

M133 / M133i Power/Energy Calibrator



- DC/AC voltage “phase-neutral” 1V to 280V / 300mA, accuracy 250 ppm
- AC voltage “phase – phase” in the 3phase system 2V to 480V
- DC/AC current 8mA to 30A / 5V, accuracy 350 ppm
- Power factor setting -1 to +1
- Harmonic, interharmonic distortion, modulation
- Frequency range 15Hz to 1kHz
- Simulated electric power to 8.4 kVA (280 kVA with option 140-50)
- Built-in process multimeter
- GPIB & RS232 interface

M133 / M133i Power/energy calibrator is one phase calibrator of electric power and energy.

M133 contains option for generation of distorted signals with defined parameters. The option application field is focused to the field of calibration of power quality analyzers.

M133i is delivered without the Power quality functions.

Basic feature of the device is precise simulation of DC and AC electric power and energy in voltage range to 280V and in current range to 30 A. In AC electric power mode phase shift between voltage and current channel can be set in range 0° to 360°. Best accuracy of simulation is 0.044%. Calibrator offers high burden current of voltage output of several hundreds mA and compliance voltage of current output up to 5Vrms. Current range can be extended using Option 140-50 50 turns current coil up to 1000 A.

M133 calibrator is equipped with special functions for power line voltage analyzers testing. It can generate calibrated harmonic and interharmonic distortion, fluctuation harmonics, flickers, ramp signals and others. User interface offers simple and user convenient programming of output signal parameters.

Technical data

DC/AC voltage sinus

Voltage range:	1 V to 280 V
Resolution:	5½ dig.
Frequency range:	DC, 15 Hz to 1000 Hz. For 50/60 Hz synchronization to mains frequency is available.
Frequency accuracy:	0.005%
Frequency resolution:	0.001 Hz bellow 40 Hz, 0.01 Hz above 40 Hz
Distortion of output signal:	< 0.05 %

Range	% of value + % of range	Max. burden (mA)	% of value + % of range	Max. burden (mA)	% of value + % of range	Max. burden (mA)
	<i>DC</i>	<i>DC</i>	<i>15 - 40 Hz 70 - 1000 Hz</i>	<i>15 - 40 Hz 400 - 1000 Hz</i>	<i>40 - 70 Hz</i>	<i>40 - 400 Hz</i>
1.0000 - 10.0000 V	0.015 + 0.01	100	0.02 + 0.01	100	0.015 + 0.01	100
10.0001 - 30.0000 V	0.015 + 0.01	200	0.02 + 0.01	200	0.015 + 0.01	200
30.001 - 70.000 V	0.015 + 0.01	200	0.02 + 0.01	200	0.015 + 0.01	300
70.001 - 140.000 V	0.015 + 0.01	200	0.02 + 0.01	200	0.015 + 0.01	300
140.001 - 280.000 V	0.015 + 0.01	150	0.02 + 0.01	150	0.015 + 0.01	200

DC/AC current sinus

Current range:	0.008 A to 30 A
Resolution:	5½ dig.
Frequency range:	DC, 15 Hz to 1000 Hz. For 50/60 Hz synchronization to mains frequency is available.
Frequency accuracy:	0.005%
Frequency resolution:	0.001 Hz bellow 40 Hz, 0.01 Hz above 40 Hz
Distortion of output signal:	< 0.1 %

Range	% of value + % of range	Max. voltage (V)	% of value + % of range	% of value + % of range	Max. voltage (V)	Max. voltage (V)
	<i>DC</i>	<i>DC</i>	<i>15 - 40 Hz 70 - 1000 Hz</i>	<i>40 - 70 Hz</i>	<i>15 - 400 Hz</i>	<i>400 - 1000 Hz</i>
0.030000 - 0.300000 A	0.025 + 0.01	8	0.03 + 0.02	0.025 + 0.01	5.5	3.5
0.30001 - 1.00000 A	0.025 + 0.01	8	0.03 + 0.02	0.025 + 0.01	5.5	3.5
1.00001 - 2.00000 A	0.025 + 0.01	8	0.03 + 0.02	0.025 + 0.01	5.5	3.5
2.00001 - 5.00000 A	0.025 + 0.01	5	0.03 + 0.02	0.025 + 0.01	3.5	3.5
5.0001 - 10.0000 A	0.03 + 0.015	5	0.04 + 0.02	0.03 + 0.015	3.5	3.5
10.0001 - 30.0000 A	0.035 + 0.015	5	0.05 + 0.02	0.035 + 0.015	3.5	3.5

Additional uncertainty with applied current coil Opt.140-50 is 0.3 %. Output current is multiplied by factor 50.

Phase shift voltage/current - Power factor

Phase shift range:	0.00° to +359.99°
Frequency range:	15 Hz to 1000 Hz
Phase shift resolution:	0.01°
Power factor range:	-1 to +1
Power factor resolution:	0.001
Power factor accuracy:	dPF = (1 - cos(φ+dφ))/cos(φ) (-)

Phase shift accuracy φ (internal synchronization)

Frequency (Hz)	Current (A)	Accuracy dφ (°)
15.000 - 70.000	0.1 - 10	0.02
15.000 - 70.000	0.008 - 0.029999	0.1
15.000 - 70.000	0.030 - 0.099999 10.0001 - 30	0.05
70.001 - 400.000	0.008 - 30	0.1
400.001 - 1000.00	0.008 - 30	0.4

DC electric power

Total range:	0.008 W to 8400 W (280 kW with current coil option 140-50)
Quantity:	W

DC electric power accuracy (%)					
Current	Voltage				
	10 V	30 V	70 V	140 V	280 V
300mA	0.044	0.044	0.044	0.044	0.044
1 A	0.044	0.044	0.044	0.044	0.044
2 A	0.044	0.044	0.044	0.044	0.044
5 A	0.044	0.044	0.044	0.044	0.044
10 A	0.052	0.052	0.052	0.052	0.052
30 A	0.057	0.057	0.057	0.057	0.057

AC electric power *

Total range: 0.008VA to 8400 VA (280 kVA with current coil option 140-50)
 Frequency range: 15Hz to 1000Hz
 Quantity: W, VA, VAr

AC electric power accuracy (%) for PF = 1.0 f = 40 – 70 Hz					
Current	Voltage				
	10 V	30 V	70 V	140 V	280 V
300mA	0.044	0.044	0.044	0.044	0.044
1 A	0.044	0.044	0.044	0.044	0.044
5 A	0.044	0.044	0.044	0.044	0.044
10 A	0.052	0.052	0.052	0.052	0.052
30 A	0.057	0.057	0.057	0.057	0.057

AC electric power accuracy (%) for PF = 0.8 f = 40 – 70 Hz					
Current	Voltage				
	10 V	30 V	70 V	140 V	280 V
300mA	0.051	0.051	0.051	0.051	0.051
1 A	0.051	0.051	0.051	0.051	0.051
5 A	0.051	0.051	0.051	0.051	0.051
10 A	0.059	0.059	0.059	0.059	0.059
30 A	0.087	0.087	0.087	0.087	0.087

AC electric power accuracy (%) for PF = 0.5 f = 40 – 70 Hz					
Current	Voltage				
	10 V	30 V	70 V	140 V	280 V
300mA	0.075	0.075	0.075	0.075	0.075
1 A	0.075	0.075	0.075	0.075	0.075
5 A	0.075	0.075	0.075	0.075	0.075
10 A	0.080	0.080	0.080	0.080	0.080
30 A	0.160	0.160	0.160	0.160	0.160

Electric power accuracy is calculated according to formula: $dP/P = \sqrt{(dU/U)^2 + (dI/I)^2 + (dPF/P)^2 + 0.01^2}$ (%)

DC/AC electric energy

Voltage range: 1 V to 280 V
 Current range: 0.008 A to 30 A
 Power factor range: - 1 to + 1
 Time interval setting: 1 s to 10 000 s
 Time interval resolution: 0.1 s
 Time interval accuracy: 0.01% + 0.1s

Power quality functions (model M133 only)

Harmonic and interharmonic distortion *1 (H/I products)

Fundamental harmonic frequency range: 15 Hz to 1 kHz
 Fundamental harmonic amplitude uncertainty: 0.2 % of range
 Frequency range of harmonic products: 30 Hz to 5 kHz
 Frequency range of interharmonic product: 15 Hz to 1 kHz
 Max. number of harmonic products: 50
 Number of interharmonic products: 1
 Frequency uncertainty: 0.005 %
 H/I products amplitude range: max. 30% of RMS output value
 Amplitude resolution of H/I products: 0.001 %
 Noise & distortion: - 60 dB

Accuracy of H/I products amplitude

Ranges	% of range	
	30 - 3000 Hz	3000 - 5000 Hz
1.0000 - 10.0000 V	0.1	0.2
10.0001 - 30.0000 V		
30.0001 - 70.0000 V		
70.0001 - 140.0000 V		
140.0001 - 280.0000 V		
0.008000 - 0.300000 A	0.1	0.2
0.300001 - 1.000000 A		
1.000001 - 2.000000 A		
2.000001 - 5.000000 A	0.2	0.4
5.000001 - 10.000000 A		
10.000001 - 30.000000 A	0.2	0.8

Modulation, Flicker *1

Fundamental harmonic frequency range: 15 Hz to 1 kHz
 Single harmonic (2-50) frequency range: 30 Hz to 5 kHz
 Modulation frequency range: 0.001 Hz to 50 Hz
 Modulation depth: 0 to 30%
 Modulation depth resolution: 0.001%
 RMS amplitude uncertainty: 0.2% of range
 Waveform of modulation signal: sinus, rectangular
 Duty cycle ratio of rectangular signal: 1 % to 99 %
 Modulation depth accuracy: 0.2 %

Dip/Swell *1

AC voltage range:	0.1 V ... 280 V
AC current range:	1 mA ... 30 A
Amplitude uncertainty:	0.2 % of range *2
Frequency range:	15 Hz ... 1 kHz

Timing *3

t1 range:	0 s ... 60 s
t2 range:	0.1 ms ... 60 s
t3 range:	2 ms ... 60 s
t4 range:	0.1 ms ... 60 s
t5 range:	0 s ... 60 s

*1 available only for M133.

*2 range is defined according to the highest level of generated signal

*3 $t1 + t5 > 2$ ms

Built in process multimeter

Function	Range	Accuracy	Resolution
DC voltage	0 to ± 12 V	0.01 % + 0.01 %	100 μ V
DC current	0 to ± 25 mA	0.01 % + 0.01 %	100 nA
Frequency	1 Hz to 15 kHz	0.005 %	10 μ Hz – 0.1 Hz

General data

Warm up time:	60 min
Operating temperature:	23 \pm 10 $^{\circ}$ C
Storage temperature:	-10 to 55 $^{\circ}$ C, humidity < 90 %
Reference temperature:	23 \pm 2 $^{\circ}$ C
Dimensions:	460 x 580 x 320 mm
Netto weight:	27 kg
Power supply:	115/230V – 50/60 Hz
Power consumption:	max. 550 VA
Safety class:	I according EN 61010

Accessory (included)

Power supply cable	1 pc	
Operation manual, CD	1 pc	
Option 10/11 Test lead 1000V - 30 A, black/red	4 pc	Length 1m
Spare fuse	1 pc	
RS 232 cable	1 pc	Length 1.5m

Options (extra ordered)

Option 140-50	Current coil 25/50 turns	For clamp ammeters
Option 10	Test lead 1000V/32A (black)	Length 1m
Option 11	Test lead 1000V/32A (red)	Length 1m
GPIB cable	GPIB interface cable	Length 1 m
RS-232 cable	RS-232 interface cable	Length 1.5 m
POWER	Application SW. Transducers calibration.	

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