

Basic data	2
To Start	3
Input Inspection	3
Switch - On	3
Warm - up	3
Fuse replacement	4
Safety first	4
Front panel	5
Display in the 3f - Mode	8
Display in the 111f - Mode	10
Rear panel	12
Calibrator function settings	13
Output power settings	14
Output terminals ON - OFF	15
Power and Energy	16
Control in the power mode 3f	16
Settings in the power mode 111 f	20
Menu	24
Parameters of the SETUP 1	24
Parameters of the SETUP 2	26
Calibration Mode	27
Error Messages	32
Maintenance	34
Remote Control	35
Specifications	40
Addendum	43

Basic data

The basic function of the calibrator OCM103 is the generation of calibrated AC voltages between 6 V and 240 V and AC currents from 100 mA to 10 A. The voltage is generated in three terminals A, B, C with a phase shift of 120°. The phase shift of the current outputs can be individually set. The highest accuracy of generated voltages and currents is 0.05 %. Internal ranges of the calibrator (voltage 80 and 240 V, current 1, 5 and 10 A) are selected with respect of achieving the highest accuracy during calibration of power transmitters.

Another function of the calibrator is the generation of precise energy batches. The 30 mA current capability of the voltage terminals permits the calibration of analogue wattmeters. The frequency range of the generated signals is 40 to 400 Hz.

The instrument has additional functions which simplify its usage during the calibration. One of them is the Digital Multimeter for measurement of output voltages of $\pm 13\text{V}$ and currents of $\pm 25\text{ mA}$ generated by the device under test. A two or four terminal system is used for the connection of the device under test. A software calibration is implemented for internal recalibration of all ranges and modes.

The parameters, the output signals and the commands are displayed at the LCD large scale display. The setting is possible with the keyboard at the front. An IEEE 488 bus for data transfer and a remote control of the calibrator is a standard feature.

Model OCM103 is equipped with functions which permit not only the calibration of instruments for three phase power and energy measurements but also calibration of voltmeters, amperemeters, phase meters and similar instruments.

The calibrator may be used only as described in this manual.

To Start

Input Inspection

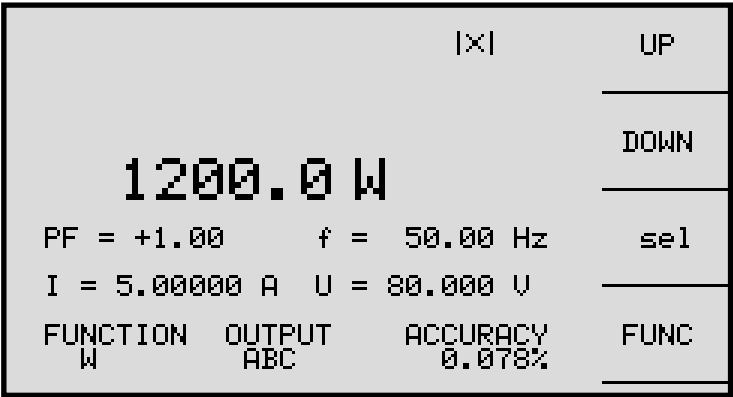
The shipment contains:

- Calibrator OCM-103
- Power cord
- Spare fuse T 6.3A
- User's manual.

The supply voltage is 230 V / 47 to 63 Hz. The specifications are valid for an ambient temperature of 23 ± 2 °C. The calibrator has to be placed on a flat surface in horizontal position. Please make sure that the ventilation holes in the bottom and the top are open as well as the fans at the rear.

Switch - On

- Insert the power cord into the socket at the rear panel and connect the cord into 230VAC mains.
- Switch-On with a toggle switch at the rear panel. The display will illuminate.



- Internal Tests are performed and the parameters are automatically set:

Function	W – real power
Voltage	80.000 V
Current	5.00000 A
Frequency	50 Hz
Power factor	+ 1.00 (phase 0°)
Output terminals	OFF
Display mode	3f

The factory default of the GPIB address is 2.

Warm - up

The calibrator can be used immediately after the power has been applied. The specifications however are valid after 30 minutes of operation. If during this warm-up time the internal calibration mode is disabled.

Fuse replacement

The fuse is placed in power supply module at the instrument's rear. To replace it, follow next steps:

- Disconnect the power cord from the mains.
- Insert the tip of a screwdriver into the slot of the fuse holder and take out the defective fuse.
- Replace the defective fuse.

Safety first

The instrument is of a safe class I by EN 61010-1, supplement 2.

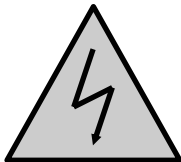
The design and the manufacturing ensure the required safety level.

The manufacturer is not responsible for damages resulting from incorrect connection, replacing of not original parts and components, modifications or any other usage which is not described in this manual.

Warning symbols



Notice inside the documentation

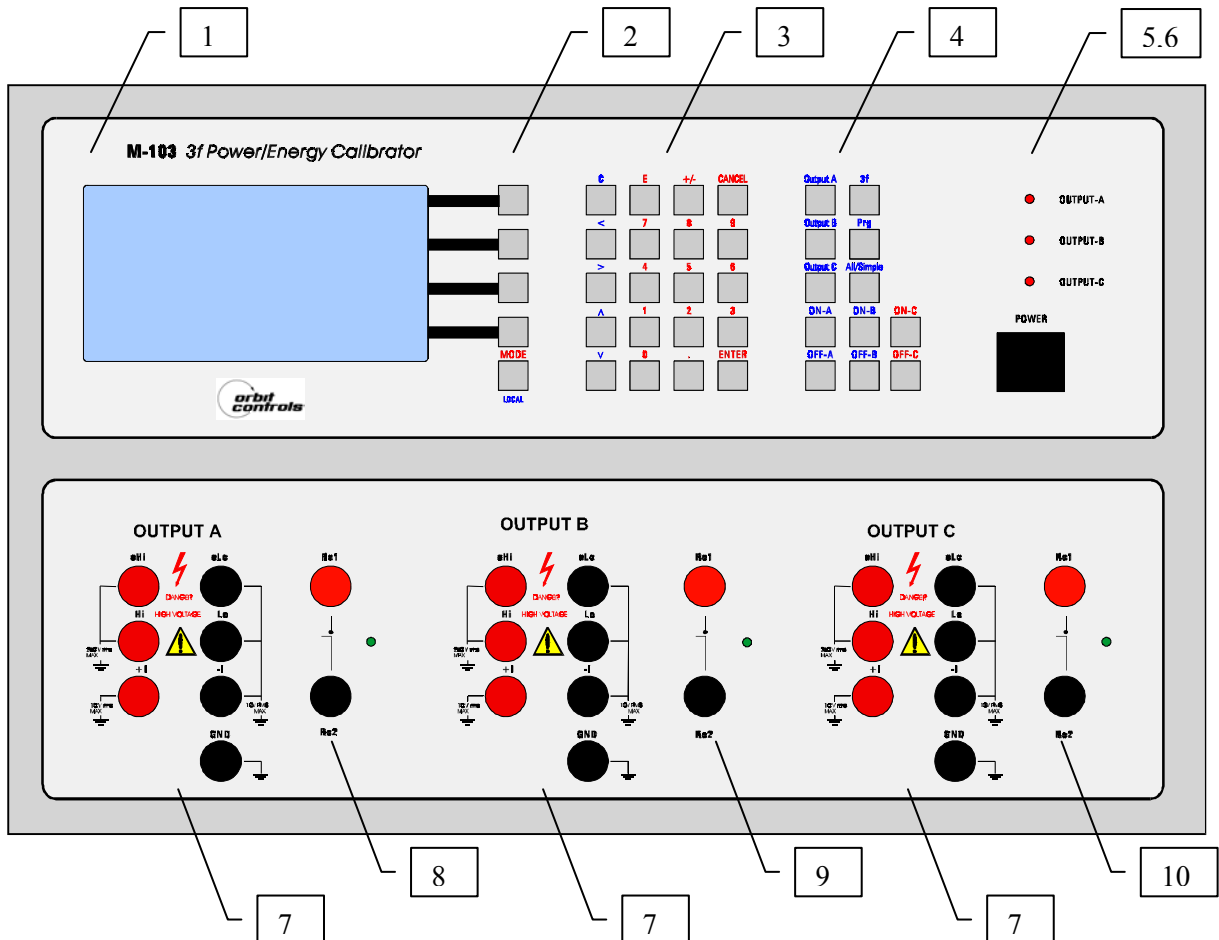


Danger - High Voltage



Attention ! High Voltage

Front panel



1 LCD display

The LCD display shows the parameters and the set conditions.

2 Display keys

The function of the four upper keys varies with the mode of operation. Their function is marked at the display. They are usually used for entering the MENU, setting the signal values, ranges, parameters etc.

The key MODE/LOCAL is used for service functions. When the calibrator is remotely controlled from the GPIB data bus, this key switches the calibrator into the local mode.

3 Numeric keys

The keyboard contains keys for cursor < >. The cursor can be moved right or left. The keys $\wedge \vee$ the digit can be changed up or down.

Additional keys are for decimal point, confirmation (ENTER), cancelling of the digit setting (C), changing the sign (+ / -), entering of exponents (E) and cancelling of the entry (CANCEL).

4 Function keys

The function keys serve for direct selection of the calibrator's functions. The first group contains the keys OUTPUT A, OUTPUT B, OUTPUT C and 3f. By using the key 3f, the all three outputs are programmed simultaneously. By using the keys OUTPUT A, B or C the outputs can be set individually.

The key ALL / SIMPLE selects the mode of the output terminals. In the mode ALL the terminals are switched on and off simultaneously with the keys ON-C and OFF-C. In the mode SIMPLE the terminals are switched-on individually with the keys ON-A, ON-B, ON-C and switched-off with OFF-A, OFF-B and OFF-C. The key PRG terminates the programming of the output terminals.

5 Output terminals indication

The LED illuminates when the terminals are connected.

6 Power supply switch

Switches-on or off the power to the instrument.

7 Output terminals

Each phase has individual terminal, marked A, B and C. The output currents are connected to the terminals +I / -I, the output voltages are connected to the terminals **Hi** / **Lo**. The calibrator permits two or four terminal connection of the voltage. When the four terminal connection is selected, **sHi** / **sLo** are the sensing terminals.



WARNING

***sHi** and **sLo** are sensing terminals. It is not allowed to draw the current out of them. Their loading might damage the calibrator !*

The terminal **GND** is connected to the calibrator's case and to the power supply ground. The output terminals **Lo** can be connected to GND or left unconnected. The grounding of the **Lo** terminal is done by internal relay which is controlled ON or OFF from the MENU. The most applications require the **Lo** terminals to be connected to GND, esp. in applications in which the calibrated device is floating.



WARNING

*When the terminals **Lo**, **sLo**, **-I** are connected with **GND**, it is not permitted to withdraw the power from **GND / Hi**, **GND / +I** or **GND / sHi**. By loading these terminals the calibrator might be damaged.*

8 DC multimeter input

The calibrator has inputs for DC volts of ± 13 V or DC amperes of ± 25 mA. The inputs are suitable for measuring of the feedback from transmitters or other devices under test. The positive terminal is **Re1**, the negative **Re2**. The input terminals are not grounded. In the MENU the terminals can be selected for voltage or current measurement or disconnected.

9 Impulse counting input

A pulse counter input is available for frequency range 0 to 20 Hz and pulse level of ± 50 V. External pulses or contact closures can be measured. This function permits testing of electrometers with pulse outputs. The positive terminal is **Re1**, the negative **Re2**. The input terminals are not grounded. In the MENU the terminals can be activated for counting or disconnected. The inputs for pulse counting and the inputs for voltage/current measurement can be used simultaneously. Each pulse is indicated with LED at the front.

10 AC voltage 24V

For supplying of external transmitters 24VAC is available. A fuse T1L250 is placed at the rear of the instrument.

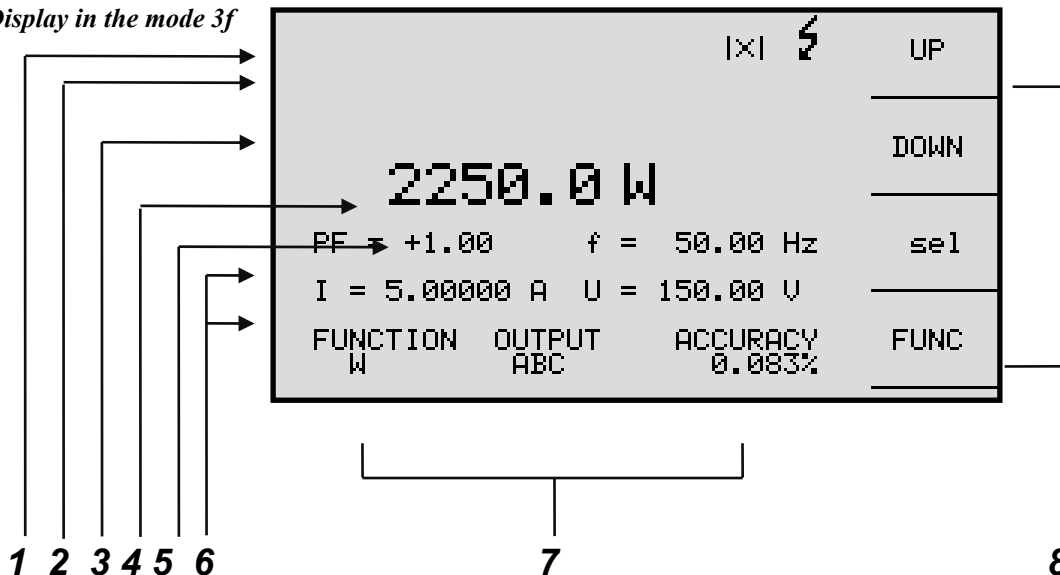
Display in the 3f - Mode

All information such as parameters, error messages and service steps are shown at the LCD display. The display is divided into several information fields. The meaning of some fields depends on the selected mode. After the instrument is switched-on, the mode 3f is activated and the voltage, the current and the power factor are set in all three phases.

The mode 3f serves for simultaneous parameter settings in all three outputs.

The mode 111f serves for individual parameter settings in each output.

Display in the mode 3f



1. Analog input

The analog input at the terminals **Re1** and **Re2** is measured and displayed. The input can measure DC voltage $\pm 13V$ or DC currents $\pm 25mA$, or it can be disconnected. The display can be selected in V or mA (absolute values) or in % (relative values).

2. Information line

This line informs about the Mode.

- Indication of dangerous voltage at the output terminals by alert arrow when output voltage setting is higher than 100 V.
- Indication of connected and disconnected terminals.
- Error messages when the calibrator is forced to invalid operation or when the output terminals are overloaded or when the GPIB bus is wrongly programmed.
- Information about remote/local control. In the remote mode of control the "REM" is shown on the left side.
- Information about four terminal connection of the voltage output. In the mode of remote sensing "4W" is displayed on the right side.

3. *Auxiliary message*

In the Energy Mode of operation the Energy and the Time are displayed. In the Power Mode of operation the value at the input A is displayed.

4. *Main value*

This line shows the generated power and the selected units. Two symbols ▲▼ indicate active position of the cursor. The position of the cursor can be controlled with < > . The setting can be done with ^ v. When the „Power stepping“ is selected (see later), the line shows the actual power value in % which corresponds to the nominal power value.

5. *Indication line*

The activated keys of the numeric keyboard are shown, when the main value is set from the numeric keyboard.

6. *Signal parameters*

Two lines indicate the parameters:

- a) Frequency
- b) Current
- c) Voltage
- d) Power factor (phase)

7. *Additional information*

Information about the calibrator's function, output terminal mode, accuracy of the generated power in % are shown in this lines. The key MODE selects the type of generation: W-VA-VAr-Ws-VAs-VAsr. The output terminals can be set for SIMPLE when each terminal group A, B, C is controlled individually, or ALL, when all terminal groups are controlled simultaneously with the keys ON-C and OFF-C.

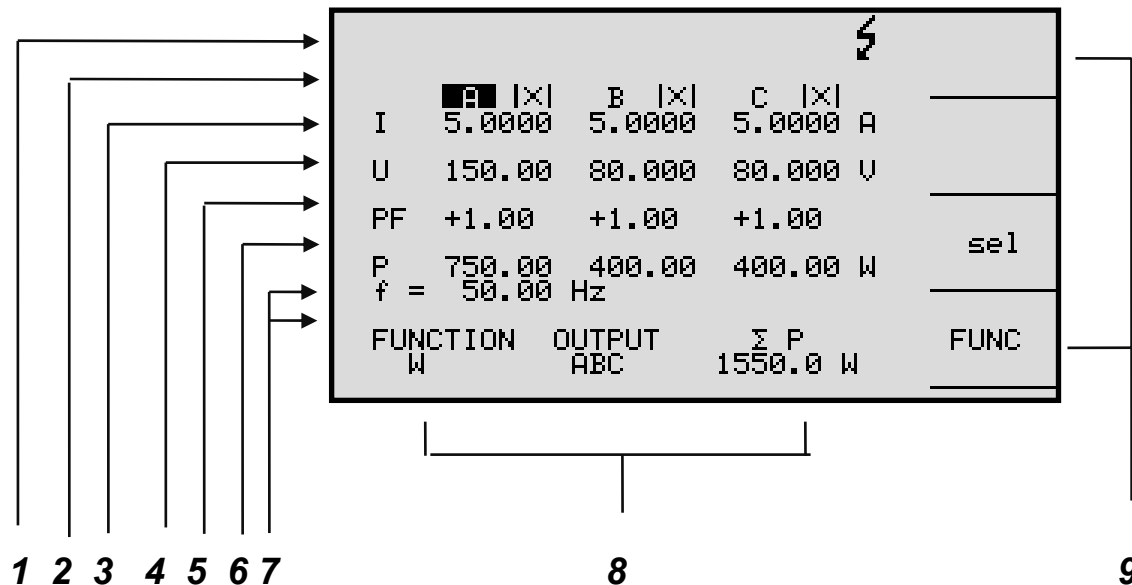
8. *The Display keys*

Symbol	Key function	Note
UP	Power increasing	the step can be set 1 - 50 %
DOWN	Power decreasing	the step can be set 1 - 50 %
sel	Selection of type	
FUNC	Type of power or energy	W-VA-VAr-Ws-VAs-VAsr
units	Unit selection	(LA = 0-180°, LE = 180-360°)
EXIT	End of entry	

Display in the 111f - Mode

When the mode 111f is selected with the keys OUTPUT A, OUTPUT B or OUTPUT C, the display shows all three outputs individually.

Display in the mode 111f



1. Analog input of the DC multimeter / pulse counter

The calibrator has inputs for DC volts of ± 13 V or DC amperes of ± 25 mA. The inputs are suitable for measuring of the feedback from transmitters or other devices under test. The positive terminal is **Re1**, the negative **Re2**. The value can be displayed in V or mA or in %.

In pulse counting mode, the number of input pulses at the terminals **Re1** and **Re2** is displayed. The pulse counting is active in energy mode only, when the output terminals are selected ON.

2. Information line in the mode 111f

This line shows information, related to calibrator state.

- Indication of dangerous voltage at the output terminals by warning arrow when output voltage setting is higher than 100 V.
- Error messages when the calibrator is forced to invalid operation or when the output terminals are overloaded or when the GPIB bus is wrongly programmed.
- Information about remote/local control. In the remote mode of control "REM" is shown on the left side.
- Information about four terminal connection of the voltage output. In the mode of remote sensing "4W" is displayed on the right side.

3. State of the outputs

Actual state of the outputs is displayed with symbols ON-OFF.

The output A, B or C which is activated, is shown in inverse color at the display. Parameters of this output such as voltage, current, PF or frequency can be selected. The output can be selected with the keys OUTPUT A, OUTPUT B, OUTPUT C.

4. Current

The current in each phase is displayed.

5. Voltages

The voltage in each phase is displayed.

6. Phase shift

The phase shift between the voltage and the current is displayed. The setting permits selection of the power factor (1.00 to – 1.00, LAG or LEAD), or as phase (0 to 360 °). The value 1.00 to -1.00 LAG corresponds to the current lagging behind the voltage in a range 0 to 180°. The phase in degrees indicates how many degrees is the current behind the voltage.

7. Supplementary data I

Output power in individual phases, output frequency and time (in energy mode only).

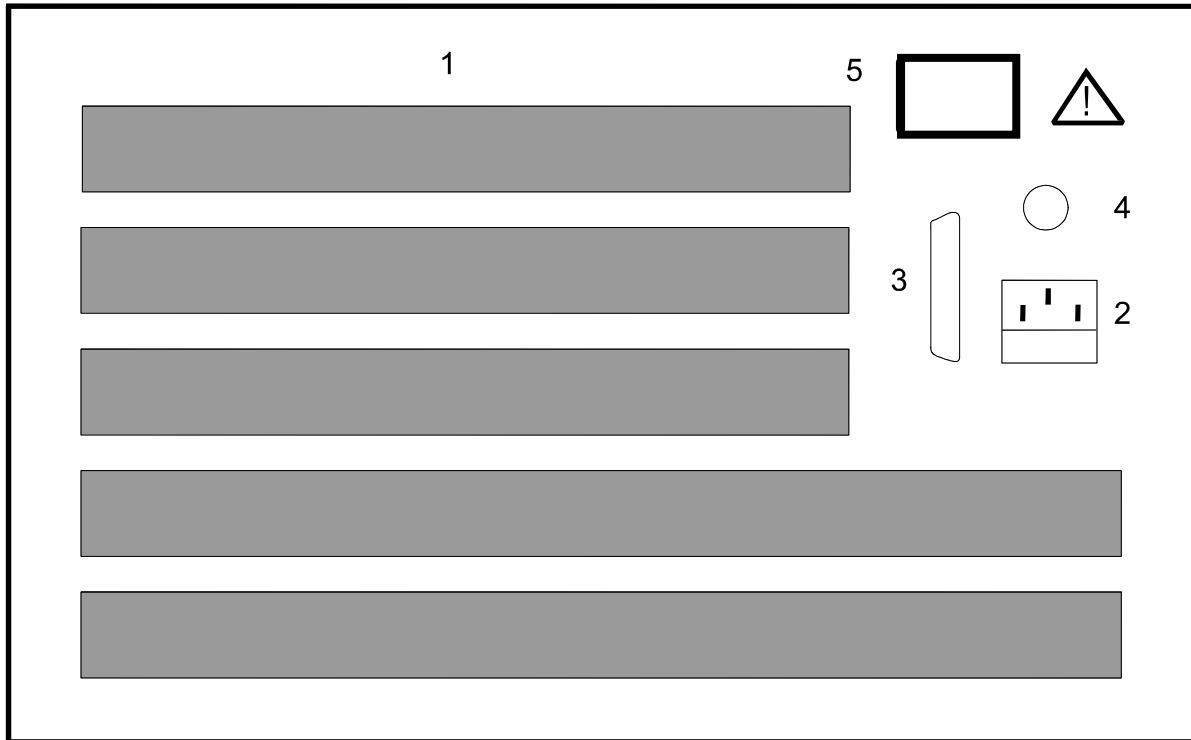
8. Supplementary data II

Information about calibrator's function, output terminal set up mode and total output power (energy). The function can be selected with "MODE" for: W-VA-VAr-Ws-VAs-VArS. The output terminals mode can be set for SIMPLE, when each terminal group A, B or C is controlled individually, or ALL when all terminal group are controlled simultaneously with the keys ON-C and OFF-C.

9. Description of the display keys

Same as in the mode 3f.

Rear panel



- 1 Holes for the forced ventilation.
- 2 Power supply module.
- 3 Connector for the GPIB bus.
- 4 Fuse for the excitation 24V AC (Re1, Re2 output C).
- 5 Instrument's sticker.

Calibrator function settings

After the calibrator has been switched-on, the internal tests are performed. At the end the parameters are set for real power in 3f mode with common setting in all three phases. The current is 5A, the voltage 80V, the power factor +1 (phase 0°), the frequency 50 Hz and the output terminals are switched-off. The output terminal mode is ALL. The mode can be changed from the front panel in following ways:

1. *Function change with the keys*

By using the keys OUTPUT A, OUTPUT B, OUTPUT C or 3f, the mode of operation can be changed from 111f into 3f. With the keys PRG and ALL/SIMPLE the output terminals can be selected. With the display-key FUNC the required function (real power [W], apparent power [VA], reactance power [VAr], real energy [Ws], apparent energy [VAs] and reactance energy [VArS]) can be set.

2. *Output terminals ON - OFF*

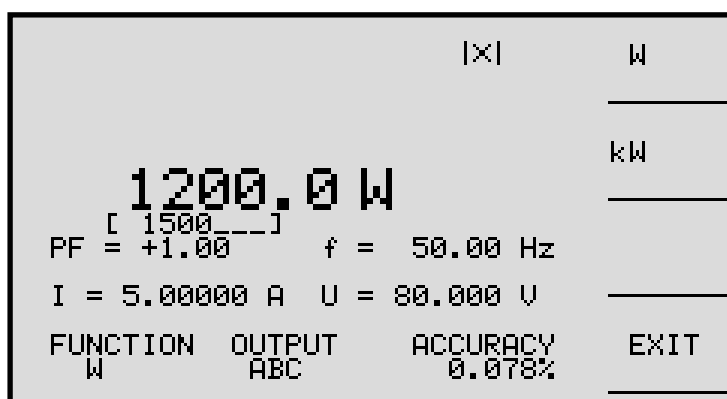
The output power can be switched ON and OFF with the keys ON-x / OFF-x. In the mode ALL the keys ON-C and OFF-C are activated.

3. *Enter the Service Menu*

With the key MODE, the service menu is displayed. With the same key the SETUP 1 or SETUP 2 will be activated.

Output power settings

The required output power can be set directly only in the mode 3f. Changing of the output power can be achieved by changing of the output current. When power value has been changed, the corresponding output current is re-calculated and displayed on the screen. The output voltage and the phase shift remain unchanged. When the mode 111f is selected, the output power can not be set directly. The power is always a calculated from the output voltage, the output current and the power factor.

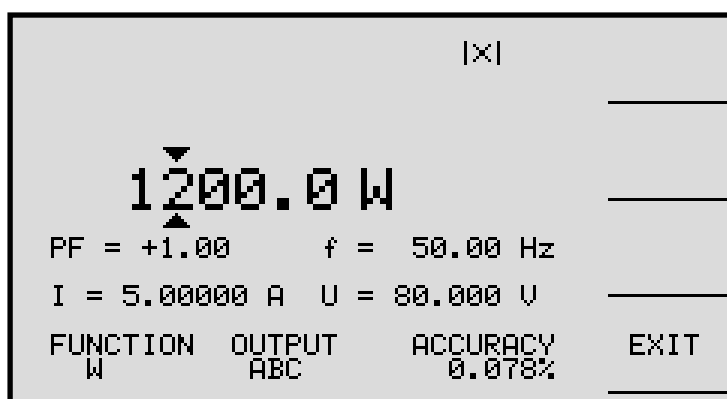


In the 3f - mode the power can be set in three ways:

1. Setting from the numeric keyboard

- Select the required power - value with the numeric keyboard . After pressing of the first digit the UNITS are displayed. The control line shows the symbol [_ _ _ _ _].
- After entering the value press the display key with required unit or press the key ENTER. When the key ENTER is used, the power must be in basic units W, VA etc.
- The new value is transferred as a main value and the control line disappears.

2. Setting with the cursor keys



- Press the key < or >. The cursor marks the active digit.

- b) The required value can be set with the keys \wedge and \vee .
- c) Return to the original display by pressing the key EXIT.

3. **Output power stepping**


- a) Press the display key UP for increasing the value of the output power. The value of the step can be set in the menu parameter POWER STEP.
- b) Press the display key DOWN for decreasing of the value.

The value of the step is expressed in % and relates to nominal value of the output power. This nominal value of output power will not change during the stepping. The nominal power can be changed by a new settings of power, current, voltage or power factor.



When the setting of the power is not at the nominal value, a supplementary information appears next to the main value at the display, showing how many % from the nominal value is adjusted.

Output terminals ON - OFF

After the instrument has been switched-on, the output terminals are automaticaly disconnected.

In the mode ALL the output terminals are controlled simultaneously. The terminals can be switched-on by pressing the key „ON-C“. The red LED illuminates. The display shows the symbol .

To switch-off the output terminals, press the key „OFF-C“. The LED switches-off and the display shows the symbol .

In the mode SIMPLE each output can be controlled individually. The terminals can be switched-on with the keys ON-A, ON-B or ON-C. The red LED illuminates and the display shows the symbol . To switch-off the output terminals, use the keys „OFF-A“, „OFF-B“ or „OFF-C“. The LED switches-off and the display shows the symbol .

In the 3f - mode the display shows always the symbol for connected terminals, even if only one terminal is selected. The corresponding LED indicates which terminals are activated.

In the 111f - mode the individual terminals are shown at the display.

Power and Energy

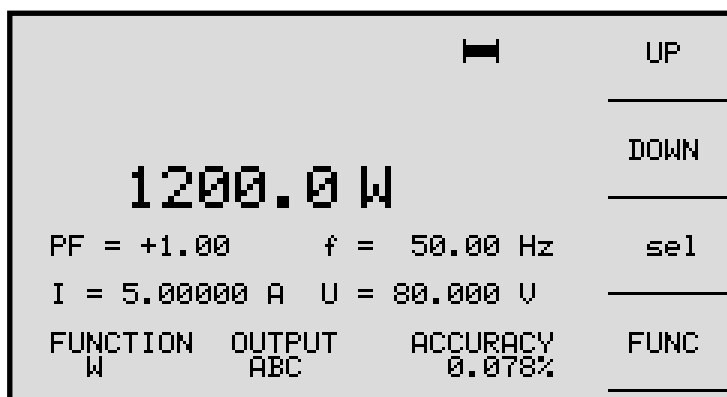
The three-phase calibrator enables to generate a precise value of AC-power and electric energy by generating the voltage at the output terminals **Hi** and **Lo** and the current at the output terminals **+I** and **-I**. The voltage terminals **Lo** of all three phases are connected together. These terminals can be grounded (recommended) or left floating. When floating, the maximum permissible voltage between them and the ground GND is 20Vrms.

Range of power setting: 1.8 VA to 7200 VA
 Range of voltage setting: 6 V to 240 V
 Range of current setting: 0.1 A to 10 A
 Range of phase setting: 0 to 360°
 Range of frequency setting: 40 Hz to 400 Hz

Control in the power mode 3f

This mode is suitable for simultaneous parameter setting in all three phases.

- Press the key 3f.
- The display shows:
 - * Main power value in W, VA, VAr
 - * Power factor or phase (can be selected in menu)
 - * Frequency
 - * Current
 - * Voltage
 - * Calibrator function
 - * Configuration of output terminals
- Additional display when the energy mode of operation is selected
 - * Time of energy generation
 - * Quantity of generated energy
- When internal meter is activated
 - * Voltage or current or number of pulses
- The required power can be set from the numeric keyboard or with the cursors < >. The output terminals are disconnected, the display shows |X|.
- Connect the device for calibration to the output terminals Hi and Lo and +I and -I. When the current is not required, short-circuit the terminals +I with -I.
- Press the key ON-x.
- The LED indicate the activated output terminals.



The generated power is available at the output terminals.

Calibrator functions

The calibrator permits three basic generation of the electric power:

- Real power (W)
- Apparent power (VA)
- Reactive power (VAr)

The function can be selected with the key FUNC.

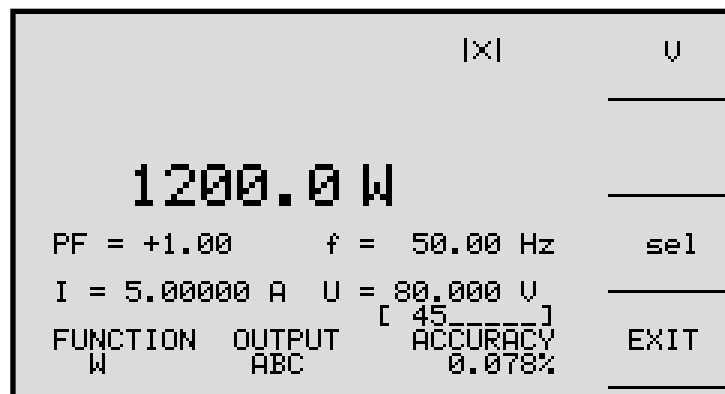
Power settings

1. Main setting

- The main value can be set directly from the numeric keyboard, or by using the cursor's keys \leftarrow , \rightarrow , \wedge , \vee , or by stepping with the display keys UP, DOWN.
- The power value changes by changing the current.

2. Voltage setting

- The main power value can be set by changing the voltage.
- Press the key SEL until the symbol [_ _ _ _ _] appears under the voltage in the form „U = xxx.xx V“.
- Set the required value of the voltage from the numeric keyboard. Confirm with „V“ or „ENTER“.
- The output power is recalculated from the voltage, the current and the power factor.



3. Current setting

- The main power value can be set by changing the current.
- Press SEL until the symbol [_ _ _ _ _] appears under the current in the form „I = xx.xxxxx A“.
- Set the required value of the current from the numeric keyboard. Confirm with „A“ or „ENTER“.
- The output power is recalculated from the voltage, the current and the power factor.

X			A
1200.0 W			
PF = +1.00	f = 50.00 Hz		sel
I = 5.00000 A	U = 80.000 V		
[1.2 _ _ _]			
FUNCTION	OUTPUT	ACCURACY	EXIT
W	ABC	0.078%	

4. Power factor setting

- When W or Var are selected, the power can be changed by changing the power factor. The setting of the power factor doesn't have any influence on the apparent power. The Menu permits selection of the power factor or the phase shift in "°".
- Press SEL until the symbol [_ _ _ _ _] appears under the power factor in form of „PF = x.xx LA“ or „PF = x.xx LE“. In case of phase shift setting, the indication is in „DEG = x °“.
- Set the required power factor (+1.00 to -1.00) from the keyboard and confirm with „LA“, for current lagging behind the voltage (0 to 180°) or „LE“, for current leading the voltage (180 to 360°). When the phase shift has been set in "°", the value shows the current lagging behind the voltage.

X			LA
1200.0 W			LE
PF = +1.00	f = 50.00 Hz		sel
I = 5.00000 A	U = 80.000 V		
[.25 _ _ _]			
FUNCTION	OUTPUT	ACCURACY	EXIT
W	ABC	0.078%	

- The output power is recalculated from the voltage, the current and the power factor.

5. Frequency setting

- Press SEL until the symbol [_ _ _ _ _] appears under the frequency in form „f = xxx.xx Hz“.
- Set the required frequency from the keyboard. Confirm with „Hz "or „ENTER".

X			Hz
1200.0 W			
PF = +1.00	f = 50.00 Hz	sel	
I = 5.00000 A	U = 80.000 U		
FUNCTION	OUTPUT	ACCURACY	EXIT
W	ABC	0.078%	

When the frequency setting is larger or smaller than the instrument's frequency range, the display shows the maximum or minimum value.

When a new frequency value is set, the output terminals will automatically be disconnected. To activate them again, press the key ON-x.

6. Energy setting

The Energy Mode is activated with the key FUNC. The display shows the time in seconds and the energy in selected units. The output terminals are activated with the key ON. The range of time setting is 10 to 1999 sec.

Energy can be set in two ways:

- Time setting
 - Press SEL until the symbol [_ _ _ _ _] appears under the time TIME [s].
 - Enter the required time from the keyboard and confirm with „s“.
 - The Energy is recalculated in accordance with the new time value.
- Direct energy setting
 - Press SEL until the symbol [_ _ _ _ _] appears under the ENERGY [Ws].
 - Set the required value in Ws or kW and confirm with „Ws“ or „kW“.
 - The Time is recalculated in accordance with the new energy setting.

X			s
TIME [s]	ENERGY [Ws]		
10.0	1.20000e+04		
[20.5 _ _]			
1200.0 W			
PF = +1.00	f = 50.00 Hz	sel	
I = 5.00000 A	U = 80.000 U		
FUNCTION	OUTPUT	EXIT	
Ws	ABC		

Settings in the power mode 111 f

This mode is suitable for individual setting of the voltage, the current and the phase shift.

- Press one of the keys Output A, Output B or the Output C.
- The display shows:
 - * Current from terminals +I -I of the phase A
 - * Voltage on terminals Hi -Lo of the phase A
 - * Power factor or phase shift (selection in the Menu) of the phase A
 - * Value of the output power in selected units W, VA, VAr of the phase A
 - * Current from terminals +I -I of the phase B
 - * Voltage on terminals Hi -Lo of the phase B
 - * Power factor or phase shift (selection in the Menu) of the phase B
 - * Value of the output power in selected units W, VA, VAr of the phase B
 - * Current from terminals +I -I of the phase C
 - * Voltage on terminals Hi -Lo of the phase C
 - * Power factor or phase shift (selection in the Menu) of the phase C
 - * Value of the output power in selected units W, VA, VAr of the phase C
 - * Frequency
 - * Function
 - * Control configuration of the output terminals
 - * Total output power on all terminals

Additional Display Information in the Energy Mode:

- * Time
- * Total Energy (instead the total power)

When the Multimeter is activated

- * Voltage or Current or number of pulses
- Set the required voltage, current and power factor in individual phases by using the keys OUTPUT A, OUTPUT B, OUTPUT C and SEL. The output terminals are disconnected and the symbols |X| are shown at the individual outputs.
- Connect the device for calibration to the output terminals Hi and Lo and +I and -I. When the current is not required, short-circuit the terminals +I with -I.
- Press the key ON-x.
- The LED indicate the activated output terminals.

	A	B	C	
I	5.0000	5.0000	5.0000	A
U	80.000	80.000	80.000	V
PF	+1.00	+1.00	+1.00	
P	400.00	400.00	400.00	W
f =	50.00	Hz		
FUNCTION	OUTPUT		Σ P	
W	ABC		1200.0	W
				sel
				FUNC

The electric power is connected to the output terminals.

Power setting

The Power can be set in several ways. The voltage, the current and the power factor can be set individually in the outputs A, B and C. The selection of the output is with the keys OUTPUT A, OUTPUT B or OUTPUT C. Within the selected phase the parameters can be activated with the key SEL.

1. Voltage setting

Select the output with Output A, Output B or Output C.

- Press SEL until the symbol [_ _ _ _ _] appear under the voltage in form „U = xxx.xx V“.
- Set the required voltage with the keyboard and confirm with „V“ or „ENTER“.
- The output power is recalculated and displayed.

				U
I	A X 5.0000	B X 5.0000	C X 5.0000	A
U	80.000	80.000	80.000	U
PF	[66.666_]	+1.00	+1.00	
P	400.00	400.00	400.00	W
f =	50.00	Hz		
FUNCTION	OUTPUT	Σ P		EXIT
W	ABC	1200.0 W		

2. Current setting

- Press SEL until the symbol [_ _ _ _ _] appear under the current in form „I = xx.xxxx A“.
- Set the required current with the keyboard and confirm with „A“ or „ENTER“.
- The output power is recalculated and displayed.

				A
I	A X 5.0000	B X 5.0000	C X 5.0000	A
U	[4.55_ _]	80.000	80.000	U
PF	+1.00	+1.00	+1.00	
P	400.00	400.00	400.00	W
f =	50.00	Hz		
FUNCTION	OUTPUT	Σ P		EXIT
W	ABC	1200.0 W		

3. Power factor setting

- When W or Var are selected, the power can be changed by setting of the power factor. Power factor or phase shift in ° can be selected in the Menu.
- Press SEL until the symbol [_ _ _ _ _] appear under the power factor in form of „PF = x.xx LA“ or „PF = x.xx LE“. By selecting of the phase shift „DEG = x °“ is shown.
- Set the required value of the power factor (+1.00 až -1.00) and confirm with „LA“ for the current lagging behind the voltage (0 to 180°) or the „LE“ for voltage leading the current (180 to 360°). The phase shift in "°" shows the angel between the current and the voltage.
- The power is recalculated in accordance with the new settings.

					LA
I	A X	B X	C X	A	
	5.0000	5.0000	5.0000		
U	80.000	80.000	80.000	U	LE
PF	+1.00	+1.00	+1.00		
P	[.25---]				sel
	400.00	400.00	400.00	W	
f =	50.00	Hz			
FUNCTION	OUTPUT		Σ P		EXIT
W	ABC		1200.0	W	

4. Frequency setting

- Press SEL until the symbol [_ _ _ _ _] appear under the frequency data in form „f = xxx.xx Hz“.
- Set the required frequency and confirm with „Hz“ or „ENTER“.

					Hz
I	A X	B X	C X	A	
	5.0000	5.0000	5.0000		
U	80.000	80.000	80.000	U	
PF	+1.00	+1.00	+1.00		
P	400.00	400.00	400.00	W	sel
f =	50.00	Hz			
	[55.7---]				
FUNCTION	OUTPUT		Σ P		EXIT
W	ABC		1200.0	W	

When the frequency set is larger or smaller than the instrument's frequency range, the display shows the maximum or minimum value.

By setting a new frequency value, the output terminals will automatically be disconnected. To activate them again, press the key ON-x.

5. Energy setting

Select the Energy Mode with FUNC. The display shows the time in seconds and the energy. The time can be set from 10 sec to 1999 sec.

	A X	B X	C X	
I	5.0000	5.0000	5.0000 A	
U	80.000	80.000	80.000 V	
PF	+1.00	+1.00	+1.00	
E	4000.0	4000.0	4000.0 Ws	sel
f =	50.00 Hz	t =	10.0 s	
FUNCTION	OUTPUT	Σ E		FUNC
Ws	ABC	12.000 kWs		

The Energy can be set in two ways:

a) Time setting

- Press „SEL“ until the symbol [_ _ _ _ _] appear under „TIME [s]“.
- Set the required time and confirm with „S“.
- The energy is recalculated and displayed.

	A X	B X	C X	
I	5.0000	5.0000	5.0000 A	
U	80.000	80.000	80.000 V	
PF	+1.00	+1.00	+1.00	
E	4000.0	4000.0	4000.0 Ws	sel
f =	50.00 Hz	t =	10.0 s	
FUNCTION	OUTPUT	Σ E	[50 _ _ _ _]	EXIT
Ws	ABC	12.000 kWs		

b) Direct energy setting

- Press SEL until the symbol [_ _ _ _ _] appear under „ENERGY [Ws]“.
- Set the required energy in Ws or kWs and confirm with „Ws“ or „kWs“.
- The energy is recalculated and displayed.

CAUTION

When the calibrated devices has isolated current and voltage input circuits, the output terminals **Lo** and **-I** of the calibrator have to be grounded by activating **GND ON** in the menu.

When the calibrated devices has the current and voltage input circuits connected together, the output terminals **Lo** and **-I** of the calibrator have to be ungrounded by setting **GND OFF** in the menu.

Note: When the terminals **Lo** and **-I** at the calibrator and at the calibrated device are connected together, the voltage drop on the current cables can damage the internal relay connecting the terminals **Lo** and **-I** with **GND**.

Menu

To enter the Menu, press MODE. The output terminals will be automatically disconnected. The display offers SETUP 1.

		CAL. MODE
GPIB	02	
GND	ON	
SENSE	2W	SETUP 1
INPUT A,B ..	20mA	
100% A = ..	20mA	
KEYB.beep ..	ON	
KEYB.vol.	10	
PHASE	COS	
CONTRAST	42 I	
POWER STEP ..	20%	
CAL.CODE	000000	EXIT
CAL.DATE	03.1997	
DEVICE N.	10301	

The keys \vee \wedge select the parameter which can be set to the required function. The key EXIT or MODE select the SETUP 2. By pressing the key MODE again, the display will return to the initial position.

Parameters of the SETUP 1

1. **GPIB** *xx UP/DOWN*

Valid address of the GPIB bus. The address can be selected with „UP“ or „DOWN“ between 00 and 30. Factory setting is 02.

2. **GND** *xx ON/OFF*

Connecting or disconnecting the Lo, sLo, -I terminals and GND. Factory setting is ON.

3. **SENSE.....xx 4W/2W**

Four or two terminal connection of the voltage output. The selection is available with the key 4W/2W. After each power-on, this parameter will be set automatically for 2W connection. The 4W connection is recommended for special applications only.

WARNING

If the output cables Lo, sLo and Hi, sHi at the four-terminal connection are reversed or wrongly connected, the calibrator can be damaged!

4. **INPUT A xx 10 V/20mA/CNT/OFF**

The function of the input terminals Re1 and Re2 (OUTPUT A) can be selected for voltage or current measurement. The range of the voltage input is $\pm 10\text{V}$, the range of the current is $\pm 20\text{ mA}$. By repeated pressing of the keys 10V or 20mA the absolute reading (V or A) or the relative reading (%) is selected.

The function of the input terminals Re1 and Re2 (OUTPUT B) can be selected for pulse measurement. Re1 is the positive input, Re2 is the negative input. By repeated pressing of the CNT the input switches between ON and OFF.

5. **100% A = ... xx numeric keyboard**

It permits setting of 100% for the relative indication of current or voltage measurement. At the settings of e.g. 100% A = ... 5 mA the input current 5 mA corresponds to relative value of 100%.

In the counter mode represents this parameter a Preset, a preselected number of pulses at which the counter stops counting.

6. **KEYB.beep xx ON/OFF**

Acoustic signal when the keys are pressed.

Setting of this parameter does not affect the warning signal when the output voltages is higher than 100 V or an error is announced.

7. **KEYB.vol. xx UP/DOWN**

Setting of the volume between 00 and 31 with UP or DOWN. The higher the number, the higher the volume. The volume corresponds to the keyboard, to the warning at higher voltage than 100V and to the error messages.

8. **PHASE xx %COS**

Setting of the phase shift between the voltage and the current. By pressing the keys ° or COS the degree 0° to 360° or the power factor 1.00 to -1.00 can be selected. The settings are: 1.00 = 0° , 0.00LA = 90° , -1.00 = 180° , 0.00LE = 270° . The readout of 90° means the current lagging behind the voltage by 90° . The factory setting is COS.

9. **CONTRAST xx y UP/DOWN/INV.**

The display contrast can be set within a range of 00 to 63 with UP or DOWN. Inverted type of display color can be achieved as well. The inversion is indicated with I at the position y.

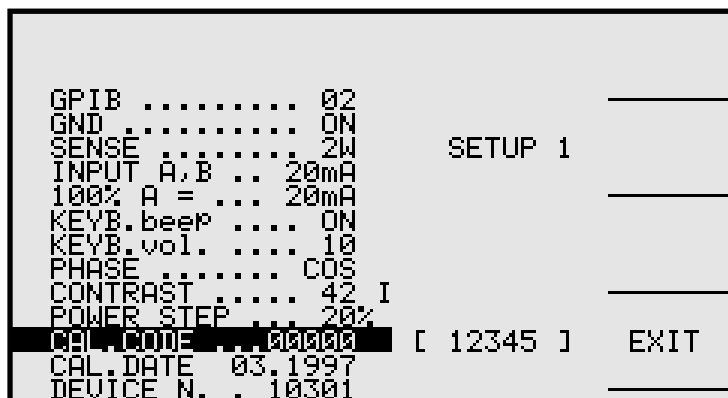
10. **POWER STEP.... xx UP/DOWN**

The power can be stepped up or down. The step size can be changed from 1 to 50%. The factory setting is 10%. The function „output power stepping“ is available only in the mode 3f.

11. **CAL.CODE .. 00000**

Calibration code entry. The calibration code is five-digit number which permits the entry into the calibration loop. Factory setting is „00000“ and can be changed by the user to any 5 digit number. The entered code has to be confirmed with ENTER.

It is recommended to note the calibration code after its setting. In case of its loss the instrument has to be returned to the manufacturer.



12. *CAL.DATE* xx.yyyy

The date of the last calibration - month and year. The date of calibration can be changed after new calibration only.

13. *DEVICE N.* . xxxxx

The identification number of the calibrator. This parameter cannot be overwritten.

Parameters of the SETUP 2**1. *PHASE UA/UB* .. xxx *numeric keyboard / CLEAR***

This function enables to set the phase shift between the channels A and B. After each power switch-on, the phase will automatically be set for 120°. To enter another value, use the keyboard and finish by pressing ENTER. To turn to the default of 120° press CLEAR.

2. *PHASE UA/UC* .. xxx *numeric keyboard / CLEAR*

This function enables to set the phase shift between the channels A and C. After each power switch-on, the phase will automatically be set for 240°. To enter another value, use the keyboard and finish by pressing ENTER. To turn to the default of 120° press CLEAR.

Calibration Mode

A Calibration Mode is available for a simple calibration of the calibrator OCM103.

Principle of calibration

Entire or partial calibrations can be performed. The entire calibration contains partial calibration sequences. If only one parameter from the calibration menu is required to be re-calibrated, e.g. „VOLTAGE“, it is necessary to perform the calibration of all ranges in this partial menu by the algorithm presented at the display. If one step or more steps are not necessary to be calibrated, the original calibration parameters can be accepted by overjumping.

Calibration method for **AC voltages** consists of setting of the scale in each output A, B and C in the ranges 80 V and 200 V at a frequency of 60 Hz.

Calibration method of **AC currents** consists of setting of the scale factor in each output A, B and C in the ranges 1 A, 5 A and 10 A at a frequency of 60 Hz.

Calibration method of internal **DC multimeter** consists of setting of the Offset at 0.000 V and 0.000 mA and scale at 10.000 V and 20.000 mA.

Accuracy of the phase shifts between the outputs A, B and C and between the voltage and the current outputs is based on accuracy and stability of the internal quartz oscillator. Since the accuracy and stability of this oscillator is much higher than the specified accuracy of phase shifts of the calibrator, the recalibration is not available.

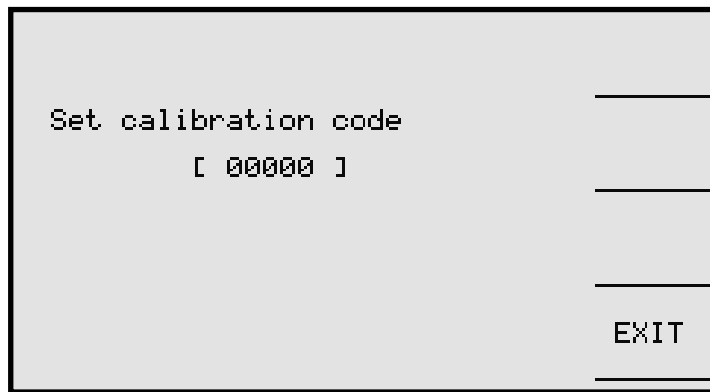
Access to the calibration mode

The instrument has to be switched-on for min. 30 minutes to warm-up. During this time the access to the calibration mode is inhibited.

- Press **MODE** to access the menu.
- Press **CAL. MODE**.

ERR: 21	CAL.
Time warm up !	MODE
GPIB 02	
GND OFF	
SENSE 2W	
INPUT A,B .. 20mA	
100% A = ... 10mA	
KEYB.beep ON	
KEYB.vol. 10	
PHASE COS	
CONTRAST 35 I	
POWER STEP ... 20%	
CAL.CODE ... 00000	EXIT
CAL.DATE 08.1998	
DEVICE N. . 10300	

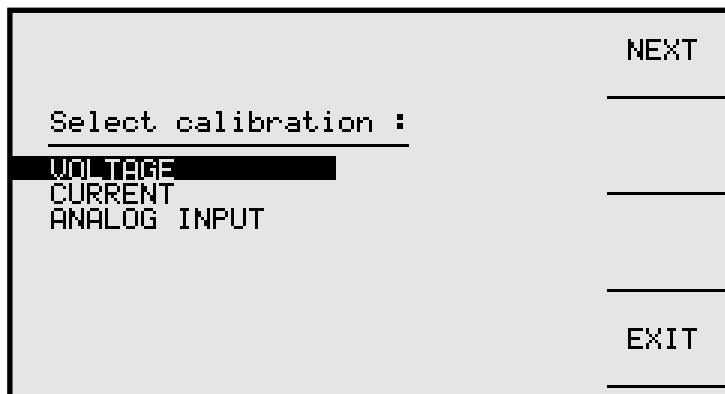
- Enter the correct calibration code and confirm with **ENTER**.



- When the calibration code is wrong, the display shows an error message for about 3 s:

Err 20
Bad calib. code!

- When the calibration code is correct, the individual functions appear at the display.

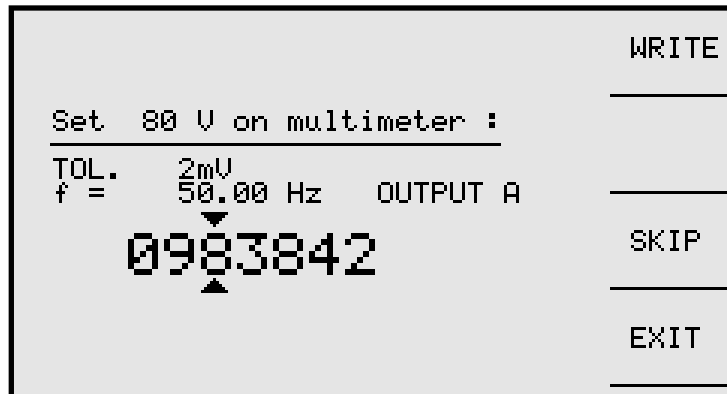


- Select the required item with \wedge or \vee .

- | | | |
|----|--------------|--|
| 1. | VOLTAGE | Voltage calibration of all outputs |
| 2. | CURRENT | Current calibration of all outputs |
| 3. | ANALOG INPUT | Multimeter calibration of 10 V and 20 mA |

Type of calibration

One of the partial calibrations can be selected with the cursor keys \wedge or \vee . After the setting of the required function press „NEXT“. The display shows following information (example of voltage calibration VOLTAGE is shown below):



The display is similar for calibration of current ranges. The display keys have following meanings:

WRITE	New value entered into the memory. It will overwrite the original calibration data.
SKIP	Skipping the calibration step. The original calibration data will remain in the memory.
EXIT	Exit from the calibration loop. The original calibration remains in the memory and the calibrator returns to the calibration menu. This can be done when only one range has to be calibrated

The display shows the required accuracy of the control instrument. The displayed value is without the sign and sets the tolerance field around the calibration value.

Setting of a new calibration value

By using the cursor keys \wedge , \vee , $<$, $>$ a value at the display has to be set until the output signal measured with a control instrument is equal to the required value. Enter "WRITE" to confirm and write the new value into the memory. When "SKIP" is pressed, the original value remain stored in the instrument's memory. After pressing "WRITE" or "SKIP" the calibration menu will be advanced to the next point.

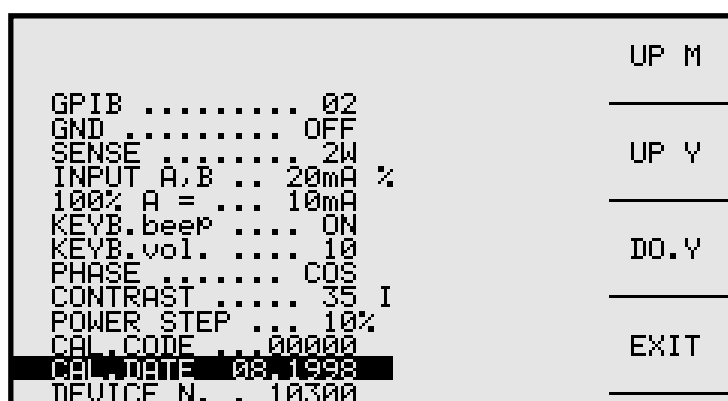
Repeat the procedure until all required points are calibrated. Finish with "EXIT".

End of calibration

The calibration can be closed:

- After the complete calibration the display returns to the calibration menu.
- After a partial calibration the display returns to the calibration menu.
- After only some ranges or functions have been calibrated. The display returns to the calibration menu.
- After the calibration was initialized but not changed. After „EXIT“ pressing, the display returns to the calibration menu.

Finish the calibration by pressing „EXIT“. The MENU will display the calibration date:



UP M Month from 01 to 12

UP Y Year stepping upwards

DO Y Year stepping downwards

Enter the date and press „EXIT“ to finish the calibration. The display returns into the service menu.

Calibration points

Each function has firm points of calibration

VOLTAGE

Nominal value [V]	Setting tolerance [V]	Range [V]	Note
80	10 m	80	Scale
200	30 m	200	Scale

Table ACU

CURRENT

Nominal value [A]	Setting tolerance [A]	Range [A]	Note
1	200 u	1	Scale
5	1 m	5	Scale
10	3 m	10	Scale

Table ACI

ANALOG INPUT

Nominal value	Setting tolerance	Range	Note
0 mA	1 μ A	20 mA	Zero
0 V	500 μ V	10 V	Zero
20 mA	1 μ A	20 mA	Scale
10 V	500 μ V	10 V	Scale

Table DCUI

Entire Calibration

Equipment required

- 8 1/2-digit multimeter, recommended type HP3458A, Wavetek 1281 or another with accuracy 0.02 % at VAC
- Current shunt 100 mΩ, recommended type Burster 1280 or another with accuracy 0.01% and known frequency characteristic to 60 Hz.

For checking of parameters following instruments are recommended: counter HP 53181A, distortion meter type HP 8903A, E , oscilloscope with bandwidth 20 MHz, standard AC wattmeter with accuracy 0.02- 0.05 %.

Calibration procedure

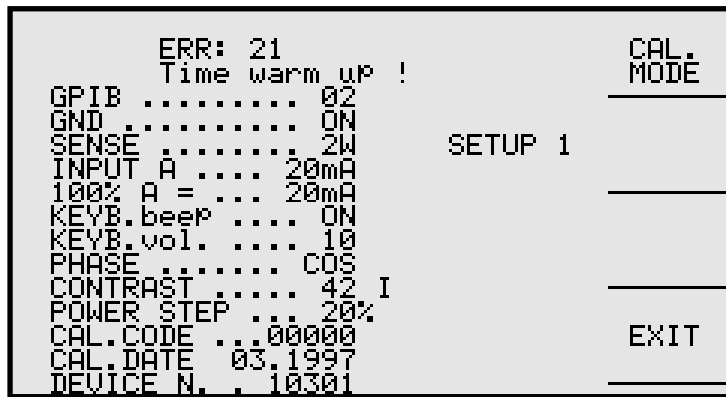
1. Connect the calibrator and the standard multimeter to the power supply for at least 3 hours to warm-up at an ambient temperature of $23 \pm 1^{\circ}\text{C}$.
2. Enter the service menu with **MODE** and the calibration menu with **CAL.MODE**.
3. Set the calibration mode.
4. **Calibration of voltage ranges.**
 - a) Set **VOLTAGE** in the menu of calibration functions
 - b) Perform the calibration in all points. Follow the instructions on the display and use tolerances in the table ACU. Confirm the new calibration with **WRITE**.
5. **Calibration of current ranges**
 - a) Set **CURRENT** in the menu of calibration functions
 - b) Perform the calibration in all points. Follow the instructions on the display and use tolerances in the table ACI. Confirm the new calibration with **WRITE**.
 - c) Use the shunt with known frequency characteristic up to 60 Hz on ranges 5A and 10 A.

Error Messages

The display shows errors which might be caused by:

- wrong entry via the keyboard, e.g. setting of unacceptable mode, value out of range, overload of the outputs, etc.
- defective communication between the functional blocks inside the instrument
- faulty control via the GPIB bus in remote mode.

Example of error message when the calibration was attempted during the warm-up time of 30 minutes:



The error message contains an error number and a brief description of the error. The following table shows the calibrator errors.

No:	Error Description	Meaning	Hints
1	Overload I Output A !	Voltage overload of the current terminal A	Voltage on load is too high. Decrease the load resistance.
2	Overload I Output B !	Voltage overload of the current terminal B	Voltage on load is too high. Decrease the load resistance.
3	Overload I Output C !	Voltage overload of the current terminal C	Voltage on load is too high. Decrease the load resistance.
4	Overload U Output A !	Current overload of the voltage terminal A	The withdrawn current is too high. Increase the load resistance.
5	Overload U Output B !	Current overload of the voltage terminal B	The withdrawn current is too high. Increase the load resistance.
6	Overload U Output C !	Current overload of voltage terminal C	The withdrawn current is too high. Increase the load resistance.
7	High temperature A !	Too high temperature of the channel A amplifier	Calibrator is overloaded. Switch-OFF the output terminals for at least 10 minutes. Check if the ventilation holes are free.
8	High temperature B !	Too high temperature of the channel B amplifier	Calibrator is overloaded. Switch-OFF the output terminals for at least 10 minutes. Check if the ventilation holes are free.

No:	Error Description	Meaning	Hints
9	High temperature C !	Too high temperature of the channel C amplifier	Calibrator is overloaded. Switch-OFF the output terminals for at least 10 minutes. Check if the ventilation holes are free.
10	Interface error !	GPIB communication error	Wrong data format on the GPIB bus.
11	Bad command !	Bad command to GPIB	Unknown GPIB command.
12	Bad communication !	GPIB communication error	Listener is not connected to the GPIB bus. Check the connection.
20	Bad calib. code !	Bad calibration code	Use correct calibration code.
21	Time warm up !	Calibration attempted during the warm-up time	Wait until the end of the warm-up time (minimum 30 minutes)
22	Overload Input A !	Analog input of calibrator overloaded	Decrease voltage (current) connected to the analogue input.
30	CPU timeout !	Communication error between processors	Internal error. Switch-off the instrument and switch-on after 5 s again. If the error remains, contact the manufacturer.
31	CPU data !	Communication error between processors	Internal error. Switch-off the instrument and switch-on after 5 s again. If the error remains, contact the manufacturer.
32	52<>analog !	Communication error between processors	Internal error. Switch-off the instrument and switch-on after 5 s again. If the error remains, contact the manufacturer.
36	Format EEPROM !	Memory formatting	Lost of data. Contact the manufacturer.
40	Value too large!	Value out of range	Set the correct value.
41	Value too small!	Value out of range	Set the correct value.
42	Bad output mode !	Wrong configuration of the output terminals	Change the configuration of output terminals with the keys PRG or All/Simple.

Maintenance

The three-phase calibrator is very sophisticated instrument with a microprocessor control. Power blocks are cooled by fan. The built-in electronic guards protect the instrument against damage.

Principles of proper handling

- *Switch the calibrator ON and OFF only with the power switch at the rear panel..*
- *Use only 230V / 47-63Hz mains.*
- *Keep the ventilation holes always free, do not cover them with paper or other objects.*
- *Operate the calibrator in laboratory conditions.*
- *Do not exceed the temperature range.*
- *Connect the calibrated device to correct output terminals. There are still some possibilities to destroy the instrument even it has build-in protection circuitry.*
- *Use only cables with correct banana diameter.*
- *Ground the output terminal Lo (service function GND ON), when the tested device is not grounded.*
- *Load the outputs (esp. 10A and 200V ranges) only as long as the application requires in order to not overheat the output stages.*
- *Use always cables which can sustain the voltage and the current from the instrument. The voltage can reach 480V and the current 10A AC.*

The calibrator does not require any special maintenance of the mechanical or electrical parts.

The calibrator has recommended recalibration interval of 12 months.

Hints

When the calibrator is out of function (display not illuminated, fans not operational), switch-off the power and replace the fuse in the power module:

- Disconnect the power cord from the mains.
- Insert the tip of a screwdriver into the slot of the fuse holder and take out the defective fuse.
- Replace the defective fuse
- Switch-on the calibrator again. If the failure continues, contact the manufacturer.

If some modes or ranges do not work properly, contact the manufacturer.

Always be sure that:

- Power supply is within declared tolerances
- Grounding is done perfectly (proper contact of the power supply GND pin, no grounding loops between the calibrator and the device under test)
- Intensive sources of interferences such as magnetic fields, HF-generators, arials etc. to be placed away from the calibrator.

Remote Control

The calibrator is equipped with standard GPIB bus with the connector at the rear panel. Following functions are permitted:

SH1, AH1, T5, RL1, DC1

Syntax of commands

All commands in the next chapter are described in two columns : KEY WORD and PARAMETERS.

The KEY WORD contains the name of the command. The command consists of one or more key words. If the key word is closed in brackets ([]), than its use is not obligatory.

Capital letters are used for abbreviated form of commands, extension written by means of small characters describes extended form of commands.

Command parameters are closed into sharp parenthesis (< >). Individual commands are separated by comma. Parameter closed in brackets ([]) is not obligatory. Vertical separating sign (|) means „or“ and is used for separating of several alternative parameters.

Semi-colon ‘;’ is used for separation of individual commands, introduced in one line.

E.g.: VOLT 20.3 ; OUTP ON

Abbreviations

- <DNPD> = Decimal Numeric Program Data. It is used for value setting by means of decimal number with or without exponent.
- <CPD> = Character Program Data usually represents group of alternative sign parameters, e.g. {ON | OFF | 0 | 1}.
- ? = Attribute of inquiry on parameter, given by command. Another parameter, except "?" cannot be used.
- (?) = Attribute of inquiry on parameter, given by command. It is a command, which permits the inquiry as well as the setting.

Subsystem OUTPut

This subsystem enables control of output terminals of the calibrator OCM-103, four-terminal output connection and outputs configuration.

Key word	Parameters
OUTPut	
[:STATe] (?)	<CPD> { ON OFF 0 1 }
:COMPensation (?)	<CPD> { ON OFF 0 1 }
:CONFigure (?)	<CPD> { A B C AB AC BC ABC 0 }

OUTP [:STAT] (?) <CPD> { ON | OFF | 0 | 1 }

This command switches ON or OFF the output terminals of OCM-103. The outputs are switched-on which are introduced in the command OUTP:CONF.

- ON or 1 terminal switches on
- OFF or 0 terminal switches off

In case of inquiry, OCM-103 answers ON if the terminal is switched on, or OFF if the terminal is switched off.

Example: OUTP ON; output terminals are switched on

OUTP ON ? the calibrator answers ON or OFF

OUTP :COMP (?) <CPD> { ON | OFF | 0 | 1 }

This command switches ON or OFF the four-terminal compensation of the output terminals.

- ON or 1 switches ON the four-terminal compensation (mode 4W)
- OFF or 0 switches OFF the four-terminal compensation (mode 2W)

In case of inquiry the OCM-103 answers ON if four-terminal compensation is switched on, or OFF when switched off.

Example: OUTP :COMP ON; switches on the four-terminal connection (mode 4W)

OUTP :COMP ? the calibrator answers ON or OFF

OUTP :CONF (?) <CPD> { A | B | C | AB | AC | BC | ABC | 0 }

This command sets the configuration of the output terminals. The terminals will be switched-on with a command OUTP ON.

- A switches ON and OFF the terminal A. Terminals B and C do not react on the command OUTP { ON | OFF }
- B switches ON and OFF the terminal B. Terminals A and C do not react on the command OUTP { ON | OFF }
- C switches ON and OFF the terminal C. Terminals A and B do not react on the command OUTP { ON | OFF }
- AB switches ON and OFF the terminals AB. Terminal C doesn't react on the command OUTP { ON | OFF }
- AC switches ON and OFF the terminals AC. Terminal B doesn't react on the command OUTP { ON | OFF }
- BC switches ON and OFF the terminals BC. Terminal A doesn't react on the command OUTP { ON | OFF }
- ABC switches ON and OFF all terminals
- 0 on the command OUTP { ON | OFF } doesn't have any influence on the outputs.

In case of inquiry OCM-103 answers the actual configuration of the outputs.

Example: OUTP :CONF AC; switches ON the output terminals A and C

OUTP :CONF ? the device answers AC

Subsystem SOURCE

This subsystem permits the control of individual functions of the calibrator OCM-103.

Key word	Parameters
[SOURCE]	
: VOLTage	
[: ELEMent <x>] (?)	<DNPD>
: CURRent	
[: ELEMent <x>] (?)	<DNPD>
: PHASe	
: UNITs (?)	<CPD> { DEG COS }
[: ELEMent <x>] (?)	<DNPD>
: FREQuency (?)	<DNPD>
: EARTH (?)	<CPD> { ON OFF 0 1 }
: POWER	
[: ELEMent <x>] ?	

[SOUR] :VOLT [:ELEM <x>] (?) <DNPD>

This command sets the amplitude of the generated AC voltage.

<x>

Represents the output related to the value. Permitted are A | B | C. If the key word ELEM is not used, the value is set (or read) which is common for the 3f mode.

<DNPD>

Represents value of the AC voltage in Volts. Limits are specified in "Specifications".

In case of inquiry the OCM-103 answers the voltage value in standard exponent format. For example for a value of 20.54V is the answer 2.054000e+01.

Example: VOLT :ELEM B 85.45; sets the mode 111f and the output B voltage to 85.45 V
VOLT :ELEM B ? the calibrator answers 8.545000e+01

[SOUR] :CURR [:ELEM <x>] (?) <DNPD>

This command sets the amplitude of generated AC current

<x>

Represents the output related to the value. Permitted are A | B | C. If the key word ELEM is not used, the value is set (or read) which is common for the 3f mode.

<DNPD>

Represents value of the AC current in Amperes. Limits are specified in "Specifications".

In case of inquiry the OCM-103 answers the current value in standard exponent format. For example for a value of 250.6 mA is the answer 2.506000e-01.

Example: CURR 1.1; sets the mode 3f and the output current to 1.1 A
CURR ? calibrator answers 1.100000e+00

[SOUR] :PHAS :UNIT (?) <CPD> { DEG | COS }

This command selects the phase shift between the current and the voltage.

- DEG selects the setting in „°“ from 0 to 360°
- COS selects the power factor setting in a range 1.00 to -1.00, LAG or LEAD.

(LAG = 0 - 180°, LEAD = 180 - 360°)

The selected setting remains memorized also when the power is switched-off.

In case of inquiry the OCM-103 answers the selected setting { DEG | COS }.

Example: PHAS :UNIT DEG; selects setting of the phase shift in degrees.
PHAS :UNIT ? calibrator answers DEG

[SOUR] :PHAS [:ELEM <x>] (?) <DNP> [, { LEAD | LAG }]

This command sets the phase shift between the voltage and the current.

<x>

Represents the related output. Permitted are parameters A | B | C. If the key word ELEM is not used, the value is set (or read) which is common for the 3f mode.

<DNP>

Represent the value of phase shift between voltage and current in degrees (setting DEG), or the power factor (setting COS). Limits are specified in "Specifications".

,{LEAD|LAG}

Can be set only in the power factor. When no value is entered, LAG is automatically inserted.

In case of inquiry the OCM-103 answers the value of the phase shift in standard exponent format. For example for the value of 156 ° the answer is 1.560000e+02.

Example: PHAS :ELEM A 250; sets the mode 111f and phase shift 250° between voltage and current of the channel A
PHAS :ELEM A ? calibrator answers 2.500000e+02

Example: PHAS 0.55 ,LAG; sets the mode 3f and the power factor of 0.55 LAG
PHAS ? calibrator answers 5.500000e-01,LAG

[SOUR] :FREQ (?) <DNP>

This command represents frequency of generated voltage and current.

<DNP>

Represents the frequency value in Hz. Limits are specified in "Specifications".

In case of inquiry the OCM-103 answers the set frequency value in standard exponent format. For the value of e.g. 205 Hz the answer is 2.050000e+02.

Example: FREQ 50; sets frequency of 50 Hz
FREQ ? calibrator answers 5.000000e+01

[SOUR] :EART (?) <CPD> { ON | OFF | 0 | 1 }

this command connects the terminals Lo, sLo, -I to the ground terminal GND.

- ON or 1 grounds the terminals
- OFF or 0 leaves the terminal ungrounded

In case of inquiry the OCM-103 answers ON if are terminals grounded or OFF when they are not grounded.

Example: EART 1; grounds the output terminals
EART ? the calibrator answers ON or OFF

[SOUR] :POWE [:ELEM <x>] ?

This command returns the generated AC output power value.

<x>

It represents the related output. Permitted are parameters A | B | C. If the key word ELEM is not used, the value is set (or read) which is common for the 3f mode.

The OCM-103 returns the output power value in the standard exponent format. For example the value of 5250.0 W returns as 5.250000e+03.

Example: POWE :ELEM A ? the calibrator answers 4.000000e+02

Note: The command does not permit to read the value of the total output power in the mode 111f. If this information is required, all three outputs have to be individually added.

Specifications

The specifications are valid after a warm-up time of 60 minutes at the ambient temperature of $23 \pm 2^\circ\text{C}$.

The Uncertainties include the long term stability for 1 year, influence of the temperature, load characteristics and traceability of the manufacturer and the national standards.

Uncertainties “of range” are calculated to the maximal value settable in the range.

Voltage

Voltage range :	6 V to 240 V
Internal ranges :	80 V, 200 V, the maximum adjustable voltage in the 200 V range is 240 V
Frequency range :	40 Hz to 400 Hz
Resolution :	5 digits
Distortion * ¹ :	max. 0.1 %
Maximum current load:	30 mA
Maximum capacitance load :	1 nF
Output resistance :	< 40 mΩ for voltages from 6 V to 80 V
	< 100 mΩ for voltages from 80.001 V to 240 V

*¹ this value includes harmonic distortion and non-harmonic noise in a frequency range up to 1 MHz

Uncertainty :

Range	% of value + % of range
6 V - 80 V	0.03 + 0.02
80 V - 240 V	0.03 + 0.02

Current

Current range :	100 mA - 10 A
Internal ranges :	1 A, 5 A, 10 A
Frequency range :	40 Hz to 400 Hz
Resolution :	5 digits
Distortion * ¹ :	max. 0.2 %
Maximum excitation:	2.5 V

*¹ value includes harmonic distortion and non-harmonic noise in a frequency range to 1 MHz

Uncertainty

Range	% of value + % of range
100 mA – 1 A	0.03 + 0.02
1 A - 5 A	0.04 + 0.02
5 A – 10 A	0.04 + 0.03

AC Power and Energy

Power factor:	1.0 to +1.0 LEAD or LAG (0 to 360°)
Range of power :	1.8 to 7200 VA
Range of time :	10 s to 1999 s
Frequency range :	40 Hz to 400 Hz
Resolution of power :	5 digits

Phase uncertainty

0.1° for U ≥ 30 V, I ≥ 300 mA and frequency 50 Hz to 200 Hz

0.2° for all other ranges

Power factor uncertainty

Power factor uncertainty can be calculated for any value of output current and PF:

For frequency range 50 - 200 Hz, voltage ≥ 30 V and current ≥ 300 mA

$$\pm (\cos(\varphi + 0.1) - \cos \varphi) \text{ [-]}$$

for all other ranges

$$\pm (\cos(\varphi + 0.2) - \cos \varphi) \text{ [-]}$$

Example of calculation: 230V, 1A, $\cos \varphi = 1$ ($\varphi = 0^\circ$), $f = 100\text{Hz}$:

$$\pm (\cos(0 + 0.1) - 1) = \pm 0.000002$$

AC power uncertainty

AC power uncertainty can be calculated:

$$\text{For effective power} \quad dP = \sqrt{(dU^2 + dI^2 + dPF^2)} \text{ [%]}$$

$$\text{For reactive power} \quad dP = \sqrt{(dU^2 + dI^2 + dPF^{*2})} \text{ [%]}$$

$$\text{For apparent power} \quad dP = \sqrt{(dU^2 + dI^2)} \text{ [%]}$$

where	dP is uncertainty of power	[%]
	dU is uncertainty of the voltage value	[%]
	dI is uncertainty of the current value	[%]
	dPF is uncertainty of the PF value ($\cos \varphi$)	[%]
	dPF* is uncertainty of the $\sin \varphi$	[%]

AC power uncertainty depends on the setting of the voltage, the current and the PF. The best uncertainty is 0.08%.

Energy uncertainty

AC energy uncertainty depends on the setting of the voltage, the current and the PF. The best uncertainty is 0.08%.

Multimeter

Voltage Range:	$\pm 13 \text{ V}$
Current Range:	$\pm 25 \text{ mA}$

Uncertainty of the multimeter

Voltage mode	$\pm 1.5 \text{ mV (0.015\%)}$.
Current mode	$\pm 3 \text{ }\mu\text{A (0.015\%)}$.

General

Warm-up Time :	30 minutes
Working Temperature Range:	$23 \pm 10 \text{ }^{\circ}\text{C}$
Reference Temperature :	$23 \pm 2 \text{ }^{\circ}\text{C}$
Dimensions :	460 x 520 x 320 mm
Weight :	30 kg
Power Supply:	230 V / 47 to 63 Hz
Fuse :	T6.3A L250
Power Consumption :	max. 800 VA
Safety Class :	I accordance with IEC 1010-1
Used fuses inside the instrument:	F400m L250 1 pc F1.6 L250 5 pcs F2.0 L250 1 pc
Used resistors with fuse effect:	1R MRS16T 1% 14 pcs

Accessories

Option 103-02	Cable Set (6 x Opt. 10, 6 x Opt. 11)
Option 10	Cable Type BANANA-BANANA 1000V/20A, 1m, black
Option 11	Cable Type BANANA-BANANA 1000V/20A, 1m, red
IEEE488/IEEE488	GPIO Cable, 2m

Addendum

ADDITIONAL COMMAND FOR CURRENT OUTPUTS

Valid for SW version 1.4.

OUTI
[:STATe] (?) <CPD> { ON | OFF | 0 | 1 }

OUTI [:STAT] (?) <CPD> { ON | OFF | 0 | 1 }

This command switches ON or OFF the output current terminals of OCM-103. Switched are only the terminals introduced in the command OUTP:CONF.

- ON or 1 current terminal switched ON
- OFF or 0 current terminal switched OFF

In case of inquiry, OCM-103 answers ON when the current terminal is switched-on, or OFF when the terminal is switched-off.

Example: OUTI ON; output current terminals are switched-on
OUTI ON ? the device answers ON or OFF