PACE Modular Pressure Controller

Druck has developed and delivered a number of high precision pressure controllers designed for test bench, bench top and rack mount calibration, and automated test applications.

Modularity increases user flexibility, reduces downtime and lowers overall cost of ownership.

Features

- Selection of chassis and interchangeable control modules
- Single, dual or auto range control module configurations
- High speed pressure control – 5 seconds to fill 300CC*
- Up to 210 bar (3000 psi/21 MPa) gauge and absolute
- Precision to 0.001% FS over calibrated temperature range
- Accuracy 2, 3.5bar a 0.0004% RDG + 0.0027% FS 8-71 bar a 0.0011% RDG + 0.0026% FS
- Long-term stability from 0.001% FS
- Barometric reference option
- Utilises Drucks new unique range of piezo-resistive and TERPS pressure sensor technology
- 28 selectable pressure units and four user defined units
- Switch test, leak test, test program, burst test, analogue output and volt free contact options
- Aeronautical option
- Negative gauge calibration included as standard
- High resolution colour touch screen operation
- Intuitive icon task driven menu structure
- Compatible with software packages
- RS232, IEEE connectivity, ethernet and USB as standard

* Variance may occur due to customer configuration

Druck
a Baker Hughes business

PACE modular pressure controller

The new PACE pneumatic modular pressure controller brings together the latest control and measurement technology from Druck to offer an elegant, fast, flexible and economical solution to pressure control for automated production, test and calibration. PACE employs full digital control to provide high control stability and high slew rate, while its digitally characterized pressure sensor offers the quality, stability, higher bandwidth and precision associated with this latest generation of piezo-resistive and TERPS devices.

PACE5000 chassis

- Single channel pressure controller chassis
- Easy to use color touch screen display
- Can be used with any interchangeable PACE CM control module as a bench top or rack mounted pressure controller
- Intuitive task driven menu with basic, preset and divide as standard
- Switch test, leak test, burst test, test program, analogue output and voltage free contacts available as optional tasks
- Multi language – any additional language to suit specific requirements can easily be translated and downloaded
- RS232, IEEE connectivity, ethernet and USB as standard

PACE6000 chassis

Additional features:

- Dual channel pressure controller chassis
- With two PACE CM control modules fitted the PACE6000 can be used in single, auto-ranging or simultaneous dual pressure control mode*
- Aeronautical option enabling full control in aeronautical units
- No module pressure range ratio limit

PACE CM – high speed pressure control module

- Interchangeable robust control module that is easily installed into a PACE chassis
- Calibration data stored in the control module (only the CM needs to be sent away for recalibration)
- High speed pressure control
- Wide choice of pressure ranges
- Choice of standard, high, premium precision or reference accuracy pressure measurement
- Barometric reference available to enable pseudo gauge/ absolute indication and control
- Aeronautical version

* for auto-ranging, both control modules have to be a range below 70 bar/1000 psi or both control modules have to be a range above 70 bar/1000 psi

PACE5000/6000 Options

Switch test

Switch test automates the testing of pressure switch devices. Following the test, the pressure at which contacts open and close and the switch hysteresis is displayed. Switch test task can also be set to repeat several times to exercise a switch or capture switch toggle maximum, minimum and average values.

Leak test

Leak test applies a test pressure(s) to an external system connected to the instrument to determine the magnitude of pressure variations due to leaks. This application sets the test pressure and a dwell time to eliminate potential adiabatic effects at the test pressure and the leak test time period. On completion, the display shows the start pressure, end pressure, pressure change and leak rate.

Test program

The test program option provides a facility for creating, storing and executing numerous test procedures within the instrument itself. This is particularly useful for longer, more repetitive and laborious procedures requiring manual inputs for rapid prototyping, manufacturing and life cycle testing. Test programs can also be transferred to a PC using a mass storage device for further editing, and copied back from the mass storage device to the instrument.

Burst test

Burst test is an application for the PACE series designed primarily for the testing of pressure rupture discs. The burst test option applies a controlled increase of pressure and accurately measures the exact point at which the device rupture or burst occurs.

Volt free contacts (VFC)

Volt free contacts enable control of peripheral devices such as vacuum pumps, ovens, etc. Each VFC option has three independent volt-free NO/NC relay contacts. A number of conditions can be set within a PACE instrument to trigger a relay toggling its contacts.

Analogue output

The analogue output can be programmed via the setup menu screen to output a signal proportional to the instrument range selected. This allows the instrument to interface with PC or PLC I/O cards, remote displays, chart recorders or other data logging equipment.

Users can select outputs of 0 to 10 V, 0 to 5 V, -5 to 5 V and 0/4 to 20 mA. Precision with respect to host instrument measured pressure 0.05% FS over the host instrument operating temperature range, variable update rate to 80 readings per second. The option is programmable between minimum and FS pressure for proportional output against pressure.

Aeronautical option (PACE6000 only, to be used with PACE CM2-A control modules)

Simultaneous control of calibrated airspeed and altitude (when used with two PACE CM2-A control modules) with a "go to ground" function.

Indication and control available in pure aeronautical units:

- Altitude – feet or meters
- Air Speed – knots or km/hour, mph
- Mach – mach number
- Rate of climb – feet or meters/minute, second

Specifications

Pressure measurement	
CM0/CM1/CM2 Pressure ranges:	25, 70, 200, 350 and 700 mbar gauge, 1, 2, 3.5, 7, 10, 20, 35, 70, 100, 135, 172, 210 bar gauge 0.35, 1, 3, 5, 10, 15, 30, 50, 100, 150, 300, 500, 1000, 1500, 2000, 2500, 3000 psi gauge 2.5, 7, 20, 35, 70, 100, 200, 350, 700 kPa gauge 1, 2, 3.5, 7, 10, 13.5, 17.2, 21 MPa gauge All gauge versions available with negative calibration as standard. For absolute pressure ranges select any range of 1 bar and above and add barometric option
CM3 pressure ranges:	1,2.5,7,10,20,35 and 70, 100, 135, 172, 210 bar pseudo gauge 2,3.5,8,11,21,36,71,101, 136, 173 and 211 Bar absolute 15, 36, 101, 145, 290, 507, 1015, 1450, 1958, 2494, 3046 Psi pseudo gauge 29, 44, 73, 116, 160, 305, 522, 1030, 1465, 1973, 2509, 3060 psi absolute 0.1, 0.25, 0.7, 1.2, 3.5, 7, 10, 13.5, 17.2 21 MPa pseudo gauge 0.2, 0.3, 0.5, 0.8, 1.1, 2.1, 3.6, 7.1, 10.1, 13.6, 17.3, 21.1 MPa absolute (other ranges available, please consult factory)
Over range indication:	10% above mbar/bar full scale pressure range
Pressure Media:	Dry, oil free, and non-combustible gas maintained at a value of 10% above the maximum required outlet pressure, dry air or nitrogen recommended.
Display	
PACE5000	4.3" TFT color VGA resolution wide format display with integral touchscreen
PACE6000	7" TFT colour VGA resolution wide format display with integral touchscreen
Comms update rate	8 times per second
Display update rate	2 times per second
Readout	±9999999
Pressure units	mbar, bar, Pa(N/m2), hPa, kPa, MPa, mmHg @ 0°C, cmHg @ 0°C, mHg @ 0°C,, inHg @ 0°C, mmH22O @ 4°C, cmH, torr, atm, psi, lb/ft2O @ 4°C, mH2, inH2O @ 4°C, inH2O @ 4°C, mmH2O @ 20°C, inH2O @ 20°C, cmH2O @ 60°F, ftH2O @20 °C, mH2O @ 4°C, ftH2O @ 20 °C, kg/m2O @ 20°C, 2, kg/cm ftH2O @ 60°F, user defined 1, user defined 2, user defined 3, user defined 4
Performance	
PACE CM0 standard precision	0.02% Rdg + 0.02% FS (25 mbar: 0.20% rdg + 0.20% FS, 70 mbar: 0.10% rdg + 0.10% FS, 200 mbar: 0.04% rdg + 0.04% FS) includes linearity, hysteresis, repeatability and temperature effects over calibrated temperature range, for gauge pressures and assumes steady state temperature and regular zeroing.
PACE CM0 controller stability	0.005% FS
PACE CM1 high precision	0.01% Rdg + 0.01% FS (25 mbar: 0.10% rdg + 0.10% FS, 70 mbar: 0.05% rdg + 0.05% FS, 200 mbar: 0.02% rdg + 0.02% FS) includes linearity, hysteresis, repeatability and temperature effects over calibrated temperature range, for gauge pressures and assumes steady state temperature and regular zeroing.
PACE CM1 controller stability	0.003% FS (25mbar range = 0.005% FS)
PACE CM2 premium precision	0.005% Rdg + 0.005% FS (25 mbar: 0.05% rdg + 0.05% FS, 70 mbar: 0.025% rdg + 0.025% FS, 200 mbar: 0.01% rdg + 0.01% FS) includes linearity, hysteresis, repeatability and temperature effects over calibrated temperature range, for gauge pressures and assumes steady state temperature and regular zeroing.
PACE CM2 – controller stability	0.001% FS (25mbar = 0.004% FS. 70 mbar = 0.003% FS)
PACE CM2-A aeronautical	Altitude range: -3,000 to +55,000 ft Altitude precision: @ Sea level ±2 ft, @ 8,500 ft ±3 ft, @ 35,000 ft ±9 ft Altitude RVSM accuracy: @ Sea level ±5 ft, @ 29,000 ft ±25 ft, @ 41,000 ft ±46 ft, @ 35,000 ft ±33 ft Airspeed range: to 650 knots Airspeed precision: @ 50 knots ±1.00 kts, @ 250 knots ±0.21 kts, @500 knots ±0.11 kts Pressure range –1 to +1bar g, pressure precision 0.005% Rdg + 0.005% FS includes linearity, hysteresis, repeatability and temperature effects for gauge pressures and assumes steady state temperature and regular zeroing. 1300 mbar reference precision 0.005% FS, Includes non-linearity, hysteresis, repeatability and temperature effects over calibrated temperature range.
PACE CM3 reference precision	0.001% FS for 2, 3.5 bar a includes non-linearity, hysteresis, repeatabilty and temperature effects over calibrated temperature range. 0.0015% FS for 8-211 bar a includes non-linearity, hysteresis, repeatabilty and temperature effects over calibrated temperature range.
PACE CM3 controller stability	0.001% of absolute range FS
PACE CM3 accuracy	Absolute ranges 2, 3.5 bar accuracy (2 Sigma) over calibrated temperature range 0.0004%Rdg + 0.0027% FS. 8-101 bar 0.0011% RDG + 0.0026 % FS* 136 Bar 0.0025% RDG + 0.0023 % FS* 173 Bar 0.0026% RDG + 0.0022 % FS* 211 Bar 0.0027% RDG + 0.0022 % FS* Includes measurement precision, measurement long term stability (see below) and calibration equipment expanded uncertainty. Pseudo gauge range accuracy (3.5bara and below) will need to include the barometer uncertainty using the RSS (root sum of squares) method.

*To meet annual CM3 accuracy specification, zeroing against a barometric reference is recommended every 28 days. The long term stability spec will be subject to the specification of the barometric reference used, quoted figures are for CM3-B.

Performance (cont.)	
PACE CM measurement long term stability	CM0, CM1 and CM2 Ranges: 2 bar g to 210 bar g (30 psi g to 3000 psi g) 0.01% of reading per annum, 1 bar g 0.02% of reading per annum and 25 mbar g to 700 mbar g 0.03% of reading per annum, assumes regular zeroing. CM3 Ranges: 2, 3.5 bar a 0.0025% FS per annum absolute ranges. CM3 Ranges: 8-211 bar a 0.001% FS per 28 days* CM0-B, CM1-B, CM2-B, CM3-B and CM2-A: barometric reference sensor 0.05 mbar a or 0.00072515 psi a per annum.
Negative gauge precision	Maximum error at any given pressure value is equal to maximum error at the equivalent positive pressure value (CM0, CM1 and CM2).
Pseudo range precision	Pseudo Absolute: gauge mode precision + barometric precision Pseudo gauge: absolute mode precision + barometric precision
PACE CM0-B precision-barometric reference	Precision for the optional barometric reference 0.10 mbar or 0.001450 psi. Includes non-linearity, hysteresis, repeatability and temperature effects over calibrated temperature range.
PACE CM1-B precision-barometric reference	Precision for the optional barometric reference 0.05 mbar or 0.000725 psi. Includes non-linearity, hysteresis, repeatability and temperature effects over calibrated temperature range.
PACE CM2-B precision-barometric reference	Precision for the optional barometric reference 0.025 mbar or 0.0003625 psi. Includes nonlinearity, hysteresis, repeatability and temperature effects over calibrated temperature range.
PACE CM3-B precision-barometric reference	Precision for the optional barometric reference 0.020 mbar or 0.0002901 psi. Includes non-linearity, hysteresis, repeatability and temperature effects over calibrated temperature range.
PACE CM3-B accuracy-barometric reference	Barometer accuracy (2 Sigma) = 0.05 mbar over the calibrated temperature range. Includes measurement precision, measurement long term stability per annum and calibration equipment expanded uncertainty ≤ (0.0032% Rdg + 0.05 mbar).
Gas consumption	All supply gas is delivered to the system. No gas is used in measure mode, or when the instrument is turned off.
Electrical	
Power supply	90 V AC to 130 V AC @ 47 to 63 Hz & 180 V AC to 260 V AC @ 47 to 63 Hz. universal input via IEC320 C14 Connector.
VFC contact rating	30V d.c. 1 amp resistive/200 mA inductive
Communications	
Communication	RS232, USB and IEEE-488, SCPI, emulation (DPI520, DPI500, DPI510 & DPI515 depending on model) ethernet (VXI-11 and Sockets using SCPI)
Environmetal	
Temperature	Operating 10°C to 50°C (50°F to 122°F) Calibrated 15°C to 45°C (59°F to 113°F) Storage -20°C to 70°C (-4°F to 158°F)
Humidity	5% RH to 95% RH non-condensing
Sealing	IP20 (EN60529), In door use only
Vibration	Compliant with Def. Stan. 66-31 8.4 Cat 3 and MIL-T-28800E Cat 2
Shock	Mechanical shock conforms to EN61010
Conformity	LVD EN61010, EMC EN61326, PED, ROHS & WEEE – CE marked
Physical	
PACE chassis – weight	PACE5000 5 Kg or 11 lbs, PACE6000 6.7 Kg or 17.7 lbs
PACE CM – weight	5 Kg or 11 lbs
PACE CM – pressure connection	G 1/8 Female (1/8 NPT Female by adaptor for North America)
PACE 5000 – dimensions	440 mm X 88 mm (2U) X 320 mm (17.3" X 3.47" X 12.6")
PACE 6000 – dimensions	440 mm X 132 mm (3U) X 320 mm (17.3" X 5.2" X 12.6")

Ordering information

Please state the following (where applicable)

1. PACE chassis

- PACE5000 single channel chassis – I5000 chassis
- PACE6000 dual channel chassis – I6000 chassis

2. PACE chassis – options

The range of optional features includes:

- Switch test – automatic and accurate calibration of pressure switches
- Leak test – automatically measures leak rates in the desired units/minute or units/second
- Test program – write and save numerous test programs
- Burst test – for testing the pressure rupture point
- Analogue output – for integration into older ATE applications
- Volt free contacts – for automatically triggering ancillary devices
- Aeronautical (PACE6000 only) – allows for the test and calibration of aeronautical instruments

3. PACE chassis – mains lead

Choose one from this list:

- Mains lead IEC-UK plug
- Mains lead IEC-Japan plug
- Mains lead IEC-EU plug
- Mains lead IEC-USA plug
- Mains lead IEC-South Africa/India plug
- Mains lead IEC-China plug
- Mains lead IEC-Australia/New Zealand plug

Area of use

Please state area of use for instrument set up:

- Europe
- North America
- Japan
- Asia
- Rest of world

bar	psi	Pa
CM2 ,CM1 ,CM0		
25 mbar g	0.35 psi g	2.5 kPa g
70 mbar g	1 psi g	7.0 kPa g
200 mbar g	3 psi g	20.0 kPa g
350 mbar g	5 psi g	35.0 kPa g
700 mbar g	10 psi g	70.0 kPa g
1 bar g	15 psi g	100.0 kPa g
2 bar g	30 psi g	200.0 kPa g
3.5 bar g	50 psi g	350.0 kPa g
7 bar g	100 psi g	700.0 kPa g
10 bar g	150 psi g	1.0 MPa g
20 bar g	300 psi g	2.0 MPa g
35 bar g	500 psi g	3.5 MPa g
70 bar g	1,000 psi g	7.0 MPa g
100 bar g	1,500 psi g	10.0 MPa g
135 bar g	2,000 psi g	13.5 MPa g
172 bar g	2,500 psi g	17.2 MPa g
210 bar g	3,000 psi g	21.0 MPa g

4. PACE control module – precision

- PACE CM0 = standard
- PACE CM1 = high
- PACE CM2 = premium
- PACE CM3 = reference

5. PACE control module – pressure range

6. PACE control module – barometric option

Provides absolute pressure option in addition to gauge pressure. In absolute mode adds barometric pressure to gauge pressure range. Pressure control in absolute range is not available for any CM0-B/CM1-B/CM2-B with a gauge range of 700 mbar
(10 psi, 70 kPa) or below.

- PACE CM0-B = standard
- PACE CM1-B = high
- PACE CM2–B = premium

Provides gauge pressure option in addition to absolute pressure. In gauge mode, subtracts barametric pressure from absolute pressure range. Not available for pressure ranges less than 2 bar (30 psi, 200 kPa) absolute.

- PACE CM3-B = reference

7. PACE control module – PACE6000 aeronautical option

- PACE CM2-A = -3000 to + 55,000 ft (altitude)
- PACE CM2-A = to 650 knots (airspeed with true mach)

CM3		
2 bar a	30 psi a	200.0 kPa a
3.5 bar a	50 psi a	350.0 kPa a
8 bar a	116 psi a	0.8 MPa a
11 bar a	160 psi a	1.1 MPa a
21 bar a	304 psi a	2.1 MPa a
36 bar a	522 psi a	3.6 MPa a
71 bar a	1,029 psi a	7.1 MPa a
101 bar a	1,465 psi a	10.1 MPa a
136 bar a	1,973 psi a	13.6 MPa a
173 bar a	2,509 psi a	17.3 MPa a
211 bar a	3,060 psi a	21.1 MPa a
1 bar pg	15 psi pg	100.0 kPa pg
2.5 bar pg	36 psi pg	250.0 kPa pg
7 bar pg	100 psi pg	700.0 kPa pg
10 bar pg	150 psi pg	1.0 MPa pg
20 bar pg	300 psi pg	2.0 MPa pg
35 bar pg	500 psi pg	3.5 MPa pg
70 bar pg	1,000 psi pg	7.0 MPa pg
100 bar pg	1,500 psi pg	10.0 MPa pg
135 bar pg	2,000 psi pg	13.5 MPa pg
172 bar pg	2,500 psi pg	17.2 MPa pg
210 bar pg	3,000 psi pg	21.0 MPa pg

8. Physical accessories

Part number	Description
IO-ADAPT-G1/4	Adaptor G 1/8 male to G 1/4 female
IO-ADAPT-1/8NPT	Adaptor G 1/8 male to 1/8 NPT female
IO-ADAPT-1/4NPT	Adaptor G 1/8 male to 1/4 NPT female
IO-ADAPT-7/16UNF	Adaptor G 1/8 male to 7/16 – 20 UNF female
IO-ADAPT-AN4	Adaptor G 1/8 male to AN4 37 deg male
IO-ADAPT-AN6	Adaptor G 1/8 male to AN6 37 deg male
IO-ADAPT-BARB	Adaptor G 1/8 male to 1/4 I.D. pipe
IO-ADAPTOR-KIT	Contains one of each of the above adaptors.
IO-DIFF-KIT-LP	**Differential connection kit low pressure** Helps reduce the impact of thermal and/or pressure changes in ambient conditions occurring during the measurement cycle.
IO-NEG-G-GEN-1	**Negative gauge pressure generator** Used to generate small – ve gauge pressure (Venturi effect) to enable control at zero gauge without the need for a vacuum pump.
IO-VAC-SYS	**Vacuum system check valve kit** Allows exhaust pressure to bypass vacuum pump to atmosphere, which improves control performance from any positive pressure downwards.
IO-SNUBBER-1	**Snubber reference port** Provides a pneumatic time constant to the sensor –ve port, thus attenuating the effect of ambient draughts.
IO-DIFFUSER-1	**Diffuser gas exhaust** Screws into vent or – ve supply port to diffuse exhaust gas.
IO-RMK-P6000	**Rack mount kit PACE6000** 19" rack mount kit
IO-RMK-P5000	**Rack mount kit PACE5000** 19" rack mount kit
IO-FILTER-KIT	**Filter kit control manifold** Contains 5 filters for control module pressure ports.
IO-IML-2	**Mains lead-Japan plug**
iO-IML-3	**Mains lead-EU plug**
iO-IML-4	**Mains lead-USA plug**
iO-IML-5	**Mains lead-South Africa/India plug**
iO-IML-6	**Mains lead-China plug**
iO-IML-7	**Mains lead-AUS/NZ plug**

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920-561G
BHCS38476 (04/2023)

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