GE
Sensing & Inspection Technologies

Druck DPI 140/141

Precision Pressure Indicators

User manual K0023

SAFETY

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

The operator must not use this equipment for any other purpose than that stated. Do not apply a pressure greater than the maximum pressure stated.

*   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

SOFTWARE ISSUE NUMBERS

This publication is correct for the following software issue numbers. If the software has a different issue number, this publication may not contain the correct description or procedures. Refer to the manufacturer for further information.

Handbook	Software Numbers
K023 Issue 6	DPI 140 DK 36 Issue 5
	DPI 141 DK 123 Issue 1

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

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

The following symbols and markings apply to this instrument.

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

This symbol, on the instrument or in the manual, indicates a risk of electric shock.

Abbreviations

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

abs	absolute
BS	British Standard
°C	degrees Celsius
contd	continued
CR	carriage return
DIN	Deutsche Industrie Norm (German Industry Standard)
DPI	digital pressure indicator
DVM	digital volt meter
EPROM	erasable programmable read only memory
FS	full-scale
ft	feet
Gnd	ground (earth)
Hz	Hertz
ICAO	International Civil Aviation Organisation
IEC	International Electrical Council
LED	light emitting diode
LSB	least significant bit
in Hg abs	absolute pressure in inches of mercury
IEEE 488	Institute of Electrical and Electronic Engineers standard 488 for parallel data transfer
kg	kilogram
kU	kilo-Ohm
kPa	kilo-Pascal
mA	milli-Ampere
max	maximum
min	minimum or minute
MΩ	mega-Ohm
mbar	millibar
mm	millimetre
mmHg	millimetre of mercury
MSB	most significant bit
-ve	negative
Ω	Ohm
PCB	printed circuit board
psi	pound per square inch
+ve	positive
REN LED	remote enable light emitting diode
RH	relative humidity
RMS	root mean square
RS232	serial data transmission standard
RV	variable resistor
SW	switch
U.K.	United Kingdom
V	version
V	Volt
V a.c.	Volts alternating current
V d.c.	Volts direct current

Abbreviations used in Remote Control

Term	Explanation	Term	Explanation
AH	acceptor handshaking	PP	parallel poll
CTS	clear to send	RTS	request to send
DC	device clear	RxD	received data
DT	data trigger	SH	source handshaking
DTR	data terminal ready	SRQ	service request
LE	listener extension	TE	talker extension
LF	line feed	TxD	transmitted data

CONTENTS

DRUCK DPI 140 and 141 SERIES
PRECISION PRESSURE INDICATORS

1   INTRODUCTION

The Druck DPI 140 precision, pressure indicator utilises a vibrating-cylinder pressure sensor providing pressure readings between 0 and 3.5 bar absolute. Depending on the specific scale values, the display shows a reading up to 999999. The instrument is housed in a lightweight case to DIN standard 43700 and can be supplied for panel mounting. Pressure connection is located on the rear panel. The instrument is supplied, as standard, with a RS232 data interface; as an option an IEEE 488 interface can also be provided.

Two output options are available parallel digital output and analogue output. A further option enables the instrument to display the non-linear pressure parameters of altitude. The selection of pressure or altitude is achieved via the instrument front panel or the IEEE 488 interface.

The Druck DPI 141 precision, barometric pressure indicator utilises a Druck resonant pressure transducer providing pressure readings between 800 and 1150 mbar absolute. The facilities and options for this instrument are the same as the DPI 140 instrument.

The specifications for these instruments are contained in Appendix B.

2   INSTALLATION

This instrument can be used on a workbench surface or, with option C, panel mounted. Before use make sure the instrument is set for the power supply voltage and has the necessary pneumatic connection.

2.1   Power Supply

This instrument can be powered from 100 to 130 V a.c. or 200 to 260 V a.c.

CAUTION: BEFORE SWITCHING ON, CHECK THAT THE POWER SUPPLY VOLTAGE IS CORRECT FOR THE VOLTAGE SETTING OF THE INSTRUMENT.

Voltage Setting

To change the power supply voltage setting, switch OFF the power supply and disconnect 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".

Power Connection

WARNINGS

1   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.

2   THIS INSTRUMENT MUST BE GROUNDED/EARTHED VIA PROTECTIVE GROUND CONDUCTOR OF THE POWER SUPPLY CABLE.

3   ISOLATE THE POWER SUPPLY BEFORE CONNECTING THE INSTRUMENT.

4   ISOLATE THE POWER SUPPLY BEFORE REMOVING THE INSTRUMENT COVERS.

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.

CAUTIONS

1   USE THE CORRECT POWER SUPPLY SETTINGS. OPERATING VOLTAGE RANGES ARE MARKED ON THE REAR PANEL OF THE INSTRUMENT AND DETAILED IN THE SPECIFICATION.

2   TO COMPLY WITH SAFETY STANDARDS THE VOLTAGE LABEL MUST BE CHANGED IF THE POWER SUPPLY VOLTAGE IS CHANGED.

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, 500 mA, 20 mm, anti-surge fuse is in the live circuit and locates in the rear panel.

CLAMP B-A3-0356-1

M4 fixings

instrument

8 max
panel thickness

17 min from edge

20 MIN
from edges

138

40 min between cut-outs
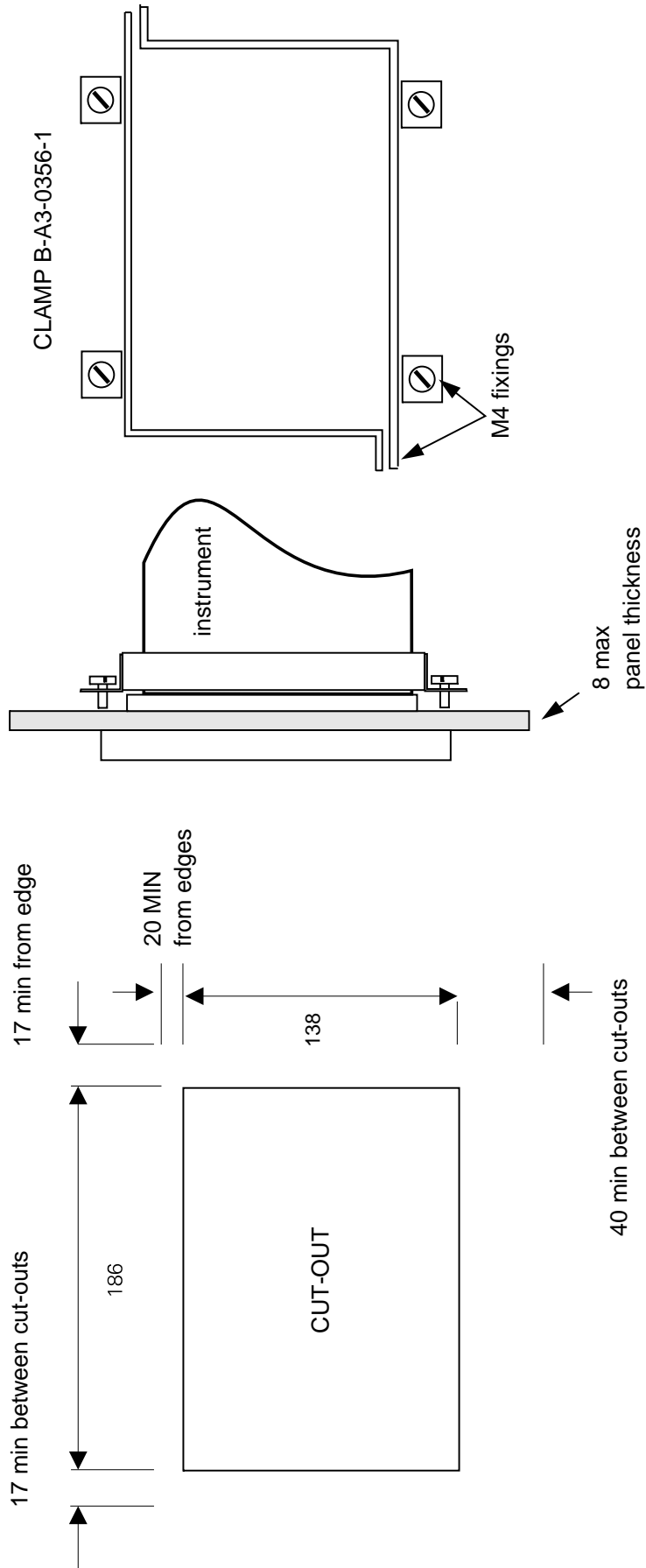
186

CUT-OUT

17 min between cut-outs

Figure 1, Panel Cut-out

2.2 Pneumatic Supply

To operate this instrument as a barometer, no connection is required. When measuring a source pressure, the connections are detailed below, the source must only be clean dry air. The DPI 141 instrument is only intended for use as a barometer.

Pneumatic Connection

The connection port on the rear panel is identified as the MEASURE port. The connection is a G¼ (female) port and requires sealing with a bonded washer.

2.3 Panel Mounting (Figure 1)

A panel mounted instrument must have the rubber feet removed so that it slides though a DIN standard 186 x 138 mm cut-out. Alternatively, one or two instruments can be mounted in a standard 19" equipment rack. It is important that a free circulation of air is available for instruments mounted in panels.

Mounting Brackets

To fit option C brackets, unscrew and remove the six screws securing the instrument case to the chassis.

1.   Withdraw the case, unscrew the two screws securing each foot to the case.

2.   Remove the two rubber plugs from the top of the case.

3.   Locate the two pins of the first bracket in the two holes in the top of the case.

4.   Locate the two pins of the second bracket in the forward two holes left by the screws securing the forward feet.

5.   Using the two screws, secure the two brackets together.

Installing in a Panel Cut-out

The fitting of the instrument into a panel cut-out requires the assembled instrument case to be secured to the panel and tensioned by the jack screws.

1.   Depending on accessibility, connect the instrument before or after fitment into the case. If the instrument's electrical power switch cannot be easily accessed ensure a separate, accessible isolating switch is installed.

2.   Carefully refit the instrument chassis into the case and secure with the six screws.

Installing in a Standard 19" Equipment Rack

The fitting of the instrument into a standard 19" equipment rack requires the assembled instrument to be secured to the panel by the four drilled lugs of the mounting brackets.

1. Carefully refit the instrument chassis into the case and secure with the six screws.

2. Secure the instrument into the equipment rack.

3. If the instrument's electrical power switch cannot be easily accessed install a separate, accessible isolating switch.

2.4 Cleaning

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

3   MANUAL OPERATION

3.1   Local Control Mode

When the instrument is switched on the POWER LED illuminates and the display shows the pressure applied to the MEASURE port. Full accuracy is achieved after a recommended warm-up period of 15 minutes.

3.2   Remote Control

RS232 Remote Control Mode

The remote control mode enables the current pressure reading to be sent to a computer, VDU or printer. The reading can be obtained either on demand, automatically or at a rate of twice every reading update. This mode also provides the link to the automatic calibration equipment. The rear panel connector identified SERIAL INTERFACE provides connection for the RS232 communication the pin identifications are as follows:

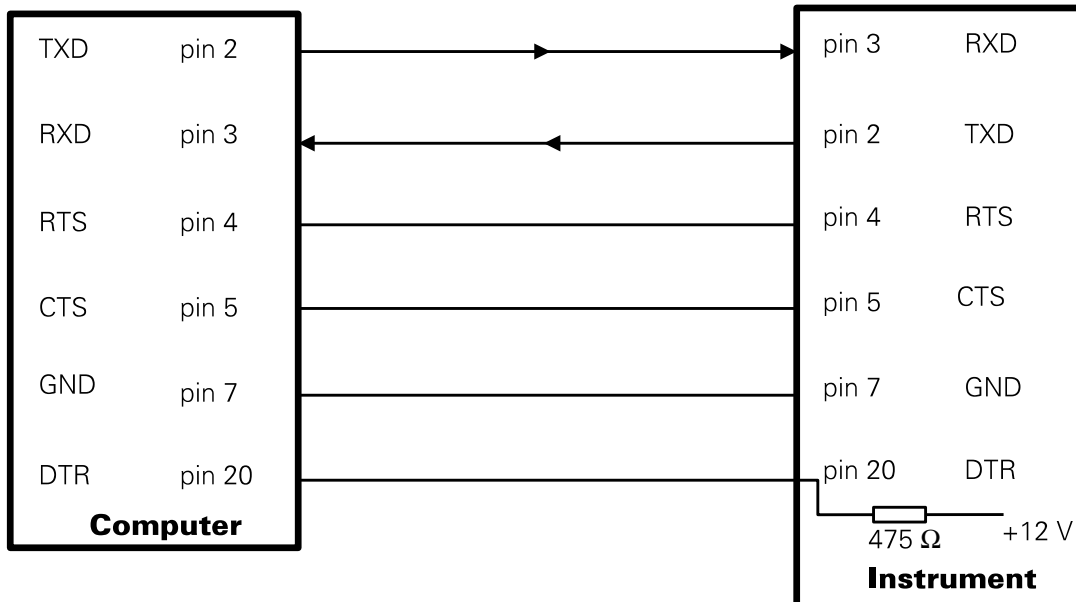|		
Pin 2	-	TXD Transmitted data from the instrument
Pin 3	-	RXD Received data to the instrument
Pin 4	-	RTS Request to send from the instrument
Pin 5	-	CTS Clear to send to the instrument
Pin 7	-	GND Signal ground (0V)
Pin 20	-	DTR Data Terminal Ready from the instrument, connected to +12V via 475 Ω.

Figure 2 RS232 Connections

Data Flow Control

Both software and hardware handshakes are implemented, with a selectable baud rate.

Software Handshake

Pins 4 and 5 (RTS and CTS) are not connected which reduces the number of connections to the instrument. The XON and XOFF commands will be acted on as soon as they are received by the instrument. The XON command will be passed out first and then the data transmission will continue. On receiving a XOFF command, all data will be halted but the XON command will be passed on.

Hardware Handshake

Hardware handshaking is implemented using the RTS/CTS pins on the 25-way D-Connector. When data is ready to be transmitted, the instrument activates the request to send (RTS) pin (+12V) and then waits for the clear to send (CTS) signal, pin (>+3V) before commencing transmission. CTS may be left disconnected as it has an internal "pull-up" resistor.

NOTE: If CTS is taken low during transmission, there may be a one character overrun due to a character having already been placed in the transmit buffer.

Baud Rate and Serial Mode Switch Selection

The baud rate is selected by switches SW4-2, SW4-3 and SW4-4. The following table shows the switch positions for the available baud rates.

SW4			Baud
-4	-3	-2	
0	0	0	9600
0	0	1	150/110*
0	1	0	300
0	1	1	600
1	0	0	1200
1	0	1	2400
1	1	0	4800
1	1	1	9600

*   110 baud can be internally selected on the PCB when link 1 replaces link 2 and SW4-2 to 4 are set to 150 baud.

Position of SW4 settings for 1200 baud in printer mode.

Switch
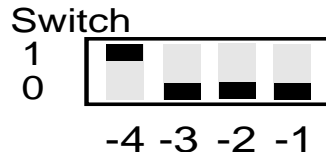
SW4-1 selects 'Printer' or 'Computer' mode.

        1 Computer mode (reading on demand)
        0 Printer mode (reading twice every update)

In the printer mode, the instruments' baud rate is preset to 1200 during manufacture. The serial data is sent as 1 start bit, 8 data bits with 1 stop bit; the MSB is zero.

Computer Mode

To select this mode, the mode select switch must be set to the computer mode position (see switch settings). In the computer mode, every time the instrument receives <CR> the current pressure reading is sent to the computer. Preceding characters will be ignored unless they are relevant e.g., entering calibration mode. To indicate that a reading has been requested, the front panel REN LED flashes on.

Printer Mode

The printer mode is selected by switch SW4-1. When the instrument is in printer mode, each new reading (approximately five per second) is sent to a printer connected to the serial port. The display updates every other reading i.e., approximately 2.5 per second. If the new reading occurs before the last reading can be transmitted, then the new reading will be lost. Subsequent readings are sent if all characters of the old reading have been sent and an XOFF condition does not exist.

Output Data Format

The output data form is as follows:

      (sign) (6 digits with floating point) (space) (carriage return) (line feed)*

    *   Line feed is transmitted only when the instrument is in printer mode.

Typical Programming Routine

The following BASIC program demonstrates taking readings on demand when the instrument is in computer mode.

```
10 OPEN 'SERIAL' AS FILE #1     Open the RS232 port as File #1

20 PRINT 'HIT RETURN TO TAKE READING'

30 INPUT A$                     Wait for user keyboard input

40 PRINT #1, ' '                Send a carriage return to demand reading.

50 INPUT #1, R$                 Input reading from RS232

60 PRINT R$                     Print input string

70 GOTO 20
```

Line 10 should be adjusted to suit the computer in use so that file #1 is opened for input and output.

IEEE 488 Option

Introduction

The IEEE 488 bus system allows up to fifteen instruments to be controlled from a single computer. Each instrument is given a unique "address" by switches or links in the instrument. Using this address the computer sends code over the IEEE 488 bus to demand data from the instrument (TALK mode) or to issue control data to the instrument (LISTEN mode). The IEEE 488 bus system also allows instruments to request "service" by activating the common SRQ (Service Request) line. An instrument, configured for this facility, can signal the occurrence of an error or an end of a pressure conversion cycle.

Setting the instrument

Transmitted Data Format

The data sent following the command to talk consists of one data string which is terminated by CR, LF or CR LF depending on the setting of SW3. The EOI is sent with the last character. The instrument reading and set-point always consists of <sign>, <six digits and one floating point> <space>. Error conditions are indicated by appending <@ 2 digit value><space>, except when disabled by the "@0" code. The complete parameter is left out if there are no errors.

Address Switch and Data Output Format

The instrument address is set by SW3-1 to SW3-5 on the rear panel, where SW3-1 is the least significant. The address at manufacture is set to 20. SW3-7 and SW3-8 control the end of line format of the data sent. EOI is always sent with the last character. The end of line formats can be selected as follows:

SW3-8	SW3-7	Line format
0	0	Reserved
0	1	LF with EOI
1	0	CR with EOI
1	1	CR, LF with EOI

The setting at manufacture is:

SW3-8	SW3-7
1	1

NOTES

1. *SW3-6 is reserved.*
2. *After changing the switches, the instrument power supply switch must be cycled off and on.*

Table 1, Address Switch Settings

Address	SW3-5	SW3-4	SW3-3	SW3-2	SW3-1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	NOT A VALID ADDRESS				

example: Rear panel switch setting for address 20, sending CR and LF with EOI.

Switch	-8	-7	-6	-5	-4	-3	-2	-1
1	■	■		■		■		
0			■		■		■	■
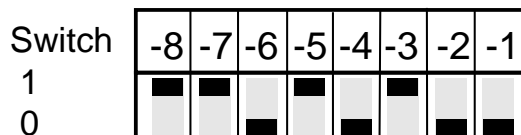
Using the IEEE 488

The current instrument reading is obtained by addressing the instrument to "TALK". The front panel REN LED flashes to show that the instrument has been addressed. The notation of the returned data string is as follows:

+x.xxxxx@xx (S)(CR)(LF)

1. x is a numeric digit 0 to 9.

2. Position of the point can vary, but is always after an "x" and is always present.

3. @xx is only sent if there is an error and error reporting is not disabled by a @0 command.

4. The last character before any line terminator is always a space.

5. The line terminator (CR + LF) is programmed by SW3-7 and SW3-8.

Table 2, lists the control codes relevant to the instrument.

Table 2, IEEE 488 Control Codes

Code	Action
I0*	No SRQ interrupts
I1	SRQ on error
I2	Reserved
I3	Reserved
I4	SRQ on End of Conversion
I5	SRQ on error and on End of Conversion
@0	Disable error reporting
@1*	Enable error reporting

*   default power-on condition

Sending control codes

Control codes are obeyed as soon as they are proven valid. If a string contains an error, the remainder of the string will be ignored. Control codes may be grouped together to form a control string. Codes may be separated by spaces or commas to add clarity, but this is not compulsory.

The following are examples of valid control strings.

@0	Disable error reporting
I1	Set SRQ on error mode
@0I1	Turn off error reporting and set SRQ on error mode
@0 I1	As above
@1, I1	Turn on error reporting and set SRQ on error mode

Received Data Format

The instrument responds to control codes in a string provided that there are no spaces within control codes.

NOTE: Spaces and commas are allowed between control codes as control code separators.

Data in one of the following categories must come after a valid control code:

1	Another valid control code
2	A space (ASCII (32))
3	A comma
4	Carriage return (ASCII (13))
5	Line feed (ASCII (10))

Sending the wrong code sets error @01, no further action is taken and the rest of the string is ignored.

IEEE Specification

IEEE Interface Function Requirements

The interface meets the IEEE 488 requirements for the following:

Code	Interface Function
SH1	Source handshaking capability
AH1	Acceptor handshaking capability
T6	Talker (basic talker, serial poll, talk only mode, unaddressed to talk if addressed to talk)
L4	Basic listener, unaddressed to listen if addressed to talk
TE0	No address extension talker mode
LE0	No address extension listener mode
SR1	Service request capability
PP0	No parallel poll capability
DC0	No device clear capability
DT0	No device trigger capability

Serial Poll

The instrument responds to a standard IEEE serial poll sequence. The serial poll response byte is as follows:

Bit	Poll Response
Bit 0-4	Error bits
Bit 5	End of conversion caused SRQ
Bit 6	SRQ bit. Set if the instrument caused the SRQ
Bit 7	Reserved

Table 3, Serial Poll Response Byte

Bit	Response
0	Programming data error
1	Reserved
2	Reserved
3	No new data available error
4	Reserved
5	Reserved
6	1 if the instrument caused
7	SRQ
	End of conversion

Error Indication

Error indication is disabled by sending the @0 code and enabled by sending @1. @1 is default at power on.

NOTE: On an error interrupt the @0 code does not affect the SRQ.

The addition of "@ value" at the end of the data string indicates an error. The occurrence of the "@" symbol changes the numeric data to an "impure" numeric string, (i.e., a non-numeric character occurs), which may give a convenient error detection process for the controlling computer.

This value is a two digit number giving the octal representation of the 6 error functions.

Bit	Error
Bit 0	Programming data error
Bit 1	Reserved
Bit 2	Reserved
Bit 3	Data not ready

example:

@01 indicates the wrong code sent to the instrument.

@10 indicates no new pressure reading available since last reading (only in NO).

@11 indicates both @01 and @10.

The 'no new reading available error' causes an SRQ error interrupt. This error is an indication only and clears when a new reading is available. A new reading is available approximately five times per second. The reading given is the current pressure reading.

Service Request (SRQ) in Error

Whenever an error occurs with the interrupt parameter set to I1 or I5 the SRQ line signal goes to a low level. The line is then "latched" to a low level until a serial poll occurs or the instrument is next addressed to talk.

4   OPTIONS

4.1   IEEE 488 (Option A)

The IEEE 488 bus system allows up to fifteen instruments to be controlled from a single computer. Details of this option are detailed in the previous section starting on page 12.

4.2   Altitude Display (Option B)

This option enables the instrument to display units of altitude (feet or metres) as an alternative to pressure. The conversion of pressure to altitude is based on the BS2G199 (ICAO Law) with separate equations for below and above the Tropopause. The accuracy of the conversion is to within one count on the altitude display. The pressure conversion cycle is slightly lengthened when the altitude display is selected.

Operation
A switch on the front panel changes the display between altitude and pressure. Two reading updates should be allowed, after changing the switch, before the correct reading is displayed.

4.3   Panel Mounting (Option C)

Instruments can be mounted into a panel using a mounting bracket kit for details see 4.

4.4   Analogue Output (Option D)

The option is scaled to a maximum output of 10V and zero set at any pressure value within the range of the instrument. The analogue output signal is available at a six-way Greenpar connector on the rear panel.

NOTE: If the pressure falls below the set zero value the analogue output will not indicate a negative pressure reading.

The output impedance is a nominal 1 kΩ and can be changed by replacing resistor R5 on the PCB to the appropriate value (100 Ω minimum). To calibrate this option see page 20. A 6-way plug supplied with the instrument must be connected as follows:

PIN NO.	FUNCTION
2	Analogue Signal
1	Signal Ground

5   CALIBRATION

The instrument is equipped with an automatic calibration facility using a pressure standard and a compatible RS232 terminal or computer. The changes in zero and span constants, measured during calibration, are displayed and can be accepted or rejected. The instrument is calibrated during manufacture, including small adjustments using the automatic calibration facility, to meet the specification stated in the data sheet. The instrument uses these calibration values until it receives a RESET command or a further calibration is carried out.

5.1   Preparation

The instrument must be connected to a compatible computer using a standard RS232 cable and then set to 'computer' mode. The old calibration values remain valid during a calibration and until the new calibration values are accepted. Also, if new calibration values are accepted, it is still possible to revert back to the previously stored calibration values by using the RESET command.

Equipment

The following equipment is required to calibrate the instrument. Use clean dry air as the pressure medium.

NOTE: Equivalent substitutes may be used.

Description	Usage
Pressure standard calibration equipment (AIR) accuracy of at least ±0.01%	Calibration
RS232 computer terminal	Calibration

Test Environment

Temperature:	20°C
(recommended)	
In standard humidity and atmospheric pressure	

5.2 Procedure

The RS232 computer terminal must be set to a baud rate of 4800, 8 bit, no parity. Switch ON and set the RS232 computer terminal in full duplex mode, i.e., no local echo back. All inputs from the RS232 computer terminal to the instrument are in upper-case, depress the caps lock key during the following tests.

NOTE: *If the RS232 computer terminal has the facility to send a line feed character following every carriage return, the facility must be turned OFF.*

1.   Connect the power supply as detailed in INSTALLATION and the pressure standard outlet port to the MEASURE port. Connect the RS232 computer terminal to the connector on the rear panel.

2.   Switch ON the instrument and the RS232 computer terminal.

        To enter calibration mode proceed as follows:

        a.   Type: K.<CR>

        NOTE: *Make sure that the full stop is included when selecting calibration mode.*

        b.   Wait at least one hour from switch on to stabilize the instrument for optimum accuracy.

        c.   The instrument displays the message "Calibration mode" with a prompt of "Pressure?".

        d.   Adjust the pressure standard to the pressure value to be applied. When the pressure is stable, enter the pressure value followed by <CR>. The value must be entered in the units of pressure measurement displayed and in the same format as the display e.g., '1013.25'.

        NOTE::   *Only the first 8 characters are recognised. A 'bad' character causes the input to be ignored and the instrument displays the prompt of 'Pressure?' again.*

        e.   The instrument stores and displays three readings at the pressure value entered and prompts for a new pressure value. Between two and ten calibration pressures may be applied.

        NOTE: *A numeric overflow error will occur if all the pressures are the same or approximately the same.*

        f.   When all the pressure values have been applied and entered, press <CR>.

g. While the instrument microprocessor calculates the new calibration constants the display shows 'Calculating...'. After the calculations, the instrument displays the change in zero (%FS) and span (%RD) from the previous calibration constants. The new calibration constants can be accepted or rejected. If rejected, the previous calibration constants remain.

h. To accept the new calibration, type 'Y', any other character will reject the new calibration.

5.3 RESET Command

To revert back to the previously stored calibration values the instrument must be in computer mode and receive the RESET command as follows:

Type: <R!>

When the instrument is using the original calibration, the display will show, for one second after power-up '0.0.0.0.0.0.' instead of a blank display. The same display appears if the latest calibration constants are corrupted.

5.4 Automatic Calibration Mode

For automatic calibration mode connect to the RS232 port any standard ASCII computer terminal. With calibration pressures applied, the instrument reads these pressure values and calculates new correction constants. The user can accept or reject the new constants, if accepted, the calibration is automatically updated. If required, reversion to previously stored calibration values can be made.

5.5 Calibration Standard

At manufacture this instrument is calibrated against precision calibration equipment which is traceable to the U.K. National Physical Laboratory.

5.6 Calibration of the Analogue Option

To calibrate the instrument carry out the following procedure:

1. Preparation
   • Remove the instrument case.
   • Connect the pressure standard and connect the instrument to the power supply.
   • Connect the DVM to pin 2 (+ve) pin 1 (-ve).

PIN NO.	FUNCTION
2	Analogue Signal
1	Signal Ground

2. Zero
   • Allow a warm-up time of approximately 1 hour.
   • Apply the base or zero pressure.
   • Adjust the analogue output signal to zero (0.0000V) by adjusting zero potentiometer RV4 on the PCB.

3. Span
   • Apply the full-scale pressure.
   • Adjust the analogue output signal to the full-scale pressure value by adjusting span potentiometer RV3 on the PCB.
   • Release all the pressure.

4. Completion
   • Switch the instrument off, disconnect the pressure standard and the power supply.
   • Refit the instrument case.
   • Disconnect the DVM.

6 FAULT FINDING

If the display shows 0.0.0.0.0.0. for one second before displaying the pressure, the latest calibration data is lost and the instrument uses the original manufacturers calibration data. See the Calibration.

APPENDIX A - HUMIDITY OF PRESSURE MEDIUM

1   DPI 140 Instrument

1.1   Introduction

This instrument should be calibrated using clean dry air, errors will occur using moist air. An increase in RH (Relative Humidity) causes an increase of the reading in the form of a span shift. The change in span relative to temperature is non-linear. With a temperature increase the error and the rate of change of error increases.

1.2   Relative Humidity Change

The expected error for a change from 0 to 70% RH at various temperatures are as follows:

Temperature (°C)	Error (% reading)
10	0.004
25	0.010
30	0.013

The error is approximately proportional to the change in % RH.

Excessive errors may result from moisture entering the transducer and condensing on the internal surfaces. It is recommended that the tubing used in the system connected to the instrument is metal or polythene. Materials such as rubber or nylon retain moisture and under low air/gas pressures release moisture increasing the relative humidity of the air. Before calibrating with dry air, the system should be purged to remove any moisture.

2   DPI 141 Instrument

2.1   Introduction

This instrument should be calibrated using clean dry air. RH (Relative Humidity) does not cause any known effect on the calibration of the DPI 141 instrument.

APPENDIX B - SPECIFICATIONS

This page shows the common DPI 140 series specification details. Individual instrument details are contained on the following pages.

Power supply

Voltage selection (switch selected on the rear panel)

.... 100 to 130V a.c.

.... or 200 to 260V a.c.

Frequency range .... 50 - 400 Hz

Power   .... 30 VA (max)

Electrical safety

This instrument meets:

.... BS EN 61010-1 as applicable

Electromagnetic compatibility

This instrument meets:

.... EN50081-1 (emissions)

.... EN50082-1 (immunity)

Dimensions

Weight (nominal) 3kg
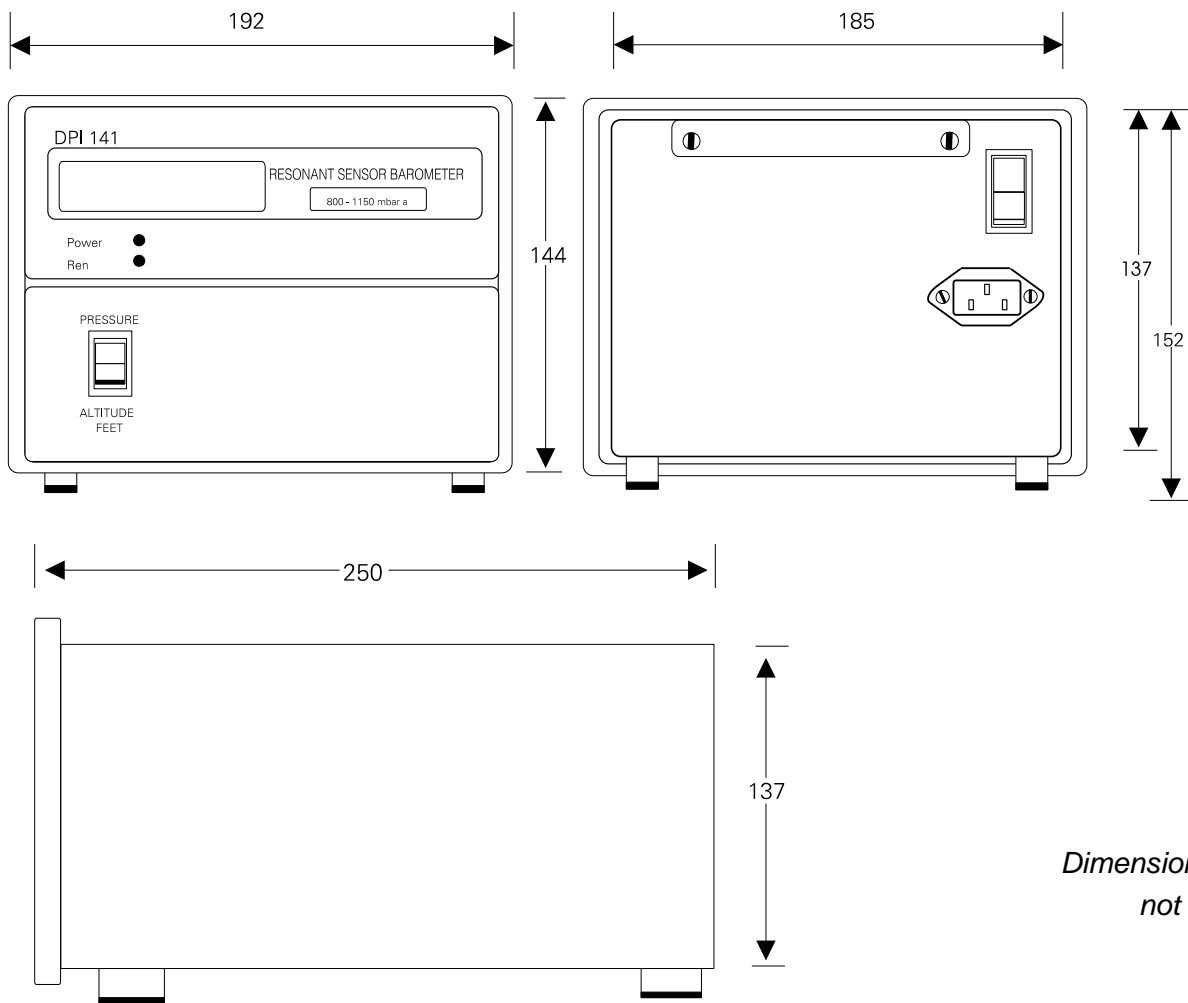
Dimensions - mm
not to scale

Instrument Dimensions

DPI 140 Digital Pressure Indicator

Pressure ranges .... 35 mbar to 1150 mbar absolute

.... 35 mbar to 2.6 bar absolute

.... 35 mbar to 3.5 bar absolute

Barometric version .... 800 mbar to 1150 mbar absolute

Display Units

Pressure units (one only) .... bar, kPa, psi, inHg and mmHg

Altitude (option) .... feet or metres

Resolution

Display 0 to 999999...0.01 mbar

(1 bar absolute version)

Accuracy

including temperature effects over 10°C to 30°C, non-linearity, hysteresis and
repeatability

.... ±0.02% of reading

.... ±0.01% F.S.

Barometric version .... ±0.15 mbar

(between 800 and 1150 mbar absolute)

Altitude Display

(BS2G199 (ICAO) equations for below or above the Tropopause)

Accuracy of conversion (pressure to altitude) .... one display digit

Resolution .... 0.1 feet

.... 0.1 metres

Stability

(12 months period, typical value) ....within 0.005% of F.S.

Operating Temperature

Calibrated temperature range ....10°C - 30°C

Operating temperature range..0°C - 50°C

Update rate

RS232/IEEE .... 5 readings/sec

Display .... 2.5 readings/sec

For further details see the data sheet.

DPI 141 Barometer

Pressure range ....800 to 1150 mbar absolute

Display Units

Pressure units (one only) .... mbar, psi, inHg or mmHg

Altitude (option) .... feet or metres

Resolution

Display 0 to 999999 (max) ....0.01 mbar

Accuracy

including temperature effects over 10°C to 30°C, non-linearity, hysteresis and repeatability, between 800 and 1150 mbar absolute

.... ±0.15 mbar

Altitude Display

(BS2G199 (ICAO) equations for below or above the Tropopause)

Accuracy of conversion (pressure to altitude) .... one display digit

Resolution .... 0.1 feet

.... 0.1 metres

Stability

(12 months period, typical value) .... better than 100 ppm/year

Operating Temperature

Calibrated temperature range ....10°C to 30°C

Operating temperature range...0°C to 50°C

Response

Sample rate (nominal) .... 4 readings/sec

Display update (nominal).. 2 readings/sec

Average variable...between 2 and 50 samples

Response over RS232/IEEE 488

Sample rate .... 4 readings/second

Variable sample rate (nominal) ....4/second to 1/hour

For further details see the data sheet.

1   PARALLEL DIGITAL OUTPUT

1.1   Introduction

This 'special order' option provides a parallel digital output for fast updating applications and is scaled by the option software so that 800 - 1150 mbar is equivalent to 0 - 65,535 (decimal). The parallel digital output signals (detailed below) i.e., two 8 bit bytes with LSB and MSB strobes are available on 25-way D-type connector marked 'Serial Interface'. The RS232 serial data output is also available on this connector as detailed on page .

Parallel Digital Output Pin Connections

Pin No.	Function
14	MSD Strobe
15	LSD Strobe
16	DB0
17	DB1
18	DB2
19	DB3
21	DB4
22	DB5
23	DB6
24	DB7

ANNEX 2 TO K023

1 REPEATER INSTRUMENT

1.1 Introduction

The DPI 140 repeater instrument displays the same pressure reading as a remote DPI 140 instrument when the two instruments are connected by a RS232 cable. The repeater fitted with the IEEE option can operate in the same way when connected by an IEEE cable.

1.2 Operation

A second DPI 140 instrument, connected via a RS232 cable to a 'master' DPI 140 instrument operates as a repeater instrument. The repeater instrument displays the master instrument pressure reading at an update rate that can be adjusted. To operate the instrument, the baud rates of the master and repeater must be the same (by correctly setting SW4-2, SW4-3 and SW4-4). Also, the master instrument must be set in "printer mode" (SW4-1 set to 0).

1.3 Baud rate

The manufacturer's setting of 1200 baud is recommended. Although the instrument correctly functions at lower baud rates it will not display every new reading. At higher baud rates, the instrument has less noise immunity and distance driving capability.

The RS232 cable should be wired as follows:

Master Instrument 25-way D Connector	Repeater Instrument 25-way D Connector
Pin 2 TxD	Pin 3 RxD
Pin 7 Gnd	Pin 7 Gnd

1.4 Display Update Rate

A standard DPI 140 produces five readings per second on the serial (RS232) or parallel (IEEE 488) communications system. However, to make the instrument display more readable, the instrument displays only every other reading (i.e., the display is updated five times per two seconds).

Settings of Switch SW4-1

On the DPI 140 repeater instrument, SW4-1 controls the display update rate. When SW4-1 is set to 0, every reading received will be displayed. When SW4-1 is set to 1, every second reading received will be displayed.

The manufacturer's setting for the master and repeater DPI 140 instruments display every second reading.

1.5   Display Point Position

The decimal point position in the pressure reading display depends on the current selected pressure units. The pressure reading sent via the RS232 or IEEE 488 has a floating point and always displays six digits. To enable the repeater to function as fixed or floating point, the decimal point position can be selected by wire wrap links within the repeater.

These are set at manufacture to suit the specified pressure units but can be re-configured as follows:-

1.   Refer to table to obtain required link settings.

2.   Remove the instrument case.

3.   Remove unwanted wire wrap links from the pins (marked PL7-1-4) (PL7 is slightly off-centre on the board and next to the EPROM IC14).

4.   Using a wire wrap tool, install the wire wrap links.

Point Position	Pins Linked to Pin 4
123456.	3
12345.6	2
1234.56	2 and 3
123.456	1
12.3456	1 and 3
1.23456	1 and 2
Floating	None

NOTE: If the number to be displayed is too big for the selected point position, the point will automatically shift.