: center;">8</td> <td style="text-align: center;">4</td> <td style="text-align: center;">2</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">0</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> <td style="border: 1px solid black; text-align: center;">x</td> </tr> </table> <p>The decimal value 1 - 359 correspond to the phase angle 1 ° - 359 °. All other values become ignored.</p>	256	128	64	32	16	8	4	2	1	0	0	0	0	0	0	0	x	x	x	x	x	x	x	
256	128	64	32	16	8	4	2	1																		
0	0	0	0	0	0	0	x	x	x	x	x	x	x													

Table 2: description of programming the PG 01-2000