Druck

PRESSURE MEASUREMENT

DPI 510
PRECISION PRESSURE CONTROLLER/CALIBRATOR
OPERATION AND MAINTENANCE HANDBOOK
K086

Prepared by Druck Publications Department
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K086 Issue No. 4

SAFETY

1 This publication contains information and warnings that must be followed to ensure safe operation and to maintain the equipment in a safe condition. Use qualified* personnel and good engineering practice for all procedures in this publication.

2. The user must not use this equipment for any other purpose than that stated. This equipment is designed to be used with dry air or nitrogen in a gaseous state; do not use any medium without first consulting Druck Ltd.

3. Do not apply a pressure greater than 110% of the full-scale pressure in the selected pressure range of the unit. If excessive pressure, greater than that stated, is applied personnel can possibly receive injures that in extreme circumstances be lethal. Furthermore possible serious damage can occur to the instrument and the user system and equipment.

* A qualified person must have attended a product training course given by the manufacturer or appointed agent and successfully completed the training course on this equipment.

IMPORTANT

USE THIS MANUAL WITH MAIN SOFTWARE ISSUE 16

This information in this publication includes operating details for software at DK 80 Issue 16. During the power-up routine the instrument displays the main software issue number. Subsequent issues of the software that change the operation of the instrument will detailed in a new issue of this publication.

Associated DRUCK Publications

K087	Function Key Summary Card
K086A	IEEE 488 Option Handbook
K087A	IEEE 488 Summary Card
K086B	RS232 Option Handbook
K087B	RS232 Summary Card
K086C	Sensor Conditioning Module Option Handbook
K087C	Sensor Conditioning Module Summary Card
K086D	Analogue Output Option Handbook
K086E	Rack and Panel Mount Option Leaflet
K086H	Barometric Pressure Option Handbook
K086J	Aeronautical Option Handbook

Abbreviations

The following abbreviations are used in this publication.

NOTE: *Abbreviations are the same in the singular and plural.*

A	Ampere
abs	absolute pressure
AC	alternating current
atm	atmosphere
AUTO	automatic
BS	British Standard
cmHg	centimetre of mercury
cmH_2O	centimetre of water
contd	continued
DAC	digital analogue convertor
db	decibel
°C	degrees Celsius
DPI	digital pressure indicator
$'H_2O$	foot of water
FS	full-scale
GPIB	general purpose interface bus
HP	high pressure
HRC	high rupture capacity
Hz	hertz
IEEE 488	Institute of Electrical and Electronic Engineers standard 488 data
inHg	inch of mercury
$"H_2O$	inch of water
Iss	issue
kg/cm^2	kilogram per square centimetre
kHz	kilo-Hertz
kg/m^2	kilogram per square metre
kPa	kiloPascal
LED	light emitting diode
lbf/ft^2	pound force per square foot
LP	low pressure
mbar	millibar
mHg	metre of mercury
mH_2O	metre of water
mmHg	millimetre of mercury
MAX	maximum
mm	milli-metres
mPa	mega-Pascal
Pa	Pascal
PCB	printed circuit board
PIN	personal identification number
psi	pound force per square inch
PSU	power supply unit
rev	revision

Abbreviations (contd)

RMS	root mean square
RS232	serial data transmission standard
sec	second
SK	socket
torr	1/760 x 1 atm (1 torr = 1 mmhg)
V	volts
VA	volt ampere
VHP	very high pressure
VLP	very low pressure

Symbols

This symbol, on the instrument, indicates that the user should refer to the user manual.

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

ILLUSTRATIONS

DRUCK DPI 510
PRECISION PRESSURE CONTROLLER AND CALIBRATOR

Introduction

The DPI 510 instrument is a programmable, high-accuracy, pneumatic pressure source. The range of DPI 510 instruments operate between pressures of -1bar and +210 bar full-scale. An optional Sensor Conditioning Module permits a complete calibrator to be configured. Pressure control is achieved using a modulated electro-magnetic flow regulator and the derived pressure may be entered and displayed on the front panel or remotely, by RS232 and IEEE 488, on a controlling computer. Sensing of pressure is accomplished using a Druck transducer, the dual range instrument uses a second transducer to extend the instrument's pressure range. Optionally, a transducer may sense pressure at a remote point. The instrument is controlled by two microprocessors providing a wide range of features. Accuracy and fast response is ensured by the use of two feed-back control loops.

Description

Located on the front panel are a membrane key-pad, displays and LED indicators. The membrane key-pad comprises numeric keys, function keys and blue, main keys. The two front panel, vacuum fluorescent displays consist of a 6 digit, 7 segment reading panel to show pressure values and a 2 line, 20 character message panel. LED indicators illuminate on a schematic diagram when the control and protection valves are energized. The front panel label indicates the instrument's full-scale pressure ranges.

The instrument provides programmable scale pressure measurement units selected from the front panel. An audible alarm sounds and a message displayed if the instrument exceeds 120% of the rated pressure. Negligible calibration change will be caused at two times the rated full-scale pressure. Dual range instruments, except very high pressure instruments, have auto-protection of the low pressure range transducer.

Options

Some options are contained on PCB that plug into a standard option connector, on the main PCB, with an external connector on the rear panel. The options on plug-in PCB provide IEEE 488 or RS232 output/control, Sensor Conditioning Module, Analogue signal output, Barometric pressure (with an additional vibrating-cylinder transducer) and Aeronautical units. Further options are a remote sensor, rack and panel mountings and a minus 1 bar measurement.

SUMMARY DATA

Accuracy

The following figures include 90 day stability and use of the auto-zero facility.

70 mbar to 70 bar range

..... ±0.01% F.S. from 0% to 20% F.S.
..... ±0.04% of reading from 20% to 100% F.S.

70 bar to 210 bar range

..... ±0.02% F.S. from 0% to 20% F.S.
..... ±0.08% of reading from 20% to 100% F.S.

Maximum resolution

.....0.01% FS below 100mbar
..... 0.005% FS over 100mbar

Controller Stability

.....0.004% F.S. random variation around control value set-point

Combined Non-linearity, Hysteresis and Repeatability (Short Term Accuracy)

70 mbar to 70 bar range

..... ±0.008% F.S. from 0% to 20% F.S.
..... ±0.025% of reading from 20% to 100% F.S.

70 bar to 210 bar range

..... ±0.015% F.S. from 0% to 20% F.S.
..... ±0.04% of reading from 20% to 100% F.S.

Thermal Effect

Calibrated temperature range ..... 10° to 30°C
Operating temperature range ..... 0° to 50°C
Thermal sensitivity of span ..... ≤0.002% Reading/°C
(Zero - adjusted by key press) ..... (averaged over 10-30°C)

Power Supply

Voltage selection ..... 88 to 132V or 176 to 264V
Frequency range ..... 47 to 440Hz
Power 80VA

Electrical safety

This instrument meets:

..... BS EN 61010-1 as applicable

Electromagnetic compatibility

This instrument meets:

..... EN50081-1 (emissions)
..... EN50082-1 (immunity)

EMC 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.

For further information refer to the data sheet.

1 INSTALLATION

1.1 Power Supply

CAUTION: Check that the power supply voltage is correct for the voltage setting of the instrument.

1.1.1 Voltage Setting

The instrument can be set to either 88 to 132V AC or 176 to 264V AC. The power supply frequency range is 47 to 440 Hz. To change the power supply voltage setting, switch off the power supply and disconnect from the instrument. Select the supply voltage switch, on the rear panel, to the required voltage setting. Connect the power supply to the instrument. Check that the power supply voltage is correct for the voltage setting and switch the instrument "ON".

1.1.2 Power Connection

WARNINGS

VOLTAGES, IN EXCESS OF 30 VOLTS (RMS) AC OR 50 VOLTS DC CAN, IN CERTAIN CIRCUMSTANCES, BE LETHAL. CARE MUST BE TAKEN WHEN WORKING ON LIVE EXPOSED CONDUCTORS.

SAFETY !

INSTRUMENT MUST BE GROUNDED VIA PROTECTIVE GROUND CONDUCTOR OF THE POWER CORD.
DISCONNECT POWER BEFORE REMOVING COVERS.

The Power Supply connector is a 3 pole connector to BS4491 (IEC 320). The power must be supplied by a three core cable installed as follows:

Brown	-	Live
Blue	-	Neutral
Green/Yellow	-	Earth (Ground)

The power supply, 2A, 20mm, HRC anti-surge fuse is in the live circuit and locates in the rear panel. An internal 3A, anti-surge fuse is located in the power supply unit. To replace either fuse refer to MAINTENANCE section 4.

1.1.3 External Valve Control (Figure 1)

Two integral relays provide fully-isolated change-over contacts which can be used to control external valves (normally called roughing valves). These valves allow large volumes to be pressurised, they function in the same way as the internal apply and release valve.

A further integral relay enables one of two pressure sources to be remotely selected via an external solenoid valve. This relay operates on the change-over from RANGE 1 to RANGE 2.

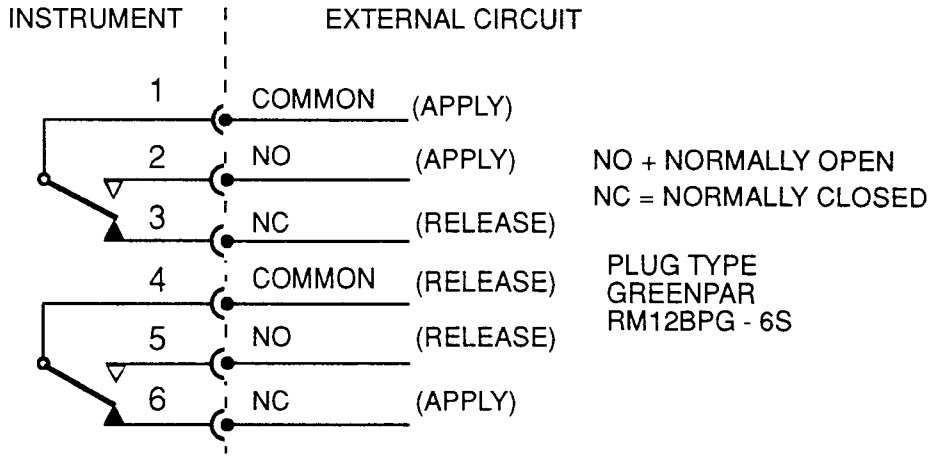


Figure 1, External Valve Control Connection

1.1.4 External Transducer Connectors

The external transducer connectors are located on the rear panel and identified REMOTE TRANSDUCERS 1 and 2. External transducers connect to either of the 6 pole connectors as shown in Figure 2.

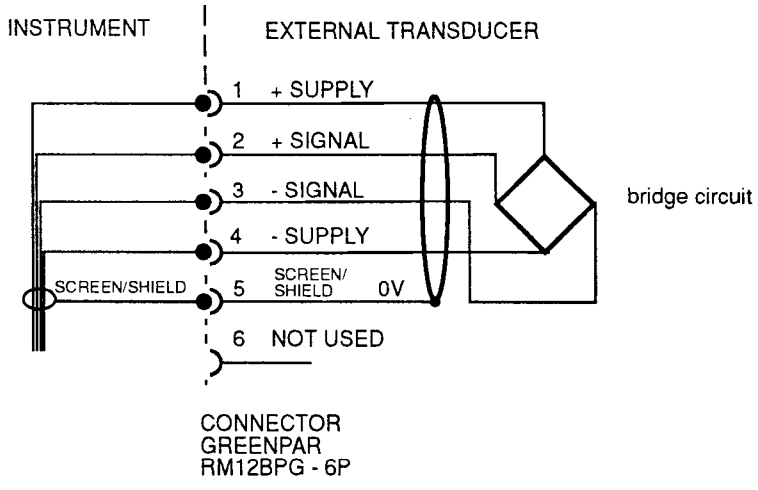


Figure 2, External Transducer Connections

1.2 Pneumatic Supply

WARNING

COMPRESSED GAS CAN, IN CERTAIN CIRCUMSTANCES, BE LETHAL. WHEN CONNECTING AND DISCONNECTING COMPRESSED GAS SUPPLY LINES, ENSURE THAT THE SOURCE PRESSURE IS TURNED OFF AND THE PRESSURE LINES ARE VENTED. PROCEED WITH CARE.

1.2.1 Pneumatic Connection

There are four connection ports on the rear panel identified OUTLET, VENT, SOURCE and REFERENCE. Before installation remove the polythene blanking plugs from the appropriate connection ports. A filter locates in the bore of each connection.

NOTE: *For absolute pressure measurement instruments the polythene blanking plug should remain in the unused REFERENCE port.*

The connections are G 1/8 (female), each connection requires sealing with a bonded washer. For details of the pneumatic connections see figure 3 page . If regular disconnection/connection of the instrument is likely, the fitting of adaptors in the pneumatic ports is recommended.

NOTE: *It is recommended that warnings be placed near the user's system and equipment, informing personnel of the dangers of compressed gas.*

1.2.2 Source Port

WARNING

SOURCE PRESSURE CAN LEAK TO THE OUTLET PORT UNDER FAILURE CONDITIONS, EVEN WITH ELECTRICAL POWER REMOVED. MAKE SURE THE USER SYSTEMS CAN BE ISOLATED AND VENTED. PROCEED WITH CARE.

The SOURCE pressure must not exceed 110% of the full-scale pressure value of the selected range. On dual range instruments, care must be taken before changing to the lower pressure range, reduce the SOURCE pressure to within 110% of the full-scale pressure of the range. External valve control automatically changes the source pressure.

WARNING

KEEP CLEAR AND DO NOT OBSTRUCT THE VENT PORT. COMPRESSED GAS FROM THE VENT PORT CAN BE AS HIGH AS THE SOURCE PRESSURE.

1.2.3 Vent Port

CAUTION: The VENT port must be free from obstruction.

During venting of the system, gas will flow from the system volume out of the VENT port and initially can be at the full working pressure of the system. Any equipment connected to the VENT port (e.g. pipes, fittings and vacuum pump) must be capable of handling the flow/pressure safely. On gauge pressure instruments a vent silencer screws into the VENT port of the rear panel to reduce the noise of the vented gas.

1.2.4 Reference Port

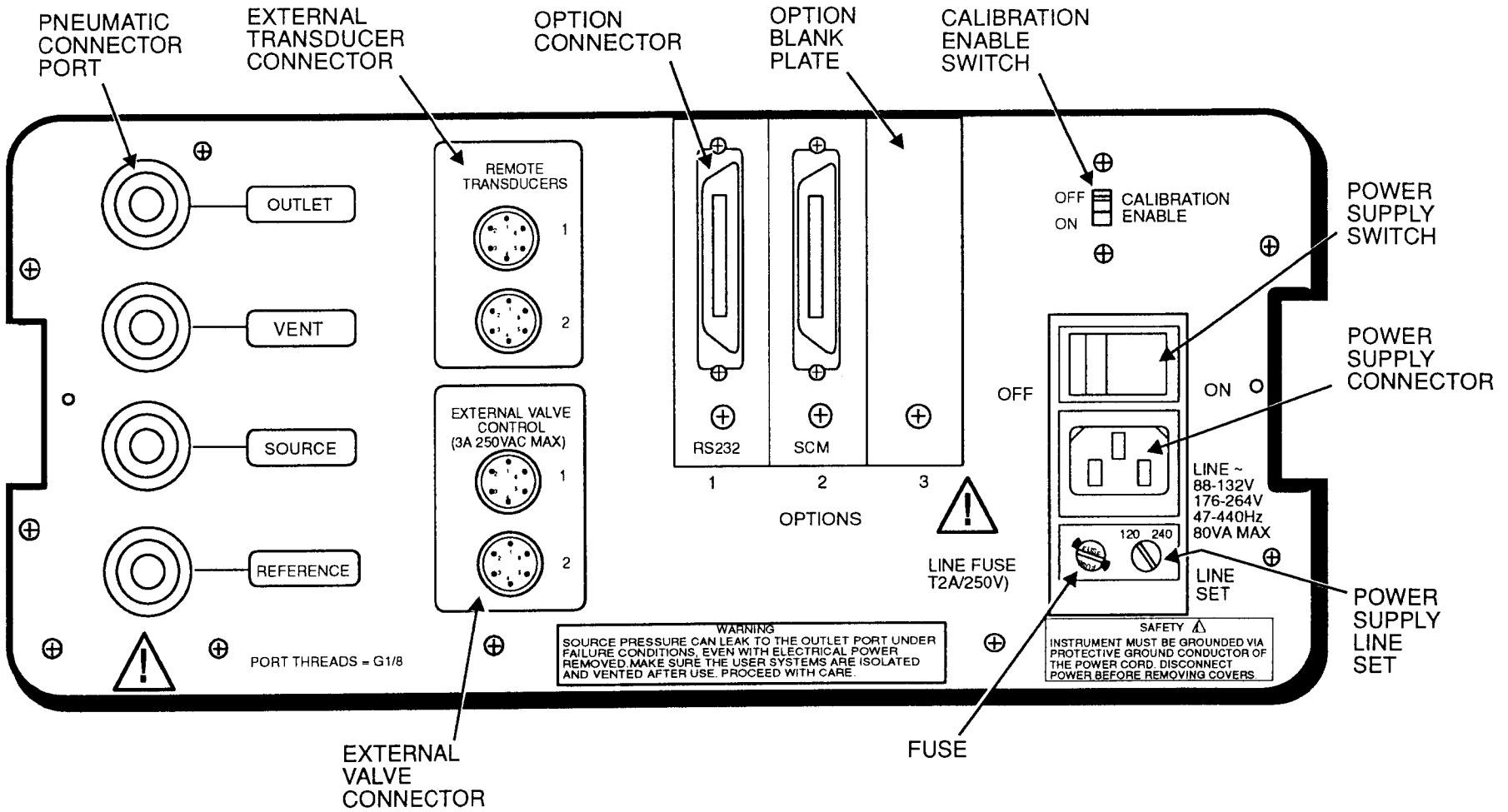
CAUTION: The instrument will be damaged if the source pressure is connected to the REFERENCE port.

The REFERENCE port is used on gauge and differential instruments. A single REFERENCE port provides the reference connection for both range 1 and range 2 transducers. Ambient pressures acting on the REFERENCE port of low pressure instruments can have significant affects on the pressure reading, a diffuser screwed into the port reduces ambient pressure variations.

CAUTION: The REFERENCE port, line pressure must not exceed two times the full-scale pressure range or 2 bar, whichever is the smaller, the integral transducer can be damaged.

1.2.5 Outlet Port

The OUTLET port provides the controlled pressure output of the instrument. The remote transducer pneumatic connects, via a tee-piece, to the OUTLET port for sensing the controlled pressure output.



NOTE: *On the 10 to 70bar range instruments the position of the SOURCE and VENT connections are reversed.*

Figure 3, Rear Panel

2 OPERATION

2.1 Power-up

When the instrument is installed, in accordance with Section 1, it is safe to proceed with power-up.

Switch on the instrument, the message panel will briefly display the current display software and issue number. A further brief display indicates the current instrument main software and issue number.

1. After two seconds the system enters the power-up sequence. The instrument, unless otherwise requested, is supplied by Druck in a safe default condition called Power-up: Reset and, is set as follows: Range 1, Scale 1, Controller OFF, Set-point 0 or 1 bar (for abs instruments) Rate 'F1' and Set-point Value mode. Selection of the default conditions of the power-up sequence is made in SET-UP see section 2.3.2.

2. The reading panel displays the current pressure. The appropriate LED illuminates on the front panel schematic display diagram.
   On the front panel schematic display diagram the LED are identified and indicate the following:

   'A' External valve control apply signal.
   'S' Apply solenoid for source pressure.
   'V' Release solenoid for vent pressure.
   'R' External valve control release signal.
   'OUT' Isolation solenoid (0 - 70bar instruments only).
   'V/P' Low pressure protect (dual range instruments only 0 - 70bar).

3. Allow one hour from power-up for the instrument to reach thermal stability and achieve optimum accuracy.

4. The message panel displays the current set-point and a prompt for a new set-point. Press ENTER after selecting a new set-point. After entering a new set-point, to obtain the set-point pressure select CONTROL to ON. The instrument controls the pressure safely to the set-point pressure value. The nudge keys can be used to make fine adjustments of the set-point value. The null indicator in the top right position of the message panel shows the measured difference between the current pressure reading and the aim set-point. The null indication shows ± 0 - 9 where, each digit equals 0.005% FS. Outside of the 0 - 9 range of the set-point the digits are replaced by the symbols << or >>. When the controller is ON the 'S' apply and 'V' release LED illuminate to provide further indications of the controller function.

   Further set-point values can be entered and the instrument controls safely within the pressure range shown on the front panel. For more functions and facilities of the instrument see Operator Control Mode, 2.2 and Supervisor Control Mode, 2.3

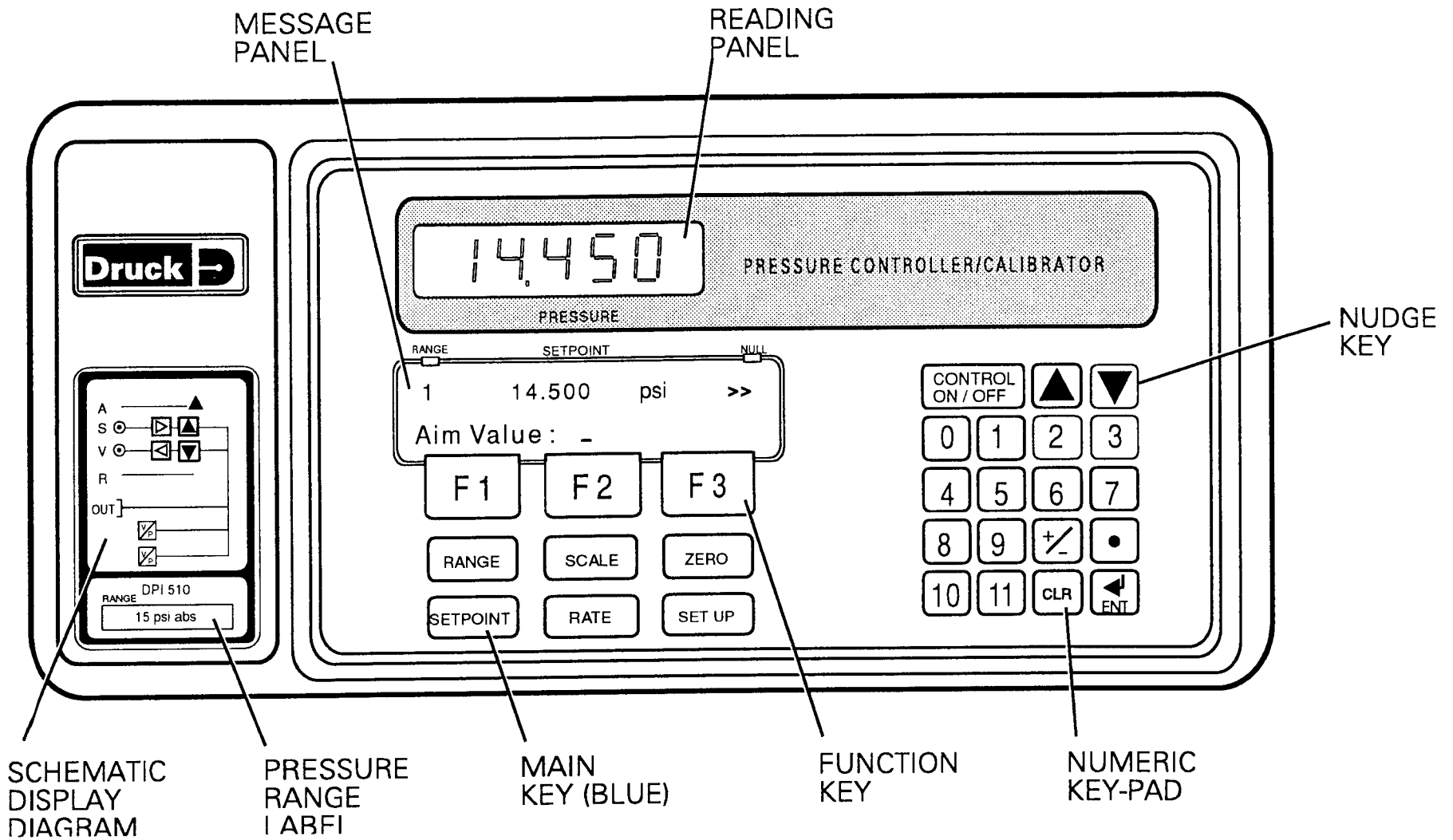


Figure 4, Front Panel

2.2 Operator Control Mode

In the operator control mode the instrument is controlled by the blue main keys and function keys on the front panel. The functions of the instrument can be limited and protected by a lock mode and password. The blue main keys select RANGE, SCALE, ZERO, SET-POINT, RATE and CONTROL ON/OFF. Within each mode, the front panel display provides a choice, using the function keys F1, F2 and F3, shown on the message panel. Numeric values can be entered using the front panel key-pad and are prompted by a flashing cursor. Pre-determined limits and function-enable commands are entered in SET-UP (see 2.3.1). The front panel functions and selections are shown on figure 4 page 13. If a specific fault condition occurs an error message will be displayed on the message panel (see Section 5.1).

NOTE: *On instruments with full-scale pressures between 10 bar and 70 bar a thermal trip is fitted. If a high temperature of the pressure manifold occurs, operation of the control solenoids is inhibited until the manifold cools.*

2.2.1 Range Key

The range key selects range 1, range 2 or the option selection. The message panel displays, in the top left position, the current selected range. When a range selection is made the controller is automatically switched off. The changing of the range key can be locked (see 2.3.2.2). If the instrument is fitted with options, one of the function keys is used to initiate the option selection (see OPTIONS). When range 2 is selected on 0 to 70 bar range instruments, the low pressure protect valve should open (solenoid energized) if the current pressure is within the 120% of the range 2 transducer.

Overpressure
Should an overpressure of range 2 occur the instrument isolates the user system and opens the vent valve. To recover from an overpressure the instrument must be switched off.

NOTE: *An overpressure condition may exist when changing range on some instruments with a combination of differing transducer types and pressure ranges. This does not apply to an instrument with a range 2 transducer of 1.4 bar abs or less.*

2.2.2 Scale Key

The selected scale unit is indicated in the top right position of the message panel display. Three pressure measurement units are available using the three function keys. The function keys are programmed, for the pressure measurement units or special constant, in SET-UP (see 2.3.4). It is possible when changing to some small scale units (e.g., Pascals) to "over-scale". This occurs when the converted value is numerically larger than the maximum display reading. A reading display of 9.9.9.9. shows an "over-scale".

2.2.3 Zero Key

Within the zero mode two selections are available Zero and Tare. The maximum zero offset is ±5% of the full-scale value. The Tare selection has no limits. An error message is displayed if the Zero value is outside the limits of the instrument.

2.2.3.1 Zero

There are three modes that can be programmed in the Zero SET-UP: Manual, Timed and Auto (see 2.3.5).

NOTE: *The zero offset is not retained after power is removed in the auto and timed modes. The offset is retained after a manual zero.*

Manual Zero

The Manual Zero mode, selected in SET-UP Zero, can be ENABLED/DISABLED or ISOLATED.

a. ENABLED/DISABLED
In the ENABLED mode, when the Zero main key is pressed, the instrument attempts to zero the current pressure reading. In the DISABLED mode, when the Zero main key is pressed, an error message will be displayed.

b. ISOLATED
When the ZERO main key is pressed, the instrument initiates an isolated zero sequence. This sequence first isolates the instrument from the user's system before opening the vent valve, then waits until a stable condition is achieved and then zeros the instrument. After taking the new zero reading, the instrument re-pressurises to the current set-point. The isolation valve then opens and re-connects the instrument to the users system.

NOTE: *An isolation valve is not fitted on instruments with a pressure range of >70 bar. When manual zero isolated or timed zero is in progress, the complete users' system vents as it is not isolated.*

A Zero function can be programmed in SET-UP to automatically zero the current reading at regular, timed intervals. Timed Zero, in minutes, allows a time period between taking Zero ISOLATED measurements. When Auto Zero is enabled, the zeroing of the instrument automatically takes place by venting the system whenever the aim set-point value is entered as zero with the controller 'ON' and the zero set-point attained.

Timed Zero

Timed Zero allows a time period (minutes) between taking Zero Isolated measurements.

Auto Zero

When Auto Zero is enabled the zeroing of the instrument automatically takes place by venting the system. Whenever the aim set-point is entered as zero with the controller and the zero set-point attained.

2.2.3.2 Tare

The Tare function, when selected within the zero mode, may be switched on and off. Pressing the NEXT key provides a display of the current Tare offset and a prompt to enter a new Tare value. Pressing SAMPLE enables a sample of the current reading to be taken, the sample is used as the new Tare value. When a Tare offset is in operation a '**T**' appears next to the range indicator on the message panel.

NOTE: *Instruments with the Barometric Reference Option: The Tare offset is not applied to the displayed pressure reading when selected in the absolute range of the Barometric Option.*

2.2.4 Set-point Key

The selection of set-point is made via the main key and function keys. The function keys are used to select Value, Ratio and Preset modes (for set-up see 2.3.6). The changing of the set-point mode can be locked (see 2.3.2.2). Numeric values, within each selection, are entered and can be "nudged" for fine adjustments on the front panel key-pad.

1. Value mode, enables a new aim set-point to be entered by the front panel key-pad. If the new set-point is outside the preset limit (see 2.3.6) an error message is displayed and the buzzer sounds.

2. Ratio mode, provides a range divider based on the current value of the set-point. The first line of the message display shows the range, set-point and units. The second line of the message display shows the ratio as a % of the current set-point. The ratio can be changed by selecting a new ratio on the front panel key-pad (0 -11). The display will change to show the new % ratio of the set-point on the second line and the first line set-point will change to the new ratio of the set-point expressed in pressure units. If the new set-point is outside the preset limit (see 2.3.6) an error message is displayed and the buzzer sounds.

3. Preset mode, provides up to twelve preset pressure values, held in memory, and recalled by a selection on the front panel key-pad (0 - 11). The preset pressure value is shown on the second line of the display. The pressure value can be selected as the new set-point value by pressing the ENTER key. The preset pressure values can be stored in one unit of measurement but the instrument will automatically display the set-point value in the current units of measurement. If the new set-point is outside the preset limit (see 2.3.6) an error message is displayed and the buzzer sounds.

2.2.5 Rate Key

The rate, is the change in pressure units/sec determined by the controller and can be selected by the RATE main key. The first line of the message display shows the current selected rate. The second line of the message display offers rates in the current pressure units/sec, VALUE, AUTO or MAX dependant on the SET-UP programming (see 2.3.2.5, 2.37). The MAX selection sets the controller to achieve the set-point value in the fastest time but causes the controller to overshoot the set-point value. The AUTO selection sets the controller to achieve the set-point value at a fast rate causing the controller minimum overshoot of the set-point value. Adjustments to the rate can be made in controller set-up (see 2.3.2.4).

2.2.6 Controller ON/OFF Key

The controller on/off function key toggles between the two selections. When the controller is ON the null indicator shows the difference between the current pressure reading and the aim set-point. The null indicator in the top right position of the message panel shows the difference between the current pressure reading and the aim set-point. The null indication shows ± 0 - 9 where each digit equals 0.005% FS. Outside of the 0 - 9 range of the set-point the symbols << or >> replace the digits.

2.3 Supervisor Control Mode

The supervisor control mode provides access to the SET-UP facility which programs the operator control functions.

2.3.1 SET-UP Key

Set-up provides a secure method of selecting and storing default values for all function key parameters and for any options installed on the instrument. The SET-UP mode is protected against unauthorised settings by a number code. When SET-UP is selected the second line of the message panel shows, if enabled, a prompt of "Enter PIN:", the instrument expects up to a four digit, Personal Identification Number. If the incorrect Personal Identification Number is entered, two further attempts are permitted before "Access Denied" is displayed. The SET-UP mode provides three selections MENU, OPTION and QUIT on the function keys and programming of the main keys.

2.3.1.1 Menus

The SET-UP menu provides a range of menu statements for programming functions and values. The set-up menu statements, selected by the function keys, are used as follows:

1. Alter
   Allows change to the current state or value. For value entry use of the key-pad is prompted when required.

2. Next
   Moves to the next menu window.

3. Quit
   Returns to a previous menu from which a further QUIT is available. Continuous use of QUIT will eventually leave the SET-UP mode.

4. Yes
   Immediate action.

5. CLR Key
   Deletes last entry or acts as Next key selection.

2.3.2 SET-UP Menu

The SET-UP values and modes are changed and selected as follows:

2.3.2.1 Power-up: Reset

If the statement remains unaltered, the instrument powers-up in a safe reset mode as follows: RANGE 1, SCALE 1, CONTROLLER OFF, Set-point 0 (or 1 bar for abs instruments) RATE 1 and Value mode.

alternatively:

Power-up: Restore

When selected in SET-UP the instrument, at power-up, recalls the operating conditions stored at the last "store defaults". This selection only recalls the operating conditions of the set-point, range, controller ON/OFF, tare and zero modes. The SET-UP features are not replaced or recalled.

2.3.2.2 Keyboard: locked

If the statement is unaltered, the current RANGE and SET-POINT mode is locked to prevent the operator from changing the current values. The SCALE and RATE modes can be effectively locked by setting all three keys to the same value. The zero mode can also be effectively locked see 2.3.5.

alternatively:

Keyboard: unlocked

If the statement is unaltered, the RANGE and SET-POINT mode is unlocked to enable the current values to be changed.

2.3.2.3 Recall defaults?

If YES, the stored default SET-UP settings are recalled to immediately place the instrument in the operating conditions existing when Replace defaults was last selected.

alternatively:
Replace defaults?

If YES, stored as default settings are all the settings in SET-UP (except some option parameters) and the current controller operating conditions. The settings in SET-UP include the stored ratios, presets and controller set-up and zero offset. Operating conditions include controller on/off state, range, scale, tare mode and tare offset. These conditions are stored as Power-up Restore.

NOTE: *When the default settings are changed, the previous 'default' settings are over-written.*

2.3.2.4 Set-up Controller?

The changes to controller set-up will result in the controller circuits being adjusted for optimum stability. The controller set-up selections are as follows:

Controller Stability

The controller stability may need adjusting when the system volume is changed. The stability setting is matched to the volume of the system under control and is typically between the digital settings of 25 to 200.

To set the stability value for a given volume proceed as follows:

i. Enter a set-point of 80% F.S.

ii. Switch the controller ON.

iii. Reduce the stability value until the controller begins to oscillate.

iv. Increase the stability value until the controller oscillations cease and note the value.

v. Enter a set-point of 0% F.S.

vi. Double the noted stability value and enter the new value.

vii Repeat steps i and ii. Ensure that the controller is stable.

Roughing on/off (External Valve Control)

The external roughing valves signals are supplied, through the external output connection, by integral relays that are selected on (enable) or off (disable). Selecting on allows A/R Limit to be set.

The A/R limit provides preset limits within which the controller will normally operate. When a new Set-point value is entered the instrument calculates the ideal pressure change (slope), the A/R limit is a safety band on each side of the slope. If the actual pressure change is outside the A/R limit the instrument holds the A or R solenoids energized until the actual pressure is within limits. The controller then continues controlling within the preset limits.

Auto rate

The Auto rate function allows a smooth, optimally fast approach to the set-point with minimal over-shoot. The controller follows a decreasing rate as the set-point is approached. When correctly adjusted, Auto rate always gives the shortest time to a set-point for the minimum over-shoot. There are two parameters to be set that control the operation of Auto rate:

a. Auto-speed

Auto-speed sets the time to reach the set-point and the over-shoot performance of the Auto rate function. Auto-speed sets the change in pressure which is demanded of the controller in every instrument update cycle. With a value of 1.0 the time to reach the set-point is short and the over-shoot is moderate. With a value of 0.1 the time to reach the set-point is long but the over-shoot is reduced.

b. Auto-max

The auto-max setting reaches a set-point quickly with minimum over-shoot Auto rate selects a high initial rate and then reduces this rate. This high initial rate can cause instability when feeding certain volumes above 70 bar. Auto-max limits the initial rate of change that the Auto rate function can select. At manufacture, the auto-max setting is 3 bar/second. If this setting is too slow, use the following procedure to find the optimum value for the system volume.

Example

Instrument with a full-scale above 70 bar

i. Monitor the outlet port pressure with a suitable pressure instrument (a dial gauge is recommended).

ii. Apply a set-point of 60 bar g and then set a rate of 20 bar/sec.

iii. Apply a pressure of 0 bar g and monitor the pressure at the outlet port.

iv. If the pressure at the outlet port decreases erratically, adjust the rate to a lower value.

v. Repeat the above procedure until the pressure decrease is smooth and note the rate, this should be entered as the auto-max value.

NOTE: *Automax rate value is entered in the current units/second (i.e., 6 bar/sec when bar is the selected unit). When other units are selected this rate is automatically converted and displayed in the new units.*

2.3.2.5 Nudge Set-up

The nudge key increments may be pre-programmed for each range.

2.3.2.6 Set PIN? (Personal Identification Number)

Changes the PIN value or "password" for access into the set-up mode. A PIN value of 0 removes the "password". When a PIN is entered it is important to remember it as there is no way of interrogating the instrument.

NOTE: *The instrument is shipped without a number entered, enabling the supervisor to select the initial PIN setting.*

CAUTION: After entering the PIN the supervisor must switch the instrument off and on to regain the security of the PIN.

NOTE: *Should the PIN be lost, a "skeleton key" can be provided; in such emergencies, contact DRUCK.*

2.3.2.7 Show Option S/W Rev?

Selects the list of Option software issue numbers which are prefixed "DK". The menu selections are Yes, No, Quit; press Yes for the list of software DK numbers.

2.3.3 Option set-up

The OPTION set-up selection enables various changes to be made to the options fitted to the instrument. For details see OPTIONS page 31.

2.3.4 SCALE set-up

The SCALE set-up permits the three function keys to be programmed to standard pressure units or a special constant. Selecting SET-UP and pressing the SCALE main key will change the display to the scale set-up menu. The first line of the message panel shows the current pressure units and the second line shows the prompts Alter, Next and Quit.
Pressing Alter displays, in turn, the pressure measurement units available to program each function key. Pressing Alter again changes to the next pressure measurement unit in the following order:

Pa, kPa, MPa, mbar, bar, kg/cm^2, kg/m^2, mmHg, cmHg, mHg, mmH_2O, cmH_2O, mH_2O, torr, atm, psi, lbf/ft^2, inHg, 'H_2O04, "H_2O04, SPEC'L, 'H_2O20, "H_2O20.

To program a scale, leave the required units of measurement in the display. SPEC'L allows a special conversion factor to be entered. Selecting Next programs the next function key to the pressure measurement units shown in the first line of the display and steps to the next function key. Selecting Quit changes the system back to the SCALE SET-UP mode.

Units of Pressure Measurement

atm	atmosphere
cmHg	centimetre of mercury
cmH2O	centimetre of water
'H2O04	foot of water at 4°C
"H2O04	inch of water at 4°C
'H2O20	foot of water at 20°C
"H2O20	inch of water at 20°C
inHg	inch of mercury
kg/cm2	kilogram per square centimetre
kg/m2	kilogram per square metre
kPa	kiloPascal
lbf/ft2	pound force per square foot
mbar	millibar
mHg	metre of mercury
mH2O	metre of water
mmHg	millimetre of mercury
mPa	mega-Pascal
Pa	Pascal
psi	pound force per square inch
torr	1/760 x 1 atm (1 torr = 1 mmHg)

NOTE: *The conversion factor for pressure units ftH_2O04 and inH_2O04 are calculated for a water temperature of 4°C, pressure units inH_2O20 and ftH_2O20 are calculated for a water temperature of 20°C (68°F).*

2.3.5 ZERO set-up

The ZERO set-up provides the selection of zeroing modes and permits the three function keys to select MANUAL, TIMED and AUTO. When a zero takes place, in operator mode, any off-set is deducted from the transducer output display value.

Manual zero mode (Zero key press)

Selecting MANUAL permits the Manual Zero disabled, Manual Zero enabled or Manual Zero Isolated to be selected. When Manual Zero Isolated is selected, pressing the 'zero' selection of the zero main key menu causes an isolated zero as follows:

When the instrument is connected to a system, the Manual Zero Isolated will energize the outlet solenoid to isolate the system. After the system is isolated the vent valve of the instrument is opened before the zero takes place. A wait time after zero has been reached is also used when Manual Zero and Manual Zero Isolated are selected. The period for the wait time can be entered, as described below.

NOTE: *On instruments with a pressure range >70 bar an isolation valve is not fitted. The system is not isolated when manual zero isolated or timed zero is in progress. If the user system is a large volume, the venting sequence will take a comparable time. The wait time can be extended, to allow for the venting of a large volume, before zeroing takes place.*

Timed mode

Selecting TIMED allows the time period for timed automatic isolated zero to be changed and stored. The time period, in minutes, is the time between automatic zeroes. The time period is selected in SET-UP. A further time period, in seconds, is the wait time before zero pressure correction is made.

NOTE: *On absolute instruments it is important to ensure that the vacuum pump to be used is capable of producing the vacuum pressure in the wait time period.*

Auto mode

Selecting AUTO enables or disables the auto-zero when the set-point aim value = 0. Enabling the Zero on Aim = 0, with the controller ON and the controlled pressure attaining zero causes the vent valve to open which vent the user system. When the pressure reading stabilises and after a wait time the pressure reading is zeroed. The zeroing of the pressure reading is repeated every few seconds until the controller is OFF or a set-point other than zero is entered.

Wait time

The wait time, in seconds, is entered to allow the system to reach zero condition before a zero pressure correction is made.

2.3.6 SET-POINT Set-up Mode

The Set-Point set-up permits the three function keys to select the three set-point modes VALUE, RATIO and PRESET.

VALUE Set-up

Selecting VALUE allows the minimum and maximum set-point values to be set. The minimum set-point pressure limit value in the current pressure units is displayed. Pressing Alter enables the minimum value to be changed. Selecting Next changes the display to show the maximum set-point pressure limit value. Pressing Next reverts the display back to the minimum set-point pressure limit value.

RATIO Set-up

Selecting RATIO places the system into a menu of 12, programmed % divider ratios starting with 0 and ending with 11, selected on the front panel key-pad. When RATIO is selected the display shows, on the first line, the % key ratio number and the % ratio value. On the second line the display shows Alter, Next and Quit. Alter enables the value to be changed within the range of the current set-point value. Selecting Next changes the first line of the display to show the next % ratio value. Quit changes the display back to the set-up menu.

PRESET Set-up

Selecting PRESET places the system into a menu of 12, programmed values of the current set-point value starting with 0 and ending with 11, selected on the front panel key-pad. When PRESET is selected the display shows, on the first line, the key preset number and the preset value. On the second line the display shows Alter, Next and Quit. Alter enables the value to be changed. Selecting Next changes the first line of the display to show the next preset number. Quit changes the display back to the set-up menu.

NOTE: *If the pressure measurement units are changed in normal operation, the preset values are automatically converted to the new pressure measurement units.*

2.3.7 RATE Set-up Mode

The rate set-up permits the RATE main key to be programmed for slew rate settings of VALUE, AUTO and MAX. When rate set-up is selected the display shows, on the first line, the current rate mode Max, Auto or Value in units/sec.

1. The VALUE rate setting permits the rate of change to be altered shown in the current pressure units/sec.

2. AUTO establishes a maximum rate of change, in normal operation, that can be achieved with minimum over-shoot of the set-point value. The auto-speed value must be set for the AUTO to function, see Controller Set-up 2.3.2.4. The auto-speed value is set for the system under test.

3. MAX permits the maximum rate of change, in normal operation, that can be achieved in the shortest time and may over-shoot the set-point value.

2.4 Calibration

If the accuracy of the instrument is suspect and at regular intervals a calibration check should be carried out. The instrument is calibrated by operating the CALIBRATION ENABLE switch on the rear panel, calibration data is entered via the front panel. The calibration memory is over-written if new calibration values are accepted in CALIBRATION mode. It is recommended that calibration is carried out by the supervisor or an equivalent responsible person. To prevent inadvertent or illegal entry of calibration data the PIN (Personal Identification Number) protects the calibration memory.

2.4.1 Equipment

The following equipment is required to calibrate the instrument.

NOTE: *Equivalent substitutes may be used.*

Pressure standard calibration equipment (AIR)

- 0 to 70 bar (accuracy ±0.01%)
- 0 to 210 bar (accuracy ±0.015%)

2.4.2 Test Environment

Recommended Temperature ..... 20°C
In standard humidity and atmospheric pressure.

2.4.3 Calibration Check

a. Switch off the instrument and disconnect the power supply and pneumatic supply source.

b. If necessary, remove the instrument from the equipment rack or panel mount.

c. Place the instrument on a stable work bench.

WARNING

VOLTAGES, IN EXCESS OF 30 VOLTS (RMS) AC OR 50 VOLTS DC CAN, IN CERTAIN CIRCUMSTANCES, BE LETHAL. CARE MUST BE TAKEN WHEN WORKING ON LIVE EXPOSED CONDUCTORS.

d. Reconnect the power supply to the instrument as detailed in INSTALLATION.

e. Connect the pressure standard outlet port to the OUTLET port of the instrument. On instruments of the 10 to 70 bar range blank the SOURCE port.

f. Wait one hour to allow the instrument to stabilize.

g. Adjust the pressure standard to the most negative pressure value within the range of the instrument, for positive indicating instruments the value is zero. Apply the pressure to the instrument, allow the pressure to stabilize.

h. Record the value of pressure set on the pressure standard and the pressure value displayed on the reading panel.

i. Repeat steps g. and h. for a minimum of six pressure values.

j. Release the pressure of the pressure standard.

k. Calculate the percentage of the pressure reading to the value of the pressure standard.

l. Check the percentage value with the following tolerances:

   i. Ranges 70 mbar to 70 bar
   0.025% of reading from 20% to 100% FS.
   0.008% FS from 0% to 20% FS.

   ii. Ranges 70 bar to 210 bar
   0.04% of reading from 20% to 100% FS.
   0.015% FS from 0% to 20% FS.

m. If the recorded results are greater than the tolerances stated above, carry out the Calibration Procedure below.

n. If the recorded results are within the tolerances stated above, install and connect the instrument as detailed in INSTALLATION page 7.

2.4.4 Calibration Procedure

a. Switch the instrument OFF and select the rear panel CALIBRATION ENABLE switch to ON.

b. Switch the instrument ON and ensure that the CONTROLLER is selected to OFF.

c. Enter: PIN.

d. Wait one hour to allow the instrument to stabilize.

e. Select calibration mode and wait for the DAC to calibrate.

f. Select linearity (Linrty) mode.

g. Adjust the pressure standard to the most negative pressure value (calibration point) within the range of the instrument, for positive calibration instruments the value is zero. Apply the pressure to the instrument allow the pressure to stabilize. Enter the applied pressure value by the numeric key-pad and press the ENTER function key when the pressure value is stable.

h. Repeat the operation (g.) for a minimum of five more pressure values. If an error is made the ABORT function key can be pressed to take the mode back to applying the first pressure.

NOTE: *Greater accuracy can be achieved with more calibration points up to a maximum of twelve.*

i. When the required calibration points are entered select NO function key and the display shows CALIBRATION COMPLETE.

j. Release the pressure from the pressure standard.

k. If necessary, select range 2 and repeat operations g. to j. for range 2.

l. Select QUIT at the completion of calibration. Select the CALIBRATION ENABLE switch to OFF and switch the instrument off.

2.4.5 Post Calibration

After calibration, carry out a Calibration Check as detailed in 2.4.3. Install and connect the instrument as detailed in INSTALLATION page 7.

2.4.6 Functional check

If necessary, after installation, carry out the following check:

1. Blank the OUTLET connection port.

2. Switch on the instrument.

3. Select a set-point of the full-scale value of the instrument.

4. Select CONTROL on and ensure that the instrument controls to the set-point value.

5. Select a set-point of ambient or zero pressure and ensure that the instrument controls to the set-point value.

6. Vent the system to release any locked pressure.

7. Select CONTROL off and switch the instrument off.

8. Remove the blank from the OUTLET connection port.

9. Connect the OUTLET connection port.

3 OPTIONS

3.1 IEEE 488

A plug-in option PCB provides the interface for the IEEE 488 GPIB communication system. For details of installation and operation see Option Handbook K086A.

3.2 RS232

A plug-in option PCB provides the interface for the RS232 communication system. For details of installation and operation see Option Handbook K086B.

3.3 Sensor Conditioning Module

A plug-in option PCB provides the interface for the Sensor Conditioning Module. For details of installation and operation see Option Handbook K086C.

3.4 Analogue Output

A plug-in option PCB provides the interface for the Analogue Output. For details of installation and operation see Option Handbook K086D.

3.5 Rack and Panel Mounting

The rack and panel mounting options are provided in the form of a kit. For details of installation see Option Leaflet K086E.

3.6 Remote Transducer

Two compatible transducers can be connected remotely using 6 pole connectors on the rear panel, identified as Remote Transducers 1 and 2 see figure 2 page 11. For connection of the External Transducers see Figure 2 page 8.

3.7 Barometric Pressure

This Option is installed at manufacture and provides a precision reference transducer to operate as an absolute or gauge pressure controller. In addition atmospheric pressure can be displayed. For details of operation see Option Handbook K086H.

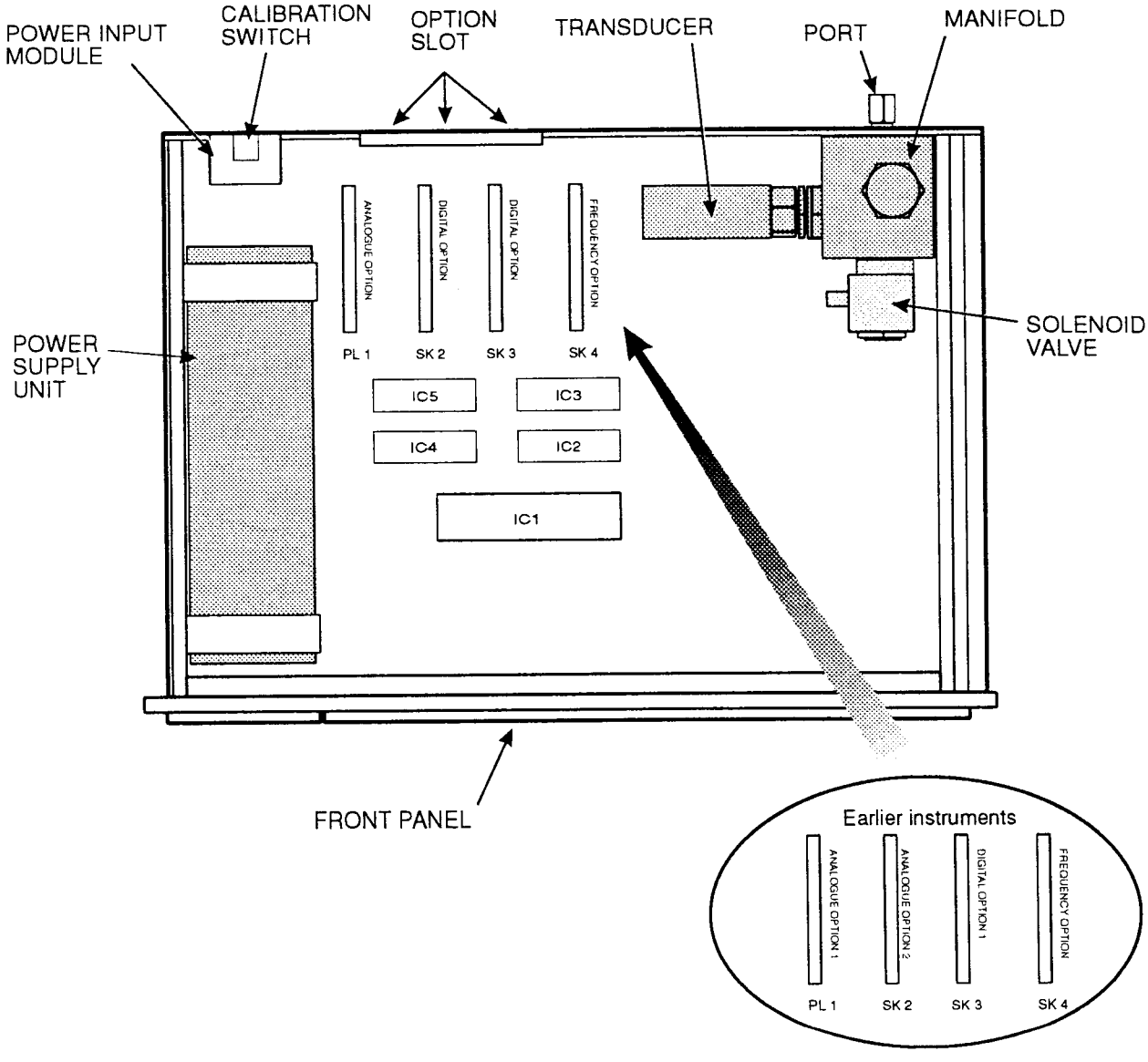


Figure 5, General Internal View

4 MAINTENANCE

4.1 General

Maintenance is divided into schedules which should be carried out when stated. Items replaced in the following schedules are contained in the spare parts list see 5.2.

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

4.2 Maintenance schedules

4.2.1 Procedure

The following procedure must be carried out before a maintenance schedule.

a. Switch off the instrument and disconnect the power supply and pneumatic supply source.

b. If necessary, remove the instrument from the equipment rack or panel mount.

c. Place the instrument on a stable work bench.

WARNING

VOLTAGES IN EXCESS OF 30 VOLTS(RMS) AC OR 50 VOLTS DC CAN, IN CERTAIN CIRCUMSTANCES, BE LETHAL. CARE MUST BE TAKEN WHEN WORKING ON LIVE, EXPOSED CONDUCTORS.

COMPRESSED GAS CAN, IN CERTAIN CIRCUMSTANCES BE LETHAL. WHEN CONNECTING AND DISCONNECTING COMPRESSED GAS SUPPLY LINES, ENSURE THAT THE SOURCE PRESSURE IS TURNED OFF AND THE PRESSURE LINES ARE VENTED. PROCEED WITH CARE.

4.2.2 Schedule 1

The manifold filters require replacement if suspect.

To replace the manifold filters proceed as follows:

a. Unscrew and remove the vent silencer from the VENT connection port.

b. On very low pressure instruments, unscrew and remove the reference diffuser from the REFERENCE connection port.

CAUTION: Ensure that the screwdriver does not damage the threads in the bore of the connection ports.

c. Using a screwdriver, carefully unscrew and remove each filter plug and filter from the bores of the connection ports.

CAUTION: Do not over-tighten the filter plug, the filter will be crushed.

d. Position the instrument with the rear panel inclined at less than 45° towards the work surface. Carefully insert the new filter and filter plug into each bore of the manifold.

e. Using a screwdriver, carefully screw each filter plug into the bore of the manifold. Check that the filters are correctly located, the filters can be seen through the centre hole of the filter plugs.

4.2.3 Schedule 2

The vent silencer, on all instruments, and reference diffuser, on very low pressure instruments, should be inspected when the components are suspect.

a. Unscrew and remove the vent silencer form the vent connection port.

b. Inspect the element for cleanliness and, if necessary, replace.

c. On very low pressure instruments, unscrew and remove the reference diffuser from the reference connection port.

d. Inspect the element for cleanliness and, if necessary, replace.

4.2.4 Schedule 3

To replace the power supply fuse proceed as follows:

a. Turn anti-clockwise and withdraw the spring-loaded, bayonet type, fuse holder and collect the fuse.

b. Replace the fuse with a serviceable 2A, 20mm, HRC anti-surge fuse.

Schedule 4

To replace the power supply unit internal fuse proceed as follows:

4.2.5.1 Instrument dismantling

a. Unscrew and remove the four screws securing the top cover. Repeat this operation for the bottom cover.

b. Hold the PSU, unscrew and remove the four screws securing the PSU to the side panel of the instrument. Carefully lift out the PSU (with the cables attached).

c. Disconnect the power supply, output and ground connectors from the PSU. Disconnect the two voltage line set cables (identified black and white) from the power inlet module.

d. Unscrew the two screws (6 mm max) securing each of the mounting brackets on the PSU.

4.2.5.2PSU

a. Unscrew and remove the four screws retaining the cover.

b. Lift the cover from the instrument.

c. Replace the fuse with a serviceable 3A, 20mm, anti-surge fuse.

d. Refit the cover and secure with the four screws.

e. Refit the mounting brackets to the PSU.

4.2.5.3 Instrument assembling

a. Reconnect the two voltage line set cables (identified black and white) to the power inlet module. Reconnect the power supply, output and ground connectors to the PSU.

b. Locate the PSU on the side panel of the instrument.

c. Secure the PSU with the four screws.

d. Refit the bottom cover and secure with the four screws. Repeat the operation for the top cover.

4.3 Post maintenance

After any schedule of maintenance, install and connect the instrument as detailed in INSTALLATION page 7.

4.4 Functional check

1. Blank the OUTLET connection port.

2. Switch on the instrument.

3. Select a set-point of the full-scale value of the instrument.

4. Select CONTROL on and ensure that the instrument controls to the set-point value.

5. Select a set-point of ambient pressure and ensure that the instrument controls to the set-point value.

6. Select CONTROL off and switch the instrument off.

7. Remove the blank from the OUTLET connection port.

8. Connect the OUTLET connection port.

5 FAULT FINDING

In the event of a malfunction instruments can be returned to the **Druck Service Department** or **Druck Agent** for rectification. A Service Charge Price list is produced which details the charges associated with various repair functions.

5.1 Error Codes

When the instrument detects an error a code is displayed. The error and remedy for each code are listed as follows:

Code	Error	Remedy
"Err001"	Over-pressure	Reduce source pressure and switch off.
"Err002"	Lock mode on	Unlock see 2.3.2.2
"Err003"	Pressure too high for range	Reduce SOURCE range pressure for current selected range. Vent pressure locked in manifold.
"Err004"	Set-point out of limits	See 2.3.6
"Err005"	Manual Zero disabled	See 2.3.5
"Err006"	Zero reading in progress	Wait for the zero function to finish
"Err007"	Zero error too large, (Zero off-set exceeds 5% of preset limit)	Ensure system is correctly vented. Cycle power switch (off/on) and zero again. If "Err007" is repeated, return instrument to DRUCK
"Err008"	Illegal PIN entry	Incorrect PIN entered
"Err009"	Access denied	Three consecutive incorrect PIN entries made
"Wrn010"	Wait! Zeroing	Zero in progress. Set-point, rate and controller ON/OFF commands will not be executed until after zero action is completed
"Err011"	Set-point value 120% of range	Reduce set-point value or change range
"Err012"	Remote enabled	Do not enter data by the front panel or Enable front panel for manual control
"Err013"	Invalid entry	Value entered is outside limits or illegal

5.2 Spare Parts List

The purpose of this list is to itemise the parts that are replaced in the maintenance schedules detailed in MAINTENANCE and the parts used in INSTALLATION. The number shown in the quantity column is the quantity required per instrument. The part number indicates the **DRUCK** part number. When a part is not procurable from **DRUCK**, the letters "NP" appear in the Part Number column. The manufacturer and part number appear in brackets in the description column for parts manufactured by other vendors.

Part No.	**Description**	Quantity
195_077	Filter, (0 - 70 bar)	4
195_078	Filter, (0 - 210 bar)	4
IA0906_1_V0	Silencer, Vent	1
184_004	Diffuser, Reference (VLP instruments only)	1
	1	
195_075	Fuse, 2A, 20mm, HRC, anti-surge	1
-	Fuse, 3A, 20mm, anti-surge	1
NP	Washer, bonded (Dowty 400-020-4490-41)	4