CONTENT

1. Device Application

The current calibrator M-150S can supply very stable calibrated DC and AC currents. The output current value can be set within one range with the resolution correct to four decimal places. The frequency can be set in range from 40 Hz to 120 Hz with the possibility of setting six discrete frequencies. The very good time stability of amplitude is determined by the voltage reference of the eighteen-bit DAC729 converter. The microprocessor used for the inner control enables easy service in the manual control mode and secures the full compatibility with the GPIB bus. The low non-linear distortion factor enables the device's application for calibration of measuring instruments indicating both the average and effective values, respectively the peak output values. The calibrator is intended especially for calibration of analogue and digital ammeters.

2. Content of Supply Set

Calibrator M-150S	1 pc
Supply cable	1 pc
Fuse	1 pc
Service instructions	1 pc

3. Technical Data

DC Current Output

Total current range: from 9 A to 100 A

Accuracy:

	% of the value + % of the range	
frequency range	DC	range of values
100 A	0.1 + 0.1	from 9 A to 100 A

- valid for the reference temperature of 23 °C ± 2 °C during the period of 12 months.
- the range of values is valid with the ERR function put out of operation.
- voltage on load : 1 V
- current resolution: 4 digit

AC Current Output

Total current range: from 9 A to 100 A

Accuracy:

	% of the value + % of the range	
frequency range	from 40 Hz to 120 Hz	range of values
100 A	0.1 + 0.1	from 9 A to 100 A

- valid for the reference temperature of 23 °C ± 2 °C during the period of 12 months
- the range of values is valid with the ERR function put out of operation.
- non-linear distortion 0.3 % for resistance load
- frequency 40 Hz, 50 Hz, 60, 08, 100, 120 Hz
- load voltage 1 Vef
- current resolution 4 digit
- frequency accuracy 0.01 %

DC Current Output - External Input

Total current range: from 9 A to 100 A

Input voltage: from ± 0.9 to ± 10 V

Accuracy:

	% of value + % of range	
frequency range	DC	range of values
100 A	0.1 + 0.2	from 9 A to 100 A

- 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 range of values is valid with the ERR function put out of operation.
- voltage on the load: 1 V
- maximum input voltage: ± 10 V

AC Current Output - External Input

Total current range: from 9 A to 100 A

Input voltage: from 0.9 to 10 Vef

Accuracy:

	% of value + % of range	
frequency range	from 40 Hz to 120 Hz	range of values
100 A	0.1 + 0.3	from 9 A to 100 A

- accuracy does not include uncertainty of the external reference
- the maximum input voltage: 10 Vef
- frequency range: from 40 Hz to 120 Hz
- voltage on the load: 1 Vef
- current resolution: 4 digit

General Data

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

Outer electric field: inconsiderably low

Outer magnetic field: inconsiderably low

Dimensions: 460 x 520 x 320 mm

Voltage supply: 220 V / 50 Hz

Power input: max. 800 VA

Control:	- manual with micro-switches on the front panel
	- remote control, through GPIB bus
Indication:	2 four-digit displays indicating
	- output current
	- frequency
	- specification
	- deviation reading
	- error reporting

4. Function Principle

The calibrator is based on the stable DC voltage reference derived from the eighteen-bit converter DAC 729. The whole range of DC and AC currents is derived from the reference voltage value. The digital harmonic voltage generator works on the basis of the sine wave synthesis through the step approximation by means of a 12-bit D/A converter. The D/A converter is a multiplying converter with controlled current supplies. The feedback loop control voltage is used as the reference voltage. Data defining the sine signal wave are saved in the fixed PROM memory. The output AC voltage is very stable in respect of temperature and time. To reduce higher harmonic frequencies, the sine wave is also filtered in the low-pass filter with the breaking frequency, which does not allow exceeding of output signal distortion by more than 0.1 %. The amplitude regulation circuit is controlled by the deviation amplifier integrator. The deviation amplifier compare the calibrator's output voltage with the variable direct current reference and generates the control 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 microprocessor's circuits secure a correct function of the display and the keyboard and mediate the co-operation of single analogue blocks, the connection to the GPIB bus and carry out required mathematical calculations.

5. Calibrator start

If the device was stored at the temperature lower than 5 °C, it's necessary to acclimatise it for 2 hours under operating and working conditions. The device can be switched on by pressing the power button (POWER) located in the front panel. The device is constructed for the power supply from the mains 230V / 50 Hz. The exposed metal parts are connected to the protective conductor (except the output terminal).

6. Service Instructions

6.1 Description of Control and Indication Units

Explanation:

1 - power supply switch

2 - external input terminal

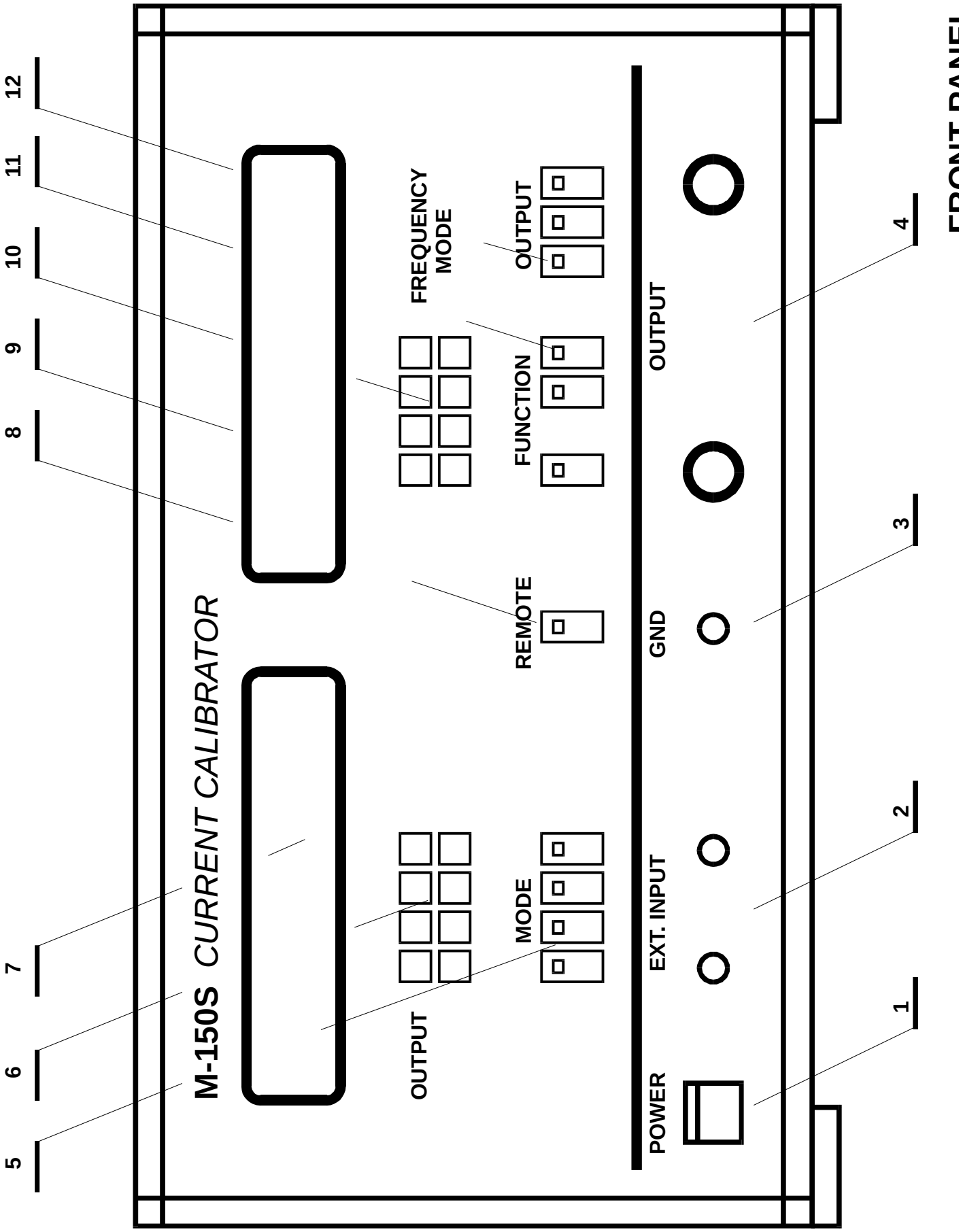
3 - protective conductor terminal

4 - output terminal

5 - MODE buttons

6 - OUTPUT buttons

7 - A display


FRONT PANEL
M-150S CURRENT CALIBRATOR
FREQUENCY MODE
OUTPUT
FUNCTION
REMOTE
MODE
OUTPUT
OUTPUT
GND
EXT. INPUT
POWER
1
2
3
4
5
6
7
8
9
10
11
12

8 - LOCAL button
9 - B display
10 - FREQUENCY and MODE buttons
11 - FUNCTION buttons
12 - OUTPUT display

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 terminal and protective (guard) conductor terminal (GND) are placed in the lower part of the front panel.

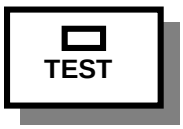
Function of buttons

OUTPUT Four pairs of keys under each digit in the display can be used for setting up any output value in the set current mode within one range with resolution correct to four decimal places. By holding the upper key pressed for about 0.5 second, the adjusted value is automatically increasing, by holding the lower key pressed, the adjusted value is decreasing.

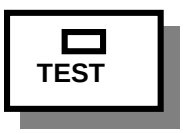
FREQUENCY

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

MODE By pressing the TEST button the testing mode is called. The testing mode can be only released, if the output terminal is disconnected (OUTPUT OFF). A LED diode above the button will light up and the display will show ”t 0”. The required test number can be set by the button under the digit. By pressing the TEST button once again the test is started. Testing can be stopped by next pressing the TEST button. The device offers the following tests:



TEST 0	finishing the testing mode
TEST 1	enables the functioning check of all display and indication units. Particular segments and LED diodes are gradually lighted up.
TEST 2	enables checking of control buttons. After pressing any button, the display shows its code. Pressing the buttons is accompanied by an acoustic check. 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 up the GPIB instrument address. The actual address is shown on the right display. The address value can be changed by means of buttons placed under the right display within the range from 0 to 30.

TEST 4 displays the serial number of the calibrator

TEST 5 Grounding of the L terminal can be adjusted during this test. Adjusting is carried out with the last two keys of the keyboard for setting current values. The display shows the existing state ”on - oF”

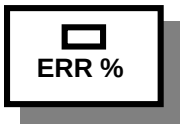
TEST 6 unoccupied

TEST 7 calls the date of the last calibration. After completing a calibration a new calibration date is recorded here.

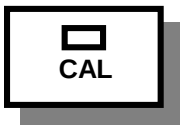
TEST 8 setting the calibration code (0000 to 19999). The code set up implicitly is 0. Any calibrating code different from 0 can be set only once. After setting any calibrating code different from 0, the TEST 8 is no more accessible.

%SPEC by pressing a key the display of calibrating jitter at a preset current value can be called

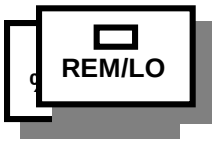
on the B display.



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

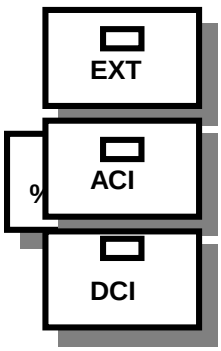


The CAL key enables access to the calibrating procedure. The calibration mode is indicated by lighting of the LED diode above the key. The calibration mode is protected against encroachments by means of the calibrating code. For the calibration procedure see the chapter 10.



By pressing the key, the forced control of the calibration supply is converted to the local control from the front panel (on condition that the front panel is not locked by a programme). The key is active only if the calibrator is in the remote control mode through the GPIB bus. In the local control mode the button has no other function. The LED diode above the button is only lighting if the device is in the remote control mode.

FUNCTION

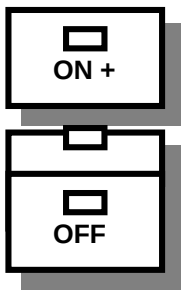


The EXT key is used for selection of the external input. Then the calibrator works with the external voltage reference.

The ACI key is used for selection of the alternating current mode.

The DCI key enables selecting of the direct current mode.

OUTPUT



- by pressing the ON+ key the preset current is connected to the output terminal of the calibrator in the positive polarity.
The connection is indicated by lighting a yellow LED diode above the key.
- by pressing the ON+ key the preset current is connected to the output terminal of the calibrator in the negative polarity.
The connection is indicated by lighting a yellow LED diode above the key.
- by pressing the OFF key the preset current is disconnected from the output terminal.

A DISPLAY

- displays the preset current value correct to four decimal places

B DISPLAY

- displays the output current frequency, percentage balance of preset output value in ERR % mode, specification referring to the preset value and other functions, see the chapter ”Calibration”.

POWER

- The power supply button. It enables connection of the device to the voltage supply.

EXTERNAL INPUT

The calibrator has two input terminals for connecting the external voltage reference.

H INPUT input terminal (HIGH). The terminal is intended for connecting the signal conductor of the external reference.

L INPUT input terminal (LOW). The terminal is intended for connecting the common conductor of the external reference.

Note: The external input is connected by the L INPUT terminal with the potential of the calibrator’s L OUTPUT terminal.

OUTPUT TERMINALS

The voltage supply has two output terminals and one terminal with the protective (guard) conductor (GND) connected. All terminals are placed on the front panel.

H OUTPUT CURRENT - the output signal current terminal (HIGH). The terminal is intended for connection of the signal current input of the checked ammeter. The calibrator’s current output is led to this terminal

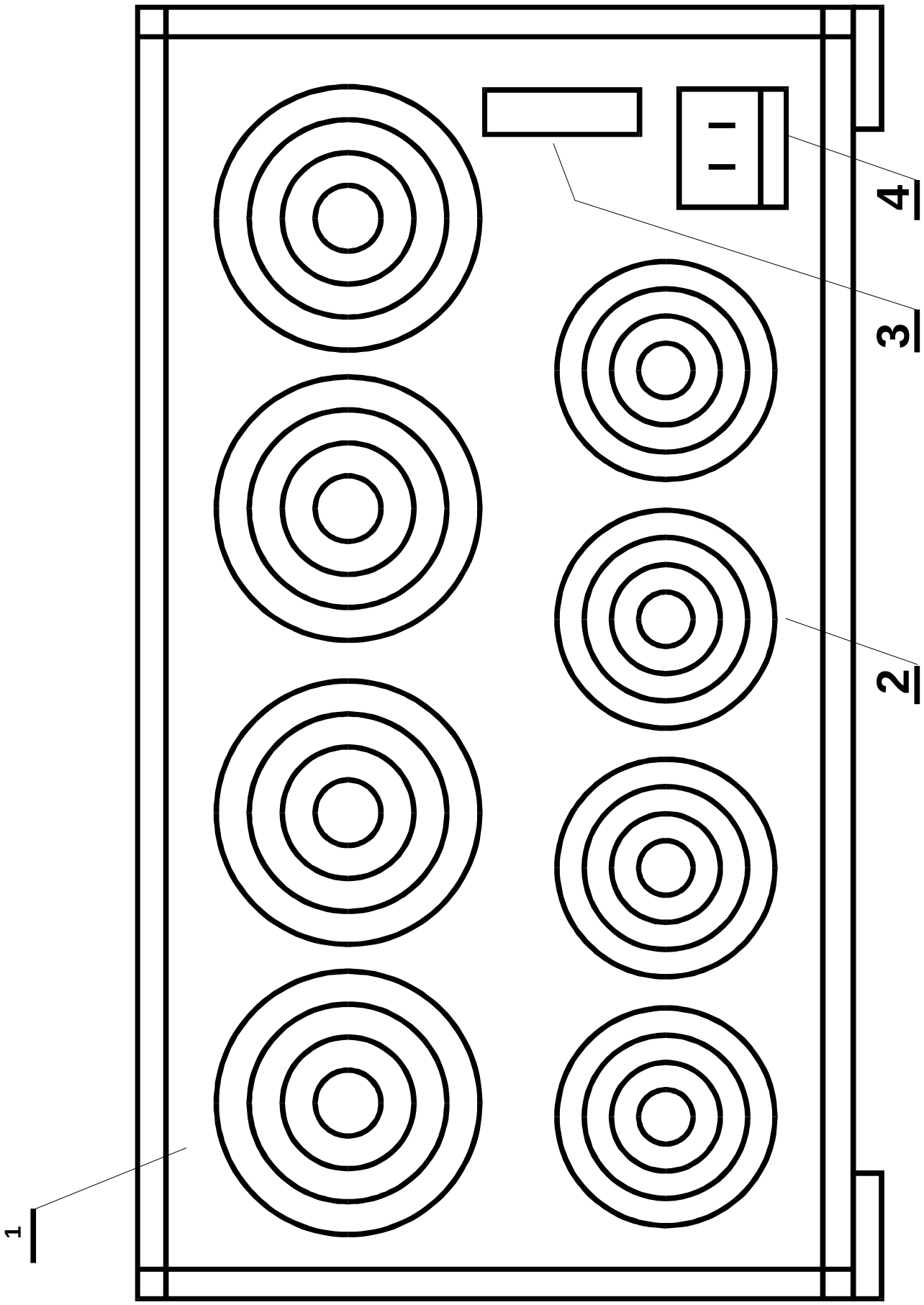
L OUTPUT CURRENT - the output current terminal of the common conductor (LOW). The terminal is intended for connection of the common conductor (LOW) of the checked ammeter current input.

GND - protective conductor terminal (instrument frame).

6.1.2 Rear Panel

The rear panel contains the socket for the mains voltage supply combined with the case for a cut-out fuse and a connector for GPIB bus (IEC 625). The remaining surface of the back panel is filled with air holes used for the forced ventilation of the calibrator inner space.

Explanation:
1 - air holes of switched supplies
2 - air holes of the current amplifiers
3 - connector of the GPIB bus
4 - mains voltage supply socket with the fuse housing


4
3
2
1

6.2 Starting the Device

Place the calibrator in a laboratory or in a room intended for its operation and connect it to the mains. Make sure that the space near the ventilation holes is not covered or blocked. Poor ventilation during operation, caused e.g. by blocking the inlet hole, can result in overheating of electronic components that can damage the device.

Switch on the device by pressing the power button placed in the left part of the front panel. After the device is switched on, the initial test of the calibrator is performed.

The test consists of:

- check of the display and indication units. After switching on all the units light up.
- check of the GPIB address. The display shows the actual calibrator address.
- internal memory checks (are not indicated)

After the test is completed, the following mode of the calibrator is set:

OUTPUT CURRENT	
output value	10 A
FUNCTION	DCI
OUTPUT	OFF

6.3 Control of the Calibrator

6.3.1 Selection of Output Current Value

The output current value can be set up with buttons located under the A display by stepping upward and downward. The setting range for setting up values within the 100 A range is following: 9 A to 100 A

6.3.2 Frequency Setting

The frequency value can be set by pressing the FREQUENCY buttons located under the B display, if the ACI function has been previously selected. The means of setting is similar to the method of setting the output current value. Frequency can be set with two buttons by stepping upward and downward. The display shows the selected frequency value.

6.3.3 Deviation Setting

After pressing the ERR% button, the calibrator enables to change current values in percentage deviations from the preset value. The preset value is shown in the left A display and the percentage deviation in the right B display. The deviation can be changed by pressing the buttons placed under the B display The mode is suitable for calibration of analogue ammeters, where this mode enables direct reading of errors of the calibrated instrument. This function cannot be used in the EXT mode.

6.3.4 Calling Calibrator Specification

The specifications corresponding to the preset output current value in the A display can be called by pressing the SPEC% button. Then the calibration accuracy is displayed on the right B display. Accuracy is not displayed in the EXT mode. The function cannot be used in the EXT mode.

6.3.5 Connection of Output Terminal

The output current can be connected to the output terminal by pressing the OUTPUT ON button (indicated by a LED diode). The connection is always accompanied with delay. Signal cannot be connected to the output terminal without a load connected. By pressing the OFF key the current is disconnected from the output terminal. At the same time the yellow LED diode is turned off. If the calibrator reports an error made by the user or the instrument (see the Chapter 6.4), the output terminal is automatically switched off. Reconnection of the terminal is only possible after the cause of the error is removed, by pressing the OUTPUT ON button.

Note: By pressing the ON key, the internal relay, which short-circuits the output terminals H OUTPUT and L OUTPUT, is disconnected and the output current value is fluently increased as high as to the preset value that is shown in the A display. Anytime during adjustment of the output current value, the OFF function can be started.

By pressing the OFF key the preset value of output current is fluently lowered as low as to approx. 10 A. Then the internal relay, which short-circuits the output terminals H OUTPUT and L OUTPUT, is

connected. During the OFF operation neither ACI and DCI functions can be changed nor the ON function can be started.

For accurate calibration of DUT from the current output terminals, the load wouldn't change its impedance too quickly. This effect can also cause modulation of output current. This practically means that the loads of current terminals must be properly connected and tightened under the terminals so as the contact resistance cannot change more that by 5 % of the load value.

!!!CAUTION!!!
Before disconnecting the calibrator from the mains supply it is necessary to enter the OFF function and wait until the LED diode located under this button is lighted up.

6.3.6 Tests

The tests are started by pressing the TEST button. The buttons placed under the display are used for setting the test number. By pressing again the TEST button, the test number is confirmed. The testing function is finished by pressing the TEST button. The meaning of particular tests is mentioned in the Chapter 6.1.1.

6.4 Error Reporting

During control of the calibrator, the microprocessor checks the correctness of entered data. If the entered data are incorrect or cannot be processed by the device, the calibrator displays the error report to the user. The visual reporting on the display is accompanied by acoustic signalling .

Error Reporting Summary

User's errors

Err. 00	Current overload of a current unit
Err. 01	Too high output voltage on the load (no load on terminals)
Err. 04	Attempt to recalibrate with output terminals turned off.
Err. 06	Attempt to recalibrate the device that has not been turned on minimally 30 minutes.

GPIB errors

Err. 10	Incorrect data format entered.
Err. 11	Incorrect command entered.
Err. 12	Listener is not connected.
Err. 13	Data out of reach of the instrument entered.

Instrument errors

Err. 30	Error during data transmission between the floating and non-floating parts of the instrument.
Err. 31	Error during recording data into EEPROM memory
Err. 32	Error during check of the EEPROM memory.

6.5 System Control via GPIB bus

The calibrator is equipped with the normalised GPIB bus. The system connector can be found on the rear panel.

The instrument can perform following functions:

SH1, AH1, T5, RL1, DC1

See the list of control commands in the table below:

Cx	AC/DC mode	C0 - alternating current
		C1 - direct 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 - unoccupied
		V5 - specification

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

Output Format of Values

If the V0 function is applied, the output data have the following format:

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

If the V1 function is applied:

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

If the V2 function is applied:

_ C X E X O X CR LF

If the V3 function is applied:

_ V 1 5 0 X X CR LF

If the V5 function is applied:

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

Setting of Current Value

The format for value setting is as follows:

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 Instructions

Except the button switches, power supply switch and ventilator, there are not any moveable parts in the instrument and the instrument does not require any mechanical maintenance.

Calibrator Breakdowns

The electronic components underwent the artificial ageing by means of temperature cycling during production and so no breakdowns should occur during operation. If after all any breakdown occurs, it is recommended to proceed as follows:

1. If the testing procedure is not started and completed after the instrument is switched on, check the fuse on the back panel. Unplug the mains before unscrewing the fuse holder!
2. If the instrument reports the ERR 01 failure, check whether the calibrator is not overloaded by the connected load.

If the breakdowns occurred during operation cannot be repaired by replacement of fuses, it is necessary to consult with the manufacturer. The spare fuse is placed in the fuse case and it is accessible after pulling out the plug-in part of the case.

8. Calibration

8.1 Calibration Principle

The calibrator M-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 or from the first calibration during production. The recommended recalibration interval is 12 months.

M-150S is equipped with the calibrating procedure that enables a simple recalibration. To carry out the calibration doesn't require setting of any mechanical setting unit (resistance or capacitance trimmers) The calibration is carried out according to the prescribed procedure only by entering data via the instrument keyboard. The calibrating procedure consists in setting the slope of current range in the alternating current generating mode and in setting the slope and off-set in the direct current mode. The recommended calibrating frequency is 60 Hz.

8.2 Calibration Procedure

To calibrate M-150S, the following instruments are required:

1. Standard multimeter with the AC U accuracy at least of 0.03 % 40 to 120 Hz
   with the DC U accuracy at least of 0.3 %
   Range: from 10 to 200 mV

   Recommended types: Datron 1271
   Datron 1081
   HP 3458A

2. Standard resistor 0.001 mOhm with the calibrating uncertainty lower than 0.02 % in the DC frequency band up 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: Meatest M-130
   Datron 9100
   Fluke 5500

Carry out the calibration only after the thermal conditions of the calibrator have been stabilised at least 30 minutes after it was switched on.

8.2.1 Calibrating Code

Access to the calibrating procedure is protected by calibrating code. The manufacturer supplies the instrument with the calibrating code equal 0. This code is also shown on the display. The user can set up a five-digit code that makes it possible for him to enter in the calibrating procedure only once. When non-zero calibrating code was set, the user neither can more change this code nor read it from the instrument. He should consider properly whether to use this function or not and record the code. Unlocking the code can be done by the manufacturer only. The TEST 8 is used for setting up the code.

Coding Procedure:

1) Press the TEST button, select the TEST 8

2) Press again the TEST button. Right display will show ”0”. Maximally a five-digit code can be set by means of the buttons under the right display. This code must be recorded.

3) Press the TEST button and the instrument will be returned to the previous state. Thus the coding procedure is completed

8.2.2 Calibration of Current Range

1. Connect the current terminals of the standard resistance to the calibrator output terminals; connect standard multimeter to the voltage terminals of the standard resistance (see the figure).

Calibration of DC current range

Set the calibrator as follows:

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

2. Select the measuring mode DC - U on the standard multimeter. Switch output terminals ON.

3. Press the CAL button. Set the code protecting the calibrating data against undesirable manipulation by pressing the buttons under the right display. After the code is set, press the CAL button. If the code is incorrect, the instrument is turned back on the previous mode. If the code was correctly set, the red LED diode above the CAL button will light up.

4. Press the CAL button on M150S. The display B will show OFS. 0, the left A display will show the correcting value of previous calibration. Set by pressing the buttons under the left display such data so as the multimeter can indicate the 0 V value according the table POSITIVE OFF-SET CORRECTIONS.

5. Press the CAL button. The right display will show -OFS, the left display will show the negative correcting value of the previous calibration. By pressing the buttons under the left display set such value that standard multimeter indicate 0 V value in the range according the table NEGATIVE OFFSET CORRECTIONS.

6. Press the CAL button. The right display will show 100.00, which means calibration in the point 100 A of the 100 A range. Set the value of 100 x R_N on the multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at DC current. The set value tolerance is given in the table POSITIVE SLOPE CORRECTIONS. The value set on the calibrator, has no direct numerical connection with the calibrated current!

7. Press the CAL button. The right display will show the value of -100.00, which means calibration of the point -100 A of the 100 A range. Set the value of 100 x R_N on the standard multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at DC current. The set value tolerance is given in the table NEGATIVE SLOPE CORRECTIONS. The value set on the calibrator has no direct numerical connection with the

calibrated current!

Calibration of AC current range

8. Press the CAL button. Now the calibrator mode can be set again. Press the OUTPUT OFF button, select the ACI mode and set the frequency of 60 Hz. Switch standard multimeter to the AC voltage measuring mode and press the OUTPUT ON button.

9. Press the CAL button. The right display will show the value of 100.00, which means calibration point 100 A AC on the 100 A range. Set the value of 100 x R_N on the multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at the AC current 60 Hz. The set value tolerance is given in the table SLOPE CORRECTIONS. The date set on the calibrator has no numerical connection with the calibrated current!

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

11. Press the CAL button. The right display will show the value of 100.00, which means calibration point 100 A on the 100 A range. Now connect the external DC reference in the positive polarity with the input terminals H INPUT (+) and L INPUT (-) e.g. from the DC calibrator. Set the value of +10 V on the external reference. Set the value of 100 x R_N on the multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at DC current. The set value tolerance is given in the table POSITIVE SLOPE CORRECTIONS.

12. Press the CAL, OFF and ON- buttons on M150S.

13. Press the CAL button. The right display will show the value of -100.00, which means calibration point -100 A on the 100 A range. Now connect the external reference in the negative polarity to the input terminals H INPUT (-) and L INPUT (+) e.g. from the DC calibrator. Set the value of -10 V on the external reference. Set the value of 100 x R_N on the multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at DC current. The set value tolerance is given in the table NEGATIVE SLOPE CORRECTIONS.

14. Press the CAL button. Now the calibrator mode can be set again. Press the OUTPUT OFF button, select the ACI mode. Set the external reference voltage 10 V AC on AC voltage standard calibrator and set the external reference frequency f ext in the range from 40 Hz to 120 Hz. Switch the standard multimeter to the AC voltage measuring mode and press the OUTPUT ON button.

15. Press the CAL button. The right display will show the value of 100.00, which means calibration point 100 A on the 100 A range. The left display is showing -E-. Set the value of 100 x R_N on standard multimeter by pressing the buttons under the left display. The R_N value is the calibrating value of the standard resistance at AC current on frequency f ext. The set value tolerance is given in the table SLOPE CORRECTIONS.

16. Press the CAL, OFF and EXT buttons. Now the calibrator is set in mode before calibration. After the calibration is completed, press the TEST button, set 7 on the left display and record the date of calibration by means of buttons under the display. After the date is recorded, press again the TEST button. The TEST light indication will be turned off as well as the MODE CAL indication. The calibration is completed.

Table of Calibrating Values Tolerance

range	DC value	AC
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.

To review the procedure, the following table summarises the calibrating procedure, recorded displayed indications and pressing the buttons

Button	function	left display	right display	Note
I. Selection of calibrating mode				
CAL	calling CAL function	XYZ	0	
	setting the calibrating code	XYZ	*****	
CAL	calling the calibration	XYZ	XYZ	LED
II. Calibration of the range 100 A DC				
RANGE 100A	setting	100.00		
ON+	connection of 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 of terminals			OFF
III. Calibration of the range 100 A AC				
RANGE 100A	setting	100.00	60	
ON+	connection of 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 of terminals			OFF

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

V. Calibration of the range 100 A -DC external input				
RANGE 100A	setting	- E -		
ON-	connection of output terminals	- E -		
CAL	setting the slope 100 A	55000	-100.00	
	”	****	-100.00	
CAL	end of the calibration - 100 A	- E -		
OFF	disconnection of terminals			OFF
VI. Calibration of the range 100 A AC external input				
RANGE 100A	setting	- E -	- F -	
ON-	connection of 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 of 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 real previous correcting values will appear in these positions.

XYZ is the state of the display during the previous step.

8.3 Check of Parameters

To check the parameters, the following instruments are required:

1. Standard multimeter with the accuracy

   AC U at least of 0.03 % in range 40 to 120 Hz

   DC U at least of 0.03 %

   Range of AC/DC voltage: from 10 to 200 mV

   types: Datron 1281

   Datron 1081

   HP3458A

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

types: Tinsley 5686 0.001 Ohm
BURSTER 1281 0.001 Ohm

The check is carried out after the temperature mode of the calibrator has been stabilised, at least 30 minutes after it was switched on.

2. Counter with period function and with accuracy at least 0.01 % in the range up 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 Check of Current Ranges

1. Connect the current terminals of 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 ON

2. Select the measuring mode DC U 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 do again the instructions in paragraphs 1 to 3
Switch off the calibrator output OFF

5. Set the current calibrator.

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 tolerance values.

8.3.2 Check of non-linear distortion

1. Connect to the output terminals of M-150S resistance load, the value of which must be sufficient for reaching the voltage on the load of about 0.5 Vef. For this reason you can also use the standard resistor 0.001 Ohm, which shall be connected with longer cables with approx. resistance 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 calibrator 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) Never switch off the calibrator with the output terminals switched on (ON mode) by means of the power button (POWER).

2) Switch off the current calibrator by pressing the power button (POWER) only after the OUTPUT OFF button was pressed and after the time-out of about 20 second.

3) Don’t switch on the calibrator by means of the power button until the time-out between the last switch-out and the next switch-on is longer than cca. 20 seconds.