MC-142 Multifunction Calibrator 15 ppm

- **DC/AC voltage to 1000 V accuracy 15ppm/year**
- **DC/AC current to 30A**
- **Resistance to 1000 MΩ Capacitance to 100 µF**
- **TC/RTD Temperature sensor simulation**

- **Frequency output to 20MHz**
- **Electric power/energy to 240V/20A**
- **Built-in process multimeter**
- **GPIB & RS232 interface**

MC-142 Multifunction calibrator is accurate source of AC/DC voltage and current with application focused to calibration laboratories and instrumentation. It is designed for calibrations of meters of electric quantities.

Basic function of the calibrator is generating of accurate electric quantities, especially AC and DC voltage and current. Range of the voltage is from 0 mV to 1000 V, range of current is from 0 mA do 30 A. When 50-turns current coil Option 140-50 is applied, current range can be extended to 1000 A for clamp ammeters calibrations. Best accuracy on DC voltage function is 15 ppm, 250 ppm on AC voltage, 130 ppm on DC current and 550 ppm on AC current. Maximal frequency range covers band 20 Hz to 100 kHz.

Except current and voltage the calibrator offers function of simulated electric power and energy, sometimes called "phantom" power. Electric power can be set in voltage range to 240 V and in current range to 20 A, both AC and DC and in AC mode with settable phase shift between voltage and current. The phase shift can be expressed either in degrees or as power factor. Electric power function can be applied for calibration of wattmeters, electric power transducers, PF meters. Electric energy function application field is focused to energy meters testing. The calibrator is equipped with two modes of frequency function. The functions enable calibration of scopes in frequency range to 20 MHz offering square weave signal with calibrated amplitude, frequency and duty cycle ratio.

For application field of temperature the calibrator offers simulation of RTD and TC temperature sensors. The calibrator can simulate the most frequently used thermocouple sensors of type R, S, B, J, T, E, K, N. Cold junction compensation can be performed either manually by entering from front panel keyboard or automatically using Option 140-01 cable adapter. The cable adapter has build in Pt100 sensor which senses ambient temperature and which can compensate precisely the cold junction influence. Both Pt and Ni resistance sensors can be simulated in full temperature range. Accuracy of simulated RTD sensors is from 0.04 °C to 0.5 °C, and of TC sensors from 0.4 °C do 4.3 °C.

Built in process multimeter offers directly measure and calibrate response of various types of electric quantity transducers, sourcing them with calibrated signal and sensing their output simultaneously.

The calibrator is equipped with many further functions who simplify control and application. Among them belongs relative or absolute deviation setting, accuracy of amplitude of set output signal on the display, calibration procedure with simple process of recalibration, etc. The calibrator has color large front panel luminescent display where all related information are shown. Calibrator is equipped both with RS-232 and GPIB interface. It is fully compatible with Powertek calibration SW CALIBER.

Specification

DC/AC voltage sin

Voltage range: 0 to 1000 V
Frequency voltage: 20 Hz to 100 kHz
Resolution: 6½ dig.

Range	% of value + uV	% of value + uV	% of value + uV	% of value + uV
	DC	20 Hz - 10 kHz	10 kHz - 50 kHz	50 kHz - 100 kHz
0 mV - 20 mV	0.005 + 6	0.2 + 30	0.20 + 30	1.0 + 30
20mV - 200mV	0.0015 + 8	0.1 + 80	0.15 + 120	0.3 + 120
200 mV - 2 V	0.0012 + 10	0.018 + 100	0.05 + 200	0.2 + 1 000
2 V - 20 V	0.0010 + 50	0.018 + 1 000	0.05 + 6 000	0.2 + 10 000
20 V - 240 V	0.0015 + 500	0.018 + 10 000	- -	- -
240 V - 1000 V	0.005 + 20 000	0.03 + 200 000 *	- -	- -

* Maximal frequency 1000 Hz

DC/AC current sin

Current range: 0 to 30 ADC, 1uA to 30 AAC
Frequency range: 20 Hz to 10 kHz
Resolution: 6½ dig.

Range	% of value+ μA	% of value+ μA	% of value+ μA	% of value+ μA
	DC	20 Hz - 1 kHz	1 kHz - 5 kHz	5 kHz - 10 kHz
1 μA - 200 μA	0.05 + 0.02	0.15 + 0.02	0.30 +0.22	- -
200 μA - 2 mA	0.02 + 0.1	0.07 + 0.2	0.20 + 1	0.50 + 1.4
2 mA - 20 mA	0.01 + 0.6	0.05 + 1	0.20 + 10	0.50 + 14
20 mA - 200 mA	0.01 + 6	0.05 + 10	0.20 + 100	0.50 + 140
200 mA - 2 A	0.015 + 100	0.05 + 100	- -	- -
2 A - 20 A	0.02 + 2 000	0.10 + 6 000	- -	- -
20 A - 30 A *	[0.02 + 0.003* (I-20)] + 2000	[0.1 + 0.003* (I-20)] + 6 000	- -	- -

* I is set current value in A

Additional uncertainty when current coil Option 140-50 applied is 0.3 %. Output current is multiplied by factor 25 or 50.

Shape function (non-harmonic signal)

Voltage range: 1 mV to 200 V
Current range: 100uA to 2 A
Output signal waveform: square positive, negative, symmetrical, saw A, saw B, triangle
      limited sin with defined distortion k=13,45 %
Peak value accuracy: 0.3 % + 50 uV
Displayed values: peak, calculated rms
Frequency range: 1000 Hz for AC voltage, 120 Hz for AC current

The lowest settable frequency for squarewave signal is 0.1 Hz, pro other waveforms 20 Hz.

Resistance and Capacitance

Resistance range: 0 to 1000 MΩ
Capacitance range: 900pF to 100 μF
Resolution: 4 dig.

Resistance range	% of value + mΩ	Current range **	Capacitance range *	% of value+ pF
0 Ω - 10 Ω	0.03 + 5	400 uA - 100 mA	700 pF – 1 nF	0.5 + 15
10 Ω - 33 Ω	0.015 + 5	400 μA - 100 mA	1 nF – 3.3 nF	0.5 + 5
33 Ω - 100 Ω	0.010 + 5	400 μA - 100 mA	3.3 nF - 10 nF	0.5
100 Ω - 330 Ω	0.010 + 5	400 μA – 40 mA	10 nF – 33 nF	0.5
330 Ω - 1 kΩ	0.010	400 μA – 11 mA	33 nF – 100 nF	0.5
1 kΩ - 3.3 kΩ	0.010	100 μA – 6 mA	100 nF – 330 nF	1
3.3 kΩ - 10 kΩ	0.010	20 μA – 2 mA	330 nF - 1 μF	1
10 kΩ - 33 kΩ	0.010	4 μA – 600 μA	1 μF – 3.3 μF	1.5
33 kΩ - 100 kΩ	0.010	1 μA – 200 μA	3.3 μF – 10 μF	1.5
100 kΩ - 330 kΩ	0.010	1 μA – 60 μA	10 μF - 100 μF	2.0
330 kΩ -1 MΩ	0.010	0.2 μA – 20 μA		
1 MΩ - 3.3 MΩ	0.020	40 nA – 6 μA		
3.3 MΩ - 10MΩ	0.050	10 nA – 2 μA		
10 MΩ - 33 MΩ	0.1	10 nA – 600 nA		
33 MΩ - 100MΩ	0.2	10 nA – 180 nA		
100 MΩ - 1000 MΩ	0.5	4 nA – 20 nA		

* Maximal applicable test voltage on output terminals is 2 to 5.5Vrms.

** Maximal applicable voltage on output terminals is 20Vrms.

DC/AC electric power and energy

Voltage range:	0.2 V to 240 V
Current range:	2 mA to 20 A
Electric power range:	0.0004 to 2.4 kVA
Time setting:	1.1 s to 1999 s
Frequency range:	DC, 40 Hz to 400 Hz
Frequency accuracy:	0.005 %

AC/DC current accuracy   Phase shift accuracy

Current range	% of value + uA	Frequency range	Phase shift accuracy $d\varphi$ [°]
2 mA - 20 mA	0.05 + 2	40 – 200 Hz	0.15
20 mA - 200 mA	0.05 + 10	200 – 400 Hz	0.25
200 mA - 2 A	0.05 + 100		
2 A – 20 A	0.05 + 2000		

AC power accuracy:	$dP = \sqrt{(dU^2 + dI^2 + dPF^2 + 0.03^2)}$ [%]
DC power accuracy:	$P = \sqrt{(dU^2 + dI^2 + 0.01^2)}$ [%]
Power factor accuracy:	$dPF = (1 - \cos(\varphi+d\varphi)/\cos\varphi) * 100$ [%]

Frequency function

Total frequency range:	0.1 Hz to 20 MHz
Resolution:	6 dig.
Accuracy of frequency:	0.005 %
Mode:	- PWM, square wave signal with calibrated duty cycle ratio, frequency and amplitude
	- HF, square wave signal with calibrated frequency and amplitude

PWM mode   *HF mode*

Voltage range	% of value + uV		Frequency range:	0.1 Hz to 20 MHz
1 mV - 20 mV	0.2 + 5 0		Output impedance:	50 Ω
20 mV - 200 mV	0.1 + 5 0		Output signal shape:	square, symmetrical
			Output signal amplitude:	4 V $_{pk\text{-}pk}$
200 mV - 2 V	0.1		Output amplitude:	0, -10, -20 dB, -30 dB +/- 1 dB
2 V - 10 V	0.1		Amplitude accuracy:	10 %
			Rise and fall time slope:	< 3 ns

RTD temperature sensor simulation

Type	Range –200 - +250 °C	Range 250 – 850 °C			
Pt100	0.1 °C	0.3 °C		Sensor standard:	DIN, US/JS, Ni
Pt200	0.1 °C	0.2 °C		R0 constant setting:	20 Ω to 2 kΩ
Pt1000	0.2 °C	0.4 °C			
Ni100	0.07 °C	- -			

TC temperature sensor simulation

R	Range [°C]	-50 – 0	0 - 400	400 – 1000	1000 – 1767
	Accuracy [°C]	2.0	1.5	0.9	1.0
S	Range [°C]	-50 - 0	0 - 250	250 – 1400	1400 – 1767
	Accuracy [°C]	1.8	1.5	1.0	1.0
B	Range [°C]	400 - 800	800 – 1000	1000 – 1500	1500 – 1820
	Accuracy [°C]	1.9	1.1	1.0	0.9
J	Range [°C]	-210 – -100	-100 – 150	150 – 700	700 – 1200
	Accuracy [°C]	0.6	0.4	0.3	0.4
T	Range [°C]	-200 – -100	-100 - 0	0 – 100	100 – 400
	Accuracy [°C]	0.6	0.4	0.3	0.4
E	Range [°C]	-250 - -100	-100 - 280	280 – 600	600 – 1000
	Accuracy [°C]	0.9	0.3	0.2	0.2
K	Range [°C]	-200 - -100	-100 – 480	480 – 1000	1000 – 1372
	Accuracy [°C]	0.7	0.4	0.4	0.5
N	Range [°C]	-200 - -100	-100 – 0	0 – 580	580 – 1300
	Accuracy [°C]	1.0	0.5	0.5	0.5

Built-in process multimeter

Powertek

Function	Range	Accuracy (%)	Resolution / Range
DC voltage - DCV	0 to ±20 V	0.01 % + 300 µV	100µV / 20V
DC current	0 to ±25 mA	0.015 % + 300 nA	100 nA/20mA
DC voltage - mVDC	0 to ±2 V	0.02 % + 7 µV	20mV / 100nV, 200mV / 1uV, 2V / 10uV
Resistance *	0 to 2.5 k Ω	0.02% + 10 m Ω	20Ω / 1mΩ, 200Ω / 1mΩ, 2kΩ / 10mΩ
Frequency	1 Hz to 15 kHz	0.005	10 µHz – 0.1 Hz
TC temperature sensor simulation	-250 to +1820 ℃	0.4 to 2.5 ℃	0.01 ℃
RTD temperature sensor simulation	-200 to +850 ℃ *3	0.1 ℃	0.1 ℃

* Test current 1mA

General data

Warm up time:	60 min
Working temperature range:	23 ± 10 ℃
Storing temperature range:	0 to 40 ℃ at RH bellow 80 %
Reference temperature :	23 ± 2 ℃
Dimensions:	450 x 480 x 150 mm
Weight:	22 kg
Power supply voltage:	230V - 50Hz
Consumption:	max. 250 VA

Accessories (included)

Power line cable	1 pc	
Operation manual, CD	1 pc	
Option 10/11 Test lead 1000V - 20 A, black/red	2 pcs	Length 1m
Option 40, 60, 70, 80	1 pc	Length 1m
Spare fuse	1 pc	
RS 232 cable	1 pc	Length 1m

Options (extra ordered)

Option 140-50	Current coil 25/50 turns	For clamp ammeters calibration
Option 10	Test lead 20A/1000V (černý)	Length 1m
Option 11	Test lead 20A/1000V (červený)	Length 1m
Option 20	Test cable BNC – BNC	Length 1m
Option 30	Test cable BNC – banana	Length 1m
Option 40	Cable adapter Canon 25 / 2 x banana	For DC voltage/current
Option 60	Cable adapter Canon 25 / 4 x banana	Four wire resistance measurement
Option 70	Four wire cable adapter	Four wire resistance simulation
Option 80	Cable adapter Cannon 25 / 2 x banana	mVDC and TC measurement
Option 90	External sensor	RTD temperature sensor
Option 140-01	Cable adapter with metal pad for test unit	Contains Pt100 sensor for ambient temperature measurement and cold junction compensation.
Cable GPIB	GPIB cable	Length 1m
Cable RS-232	RS-232 cable	Length 1m
WinQbase	Database software for meter calibration	
CALIBER	Software for automatic calibration of meter	