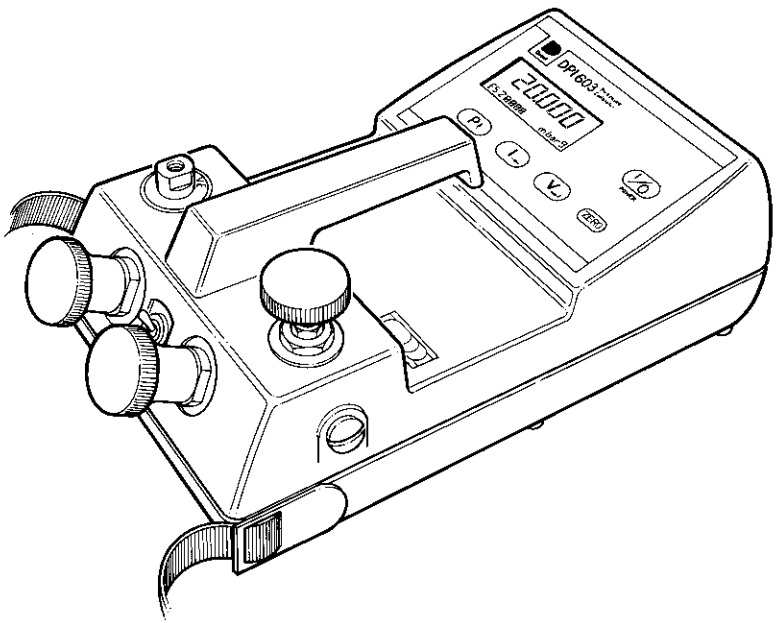
RS 213-0844 = DPI 603 20 BAR
RS 215-0832 = DPI 603 10 BAR
RS 215-0826 = DPI 603 2 BAR

DPI 603
PORTABLE PRESSURE CALIBRATOR
USER MANUAL



DPI 603 Portable Pressure Calibrator

SAFETY

The Manufacturer has designed this product to be entirely safe when operated correctly.

- Please pay close attention to the Safety Instructions outlined on this page and elsewhere in this manual. They have been designed to protect the user from personal injury and the equipment from damage.

- Potentially hazardous operations are indicated in the text by means of a hazard warning triangle. Specific warnings relating to each section of the manual are given at the beginning of that section.

- Please observe the installation advice and any operational limits given in this manual.

- This equipment must only be used for the purpose for which it was designed

Pressure Safety

Do not permit pressures greater than the Safe Working Pressure to be applied to the instrument. The specified Safe Working Pressure for the instrument is stated in the Specification section of this manual.

Electrical Safety

The instrument is designed to be completely safe when used with Options and Accessories supplied by the manufacturer for use with the instrument.

Toxic Materials

No toxic materials are employed in this equipment

Repair and Maintenance

The instrument must be maintained, either by the manufacturer or a competent person. Please refer to supplier for details of approved service agents. Section 6 also gives a list of Druck Subsidiaries who will be able to assist and advise.

Software Issue

This User Manual supports **Software Issue No. 1.XX**

CE This product meets the essential protection requirements of the relevant EEC directives. Further details of applied standards may be found in the product specification.

CONTENTS

1. INTRODUCTION

Description

The DPI 603 is a portable pressure calibrator, intended for use in remote locations for pressure testing and calibration of pressure devices and systems.

This microprocessor based instrument uses an internally mounted pressure transducer to measure the pneumatic pressure applied to the outlet port. This pressure may be generated locally. The local pressure generation facilities are by means of a hand operated pump, capable of supplying pressures up to 20 bar gauge maximum and, optionally, by means of a manually operated changeover valve, negative pressures to -850 mbar gauge.

The electrical features of the instrument include a fully isolated 24V dc electrical output, a fully floating constant current source, a voltmeter and a milliammeter. The 24V dc supply is capable of supplying a load current of 25mA and is designed to energise external devices (e.g.) pressure transmitters.

The fully floating constant current source is provided to enable the testing of external current loops. The constant current source provides a controlled loop current of nominally 12mA and can be used in conjunction with the instrument's built-in 24V electrical output to provide a constant current source. It may also be used in conjunction with an external power supply (30V max), to sink a loop current of 12mA.

The built-in, voltmeter and milliammeter provide electrical monitoring facilities. It is possible to configure the display to read pressure, voltage or current or, in dual display mode, to read pressure and current or pressure and voltage. In dual display mode, pressure is always the primary (top) display.

A dc input socket allows for the connection of a combined power adaptor/charger unit. Either alkaline D-cells or rechargeable D-cells can be fitted to power the instrument. When alkaline cells are fitted, the instrument is configured to inhibit the charging facility.

1.1 INSTRUMENT SPECIFICATION

1.1.1 Pressure Specification

Pressure Ranges

-1 to 1 bar gauge *(Overpressure to 4 bar max)*
-1 to 2 bar gauge *(Overpressure to 8 bar max)*
-1 to 10 bar gauge *(Overpressure to 25 bar max)*
-1 to 20 bar gauge *(Overpressure to 25 bar max)*

Maximum Safe Working Pressure

25 bar

Accuracy (Pressure)

Combined non-linearity, hysteresis and repeatability

All pressure range versions	± 0.075% Full Scale

Pressure Temperature Effects

All versions (0° to 40°C)	± 0.5 % (T.E.B)

Pressure Output

Type	Handpump and Volume Adjuster
Pump Range	-1 to 20 bar gauge
Pressure/Vacuum Changeover	Manual Switch (Only with Pressure/Vacuum Option)

1.1.2 Electrical Specification

Electrical Safety

Meets EN61010-1 as applicable.

Power Supplies

External d.c. supply	3.5 to 12V (Max) d.c.
Internal batteries	4 x D Cell
Battery life	
Standard D-Cell	20 hours approx
Alkaline D-Cell	70 hours approx
Nicad (4 Ah)	18 hours approx
Battery charge current (NiCad only)	400mA

Voltage Measurement Range

Maximum voltage	±50V d.c.
Accuracy	±0.15% of reading, +0.02% F.S.
Input current	20 µA max
Input Impedance	5 MΩ
Temperature coefficient	±0.01% of reading per °C

Current Measurement Range

Maximum current	±55mA d.c.
Accuracy	±0.075% of reading, +0.005% F.S.
Sense resistance	10Ω
Temperature stability	±0.01% of reading per °C

Voltage Output

Output Voltage	24V d.c., ±0.5V
Maximum Supply Current	25mA

Constant Current Circuit

Nominal current	12mA d.c.
Maximum external voltage source	30V d.c.
Polarity	bipolar
Output	fully floating

Display

Main display	5 x 7 segment characters
Secondary Display	16 Alpha/Numeric characters

Electrical Connections

Test Connections	4mm Socket
Power Adaptor/Charger	2.1mm concentric plug

1.1.3 Environmental Specification

Temperature

Operating	-10° to +50°C
Storage	-20° to +70°C

EMC

This equipment complies with the European EMC directive and meets

EN50081-1 Emissions
EN50082-1 Immunity

WARNING: The equipment is designed for use in a Class A industrial environment. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Pressure Media

Clean, dry gas

Weight

4.2 kg

Dimensions

195 mm (Wide) x 320 mm (Deep) x 125mm (high)

1.1.4 Options

A - Pressure/Vacuum Capability

A manually operated valve, located between the pump and volume adjuster, permits the pump to generate negative pressures.

Pressure/Vacuum Changeover	Manual Changeover Valve
Negative Pressure Capability	-850 mbar
Positive Pressure capability	As instrument full scale

B - Rechargeable Batteries

Ni-Cad rechargeable cells can be supplied, complete with an external charger unit.

Battery Size	D-Cell
Battery Capacity	4 Ampere Hour
Operating Period (With fully charged cells)	18 Hours Approx.

Power Adaptor/Charger Units

Four power adaptor/charger units can be supplied depending on input supply voltage requirements.

Frequency range (all types)	48 to 65 Hz
Power output (all types)	9V d.c. at 500mA
Power input 230V a.c (U.K.)	*Part No. 191-054*
Power input 230V a.c (Europe)	*Part No. 191-057*
Power input 100V a.c. (Japan)	*Part No. 191-062*
Power input 120V a.c. (U.S.)	*Part No. 191-055*

1.1.5 Accessories

The standard DPI 603 instrument is despatched with the following items:

User Manual (K184, Part No. 197-211)
User Guide (K187, Part No. 197-217)
Calibration Certificates
Set of Test Leads
1 set of 4, standard type, D-cells (Not fitted)
Carrying Case

1.2 APPLICATIONS

By combined use of the independent pressure and electrical functions, the instrument can be used in a number of ways. The following sections outline a few of the more common applications.

1.2.1 Test Method

Generally, the instrument is used to either generate, positive or (optionally) negative pressures, for calibrating external devices or to measure an applied pressure. The electrical functions of the instrument can be used to provide an excitation supply for external devices, to measure voltages and currents generated by external devices and to provide a fully floating constant current supply for current loop test applications.

For all types of device connected to the DPI 603 instrument, the following set-up procedure should be adopted.

- Ensure that the vent valve on the instrument is open.
- Make the pressure connection between the instrument and the device under test.
- Make the electrical connections between the instrument and the device under test. Use only the recommended 4mm plug connections to connect to the instrument. **DO NOT PUSH BARE WIRES INTO THE SOCKETS.**
- Switch the instrument ON.
- Zero the pressure range and voltage or current ranges as required
- Check the test set up before applying any pressures.

  Note: The Maximum safe working pressure must NOT be exceeded.

- Close the vent valve and carry out the required test (calibration).

Table 1.1 details the types of test that can be carried out with the DPI 603. The figure number quoted in the table refers to the drawing which shows the corresponding connections to the instrument.

Test	Connection Diagram
Transmitter Calibration	Fig 1.1
Loop test, 12mA current source	Fig 1.2
Loop Test, Externally Powered, 12mA Current Source	Fig 1.3
Pressure Switch Testing	Fig 1.4

Table 1.1 - Typical Calibration Configurations

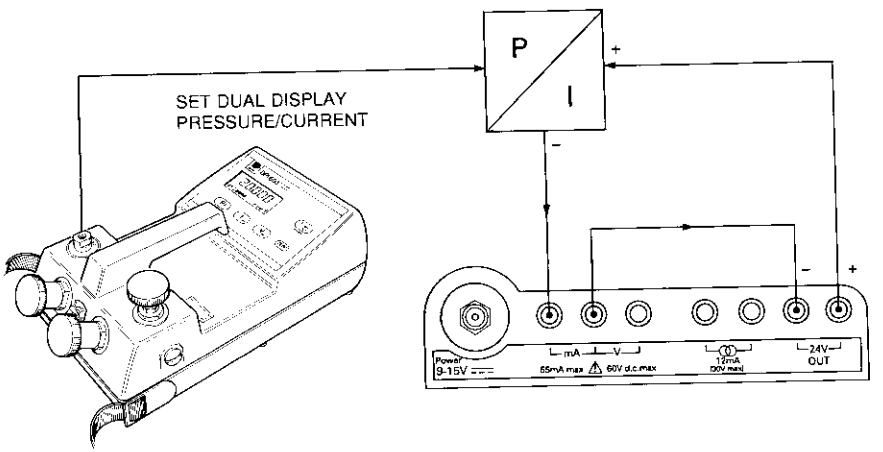


Figure 1.1 - Transmitter Calibration

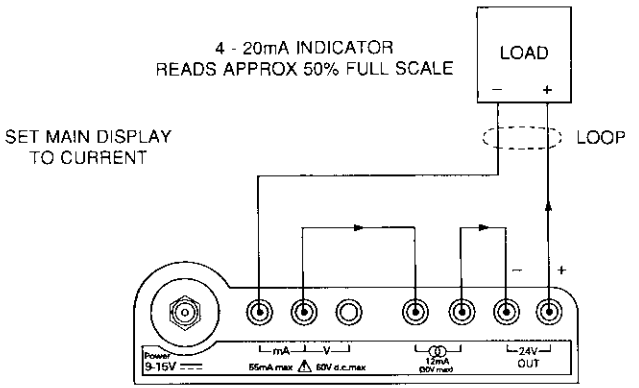


Figure 1.2 - Loop Test, 12mA Current Source

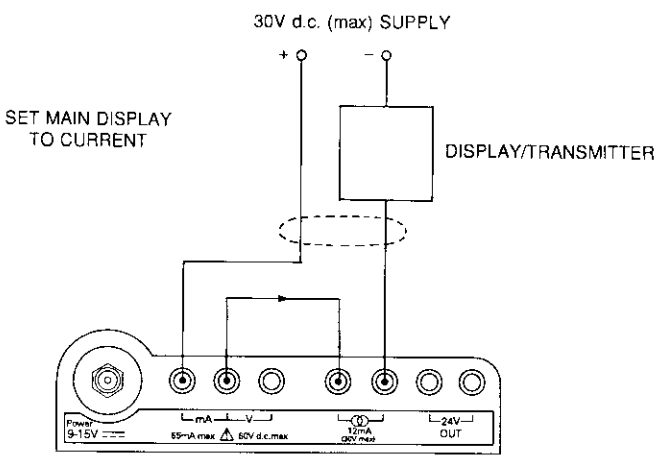
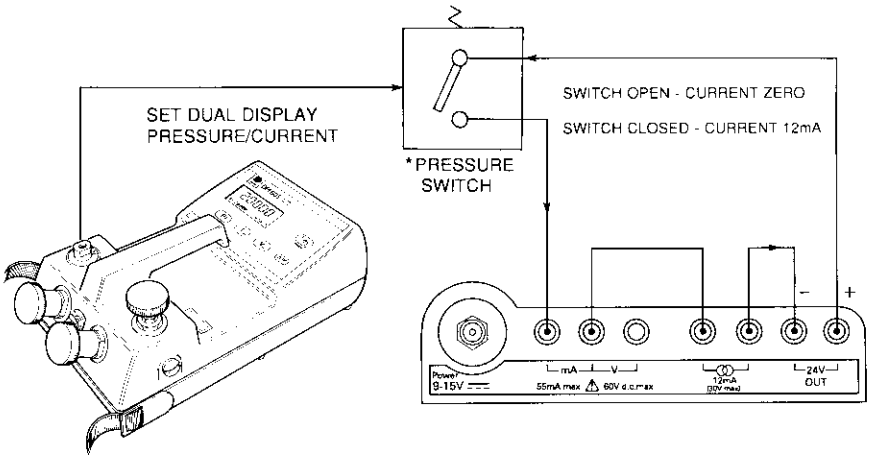


Figure 1.3 - Loop Test, Externally Powered, 12mA Current Source



* Leaving contacts closed for long periods will shorten battery life

Figure 1.4 - Pressure Switch Testing

2. INSTALLATION

2.1 Power Supply

The instrument can be powered from internal batteries or from an (optional) external power adaptor/charger unit. Four D-cells are supplied with each instrument. These may be either standard dry cells, alkaline cells or rechargeable Nicad cells, depending upon the option ordered.

2.1.1 Fitting Batteries (Figure 2.1)

DO NOT ATTEMPT TO CHARGE DRY CELL BATTERIES. THIS INSTRUMENT IS CONFIGURED BY DEFAULT TO INHIBIT BATTERY CHARGING WHEN DRY CELLS ARE FITTED. CHECK CONFIGURATION (REFER TO SECTION 2.2) BEFORE CONNECTING THE EXTERNAL POWER UNIT/CHARGER.

Caution:

- *Old batteries can leak and cause corrosion.*
- *Never leave discharged batteries in the instrument.*

To fit the batteries, refer to Figure 2.1 and proceed as follows.

- Turn the instrument over to expose the battery compartment.
- Release the battery cover retaining screws and raise the cover to expose the battery compartment.
- Fit the batteries as shown in Fig 2.1 observing the polarity indicated.
- Tighten the captive screws, turn the instrument over and switch the instrument on by pressing the **I/O** key. The instrument will bleep and an indication should appear on the display. During the start-up period, the battery status will be reported (e.g.)

  Battery O.K.

  If dry cells are fitted and a **Battery Low** indication is given, replace them immediately with new cells.

- Check that the instrument is correctly configured for the type of cells fitted (Refer to Section 2.2).

  Note: *If rechargeable cells are fitted, they may not initially be fully charged and may give rise to a* ***Battery low*** *indication. Fit the power adaptor/charger unit and charge the batteries, (refer to Section 2.1.2).*

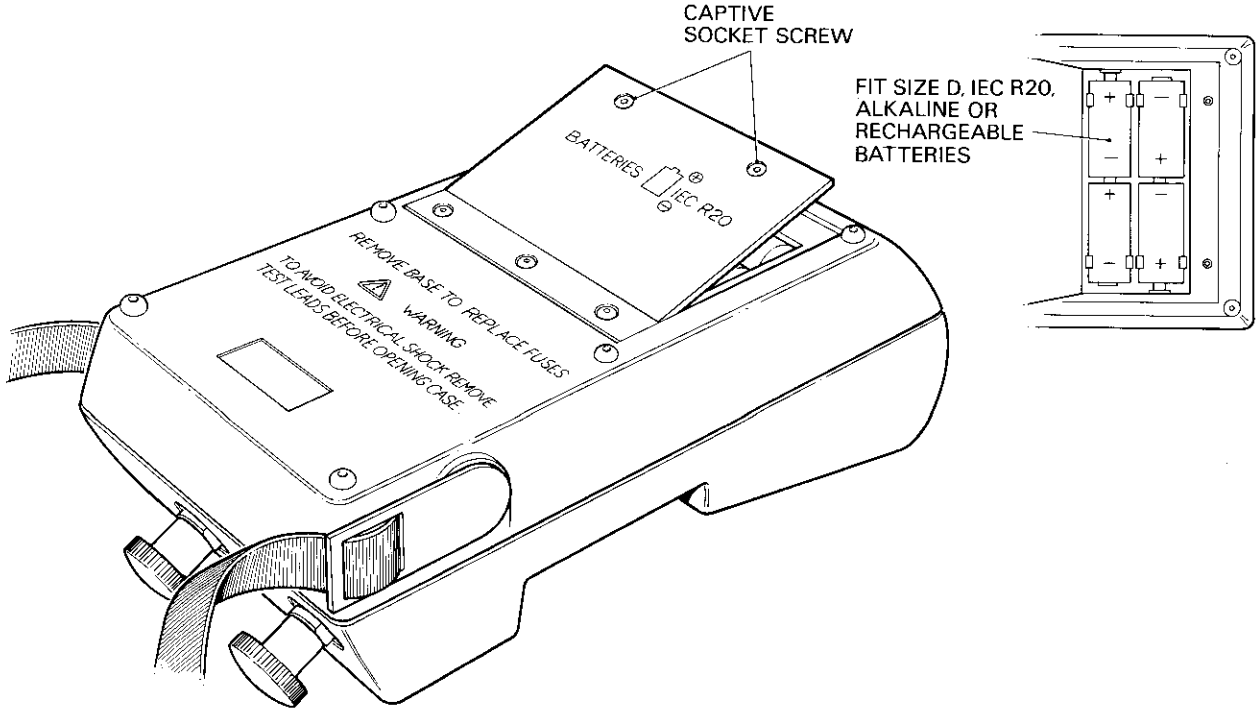


Figure 2.1 - Battery Compartment

2.1.2 Battery Charging

If rechargeable cells are fitted, proceed as follows.

- Check configuration (see Section 2.2), to ensure that the instrument is configured for NiCad batteries.

- Remove the dust cover from the power inlet socket (see Fig 2.2) and insert the power unit/charger output connector. Input level is 9V dc at 500mA, centre pole negative. A set of fully discharged batteries will require 14 hours to recharge.

2.2 Instrument Configuration

The instrument configuration function allows it to be configured for operation from standard dry cells or rechargeable NiCad cells. It also enables the special (USER) units conversion factor to be set up for units selection (refer to Section 2.2.1). To set up the instrument configuration, proceed as follows.

- Switch the instrument on by pressing the **I/O** key.

- Immediately press the **P** and **Zero** keys together. The instrument responds by briefly displaying **Battery O.K.** and **Configuration.** It then prompts for a PIN number to be entered (e.g.),

  Enter PIN: 000

- Enter a valid configuration **PIN** number. Initially, this PIN number is set to **123.** A flashing cursor appears over the first digit position. Press the **P↑** key to scroll through the digits 0 through 9 and when the correct digit for this position is displayed, press the **I→** key to move to the next digit position. Scroll through the numbers using the **P↑** key and when the correct digit for this position is displayed, use the **I→** key to move to the final digit position. Select the final digit by using the **P↑** key. When the full **PIN** has been entered, press the **V←** key to accept the entered PIN. If the **PIN** is incorrectly entered, access to the Configuration function is denied.

- The configuration status of the batteries is now reported (e.g)

  Battery: Dry

  In this configuration, battery charging is inhibited when the external power unit/charger is connected.

- To accept the configuration as reported, press the **V←** key.

- To change the configuration, press the **P↑** key. The indicated status will now change as follows (e.g.),

  Battery: Nicads

  In this configuration, battery charging is enabled. The internal batteries will automatically be charged when the external power unit/charger is connected.

- To accept the configuration, press the **V←** key.

2.2.1 User Units Configuration

Following selection and acceptance of the battery type, the conversion factor for the special (USER) units, selectable under the pressure units menu (see Section 3.3.2.), is displayed (e.g.),

USER Pa : 10000

This indicates that currently, *1 USER unit = 10000 Pa.*

Set the required conversion factor at the first cursor position by using the **P↑** key. Use the **I→** key to move along to the next cursor position and repeat the process for this digit. When all the digits have been entered, check the displayed conversion factor is correct and press the **V←** key to accept the entered value.

2.3 Electrical Connections(Figure 2.2)

- **Electrical Safety Instructions**

WHEN THE INSTRUMENT IS POWERED FROM LOW VOLTAGE DC (9V, 500mA) ENSURE THAT THE CORRECT VOLTAGE AND POLARITY IS USED.

USE ONLY THE MANUFACTURER'S RECOMMENDED POWER ADAPTOR/CHARGER UNIT.

Electrical connections are made to the panel located on the top end of the instrument, (refer to Figure 2.2). These comprise the following.

- External power adaptor/charger unit (2.1 mm concentric plug, centre pole negative)
- 24V dc, 25mA max, fully floating supply (Red +ve, Black -ve).
- Loop test constant current (12mA) source sink (both terminals yellow - non polarity sensitive).
- Voltmeter and milliammeter inputs (Black[com], Red (**V** +ve), Red (**I** +ve).

Connections to the sockets are made via 4mm plugs and matching test leads are supplied with the instrument.

Caution: *Use 4mm plugs, do not push bare wires into the sockets.*

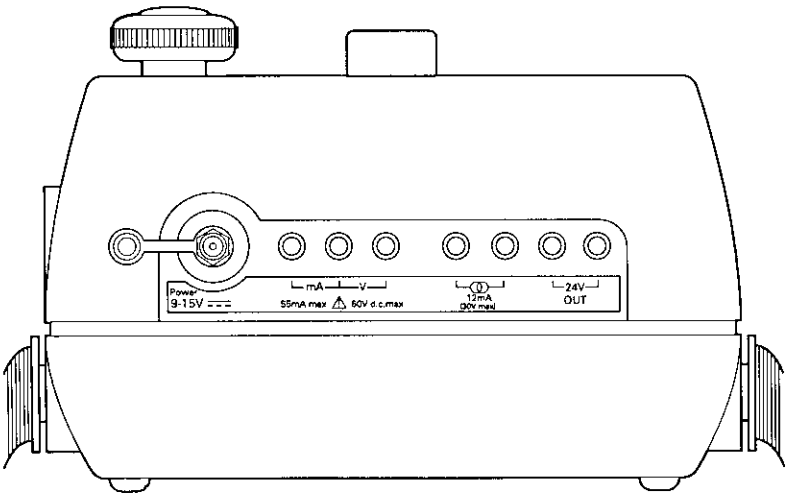


Figure 2.2 - Instrument Connections

2.4 Pneumatic Connections

- **Pressure Safety Instructions**

ALWAYS CHECK FOR TRAPPED PRESSURE BEFORE CONNECTION/DISCONNECTION OF PRESSURE COUPLINGS. ENSURE THAT CORRECTLY RATED PIPES AND FITTINGS ARE USED.

- **Connection**

To connect up to the instrument's output port, proceed as follows.

- Open the instrument's vent valve and ensure that the pressure supply or the external system to be connected to the instrument is at zero pressure before connection.

- Fit the pressure input/output line to the output port, fitting a bonded seal between the pressure union and the output port. The output port has a G⅛ thread. Ensure that the coupling is tight.

3 OPERATING INSTRUCTIONS

3.1 Introduction

The DPI 603 can, depending upon the pressure range chosen, calibrate at pressures up to 20 bar gauge. Section 1, Specification, gives details of the pressure ranges available. The instrument has the facilities to generate both positive and negative output pressures (negative pressure facility optional), or to monitor applied external pressures.

WARNING *Do not exceed the Maximum Working Pressure of the instrument. (Refer to Section 1).*

Additionally, the instrument provides a fully isolated, 24V dc electrical output for energising external devices (e.g.) transducers.

A digital multimeter (DMM) facility, comprising a 0 to 50V dc voltmeter and a 0 to 55mA milliammeter is built into the instrument to permit monitoring of voltage and current signals.

A 12mA, fully isolated constant current source, provides an external current loop test facility.

3.2 Operator Controls (Figure 3.1)

The operator controls for this instrument comprise five keys which are located on a membrane keypad as shown on Figure 3.1.

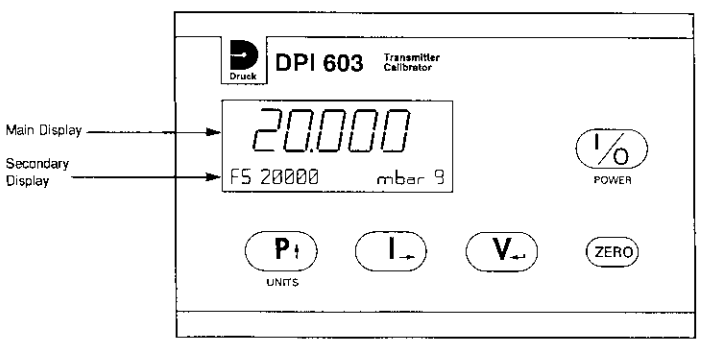


Figure 3.1 - DPI 603 Keypad

3.2.1 Zeroing The Instrument

(ZERO)

The **Zero** key is used in conjunction with the **P↑, I→** and **V←** keys to zero any small offsets in the **Pressure, Current** and **Voltage** displays respectively.

To zero a displayed function, press the appropriate function key and press **Zero** (e.g.), pressing **P** followed by **Zero** would zero the pressure display. A message (e.g.) **Zeroing P** is briefly written to the display as the operation is carried out.

Note: If the display offset is > 5% of full scale reading, an error message **Large Offset** is displayed, indicating that the error is too large for the zero function.

The **Zero** key, when operated at the same time as the **P** key during the power up period, is used to select the Configuration mode, (refer to Section 2.2.).

3.3 Set up Display Mode

The instrument display is divided into two sections, a main (large character, seven segment) display and a secondary (smaller, dot matrix) display. The main display is located at the top of the display window and the secondary display at the bottom of the window. The following display modes are available.

- Pressure as main display
- Voltage as main display
- Current as main display
- Dual display, Pressure main, voltage secondary
- Dual display, Pressure main, current secondary.

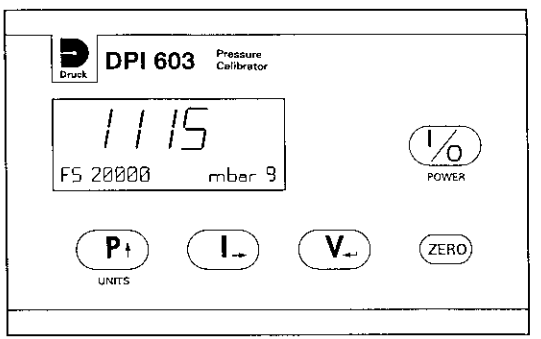
3.3.1 Set Pressure As Main Display

This is the default display mode which is always entered when the instrument is switched on. The display is as shown below.

To set this display mode from any other display mode, proceed as follows.

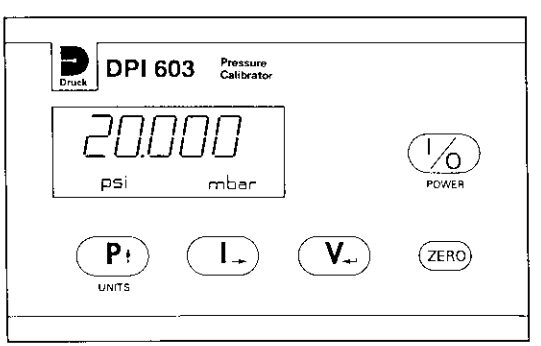
- Press the **P** key once.

A typical display is shown below (e.g.),



3.3.2 Change Pressure Units

When the instrument is delivered, a pressure unit will be allocated to the **P** key and the **I** key (e.g) **mbar** and **psi**. To display the units allocated to the function keys, press the **P** key. A typical display is shown below.



To change the units selected by either of these keys, press and hold the appropriate key until the allocated units legend starts to flash. Sequential pressing of that key will then scroll through the 24 units available for allocation to that key. When the required unit is displayed, press one of the other function keys (**P** if the **I** key is being set up, **I** if the **P** key is being set up, or the **V** key for either). The selected unit will now be allocated to the appropriate key. Table 3.1 gives a full list of the units available to each key.

Unit Symbol	Unit
Pa	Pascal
kPa	kilo-Pascal
MPa	mega-Pascal
mbar	millibar
bar	bar
kg/cm^2	kilogram per square centimetre
kg/m^2	kilogram per square metre
mmHg	millimetre of Mercury
cmHg	centimetre of Mercury
mHg	metre of Mercury
mmH_2O	millimetre of water
cmH_2O	centimetre of water
mH_2O	metre of water
torr	1/760 x 1 atm (1 mm Mercury)
atm	atmosphere
psi	pound per square inch
lbf/ft^2	pound force per square foot
inHg	inch of Mercury
$''H_2O04$	inch of water at 4°C
$'H_2O04$	feet of water @ 4°C
USER	Special Unit (See Sect.3.2.1)
$''H_2O20$	inch of water @ 20°C
$'H_2O20$	feet of water @ 20°C
hPa	hecta-Pascal

Table 3.1. - Pressure Scale Units

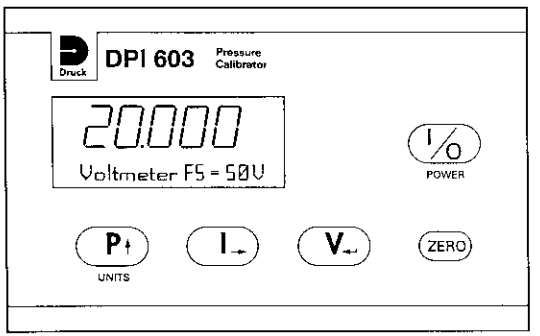
The user units are for the selection of any special units conversion factor that may be required. Refer to Section 2.2.1 for details of the procedure for setting up the conversion factor.

3.3.3 Single Display

To set voltage or current as the main display, proceed as follows.

- **Voltage:** Press the **V** key.
- **Current:** Press the **I** key.

A typical display is shown below.

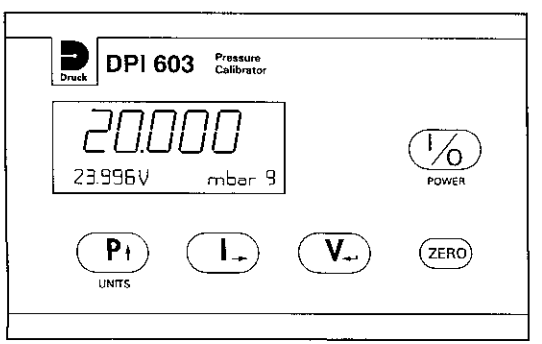


3.3.4 Dual Display, Voltage or Current with Pressure

To set voltage or current with pressure as the main display, proceed as follows.

- **Pressure and Voltage:** Press the **V** and **P** keys together.
- **Pressure and Current:** Press the **I** and **P** keys together.

When the two selection keys are pressed simultaneously, a long beep is emitted and pressure is displayed in the main display in the upper window and the selected electrical function in the lower window. A typical display is shown below.



3.4 Generating An Output Pressure

- **Pressure Safety Instructions**

ALWAYS CHECK FOR TRAPPED PRESSURE BEFORE CONNECTION/DISCONNECTION OF PRESSURE LINES.

ENSURE THAT CORRECTLY RATED PIPES AND FITTINGS ARE USED.

- **Procedure**

Generate Output Pressure

To generate an output pressure, proceed as follows.

- Open the instrument's vent valve.
- Connect the external device/system to the output port. The output port uses a G⅛ coupling. Use a Dowty washer between the output connector and the port.
- On instruments to which the pressure/vacuum option is fitted, set the output selector switch, located between the handpump and the volume adjuster, to **+ve** or **-ve** as required.
- Switch the instrument ON using the **I/O** key. Set up the display to read the required parameters as detailed in Section 3.3 and set the required pressure scale units by pressing the **P** key to display the units available and then using the **P** or **I** key to select the units required. Refer to Section 3.3.2 if required pressure units are not displayed.
- Close the vent valve. Press the **Zero** key followed by the **P** key to remove any zero offset and zero the display.
- Use the handpump to pressurise the system to the required level. Allow the display to settle. Screw the volume adjuster in or out as a fine adjustment to the required pressure.
- Set up all the test pressures required in a similar manner and open the vent valve before disconnecting.

WARNING: FOR INSTRUMENTS ON WHICH THE PRESSURE/VACUUM OPTION IS FITTED, DO NOT SWITCH DIRECTLY FROM A POSITIVE PRESSURE TO A NEGATIVE PRESSURE WITHOUT FIRST OPENING THE VENT VALVE.

- On instruments on which the pressure/vacuum option is fitted, if negative pressures are to be used, first open the vent valve before switching over the pressure output select switch to **-ve.**

Note: ***An overrange condition i.e. > 1.20% Full Scale, causes the display to flash.***

3.5 Electrical Measurements

- **Electrical Safety Instructions**

DO NOT EXCEED THE MAXIMUM INPUT LIMITS (REFER TO SECTION 1 FOR DETAILS).

WHEN THE INSTRUMENT IS POWERED FROM AN EXTERNAL SOURCE, CHECK THAT THE CORRECT VOLTAGE AND POLARITY ARE APPLIED TO THE INSTRUMENT. IT IS RECOMMENDED THAT ONLY THE MANUFACTURER'S POWER ADAPTOR/CHARGER UNIT BE USED FOR THIS PURPOSE.

USE TEST LEADS PROVIDED OR CORRECTLY TERMINATED WIRES TO MAKE CONNECTIONS TO THE 4mm INPUT/OUTPUT SOCKETS. DO NOT PUSH BARE WIRES INTO THE SOCKETS. FOR EMC COMPLIANCE, USE THE PROVIDED TEST LEADS ONLY.

3.5.1 Voltage Measurements

To select the voltage measurement mode, proceed as follows.

- Connect the test leads to the voltage measurement **(V)** input sockets located on the top end panel of the instrument, Red (+ve), Black (-ve).
- Switch the instrument on.
- Set the instrument to read voltage by pressing the **V** key. This will set the Voltage function as the main display reading. For a dual display, pressure with voltage, press the **P** and **V** keys together. (Refer also to Section 3.3.4).

Note: *An overrange condition i.e. Applied Voltage > **50V**, causes the display to flash.*

3.5.2 Current Measurements

To select the current measurement mode, proceed as follows.

- Connect the test leads to the current **(I)** input measurement sockets located on the top end panel of the instrument, Red (+ve), Black (-ve).
- Switch the instrument on.
- Set the instrument to read current by pressing the **I** key. This will set the Voltage function as the main display reading. For a dual display, pressure with voltage, press the **P** and **I** keys together. (Refer also to Section 3.3.4).

Note: *An overrange condition i.e. Applied Current >55mA, causes the display to flash.*

3.5.3 24V D.C. Output

To use the 24V d.c. output, proceed as follows.

- Connect the test leads to the current (I) input measurement sockets located on the top end panel of the instrument, Red (+ve), Black (-ve).

- Connect the external device to the instrument, observing the correct polarity.

  Caution: *Do NOT short the supply output terminals and DO NOT overload the output. The maximum current that can be supplied is 25mA.*

- Switch the instrument ON.

- To maximise battery life, disconnect the load from the instrument as soon as tests are completed.

3.5.4 Current Loop Tests

To use the current loop test output, proceed as follows.

- Connect the test leads to the current loop test sockets located on the top end panel of the instrument. The current loop circuit is not polarity sensitive.

- Connect the external device to the instrument. Figures 1.2 and 1.3, Section 1.2, give details of typical current sourcing and sinking applications.

  Note: *The output is fully floating.*

- Switch the instrument ON. An output current of 12mA (50% full scale for 4 to 20mA current loop), will be output from the instrument.

3.5.5 Pressure Switch tests

Pressure switch tests can be carried out by using the loop test facility to monitor the state of the pressure switch contacts. Connection details are shown in Figure 1.4. To carry out a pressure switch test proceed as follows.

- Connect the pressure switch to the instrument as shown in Figures 1.4.

- Switch on the instrument and set up the display to read pressure and current by pressing the **P** and **I** keys simultaneously.

- If monitoring normally open contacts, open the volume adjuster to approximately half way out, close the vent valve and pump up the pressure to just below the operating pressure of the switch.

- Screw in the volume adjuster until the switch operates (indicated by a loop current of 12mA. Record the operating pressure.

- Screw the volume adjuster out until the switch operates again (indicated by zero loop current). Record the pressure at which the switch operates.

4 CALIBRATION

The instrument is supplied by the manufacturer, complete with calibration certificate(s). The re-calibration interval will depend on the total measurement uncertainty which is acceptable for a particular application. In order that the instrument remains within the quoted accuracy, it is suggested that it's calibration be checked at 90 day intervals.

The DPI 603 is a very precise calibrator and measuring instrument and the test equipment and conditions of test must be suitable for the type of work. The use of a Class A compensated deadweight tester is essential. The tests should be carried out in a controlled environment by a competent, trained person.

If, when the accuracy of the instrument is checked, it is found to fall outside the specification, calibration adjustment can be undertaken to compensate errors.

The manufacturer offers a comprehensive and, if required, NAMAS accredited calibration service.

4.1 Calibration Check

At the chosen interval, the instrument readings should be compared with a known standard. Any deviations between the instrument and the standard should be noted, taking due account of the traceability (accuracy to a National Standard). If these deviations exceed the published tolerance, or any other suitable chosen performance standard, then the user may wish to carry out a calibration adjustment. The following sections in this chapter explain the method of calibration adjustment for both the pressure, voltage and current ranges.

The pressure and electrical parameter calibration routines are built into the instrument's software.

4.2 Calibration Adjustment

Before carrying out any calibration adjustments, the results of the calibration check should be studied to determine the nature of the deviations to be adjusted.

For pressure calibration, the use of a dead weight tester, having measured masses and correcting for temperature and gravity, is considered mandatory for this level of calibration. The work should be conducted in a controlled environment, with adequate stabilisation time prior to and during adjustment.

Electrical calibration should be carried out using calibrated test equipment of equal, or preferably, higher accuracy than that of the instrument.

4.2.1 General Procedures

The following general hints are provided as a guide to calibration procedures.

Do

Use high quality ***Repeatable and Linear*** pressure sources and allow adequate stabilisation time before calibration (minimum 1 hour).

Conduct the calibration in a temperature and preferably, humidity controlled environment. Recommended temperature is **21°C, ±2°C.**

Use deadweight testers carefully and away from draughts.

4.3 Checking Pressure Calibration

VENT THE SYSTEM PRESSURE BEFORE DISCONNECTING OR CONNECTING ANY PRESSURE LINES. PROCEED WITH CARE.

To check an instrument's pressure calibration, proceed as follows.

- Connect the outlet port of a pressure standard to the OUTLET port of the instrument under test.
- Wait one hour to allow the instrument to stabilise.
- Adjust the pressure standard to the most negative pressure value within the range of the instrument. Allow the applied pressure to stabilise.
- Record the output pressure of the pressure standard and the corresponding instrument reading (shown on the display).
- Repeat the application of test pressures for four increasing pressures, i.e. -F.S., Zero, 50% and 100% F.S., recording the corresponding instrument readings for each applied test pressure.
- Commencing at Full Scale, repeat the application of test pressures in decreasing steps i.e. F.S, 50%, zero and -F.S. DO NOT VENT TO ATMOSPHERE BETWEEN CONSECUTIVE POINTS.
- Calculate the percentage error of the instrument's pressure reading against the applied test pressures.
- Check that the calculated values are within the accuracy limits stated in Section 1.

4.4 Checking Electrical Calibration

To check an instrument's electrical calibration, proceed as follows.

4.4.1 Voltmeter

- Switch the DPI 603 instrument on.
- Connect the instrument's test leads between the common (Black) and V (Red) test sockets. Connect the leads to a stable voltage source.
- Connect the test equipment voltmeter across the voltage source (in parallel with the instrument).
- Set the voltage source to zero and record the voltages read on the instrument and the test instrument. If the test instrument shows zero and the DPI 603 instrument indicates a small offset, zero the instrument by holding the **V** key depressed whilst pressing the **Zero** key.
- Apply test voltages of **OV, 12.5V, 25V** and **50V,** (measured on the test equipment), recording the corresponding instrument voltage reading for each applied voltage.
- Calculate the percentage error of the instrument's voltage reading against the applied test voltage.
- Check that the calculated values are within the accuracy limits stated in Section 1.

4.4.2 Current

- Switch the DPI 603 instrument on.
- Connect the instrument's test leads between the common (Black) and I (Red) test sockets. Connect the instrument in series with a test milliammeter to a variable current source.
- Set the current source to zero and record the current read on the instrument and the test instrument. If the test instrument shows zero and the DPI 603 instrument indicates a small offset current, zero the instrument by holding the **I** key depressed whilst pressing the **Zero** key.
- Apply test currents of **Zero, 20mA, 40mA** and **55mA,** (measured on the test equipment), recording the corresponding instrument voltage reading for each applied voltage.
- Calculate the percentage error of the instrument's current reading against the applied test current.
- Check that the calculated values are within the accuracy limits stated in Section 1.

4.5 Pressure Calibration Adjustment

VENT THE SYSTEM PRESSURE BEFORE DISCONNECTING OR CONNECTING ANY PRESSURE LINES. PROCEED WITH CARE.

The pressure calibration routine requires the entry of three calibration pressures. Calibration data is not overwritten until all three calibration pressures have been entered and accepted. To abort a calibration run, without updating the existing calibration data, switch the instrument off, **BEFORE accepting the final calibration pressure.**

To perform a pressure calibration proceed as follows.

- Connect the outlet port of a pressure standard to the instrument's Outlet port.
- Switch the instrument OFF.
- Enter the **Pressure** calibration menu by pressing and holding the **P** key whilst switching the instrument on. The instrument now prompts for a password before allowing entry into the pressure calibration routine (e.g.),

  Enter PIN: 000

  Caution: *Do not enter the calibration function unless it is intended to carry out a calibration.*

- Enter a valid calibration **PIN** number. Initially, this PIN number is set to **123.** A flashing cursor appears over the first digit position. Press the **P↑** key to scroll through the digits 0 through 9 and when the correct digit for this position is displayed, press the **I→** key to move to the next digit position. Scroll through the numbers using the **P↑** key and when the correct digit for this position is displayed, use the **I→** key to move to the final digit position. Select the final digit by using the **P↑** key. When the full **PIN** has been entered, press the **V←** key to accept the entered PIN. If the **PIN** is incorrectly entered, access to the pressure calibration function is denied.
- Following correct entry of the PIN number, the calibration menu is displayed (e.g.).

  Pressure Cal
  Edit value to press
  Zero Point 00133

- Wait one hour to allow the instrument to stabilise.
- Apply the lowest pressure (-F.S.), (e.g.) -1 bar to the instrument from the pressure standard.

- Allow the applied pressure to stabilise.
- To enter a value for the zero point, edit the reading given on the display to the applied pressure by using the **P** (↑) key to scroll the first digit of the display reading through the digits **0** through **9** until the correct digit is displayed.
- Press the **I** (→) key to move the cursor to the next digit position and edit this digit to the required value by means of the **P** (↑) key. Repeat until all digit positions have been edited to the correct value.
- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the zero value the instrument prompts for the next calibration pressure to be entered (e.g.),

  50% 10.0000 Edit

- Set the pressure standard to apply a pressure of 50% of positive full scale and allow the applied pressure to stabilise.
- Edit the pressure reading using the **P** (↑) **and I** (→) keys as described for Zero point above.
- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the **50% F.S.** value, the instrument prompts for the next calibration pressure to be entered (e.g.),

  100% 20.0000 Edit

- Set the pressure standard to apply a pressure of 100% of positive full scale and allow the applied pressure to stabilise.
- Edit the pressure reading using the **P** (↑) **and I** (→) keys as described for Zero and 50% F.S. points above.
- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the **100% F.S.** value, calibration is complete and the old calibration data is overwritten. The following prompt is given(e.g.),

  Cal done

- Repeat the calibration check to see that the correction has been effective.

4.6 Electrical Calibration Adjustment

The electrical calibration routines require the entry of two signals for both the **Voltage** and the **Current** measuring circuits. Calibration data for each measurement channel is not overwritten until both calibration parameters have been entered and accepted. To abort a calibration run, without updating the existing calibration data, switch the instrument off, **BEFORE accepting the second calibration parameter.**

4.6.1 Voltage Range

To perform calibration of the voltage measurement channel, proceed as follows.

- Connect the instrument test leads to the common **(Black)** and the **V** (Red) test sockets. Connect the instrument terminals in parallel with a calibrated digital voltmeter, preferably of greater accuracy than the instrument.

- Switch the instrument OFF.

- Enter the **Voltage** calibration menu by pressing and holding the **V** key whilst switching the instrument on. The instrument now prompts for a password before allowing entry into the voltage calibration routine (e.g.),

  Enter PIN: 000

  Caution: *Do not enter the calibration function unless it is intended to carry out a calibration.*

- Enter a valid calibration **PIN** number. Initially, this PIN number is set to **123.** A flashing cursor appears over the first digit position. Press the **P↑** key to scroll through the digits 0 through 9 and when the correct digit for this position is displayed, press the **I→** key to move to the next digit position. Scroll through the numbers using the **P↑** key and when the correct digit for this position is displayed, use the **I→** key to move to the final digit position. Select the final digit by using the **P↑** key. When the full **PIN** has been entered, press the **V←** key to accept the entered PIN. If the **PIN** is incorrectly entered, access to the voltage calibration function is denied.

- Following correct entry of the PIN number, the voltage calibration menu is displayed (e.g.).

  Apply Short
  Reading Value 000012

- Short out the instrument terminals

- Edit the voltage reading given on the instrument display to that given on the DVM by using the **P** (↑) key to scroll the first digit of the display reading through the digits **0** through **9** until the correct digit is displayed.

- Press the **I** (→) key to move the cursor to the next digit position and edit this digit to the required value by means of the **P** (↑) key. Repeat until all digit positions have been edited to the correct value.

- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the zero value the instrument prompts for the next calibration voltage to be entered (e.g.),

  Reading Value 49.9997

- Remove the short and apply a test voltage of 50V (Full Scale).

- Edit the instrument's voltage reading to give the same value as that indicated on the DVM , using the **P** (↑) and **I** (→) keys as described above.

- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the **F.S.** value, voltage calibration is complete and the old calibration data is overwritten. The following prompt is given (e.g.),

  Cal done

- Repeat the voltage calibration check to see that the correction has been effective.

4.6.2 Current Range

To perform calibration of the current measurement channel, proceed as follows.

- Connect the instrument test leads to the common **(Black)** and the **I (Red)** test sockets. Connect the instrument terminals in series with a calibrated digital milliammeter, preferably of greater accuracy than the instrument.

- Switch the instrument OFF.

- Enter the **Current** calibration menu by pressing and holding the **I** key whilst switching the instrument on. The instrument now prompts for a password before allowing entry into the current calibration routine (e.g.),

  Enter PIN: 000

  Caution: *Do not enter the calibration function unless it is intended to carry out a calibration.*

- Enter a valid calibration **PIN** number. Initially, this PIN number is set to **123.** A flashing cursor appears over the first digit position. Press the **P↑** key to scroll through the digits 0 through 9 and when the correct digit for this position is displayed, press the **I→** key to move to the next digit position. Scroll through the numbers using the **P↑** key and when the correct digit for this position is displayed, use the **I→** key to move to the final digit position. Select the final digit by using the **P↑** key. When the full **PIN** has been entered, press the **V←** key to accept the entered PIN. If the **PIN** is incorrectly entered, access to the current calibration function is denied.

- Following correct entry of the PIN number, the curent calibration menu is displayed (e.g.).

  Apply Open Circuit
  Reading Value 000002

- Edit the current reading given on the instrument display to that given on the DVM (Zero) by using the **P** (↑) key to scroll the first digit of the display reading through the digits **0** through **9** until the correct digit is displayed.

- Press the **I** (→) key to move the cursor to the next digit position and edit this digit to the required value by means of the **P** (↑) key. Repeat until all digit positions have been edited to the correct value.

- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the zero value the instrument prompts for the next calibration voltage to be entered (e.g.),

  Apply Known I 49.9997

- Connect the series connected instrument and DVM to a current source. Adjust the current source to give an output of **55mA.**

- Edit the instrument's current reading to give the same value as that indicated on the digital milliammeter , using the **P** (↑) **and I** (→) keys as described above.

- Check the entered value and when satisfied, press the **V** (←) to accept the entered value. On acceptance of the **F.S.** value, current calibration is complete and the old calibration data is overwritten. The following prompt is given (e.g.),

  Cal done

- Repeat the current calibration check to see that the correction has been effective.

5 MAINTENANCE

There are no user serviceable parts on the DPI 603 instrument.

5.1 Safety Instructions

- Observe the general safety procedures detailed at the beginning of this User Manual.
- This instrument must only be serviced by a Druck approved service organisation or by a competent person. Section 5.4 details a list of Druck subsidiaries worldwide.
- Do not use replacement parts other than those supplied by the manufacturer or manufacturer's agent.

5.2 Battery Replacement

The instrument's batteries are located in the base of the instrument. The method of replacing the batteries is outlined in Section 2.1.

5.3 Fault Finding

During normal operation, if an error condition occurs, an appropriate warning will be written to the display screen. The following operational warnings may be given.

Display	Error Condition	Remedy
Battery Low	Battery voltage low	If rechargeable cells fitted, connect charger. If dry cells fitted, switch off and replace batteries. (See Section 2.1)
Large Offset	Offset for selected function outside range of Zero key	For Voltage and Current, disconnect voltmeter or milliammeter before zeroing. For pressure, open vent valve before attempting to Zero.

In the event of an instrument malfunction, it can be returned to the Druck Service Department or Druck Agent for repair. A service charge price list is available which details the charges associated with various service functions.

5.4 Cleaning

Clean the instrument case with a damp cloth and mild detergent.

DO NOT USE ANY TYPE OF SOLVENT FOR CLEANING PURPOSES

5.5 Approved Service Agents

The following are approved Service Agents for Druck Instruments.

FRANCE

Druck S.A.R.L.,
26 Rue Edith Cavell,
F924000 Courbevoie,
France.

Tel: (1) 43 34 24 75
Fax: (1) 43 34 86 08

GERMANY

Druck Messtechnik GmbH,
Lessingstrasse 12,
61231 Bad Nauheim,
Germany.

Tel: 6032 35028
Fax: 6032 71123

HOLLAND

Druck Nederland B.V.,
Postbus 232,
Zuideinde 37,
2991 LJ Barendrecht,
The Netherlands.

Tel: 1806 11555
Fax: 1806 18131

ITALY

Druck Italia Srl.,
Via Capecelatro 11,
20148 Milano,
Italy.

Tel: 2 48707166
Tel: 2 48705568

JAPAN

Druck Japan KK,
Medie Corp Building 8,
2-4-14 Kichijyoji-Honcho,
Musashino,
Tokyo 180,
Japan.

Tel: 422 20 7123
Fax: 422 20 7155

UK

Druck Ltd.,
Fir Tree Lane,
Groby,
Leicester,
LE6 OFH.

Tel: 0116 231 4314
Fax: 0116 232 0309

USA

Druck Incorporated,
4 Dunham Drive,
New Fairfield,
Connecticut 06812,
USA.

Tel: 203 746 0400
Fax: 203 746 2494