# *M-140 Multifunction Calibrator*

Model M-140 is a bus compatible multifunction calibrator for precise generation of electric units. It is mainly designed for calibration by manufacturers of electronic instrumentation. It also finds its application at laboratories, design and service departments as well as at institutions that have to frequently calibrate their equipment in accordance with their internal quality certification system.

Compared with standard calibrators, the model M-140 represents a new concept of multifunctional calibrators, which generate not only the standard electric parameters but also parameters for temperature and energy applications. Apart from this, the calibrator generates non-harmonic signals for the testing of equipment with non-zero distortion input signals. The signals can be generated with variable frequency, amplitude and pulse-width ratio. The simulation of DIN thermocouples and RTD sensors is provided. M-140 is a high accuracy and high stability instrument with easy operation, which can be used for the calibration of multimeters, analog instruments, panelmeters, clamp amperemeters, hand calibrators, wattmeters, electrometers, oscilloscopes, thermometers, dataloggers, X-Y recorders, etc. A built-in multimeter function can be utilised for simultaneous testing/calibration of transmitters, regulators and other controllers without the need of using supporting equipment.

## *Parameters*

The calibrator´s main function is the generation of DC- and AC- voltage between 0 µV and 1000 V and DC- and AC- currents from 0µA to 20 A. By using an optional output booster the currents from 50 µA to 500A can be calibrated. The frequency range is programmable from 20Hz to 50kHz. The best accuracy for DC voltage is 0.0035%, for AC voltage 0.03%, for DC current 0.013% and for AC current 0.055%.

A non-harmonic periodical signal with a defined crest factor can be generated and used for the calibration of multimeters, considering accuracy during measurements of distorted AC signals.

Resistors and capacitors can be simulated between 0 Ω and 50 Ω (accuracy of 0.03%) and 1 nF to 50 µF (accuracy of 0.5%). The resistors can be used for AC signals up to 1kHz.

Model M-140 generates square wave signals with a programmable pulsewidth. The amplitude is programmable from 1mV to 10V within a frequency range of 0 to 10kHz.
Another frequency output of up to 20MHz square wave with very fast edges is available and can be used for calibration of frequency characteristics of multimeters, oscilloscopes and time bases of instruments.

Wattmeters and electrometers for measuring DC or AC power can be calibrated up to 240V and 20A with a phase setting from -1 to +1 with a resolution of 1% within a frequency range of 20Hz to 400Hz. The voltage output can be loaded with 30mA and permits a calibration of classic analogue wattmeters.

The calibrator can simulate RTD thermometers and DIN thermocouples R, S, B, J, K, T, E and N. The cold junction can be set with the keyboard directly as temperature. The accuracy of the RTD thermometers is 0.04ºC to 0.5ºC. The accuracy of thermocouples is 0.4ºC to 4.3ºC.

## *Built-in Multimeter*

Multimeter with inputs for 0-20mA and 0-10V has an accuracy of 0.01 % and is suitable for measuring standardised process signals from transmitters which are under test or calibration.

## *Calibrator - Tester*

M-140 can be programmed as a calibrator-tester with up to 10 steps of selected testing procedure. The end of the test sequence is terminated with a display record output of a type PASS/FAIL. The output relay allows to control additional equipment.

## *Easy to use*

There are additional functions available, which simplify the use of the instrument, such as programming the relative error band, displaying the actual uncertainty of the generated signal, calibration procedures, etc.

The large-scale LCD display shows the menu steps, the generated parameters as well as other additional information. Some of the keys are directly assigned to frequently used functions. Output ports GPIB – IEEE488 and RS232 are standard and permit to operate the calibrator in automatic testing set-ups.

The Meatest WinQbase is available for operation under Windows.

# Specification

Uncertainties include long-term stability, temperature coefficient, linearity, load and line regulation and the traceability of factory and National calibration standards. Specified accuracy is valid after one hour warm up in temperature range 23 ± 2 °C. Specified accuracy is one year accuracy.

## *Calibrator*

### *Voltage*

summary range DCV: 0 µV - 1000 V
summary range ACV: 1 mV – 1000 V
internal ranges: 20 mV, 200 mV, 2 V, 20 V, 240 V, 1000 V
frequency range: 20 Hz to 50 kHz bellow 20 V
20 Hz to 10 kHz bellow 200 V
20 Hz to 1000 Hz bellow 1000 V

***DCV uncertainty***

| *range* | *% value + % range* | *max. current mA* |
|---|---|---|
| 0 µV - 20 mV | 0.03 + 0.0 + 10 µV | 5 |
| 20 mV - 200 mV | 0.01 + 0.0 + 15 µV | 5 |
| 200 mV - 2 V | 0.003 + 0.0008 | 30 |
| 2 V - 20 V | 0.003 + 0.0005 | 30 |
| 20 V – 240 V | 0.003 + 0.0005 | 30 |
| 240 V - 1000 V | 0.005 + 0.005 | 2 |

*[2] value of the range for uncertainty calculation is 200 V

***ACV uncertainty***

| *range* | *% value + % range* | *max. current mA* | *% value + % range* | *max. current mA* |
|---|---|---|---|---|
| | *20 Hz - 10 kHz* | *20 Hz - 10 kHz* | *10 kHz - 50 kHz* | *10 kHz - 50 kHz* |
| 1 mV - 20 mV | 0.2 + 0.05 + 20 µV | 5 | 0.20 + 0.10 + 20 µV | 5 |
| 20 mV - 200 mV | 0.1 + 0.03+ 20 µV | 5 | 0.15 + 0.05 + 20 µV | 5 |
| 200 mV - 2 V | 0.025 + 0.005 | 30 | 0.05 + 0.01 | 10 |
| 2 V - 20 V | 0.025 + 0.005 | 30 | 0.05 + 0.03 | 10 |
| 20 V – 240 V *[2] | 0.025 + 0.010 | 30 | - - | |
| 240 V – 1000 V | 0.03 + 0.02 *[1] | 2 | - - | |

*[1] valid for f < 1000 Hz
*[2] value of the range for uncertainty calculation is 200 V, in the range 200 to 240 V is frequency limited to 1 kHz.

| *range* | *% value+ % range* | *max. current mA* |
|---|---|---|
| | *50 kHz - 100 kHz* | *50 kHz - 100 kHz* |
| 1 mV - 20 mV | 1.0 + 0.10 + 20 µV | 3 |
| 20 mV - 200 mV | 0.3 + 0.05 + 20 µV | 3 |
| 200 mV - 2 V | 0.2 + 0.05 | 5 |
| 2 V - 20 V | 0.2 + 0.05 | 5 |
| 20 V – 240 V | - - | |
| 240 V – 1000 V | - - | |

***Auxiliary parameters***

| *range* | *20mV* | *200mV* | *2V* | *20V* | *200V* | *1000V* |
|---|---|---|---|---|---|---|
| THD *[2] *[3] | 0,05% + 200 uV | 0,05% + 300 uV | 0,05% | 0,05% | 0,05% | 0,2% |
| output impedance | < 10 mΩ | < 10 mΩ | < 10 mΩ | < 10 mΩ | < 100 mΩ | < 100 mΩ |
| maximal capacitance load | 500 pF | 500 pF | 500 pF | 500 pF | 300 pF | 150 pF |

*[2] parameter includes non-linear distortion and non-harmonic noise
*[3] valid for frequencies to 10 kHz

***Function Shape***

| | |
|---|---|
| voltage range: | 1 mV to 200 V |
| wave form: | square, positive, negative, symmetrical, ramp A, ramp B, triangle truncated sin with THD 13,45 % |
| peak value uncertainty: | 0.3 % + 50 uV |
| displayed values: | peak, effective |

Minimum frequency for squarewave signals is 0.1 Hz, for all others 20 Hz.

## *Current*

| | |
|---|---|
| summary range DCI: | 0 - 20 A (with adapter 130-50 to 500 A) |
| summary range ACI: | 1 µA - 20 A (with adapter 130-50 to 500 A) |
| internal ranges: | 200 µA, 2 mA, 20 mA, 200 mA, 2 A, 20 A |
| frequency range: | 20 Hz to 5 kHz bellow 200 mA<br>20 Hz to 1000 Hz bellow 20 A |

***DCI uncertainty***

| *range* | *% value + % range* | *max. voltage V* |
|---|---|---|
| 0 µA - 200 µA | 0.05 + 0.0 + 20 nA | 3 |
| 200 µA - 2 mA | 0.02 + 0.005 | 3 |
| 2 mA - 20 mA | 0.01 + 0.003 | 3 |
| 20 mA - 200 mA | 0.01 + 0.003 | 3 |
| 200 mA - 2 A | 0.015 + 0.005 | 3 |
| 2 A - 20 A | 0.02 + 0.010 | 1.5 |

***ACI uncertainty***

| *range* | *% value + % range* | *max voltage Vef* | *% value + % range* | *max voltage Vef* |
|---|---|---|---|---|
| | ***20 Hz - 1 kHz*** | | ***1 kHz – 5 kHz*** | |
| 1 µA - 200 µA | 0.15 + 0.0 + 20 nA | 3 | 0.30 + 0.10 + 20 nA | 3 |
| 200 µA - 2 mA | 0.07 + 0.01 | 3 | 0.20 + 0.05 | 3 |
| 2 mA - 20 mA | 0.05 + 0.005 | 3 | 0.20 + 0.05 | 3 |
| 20 mA – 200 mA | 0.05 + 0.005 | 3 | 0.20 + 0.05 | 3 |
| 200 mA – 2 A | 0.05 + 0.005 | 3 | - - | - - |
| 2 A - 20 A | 0.10 + 0.03 | 1.5 | - - | - - |

| *range* | *% value + % range* | *max voltage Vef* |
|---|---|---|
| | ***5 kHz – 10 kHz*** | |
| 1 µA - 200 µA | - - | - - |
| 200 µA - 2 mA | 0.50 + 0.07 | 2 |
| 2 mA - 20 mA | 0.50 + 0.07 | 2 |
| 20 mA - 200 mA | 0.50 + 0.07 | 2 |
| 200 mA - 2 A | - - | - - |
| 2 A - 20 A | - - | - - |

When option 130-50 Current Coil is used, add uncertainty 0.3% of the set current to the value specified in above table. Output current is multiplied by factor 50.

***Auxiliary parameters***

| *range* | *200 uA* | *2 mA* | *20 mA* | *200 mA* | *2 A* | *10 A* |
|---|---|---|---|---|---|---|
| maximal inductive load | 400 uH | 400 uH | 400 uH | 400 uH | 200 uH | 100 uH |
| THD[*1] | 0,2% | 0,2% | 0,2% | 0,2% | 0,2% | 0,3% |

[*1] parameter includes non-linear distortion and non-harmonic noise

***Function Shape***

| | |
|---|---|
| current range: | 100 uA to 2 A |
| wave form: | square, positive, negative, symmetrical, ramp A, ramp B, triangle truncated sin with THD 13,45 % |
| peak value uncertainty: | 0.3 % + 500 nA |
| displayed values: | peak, effective |

Minimum frequency for squarewave signals is 0.1 Hz, for all others 20 Hz.

## *Resistance*

summary range: 0 Ω to 50 MΩ

***Resistance uncertainty***

| *resistance range* | *uncertainty of value [%]* | *current range* |
|---|---|---|
| 0 Ω - 100 Ω | 0.03 + 10 mΩ | 1 mA - 40 mA |
| 100 Ω - 400 Ω | 0.015 | 400 µA - 20 mA |
| 400 Ω - 2 kΩ | 0.015 | 100 µA - 4 mA |
| 2kΩ - 10 kΩ | 0.015 | 20 µA - 1 mA |
| 10 kΩ - 40 kΩ | 0.015 | 4 µA - 200 µA |
| 40 kΩ - 200 kΩ | 0.015 | 1 µA - 40 µA |
| 200kΩ -1 MΩ | 0.05 | 0.2 µA - 10 µA |
| 1 MΩ - 4 MΩ | 0.1 | 40 nA – 2 µA |
| 4 MΩ - 20MΩ | 0.2 | 10 nA – 500 nA |
| 20 MΩ - 50MΩ | 0.5 | 4 nA – 150 nA |

Maximal allowed voltage on output terminals is 8 $V_{pp}$. Uncertainty is valid for four-terminal connection with use of Option 70 or Option 140-41 Cable adapters. For two-wire connection from the terminals Hi-Lo na the front panel add to the specified uncertainty next +10 mOhm.

## *Capacitance*

summary range: 0.9 nF to 50 µF

***Capacitance uncertainty***

| *range* | *uncertainty of value [%]* | *max. frequency* |
|---|---|---|
| 900 pF - 2.5 nF | 0.5 + 15 pF | 1000 Hz |
| 2.5 nF - 10 nF | 0.5 + 5 pF | 1000 Hz |
| 10 nF - 50 nF | 0.5 | 1000 Hz |
| 50 nF – 250 nF | 0.5 | 1000 Hz |
| 250 nF - 1 µF | 0.5 | 500 Hz |
| 1 µF – 2.5 µF | 1 | 300 Hz |
| 2.5 µF - 5 µF | 1 | 300 Hz |
| 5 µF – 10 µF | 1.5 | 300 Hz |
| 10 µF - 50 µF | 2.0 | 300 Hz |

Maximal allowed voltage on output terminals is 8 $V_{pp}$.

## *AC and DC power/energy*

summary voltage range: 0.2 V to 240 V
current capability of voltage output: depends on the voltage range
summary current range: 2 mA to 10 A
maximal voltage on current output: depends on the current range
power range: 0.0004 to 2.4 kVA
time period range: 1.1 s to 1999 s
frequency range: DC, 40 Hz to 400 Hz

***DCV uncertainty***
See table of DCV uncertainty.

***DCI uncertainty***

| *range* | *% value + % range* | *max. voltage **[V]*** |
|---|---|---|
| 2 mA - 20 mA | 0.05 + 0.010 | 3 |
| 20 mA - 200 mA | 0.05 + 0.005 | 3 |
| 200 mA - 2 A | 0.05 + 0.005 | 3 |
| 2 A – 10 A | 0.05 + 0.010 | 1.5 |

***DC POWER uncertainty***
Uncertainty of DC power can be calculated from the following formula:

$$d P = \sqrt{( dU^2 + dI^2 + 0.01^2 )} \ [\%]$$

where dP is uncertainty of output power [%]
dU is uncertainty of set voltage [%]
dI is uncertainty of set current [%]

DC ENERGY uncertainty
Depends on voltage, current, time values. The best uncertainty is 0.016 %.

ACV uncertainty
See table of ACV uncertainty.

***ACI uncertainty***

| *range* | *% value + % range* | *max. voltage [V]* |
|---|---|---|
| 2 mA – 20 mA | 0.05 + 0.010 | 3 |
| 20 mA – 200 mA | 0.05 + 0.005 | 3 |
| 200 mA - 2 A | 0.05 + 0.005 | 3 |
| 2 A – 10 A | 0.05 + 0.010 | 1.5 |

***PHASE uncertainty***

| *frequency range [Hz]* | *phase uncertainty d j [°]* |
|---|---|
| 40 – 200 | 0.15 |
| 200 – 400 | 0.25 |

***AC POWER uncertainty***
Uncertainty of AC power can be calculated from the following formula:

for active power $d P = \sqrt{( dU^2 + dI^2 + dPF^2 + 0.03^2)}$ [%]
for reactive power $d P = \sqrt{( dU^2 + dI^2 + dPF*^2 + 0.03^2)}$ [%]
for apparent power $d P = \sqrt{( dU^2 + dI^2 + 0.03^2)}$ [%]

where dP is uncertainty of power [%]
dU is uncertainty of set voltage [%]
dI is uncertainty of set current [%]
dPF is uncertainty of power factor (cosφ) [%]

For calculation of dPF is valid following formula:

$$dPF = (1 - \cos(\varphi+d\varphi)/\cos\varphi) * 100 \quad [\%]$$

where φ is set phase shift between voltage and current outputs
dφ is uncertainty of set phase shift in table above

dPF* is uncertainty of of sinφ [%]

For dPF* is valid following formula:

$$dPF^* = (1 - \sin(\varphi+d\varphi)/\sin\varphi) * 100 \quad [\%]$$

*Example:*
Set parameters: U = 100 V, I = 10 A, cos φ = 0.5, f = 50 Hz, displayed value of active power in W
Output voltage uncertainty: dU = 0.025 % value + 0.010 % range = 0.045 %
Output current uncertainty: dI = 0.10 % value + 0.03 % range = 0.7 %
Uncertainty due the set phase shift: PF 0.5 corresponds phase shift 60 °
dPF = (1 – cos (60+0.15)/cos 60) * 100 = (1 – 0.4977/0.5) * 100 = 0.45 %
Output power uncertainty: $dP = \sqrt{( 0.045^2 + 0.7^2 + 0.45^2 + 0.03^2)} = 0.95$ %

***POWER FACTOR (PF)***
range: -1.0 to +1.0
PF uncertainty can be calculated for any set value of output voltage, current and PF from following formula:

$$dPF = (1 - \cos(\varphi + d\varphi)/\cos\varphi) * 100 \quad [\%]$$

where $\varphi$ is set phase shift between voltage and current
$d\varphi$ is uncertainty of set phase shift form the above table

***AC ENERGY uncertainty***
It depends on set value of voltage, current, time and PF. The best uncertainty is 0.07% for apparent energy.

## ***Frequency***

summary range: 0.1 Hz to 20 MHz
frequency uncertainty: 0.005 %
output: BNC connector located on the front panel
modes: - PWM square wave output with calibrated duty cycle ratio, frequency and amplitude
- HF square wave output with calibrated frequency and amplitude

***Mode PWM***

frequency range: 0.1 Hz to 100 kHz
voltage range: 1 mV to 10 V
duty cycle ratio range: 0.01 to 0.99
wave form: square, symmetrical– positive – negative
duty cycle ratio uncertainty: 0.05 %

***Amplitude uncertainty***

| *range* | *% value + % range* |
|---|---|
| 1 mV - 20 mV | 0.2 + 50 µV |
| 20 mV - 200 mV | 0.1 + 50 µV |
| 200 mV - 2 V | 0.1 |
| 2 V - 10 V | 0.1 |

***Mode HF***

frequency range: 0.1 Hz to 20 MHz
output impedance: 50 Ω
wave form: square symmetrical, duty cycle ratio 1:1
amplitude: 4 $V_{pk-pk}$
output amplitude range: 0, -10, -20, -30 dB +/- 1 dB
amplitude uncertainty: 10 %
rise/fall time: < 3 ns

## ***Temperature sensors simulation***

temperature scale: ITS 90, PTS 68
types of sensors: RTD, TC

***A. RTD (resistance) sensors***

types: Pt 1.385, Pt 1.392, Ni
range of R0 setting: 20 Ω to 2 kΩ
temperature range: -200 to +850 °C
temperature uncertainty: 0.04 °C to 0.5 °C (see table bellow)

***Ranges and uncertainties of RTD sensor simulation***

| type | range –200 – 250 °C | range 250 – 850 °C |
|---|---|---|
| Pt100 | 0.1 °C | 0.3 °C |
| Pt200 | 0.1 °C | 0.2 °C |
| Pt1000 | 0.2 °C | 0.4 °C |
| Ni100 | 0.07 °C *1 | - - |

*1 Valid in range –60 to +180 °C.

Uncertainties in the table are maximal uncertainties of RTD sensor simulation. Actual uncertainty for each set value of simulated temperature is determined by uncertainty of relevant resistance. Actual temperature uncertainty is displayed on the calibrator display. Actual uncertainties are always lower than those in above table.

***B. TC sensors:***

types: K, N, R, S, B, J, T, E
temperature range: -250 to +1820 °C according to the type
temperature uncertainty: 0.4 to 4.3 °C (see table bellow)

***Ranges and uncertainties of TC sensor simulation (with function AUTOCAL ON)***

| | | | | | |
|---|---|---|---|---|---|
| R | range [°C] | -50 - 0 | 0 - 400 | 400 – 1000 | 1000 – 1767 |
| | uncertainty [°C] | 3.2 | 2.1 | 1.4 | 1.7 |
| S | range [°C] | -50 - 0 | 0 - 250 | 250 – 1400 | 1400 – 1767 |
| | uncertainty [°C] | 2.7 | 2.1 | 1.7 | 2.0 |
| B | range [°C] | 400 – 800 | 800 - 1000 | 1000 – 1500 | 1500 – 1820 |
| | uncertainty [°C] | 2.8 | 1.8 | 1.6 | 1.8 |
| J | range [°C] | -210 - -100 | -100 - 150 | 150 – 700 | 700 – 1200 |
| | uncertainty [°C] | 0.9 | 0.5 | 0.6 | 0.7 |
| T | range [°C] | -200 - -100 | -100 - 0 | 0 – 100 | 100 – 400 |
| | uncertainty [°C] | 0.9 | 0.5 | 0.4 | 0.4 |
| E | range [°C] | -250 - -100 | -100 - 280 | 280 – 600 | 600 – 1000 |
| | uncertainty [°C] | 1.6 | 0.4 | 0.5 | 0.5 |
| K | range [°C] | -200 - -100 | -100 - 480 | 480 – 1000 | 1000 – 1372 |
| | uncertainty [°C] | 1.0 | 0.6 | 0.7 | 0.8 |
| N | range [°C] | -200 - -100 | -100 - 0 | 0 – 580 | 580 – 1300 |
| | uncertainty [°C] | 1.2 | 0.7 | 0.6 | 0.8 |

Uncertainties in the table are maximal uncertainties of TC sensor simulation. Actual uncertainty for each set value of simulated temperature is determined by uncertainty of relevant resistance. Actual temperature uncertainty is displayed on the calibrator display. Actual uncertainties are always lower than those in above table.

# ***Multimeter***

***Measuring:*** DC voltage
DC current
resistance, temperature
strain gauge sensors

***Ranges and uncertainties***

| *function* | *total range* | *uncertainty (%)* | *resolution / range* |
|---|---|---|---|
| DC voltage - DCV [*1] | 0 to +/-12 V | 0.01 % + 300 µV | 100µV / 10V |
| DC voltage - mVDC [*1] | 0 to +/-2 V | 0.02 % + 7 µV | 20mV / 100nV, 200mV / 1uV, 2V / 10uV |
| DC current [*1] | 0 to +/-25 mA | 0.015 % + 300 nA | 100 nA/20mA |
| Frequency | 1 Hz to 15 kHz | 0.005 | 10 µHz – 0.1 Hz |
| Resistance [*2] | 0 to 2.5 k Ω | 0.02% + 10 m Ω | 20Ω / 1mΩ, 200Ω / 1mΩ, 2kΩ / 10mΩ |
| Temperature - Pt sensor | -200 to +850 °C [*3] | 0.1 °C | 0.1 °C |
| Temperature – TC sensor | -250 to +1820 °C | see Table | 0.01 °C |
| Strain gauge sensors [*4] | depends on sensor | 0.05 % + 10 µV + uncertainty of sensor | |

[*1] Uncertainties are valid after performing ZERO correction in set mode

[*2] Measuring current 1 mA

[*3] For Pt 1000 sensor maximum temperature is 350 °C

[*4] Supply voltage: 2 to 10 V DC, non-symmetrical
Max. current: 40 mA
Input resistance: min. 100 MΩ
Sensitivity: setable in range 0.5 mV to 100 mV /V
Displayed unit : user´s defined

***Ranges and uncertainties of temperature measuring with TC sensor***

| | | | | | |
|---|---|---|---|---|---|
| R | range [°C] | -50 - 0 | 0 – 400 | 400 – 1000 | 1000 – 1770 |
| | uncertainty [°C] | 2.5 | 1.5 | 1.0 | 1.2 |
| S | range [°C] | -50 - 0 | 0 – 250 | 250 – 1400 | 1400 – 1770 |
| | uncertainty [°C] | 2.0 | 1.6 | 1.1 | 1.3 |
| B | range [°C] | 400 - 800 | 800 – 1000 | 1000 – 1500 | 1500 – 1820 |
| | uncertainty [°C] | 2.0 | 1.3 | 1.2 | 1.1 |
| J | range [°C] | -210 - -100 | -100 – 150 | 150 – 700 | 700 – 1200 |
| | uncertainty [°C] | 0.7 | 0.4 | 0.4 | 0.6 |
| T | range [°C] | -200 - -100 | -100 - 0 | 0 – 100 | 100 – 400 |
| | uncertainty [°C] | 0.8 | 0.5 | 0.4 | 0.4 |
| E | range [°C] | -250 - -100 | -100 - 280 | 280 – 600 | 600 – 1000 |
| | uncertainty [°C] | 1.1 | 0.4 | 0.4 | 0.5 |
| K | range [°C] | -200 - -100 | -100 - 480 | 480 – 1000 | 1000 – 1372 |
| | uncertainty [°C] | 0.8 | 0.4 | 0.6 | 0.8 |
| N | range [°C] | -200 - -100 | -100 – 0 | 0 – 580 | 580 – 1300 |
| | uncertainty [°C] | 0.9 | 0.5 | 0.5 | 0.8 |

***Sorting function***

Output GO/NG: 1 x make, 1 x break contacts, 50Vpp / 100mA
Triggering : external, internal, manual

### ***General data***

| | | | |
|---|---|---|---|
| Warm up time: | 1 hour | | |
| Range of working temperatures: | 23 ± 10 °C | | |
| Reference temperature: | 23 ± 2 °C | | |
| Dimension: | 450 x 480 x 150 mm | | |
| Power line: | 115 - 220/230 V – 50/60 Hz | | |
| Power consumption: | 45 VA without load<br>Max. 150 VA with full load | | |
| Safety class: | I according EN 1010-1 | | |
| Used fuses inside instrument: | F315mL250 | | 2 pcs |
| | F1.6L250 | | 2 pcs |
| Used resistors with fuse effect: | 0.5R | MRS16T 1% | 1 pc |
| | 1R | MRS16T 1% | 18 pcs |

# Accessories

### ***Basic accessories (included in delivery)***

- Power line cord 1 pc
- User´s manual 1 pc
- Test report 1 pc
- Spare fuse 1 pc
- Test cable 1000V/20A, 1m 2 pc
- Option 40 Cable adapter Canon 25 / 2 x BANANA, 1 m 1 ks
- Option 60 Cable adapter Canon 25 / 4 x BANANA, 1 m 1 ks
- Option 70 Adapter for four-terminal resistance generation 1 ks

### ***Options (extra ordered)***

- 130-50 Current coil 50 turn
- 140-01 Cable adapter for calibration of multimeters
- 140-02 Set of cables
- 140-41 Cable adapter for simultaneous calibration/measuring
- Option 10 Output cable 20A/1000V (black)
- Option 11 Output cable 20A/1000V (red)
- Option 20 Output cable BNC/BNC
- Option 30 Output cable BNC/BANANA
- Option 40 Output cable D-SUB25/ 2xBANANA, 1 m
- Option 60 Output cable D-SUB25/ 4xBANANA, 1 m
- Cable GPIB IEEE488/IEEE488, 2m
- Cable RS Cable RS-232 for connecting to PC
- WinQbase SW for calibration of instrument
- MEACA Program module for multimeters
- Caliber Program module for multimeters

### ***Manufacturer***

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