- ✓ **DC and AC Voltages**
- ✓ **DC and AC Currents**
- ✓ **Power and Energy Calibration**
- ✓ **cos φ free selectable**
- ✓ **Digital Camera automatic Calibration**
- ✓ **RTD, Ni and Thermocouples**
- ✓ **Resistors and Capacitors**
- ✓ **Frequency generation**
- ✓ **IEEE 488, RS232**

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 thermo-couples and RTD sensors is provided.
OCM-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, oscillo-scopes, thermometers, dataloggers, X-Y recorders, etc.

A built-in multimeter function can be utilized for simultaneous testing-calibration of transmitters, regulators and other controllers without the need of using supporting equipment.

VOLTAGE and CURRENT
The main function of the calibrator 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%.

DIGITAL CAMERA
For calibration of multimeters with LCD display a digital camera is available. The LCD display of the multimeter is scanned by the camera and the measurements directly incorporated into the calibration software. By using *WinQbase* and *Caliber* Software an automatic calibration system with generation of calibration protocols can be achieved.

POWER and ENERGY
For calibration of energy measuring instruments with isolated voltage and current circuits the energy mode can be selected.. The voltage is adjustable from 0,2V to 240V, the current from 2mA to 10A and the time 10 to 1999 sec.
DC or AC Wattmeters and electro-meters can be calibrated up to 240V and 20A with a phase setting -1 to +1 with a resolution of 0,1% within a frequency range of 20Hz to 400Hz. The voltage output can be loaded with 30mA, permitting calibration of classic analog wattmeters.

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

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

Precision frequency output 0.1Hz to 100kHz with adjustable amplitude 1mV to 10V is suitable for calibration of input characteristics of instruments, analog circuits, signal conditioners etc. Digital frequency TTL output 0.1Hz to 20MHz with fast edges is generated for frequency calibration purposes such as calibration of digital counters, oscilloscopes, filters, delay lines and other digital and analog circuits.

Simulation of RTD thermometers and DIN thermocouples R, S, B, J, K, T, E, and N is a standard function. The cold junction can be set with the keyboard directly as temperature or can be compensated automatically at the input terminals. The accuracy of the RTD thermometers is 0.04ºC to 0.5ºC. The accuracy of thermocouples is 0.4ºC to 2.9ºC.

Output ports GPIB - IEEE488 and RS232 are standard and permit the calibrator to operate in automatic testing lines.

OPERATION

The instrument is operated via the keyboard at the front. The entry is supported by a large scale display with concentrated information.
Standard functions are integrated which simplify the operation during the calibration, such as entry of the absolute and relative tolerance and error band, calibration sequences, two- or four wire connections, grounding of terminals and other. Some of the keys are directly assigned to frequently used functions. IEEE488 and RS232 make the instrument suitable for automatic calibrating operation.

BUILT-IN MULTIMETER

A multimeter with inputs 0-20mA and 0-10V has an accuracy of 0.01% and is suitable for feedback measurement of standardized process signals from transmitters which are under test or calibration.

CALIBRATOR - TESTER

OCM-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 controlling of additional equipment.

EASY TO USE

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

The large-scale color display shows the value of the generated output signal, selected parameters, and accuracy of the momentary generated signal as well as other additional information. Some of the keys are directly assigned to frequently used functions.

SPECIFICATIONS

The stated errors are defined for an ambient temperature of 23 ºC ± 2 ºC and after a warm-up time of 60 minutes. They contain the long time stability, the temperature coefficient, the load characteristics, the mains stability and the traceability to the national standards. The parameters are valid for 12 month.

DC - VOLTAGE		DC – CURRENT	
Range	% of Value + % of Range	Range	% of Value + % of Range
0 μV - 20mV	0.05+0.0+10μV	0μA - 200μA	0.05+0.0+20nA
20mV - 200mV	0.03+0.0+10 μV	200μA - 2mA	0.02+0.005
200mV - 2V	0.003+0.0008	2mA - 20mA	0.01+0.003
2V - 20V	0.003+0.0005	20mA - 200mA	0.01+0.003
20V - 240V	0.003+0.0005	200mA - 2A	0.015+0.005
240V - 1000V	0.003+0.0005	2A - 10A	0.02+0.01
		10A - 20A [2]	0.02+0.01

AC - VOLTAGE			AC - CURRENT		
Range	% of Values + % of Range	% of Value + % of Range	Range	% of Value + % of Range	% of Value + % of Range
	20Hz - 10kHz	10kHz - 50kHz		20Hz - 1kHz	1kHz - 5kHz
1mV - 20mV	0.2+0.05+20μV	0.2+0.1+20 μV	1μA - 200μA	0.15+0.0+20nA	0.3+0.1+20 nA
20mV - 200mV	0.1+0.03+20 μV	0.15+0.05+20 μV	200μA - 2mA	0.07+0.01	0.2+0.05
200mV - 2V	0.025+0.0	0.05+0.01	2mA - 20mA	0.05+0.005	0.2+0.05
2V - 20V	0.025+0.005	0.1+0.03	20mA - 200mA	0.05+0.005	0.2+0.05
20V - 240V	0.025+0.01	---	200mA - 2A	0.05+0.005	---
240V - 1000V	0.03+0.02 [1]	---	2A - 10A	0.1+0.03	---
			10A - 20A [2]	0.1+0.03	---

[1] valid for f < 1000 Hz

[2] with OUTPUT-ON can ON/OFF be max. 1/10.
Continuous Output of 20A for max. 30 sec.

By using the 500A-coil (Option M140-50) the corresponding ranges have to be multiplied by 50. Additional inaccuracy of 0.3% from value has to be added to the specifications.

FUNCTION SHAPE

Voltage Range	1mV to 200V
Current Range:	100µA to 2A
Output Type of Signal:	Squarewave positive, negative or symmetrical, saw, triangle and sine wave with cut tops.
Accuracy of the Amplitude:	0.3%

RESISTORS (selectable to 5 decimal points)
Ranges: 0 Ohm - 50 MOhm

CAPACITY (selectable to 5 decimal points)
Ranges: 900 pF - 50 µF

RESISTORS		CAPACITY		
Range	Accuracy (% of Value)	Range	Accuracy (% of Value)	Max. Frequency (Hz)
0Ω - 100Ω	0.03 + 10mΩ	900pF - 2.5nF	0.5 + 15pF	1000
100Ω - 400Ω	0.015	2.5nF - 10nF	0.5	1000
400Ω - 2kΩ	0.015	10nF - 50nF	0.5	1000
2kΩ - 10kΩ	0.015	50nF- 250nF	0.5	1000
10kΩ - 40kΩ	0.015	250nF - 1µF	0.5	1000
40kΩ - 200kΩ	0.015	1µF - 3.5 µF	1	300
200kΩ - 1MΩ	0.03	3.5 µF - 5µF	1	300
1MΩ - 4MΩ	0.03	5 µF - 10µF	1.5	300
4MΩ - 20MΩ	0.05	10 µF - 50 µF	1.5	300
20MΩ - 50MΩ	0.2			

Max. voltage across the load is 8V p-p   Max. voltage across the load is 8V p-p

FREQUENCY						
Type	Frequency Range	Frequency Accuracy	Amplitude	Amplitude Accuracy	Ratio	Ratio Accuracy
PWM (POS, NEG, SYM)	0.1 Hz-100 kHz	0.005 %	1mV-10V	0.1%	0.1 - 0.99	0.0005
HF [1]	0.1 Hz - 20 MHz	0.005 %	5V s-s	10	--	--

[1] rise time < 5 ns

Frequency Output with constant Amplitude
Output Impedance < 100 Ω.
Frequency selection to 3 decimal points

Frequency Output with variable Amplitude
Output Impedance: 10V Range: < 200 mΩ
                         Other Ranges: < 100 Ω.

DC – POWER and ENERGY		
Output	Range	Accuracy (%)
Voltage	0.2V - 240V	0.004 to 0.015
Current	2mA - 10A	0.05 to 0.15

AC – POWER and ENERGY		
Output	Range	Accuracy (%)
Voltage	0.2V - 240V	0.03 - 0.12
Current	2mA - 10A	0.05 - 0.15
Frequency	40 - 400 Hz	0.005%
cos φ	-1 … +1	0.005 - 0.0005
Phase	0 - 360 °	0.15 - 0.25

In the energy mode of operation the time can be set from 10 sec to 1999 sec.
The accuracy at the AC Power depends on the set Voltage, Current and Phase. The best accuracy is 0.08%.
The accuracy in the Energy Mode of operation depends on the set Voltage, Current, Phase and Time. The best accuracy is 0.09%.

TEMPERATURE SENSORS

The RTD Thermometers and the Thermocouples are in accordance with IST 90, PTS 68.

RTD Thermometers:	Pt 1.385, Pt 1.392, Ni	Temperature Range:	-200 to +850 °C
Range of the RO constant:	20 Ω to 2 kΩ	Temperature Accuracy:	0.04 °C to 0.5 °C

THERMOCOUPLES					
R	Range (°C)	-50 ... 0	0 ... 400	400 ... 1000	1000 ... 1770
	Max. Error (°C)	2.9	2.1	1.4	1.7
S	Range (°C)	-50 ... 0	0 ... 250	250 ... 1400	1400 ... 1770
	Max. Error (°C)	2.7	2.1	1.7	2.0
B	Range (°C)	400 ... 800	800 ... 1000	1000 ... 1500	1500 ... 1820
	Max. Error (°C)	2.8	1.8	1.6	1.8
J	Range (°C)	-210 ... -100	-100 ... 150	150 ... 700	700 ... 1200
	Max. Error (°C)	0.9	0.5	0.6	0.7
T	Range (°C)	-200 ... -100	-100 ... 0	0 ... 100	100 ... 400
	Max. Error (°C)	0.9	0.5	0.4	0.4
E	Range (°C)	-250 ... -100	-100 ... 280	280 ... 600	600 ... 1000
	Max. Error (°C)	1.6	0.4	0.5	0.5
K	Range (°C)	-200 ... -100	-100 ... 480	480 ... 1000	1000 ... 1372
	Max. Error (°C)	1.0	0.6	0.7	0.8
N	Range (°C)	-200 ... -100	-100 ... 0	0 ... 580	580 ... 1300
	Max. Error (°C)	1.2	0.7	0.6	0.8

MULTIMETER		
Type	Range	Accuracy
DC - Voltage (V)	0 ... ± 12V	0.01% + 300 μV
DC - Voltage (mV)	0 ... ± 2V	0.02% + 7μV
DC – Current	0 ... ± 25mA	0.015% + 300 nA
Frequency	1 Hz - 15 kHz	0.005%
Resistor	0 ... 2 kOhm	0.02% + 10 mΩ
Temperature (Pt Sensor)	-150 ... +600 °C	0.1 °C
Temperature (T/C Sensor)	-250 ... +1820 °C	0.4 to 4 °C, depends on sensor
Strain Gauge Sensors *1	Depends on the sensor type	0.05% + 10 μV + sensor error

*1   Voltage: 2-10V
     Max. Current: 40mA
     Input Impedance: min. 100 MOhm
     Sensitivity: 0.5 to 100 mV/V
     Display units: selectable
     Output Function: Relay

ADDITIONAL SPECIFICATIONS

Warm-up time for full specs:	60 min.
Working Temperature:	23 ± 10 °C
Storing Temperature:	0 to 40 °C @ max. 80 % r.F.
Reference Temperature:	23 °C ± 2 °C
Ambient Pressure:	860 to 1060 HPa
Dimensions:	450 x 480 x 150 mm, weight 28 kg
Supply:	115V/230V, ± 10%, 50-60Hz, 250 VA at full loa

Current Coil Option 140-50 for calibration of clamp amperemeters.