

M-140 Multifunction calibrator/tester



Multifunction calibrator M-140 is calibrator - tester, determined mainly as standard of electric quantities in calibration laboratories. It can be used for calibration of electrical quantity meters from the field of voltage, current, resistance, capacity and frequency. Installed harmonic and non-harmonic shape signals as well make it possible to test parameters of the meters by a signal with various crest factor. Frequency modes enable to set frequency, amplitude and duty ratio of the output signal. They are suitable for basic calibration of oscilloscopes. The calibrator is equipped with possibility to measure temperature with TC and RTD temperature sensors. Built-in multimeter can be used independently or in simultaneous operation with source part of the calibrator together. Testing of transducers of various types, regulators and evaluating units can be performed with it without necessity to use any other measuring instrument.

M-140 multifunction calibrator is available in bench-top and in 19" rack housings.

Basic parameters

Basic function of the calibrator is generating of the calibrated **DC/AC voltage** in the range from 0 μ V to 1000 V and **DC/AC current** in the range from 0 to 20 A. Using a 50-turn coil the current range can be extended from 50 μ A to 500 A. The best accuracy of the calibrator on DC voltage ranges is 0.0035%, on AC voltage ranges 0.03%, on DC current ranges 0.013% and on AC current ranges 0.055%. Maximum frequency range is from 20 Hz to 100 kHz for harmonic output waveform. The calibrator is equipped with the function of generation the periodic **non-harmonic signals** with the defined crest factor. Thus it makes possible to test sensitivity of multimeters to distorted signals. Next function of the calibrator is simulation of resistance and capacity. With the calibrator, the **resistance** in range from 0 Ohm to 50 MOhm and **capacitance** from 1 nF to 50 μ F can be simulated with the enough precision for calibration of common used hand-held multimeters. The basic accuracy of the resistance ranges is 0.03%, of the capacitance ranges it is 0.5%. The resistance may be used both with DC and AC signals up to 1 kHz.

The frequency function of the calibrator makes it possible to generate a square wave signal with adjustable and **calibrated duty ratio, frequency** and amplitude in range from 1 mV to 10 V in the frequency band up to 10 kHz. In the mode HF the square wave signal up to 20 MHz with a very low risetime can be generated. The frequency functions are suitable for the calibrations of corresponding frequency ranges of the multimeters, and for calibration of the channel sensitivities and time bases of the oscilloscopes as well.

For calibrations of DC and one-phase AC power-meters and energy meters, the **power - energy mode** is determined. Output voltage can be set up to 240 V and output current up to 10 A with the **power factor** in range from -1 to +1 in the frequency band from 20 Hz to 400 Hz. Current capability of the voltage output is 30 mA. It allows to calibrate also analogue power-meters which has usually higher consumption. For calibrations of the thermometers and temperature regulators, the function of **simulation of temperature sensors** is determined. Calibrator is able to simulate all common used Pt and Ni resistance sensors and TC sensors of the R, S, B, J, T, E, K and N types as well. Compensation of the TC cold junction is made either by entering value from the keyboard, or automatically by measuring the ambient temperature with Pt-100 sensor. The precision of the simulated resistance and TC sensors depends on set value and type of the sensor. For resistance sensors uncertainty band is in the range from 0.04 $^{\circ}$ C to 0.5 $^{\circ}$ C, for TC sensors from 0.4 $^{\circ}$ C to 4.0 $^{\circ}$ C.

Build-in multimeter

Internal multimeter with basic capability to measure **DC current** to 20 mA, **DC voltage** to 10 V, **resistance** to 2 kOhm and **frequency** to 15 kHz is standard part of the calibrator. With accuracy of 0.01% it enables to measure output signals of various types of transducers. With external TC or resistance temperature sensor **temperature** can be scan and similarly, with **external strange gauge sensors** pressure, torsion, strength, etc. can be measured and displayed.

Calibrator - Tester

Calibrator can be used in **simultaneous mode**, i.e. selected output signal is generated and the response of the device under test is measured at the same time by internal multimeter. **Programmable capability** of the calibrator enables setting of 10 steps defined by output signal function and output value on source side and awaiting response of DUT measured by internal multimeter including allowed limits of the DUT. The testing can run automatically. After completing information of the PASS/FAIL type in each step is displayed on the front panel screen. With the testing function an isolated relay contacts are coupled, which enables to control other (sorting) equipments.

User comfort

M-140 Calibrator is equipped with a number of other functions which make its use easier. Among them belong possibility to set relative deviations from the actual value of the selected output signal, displaying of the output signal uncertainty, internal calibration procedure and others. Concept of the calibrator's control and indication uses a large area luminescence display on which all necessary information

is concentrated. The control is performed by selection from the menu. Moreover, frequently used functions have firmly assigned keys with direct control. Normally, the calibrator is equipped with the GPIB bus and with the RS-232 serial port making it possible to be controlled by personal computer.

The calibrator can be included into MEATEST's WinQbase software calibration systems.

Specification

DC/AC voltage

range	% of value + % of range	% of value + % of range	% of value + % of range	% of value + % of range
	DC	20 Hz - 10 kHz	10 kHz - 50 kHz	50 kHz - 100 kHz
0 mV - 20 mV **	0.05 + 0.0 + 10 μ V	0.20 + 0.05 + 20 μ V	0.20 + 0.10 + 20 μ V	0.20 + 0.10 + 20 μ V
20mV - 200mV	0.01 + 0.0 + 10 μ V	0.1 + 0.03 + 20 μ V	0.15 + 0.05 + 20 μ V	0.15 + 0.05 + 20 μ V
200 mV - 2 V	0.003 + 0.0008	0.025 + 0.005	0.05 + 0.01	0.05 + 0.01
2 V - 20 V	0.003 + 0.0005	0.025 + 0.005	0.05 + 0.03	0.05 + 0.03
20 V - 240 V	0.003 + 0.0005	0.025 + 0.010	--	--
240 V - 1000 V	0.005 + 0.005	0.03 + 0.02 *	--	--

* valid for $f < 1000$ Hz

** DC voltage from 0 μ V, AC voltage from 1 mV

DC/AC current

range	% of value + % of range	% of value + % of range	% of value + % of range	% of value + % of range
	DC	20 Hz - 1 kHz	1 kHz - 5 kHz	5 kHz - 10 kHz
1 μ A - 200 μ A	0.05 + 0.0 + 20 nA	0.15 + 0.0 + 20 nA	0.30 + 0.10 + 20 nA	--
200 μ A - 2 mA	0.02 + 0.005	0.07 + 0.01	0.20 + 0.05	0.20 + 0.05
2 mA - 20 mA	0.01 + 0.003	0.05 + 0.005	0.20 + 0.05	0.20 + 0.05
20 mA - 200 mA	0.01 + 0.003	0.05 + 0.005	0.20 + 0.05	0.20 + 0.05
200 mA - 2 A	0.015 + 0.005	0.05 + 0.005	--	--
2 A - 20 A	0.02 + 0.010	0.10 + 0.03	--	--

When Option 140-50 Current coil is used, add uncertainty 0.3 % of the set current to the value specified in the above table. Output current is multiplied by factor 25/50.

Resistance

range	% of value + % of range
0 Ohm - 100 Ohm	0.03 + 10 mOhm
100 Ohm - 400 Ohm	0.015
400 Ohm - 2 kOhm	0.015
2 kOhm - 10 kOhm	0.015
10 kOhm - 40 kOhm	0.015
40 kOhm - 200 kOhm	0.015
200 kOhm - 1 MOhm	0.05
1 MOhm - 4 MOhm	0.1
4 MOhm - 20 MOhm	0.2
20 MOhm - 50 MOhm	0.5

Capacitance

range	% of value + % of range
900 pF - 2.5 nF	0.5 + 15 pF
2.5 nF - 10 nF	0.5 + 5 pF
10 nF - 50 nF	0.5
50 nF - 250 nF	0.5
250 nF - 1 μ F	0.5
1 μ F - 3.5 μ F	1.0
3.5 μ F - 5 μ F	1.0
5 μ F - 10 μ F	1.5
10 μ F - 50 μ F	2.0

Maximum allowed voltage on the load is 8 Vpk.

Frequency

frequency mode	PWM (pos, neg, sym)	HF *
range	0.1 Hz - 100 kHz	0.1 Hz - 20 MHz
frequency uncertainty [%]	0.005	0.005
amplitude	1 mV - 10 V	2 V (0, -10, -20, -30, -40) dB
pk amplitude uncertainty [%]	0.1	10
ratio	0.00 - 1.00	--
ratio uncertainty [%]	0.05	--

* Rise time < 5 ns

DC/AC power - energy

quantity	range	DC uncertainty	AC uncertainty
voltage	200 mV - 240 V	see voltage table	see voltage table
current	2 mA - 10 A	0.05 % + 0.01 %	0.05 % + 0.01 %
frequency	40 Hz - 400 Hz	--	0.005
power factor	-1 - +1	--	0.005 - 0.0005
phase shift U/I	0 - 360 °	--	0.15 ° - 0.25 °

- Time range in energy mode is 10 s - 1999 s.

- Uncertainty of DC and AC power depends on set value of voltage, current, phase. The best uncertainty is 0.03 % for DC power and 0.08 % for AC power.

- Uncertainty in energy mode depends on set value of voltage, current, phase and time. The best uncertainty is 0.09 %.

Resistance temperature sensor simulation

types	Pt 1.385, Pt 1.392, Ni
range of R0	20 Ohm - 2 kOhm
range of temperature	-200 °C - 850 °C
temperature uncertainty	0.04 °C - 0.5 °C
temperature scale	ITS 90, PTS 68

Termocouple sensor simulation

types	R, S, B, J, T, E, K, N
range of temperature	-250 °C - 1820 °C
temperature unc.	0.4 °C - 4.0 °C
temperature scale	ITS 90, PTS 68




Build-in multimeter

function	range	uncertainty
VDC (DC voltage)	0 - ± 12 V	0.01 % + 100 µV
mVDC (DC voltage)	0 - ± 2000 mV	0.01 % + 10 µV
mADC (DC current)	0 - ± 25 mA	0.02 % + 1 µA
FREQ (Frequency)	1 Hz - 15 kHz	0.005 %
R4W (Resistance)	0 - 2 kOhm	0.02 % + 100 mOhm
TRTD (RTD sensors)	-150 - +600 °C	0.1 °C
TTC (TC sensors)	-250 - +1820 °C	0.4 - 4 °C
SGS (strain gauge sensor) *	depends on sensor	0.01 % + 10 µV + sensor unc.


* Adjustable supply voltage 2 to 10 V DC, max. current 40 mA, input resistance > 100 MOhm
sensitivity 0.5 - 100 mV/V



Accessories (included)

Power line cable	1 pc
Operation manual	1 pc
Option 10/11 : Test cable for 1000V - 20 A, black/red	2 pcs

<p>Option 40 : Test cable for build-in multimeter, 2 bannana</p> <p>Cable adapter with 2 bannana terminals can be used for DC voltage to 12 V and DC current to 25 mA measuring with internal multimeter. Calibrator can automatically recognize when the adapter is connected to Auxiliary connector on the front panel.</p>	1 pc	
<p>Option 60 : Test cable for build-in multimeter, 4 bannana.</p> <p>With cable adapter resistance function of internal meter can be used. Range of measurement is 0 to 2 kOhm, temperature measuring with external Pt/Ni sensor is available too.</p> <p>With cable adapter low DC volatges can be measured including temperature measurements with external TC temperature sensors.</p>	1 pc	
<p>Option 70 : 4-wire resistance adapter.</p> <p>With adapter resistance output of the calibrator can be used with four-terminal technique and with better accuracy.</p>	1 pc	

Options (extra ordered)

Option 140-50	<p>Current coil with 25 and 50 turns.</p> <p>Suitable for clamp A-meters testing up to 1000 A. Maximal recommended output current into the coil is 20 A.</p>	
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Option 140-01	<p>Cable adapter for multimeters.</p> <p>It is formed with plate for placing meter under test with simple cable connection to the calibrator front panel terminals. Adapter is equipped with build-in Pt-100 temperature sensor. Internal meter can measure ambient temperature and display it on the screen and automatically make cold junction compensation, when TC temperature sensor simulation is selected. .</p> <p>Adapter serves as plate for fixing CAM-OCR Camera module holder when automatic calibration with scanning of DUT display with CAM-OCR is performed.</p>	
Option 140-41	<p>Cable adapter for simultaneous applications.</p> <p>Cable adapter is designed for low-voltage/current applications to 20 VDC and 200 mADC. There are two fields on the adapter. The first contains terminals with calibrator output signals, the second contains internal multimeter input terminals. Various calibration tasks can be fulfilled with the adapter, especially such measuring where simultaneous generation of the calibrated signal and response of unit under test measuring is required. With the adapter temperature of external TC temperature sensor can be measured and display.</p>	
Option 140-02	<p>Set of cables and adapters.</p> <p>It includes Option 140-01, Option 140-41, Option 10 2pcs, Option 11 2pcs, Option 20, Option 30, Option 40, Option 60, Option 70</p>	
Option 10	Test cable 20A/1000V (black)	
Option 11	Test cable 20A/1000V (red)	
Option 20	Test cable BNC/BNC 1m	
Option 30	Test cable BNC/banana 1m	
Cable GPIB	IEEE488/IEEE488, 2m	
Cable RS-232	RS-232, 2m	
19:23 11.5.2003	Application SW for making database of meters and for automatic meter calibration.	
CALIBER	SW module for automatic calibration of multimeters.	