CURRENT CALIBRATOR

OCM 150S

Owner's manual

CONTENT

1. Current Calibrator OCM150S

The current calibrator OCM-150S is designed for calibration purposes of DC and AC Currents. The output current is very stable and accurate and can be set with a resolution of four decimal points from 40 to 120 Hz in six firm frequency ranges. The microcontroller used permits easy handling and GPIB compatibility. The output current features very low distortion and stability and permits calibration of measuring instruments for average, peak and true RMS values. The calibrator permits mainly calibrator of analogue and digital amperemeters.

2. Content of Delivery

Calibrator OCM-150S	1 pc
Supply cable	1 pc
Fuse	1 pc
Owner's Manual	1 pc

3. Specifications

DC Current Output

Total current range: 9 to 100 A

Accuracy:

	% of the value + % of the range	
Frequency Range	DC	Output Current
100 A	0.1 + 0.1	9 to 100 A

- Valid for the reference temperature of 23 °C ± 2 °C during the period of 12 months.
- The values are valid with the ERR function ON.
- Voltage on the load : 1 V
- Current resolution: 4 digits

AC Current Output

Total current range: 9 to 100 A

Accuracy:

	% of the value + % of the range	
Frequency Range	40 Hz to 120 Hz	Output Current
100 A	0.1 + 0.1	9 to 100 A

- Valid for the reference temperature of 23 °C ± 2 °C during the period of 12 months
- The values are valid with the ERR function ON.
- Non-Linear Distortion 0.3 % for resistance load
- Frequency 40 Hz, 50 Hz, 60, 80, 100, 120 Hz
- Load voltage 1 Vrms
- Current resolution 4 digit
- Frequency accuracy 0.01 %

DC Current Output - External Input Control

Total current range: 9 to 100 A

Input voltage: ± 0.9 to ± 10 V

Accuracy:

	% of value + % of range	
Frequency Range	DC	Output Current
100 A	0.1 + 0.2	9 to 100 A

- The accuracy does not include uncertainty of the external reference
- Valid for the reference temperature of 23 °C ± 2 °C during the period of 12 months
- The values are valid with the ERR function ON.
- Load voltage: 1 V
- Maximum input voltage: ± 10 V

AC Current Output - External Input Control

Total current range: 9 to 100 A

Input voltage: from 0.9 to 10 V rms

Accuracy:

	% of value + % of range	
frequency range	40 to 120 Hz	Output Current
100 A	0.1 + 0.3	9 to 100 A

- The accuracy does not include uncertainty of the external reference
- Maximum input voltage: 10 Vrms
- Frequency range: from 40 Hz to 120 Hz
- Load voltage: 1 Vrms
- Current resolution: 4 digit

Additional Specifications

Warm up time: 20 minutes

Operating temperature range: 23 ± 10 °C

Relative humidity: 45 to 75 %

Storage temperature range: 0 to 40 °C at the relative humidity of 80 %

Reference temperature: 23 °C

Air pressure: 86000 to 106000 Pa

External electric field: inconsiderably low

External magnetic field: inconsiderably low

Dimensions: 460 x 520 x 320 mm

Voltage supply: 230 V - 50 Hz

Power input: max. 800 VA

Control:	- Manual with micro-switches on the front panel
	- Remote control, through GPIB Bus
Indication:	Two 4 digit displays indicating
	- Output current
	- Frequency
	- Accuracy
	- Deviation
	- Error reporting

4. Principle of Operation

The calibrator is based on very stable DC voltage reference derived from an eighteen bit DAC. The DC and AC currents are scaled from this voltage reference. The digital harmonic voltage generator operates on a sine wave synthesis through 12 bits steps approximation. The D/A converter used is a multiplying converter with controlled current feedback from the output terminals. The feedback loop control voltage is compared with the reference voltage. The generated sine wave signal is saved in internal memory. The resulting output AC voltage is very stable with temperature and time. The output sine wave is filtered in a LPF in order to reduce higher harmonics and distortion. The amplitude regulation circuit is controlled by an deviation amplifier integrator which compares the output voltage of the calibrator with the variable current reference. The output product is used for controlling of the amplitude output stage.

rol voltage for setting up the amplitude. Generating DC or AC voltage (according to the mode) is led to the voltage/current converter, to the output current amplifier and to the output terminal. The amplitude feedback includes the voltage/current converter and the output amplifier.

The microcontroller assures also the communication with the display and the keyboard and coordinates the operation of all analogue circuits and the GPIB data bus. It performs also all mathematic calculations which are displayed and also available at the data bus.

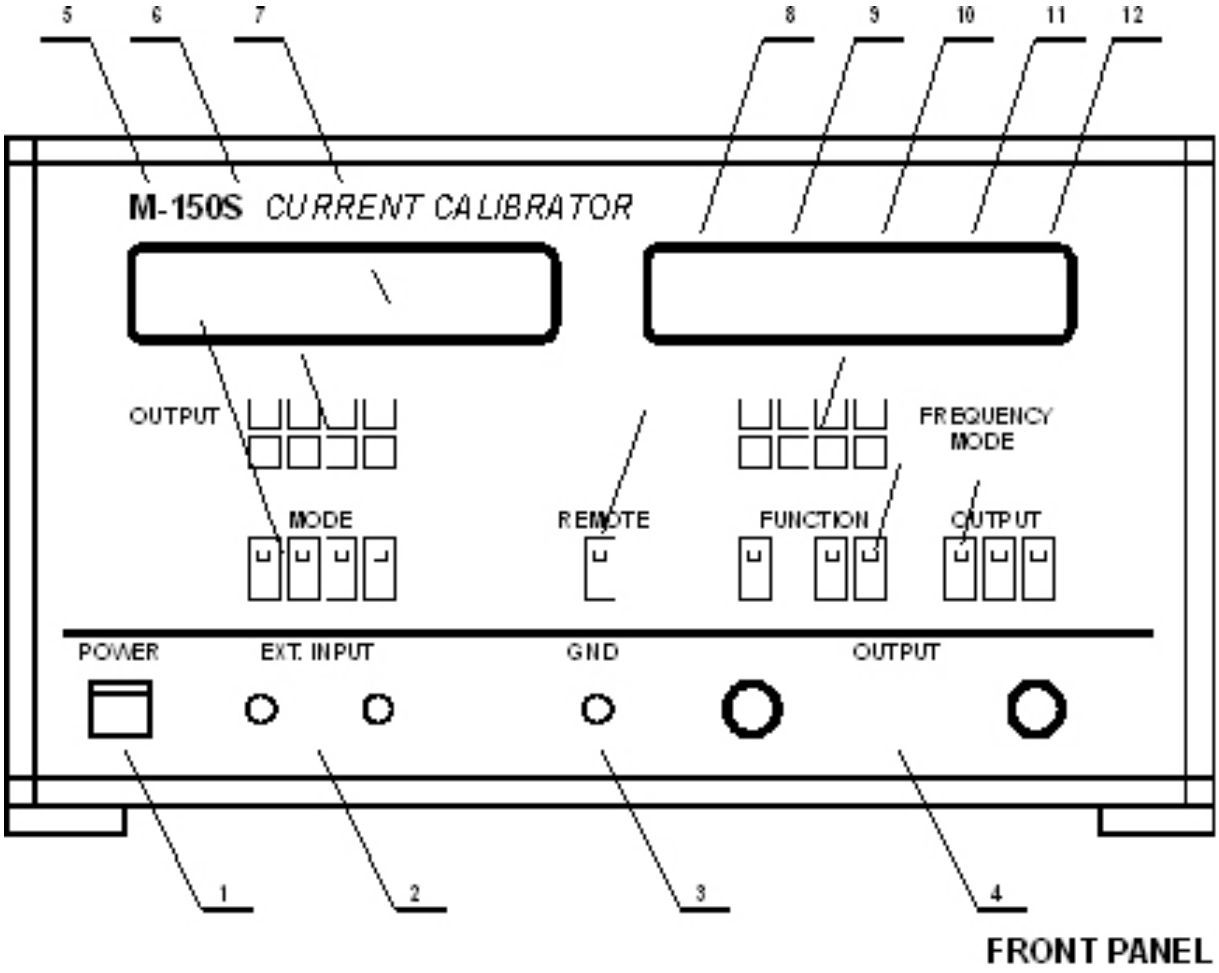
5. Switching-On

When the calibrator has been stored at the temperature lower than 5 °C, it is recommended to have it warmed at the ambient room temperature. The calibrator will be powered by pressing the button POWER located at the front panel. The standard voltage supply is 230V-50Hz. The exposed metal parts are connected to the GND mains protective conductor (except the output terminal).

6. Control and Indication

6.1 Description

1 - Power Supply Switch
2 - External Input Terminal
3 - Protective Conductor Terminal
4 - Output Terminal
5 - MODE
6 - OUTPUT
7 - A display
8 - LOCAL
9 - B display
10 - FREQUENCY and MODE
11 - FUNCTION
12 - OUTPUT Display



FRONT PANEL

6.1.1 Front Panel

All control and indication units are located in the upper part of the front panel. The external input terminal, output terminals and protective (guard) conductor terminal (GND) are placed in the lower part of the front panel.

Function of the keys

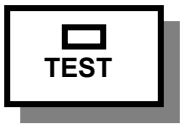
OUTPUT Four pairs of keys under each digit of the display can be used for setting of the output current in the current mode of operation. The resolution is four digits. By holding the upper key pressed for about 0.5 second, the value will automatically increase, by holding the lower key pressed, the value will automatically decrease.

FREQUENCY

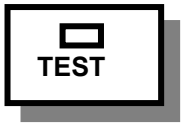
MODE Frequency, percentage balance in the mode ERR % and calibrating code can be set with the four pairs of keys under each digit of the display. By holding the upper key pressed for about 0.5 second, the adjusted value will automatically increase, by holding the lower key pressed, the value will automatically decrease.

.

MODE By pressing the TEST key the test mode is activated. The testing mode can only be started when the output terminal is disconnected (OUTPUT OFF). An LED lights up and the display shows ”t 0”. The required test number can be set by the button under the digit. By pressing the TEST button once again the test will start. The test will stop by pressing the TEST key. Following tests are available:



TEST 0	finishing of the test mode
TEST 1	check of all displays and indicating units. The segments and the LED are illuminated.
TEST 2	check of all control keys. When any of the keys is pressed, the display will show its code. Each key activation is accompanied by an acoustic sound. The figures below show the button codes.



OUTPUT

00	10	20	30
01	11	21	31

FREQUENCY MODE

02	12	22	32
03	13	23	33

MODE

72	72	43	53	63

REMOTE

61

FUNCTION

44		64	74

OUTPUT

55	62	75

TEST 3 enables to display and set the GPIB address. The actual address is shown on the right display. The address can be changed from 0 to 30 with the keys under the right display.

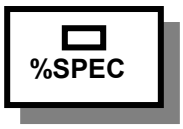
TEST 4 displays the serial number of the calibrator

TEST 5 grounding of the L terminal can be adjusted. The setting is performed with the last two keys of the keyboard (used for current setting). The display shows ”ON - OFF”

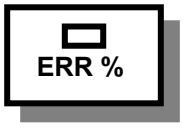
TEST 6 not used

TEST 7 date of the last calibration.

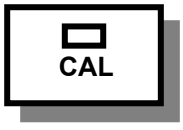
TEST 8 setting the calibration code (0000 to 19999). The factory setting is 0. Non-zero code can be set only once. After non-zero setting the TEST 8 is no more accessible.



By pressing this key the display B shows the calibrating uncertainty of the momentary value.



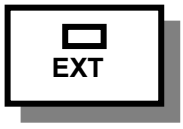
Pressing this key enables the percentage setting of the deviation (error) from the momentary value. The setting range is ± 5% of the value.



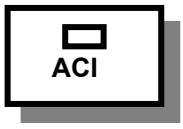
The key CAL permits the access to the calibrating procedure. The calibration mode is indicated by the LED above the key. The calibration mode is protected against unauthorized approach by the calibrating code.
See chapter 10 for calibration procedure.

By pressing the key, the control of the calibrator is switched from remote to local front keys. The key REM/LO is active only when the calibrator is in remote mode of operation via the GPIB Bus. In the local control mode the button has no other function. The LED diode above this key lights up only when the calibrator is in the remote control mode.

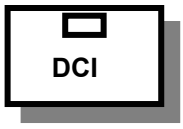
FUNCTION



With the EXT key the external input is activated and the calibrator can be controlled by an external voltage reference.

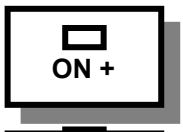


The ACI key activates the AC current mode.

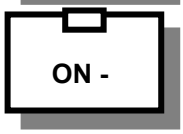


The DCI key activates the DC current mode.

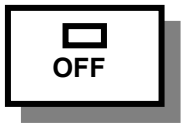
OUTPUT



- by pressing the ON+ key the selected current is connected to the output terminals in positive polarity. The connection is indicated by yellow LED.



- by pressing the ON+ key the selected current is connected to the output terminals in negative polarity. The connection is indicated by yellow LED.



- by pressing the OFF key the current is disconnected from the output terminals.

DISPLAY A

The display A shows the current value in four digits.

DISPLAY B

The display B shows the frequency, percentage balance of preset output value in ERR % mode, specification referring to the selected value and other functions shown in ”Calibration”.

POWER

The power key switches ON and OFF the calibrator.

EXTERNAL INPUT

The calibrator has two inputs for connection of the external voltage reference:

H INPUT Terminal (HIGH) for the signal connection from the external reference.

L INPUT Terminal (LOW) for connection the GND of the external reference.

Note: By the L INPUT terminal is the external input connected with the L OUTPUT terminal.

OUTPUT TERMINALS

The voltage supply has two output terminals and one protective terminal (guard - GND). All terminals are located at the front panel.

H OUTPUT	Output Current Terminal HIGH
L OUTPUT	Output Current Terminal LOW
GND	Protecting terminal GND (cabinet)

6.1.2 Rear Panel

The rear panel contains the socket with the fuse for the mains voltage connection, the connector for the GPIB data bus and two outlets for forced air cooling.

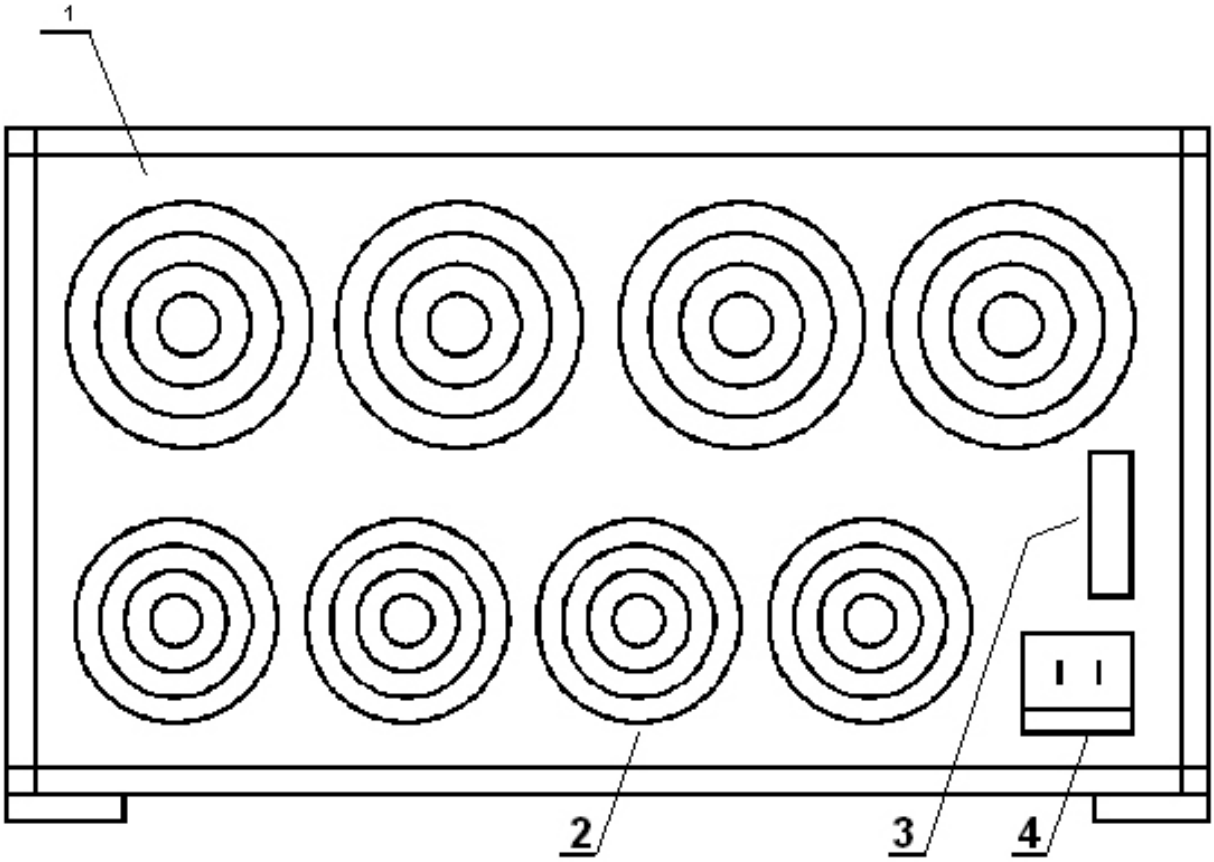
Explanation:

1 - Air outlets for the switched supplies

2 - Air outlets for the current output amplifiers

3 - Connector of the GPIB bus

4 - Mains voltage supply socket with fuse



REAR PANEL

6.2 Connecting the Power

Place the calibrator in the room intended for its operation and connects it to the mains. Make sure that the rear panel is not covered or blocked. Poor ventilation during the operation caused by covered outlets can result in overheating of the electronic components and damaging of the instrument.

Switch on the calibrator by pressing the power key. The calibrator performs initial tests:

- Display and indication checks.
- GPIB check. The display shows the actual calibrator address.
- Internal memory checks.

After the test is completed, following parameters and operation mode is set:

OUTPUT CURRENT	
Output	10 A
FUNCTION	DCI
OUTPUT	OFF

6.3 Settings

6.3.1 Selection of Output Current

The output current can be set up with the keys located under the Display A. The current can be adjusted from 9 to 100A.

6.3.2 Frequency Setting

The frequency can be set with the FREQUENCY keys located under the Display B, provided the ACI function has been selected. The Frequency can be set with two buttons by incrementing up or down. The display shows the selected frequency.

6.3.3 Deviation Setting

After pressing the ERR% key, the display permits changing of the current in percentage deviations from the preset value. The preset value is shown at the left part of the Display A, the percentage deviation at the right part of the Display B. The deviation can be changed by pressing the keys under the Display B. This mode is suitable for calibration of analogue amperemeters, which permit direct error readings. This function can not be used in the EXT mode.

6.3.4 Displaying of the Calibrator Specification

The specifications corresponding to the selected output current at the Display A can be shown by pressing the SPEC% key. The calibration accuracy is displayed on the right part of the Display B. This mode is not available in the EXT mode.

6.3.5 Connecting the Output Terminal

The output current can be connected to the output terminal by pressing the OUTPUT ON key (indicated by LED). The connection is always with a delay. The load must always be connected to the output terminals. By pressing the key OFF the current is disconnected from the output terminal. The yellow LED is turned off. By an error made by the operator, the output terminal is automatically switched off (see the Chapter 6.4). The terminals can be reconnected by pressing OUTPUT ON.

Note: By pressing the key ON, the internal relay shorting the output terminals H OUTPUT and L OUTPUT is deactivated and the output current slowly increases to the preselected value. Its magnitude is displayed at the Display A.
By pressing the key OFF the output current slowly decreases to approx. 10 A. Then the internal relay shorting the output terminals H OUTPUT and L OUTPUT is activated. During the OFF operation neither ACI and DCI functions can be changed nor the ON function can be started.

For accurate calibration of the DUT, the load is not allowed to change its impedance too fast. This effect might cause a modulation of output current and cause incorrect output value. This practically means that the connecting cables must be properly connected and tightened under the terminals so as the contact resistance cannot change more that 5 % of the load value.

!!!CAUTION!!!
Before disconnecting the calibrator from the mains enter the function OFF and wait until the LED located under this key switches-off.

6.3.6 Tests

The tests are started by pressing the TEST key. The keys bellow the display are used for setting of the test numbers. By pressing the TEST key again, the test number is confirmed. To close the test, press the key again. The test are mentioned in 6.1.1.

6.4 Error Reporting

The tests are initiated with the key TEST. With the keys bellow the display the number of the required test will be entered and confirmed with the key TEST again. At the end of each test press the key TEST to terminate it. The overview of the tests is under 6.1.1.

Error Reporting Summary

User's errors

Err. 00	Overload of a current output
Err. 01	The output voltage at the load is too large (no load connected)
Err. 04	Attempt to recalibrate with output terminals turned off.
Err. 06	Attempt to recalibrate when the time after switching-on was shorter than 30 minutes.

GPIB errors

Err. 10	Incorrect data format entered.
Err. 11	Incorrect command entered.
Err. 12	Listener is not connected.
Err. 13	Entered data are out of range.

Instrument errors

Err. 30	Error during data transmission between the floating and non-floating circuits inside the calibrator.
Err. 31	Error during storing data in the internal memory
Err. 32	Error during the memory check.

6.5 System Control via GPIB bus

The calibrator is equipped with the normalized GPIB bus. The system connector is located at the instruments rear.

The instrument can perform following functions:

SH1, AH1, T5, RL1, DC1

Description of commands:

Cx	AC/DC mode	C0 – AC current
		C1 – DC current
Ex	external reference mode	E0 - external input disconnected
		E1 - external input connected
F	frequency	F - CR frequency
Ox	output	O0 - output disconnected
		O1 - + output connected
		O2 - - output connected
M	current amplitude	U - CR current
Vx	verification	V0 - current amplitude
		V1 - frequency
		V2 - status [CxExOx]
		V3 - serial number
		V4 – not used
		V5 - specification

The instrument can be programmed with the sequence of control codes A X A X A X . . . , where A is the control code of the function and X is the function status.

Output Format

By using the V0 function, the output data have the following format:

_ A X . X X X X E {+/-} X X A CR LF

V1 function:

_ F X . X X X X E {+/-} X X H from CR LF

V2 function:

_ C X E X O X CR LF

V3 function:

_ V 1 5 0 X X CR LF

V5 function:

_ E X X X . X X X % CR LF

Setting of the Current

The format for setting of the current:

M . . . CR (F . . . CR)

The control code is followed by a decimal number in the free format with an exponent or without it.

7. Maintenance

With exception of the switches and the ventilators, there are not moveable parts inside the instrument. The instrument does not require any mechanical maintenance.

Components

The electronic components artificially aged during the production. The expected life of operation is very high. If however any failure occurs, please proceed following steps:

1. If the testing procedure is not started and completed after the instrument is switched on, check the fuse on the rear panel. Unplug the mains before removing the fuse!
2. If the instrument reports the ERR 01 failure, check whether the calibrator is not overloaded at the output load.

When a failure is reported during the operation and cannot be repaired by replacement of the fuses, please contact the manufacturer: info@orbitcontrols.ch.

8. Calibration

8.1 Calibration Principle

The calibrator OCM-150S is a source of accurate DC and AC currents. The instrument specification guarantees the compliance with parameters for the period of 12 months from the date of last calibration. The recommended recalibration interval is 12 months.

OCM-150S is equipped with the calibrating procedure that enables a simple recalibration. The recalibration doesn't require setting of potentiometers or any other hardware components. The recalibration is being performed by internal software and executed with the front panel keys. The calibrating procedure consists of setting the slope of the current range in the AC mode and setting the slope and the offset in the DC mode. The recommended calibrating frequency is 60 Hz.

8.2 Calibration Procedures

To calibrate OCM-150S, following instruments are required:

1. Standard multimeter with the AC-V accuracy of at least of 0.03 % @ 40 to 120 Hz
   and DC-V accuracy of at least of 0.3 % in ranges from 10mV to 200 mV

   Recommended Instrument: Datron 1271
   Datron 1081
   HP 3458A

2. Standard resistor 0.001 mOhm with the calibrating uncertainty lower than 0.02 % from DC to 60 Hz.
   Recommended types: Tinsley 5686 0.001 Ohm (up to 150 Hz)
   Burster 1281 0.001 Ohm

3. AC/DC voltage calibrator to 10 V
   Recommended types: Orbit Controls OCM-130
   Datron 9100
   Fluke 5500

The cali0bration can be performed after 30 minutes warm-up time.

8.2.1 Calibrating Code

Access to the calibrating procedure is protected by a calibrating code. The factory setting is 0. This code is also shown at the display. The user can change the code by using a five digit code. After entering a new code, this remains in the instrument and can not be modified. It is strongly recommended to write down this code combination. When lost, the calibration of the calibrator can not be initialized and the calibrator has to return to the factory for encoding.
The TEST 8 is used for setting the code.

Setting the code

1) Press the TEST button, select the TEST 8

2) Press again the TEST button. The right display will show ”0”. Enter the new code with maximum of five digits by using the key bellow the right display. Record this code combination.

3) Press the TEST key. The0 new code is stored.

8.2.2 Calibration of Current Ranges

1. Connect a standard resistor to the output terminals. Connect a standard multimeter to the voltage terminals of the standard resistor.

Calibration of DC currents

Set the calibrator as follows:

FUNCTION	DCI
OUTPUT	OFF
OUTPUT VALUE	10 A
TEST 5	grounding of the output terminal is ON

2. Select the measuring mode DC - V on the standard multimeter. Apply the current.

3. Press the CAL key. Enter the calibration code bellow the right display. Press the CAL key. With an incorrect code the display returns to the previous mode. With a correct code, the red LED diode above the CAL key illuminates.

4. Press the CAL key. The display B will show OFS. 0 and the left A display will show the correcting value from the previous calibration. Use the keys bellow the left display and adjust such value that the external voltmeter displays 0 V, according the table POSITIVE OFFSET CORRECTIONS.

5. Press the CAL key. The right display will show -OFS, the left display will show the negative correcting value from the previous calibration. Use the keys bellow the left display and adjust such value that the external voltmeter displays 0 V, according the table NEGATIVE OFFSET CORRECTIONS.

6. Press the CAL KEY. The right display will show 100.00, which is the calibration of 100A in the 100A range. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at DC current. The tolerance is shown in the table POSITIVE SLOPE CORRECTIONS. The value set on the calibrator, has no a direct numerical connection with the calibrated current!

7. Press the CAL key. The right display will show the value of -100.00, which is the calibration -100 A in the 100A range. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at DC current. The tolerance is shown in the table NEGATIVE SLOPE CORRECTIONS. The value set on the calibrator, has no a direct numerical connection with the calibrated current!

Calibration of AC currents

8. Press the CAL key. The calibrator is set into the calibration mode. Press the OUTPUT OFF key, select the ACI mode and set the frequency of 60 Hz. Switch the external voltmeter into AC mode. Apply the current to the load by pressing the key OUTPUT ON.

9. Press the CAL key. The right display will show 100.00, which indicates the calibration point 100 A AC in the 100A range. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at AC current at 60 Hz. The tolerance is shown in the table SLOPE CORRECTIONS. The value set on the calibrator, has no a direct numerical connection with the calibrated current!

10. Press following buttons: CAL, OFF, EXT, ON+ . The A display will show - E -.

11. Press the CAL key. The right display will show the value of 100.00, which indicates the calibration point 100 A in the 100A range. Connect the external DC reference from the DC calibrator in the positive polarity to the input terminals H INPUT (+) and L INPUT (-). Set +10 V on the external reference. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at DC current. The tolerance is shown in the table POSITIVE SLOPE CORRECTIONS.

12. Press the keys CAL, OFF and ON- .

13. Press the CAL key. The right display will show the value of -100.00, which indicates the calibration point -100 A in the 100 A range. Connect the external DC reference from the DC calibrator in the negative polarity to the input terminals H INPUT (-) and L INPUT (+). Set -10 V on the external reference. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at DC current. The tolerance is shown in the table NEGATIVE SLOPE CORRECTIONS.

14. Press the CAL key. Press the OUTPUT OFF key and select the ACI mode. Set the external reference voltage 10 V AC on an AC voltage standard calibrator. Set the external reference frequency f ext in the range from 40 Hz to 120 Hz. Switch the standard multimeter for AC voltage measuring mode and press the OUTPUT ON key.

15. Press the CAL key. The right display will show the value of 100.00, which indicates the calibration point 100 A in the 100A range. The left display is shows -E -. Use the key bellow the left display and set a value of 100 x R_N on the multimeter, whereas R_N is the calibrating value of the standard resistance at AC current at f ext. The tolerance is shown in the table SLOPE CORRECTIONS.

16. Press the CAL, OFF and EXT keys. After the calibration is completed, press the TEST key, set 7 on the left display and enter the calibration date with keys bellow the display. Press the key TEST. The LED turns-off. The calibration is completed.

Calibrating Tolerances

RANGE	DC VALUE	AC VALUE
100 A	0 ± 10 mA	
	100 A ± 20 mA	100 A ± 50 mA
	- 100 A ± 20 mA	
100 A ext.		
	100 A ± 20 mA	100 A ± 50 mA
	- 100 A ± 20 mA	

Note: The previous values are set on the standard multimeter as voltage with the converting constant of the standard resistor R_N.

The following tables summarize the calibrating procedure.

Key	Function	Left display	Right display	Note
I. Selection of calibrating mode				
CAL	calling the CAL function	XYZ	0	
	setting the calibrating code	XYZ	*****	
CAL	calling the calibration	XYZ	XYZ	LED
II. Calibration of 100 A DC				
RANGE 100A	setting	100.00		
ON+	connection output terminals	100.00		
CAL	correction of + DC offset	2	OFS. 0	cor.
	”	*****	OFS. 0	zero
CAL	correction of - DC offset	-2	OFS. 0	
	”	*****	OFS. 0	
CAL	setting the slope 100 A	55000	100.00	
	”	*****	100.00	
CAL	setting the slope -100 A	55000	-100.00	
	”	*****	-100.00	
CAL	end of the calibration ± 100 A	100.00		
OFF	disconnection terminals			OFF
III. Calibration of 100 A AC				
RANGE 100A	setting	100.00	60	
ON+	connection output terminals	100.00	60	
CAL	setting the slope 100 A	55000	100.00	
	”	*****	100.00	
CAL	end of the calibration 100 A	100.00		
OFF	disconnection terminals			OFF

IV. Calibration of 100 A +DC external input				
RANGE 100A	setting	- E -		
ON+	connection output terminals	- E -		
CAL	setting the slope 100 A	55000	100.00	
	”	****	100.00	
CAL	end of the calibration + 100 A	- E -		
OFF	disconnection terminals			OFF

V. Calibration of 100 A -DC external input				
RANGE 100A	setting	- E -		
ON-	connection output terminals	- E -		
CAL	setting the slope 100 A	55000	-100.00	
	”	****	-100.00	
CAL	end of the calibration - 100 A	- E -		
OFF	disconnection terminals			OFF
VI. Calibration of 100 A AC external input				
RANGE 100A	setting	- E -	- F -	
ON-	connection output terminals	- E -	- F -	
CAL	setting the slope 100 A	55000	100.00	
	”	****	100.00	
CAL	end of the calibration 100 A	- E -	- F -	
OFF	disconnection terminals			OFF
VII. Closing the calibrating cycle				
TEST	calling the TEST function	t 0		
	setting TEST 7	t 7	MM.RR	origin.
	setting the calibration data	t 7	**.**	new
TEST	Closing the calibrating cycle (LED CAL is turned off)			

Note: The correcting values 550.00 are related to the first calibration.
During recalibration, the previous correcting values will appear in these positions.
XYZ is the display during the previous step.

8.3 Check on Parameters

To check the parameters, the following instruments are required:

1. Standard multimeter with the accuracy
   AC V at least of 0.03 % in range 40 to 120 Hz
   DC V at least of 0.03 %
   Range of AC/DC voltage: from 10 to 200 mV
   Types: Datron 1281
   Datron 1081
   HP3458A

2. Resistance standard of a nominal value 0.001 .Ohm with uncertainty of calibration value better than 0.03 % in the frequency range 0 to 60 Hz,

Types: Tinsley 5686 0.001 Ohm
BURSTER 1281 0.001 Ohm

The check can be attempted after warm-up of 30 minutes.

2. Counter with period function and with accuracy at least 0.01 % in the range DC to 120 Hz.

Types: TESLA BM526
BM640

3. Distortion meter for frequency range to 120 Hz

Types: TESLA BM 543
HP 8903A

8.3.1 Checking the Current Ranges

1. Connect the standard resistance to the calibrator output terminals and connect the multimeter to the voltage terminals of the standard resistance.
   Set the calibrator as follows:

FUNCTION	DCI
OUTPUT	OFF
OUTPUT VALUE	100 A
TEST 5	grounding of the output terminal is ON

2. Select the measuring mode DC V on the multimeter and OUTPUT ON+ on the calibrator.
3. Check whether the measured value is in compliance with the tolerance mentioned in the table.
4. Press ON- and follow the instructions in paragraphs 1 to 3
   Switch off the calibrator output .

5. Check on the Current Setting

FUNCTION	ACI
FREQUENCY	60 Hz
OUTPUT	OFF
OUTPUT VALUE	100 A

6. Select the measuring mode AC U on the multimeter and OUTPUT ON+ on the calibrator.
7. Check whether the measured value is in compliance with the tolerance mentioned in the table.
8. Repeat instructions 1 to 7 for the mode DCI_{EXT} and ACI_{EXT}.
9. Switch off the calibrator output OUTPUT OFF.

Function	Range	Tolerance [mV]	
DCI	+100 A	99.8 x R_N -	100.2 x R_N
	- 100 A	- 99.8 x R_N -	-100.2 x R_N
ACI	100 V	99.8 x R_N -	100.2 x R_N
DCI_{EXT}	+100 A	99.7 x R_N -	100.3 x R_N
	- 100 A	- 99.7 x R_N -	-100.3 x R_N
ACI_{EXT}	100 V	99.6 x R_N -	100.4 x R_N

Table of tolerances.

8.3.2 Check on the non-linear distortion

1. Connect a resistor to the output terminals. The value has to be sufficient large to reach the voltage on the load of about 0.5 V rms. The standard resistor 0.001 Ohm can be used connected with cables of approx. 0.005 Ohm. Connect the distortion meter to the H OUTPUT and L OUTPUT.

FUNCTION	ACI
FREQUENCY	60 Hz
OUTPUT	OFF
OUTPUT VALUE	100 A

2. Press OUTPUT ON and measure the non-linear distortion of the generated signal.
3. The value of distortion must not exceed 0.03 %
4. Switch off the output OUTPUT OFF

8.3.3 Frequency Check

1. Set the counter in the period measuring mode and connect it to the output terminals H OUTPUT and L OUTPUT. Connection of the load is the same as during distortion metering.

FUNCTION	ACI
FREQUENCY	50 Hz
OUTPUT	OFF
OUTPUT VALUE	100 A

2. Press OUTPUT ON+ and measure the output signal period. This must not exceed the range from 19.998 ms to 20.002 ms.

C A U T I O N

1) Do not switch-off the calibrator with activated output terminals (ON mode).

2) Switch-off the calibrator by pressing the POWER key only, after the OUTPUT OFF key was pressed and after an elapsed time of about 20 seconds.

3) Do not switch-on the calibrator immediately after it has been switched-off. Wait at least 20 seconds.