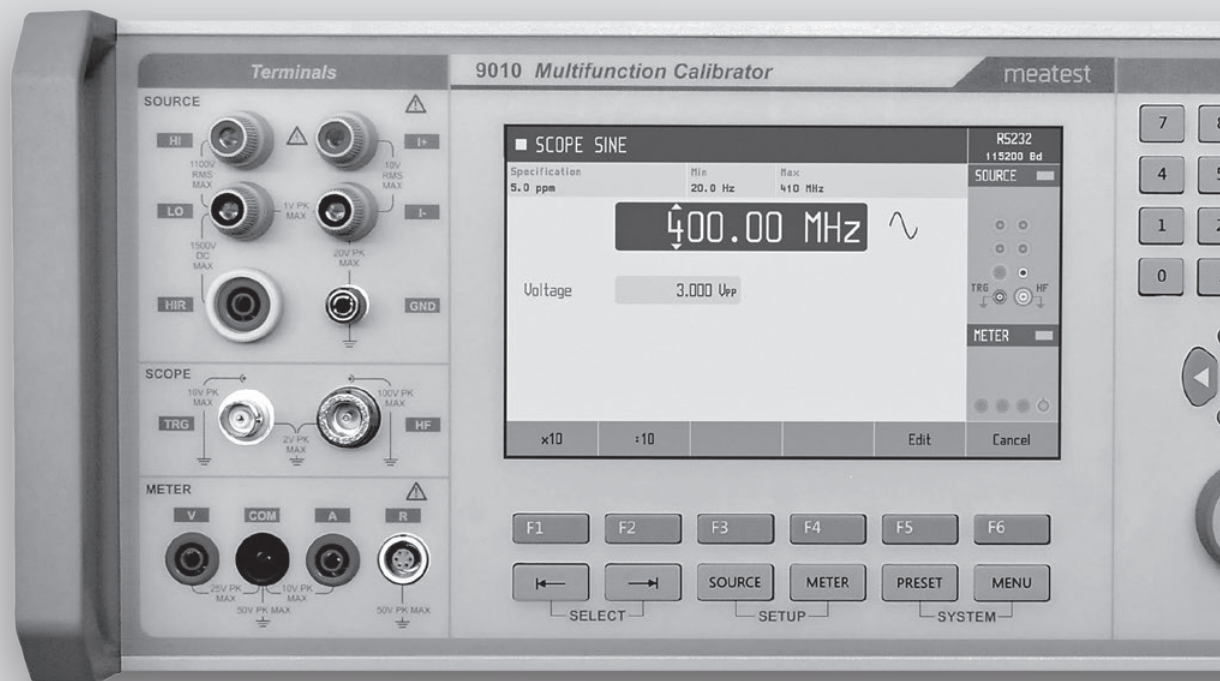


# ELECTRICAL CALIBRATION

detailed specifications



## **RANGE OF PRODUCTS**

Multifunction Calibrators	(pg. 3)
Power & Energy Calibrators	(pg. 14)
Special Laboratory Instruments	(pg. 20)
Programmable Decades	(pg. 28)
Calibration Software	(pg. 40)

## **COMPANY PROFILE**

Meatest company was founded in 1991 and first designs date back another decade. With almost 40 years of experience in electrical metrology we make calibration and measurement equipment with lasting reliability, user-friendliness and high performance at the very top of our priorities.

Development is focused on robust and flexible solutions matching everyone's needs and making your work easier. Meatest developers account for full 25 % of Meatest staff. Utilizing decades of experience, sophisticated design, premium parts and ISO 9001:2015 framework they create unique instruments some of which don't have their counterpart anywhere in the world.

## **MADE TO LAST**

Customer support, as a way of keeping operating costs as low as possible, is taken very seriously in Meatest. More than 50 representatives are at your service all over the world, helping you to find the best solution to your needs. Standard 2 year warranty can be extended to up to 5 years for all our instruments and general lifetime support is limited only by availability of external parts. Recalibration and maintenance is a matter of weeks, not months.

# 9010

# MULTIFUNCTION CALIBRATOR



## HIGHLIGHTS

- AC/DC voltage/current up to 1050V/20A
- Basic uncertainty 35 ppm
- AC/DC power, energy, resistance, capacitance, frequency, TC, RTD
- Scope option up to 400 MHz
- High voltage resistance option for 1.5 kV insulation testers
- Built-in process multimeter
- Interface RS232, LAN, USB, GPIB

## DESCRIPTION

Multifunction calibrator 9010 is designed as universal calibration tool for electrical calibration laboratories, covering most of their workload like multimeters clamp meters, ohm meters, power meters and power analyzers, energy meters, transducers, insulation testers, process meters, scopes and many others. High load capacity of both voltage (up to 50 mA) and current output allows for calibration of high-consumption analogue meters. Installed harmonic and non-harmonic shape signals allow for testing meter sensitivity to distorted signals by a signal with various crest factor. Advancing from previous M14x calibrator series, 9010 can now calibrate even 400 MHz scopes, 1.5 kV insulation testers and 1 MW power meters. On the other hand we kept all the popular functions including complete transducer and external sensor calibration (strain gauge, pressure, torsion, strength, etc.) using built-in multimeter, automatic uncertainty calculation, remote control and easy recalibration.

9010 calibrator is fully compatible with Meatest calibration SW package CALIBER/WinQbase which allows for time saving automated calibrations using any of the four installed remote control interfaces.

## SPECIFICATION

### DC/AC Voltage

Voltage range summary	DC: 0 mV – 1050 V AC sine: 1 mV <sub>rms</sub> – 1050 V <sub>rms</sub> Non-sine: 1 mV <sub>rms</sub> – 200 V <sub>rms</sub>
Internal ranges	20 mV, 200 mV, 2 V, 20 V, 280 V, 1050 V
Frequency accuracy and resolution	25 ppm, 5 digit
Non-sine waveform types	saw, triangle, square, truncated sin; 1kHz max.
Non-sine amplitude uncertainty	0.3 % of range + 50 μV <sub>rms</sub>
Voltage output modes	passive 50Ω output up to 200 mV <sub>dc</sub> active output in all DC and AC ranges

### Ranges, resolution, 1 year uncertainty [ppm of value]

Range	DC	15 Hz – 10 kHz	10 kHz – 30 kHz	30 kHz – 100 kHz	100 kHz – 300 kHz
0.00000 – 20.00000 mV	220 + 3 μV <sup>*1</sup>	2000 + 30 μV	2000 + 40 μV	10000 + 100 μV	50000 + 900 μV
20.00001 – 200.00000 mV	45 + 3 μV <sup>*1</sup>	1000 + 80 μV	1500 + 120 μV	3000 + 300 μV	5000 + 1 mV
0.200001 – 2.000000 V	35 + 10 μV	250 + 120 μV	500 + 300 μV	2000 + 1 mV	5000 + 1 mV
2.000001 – 20.000000 V	35 + 40 μV	250 + 700 μV	500 + 1.5 mV	2000 + 10 mV	N/A
20.00001 – 100.00000 V	42 + 250 μV	270 + 5 mV	500 + 15 mV	N/A	N/A
100.00001 – 280.00000 V <sup>*2</sup>	42 + 500 μV	300 + 12 mV	500 + 50 mV	N/A	N/A
280.0001 – 1050.0000 V <sup>*3</sup>	50 + 7 mV	420 + 85 mV	N/A	N/A	N/A

\*1 Uncertainty in passive mode. Active mode uncertainty is 220 ppm + 20 μV and 45 ppm + 20 μV respectively.

\*2 Frequency is limited to 15 – 10 kHz above 200 V.

\*3 Frequency is limited to 20 – 1 kHz.

### Distortion and Load Characteristics

Parameter	Range	20 mV	200 mV	2 V	20 V	100 V	280 V	1000 V
THD + noise <sup>*4</sup>	15 – 45 Hz	0.05 % + 200 μV	0.05 % + 300 μV	0.15 %	0.15 %	0.15 %	0.15 %	0.25 %
	45 – 10000 Hz	0.05 % + 200 μV	0.05 % + 300 μV	0.05 %	0.05 %	0.05 %	0.05 %	0.20 %
	10 – 30 kHz	0.25 % + 200 μV	0.25 % + 300 μV	0.12 %	0.15 %	0.3 %	0.3 %	N/A
	30 – 100 kHz	0.35 % + 230 μV	0.35 % + 300 μV	0.22 %	0.3 %	N/A	N/A	N/A
	100 – 300 kHz	1.5 % + 500 μV	1 % + 700 μV	0.7 %	N/A	N/A	N/A	N/A
Burden current	DC active	1 mA	5 mA	30 mA	50 mA	50 mA	50 mA	5 mA
	45 – 10000 Hz	0.5 mA <sub>rms</sub>	4 mA <sub>rms</sub>	30 mA <sub>rms</sub>	50 mA <sub>rms</sub>	50 mA <sub>rms</sub>	40 mA <sub>rms</sub>	3 mA <sub>rms</sub>
	10 – 30 kHz	0.5 mA <sub>rms</sub>	4 mA <sub>rms</sub>	10 mA <sub>rms</sub>	10 mA <sub>rms</sub>	10 mA <sub>rms</sub>	10 mA <sub>rms</sub>	N/A
	30 – 100 kHz	0.5 mA <sub>rms</sub>	2 mA <sub>rms</sub>	5 mA <sub>rms</sub>	5 mA <sub>rms</sub>	N/A	N/A	N/A
	100 – 300 kHz	100 Ω min. load	100 Ω min. load	1 mA	N/A	N/A	N/A	N/A

\*4 THD in bandwidth up to 500 kHz or 10 lowest harmonics.

### DC/AC Current

Current range summary	DC: 0.0000 μA – 20.000000 A AC Sine: 10.0000 μA <sub>rms</sub> – 20.000000 A <sub>rms</sub> 100.0000 μA <sub>rms</sub> – 2.000000 A <sub>rms</sub>
Non-sine:	200 μA, 2 mA, 20 mA, 200 mA, 2 A, 20 A
Internal ranges	200 μA, 2 mA, 20 mA, 200 mA, 2 A, 20 A
Frequency accuracy and resolution	25 ppm, 5 digit
Non-sine waveform types	saw, triangle, square, truncated sin; 1kHz max.
Non-sine amplitude uncertainty	0.3 % of range + 0.5 μA <sub>rms</sub>

### Ranges, resolution, 1 year uncertainty [% of value]

Range	DC	15 Hz – 1 kHz	1 kHz – 5 kHz	5 kHz – 10 kHz
0.00000 – 200.00000 μA	0.05 + 20 nA	0.15 + 150 nA	0.3 + 200 nA	0.5 + 500 nA
0.200000 – 2.000000 mA	0.028 + 100 nA	0.085 + 300 nA	0.2 + 1 μA	0.5 + 1.4 μA
2.000000 – 20.000000 mA	0.015 + 600 nA	0.05 + 2 μA	0.2 + 10 μA	0.5 + 14 μA
20.00000 – 200.00000 mA	0.015 + 6 μA	0.05 + 20 μA	0.2 + 100 μA	0.5 + 140 μA
0.200000 – 2.000000 A	0.02 + 130 μA	0.07 + 200 μA	0.2 + 500 μA	N/A
2.000000 – 20.000000 A	0.025 + 2 mA	0.1 + 6 mA	N/A	N/A

## Distortion and Load Characteristics

Parameter	Range	200 $\mu$ A	2 mA	20 mA	200 mA	2 A	20 A
Max. inductive load	15 Hz - 10 kHz	1 H	100 mH	100 mH	10 mH	1 mH	500 $\mu$ H
THD + noise*5	15 - 1000 Hz	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %	0.3 %
	1 - 5 kHz	0.2 %	0.2 %	0.2 %	0.2 %	0.2 %	N/A
	5 - 10 kHz	0.5 %	0.4 %	0.4 %	0.4 %	N/A	N/A
Compliance voltage*6	DC	5 V	5 V	10 V	10 V	5 V	5 V
	15 - 1000 Hz	4 V <sub>rms</sub>	4 V <sub>rms</sub>	5 V <sub>rms</sub>	5 V <sub>rms</sub>	3.5 V <sub>rms</sub>	3 V <sub>rms</sub>
	1 - 5 kHz	4 V <sub>rms</sub>	4 V <sub>rms</sub>	5 V <sub>rms</sub>	5 V <sub>rms</sub>	3.5 V <sub>rms</sub>	N/A
	5 - 10 kHz	2 V <sub>rms</sub>	2 V <sub>rms</sub>	2 V <sub>rms</sub>	2 V <sub>rms</sub>	N/A	N/A

\*5 THD in bandwidth up to 100 kHz.

\*6 Additional uncertainty for compliance voltage above 0.5 V<sub>rms</sub>.

### Voltage from current

Voltage range	5.00000 mV - 5.000000 V
Waveform	DC, 15.000 Hz - 400.00 Hz sine
Amplitude uncertainty	0.05 % + 0.04 % of range
Distortion	< 0.1 % in 100 kHz bandwidth
Source impedance	2.2, 22 or 220 $\Omega$

### Current coil (option 140 - 50)

Applicable multiplier	2 - 200
Max. simulated current	multiplier $\cdot$ 20 A (1000 A with 140 - 50 Current Coil)
Frequency range	45 - 65 Hz
Additional uncertainty	0.25 %

### Resistance

Resistance range summary	0.0000 $\Omega$ - 100.0000 k $\Omega$ in 4W 0.0000 $\Omega$ - 1.000000 G $\Omega$ in 2W
Modes	2W and 4W continuous range 2W and 4W fixed decadic standards 100 G $\Omega$ High Voltage Resistance (optional)

## Basic resistance modes and 1 year uncertainty [ppm of value]

Continuous range mode	4 W	2 W	Nominal standard value	4 W	2 W
0 - 10 $\Omega$	300 + 1 m $\Omega$	300 + 131 m $\Omega$	0 $\Omega$	< 0.2 m $\Omega$	0.2 $\Omega$
10 - 33 $\Omega$	250 + 1 m $\Omega$	250 + 131 m $\Omega$	1 $\Omega$	200	0.05 $\Omega$
33 - 100 $\Omega$	150 + 1 m $\Omega$	150 + 131 m $\Omega$	10 $\Omega$	20	0.05 $\Omega$
100 - 1000 $\Omega$	100 + 3 m $\Omega$	100 + 133 m $\Omega$	100 $\Omega$	15	150
1 - 10 k $\Omega$	100 + 30 m $\Omega$	100 + 160 m $\Omega$	1 k $\Omega$	15	15
10 - 100 k $\Omega$	100 + 300 m $\Omega$	100 + 430 m $\Omega$	10 k $\Omega$	15	15
100 - 330 k $\Omega$	100 + 3 $\Omega$	100 + 3 $\Omega$	100 k $\Omega$	15	15
330 - 1000 k $\Omega$	150 + 3 $\Omega$	150 + 3 $\Omega$	1 M $\Omega$	-	30
1 - 3.3 M $\Omega$	-	150 + 30 $\Omega$	10 M $\Omega$	-	500
3.3 - 10 M $\Omega$	-	200 + 30 $\Omega$	100 M $\Omega$	-	1000
10 - 33 M $\Omega$	-	1000 + 300 $\Omega$	1 G $\Omega$	-	2500
33 - 100 M $\Omega$	-	2000 + 300 $\Omega$			
100 - 330 M $\Omega$	-	3000 + 300 $\Omega$			
330 - 1000 M $\Omega$	-	7000 + 1 k $\Omega$			

## Capacitance

Capacitance range summary  
Modes

0.800000 nF – 120.0000 mF in 2W  
2W continuous range  
2W fixed decadic standards

### Capacitance modes and 1 year uncertainty [% of value]

Continuous range mode	Uncertainty	Nominal standard value	Uncertainty
0.8 – 3.3 nF	0.5 % + 15 pF	1 nF	2.5 %
3.3 nF – 10 µF	0.5 %	10 nF	0.35 %
10 – 33 µF	1.5 %	100 nF	0.25 %
33 – 100 µF	2.5 %	1 µF	0.25 %
0.1 – 1 mF	3 %	10 µF	0.35 %
1 – 120 mF	5 %	100 µF	0.8 %

## DC/AC Power & Energy

Range summary

power: 40 µW – 5.6 kW  
voltage: 0.2 V – 280 V  
current: 0.2 mA – 20 A  
frequency: DC, 15 – 1000 Hz  
time period: 10 s – 1999 s

Total uncertainty

based on voltage, current, phase shift and energy period specifications

Phase shift uncertainty

0.15° up to 200 Hz  
0.25° above 200 Hz

Energy period uncertainty

0.01 % + 0.3 s

Additional features

harmonic distortion, voltage from current, current coil multiplication

### Total 1 year uncertainty overview [% of value]

Current range	DC	15 Hz – 1 kHz, $\varphi = 0^\circ$	15 Hz – 200 Hz, $\varphi = 60^\circ$
2 mA	0.035 – 0.079 %	0.11 – 0.25 %	0.47 – 0.52 %
20 mA, 200 mA	0.021 – 0.047 %	0.073 – 0.18 %	0.46 – 0.49 %
2 A	0.029 – 0.086 %	0.090 – 0.19 %	0.46 – 0.49 %
20 A	0.037 – 0.13 %	0.14 – 0.41 %	0.47 – 0.61 %

## Harmonic distortion

Number of products:

50

Fundamental harmonic range

1 mV – 200 V or 10 µA – 2 A at 15 – 1000 Hz

Fundamental harmonic uncertainty

amplitude:  $\geq 0.2$  % of range  
frequency: 25 ppm  
phase shift: 0.2 – 0.5°

Harmonic product amplitude range

0 – 30 % of fundamental

Harmonic product frequency range

30 – 5000 Hz

Harmonic product phase shift unc.

5 µs (typical)

## Temperature (RTD, TC)

RTD temperature standards

Pt3850, Pt3851, Pt3916, Pt3926, Ni120, custom

RTD R0 range

20 Ω – 2 kΩ

Thermocouple types

B, C, D, E, G2, J, K, M, N, R, S, T

TC cold junction compensation

Manual or automatic with adapter 91

Uncertainty

0.03 °C – 0.18 °C in RTD  
0.18 °C – 0.96 °C in TC

## 9010/MER Multimeter option

Measurement function	Range	Uncertainty
DC voltage	12 mV 120 mV, 1.2 V, 12 V	50 ppm + 3 $\mu$ V 50 ppm + [5 - 500] $\mu$ V
DC current	100 $\mu$ A, 1 mA 2.4 mA, 24 mA	200 ppm + [20 - 100] nA 150 ppm + 800 nA
Frequency	0.1 Hz - 100 kHz	50 ppm
Resistance <sup>*7</sup>	2 k $\Omega$ , 20 k $\Omega$	200 ppm + 5 ppm of range
RTD temperature <sup>*7</sup>	Pt3850, Pt3851, Pt3916, Pt3926, Ni120, custom	0.08 - 0.42 $^{\circ}$ C
TC temperature	BCDEG <sub>2</sub> JKMNRST	0.22 - 1 $^{\circ}$ C

\*7 Using 9000 - 60 4W measurement adapter (comes as standard with MER option)

## 9010/SCO Frequency/Scope option

Functions	HF mode (levelled sine) high voltage LF mode low voltage LF mode PWM mode Time marker mode Trigger mode Input impedance measurement
Frequency uncertainty	25 ppm in LF mode 2.5 ppm otherwise
HF mode amplitude range	1.4 mV <sub>pk</sub> - 1.5 V <sub>pk</sub>

HF mode frequency range	Harmonic distortion	Flatness	Amplitude uncertainty
15 Hz - 100 kHz	-55 dB	< 0.2 %	0.5 % + 350 $\mu$ V <sub>pk</sub>
100 - 500 kHz	-38 dB (< 10 dBm)	< 0.7 % + 100 $\mu$ V <sub>pk</sub>	2.0 % + 250 $\mu$ V <sub>pk</sub>
0.5 - 10 MHz	-38 dB (< 10 dBm)	< 1.2 % + 100 $\mu$ V <sub>pk</sub>	2.5 % + 250 $\mu$ V <sub>pk</sub>
10 - 100 MHz	-38 dB (< 10 dBm)	< 2.0 % + 100 $\mu$ V <sub>pk</sub>	3.3 % + 250 $\mu$ V <sub>pk</sub>
100 - 400 MHz	-30 dB (< 10 dBm)	< 2.5 % + 100 $\mu$ V <sub>pk</sub>	3.7 % + 250 $\mu$ V <sub>pk</sub>

## 9010/HVR High Voltage Resistance option

Resistance range	Maximum test voltage	Resistance uncertainty	Test voltage uncertainty
100 - 200 k $\Omega$	800 V <sub>dc</sub>	0.2 %	0.3 % + 2 V
200 k $\Omega$ - 1 M $\Omega$	1100 V <sub>dc</sub>	0.2 %	0.3 % + 2 V
1 - 10 M $\Omega$	1150 V <sub>dc</sub>	0.3 %	0.5 % + 5 V
10 M $\Omega$ - 1 G $\Omega$	1575 V <sub>dc</sub>	0.5 %	0.5 % + 5 V
1 - 10 G $\Omega$	1575 V <sub>dc</sub>	1.0 %	1 % + 5 V
100 G $\Omega$ (fixed standard)	1575 V <sub>dc</sub>	3.0 %	1.5 % + 5 V

## GENERAL DATA

Warm-up time	30 minutes
Reference temperature	+22 $^{\circ}$ C - +24 $^{\circ}$ C
Operating temperature	+13 $^{\circ}$ C - +33 $^{\circ}$ C
Storage temperature	-10 $^{\circ}$ C - +55 $^{\circ}$ C
Temperature coefficient	10 % of accuracy/ $^{\circ}$ C outside Tref
Max relative humidity	70 %
Power supply	115/230V - 50/60 Hz, 450 VA max
Dimensions (W x H x D)	435 x 175 x 620 mm
Weight	24 kg
Interfaces	RS232, IEEE488, USB, Ethernet

# M142

# MULTIFUNCTION CALIBRATORS



## HIGHLIGHTS

- AC/DC voltage/current to 1000V/30A
- Basic accuracy 10 ppm
- AC/DC power, energy, phase shift, resistance, capacitance, frequency, TC, RTD
- Build-in process multimeter
- GPIB and RS-232 as standard

## DESCRIPTION

Multifunction calibrator M142 is calibrator of electric quantities for application in calibration laboratories and in production lines where voltage, current, resistance, capacity and frequency meters are manufactured. Load capacity of the voltage output is 30 mA – enough for most high-consumption analogue power -meters. Installed harmonic and non -harmonic shape signals allow for testing meter sensitivity to distorted signals by a signal with various crest factor. Frequency modes, suitable for calibration of multimeters and time bases of oscilloscopes, have adjustable 6-digit frequency, amplitude and duty ratio of the output signal. The calibrator can measure temperature with TC and RTD temperature sensors to show it on display or use for cold junction compensation.

Built-in process multimeter, standard part of M142 full version, can be used independently or simultaneously with source functions which makes testing transducers , regulators and evaluation units really easy. Using a single instrument you can evaluate output signals of various types of transducers and external sensors (strain gauge, pressure, torsion, strength, etc.), read them directly from calibrator display and use them in your calibrations.



## SPECIFICATION

### DC/AC Voltage Ranges & 1 year Accuracy [ppm of value]

Range	DC	20 Hz – 10 kHz* <sup>1</sup>	10 kHz – 50 kHz	50 kHz – 100 kHz
1 mV – 20 mV	50 + 6 $\mu$ V	2000 + 30 $\mu$ V	2000 + 30 $\mu$ V	10000 + 30 $\mu$ V
20 mV – 200 mV	15 + 8 $\mu$ V	1000 + 80 $\mu$ V	1500 + 120 $\mu$ V	3000 + 120 $\mu$ V
200 mV – 2 V	12 + 10 $\mu$ V	180 + 100 $\mu$ V	500 + 200 $\mu$ V	2000 + 1 mV
2 V – 20 V	10 + 50 $\mu$ V	180 + 1 mV	500 + 6 mV	2000 + 10 mV
20 V – 240 V	15 + 500 $\mu$ V	180 + 10 mV	–	–
240 V – 1000 V	50 + 20 mV	300 + 200 mV	–	–

\*1 Frequency is limited to 1 kHz above 200 V.

### DC/AC Current Ranges & 1 year Accuracy [ppm of value]

Range	DC	20 Hz – 1 kHz	1 kHz – 5 kHz	5 kHz – 10 kHz
1 $\mu$ A – 200 $\mu$ A	500 + 20 nA	1500 + 20 nA	3000 + 220 nA	–
200 $\mu$ A – 2 mA	200 + 100 nA	700 + 200 nA	2000 + 1 $\mu$ A	5000 + 1400 nA
2 mA – 20 mA	100 + 600 nA	500 + 1 $\mu$ A	2000 + 10 $\mu$ A	5000 + 14 $\mu$ A
20 mA – 200 mA	100 + 6 $\mu$ A	500 + 10 $\mu$ A	2000 + 100 $\mu$ A	5000 + 140 $\mu$ A
200 mA – 2 A	150 + 100 $\mu$ A	500 + 100 $\mu$ A	–	–
2 A – 30 A* <sup>2</sup>	200 + 2 mA	1000 + 6 mA	–	–

\*2 Additional uncertainty applies above 20A: 900\*(I-20)  $\mu$ A, where I is set output current in [A]. Frequency is limited to 40 – 500 Hz.

### TC Temperature Sensor Simulation

<b>R</b>	range [°C]	-50 – 0	0 – 400	400 – 1000	1000 – 1767
	accuracy [°C]	1.8 – 1.4	1.4 – 0.7	0.7 – 0.6	0.6 – 0.5
<b>S</b>	range [°C]	-50 – 0	0 – 250	250 – 1400	1400 – 1767
	accuracy [°C]	1.6 – 1.3	1.3 – 0.8	0.8 – 0.6	0.7 – 0.6
<b>B</b>	range [°C]	400 – 800	800 – 1000	1000 – 1500	1500 – 1820
	accuracy [°C]	1.7 – 0.9	0.9 – 0.8	0.8 – 0.7	0.7 – 0.6
<b>J</b>	range [°C]	-210 – -100	-100 – 150	150 – 700	700 – 1200
	accuracy [°C]	0.3 – 0.2	0.2 – 0.1	0.2 – 0.1	0.2
<b>T</b>	range [°C]	-200 – -100	-100 – 0	0 – 100	100 – 400
	accuracy [°C]	0.4 – 0.3	0.2	0.2	0.1
<b>E</b>	range [°C]	-250 – -100	-100 – 280	280 – 600	600 – 1000
	accuracy [°C]	0.7 – 0.2	0.2 – 0.1	0.1	0.1
<b>K</b>	range [°C]	-200 – -100	-100 – 480	480 – 1000	1000 – 1372
	accuracy [°C]	0.5 – 0.2	0.2	0.3 – 0.2	0.3
<b>N</b>	range [°C]	-200 – -100	-100 – 0	0 – 580	580 – 1300
	accuracy [°C]	0.7 – 0.3	0.3	0.2	0.2

## GENERAL DATA

Warm up time	60 min
Storing temperature	0 to 40 °C @ max. 80 % r.h.
Reference temperature	23 °C $\pm$ 2 °C
Dimensions/Weight	450 x 480 x 150 mm/23 kg
Power supply	115 V/230 V – 50/60 Hz
Max. power consumption	250 VA

## ADDITIONAL FULL VERSION FUNCTIONS

### Function Shape

Range of voltage:	1 mV to 200 V
Range of current	100 $\mu$ A to 2 A
Output waveform	square, positive, negative, symmetrical, ramp A, ramp B, triangle, truncated sinus
Peak value accuracy	0.3 %

### DC/AC Power & Energy

Function	Range	Accuracy
DC Voltage	0.2 V - 240 V	40 - 150 ppm
DC Current	2 mA - 20 A	500 - 1500 ppm
AC Voltage	0.2 V - 240 V	300 - 1200 ppm
AC Current	2 mA - 20 A	500 - 1500 ppm
Frequency	20 - 400 Hz	50 ppm
Power factor	-1 - +1	0.005 - 0.0005
Phase	0 - 360°	0.15 - 0.25°
Time in energy mode	10 s - 1999 s	0.1 s

Accuracy of AC power depends on set value of voltage, current, phase. Best accuracy is 0.08 %. Accuracy in energy mode depends on set value of voltage, current, phase and time. Best accuracy is 0.09 %.

### Resistance and Capacitance

Range	ppm of value	Range	% of value
0 - 10 $\Omega$	300 + 5 m $\Omega$	700 pF - 1 nF	0.5 + 15 pF
10 - 33 $\Omega$	150 + 5 m $\Omega$	1 nF - 3.3 nF	0.5 + 5 pF
33 - 330 $\Omega$	100 + 5 m $\Omega$	3.3 nF - 100 nF	0.5
330 $\Omega$ - 1 M $\Omega$	100	100 nF - 1 $\mu$ F	1
1 - 3.3 M $\Omega$	200	1 $\mu$ F - 10 $\mu$ F	1.5
3.3 - 10M $\Omega$	500	10 $\mu$ F - 100 $\mu$ F	2.0
10 - 33 M $\Omega$	1000	-	-
33 - 100 M $\Omega$	2000	-	-
100 M $\Omega$ - 1 G $\Omega$	5000	-	-

Maximum compliance voltage 10 - 20 V<sub>pk</sub> in resistance mode, 5.5 V<sub>pk</sub> in capacitance mode.

### Multimeter

Measurement function	Range	Accuracy
DC voltage - DCV	0 - +/-20 V	0.01 % +500 $\mu$ V
DC voltage - mVDC	0 - +/-2 V	0.02 % +7 $\mu$ V
DC Current	0 - +/-25 mA	0.015 % +300 nA
Frequency	1 Hz - 15 kHz	0.005
Resistance	0 - 2.5 k $\Omega$	0.02 % +10 m $\Omega$
RTD temperature	-150 - +600 °C	0.1 °C
TC temperature	-250 - +1820 °C	0.4 - 2.5 °C

### RTD Temperature Sensor Simulation

Type	Pt 1.385, Pt 1.392, Ni
Range of R <sub>O</sub>	20 $\Omega$ to 2 k $\Omega$
Range of temperature:	-200 to +850 °C
Temperature accuracy	0.04 °C to 0.5 °C
Temperature scale	ITS 90, PTS 68

### Frequency

Type	Range	Frequency acc.	Amplitude	Amplitude acc. [%]	Ratio	Ratio acc.
PWM (POS, NEG, SYM)	0.1 Hz - 100 kHz	0.005 %	1 mV - 10 V	0.1 %	0.1 - 0.990, 1 - 0.99	0.0005
HSO <sup>*3</sup>	0.1 Hz - 20 MHz	0.005 %	5 V <sub>pk-pk</sub>	10 %	-	-

\*3 Rise time of generated output waveform in HSO function < 5 ns.

## MAIN DISPLAY

Auxiliary information  
grounding, local/remote control,  
current coil application

Output ON/OFF indication

Output signal waveform

Current time and date indication

Output parameters field

Main parameter of the output signal

Additional parameters  
of the output signal like:  
waveform, frequency,  
absolute or relative Deviation

METER field

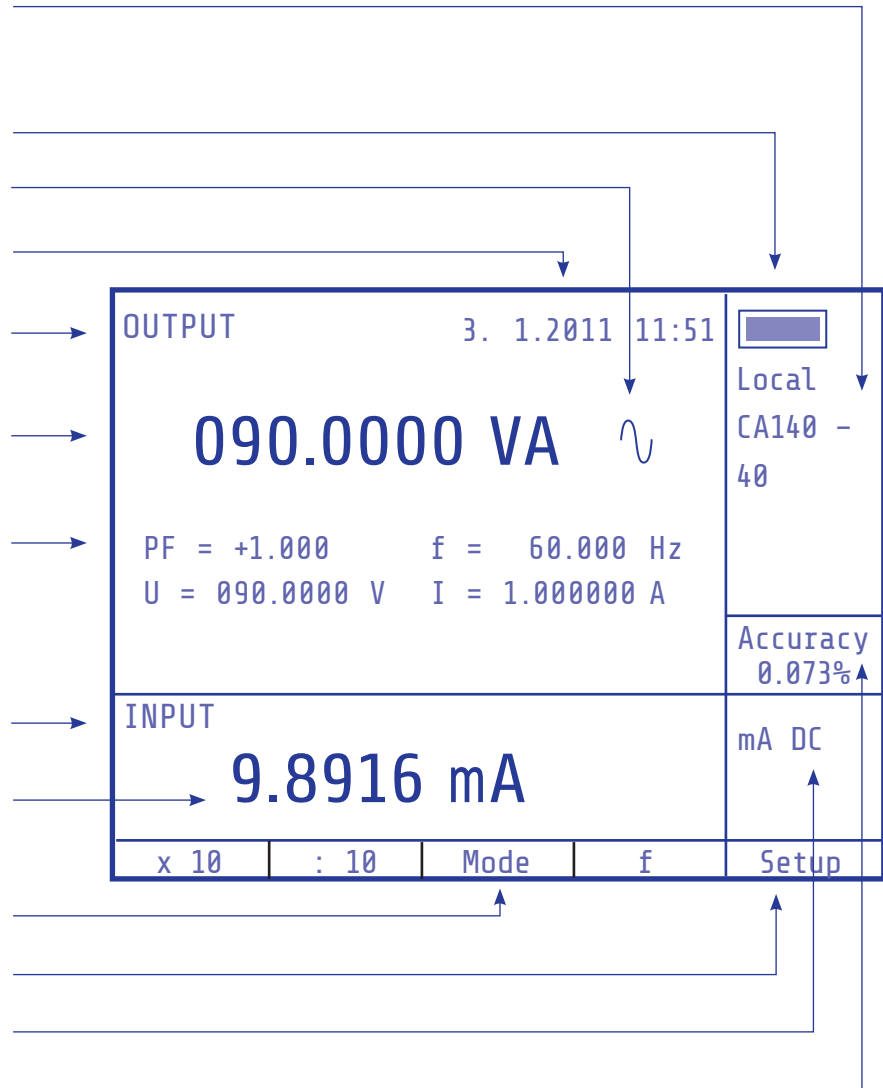
Value measured by  
internal meter

Line with display button description

SETUP menu

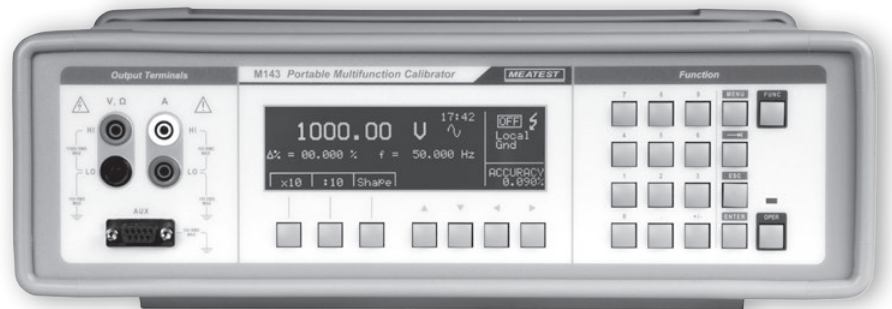
METER selected function

Calculated accuracy



# M143

# PORTABLE MULTIFUNCTION CALIBRATOR



## HIGHLIGHTS

- AC/DC voltage/current up to 1000 V/20 A
- Basic accuracy 60 ppm, cold junction compensation
- Calibration of clamp meters up to 1000 A using 140-50 Current Coil
- Non-sinusoidal waveforms, resistance, frequency, TC, RTD
- Fixed standard resistors from 10  $\Omega$  to 100 M $\Omega$
- GPIB and RS-232 interface
- Compact dimensions, overall weight 9 kg

## DESCRIPTION

M143/143i Multifunction calibrator is cost saving solution for calibration of meters of electric quantities up to 1000 V and 20 A. It offers basic accuracy 0.01 % in DC voltage needed for calibration of 3½ and 4½ digit multimeters. Resistance function is covered by eight fix resistors in range from 10  $\Omega$  to 100 M $\Omega$ . Thanks to its small dimensions and low weight the calibrator can be applied easily for field calibrations.

M143's main application field are production lines of panel meters, multimeters, transducers, measuring amplifiers, thermometers, and calibration laboratories where the calibrator can be applied as source of standard value for calibrations, verifications and adjustments of units under test.

## SPECIFICATION

### DC/AC Voltage & Current

Voltage range summary	0.0000 mV – 1000.00 VDC, 1.0000 mV – 1000.00 VAC
Waveform	sin, saw, triangle, square sym, truncated sin
Current range summary	0.000 $\mu$ A – 20.000 ADC, 1.000 $\mu$ A – 20.000 AAC (M143i version to 2A only)

#### Voltage accuracy

Range	% of value + % of range		
	DC	20 – 200 Hz	0.2 – 10 kHz
0.0000 mV – 10.0000 mV <sup>*1</sup>	0.050 + 0.070	0.20 + 0.25	0.20 + 0.30
10.000 mV – 100.000 mV	0.010 + 0.0070	0.10 + 0.05	0.15 + 0.07
0.10000 V – 1.00000 V	0.006 + 0.0010	0.05 + 0.005	0.07 + 0.01
1.0000 V – 10.0000 V	0.006 + 0.0005	0.05 + 0.005	0.07 + 0.03
10.000 V – 100.000 V <sup>*2</sup>	0.006 + 0.0010	0.05 + 0.010	0.07 + 0.03
100.00 V – 1000.00 V <sup>*2</sup>	0.010 + 0.0020	0.07 + 0.020	0.10 + 0.03

\*1 AC range starts at 1 mV.

\*2 voltage ranges 100 and 1000V from 40 Hz to 1kHz.

#### Current accuracy

Range	% of value + % of range		
	DC	20 – 200 Hz	0.2 – 1 kHz
0.000 $\mu$ A – 200.000 $\mu$ A <sup>*3</sup>	0.050 + 0.010	0.25 + 0.010	0.20 + 0.10
0.20000 mA – 2.00000 mA	0.025 + 0.005	0.10 + 0.010	0.10 + 0.02
2.0000 mA – 20.0000 mA	0.015 + 0.003	0.07 + 0.005	0.10 + 0.02
20.000 mA – 200.000 mA	0.015 + 0.003	0.07 + 0.005	0.10 + 0.02
0.2000 A – 2.0000 A	0.015 + 0.005	0.10 + 0.005	0.15 + 0.05
2.0000 A – 20.000 A <sup>*4*</sup>	0.1 + 0.01	0.20 + 0.015	0.25 + 0.05

\*3 AC range starts at 1  $\mu$ A.

\*4 continuous output ON in current range 10 A to 20 A is limited to 5 minutes max.

\*5 20 A range in M143 model only.

### Resistance

Nominals	10 $\Omega$ – 100 M $\Omega$ ; 8 decadic values
Accuracy	0.02 – 0.5 %

### TC Simulation

Sensor types	B, C, D, E, G2, J, K, M, N, R, S, T
Accuracy	0.2 – 2.7 $^{\circ}$ C

### RTD Simulation (option)

RTD types	Pt, Ni
R0 range	100 – 1000 $\Omega$
Accuracy	0.1 – 0.2 $^{\circ}$ C

### Frequency

Frequency range	0.1000 Hz – 2.00000 MHz
Accuracy	0.005 %
Waveform type	positive squarewave, 5 $V_{pk}$ $\pm$ 10 %

## GENERAL DATA

Interface	RS232, (IEEE488 as option)
Reference temperature	21 ... 25 $^{\circ}$ C
Operating temperature	10 ... 40 $^{\circ}$ C
Storage temperature	-10 ... +55 $^{\circ}$ C
Power supply	115/230 VAC, 50/60 Hz
Consumption	250 VA max
Dimensions	W 390 mm, H 128 mm, D 430 mm
Weight	9 kg

### Models

M143	1000 V/20 A model with RS232
M143i	1000 V/2 A model with RS232
M143(i) RTD	model with built-in RTD simulator
M143(i) GPIB	model with RS232 and GPIB interface

# M160

# PRECISION DC CALIBRATOR



## HIGHLIGHTS

- DC Voltage up to 100.0000 V, 20 ppm
- DC Current up to 50.0000 mA, 50 ppm
- Reference temperature range 13 – 33 °C
- Resistance, frequency, RTD
- TC simulation R, S, B, J, T, E, K, N, M, C, D, G2
- GPIB, USB, RS-232 and ethernet interface

## DESCRIPTION

Precision DC calibrator M160 is a portable source of industrial process signals including DC voltage, DC current, thermocouple and RTD simulation, resistance and frequency. Unlike most of the other process calibrators, the M160 comes with exceptional 20 ppm accuracy over 20 °C-wide reference temperature range. All these features are combined with user friendly interface multi-interface remote control and robust design make this calibrator ideal for both calibration laboratories as well as industry professionals. Main parameters of both generated and measured signals are displayed on large LCD together with function-specific tooltip, providing auxiliary information like range, accuracy or load limit. Instrument can be connected to different ATE systems via RS232, USB, LAN or GPIB interface.

M160 is sophisticated instrument with its own recalibration procedure. The procedure enables to correct any deviation without mechanical adjustment.

## SPECIFICATION

### DC Voltage source accuracy

Range/Resolution	Accuracy	Max. load
0.0000 - 300.0000 mV	20 ppm + 3 $\mu$ V	50 mA
0.000000 - 3.000000 V	20 ppm + 20 $\mu$ V	50 mA
0.00000 - 30.00000 V	20 ppm + 200 $\mu$ V	50 mA
0.0000 - 100.0000 V	20 ppm + 1 mV	25 mA

### DC Current source accuracy

Range/Resolution	Accuracy	Max. load
0.0000 - 25.0000 mA	50 ppm + 1 $\mu$ A	100 V
0.0000 - 50.0000 mA	50 ppm + 1 $\mu$ A	30 V

### Frequency source accuracy

Range/Resolution	Accuracy
10.0000 - 200.0000 mHz	50 ppm
200.001 - 2000.000 mHz	50 ppm
2.00001 - 20.00000 Hz	50 ppm
20.0001 - 200.0000 Hz	50 ppm
200.01 - 2000.00 Hz	50 ppm
2.0001 - 4.0000 kHz	100 ppm
4.001 - 10.000 kHz	600 ppm
10.01 - 15.00 kHz	1500 ppm

Max. load 30V/50mA or internal pull up to +5V.

### Frequency meter accuracy

Summary range	10 mHz to 100 kHz
Frequency resolution	5½ digits
Accuracy	50 ppm

### TC Simulation

TC types	R, S, B, J, T, E, K, N, M, C, D, G2
Resolution	0.01 °C
Accuracy	0.1 - 0.8 °C, see user's manual for detailed specification
Cold junction comp.	manual or automatic (with Adapter 91)

### RTD Simulation (option)

RTD types	Pt, Ni
Resolution	0.01 °C
Accuracy	0.1 - 0.2 °C, see user's manual for detailed specification

### Resistance (option)

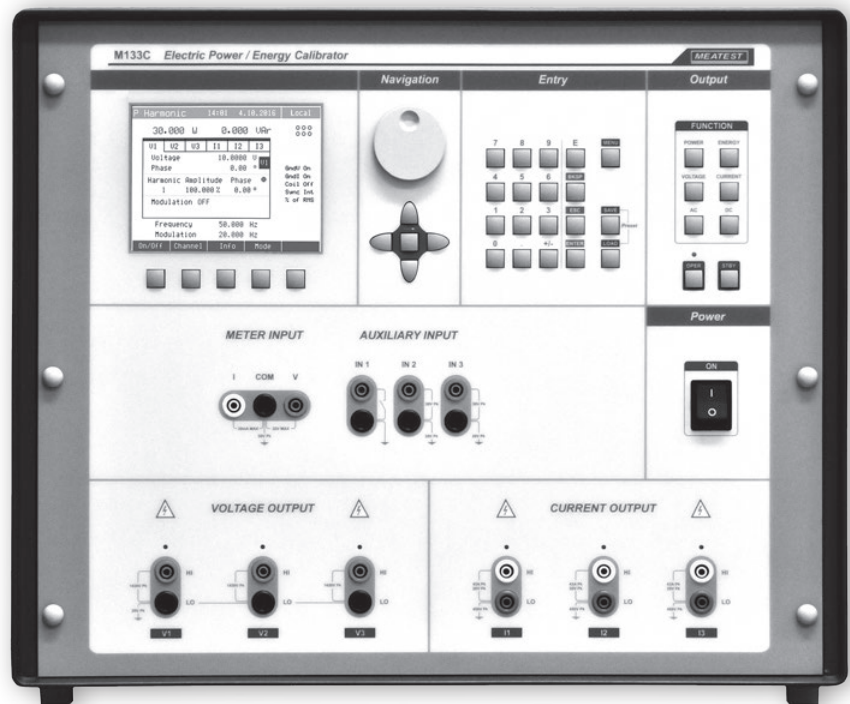
Resistance range	10 $\Omega$ - 300 k $\Omega$ , continuous
Resolution	from 0.0001 $\Omega$
Accuracy	0.02 %

## GENERAL DATA

Reference temperature	+13 °C ... +33 °C
Operating temperature	+5 °C ... +45 °C
Storage temperature	-10 °C ... +55 °C
Remote control	RS232 interface (optionally USB, LAN, IEEE488)
Power supply	115/230 Vac, 50/60 Hz, 60 W max
Dimensions	W 390 mm, H 128 mm, D 310 mm
Weight	5.5 kg

# M133C

# POWER / ENERGY CALIBRATOR



## HIGHLIGHTS

- Power quality and energy functions
- Three and single phase versions
- Phase accuracy 0.01°, frequency range 15 - 1000 Hz
- AC power up to 3x 18 kVA, DC up to 25.2 kW
- Optical scanning head, built-in multimeter
- Floating current outputs for 3-wire power meters
- Current coil for clamp meters up to 2250 A

## DESCRIPTION

M133C is electric AC/DC power and energy calibrator for calibration of power meters, power transducers, power quality analyzers and generally all kinds of power measuring devices.

Full version of M133C calibrator can generate four types of power distortion: harmonic up to 50 products, interharmonic up to 5 kHz, amplitude modulation using symmetrical sine or square wave envelope and finally dip/swell amplitude modulation using custom square wave envelope. All the parameters including distortion can be set independently for each phase.

M133C is more than just a sophisticated power source. Using built-in process multimeter, both transducer inputs and outputs can be handled by the M133C at the same time so you can calibrate it more easily, using no other calibration equipment. Floating current outputs can be connected directly with voltage outputs o allow for 3-wire power meter calibration. One calibrator, many applications - saving your time, space and costs.



## SPECIFICATION

### DC/AC Voltage

Voltage range summary	DC: 1 V – 280 V AC sine: 1 V <sub>rms</sub> – 600 V <sub>rms</sub>
Internal ranges	10 V, 30 V, 70 V, 140 V, 280 V, 600 V
Frequency range and accuracy	15 Hz – 1000 Hz, 50 ppm
Frequency resolution	≤ 500 Hz: 1 mHz > 500 Hz: 10 mHz
Total harmonic distortion	< 0.05 %

### Ranges, resolution, 1 year accuracy [% of value + % of range]

Range	DC	40 – 70 Hz	15 – 40 Hz 70 – 1000 Hz	Maximum burden current*1
1.0000 – 10.0000 V	0.015 + 0.01	0.012 + 0.01	0.016 + 0.01	100 mA
10.0001 – 30.0000 V	0.015 + 0.01	0.012 + 0.01	0.016 + 0.01	200 mA
30.001 – 70.000 V	0.015 + 0.01	0.012 + 0.01	0.016 + 0.01	300/200 mA
70.001 – 140.000 V	0.015 + 0.01	0.012 + 0.01	0.016 + 0.01	300/200 mA
140.001 – 280.000 V	0.015 + 0.01	0.012 + 0.01	0.016 + 0.01	200/150 mA
280.001 – 600.000 V*2	–	0.016 + 0.01	0.024 + 0.01	60/50 mA

\*1 In 40 – 70 Hz AC/otherwise. Sum of all currents from three phases is limited to 400 mA.

\*2 Frequency is limited to 20 – 1 kHz.

### DC/AC Current

Current range summary	DC: 5.000 mA – 30.0000 A AC Sine: 5.000 mA <sub>rms</sub> – 30.0000 A <sub>rms</sub>
Internal ranges	300 mA, 1 A, 2 A, 5 A, 10 A, 30 A
Frequency range and accuracy	15 Hz – 1000 Hz, 50 ppm
Frequency resolution	≤ 500 Hz: 1 mHz > 500 Hz: 10 mHz
Current output isolation	Up to 450 V <sub>pk</sub> against GND
Total harmonic distortion	< 0.1 %

### Ranges, resolution, 1 year accuracy [% of value + % of range]

Range	DC	40 – 70 Hz	15 – 40 Hz 70 – 1000 Hz	Compliance voltage*3
0.005000 – 0.300000 A	0.0175 + 0.01	0.0175 + 0.01	0.021 + 0.02	8 V <sub>pk</sub> /5 V <sub>pk</sub>
0.30001 – 1.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.021 + 0.02	8 V <sub>pk</sub> /5 V <sub>pk</sub>
1.00001 – 2.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.021 + 0.02	8 V <sub>pk</sub> /5 V <sub>pk</sub>
2.00001 – 5.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.021 + 0.02	5 V <sub>pk</sub>
5.0001 – 10.0000 A	0.021 + 0.015	0.021 + 0.015	0.028 + 0.02	5 V <sub>pk</sub>
10.0001 – 30.0000 A	0.0245 + 0.015	0.0245 + 0.015	0.035 + 0.02	5 V <sub>pk</sub>

\*3 In DC or 40 – 70 Hz AC/otherwise.

### Current coil (option 151-25)

Applicable multiplier	25 or 50
Max. simulated current	multiplier · 90 A (2250 A with 151-25 Current Coil)
Frequency range	DC, 15 – 100 Hz
Additional accuracy	0.3 %

## DC/AC Power & Energy

Power range summary	DC: 5 mW – 25.2 kW AC: (3×) 5 mVA – 18 kVA
Total accuracy	based on voltage, current, phase shift and energy period specifications.
Phase shift accuracy (I <sub>x</sub> to U <sub>x</sub> and U <sub>x</sub> to I <sub>x</sub> )	≤ 70 Hz, 0.1 – 10 A: 0.01° ≤ 70 Hz, V channels: 0.01° ≤ 70 Hz, otherwise: 0.05° 70 – 400 Hz: 0.1° > 400 Hz: 0.4°
Energy period range and accuracy	1 s – 100 Ms, 0.01 % of value + 0.1 s

### Total 1 year power accuracy overview – best and worst cases [% of value]

Current range	DC	15 Hz – 1 kHz, φ = 0°	15 Hz – 400 Hz, φ = 60°
300 mA* <sup>4</sup>	0.038 – 0.628 %	0.037 – 1.227 %	0.047 – 1.263 %
1 A, 2 A, 5 A	0.038 – 0.126 %	0.037 – 0.146 %	0.047 – 0.336 %
10 A	0.045 – 0.126 %	0.043 – 0.135 %	0.053 – 0.331 %
30 A	0.048 – 0.135 %	0.046 – 0.150 %	0.158 – 0.338 %

\*<sup>4</sup> Worst case scenario at bottom of the range (5 mA) and maximum frequency (1 kHz).

### Total 1 year power accuracy in common applications [% of value]

Set current	EU grid power (230 V, 50 Hz)	US grid power (115 V, 60 Hz)	Aircraft onboard power (115 V, 400 Hz)	Ship onboard power (440 V, 60 Hz)
100 mA	0.054 %	0.054 %	0.086 %	0.057 %
1 A	0.038 %	0.038 %	0.051 %	0.042 %
10 A	0.045 %	0.045 %	0.057 %	0.048 %
30 A	0.047 %	0.047 %	0.063 %	0.050 %

## Voltage from current

Voltage range	1.000 mV – 5.00000 V
Waveform	DC, 15.000 Hz – 400.00 Hz sine
Amplitude accuracy	0.05 % + (0.02 – 0.1) % of range
Distortion	< 0.1 %
Source impedance	1 or 18 Ω

## Distortion functions (MI33C only)

<b>Harmonic &amp; interharmonic distortion</b>	Max. number of products	63 harmonic or 1 interharmonic
	Harmonic product frequency range	30 – 5000 Hz
	Interharmonic product frequency range	15 – 1000 Hz
	Product amplitude accuracy	≤ 3 kHz: 0.1 – 0.2 % of range > 3 kHz: 0.2 – 0.8 % of range
<b>Modulation (Flicker)</b>	Modulation envelope shapes	Sine, squarewave
	Modulation frequency range	1 mHz – 50 Hz
	Amplitude accuracy	0.2 % of range
<b>Dip/Swell</b>	Amplitude range	100 mV – 280 V, 1 mA – 30 A
	Amplitude accuracy	0.2 % of range
	Time period ranges	transition: 0.1 ms – 60 s other states: 2 ms – 60 s

## Multimeter

Measurement function	Measurement function	Accuracy
DC voltage	0.0000 – 12.0000 V	100 ppm + 1 mV
DC current	0.0000 – 25.0000 mA	100 ppm + 2.5 µA
Frequency	1.00000 Hz – 15.0000 kHz	50 ppm

## Optical scanning head (option 133-02)

Frequency range & accuracy	same as multimeter
Sensor size	32 mm diameter × 24 mm height
DUT attachment	magnetic

## GENERAL DATA

Warm-up time	60 minutes
Reference temperature	+21 °C – +25 °C
Operating temperature	+13 °C – +33 °C Storage temperature -10 °C – +55 °C
Temperature coefficient	10 % of accuracy/°C outside TREF
Max storage humidity	90 %
Power supply	115/230 V – 50/60 Hz, 1875 VA max
Dimensions (W x H x D)	520 x 430 x 500 mm
Weight	59 kg
Interfaces	RS232, IEEE488, Ethernet

## APPLICATION

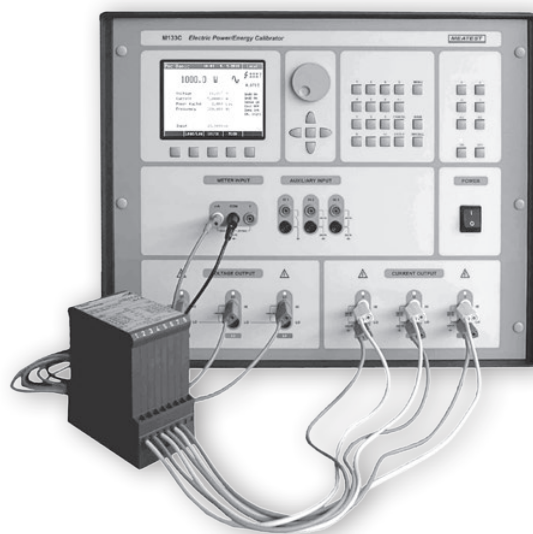
Power analyzer  
calibration



Clampmeter calibration  
with 151-25 Current Coil



Power transducer  
calibration



# M133C FRONT PANEL

**Output On/Off**  
Operate/Standby with LED indicator

**Function keys** – Direct function selection

**Numeric keys** – Direct value setting

**Adjustment controls**  
Multifunction rotary knob Cursor keys

**Multifunction display**  
Generated and measured values  
Accuracy of generated value  
Warnings and error messages  
Status of the calibrator  
Output terminals configuration

**Soft keys**

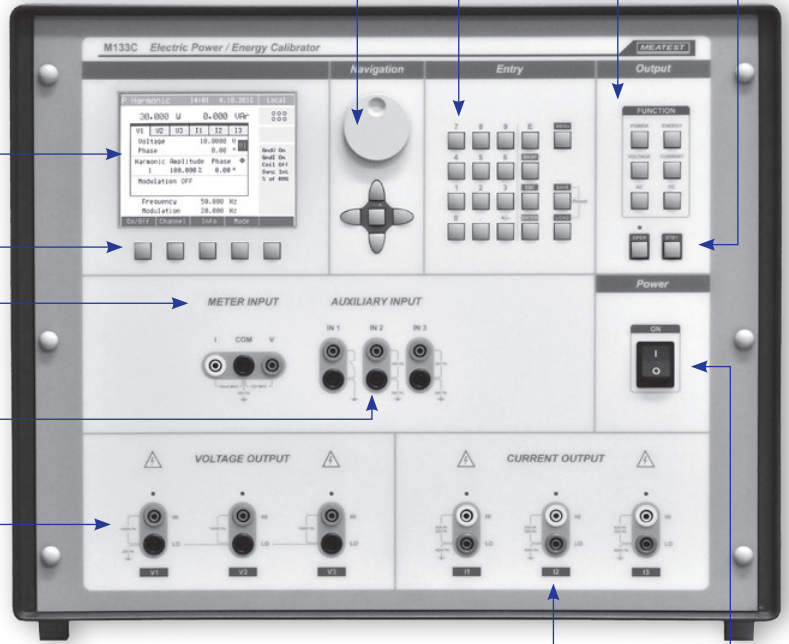
**Meter inputs**  
DC voltage, DC current, Frequency

**Auxiliary inputs** – Pulse counting,  
Synchronization, Triggering

**Output voltage terminals**  
Channels L1, L2, L3, Common LO  
terminals floating up to 20 V<sub>pk</sub>

**Output current terminals**  
Channels L1, L2, L3, Independent LO  
terminals floating up to 450 V<sub>pk</sub>

**Power line switch**



**Remote control state** – Remote/Local

**Information line**

**Output state**  
Voltage over 50 V, Output On/Off

**Main parameter** – Value, Unit, AC/DC

**Specification** – Main value accuracy

**Auxiliary parameters**  
Voltage, Current, Phase, Frequency

**Auxiliary information** – Grounding,  
Sense, Current coil, Synchronization,  
Active channels

**Process meter**  
Voltage Current Frequency

**Soft keys** – Function depends  
on actual display mode

Pac Basic	17:11 15. 3.2011	Local
21.600 kW		U I
0.051 %		
Voltage	240.000 V	GndU On
Current	30.000 A	GndI On
Phase	0.00 °	Sense 2W
Frequency	50.000 Hz	Coil Off
Input 0.0001 V		Sync Int
		Ch. 1-2-3
Units		Mode

# M151

# CURRENT CALIBRATOR



## HIGHLIGHTS

- AC/DC current 8 mA...120 A, 15 - 1000 Hz
- Total accuracy 275 - 400 ppm in all ranges
- Floating output up to 450 V<sub>pk</sub>, compliance voltage 8 V<sub>pk</sub>
- Calibration of clamp meters up to 3000 A
- Real and simulated transconductance amplifier
- GPIB and RS-232 come as standard

## DESCRIPTION

Model M151 is a stable high current calibrator up to 120 A. Basic accuracy is 275 ppm. Instrument can be controlled via RS232 or GPIB interface. Calibrator can work in a simulated amplifier mode to increase current ranges of any multifunction calibrator. It is suitable for power meter's calibration because M151 can be synchronized with the input signal not only in amplitude but also in frequency and phase. Current terminals are isolated up to 450 V<sub>pk</sub> against case (protective earth). M151 is a sophisticated instrument with its own recalibration procedure. The procedure enables to adjust any deviation directly from the front panel. Calibrator is designed for checking parameters of amp meters. With current coil it can be used for calibration of clamp meters.

## SPECIFICATION

Range	1-year accuracy [% of value + % of range]			Compliance voltage		
	DC	40 – 70 Hz	15 – 40 Hz 70 – 1000 Hz	DC	15 – 400 Hz	400 – 1000 Hz
0.008000 – 0.300000 A	0.0175 + 0.01	0.0175 + 0.01	0.025 + 0.02	8 V	5.5 V	3.5 V
0.30001 – 1.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.025 + 0.02	8 V	5.5 V	3.5 V
1.00001 – 2.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.025 + 0.02	8 V	5.5 V	3.5 V
2.00001 – 5.00000 A	0.0175 + 0.01	0.0175 + 0.01	0.025 + 0.02	5 V	3.5 V	3.5 V
5.0001 – 10.0000 A	0.021 + 0.015	0.021 + 0.015	0.04 + 0.02	5 V	3.5 V	3.5 V
10.0001 – 30.0000 A	0.025 + 0.015	0.025 + 0.015	0.05 + 0.02	5 V	3.5 V	3.5 V
30.0001 – 60.0000 A	0.025 + 0.015	0.025 + 0.015	0.05 + 0.02	5 V	3.5 V	3.5 V
60.0001 – 120.000 A	0.025 + 0.015	0.025 + 0.015	0.05 + 0.02	5 V	3.5 V	3.5 V

## Built in process multimeter

Function	Range	% of value + % of range
AC voltage < 1 kHz	0 – 20 V	0.02 % + 0.02 %
AC voltage > 1 kHz	0 – 20 V	0.05 % + 0.05 %
DC voltage	±20 V	0.01 % + 0.01 %
AC current < 1 kHz	0 – 200 mA	0.02 % + 0.02 %

Function	Range	% of value + % of range
AC current > 1 kHz	0 – 200 mA	0.05 % + 0.05 %
DC Current	±200 mA	0.01 % + 0.01 %
Frequency	1 Hz – 10 kHz	0.005 % + 0.00 %

## GENERAL DATA

Warm-up time	15 min
Output terminals isolation	up to 450 V <sub>pk</sub> against GND (protective earth)
Distortion of output signal	< 0.1 %
Frequency accuracy	0.005 %
Frequency resolution	0.001, 0.01 Hz above 500 Hz
Frequency synchronization	internal, external, power supply
Simulated amplifier gain	0.5 ... 10 A/V (transconductance amplifier) 50 ... 1000 A/A (current amplifier)
Remote control	RS232, IEEE488
Power supply	115/230 VAC, 50/60 Hz
Reference temperatures	+20 °C ... +26 °C
Working temperatures	+5 °C ... +40 °C
Storage temperatures	-10 °C ... +55 °C
Dimensions	W 538 mm, H 283 mm, D 540 mm
Weight	42 kg

## Option 151-25 Current Coil

Actively cooled 25-turn current coil for calibration of clamp ammeters up to 3000 A.



### AC current source

Source AC		14:35 21. 9.2012		Local	
102.000 A		0.853 %		Gnd Off Coil Off Sync Int	
Frequency 50.000 Hz					
Input A meter					
Amplitude 99.990 mA					
Frequency 50.000 Hz					
AC/DC	Freq				Setup

### Simulated transconductance amplifier

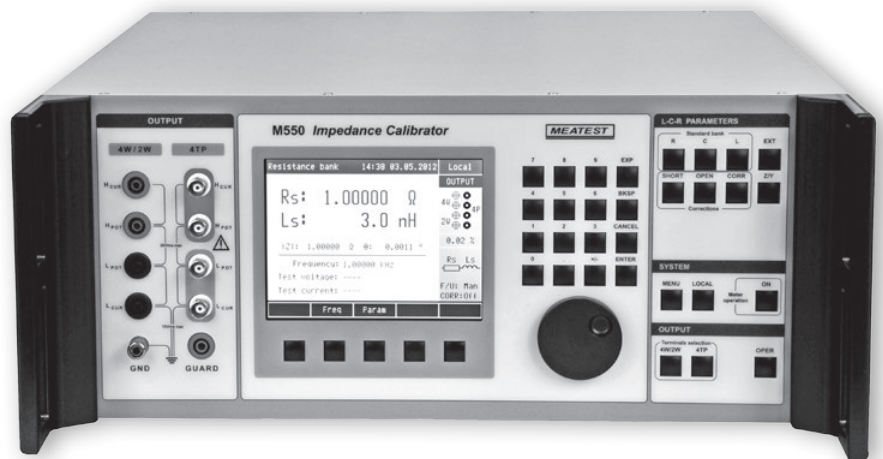
Amplifier AC		14:43 21. 9.2012		Local	
117.000 A		0.853 %		Gnd Off Coil Off Sync Int	
Frequency 1000.00 Hz					
Gain 10.00 A/V					
Step 1.0 A					
Input U meter					
Amplitude 11.7069 U					
Frequency 1000.00 Hz					
AC/DC	Freq	Gain	Step		Setup

### Recalibration

Current AC		Setup	
Range 300mAc low (30mA)			
Range 300mAc high (300mA)			
Range 1Ac low (0.3A)			
Range 1Ac high (1A)			
Range 2Ac low (1A)			
Range 2Ac high (2A)			
Range 5Ac low (2A)			
Range 5Ac high (5A)			
Range 10Ac low (5A)			
Range 10Ac high (10A)			
Range 120Ac low 1 (10A)			
Range 120Ac high 1 (30A)			
Range 120Ac low 2 (10A)			
Select			Exit

# M550

# IMPEDANCE CALIBRATOR



## HIGHLIGHTS

- Calibration of LCR meters up to 1 MHz
- Resistance range 100 mΩ to 100 MΩ
- Capacitance range 10 pF to 100 μF
- Simulated inductance standards 10 μH to 10 H
- Best calibration uncertainty 0.02 % at 1 kHz
- GPIB and RS-232 come as standard
- Four pair coaxial terminal connection, four terminal connection, two terminal connection
- OPEN and SHORT reference functions

## DESCRIPTION

Idea behind M550 Impedance Calibrator is to replace countless single value RCL standards with one calibrator that can switch between the standards like a CD changer in your car. The calibrator contains stable and temperature independent resistance standards, partial capacitance standards and partial inductance standards, simulated by RC T-type passive network. Calibration values of both complex parameters of partial standards are displayed on large LCD screen in preselected pairs of parameters as well as voltage, current and frequency readouts from built-in test signal meter. OPEN and SHORT reference positions are available as well.

The philosophy of M550 is based on remote control and automated calibration. For this reason, the calibrator is equipped with RS-232 and GPIB interfaces and of course, supported in CALIBER/WinQbase calibration software. Easy recalibration systems offers either full recalibration in all spot frequency points or simplified offset calibration.



## SPECIFICATION

Modes	4TP four pair terminal, 4 W four terminal 2 W two terminal
Output terminals	4x BNC connectors for coaxial output (4TP) 4x banana terminal for non-coaxial output (2 W/4 W)
Frequency range	20 Hz to 1 MHz
Reference correction positions	SHORT, OPEN

## Resistance

Range	0.1 $\Omega$ to 100 M $\Omega$ (fix decimal values)
Deviation to nominal value	0.10 % to 10 % depending on value and mode
Calibration uncertainty	0.02 % to 1 % at 1 kHz depending on value and mode
Temperature coefficient	2 to 25 ppm/ $^{\circ}$ C

## Capacitance

Range	10 pF to 100 $\mu$ F (fix decimal values)
Deviation to nominal value	< 5 %
Calibration uncertainty	0.05 % to 5 % at 1 kHz depending on value and mode
Temperature coefficient	30 to 100 ppm/ $^{\circ}$ C

## Inductance (simulated in 4TP mode)

Range	10 $\mu$ H to 10 H (fix decimal values)
Deviation to nominal value	< 15 %
Calibration uncertainty	0.1 % to 4 % at 1 kHz depending on value and mode
Temperature coefficient	50 ppm/ $^{\circ}$ C max.

## Test level meter

Frequency range	20 Hz to 100 kHz
Voltage range	200 mV to 10 V <sub>rms</sub>
Test voltage accuracy	2 to 5 %

## GENERAL DATA

Interface	RS232, GPIB
Operating temperature	15 ... 30 $^{\circ}$ C
Storage temperature	-10 ... +40 $^{\circ}$ C
Dimension	W 450 mm, H 150 mm, D 430 mm
Net weight	12 kg
Power line	115/230 VAC, 50/60 Hz
Consumption	45 VA

## APPLICATION

### LCR meter calibration



# LF IMPEDANCE STANDARDS



## HIGHLIGHTS

- Four package types for various applications
- Custom nominal values and terminals upon request
- Low time constant and temperature coefficient

## DESCRIPTION

MTE series resistance and capacitance standards are designed for calibration of ohmmeters, LCR meters and insulation testers. Alternatively, MTE standards can be used as transfer standards, keeping traceability between primary and secondary laboratories.

MTE standards come in four terminal configurations to fit every application. OPEN and SHORT standards for zero calibration of LCR meters as well as custom nominals and terminal configurations are available upon request.

### Terminal configurations

Configuration	Application	Terminals
HV	megaohmmeters, insulation testers	3x banana socket with extra insulation (as on cover photo 2)
A	ohmmeters, multimeters	4x banana socket
B	LCR bridges - wired connection	4x female BNC (as on cover photo 1)
C	LCR bridges - direct connection	4x male BNC

## Resistance

Construction	up to 1 M: Foil resistor above 1 M: Ceramic resistor
Frequency range	DC – 20 kHz
Available packages	up to 1 M: A, B and C above 1 M: HV; DC applications only

Nominal value	Max. deviation	Uncertainty DC, 1-year	Temperature coefficient	Rating *
100 mΩ	0.1 %	0.05 %	10 ppm/K	3 W
1 Ω	0.05 %	0.01 %	1 ppm/K	3 W
10 Ω	0.01 %	0.005 %	1 ppm/K	300 mW
100 Ω	0.01 %	0.005 %	1 ppm/K	300 mW
1 kΩ	0.01 %	0.005 %	1 ppm/K	300 mW
10 kΩ	0.01 %	0.005 %	1 ppm/K	50 V
100 kΩ	0.01 %	0.005 %	1 ppm/K	150 V
1 MΩ	0.01 %	0.005 %	1 ppm/K	500 V
10 MΩ	0.05 %	0.01 %	100 ppm/K	2.5 kV
100 MΩ	0.5 %	0.1 %	100 ppm/K	2.5 kV
1 GΩ	1 %	0.3 %	100 ppm/K	5 kV
10 GΩ	3 %	0.5 %	100 ppm/K	5 kV

\* Maximum dissipation power at 23 °C or maximum voltage.

## Capacitance

Construction	up to 100 nF: Multi-layer mica capacitor above 100 nF: PP film capacitor
Maximum voltage	30 V <sub>rms</sub>
Available packages	B and C

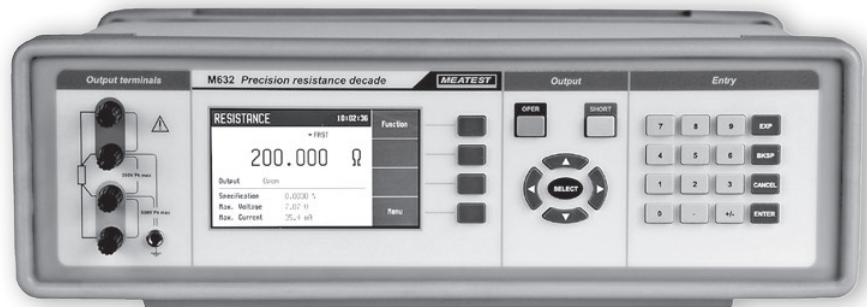
Nominal value	Max. deviation	Frequency range	Uncertainty at 1 kHz, 1-year	Temperature coefficient	Dissipation factor
10 pF	2 %	20 Hz – 20 kHz	0.1 %	30 ppm/K	< 0.001
100 pF	0.5 %	20 Hz – 20 kHz	0.05 %	30 ppm/K	< 0.001
1 nF	0.1 %	20 Hz – 20 kHz	0.02 %	30 ppm/K	< 0.0005
10 nF	0.1 %	20 Hz – 10 kHz	0.02 %	30 ppm/K	< 0.0005
100 nF	0.1 %	20 Hz – 10 kHz	0.02 %	30 ppm/K	< 0.0005
1 μF	0.5 %	20 Hz – 10 kHz	0.02 %	30 ppm/K	< 0.005
10 μF	0.5 %	20 Hz – 10 kHz	0.1 %	30 ppm/K	< 0.005
100 μF	0.5 %	20 Hz – 10 kHz	0.1 %	30 ppm/K	< 0.005

## GENERAL DATA

Reference temperature	+21 °C – +25 °C
Operating temperature	0 °C – +50 °C
Dimensions (W x H x D)	125 x 60 x 105 mm

**M 63x**  
**M 64x**

# REAL-RESISTANCE DECADE BOXES



## HIGHLIGHTS

- Real resistors switched by relays
- Ranges as wide as 14 decades, resolution from 1  $\mu\Omega$
- No parasitic resistances
- 20 ppm accuracy/5 W load capacity
- Six different languages, custom units

## DESCRIPTION

The M6xx series programmable resistance decades and RTD simulators offer an exceptional accuracy, resolution and stability of real resistance simulation. Both M63x decades contain stable foil resistors with low temperature coefficient switched by low thermal voltage relays. Built-in software has also a function of RTD temperature sensor simulation with parameters according to IEC (DIN) or US standards and temperature setting in degree of Celsius or Fahrenheit. Instrument can be controlled via RS232, USB, LAN or GPIB interface.

M6xx series programmable decades are sophisticated instruments with their own recalibration procedures. The procedure lets the user to correct any deviation in resistance without any mechanical adjusting.

Model	Usage	Range	Resolution	Max. load	Accuracy
M632	Resistance Decade	1 $\Omega$ - 1.2 M $\Omega$	10 $\mu\Omega$	0.25 W	0.003 %
M642	Resistance Decade	0.1 $\Omega$ - 22 M $\Omega$	1 $\mu\Omega$	5 W	0.02 %
M631	RTD Simulator	16 $\Omega$ - 400 k $\Omega$	0.001 $^{\circ}\text{C}$	0.25 W	0.01 $^{\circ}\text{C}$
M641	RTD Simulator	10 $\Omega$ - 300 k $\Omega$	0.01 $^{\circ}\text{C}$	5 W	0.1 $^{\circ}\text{C}$

## SPECIFICATION

### M632 Resistance accuracy

Range/Resolution	Accuracy
1.000 00 Ω - 2.000 00 Ω	0.002 % + 2 mΩ
2.000 1 Ω - 20.000 0 Ω	0.002 % + 2 mΩ
20.001 Ω - 200.000 Ω	0.002 % + 2 mΩ
200.01 Ω - 2000.00 Ω	0.003 %
2.000 1 kΩ - 20.000 0 kΩ	0.003 %
20.001 kΩ - 200.000 kΩ	0.003 %
200.01 kΩ - 1200.00 kΩ	0.005 %

### M631 Resistance accuracy

Range/Resolution	Accuracy
16.000 0 Ω - 20.000 0 Ω	0.002 % + 2 mΩ
20.001 Ω - 200.000 Ω	0.002 % + 2 mΩ
200.01 Ω - 1000.00 Ω	0.003 %
1000.1 Ω - 3000.0 Ω	0.005 %
3001 Ω - 10000 Ω	0.015 %
10.01 kΩ - 30.00 kΩ	0.03 %
30.1 kΩ - 100.0 kΩ	0.1 %
101 kΩ - 400 kΩ	0.4 %

### M642 Resistance accuracy

Range/Resolution	Accuracy
100.000 mΩ - 200.000 mΩ	0.05 % + 15 mΩ
200.01 mΩ - 2.00000 Ω	0.05 % + 15 mΩ
2.0001 Ω - 20.0000 Ω	0.05 % + 15 mΩ
20.001 Ω - 200.000 Ω	0.05 % + 15 mΩ
200.01 Ω - 2000.00 Ω	0.02 %
2.0001 kΩ - 20.0000 kΩ	0.02 %
20.001 kΩ - 200.000 kΩ	0.02 %
0.20001 MΩ - 2.00000 MΩ	0.02 %
2.0001 MΩ - 20.0000 MΩ	0.05 %

### M641 Resistance accuracy

Range/Resolution	Accuracy
10.000 0 Ω - 20.000 0 Ω	0.05 % + 15 mΩ
20.001 Ω - 200.000 Ω	0.05 % + 15 mΩ
200.01 Ω - 1000.00 Ω	0.02 %
1.0001 kΩ - 3.0000 kΩ	0.02 %
3.001 kΩ - 10.000 kΩ	0.02 %
10.01 kΩ - 30.00 kΩ	0.05 %
30.1 kΩ - 100.0 kΩ	0.1 %
101 kΩ - 300 kΩ	0.5 %

### M63x Pt simulation accuracy

Temperature	M632		M631	
	Pt10 ... Pt99	Pt100 ... Pt20000	Pt100 ... Pt500	Pt501... Pt1000
-200.000 ... 0.000 °C	0.05 °C	0.01 °C	0.01 °C	0.01 °C
0.001 ... 200.000 °C	0.06 °C	0.015 °C	0.015 °C	0.02 °C
200.001 ... 500.000 °C	0.08 °C	0.03 °C	0.03 °C	0.04 °C
500.001 ... 850.000 °C	0.1 °C	0.04 °C	0.04 °C	0.1 °C

### M63x Ni simulation accuracy

Temperature	M632		M631	
	Ni10 ... Ni99	Ni100 ... Ni20000	Ni100 ... Ni500	Ni501... Ni1000
-60.000 ... 0.000 °C	0.05 °C	0.01 °C	0.01 °C	0.01 °C
0.001 ... 300.000 °C	0.05 °C	0.01 °C	0.01 °C	0.02 °C

### M64x Ni simulation accuracy

Temperature	M642		M641
	Ni10 ... Ni99	Ni100 ... Ni20000	Ni100 ... Ni1000
-60.000 ... 300.000 °C	0.4 °C	0.1 °C	0.1 °C

### M64x Pt simulation accuracy

Temperature	M642		M641
	Pt10 ... Pt99	Pt100 ... Pt20000	Pt100 ... Pt1000
-200.00 ... 0.000 °C	0.5 °C	0.15 °C	0.15 °C
-0.001 ... 850.000 °C	1.0 °C	0.2 °C	0.2 °C

## M63x Frequency response

AC/DC difference	M632						M631				
	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ	16 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ
100 Hz	0.01 %	0.01 %	0.01 %	0.05 %	0.50 %	5.00 %	0.01 %	0.01 %	0.03 %	0.30 %	3.00 %
1 kHz	0.02 %	0.01 %	0.05 %	0.50 %	5.00 %		0.01 %	0.03 %	0.30 %	3.00 %	
10 kHz	0.20 %	0.04 %	0.50 %	5.00 %			0.04 %	0.30 %	3.00 %		

## M64x Frequency response

AC/DC difference	M642							M641				
	100 mΩ	1 Ω	10 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ	10 Ω	100 Ω	1 kΩ	10 kΩ	100 kΩ
100 Hz	0.05 %	0.02 %	0.01 %	0.01 %	0.06 %	0.60 %	6.00 %	0.01 %	0.01 %	0.04 %	0.40 %	4.00 %
1 kHz	0.20 %	0.1 %	0.02 %	0.01 %	0.60 %	6.00 %		0.01 %	0.05 %	0.40 %	4.00 %	
10 kHz	5.00 %	0.50 %	0.10 %	0.60 %	6.00 %			0.05 %	0.50 %	4.00 %		

## GENERAL DATA

Maximum voltage	200 V <sub>pk</sub>
Maximum current	500 mA
Total power dissipation	0.25 W (M63x), 5 W (M64x)
Temperature coefficient	10 % of specification per °C outside the reference temp. range
Reaction time	6 ms
Switching method	Fast/Smooth/Via short/Via open
Terminals	gold plated terminals 4 mm
Remote control	RS232 interface (optionally USB, LAN, IEEE488)
Power supply	115/230 VAC, 50/60 Hz
Reference temperatures	+20 °C ... +26 °C
Working temperatures	+5 °C ... +40 °C
Storage temperatures	-10 °C ... +50 °C
Dimensions	W 390 mm, H 128 mm, D 310 mm
Weight	5.2 kg (M63x), 4.0 kg (M64x)

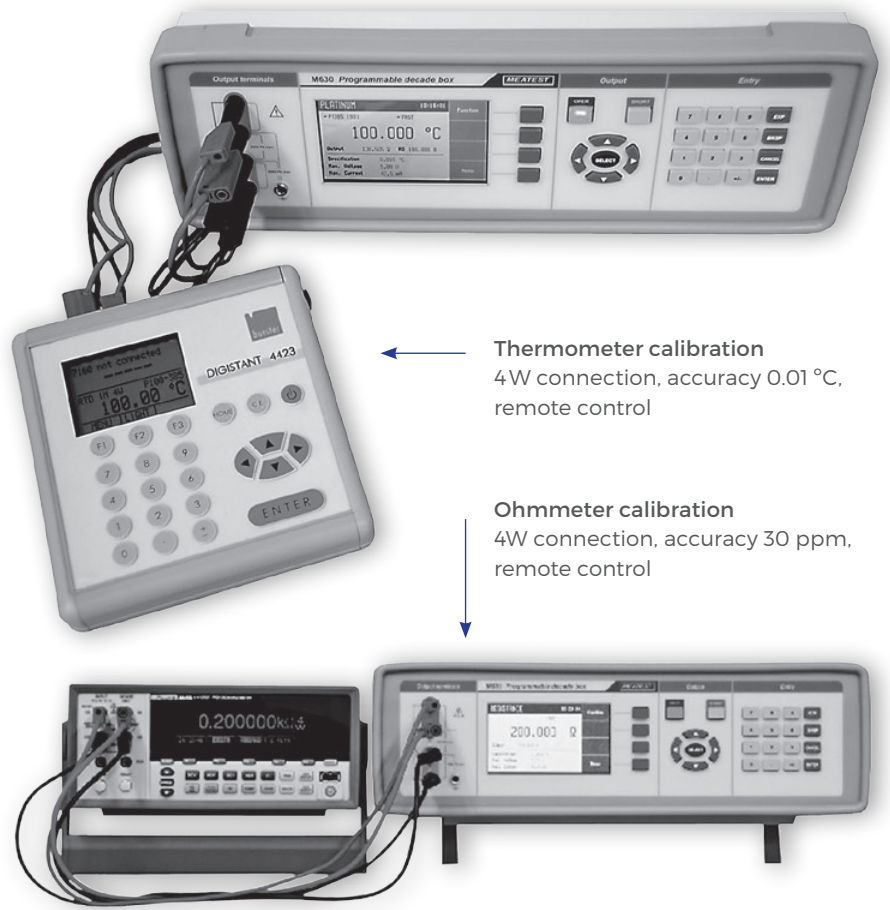
## Ordering codes

Bus	M6xx-V1xxx – RS232 M6xx-V2xxx – RS232, USB, LAN, GPIB
Housing	M6xx-Vxx0x – table version M6xx-Vxx1x – module 19", 3HE
Other	M642-Vx2xx – 22 MΩ extension for M642

## 19" rack module



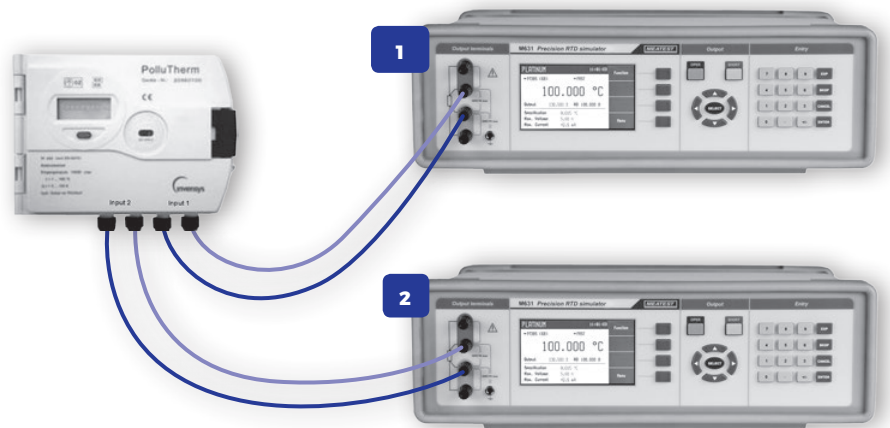
## Calibration of resistance meters and evaluation units



Thermometer calibration  
4W connection, accuracy 0.01 °C,  
remote control

Ohmmeter calibration  
4W connection, accuracy 30 ppm,  
remote control

## Calibration of heat meters using two M631 RTD simulators



RTD simulators here simulate the temperatures of input and output water of the system.

### Resistance

RESISTANCE	14:33:45	Function
FAST		
100.000 Ω		
Output 100.000 Ω		
Specification 0.0040 %		Menu
Max. Voltage 5.00 V		
Max. Current 50.0 mA		

### Temperature

PLATINUM	10:18:59	Function
PT385 (90)	FAST	
100.000 °C		
Output 138.505 Ω RO 100.000 Ω		
Specification 0.015 °C		Menu
Max. Voltage 5.88 V		
Max. Current 42.5 mA		

### Recalibration

CALIBRATION		Previous
Resistance	1 / 37	
Nominal resistance	1.95 Ω	Next
Requested accuracy	1 mΩ	
Last calibrated	07/02/2012	Save
1.9443810 Ω		Close

# M194

# HIGH RESISTANCE DECADE BOX



## HIGHLIGHTS

- Resistance range 10.00 kΩ - 100.0 GΩ
- Resistance accuracy 0.1 to 1 %
- Operating voltage to 6 kVDC
- Short current mA - meter
- Hot switching
- Timing function
- RS232 (optionally USB, IEEE488, Ethernet)

## DESCRIPTION

M194 High Resistance Decade is based on M6xx Series Real-Resistance Programmable Decades, providing cutting-edge performance, user-friendly calibration of resistance ranges as well as test meter ranges, timer and short current testing of UUTs. Main feature of M194 is adjustable high resistance decade in continuous range from 10 kΩ to 100 GΩ with 4 digit resolution. Designed for maximum operating voltages of up to 6 kVDC this decade is great for calibration of meggers, megaohmmeters and insulation testers. Accuracy from 0.1%.

Full remote control and automated calibration support is a standard for all Meatest instruments. On top of that, M194 comes with 4 interfaces (RS232, USB, LAN and GPIB) to match your system more easily.



## SPECIFICATION

Resistance range	Accuracy*1	Maximum DC test voltage*2	Test voltage accuracy
10.00 kΩ – 99.99 kΩ	0.1 %	65 V	0.5 % + 2 V
100.0 kΩ – 999.9 kΩ	0.1 %	315 V	0.5 % + 2 V
1.00 MΩ – 1.99 MΩ	0.1 %	1 250 V	0.5 % + 2 V
2.00 MΩ – 9.999 MΩ	0.1 %	2 500 V	0.5 % + 2 V
10.00 MΩ – 99.99 MΩ	0.1 %	6 000 V	0.5 % + 2 V
100.0 MΩ – 999.9 MΩ	0.2 %	6 000 V	0.5 % + 2 V
1.000 GΩ – 9.999 GΩ	0.5 %	6 000 V	0.5 % + 2 V
10.00 GΩ – 100.0 GΩ*3	1.0 %	6 000 V	0.5 % + 2 V

\*1 Accuracy is valid within reference temperature range  $23 \pm 2$  °C with RH < 50%.

\*2 Maximum measured DC test voltage is 5% over the specified range.

\*3 1 minute settling time for full accuracy.

### SHORT function (short current testing)

Current range:	0.00 – 10.00 mA DC
Input resistance	100 Ω nom.
Current meter accuracy:	0.2 % + 25 μA

### GENERAL DATA

Reference temperature	21...25 °C
Operating temperature	5...40 °C
Storage temperatures	-10 °C...50 °C
Temperature coefficient	10 % of specification per °C outside the reference temp. range
Reference humidity:	< 70 % RH, < 50 % RH above 10 GΩ
Humidity coefficient:	2 % of specification per % RH, 5 % above 10 GΩ
Terminals:	Gold plated terminals 4 mm
Remote control:	RS232 interface (optionally USB, LAN, IEEE488)
Dimensions:	W 390 mm, H 128 mm, D 310 mm
Weight	4.5 kg
Power supply:	115/230 V, 50/60 Hz

### Ordering codes

Bus	M194-V1xxx – RS232 M194-V2xxx – RS232, USB, LAN, GPIB
Housing	M194-Vxx0x – table version M194-Vxx1x – module 19", 3HE

#### Resistance

RESISTANCE		16:41:55	Function
▼ GND OFF			
10.00 GΩ			
Accuracy	0.50 %		
Max Voltage	6.00 kV		
Test Voltage	+1.974 kV		Menu

#### Time sequence

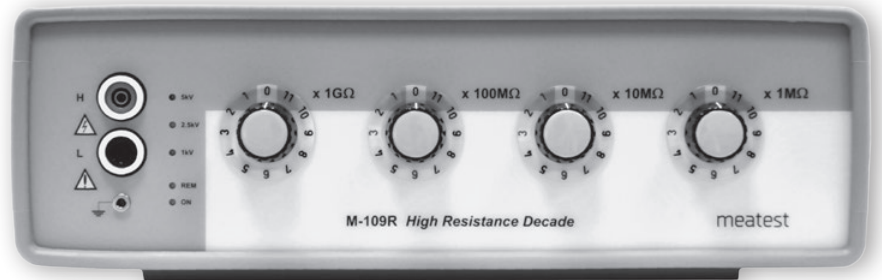
TIMINGS		Save
Preset name	TIMING A	
Timing table		Add
1) 5.0 s	1.000 MΩ	
2) 10.0 s	10.00 GΩ	Edit
3) 4.0 s	1.500 GΩ	Delete

#### Recalibration

CALIBRATION		Previous
Resistance	35 / 60	
Nominal resistance	35.8 kΩ	Next
Requested accuracy	5 Ω	
Maximum voltage	60 V	Save
Last calibrated	08-12-2015	
35.7956 kΩ		Close

# M109R

# HIGH RESISTANCE DECADE BOX



## HIGHLIGHTS

- Calibration of megaohmmeters
- 12 GΩ range, resolution 1 MΩ
- Maximum test voltage 5 kV
- Floating Lo terminal
- Battery backup
- RS-232 as standard

## DESCRIPTION

High resistance decade box is designed for calibrating of insulation meters and megaohmmeters. It is suitable for calibration laboratories and service centres, where can be used also for testing or setting of high resistance meters. High voltage relays with extremely high insulation resistance are used for switching of resistance components.

M109R is equipped with indication of maximum voltage limit. Instrument is supplied from accumulator or power line adapter. Control is possible manually or remotely via serial interface RS-232.

## SPECIFICATION

Decade	Nominal value accuracy	Voltage coefficient	Temperature coefficient	Maximum voltage
1 M $\Omega$ - 11 M $\Omega$	0.1 %	1 ppm/V	<100 ppm/°C	1000 VDC
10 M $\Omega$ - 110 M $\Omega$	0.2 %	1 ppm/V	<100 ppm/°C	2500 VDC
100 M $\Omega$ - 1.1 G $\Omega$	0.5 %	2 ppm/V	<100 ppm/°C	5000 VDC
1 G $\Omega$ - 12 G $\Omega$	1.0 %	2 ppm/V	<100 ppm/°C	5000 VDC

## GENERAL DATA

Range of resistance	1 M $\Omega$ - 12.221 G $\Omega$
Maximum voltage	5kV DC between terminals H-L, H-GND, L-GND
Connection:	2W, 3W (GUARD)
Type of terminals:	high voltage terminals with ERTALYTE isolation
Remote control	RS-232
Supply	internal accumulator, power line supply adapter 15 V (100 - 240 V/50 - 60 Hz)
Temperature range	23 °C $\pm$ 5 °C
Relative humidity	10 - 50 %
Dimensions	364 mm x 111 mm x 316 mm
Weight	4 kg

## APPLICATION



Calibration and verification of resistance meters with test voltage up to 5 kVDC - insulation testers, safety testers, megaohmmeters,...

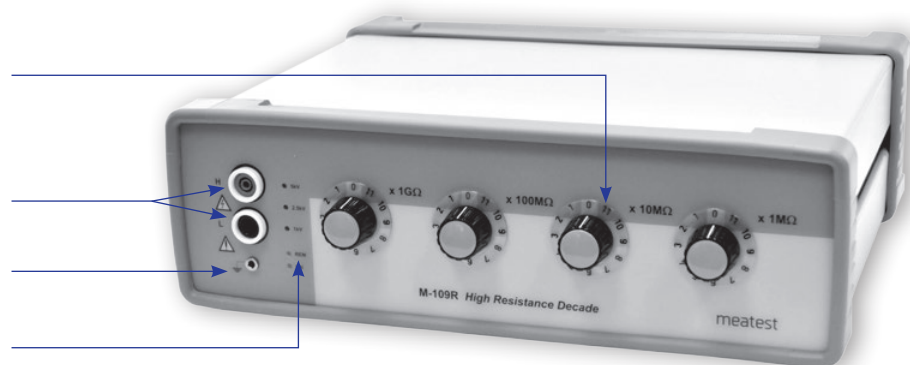
## FRONT PANEL

Mechanical rotary knobs

Floating terminals, protected up to 5 kV

GND terminal (protection earth)

LED indication (max. allowed voltage, remote control, on/off)



# M525

# CAPACITANCE DECADE BOX



## HIGHLIGHTS

- Designed for capacitance meter calibration
- Capacitance range 100 pF - 100  $\mu$ F based on real-resistance decade technology
- Capacitance accuracy 0.25 % open correction
- Operating voltage 50 V
- GPIB, USB, RS-232 and ethernet interfaces

## DESCRIPTION

Model M525 is a precise capacitance decade box with range from 100 pF to 100  $\mu$ F. Basic accuracy is 0.25 %. Best resolution on the lowest range is 1 pF. Capacitors are switched using special relays designed for high currents. Comfortable user interface offers direct setting of capacity value, OPEN correction, grounding L terminal, user conversion curves setting and others. Decade can be remotely controlled by a computer using standard RS232 interface. LAN, USB and GPIB interfaces are optional.

M525 is equipped with an internal calibration menu that allows correcting any deviation of capacity value without opening the instrument. Decade is designed for checking multimeters and simple RLC meter. It is suitable also for repair, adjustment and calibration of measuring instruments.

## SPECIFICATION

Range	Accuracy	Loss coefficient	Accuracy	Loss coefficient	Temperature coefficient
	1 kHz	1 kHz	40 Hz - 1 kHz	10 Hz - 1 kHz	ppm/°C
0.100 nF - 10.000 nF	0.25 % ± 3pF	< 0.05	0.5 % ± 3pF	< 0.05	< 270
10.001 nF - 100.00 nF	0.25 %	< 0.005	0.5 %	< 0.005	< 270
100.01 nF - 1.0000 µF	0.25 %	< 0.005	0.5 %	< 0.005	< 270
1.0001 µF - 10.000 µF	0.25 %	< 0.05	0.5 %	< 0.05	< 270
10.001 µF - 100.00 µF	0.25 %*1	< 0.2*2	0.5 %	< 0.2*2	< 270

Note:

\*1 For frequency 100 Hz

\*2 For frequency range 40 - 100 Hz

Capacity value is defined in the output terminals level.

Correction Open OFF - capacity value is defined relative to the OPEN value.

Correction Open ON - capacity value is defined absolutely.

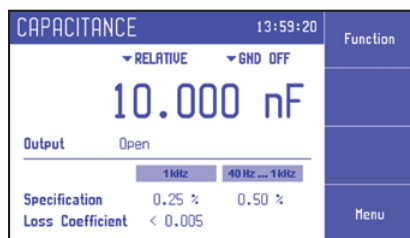
## GENERAL DATA

Maximal voltage	50 V <sub>pk</sub>
Temperature coefficient	< 270 ppm/ °C
Reaction time	< 200 ms
Terminals	gold plated terminals 4 mm
Remote control	RS232 interface (optionally USB, LAN, IEEE488)
Power supply	85 - 260 VAC, 45 - 65 Hz
Reference temperatures	+21 °C ... +25 °C
Working temperatures	+5 °C ... +40 °C
Storage temperatures	-10 °C ... +50 °C
Dimensions	W 390 mm, H 128 mm, D 310 mm
Weight	4 kg

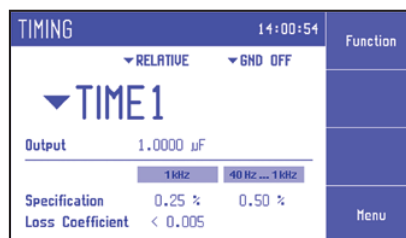
## Ordering codes

Bus	M525-V1xxx - RS232 M525-V2xxx - RS232, USB, LAN, GPIB
Housing	M525-Vxx0x - table version M525-Vxx1x - module 19", 3 HE

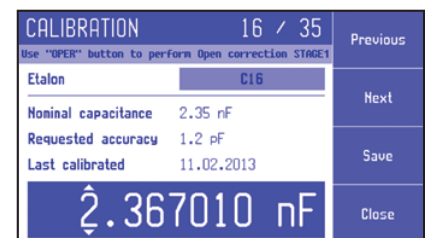
### Capacitance



### Time sequence

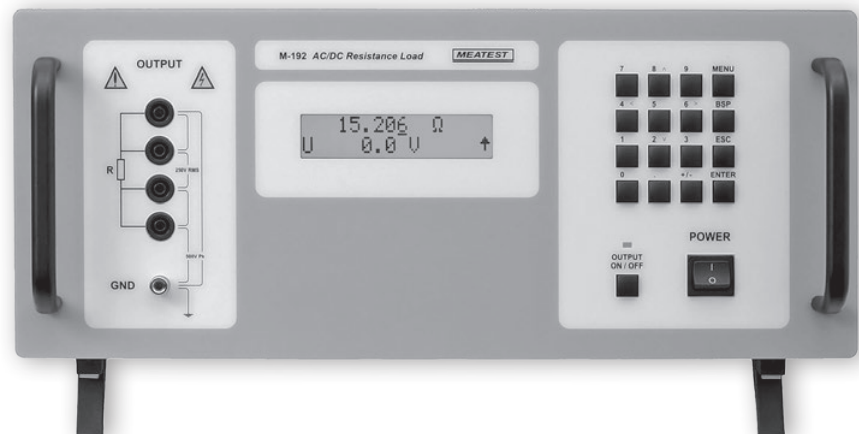


### Calibration



# M192

# REAL-RESISTANCE DC/AC LOADS



## HIGHLIGHTS

- Resistance range 15 Ω - 300 kΩ
- Maximum load 3 kW, 250 V<sub>rms</sub>
- Temperature coefficient < 10 ppm/K
- Real CR mode, simulated CP and CC modes
- RS232 and GPIB interface

## DESCRIPTION

M192 is accurate high power resistance decade for testing of power supplies and batteries up to 3000 W and 250 V<sub>rms</sub>. Being a resistance decade rather than an electronic load, resistance function uses real resistance so it can be used with AC power sources as well. See datasheet for typical frequency responses. On top of that, M192A version has built-in test signal meter using which constant power and constant current functions can be simulated. Other advantages of the M192A are extended range up to 300 kΩ and continuous resistance range rather than fixed values.

All decades' functions can be remotely controlled via RS232 or GPIB interface. This way you can introduce calibration/test stage directly into production line of any resistance based sensor and reduce time required for final quality tests dramatically.

## SPECIFICATION

### Resistance

Resistance range summary	M192: 15 Ω – 4.7 kΩ, 64 discrete values M192A: 15 Ω – 300 kΩ, continuous range
Maximum dissipation power	3000 W
Maximum voltage	250 V <sub>rms</sub>
Reaction time in CP and CC modes (M192A only)	30 – 100 ms

### Ranges, resolution, 1 year accuracy [% of value]

Range	DC, 0 – 120 Hz	120 Hz – 1 kHz	1 – 10 kHz
15.000 – 99.999 Ω	0.1 + 30 mΩ	0.2 + 30 mΩ	0.2 + 30 mΩ
100.00 – 299.999 Ω	0.1	0.1	0.2
300.0 – 999.9 Ω	0.1	0.1	0.2
1000.0 – 2999.9 Ω	0.1	0.1	0.2
3000 – 9999 Ω	0.1	0.1	2.0
10.00 – 29.99 kΩ	0.1	0.1	2.0
30.1 – 100.0 kΩ	0.2	0.2	N/A
101 – 300 kΩ	0.5	2.0	N/A

### Test voltage measurement (M192A only)

DC/AC voltage range	1.0 – 299.9 V
Frequency range	DC – 10 kHz
Measurement accuracy	DC: 0.1 % of value + 0.2 V AC: 0.2 % of value + 0.2 V

### Typical frequency response of M192A

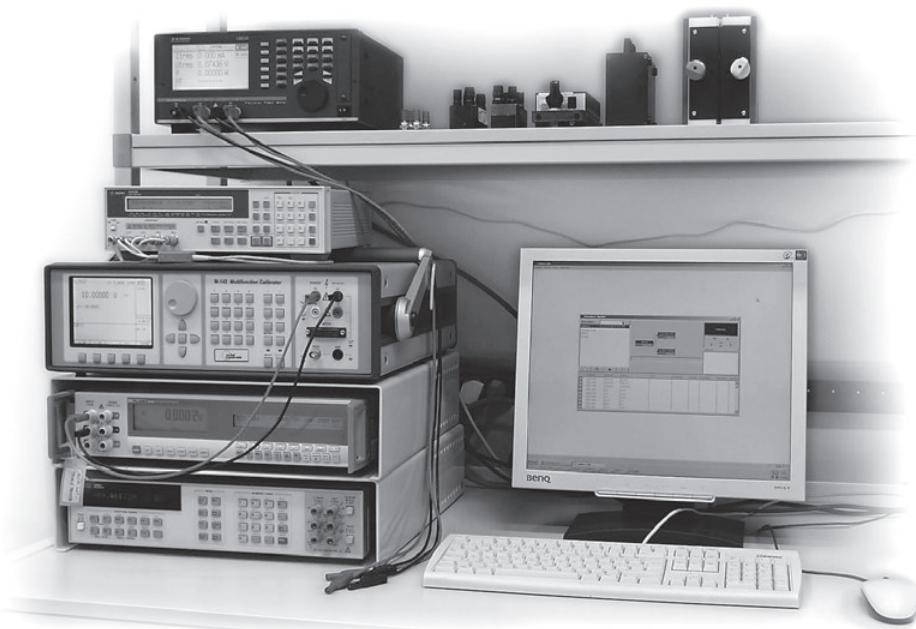
DC	100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
15 Ω	15.00 Ω	15.00 Ω	15.00 Ω	15.03 Ω	15.15 Ω
100 Ω	100.00 Ω	100.01 Ω	100.02 Ω	99.97 Ω	91.5 Ω
330 Ω	330.00 Ω	330.02 Ω	330.03 Ω	329.73 Ω	301.30 Ω
1000 Ω	1000.0 Ω	1000.0 Ω	999.9 kΩ	997.0 kΩ	854.0 kΩ
10 kΩ	10.00 kΩ	10.00 kΩ	9.97 kΩ	9.21 kΩ	3.15 kΩ
100 kΩ	100.0 kΩ	99.8 kΩ	91.7 kΩ	27.0 kΩ	N/A

## GENERAL DATA

Reference temperature	+18 °C – +28 °C
Operating temperature	+5 °C – +45 °C
Storage temperature	-10 °C – +60 °C
Temperature coefficient	< 10 – 25 ppm/K
Terminal – housing isolation	> 2 G3 at 1000 V <sub>dc</sub>
Power supply	115/230V – 50/60 Hz
Dimensions (W x H x D)	460 x 190 x 440 mm
Weight	15 kg
Interfaces	RS232, IEEE488 (option)

# CALIBER

# AUTOMATED CALIBRATION SOFTWARE



## HIGHLIGHTS

- Saves times, costs and prevents human errors
- Instrument control via RS232, GPIB, USB, RS485 or VISA ethernet
- Camera readout module
- Fully flexible, works with all kinds of instruments, any brand
- Uncertainty calculation according to metrology standards (EA 4/02)
- Easy creation of new procedures using Procedure wizard
- Up to 20 instruments per calibration point
- Runs on all Windows versions from 2000 to Windows 10
- EN, DE, RU, HU, SK and CZ language

## DESCRIPTION

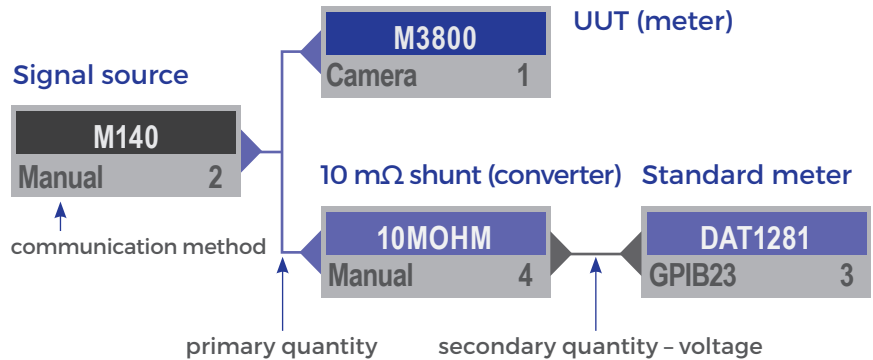
Caliber software is designed for automated calibration and reporting. It does the same thing as you would with Excel spreadsheet and manual calibration but much faster, cheaper, doing no errors and not bothering you even a minute.

Caliber controls calibration instruments using RS232, GPIB or VISA interface where possible. Instruments with no such interfaces can be read by optical readout module CamOCR or operated manually altogether.



## Instruments scheme

Program uses special symbols for displaying different types of instruments in the "Instruments scheme" diagram. Up to 20 instruments can be used in one calibration point. Diagram below shows calibration of current function with standard meter measuring voltage at current shunt.



## Caliber output

Registration number page 3

**Calibration certificate No1**

**Measured values:**

Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty
VDC-2W	200 mV	20.0 mV	20.0 mV	1.0 uV	5	200 uV	62 uV ok
VDC-2W	200 mV	180.0 mV	179.8 mV	-200 uV	-201	999 uV	66 uV ok
VDC 2W	200 mV	100.0 mV	100.2 mV	200 uV	201	1001 uV	66 uV ok
VDC-2W	2 V	0.200 V	0.200 V	0.30 mV	151	2.00 mV	0.58 mV ok
VDC-2W	2 V	1.800 V	1.800 V	0.10 mV	11	10.00 mV	0.58 mV ok
VDC-2W	2 V	-1.800 V	-1.800 V	0.00 mV	01	10.00 mV	0.58 mV ok
VDC-2W	20 V	2.00 V	2.00 V	2.0 mV	101	20.0 mV	5.8 mV ok
VDC-2W	20 V	10.00 V	10.30 V	300.0 mV	488	61.5 mV	5.8 mV *

**Uncertainty of measurements:** Extended uncertainty is defined by coefficient k=2.

Output of the CALIBER program represents a physically performed calibration with a calibration record – a table with measured and evaluated data (the test report).

## MAIN WINDOW

**Camera** – Optional camera module for digital display scanning

**User prompt window**  
Clear instruction for calibration staff

**Status line**

**Instruments scheme**  
Instruments used in selected calibration point and their configuration

**Procedure window**  
Functions, Ranges, Points, Active terminals connection, Exceptions

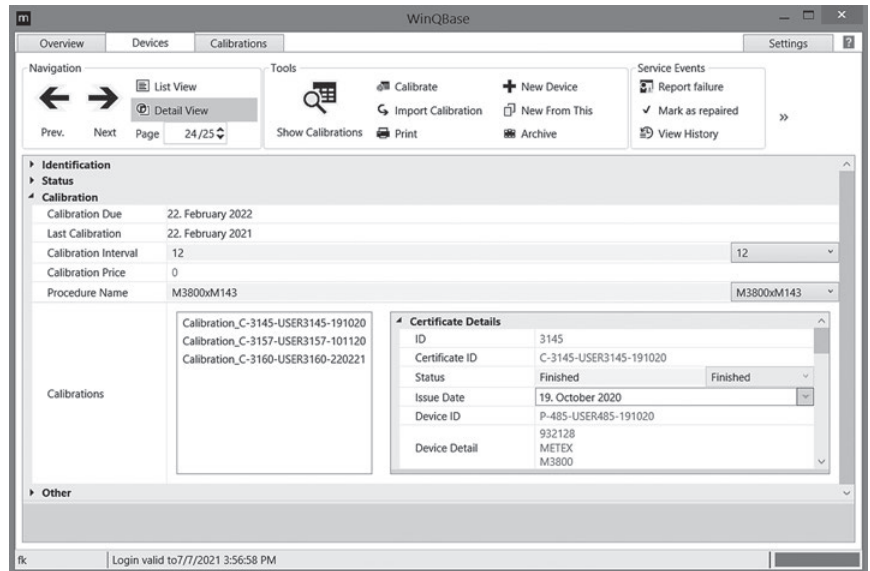
**Direct keys**  
New/Open /Save, Reload Start, Calibration, Import/Export

**Test report** – Measured and evaluated values (measured deviation, maximum allowed deviation, measurement uncertainty...)

**Readings** – Instrument readouts

Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty	Symbol
RDC-4W	1 kOhm	0.100000 kOhm	0.099996 kOhm	-0.0044 Ohm	-22	0.0200 Ohm	0.0047 Ohm	ok
RDC-4W	1 kOhm	0.900000 kOhm	0.899959 kOhm	-0.041 Ohm	-41	0.100 Ohm	0.031 Ohm	ok
RDC-4W	10 kOhm	1.000000 kOhm	0.99994 kOhm	-0.056 Ohm	-28	0.200 Ohm	0.035 Ohm	ok
RDC-4W	10 kOhm	9.000000 kOhm	8.99963 kOhm	-0.37 Ohm	-37	1.00 Ohm	0.81 Ohm	ok
RDC-4W	100 kOhm	10.000000 kOhm	9.9994 kOhm	-0.59 Ohm	-29	2.00 Ohm	0.85 Ohm	ok
RDC-4W	100 kOhm	90.000000 kOhm	89.9974 kOhm	-2.6 Ohm	-26	10.0 Ohm	3.1 Ohm	ok
RDC-4W	1 MOhm	0.100000 MOhm	0.099998 MOhm	-0.0023 kOhm	-11	0.0200 kOhm	0.0035 kOhm	ok
RDC-4W	1 MOhm	0.900000 MOhm	0.899979 MOhm	-0.021 kOhm	-21	0.100 kOhm	0.052 kOhm	ok
RDC-4W	10 MOhm	1.000000 MOhm	1.00014 MOhm	0.138 kOhm	28	0.500 kOhm	0.064 kOhm	ok

## WinQbase-Caliber



To keep things organized, you can employ database software WinQbase to work in tandem with Caliber. WinQbase is designed specifically for calibration labs to keep detailed information of both standard units and UUTs, such as instrument serial number, inventory data, owner identification, calibration dates and methods, etc.

Calibrations done by Caliber software are automatically stored in WinQbase when online or synchronized later when you're out on site without connection to the database. Database is automatically backed up, uses password protected user accounts and logs every operation within the system so you can't ever lose your calibration data.

## CamOCR (optional Camera module)



CamOcr camera module extends possibilities of MEATEST automatic calibration software Caliber. CamOcr is designed for scanning of 7 segment digital displays.

Instruments (UUT) without remote control interface can be "connected" using CamOcr to the computer. Instrument's display is scanned by digital video camera. It is very easy to do repeated measurements and calculate uncertainty type "A" for every calibration point.

### CERTIFIED BUSINESS

Our quality management system is certified to ISO 9001:2015 under UKAS certification rules. All new instruments are tested and calibrated with possibility of ISO 17025 certified calibration.



### INNOVATION FOCUS

Continuous development is taken very seriously in Meatest. That's why developers account for more than a quarter of all Meatest workforce.

### FLEXIBLE SOLUTIONS

Nothing on market to match your requirements? Or just missing critical feature in our instruments? Share with us and together we'll surely come up with solution.



### INSTRUMENTS FOR PEOPLE

Our representatives are at your service all over the world. Would you like to consult your solution with us? Get a quote? Training? Service? Calibration? Let us know.



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