

# MCS100

Modular Calibration System



**beamex**  
WORLD-CLASS CALIBRATION SOLUTIONS™



# MCS100 Modular

**MCS100 is a modular test and calibration system for workshops and laboratories. Available as a workstation, desktop cabinet or trolley, MCS100 offers efficient and ergonomic facilities for the maintenance of process instruments.**

## **▶ Many applications**

MCS100 Workstation offers a solution for a large variety of applications, such as calibration of pressure, temperature and electrical signals; electrical tests and measurements; maintenance & testing of single and 3-phase motors and other electric devices; soldering and desoldering of surface mounted and traditional components; safety & high voltage testers; educational use, etc.





# Calibration System

## ▶ Safe and ergonomic

MCS100 Workstation offers a safe environment with maximum working space as all equipment is mounted in the panel, and loose instruments and components can be placed on their own shelves and compartments.

The tabletop and module rack can be mounted to a user-defined height. Lighting is a standard feature, and AC socket outlets are within easy reach.

## ▶ Versatile

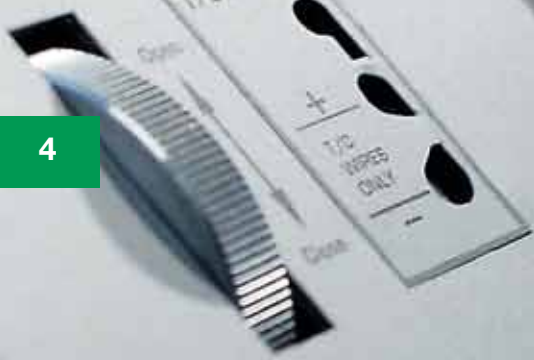
The module rack hosts a great variety of modules including calibration modules, AC & DC power supplies, multimeters, function generators, oscilloscopes, etc. This makes the MCS100 Workstation ideal for both instrument and electrical workshops, as well as for use in laboratories.

## ▶ ESD protected

Electrostatic discharges cause problems to electrical components, e.g. in repair and production facilities. MCS100 is a safe choice for places where sensitive components are handled. MCS100 Workstation and its accessories are supplied with an electrically semiconducting coat of paint. For full ESD protection, a semiconducting tabletop, ESD wrist straps, mats and grounding sets are available.

TEMPERATURE MODULE  
555P

INTERNAL REFERENCE JUNCTION  
FOR THERMOCOUPLES



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INPUT MEASURE & SIMULATE OUTPUT



555P

# Technical specification for MC5P host module

## Electrical Measurement

Function	Range	Resolution	1 Year Uncertainty ( $\pm$ ) <sup>1)</sup>
mV measurement <sup>2)</sup>	$\pm 1000$ mV	0.001–0.01 mV	0.02% RDG + 5 $\mu$ V
V measurement <sup>3)</sup>	$\pm 50$ V	0.00001–0.001 V	0.02% RDG + 0.25 mV
mA measurement <sup>4)</sup>	$\pm 100$ mA	0.0001–0.001 mA	0.02% RDG + 1.5 $\mu$ A
Hz measurement <sup>5)</sup>	0.0028 to 50 000 Hz	0.000001–0.1 Hz	0.01% RDG
Pulse counting <sup>5)</sup>	0 to 9 999 999 pulses	1 pulse	N/A
mA generation <sup>6)</sup>	0 to 25 mA	0.0001 mA	0.02% RDG + 1.5 $\mu$ A

<sup>1)</sup> Uncertainty includes reference standard uncertainty, hysteresis, nonlinearity, repeatability and typical long term stability for mentioned period. (k=2)

<sup>2)</sup> Bias current <10 nA

<sup>3)</sup> Impedance >1 Mohm

<sup>4)</sup> Impedance <7.5 ohm

<sup>5)</sup> Impedance >1 Mohm. Frequency measurement minimum amplitude 0.5 Vpp (< 5 kHz), 1Vpp (5...50 kHz). Pulse counting minimum amplitude 0.5 Vpp (pulse length > 100  $\mu$ s), 1 Vpp (pulse length 100  $\mu$ s...10  $\mu$ s). Trigger level range –1...+15 V.

<sup>6)</sup> Maximum load impedance 800 ohm

**Multichannel datalogging:** The MC5P host module can scan up to 7 datalogging channels for electrical, temperature and pressure signals, storing up to 70 000 results (option). The accompanying software allows storing the results onto the computer hard disk and viewing in graphical form. It also allows data export to spreadsheet programs.

**HART®:** The HART® option includes the 250 ohm resistor needed when the 24 VDC loop supply is used. The functions include both reading the HART® signal, editing parameters as well as sensor trimming for a great number of HART® instruments.

# Technical specification for ET module

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## Electrical Generation and Measurement

Function	Range	Resolution	1 Year Uncertainty ( $\pm$ ) <sup>1)</sup>
mV generation <sup>2)</sup>	$\pm 500$ mV	0.001–0.01 mV	0.02% RDG + 4 $\mu$ V
V generation <sup>3)</sup>	$\pm 12$ V	0.00001–0.0001 V	0.02% RDG + 0.1 mV
mA generation <sup>4)</sup>	$\pm 25$ mA	0.0001 mA	0.02% RDG + 1 $\mu$ A
Hz generation <sup>5)</sup>	0.00028 to 50 000 Hz	0.000001–0.1 Hz	0.01% RDG
Pulse generation <sup>6)</sup>	0 to 9 999 999 pulses	1 pulse	N/A
Ohm simulation <sup>7)</sup>	1 to 4000 ohm	0.01–0.1 ohm	0.04% RDG or 30 mohm 8)
Ohm measurement <sup>9)</sup>	0 to 4000 ohm	0.001–0.1 ohm	0.02% RDG + 3.5 mohm
mV measurement <sup>10)</sup>	$\pm 500$ mV	0.001–0.01 mV	0.02% RDG + 4 $\mu$ V

<sup>1)</sup> Uncertainty includes reference standard uncertainty, hysteresis, nonlinearity, repeatability and typical long term stability for mentioned period. (k=2)

<sup>2)</sup> Load effect < 5  $\mu$ V/mA. Maximum output current 5 mA.

<sup>3)</sup> Load effect < 100  $\mu$ V/mA. Maximum output current 10 mA (0 .. 10 V), 3 mA (10 .. 12 V).

<sup>4)</sup> Maximum load impedance 400 ohm.

<sup>5)</sup> Amplitude range 0 .. 12 Vpp. Amplitude setting accuracy up to 5 kHz  $\pm$ (200 mV + 5% of set value). Waveforms: Square wave (positive / symmetric) and sinewave (above 40 Hz).

<sup>6)</sup> Pulse generation frequency range 0.1 ... 1000 Hz. Amplitude setting 0 ... 12 Vpp.

<sup>7)</sup> Valid with measurement current 0.2 ... 5 mA (1 ... 1000 ohm), 0.1 ... 1 mA (1 ... 4 kohm). Ohm/RTD simulation speed 1 ms.

<sup>8)</sup> Which ever is greater.

<sup>9)</sup> Specification valid with 4 wire connection. In 3 wire connection add 10 mohm.

<sup>10)</sup> Bias current < 10 nA.

## RTD Measurement and Simulation

Type	Range	Range	Measurement 1 Year Uncertainty ( $\pm$ ) <sup>1)</sup>	Simulation 1 Year Uncertainty ( $\pm$ ) <sup>1)</sup>
Pt-sensors	–200 to 850°C	–200 to 0°C 0 to 850°C	0.06°C 0.025% RDG + 0.06°C	0.1°C 0.025% RDG + 0.1°C
Resolution 0.01°C				

Other RTD types available as standard

- Pt50 (385)      • Pt500 (385)      • Pt100 (391)      • Ni100 (618)
- Pt100 (385)    • Pt1000 (385)    • Pt100 (375)      • Ni120 (672)
- Pt200 (385)    • Pt100 (3923)    • Pt100 (3926)    • Cu10 (427)
- Pt400 (385)    • Pt100 (389)

RTD/ohm simulation excitation current 0.2 ... 5 mA (1...1000 ohm), 0.1...1 mA (1 ... 4 kohm).  
Also other RTD types available as option

## Thermocouple Measurement and Simulation

Type	Range (°C)	Range (°C)	1 Year Uncertainty (±) <sup>1)</sup>
B <sup>2)</sup>	0 to 1820	0 to 200	<sup>3)</sup>
		200 to 500	2.0°C
		500 to 800	0.8°C,
		800 to 1820	0.6°C
R <sup>2)</sup>	-50 to 1768	-50 to 0	1.0°C
		0 to 150	0.7°C
		150 to 1400	0.5°C
		1400 to 1768	0.6°C
S <sup>2)</sup>	-50 to 1768	-50 to 0	1.0°C
		0 to 50	0.7°C
		50 to 1500	0.6°C
		1500 to 1768	0.7°C
E <sup>2)</sup>	-270 to 1000	-270 to -200	<sup>3)</sup>
		-200 to 0	0.08% RDG + 0.07°C
		0 to 600	0.015% RDG + 0.07°C
		600 to 1000	0.026% RDG
J <sup>2)</sup>	-210 to 1200	-210 to -200	<sup>3)</sup>
		-200 to 0	0.07% RDG + 0.08°C
		0 to 1200	0.02% RDG + 0.08°C
K <sup>2)</sup>	-270 to 1372	-270 to -200	<sup>3)</sup>
		-200 to 0	0.1% RDG + 0.1°C
		0 to 1000	0.02% RDG + 0.1°C
N <sup>2)</sup>	-270 to 1300	1000 to 1372	0.03% RDG
		-270 to -200	<sup>3)</sup>
		-200 to -100	0.2% RDG
		-100 to 0	0.05% RDG + 0.15°C
T <sup>2)</sup>	-270 to 400	0 to 750	0.01% RDG + 0.15°C
		750 to 1300	0.03% RDG
		-270 to -250	<sup>3)</sup>
		-250 to -200	0.7°C
U <sup>4)</sup>	-200 to 600	-200 to 0	0.1% RDG + 0.1°C
		0 to 400	0.01% RDG + 0.1°C
		0 to 600	0.01% RDG + 0.15°C
L <sup>4)</sup>	-200 to 900	-200 to 0	0.07% RDG + 0.13°C
		0 to 900	0.02% RDG + 0.13°C

Resolution 0.01°C.

With internal reference junction (module RJ) add 0.1°C uncertainty.

Thermocouple types C3) (ASTM E 988-96), G3) (ASTM E 1751-95e1) and D3) (ASTM E 988-96) also available as standard.  
Also other thermocouple types available as option.

<sup>1)</sup> Uncertainty includes reference standard uncertainty, hysteresis, nonlinearity, repeatability and typical long term stability for mentioned period. (k = 2)

<sup>2)</sup> IEC 584, NIST MN 175, BS 4937, ANSI MC96.1

<sup>3)</sup> ±(0.02% of thermovoltage + 4µV)

<sup>4)</sup> DIN 43710

## Reference Junction Module (RJ)

Ambient temperature range	1 Year Uncertainty (±) <sup>1)</sup>
-10 .. 50°C	0.1°C

1) RJ module uncertainty is to be added to the uncertainty of the thermocouple used.

# Technical specification for PM modules

## Pressure Measurement

Internal Modules	Internal Modules	Range <sup>1)</sup>	Resolution	Accuracy <sup>2)</sup> (±)	1 Year Uncertainty (±) <sup>3)</sup>
PM B	EXT B	80 to 120 kPa a	0.01	0.03 kPa	0.05 kPa
		800 to 1200 mbar a	0.1	0.3 mbar	0.5 mbar
		11.6 to 17.4 psi a	0.001	0.0044 psi	0.0073 psi
PM10mD	EXT10mD	±1 kPa diff	0.0001	0.05% Span	0.05% Span + 0.1% RDG
		±10 mbar diff	0.001		
		±4 iwc diff	0.001		
PM100m	EXT100m	0 to 10 kPa	0.0001	0.015% FS + 0.0125% RDG	0.025% FS + 0.025% RDG
		0 to 100 mbar	0.001		
		0 to 40 iwc	0.001		
PM400mC	EXT400mC	±40 kPa	0.001	0.01% FS + 0.0125% RDG	0.02% FS + 0.025% RDG
		±400 mbar	0.01		
		±160 iwc	0.001		
PM1C	EXT1C	±100 kPa	0.001	0.007% FS + 0.0125% RDG	0.015% FS + 0.025% RDG
		±1 bar	0.00001		
		-14.5 to 15 psi	0.0001		
PM2C	EXT2C	-100 to 200 kPa	0.001	0.005% FS + 0.01% RDG	0.01% FS + 0.025% RDG
		-1 to 2 bar	0.00001		
		-14.5 to 30 psi	0.0001		
PM6C	EXT6C	-100 to 600 kPa	0.01	0.005% FS + 0.01% RDG	0.01% FS + 0.025% RDG
		-1 to 6 bar	0.0001		
		-14.5 to 90 psi	0.001		
PM20C	EXT20C	-100 to 2000 kPa	0.01	0.005% FS + 0.01% RDG	0.01% FS + 0.025% RDG
		-1 to 20 bar	0.0001		
		-14.5 to 300 psi	0.001		
PM60	EXT60	0 to 6000 kPa	0.1	0.005% FS + 0.0125% RDG	0.01% FS + 0.025% RDG
		0 to 60 bar	0.001		
		0 to 900 psi	0.01		
PM100	EXT100	0 to 10 MPa	0.0001	0.005% FS + 0.0125% RDG	0.01% FS + 0.025% RDG
		0 to 100 bar	0.001		
		0 to 1500 psi	0.01		
PM160	EXT160	0 to 16 MPa	0.0001	0.005% FS + 0.0125% RDG	0.01% FS + 0.025% RDG
		0 to 160 bar	0.001		
		0 to 2400 psi	0.01		
PM250	EXT250	0 to 25 MPa	0.001	0.007% FS + 0.0125% RDG	0.015% FS + 0.025% RDG
		0 to 250 bar	0.01		
		0 to 3700 psi	0.1		
PM600	EXT600	0 to 60 MPa	0.001	0.007% FS + 0.01% RDG	0.015% FS + 0.025% RDG
		0 to 600 bar	0.01		
		0 to 9000 psi	0.1		
-	EXT1000	0 to 100 MPa	0.001	0.007% FS + 0.01% RDG	0.015% FS + 0.025% RDG
		0 to 1000 bar	0.01		
		0 to 15 000 psi	0.1		

Temperature coefficient ±0.001 % Rdg/°C outside 15 ... 35°C (59 ... 95 °F)  
 PM10mD / EXT10mD < ±0.002 % Span/°C outside 15 ... 35°C (59 ... 95°F)

<sup>1)</sup> Every internal/external pressure module's range may be displayed also in absolute pressure if the Barometric Module (B) is installed

<sup>2)</sup> 'Accuracy' includes hysteresis, nonlinearity, repeatability and reference standard uncertainty (k=2)

<sup>3)</sup> '1 Year Uncertainty' includes hysteresis, nonlinearity, repeatability and typical long term stability for mentioned period. (k=2)

**All external pressure modules (EXT) are also compatible with the Beamex® MC5, MC4 and MC2 Calibrators.**

Supports the following pressure units as standard:

Pa, hPa, kPa, MPa, mbar, bar, lbf/ft<sup>2</sup>, psi, gf/cm<sup>2</sup>, kgf/m<sup>2</sup>, kp/cm<sup>2</sup>, at, mmH<sub>2</sub>O, cmH<sub>2</sub>O, mH<sub>2</sub>O, iwc, ftH<sub>2</sub>O, mmHg, cmHg, mHg, inHg, mmHg(0°C), inHg(0°C), mmH<sub>2</sub>O(4°C), inH<sub>2</sub>O(4°C), ftH<sub>2</sub>O(4°C), inH<sub>2</sub>O(60°F), mmH<sub>2</sub>O(68°F), inH<sub>2</sub>O(68°F), ftH<sub>2</sub>O(68°F), torr, atm.

PM B / EXT B; M5 (10/32") female. PM10mD and EXT10mD; Two M5 (10/32") female threads with a hose nipple included.

PM100m/EXT100m – PM20C/EXT20C; G1/8" (ISO228/1) female. A conical 1/8" BSP male with 60° internal cone adapter included for Beamex hose set.

PM60, PM100, PM160; G1/8" (ISO228/1) female. PM250, PM600, EXT60, EXT100, EXT160, EXT250, EXT600, EXT1000; G 1/4" (ISO228/1) male.

Wetted parts AISI316 stainless steel, Hastelloy, Nitrile rubber.

Maximum overpressure:

B module; 1200 mbar abs. 10mD module; 200 mbar. EXT600/PM600; 900 bar. EXT1000; 1000 bar.

For all other modules, the maximum overpressure is twice the nominal range.

HART® is a registered trademark of HART® Communication Foundation.



# Calibration Modules

## Beamex<sup>®</sup> MC5P Calibration Host Module



The MC5P includes an electrical section (E) which hosts the optional HART<sup>®</sup> modem that allows digital communication with instruments that support the HART<sup>®</sup> protocol. MC5P automatically includes an internal 250 ohm resistor required for HART<sup>®</sup> communication when the +24V DC loop supply is used.

### MC5P calibration host module features:

- Voltage and current measurement
- Pulse counting and frequency measurement
- Current generation
- Switch testing
- 24 V DC loop supply
- Connection for external pressure modules

### Optional features:

- HART<sup>®</sup> communication
- Foundation Fieldbus H1 communication
- Profibus PA communication
- Datalogging
- Communication with pressure controllers
- Communication with dry blocks
- Communication with software
- Environmental temperature sensor



The MC5P calibration host module is, with its large graphical display and membrane keyboard, the master module for temperature, electrical and pressure calibration modules. Apart from communicating with the calibration modules, it also features communication with dry blocks and automatic pressure controllers.

The MC5P can also work as a multichannel datalogger (option), using the other calibration modules.

## ET Electrical and Temperature Module

The ET electrical and temperature module simulates and measures a wide variety of RTD's and thermocouples. Additionally it generates electrical signals including frequency and pulses as well as measures and generates/simulates V, mV and ohm.

The ET module includes the reference junction (RJ) module, using advanced temperature measurement technology providing very accurate internal cold junction compensation when measuring or simulating thermocouples. The unique design of the RJ module makes it possible to use practically any connector type or bare TC wires.



### ET module features:

- RTD measurement / simulation
- Resistance measurement / simulation
- Thermocouple measurement / simulation
- Low voltage measurement / generation
- Reference junction (RJ)
- Frequency generation
- Pulse generation
- Voltage generation
- Current generation



# PM Pressure Measurement Modules

The PM pressure measurement modules incorporate advanced pressure measurement technology resulting in only a few PM modules being required to cover a wide pressure range with excellent uncertainty.

The barometric module PM B measures the ambient barometric pressure. When the barometric module is incorporated in the system, the ranges of all other pressure measurement modules can be displayed both in gauge and absolute pressure.

The read out from PM modules is displayed in the MC5P module.



# Pressure Output Modules, manual

The PO pressure output modules are designed to regulate vacuum and pressure sources with high precision. For pressures up to 20 bar (290 psi), a regulator in combination with an adjustable volume is used to help achieving the exact pressure. High-pressure modules come with high-pressure regulators combined with needle valves.

The pressure supply module PS7 provides a basic pressure supply for devices such as I/P, E/P, etc.



Module	Range
PO8C	-1 to 8 bar g / -14.5 to 116 psi
PO20	0 to 20 bar g / 0 to 290 psi
PO60	0 to 60 bar g / 0 to 870 psi
PO160	0 to 160 bar g / 0 to 2320 psi
PO250	0 to 250 bar g / 0 to 3625 psi
PS7	0 to 7 bar g / 0 to 100 psi



# Pressure Output Modules, automatic

The Beamex® POC6 is an accurate and user-friendly automatic pressure controller, providing regulated output from vacuum to 70 bar (1015 psi). The POC6 is designed for applications requiring automatic pressure testing and calibration. The POC6 communicates with the Beamex® MC5P Calibration Host Module (option). The POC6 automatically regulates the pressure output signal according to commands from the MC5P, enabling fully automated calibration of pressure transmitters and other pressure instruments.



Feature	Specification
Output range	± 1 bar (±14.5 psi) -1 to 6 bar (-14.5 to 87 psi) -1 to 20 bar (-14.5 to 290 psi) -1 to 70 bar (-14.5 to 1015 psi) Special range within -1 to 70 bar (-14.5 to 1015 psi)
Precision	< 0.015 % FS
1 year uncertainty	< 0.025 % FS

# Other modules and equipment

## Main Supply Units

The main supply unit powers the modules installed in the MCS100 Workstation. Each type of main supply unit includes a mains switch, emergency off switch, internal socket outlets for device modules, thermal overload and fault current protections, and earth terminal screw. More features are available depending on the model.



## Power Supply Modules

Many types of power supplies can be integrated into the MCS100 Workstation, such as variable and constant AC & DC supplies, dual power supplies, programmable DC supplies, isolated supply outlets, variable 3-phase AC supplies and 3-phase connections.



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## Measuring equipment

Various types of measuring equipment can be included in the module rack, such as digital multimeters, oscilloscopes, function generators / frequency counters, power analysers etc., providing an ergonomic and efficient measuring facility.



## Soldering Equipment

The MCS100 Workstation can be fitted with soldering/ desoldering stations, with optional fume extraction equipment, vision accessories, infrared soldering and preheat system etc., enabling soldering and desoldering of surface mounted and traditional electronic components.



## ESD Equipment

ESD equipment available for the MCS100 Workstation removes the problems caused by electrostatic discharges into sensitive components. The range of ESD equipment includes semiconducting laminated tabletops, semiconducting mats under the bench and on the module rack, wrist straps, grounding sets, etc.

All metal parts of the workstation are ESD painted as standard.



## Fittings

A large variety of fittings and accessories are available for the MCS100 Workstation, such as drawer units, steel shelves, pick-up boxes, swivel stands, CPU and keyboard shelves, tool holders, chairs, etc.



# MCS100 – a versatile System

## Beamex<sup>®</sup> MCS100 Desk Top System

All Beamex calibration modules can be installed into a Desk Top System. The 19" desk top chassis, which includes internal power supply to all Beamex modules, forms a complete calibration station. The MCS100 Desk Top System is ideal to be placed on existing work benches or used in small calibration laboratories, where the available space is always an issue.



## Beamex<sup>®</sup> MCS100 Trolley

The MCS100 Trolley is a movable equipment trolley allowing calibration modules, power supplies and measuring equipment to be mobile outside a confined work area. It is compact and easily transferable from one location to another. It is compatible with all MCS100 equipment modules.

The MCS100 Trolley consists of an equipment frame with wheels, main supply unit and calibration modules. In this configuration the calibration workshop can be taken to the worksite, eliminating the need to remove instrumentation from the process.



## Beamex<sup>®</sup> CMX Calibration Software

CMX is calibration management software that assists in documenting, planning, analyzing and, finally, optimizing calibration work. CMX's scalable technology and user configuration allows you to integrate it easily into other systems for a one-of-kind calibration system that fits your specific needs completely.

CMX also helps to meet the regulatory requirements, whether your plant's calibration system needs to comply with ISO 17025, cGMP or 21 CFR Part 11. By using CMX, you will have all your calibration results in a traceable and auditable form, either printed on paper or stored in electronic format in a database.





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