

# Paroscientific, Inc. Digiquartz<sup>®</sup> Pressure Instrumentation

User's Manual  
for  
Model 735 Intelligent Display  
And  
Model 745 High Accuracy  
Laboratory Standard



“The standard by which other standards are measured”



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# 1 Introduction

Thank you for your purchase of a Digiquartz® Model 735 Intelligent Display or Model 745 Laboratory Standard.

Please visit our website at [www.paroscientific.com](http://www.paroscientific.com) for the latest manual revision.

## 1.1 Latest features

With firmware revision D1.06 or later, it is now possible to achieve parts-per-billion resolution (nano-resolution) as opposed to parts-per-million resolution in standard mode. This feature can be easily enabled/disabled via software commands. Please refer to Section 6 for additional information on this new feature.

## 1.2 Conventions

The following conventions are used throughout this manual:

**Digiquartz® Intelligent Instrument** – A Digiquartz® Model 735 Intelligent Display or Model 745 Laboratory Standard.

**Digiquartz® Intelligent Transmitter** – Any Digiquartz® Series 1000, 6000, or 9000 Pressure Transmitter or Intelligent Depth Sensor.

**Digiquartz® Intelligent Device** – Any Digiquartz® Intelligent Instrument or Transmitter.

**Digiquartz® Pressure Transducer** – Any Digiquartz® pressure transducer with frequency outputs.

**CAUTION** is used to draw your attention to a situation that may result in an undesirable outcome, but will not damage the unit.

**WARNING** is used to draw your attention to a situation that may result in permanent damage to the unit or will void the warranty.

**DANGER** is used to draw your attention to a situation that may result in injury.

Commands and parameters are shown in bold type. Example: **PI** and **TI** are commands that set the integration time in increments of 0.01 second.

### 1.3 Warnings and Safety Precautions

Digiquartz® Intelligent Instruments are precision devices, and as such, they should be operated with a certain degree of care to ensure maximum performance.

**WARNING** It is recommended that the input pressure not exceed the specified limit. Calibration can be affected if this limit is exceeded, and permanent damage can result if the unit is sufficiently overpressured.

**WARNING** Excessive mechanical shock may cause irreparable damage. Do not drop a Digiquartz® Intelligent Instrument, or allow tools or other hard objects to fall on the unit or its pressure port.

## 2 Getting Familiar

### 2.1 Physical Inspection

You should have received the following items with your Model 735/745 purchase:

- Model 735 or Model 745
- User's manual
- RS-232 serial cable
- 110V or 220V AC adapter
- 4 AA alkaline batteries
- Model 735/745 Menu Quick Reference
- Digiquartz® CD Library
- Specification Control Drawing (SCD) for the Model 735 or 745
- Specification Control Drawing (SCD) for the Digiquartz® pressure transducer (Model 735 only)

### 2.2 Product Features and Configurations

Performance and feature specifications are subject to change. Please refer to the Specification Control Drawing (SCD) that was delivered with your unit.

#### **PERFORMANCE (MODEL 745)**

Resolution: Better than 0.0001% full scale

Accuracy: Better than 0.008% full scale accuracy for all ranges, except

0.08 hPa for barometric range (Model 745-16B)

0.02% full scale for 30,000 and 40,000 psi units

#### **PERFORMANCE (MODEL 735)**

Per external transducer Specification Control Drawing (SCD).

## **RANGES**

### **Model 745**

- 19 absolute pressure ranges:  
0-15 psia (0.1 MPa) to 0-40,000 psia (276 MPa)
- 6 gauge pressure ranges:  
0-15 psig (0.1 MPa) to 0-200 psig (1.38 MPa)

### **Model 735**

- Supports all Paroscientific frequency output pressure sensors with temperature signal outputs

## **FEATURES**

- Intuitive front panel menu system
- Two-line display with menu-selectable functions:
  - Taring
  - Engineering units
  - Pressure bar graph
  - Sensor temperature
  - Password protection
  - Rate of pressure change
  - Resolution and sampling speed
  - Adjustable number of display digits
  - User choice of stored or external text
- Optional part per billion resolution (Nano-resolution)
- Rack or panel mount capability
- Enhanced RS-232 command set
- 110V or 220V AC adapter power
- Multiple remote display capability
- Free configuration and logging software
- 20 hours battery operation in standard resolution mode (4 AA size alkaline)

## **QUALITY AND STANDARDS**

- CE marked.
- NIST traceable.

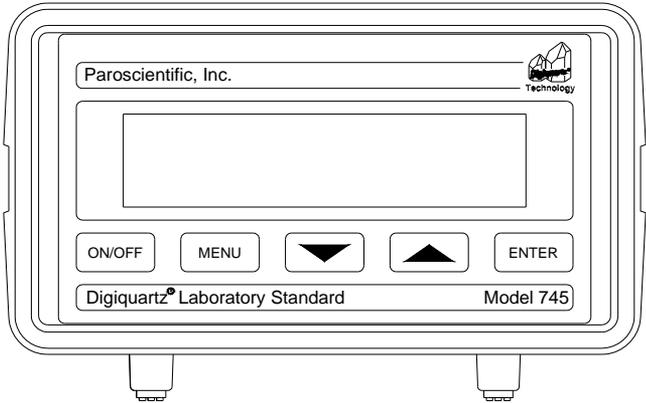
## **2.3 Physical Description**

The Model 735 and 745 are nearly identical in function and appearance. The main difference is that the Model 735 is used with an external

Digiquartz® pressure transducer, while the Model 745 has an internal Digiquartz® pressure transducer.

The Model 735/745 display pressure measurement values and related information. They can be used as stand-alone instruments or as part of an RS-232 based data acquisition system. The units can be configured using either the front panel user interface or via the RS-232 serial port. The front panel user interface provides convenient access to the most often used configuration functions. Other configuration functions are accessed via the RS-232 serial port.

## 2.4 Front Panel Features



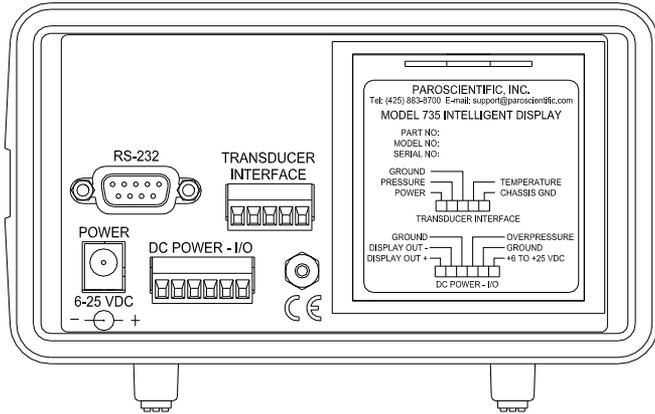
**Figure 1. Model 745 front panel**

The front panel contains the LCD display and the keypad. The LCD display shows pressure measurement values on the first line, and your choice of several other display options on the second line. The keypad provides access to the configuration menu. The configuration menu enables the user to quickly and conveniently set up the unit to suit the application.

Please refer to paragraph 4.1 for more information about configuration menu navigation. Please refer to Section 20 for more information about options available via the configuration menu.

## 2.5 Rear Panel Features

### 2.5.1 Model 735



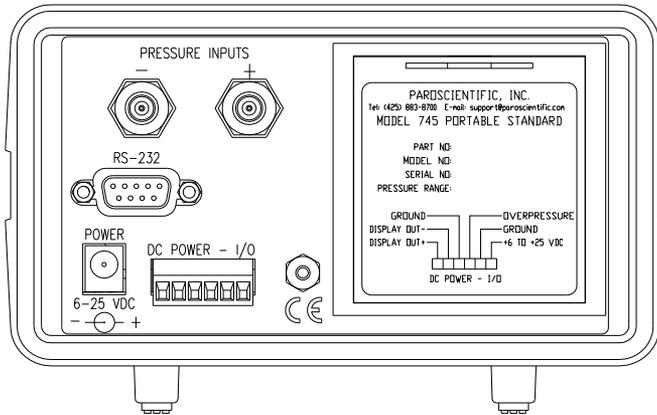
**Figure 2. Model 735 rear panel**

The Model 735 rear panel contains the following features:

- AC adapter jack
- Power and I/O terminal block
- RS-232 port
- Battery compartment
- Transducer terminal block
- Chassis grounding lug

Please refer to paragraph 4.2 for detailed information about the Model 735 rear panel features.

## 2.5.2 Model 745



**Figure 3. Model 745 rear panel**

The Model 745 rear panel contains the following features:

- Pressure port(s)
- AC adapter jack
- Power and I/O terminal block
- RS-232 port
- Battery compartment
- Chassis grounding lug

Please refer to paragraph 4.2 for detailed information about the Model 745 rear panel features.

## 3 Quick Start

This section will help you to quickly set up the Model 735/745 and begin taking pressure measurements.

### 3.1 Model 745

#### **Step 1: Apply power to the Model 745**

Refer to paragraph 4.2.1 for detailed information.

#### **Step 2: Turn Model 745 on**

Press the ON/OFF key to turn on the Model 745. After a short initialization, the Model 745 will begin to display pressure measurement values.

Your Model 745 should now be displaying correct pressure measurement values. If the displayed values are not correct, refer to Section 13 for troubleshooting tips.

Refer to Section 4 for information about configuring your Model 745 according to your application.

### 3.2 Model 735

#### **Step 1: Connect an external Digiquartz® pressure transducer to the Model 735**

- Refer to paragraph 18.1 for detailed information.

#### **Step 2: Apply power to the Model 735**

- Refer to paragraph 4.2.1 for detailed information.

#### **Step 3: Turn Model 735 on**

- Press the ON/OFF key to turn on the Model 735. After a short initialization, the Model 735 will begin to display pressure measurement values.

**Note:** If the Model 735 has not yet been configured with the calibration coefficients of the particular Digiquartz® pressure transducer to which it is connected, incorrect pressure measurement values will be displayed and the overpressure alarm may sound.

#### **Step 4: Establish communications between the Model 735 and a PC**

- Install Digiquartz® Interactive 2.0 on your PC. Digiquartz® Interactive 2.0 can be installed from the Digiquartz® CD Library that was included with your Model 735 or downloaded at the Paroscientific web site at [www.paroscientific.com](http://www.paroscientific.com).
- Connect the RS-232 port of your Model 735 to the RS-232 port of your PC, and power up the instrument.
- Run Digiquartz® Interactive 2.0.
- Select the Digiquartz® Terminal option, and click Next.
- You send commands to the unit by typing them into the Command field. Responses to commands will be displayed in the Response window.

If you are unable to establish communications, refer to the DQI online help information and Section 13 of this manual.

#### **Step 5: Configure the Model 735 with the Digiquartz® pressure transducer coefficients and parameters**

Please refer to Section 5 for more information about configuration commands and their use.

- **Set the overpressure alarm setpoint**  
The overpressure alarm setpoint (**OP**) is set to 0.0 psi at the factory. **OP** is set in the current pressure units. We recommend that the pressure units be set to psi (**UN**=1) prior to setting **OP**; refer to paragraphs 5.7.2.4 for details about setting pressure units. **OP** should be set to the full-scale pressure indicated on the Digiquartz® transducer.

The following example assumes a 45 psi transducer:

Typical set command:       \*0100EW\*0100OP=45  
Typical set response:       \*0001OP=45.00000

- **Set the transducer coefficient values**

The following parameters must be set to the corresponding values on the Calibration Coefficients data sheet that was delivered with your Digiquartz® transducer:

**U0, Y1, Y2, Y3, C1, C2, C3, D1, D2, T1, T2, T3, T4, and T5.**

You must set all calibration parameters to the exact values listed on the Calibration Coefficients data sheet.

**CAUTION** Setting calibration coefficients to incorrect values will result in incorrect pressure measurement values.

The following example shows how to set the **U0** coefficient to a typical value. Other coefficients are set in a similar manner. Refer to paragraph 5.7.2.9 for more information.

Typical set command:       \*0100EW\*0100U0=5.860513

Typical set response:       \*0001U0=5.860513

- **Set the transducer model number**

**MN** should be set to the model number indicated on the Digiquartz® pressure transducer.

The following example assumes a model 245A transducer.

Typical set command:       \*0100EZ\*0100MN=245A

Typical set response:       \*0001MN= 245A

- **Set the transducer full-scale pressure value**

Set **PF** to the full-scale pressure value indicated on the Digiquartz® pressure transducer. **PF** is set in the current pressure units. We recommend that the pressure units be set to psi (**UN**=1) prior to setting **PF**. Refer to paragraph 5.7.2.4 for more information about setting pressure units.

**CAUTION** **PF must be set to the full-scale pressure value of the Digiquartz® transducer. Failure to do so will result in improper formatting of pressure measurement values.**

The example below is for a 45 psi transducer.

Typical set command: \*0100EZ\*0100PF=45

Typical set response: \*0001PF=45.00000

- **Set the transducer overpressure limit value**

**PL** is typically set to 1.2 times the full-scale pressure value of the Digiquartz® transducer. Refer to the transducer Specification Control Drawing for specific overpressure limits. **PL** is always set and reported in psi, regardless of the pressure unit setting.

The example shown below is for a 45 psi transducer (45 x 1.2 = 54).

Typical set command: \*0100EZ\*0100PL=54

Typical set response: \*0001PL=54.00000

- **Set the transducer type value**

Set **PO** according to the Digiquartz® pressure transducer type (absolute, gauge, or differential). The table below shows the integer values used with **PO** to identify the transducer type:

<b>PO value</b>	<b>Transducer type</b>
0	Absolute
1	Gauge
2	Differential

The following example assumes an absolute transducer:

Typical set command:       \*0100EZ\*0100PO=0

Typical set response:       \*0001PO=0

- **Set the transducer serial number value**

Set **SN** to the serial number indicated on the Digiquartz® transducer.

The following example assumes serial number 1234567:

Typical set command:       \*0100EZ\*0100SN=1234567

Typical set response:       \*0001SN=1234567

At this point, your Model 735 should be fully configured and should be displaying correct pressure measurement values. If the displayed values are not correct, refer to Section 13 for troubleshooting tips.

Refer to Section 4 for information about configuring your Model 735 according to your application.

### **3.3 Applying Pressure**

Now that you have your Model 735/745 up and running, you are ready to connect your pressure source to the pressure port. If you are using a Model 745, you will connect your pressure source to the pressure port(s) located on its rear panel. If you are using a Model 735, your pressure source will be connected directly to the pressure port of the external Digiquartz® pressure transducer.

#### **ABSOLUTE UNITS**

Units equipped with absolute pressure transducers have a single pressure port.

## GAUGE UNITS

Units equipped with gauge pressure transducers have two pressure ports. Pressure should only be applied to the positive pressure port. The negative pressure port must remain vented to atmospheric pressure.

**WARNING** Consult the Model 745 or Digiquartz® pressure transducer SCD for proper pressure fitting tightening torque. Do not apply excessive torque or permanent damage to the pressure fitting may result.

**WARNING** When connecting pressure fittings, always use a second wrench to stabilize the pressure fitting on the Model 745 or Digiquartz® pressure transducer, or permanent damage to the Model 745 or Digiquartz® pressure transducer may result.

**WARNING** All Digiquartz® pressure transducer are designed to operate over a specific pressure range. Do not overpressure the Model 745 or Digiquartz® pressure transducer, or permanent damage may result.

**CAUTION** Transducers that are intended to be used in liquid pressure applications are oil-filled at Paroscientific. If your Model 745 or Digiquartz® pressure transducer is oil-filled, do not pull a vacuum or pressurize with gas, or gas bubbles may be introduced into the pressure transducer, which will negatively affect its performance. Pressure lines connected to oil-filled transducers should be filled with clean hydraulic fluid and bled to remove gas bubbles. Consult the Model 745 or Digiquartz® pressure transducer SCD to determine the oil used to fill the transducer.

**CAUTION** Pressure head effects result in zero offsets. These effects are more pronounced when liquid-filled pressure lines are being used. These effects can be minimized by keeping the transducer pressure port and the pressure source at the same elevation, or by using the tare or pressure adder functions to make an offset correction to compensate for the pressure head.

## 4 User Interface

### 4.1 Front Panel

#### 4.1.1 Display

The Model 735/745 features a 2-line, 16 character alphanumeric LCD display.

#### 4.1.2 Operating Modes

The Model 735/745 operates in one of two modes: Pressure Display Mode or Configuration Menu Mode.

##### **PRESSURE DISPLAY MODE**

At power-up, the Model 735/745 will be in Pressure Display Mode.

When in Pressure Display Mode, the first line displays the following information:

- Pressure value
- Pressure unit
- Tare indicator
- Pressure value update indicator (blinking dot between the pressure value and pressure unit)

The second line can display one of the following:

- Pressure bar graph
- Digiquartz® pressure transducer internal temperature
- Pressure rate of change
- Text stored within the Model 735/745
- External text sent to the Model 735/745 via the RS-232 port
- No information

The second line can also display an overpressure warning if the measured pressure exceeds the limits of the Digiquartz® pressure transducer. This feature is not available in the pressure rate of change and external text display modes.

## **CONFIGURATION MENU MODE**

Configuration Menu Mode is accessed by pressing the MENU key while in Pressure Display Mode. The most common functions of the Model 735/745 can be configured through the configuration menus. Less frequently used functions are accessed through the RS-232 port. See Section 5 for details. The configuration menus are organized in a hierarchical fashion, as shown in Section 20. The keypad is used to move through the menus, make selections, and change parameter values.

When in Configuration Menu Mode, the first line displays either the menu name or a description of the parameter value being displayed. The second line either displays the current menu option, or a parameter value.

The Model 735/745 automatically switches back to Pressure Display Mode if no user input is received for two minutes.

**WARNING** Do not attempt to simultaneously access the Model 735/745 through the RS-232 port and the configuration menu. Doing so may cause serial commands or configuration menu selections to be ignored.

### **4.1.3 Keypad**

The functions of the keys are as follows:

#### **ON/OFF KEY**

- Turns the unit on and off.

#### **MENU KEY**

- When in Pressure Display Mode, pressing MENU puts the unit in Configuration Menu Mode.
- When in the configuration menus, pressing MENU takes you back to the previous menu level.
- When in the MAIN MENU, pressing MENU takes you back to Pressure Display Mode.
- When in a parameter edit screen, pressing MENU aborts the edit function, and takes you back to the previous menu level.

#### **DOWN ARROW KEY**

- When in the configuration menus, pressing DOWN ARROW scrolls the menu to the next menu option.

- When in a parameter entry screen, DOWN ARROW decrements the data value.

### **UP ARROW KEY**

- When in a menu, pressing UP ARROW scrolls the menu to the previous menu option.
- When in a parameter entry screen, UP ARROW increments the data value.

### **ENTER KEY**

- When in the configuration menus, pressing ENTER selects the displayed menu item.
- When in a parameter entry screen, ENTER accepts the displayed parameter value.

## **4.1.4 Configuration Menu Options**

The Configuration Menu allows you to configure the Model 735/745 according to your application. Refer to the Menu Quick Reference card or the menu tree in Section 20.

### **4.1.4.1 Tare Menu**

#### **CURRENT VALUE**

Displays the current tare value. This is the value that is subtracted from pressure measurements when tare is on.

#### **TARE**

Turns tare on. When tare is on, the current tare value is subtracted from pressure measurements. When Tare is selected, the pressure at that time becomes the current tare value. If tare is already on when this option is selected, tare remains on, and the pressure at that time becomes the new current tare value.

When tare is on, a “T” is displayed to the left of the pressure value to indicate that it is a tared pressure value.

#### **TARE OFF**

Turns tare off. When tare is off, the actual measured pressure value is displayed.

#### **4.1.4.2 Units Menu**

##### **PRESSURE UNITS**

Selects the pressure unit. The following options are available:

- psi
- hPa
- bar
- kPa
- MPa
- inHg
- mmHg
- mH<sub>2</sub>O
- User-defined pressure unit

The user-defined pressure unit can be selected via the configuration menu, but must be configured via RS-232. Refer to Section 5 for details.

##### **TEMP. UNITS**

Selects the internal sensor temperature unit. The following options are available:

- °C
- °F

#### **4.1.4.3 Display Menu**

##### **DECIMAL DIGITS**

Selects the number of significant digits used to display pressure measurement values. Fewer significant digits will be displayed if the pressure resolution and/or pressure unit will not provide the specified number of significant digits. When the number of digits is set to 6, the maximum number of significant digits is always displayed.

##### **LINE 2 DISPLAY**

Selects the information to be displayed on the second line. The following options are available:

- Bar graph – gives a graphic representation of the current pressure value as a percentage of full-scale pressure.
- Sensor Temp. – displays the DigiQuartz® pressure transducer internal temperature.

- Pressure Rate – displays the pressure rate of change in the current pressure unit per second. Pressure rate is calculated as the difference between adjacent pressure measurements divided by the measurement time interval. Time interval accuracy is  $\pm 10$  milliseconds.
- Stored Text – displays the text stored within the Model 735/745. The text is defined via the RS-232 port using the **UL** parameter. Refer to paragraph 5.7.2.8 for more information.
- External Text – displays the text sent via the RS-232 port using the **DT** command. The text is not stored within the Model 735/745, and will be lost if the unit is turned off.
- No Line 2 – No information is displayed on the second line.

The second line can also display an overpressure warning if the measured pressure exceeds the limits of the Digiquartz® pressure transducer. The overpressure warning is not available when the external text display option has been selected. Depending on the second line display option, the overpressure warning is either “OVERPRESSURE!” or “OVPR”.

#### **4.1.4.4 Aux Menu**

##### **SAMPLING TIME**

Selects the measurement sampling time. The range is .002 to 131.07 seconds in .002-second increments.

##### **UNIT ID**

Selects the unit ID for networking applications. The range is 01 to 98.

##### **PASSWORD**

Selects the password required to change settings within the Configuration Menu. The password is a four-digit integer value. When the password value is 0000, the password function is disabled, and no password is required to change settings. When the password value is non-zero, the password will be requested each time a setting is to be changed. If the proper password is entered, the setting can be changed; if not, you will be returned to the menu.

Contact Paroscientific if you are unable to configure your Model 735/745 due to a lost password.

## **VERSION**

Displays the firmware versions. This information may be helpful for diagnostic purposes.

## **BAUD RATE**

Selects the RS-232 baud rate. The following options are available:

- 19200
- 9600
- 4800
- 2400
- 1200
- 600
- 300

## 4.2 Rear Panel

### 4.2.1 Power Options

The Model 735/745 provides three power options.

#### **AC ADAPTER**

A 120VAC or 230VAC AC adapter was supplied with the Model 735/745. It plugs into the power jack located in the lower left corner of the rear panel.

#### **BATTERIES**

The Model 735/745 can be powered by four AA alkaline batteries. A set of batteries was supplied with the unit. The battery compartment is located on the rear panel. Open the battery compartment by inserting a tool into the small opening at the top of the battery compartment cover and pressing downward while pulling the cover outward. Batteries must be installed per the diagram inside the battery compartment.

The Model 735/745 runs for more than 20 hours on a fresh set of premium AA alkaline batteries. The battery level is monitored, and “LOW BATTERY” is displayed on the second line when the batteries are nearly discharged. A few hours of operation remain at the time that the “LOW BATTERY” indication is first displayed.

**WARNING** Use only AA alkaline batteries. Other types, including rechargeable batteries, are not recommended.

**WARNING** Do not allow batteries to remain in the Model 735/745 for an extended period of time. Discharged batteries can become leaky over time, and could cause significant damage to the unit. It is recommended that batteries be examined periodically for leakage, and that any suspect batteries be removed. If the unit will not be used for an extended period of time, it is recommended that the batteries be removed.

#### **WIRE INTERFACE**

The DC Power – I/O terminal block provides a means of wiring DC power to the Model 735/745.

## 4.2.2 Terminal Block Descriptions

Terminal block(s) are provided for making wire connections to the Model 735/745. The terminal blocks can be unplugged from the unit to simplify wiring. Refer to the pinout diagrams on the rear panel label when making connections.

### DC POWER – I/O TERMINAL BLOCK

The DC Power – I/O terminal block provides the following connections:

- DC power and power ground
- Model 715 remote display signals
- Overpressure output

Refer to paragraph 17.3 for detailed information regarding the DC Power – I/O terminal block. Refer to paragraph 5.7.2.5 for detailed information regarding the overpressure output.

### TRANSDUCER INTERFACE TERMINAL BLOCK (MODEL 735 ONLY)

The transducer interface terminal block provides the connections to the external Digiquartz® pressure transducer. Refer to paragraph 18.1 for detailed information regarding the transducer interface terminal block

## 4.3 Overpressure Alert

The overpressure alert is an audible alarm that works in conjunction with the overpressure output. It sounds whenever the displayed pressure exceeds a user-selectable pressure setpoint. The setpoint is controlled via RS-232 by the **OP** parameter. Refer to paragraph 5.7.2.5 for detailed information regarding the overpressure function and the **OP** parameter.

## 5 Remote Operation

### 5.1 Local vs. RS-232 Operation

The Model 735/745 can be operated either as a stand-alone unit, or as part of a computer-based data acquisition system via its RS-232 communications port.

Virtually all of the functionality of the Model 735/745 is available via the RS-232 port. Some of the unit's more specialized features can only be configured via the RS-232 port.

No special configuration is required to access the Model 735/745 via the RS-232 port. Simply connect its industry-standard RS-232 port to the RS-232 port of your host device, set your host device to the proper baud rate and serial protocol, and you are ready to communicate with the Model 735/745.

The Model 735/745 RS-232 port is directly compatible with that of the PC. Any standard male to female 9-pin serial cable can be used to make the necessary connections. A serial cable (Paroscientific PN 6409-003) is supplied with your Model 735/745.

**WARNING** Do not attempt to simultaneously access the Model 735/745 through the RS-232 port and the configuration menu. Doing so may cause serial commands or configuration menu selections to be ignored.

### 5.2 Digiquartz® Software

Paroscientific provides several software programs that simplify common measurement and configuration tasks. These programs can be found on the Digiquartz® CD Library, which is provided with the Model 735/745. The latest versions of these and other software programs are also available at the Paroscientific web site, at [www.paroscientific.com](http://www.paroscientific.com).

#### 5.2.1 Digiquartz® Interactive 2.0 (DQI 2.0)

Digiquartz® Interactive 2.0 is a Windows program that makes it easy to communicate with and configure DIGIQUARTZ® Intelligent devices. We encourage you to install DQI 2.0 and use it to verify proper device

operation, configure your device, take measurements, and experiment with its functions.

DQI 2.0 is separated into two main sections: Configuration and Monitoring, and Digiquartz® Terminal.

The Configuration and Monitoring section provides a means of viewing, changing, storing, and retrieving the configuration parameters of your instrument. It also allows you to take measurements and display them numerically and in a real-time graph. Measurement data may also be logged to a text file in a format that can be easily imported into popular PC programs such as Microsoft Excel® or Word®.

The Digiquartz® Terminal section allows you to interactively communicate with your instrument using text-based commands. Measurement data may be logged to a text file in a format that can be easily imported into popular PC programs such as Microsoft Excel® or Word®.

### **5.2.2 Digiquartz® Assistant (DQA)**

Digiquartz® Assistant is a Windows data logging program. With DQA, you can log time-stamped measurement data from up to 8 Digiquartz® intelligent devices. Measurement data can also be displayed in real time in an automatically scaled graph. Data is stored to a text file in a format that can easily be imported into popular PC programs such as Microsoft Word or Excel. Refer to the help function in DQA for more information.

### **5.2.3 Digiquartz® Terminal (DQT)**

Digiquartz® Terminal is a Windows terminal program that was developed specifically for use with Digiquartz® intelligent devices. Like traditional terminal programs, Digiquartz® Terminal lets you interactively communicate with intelligent devices. In addition, Digiquartz® Terminal can log time-stamped measurement data to a text file in a format that can easily be imported into popular PC programs such as Microsoft Word or Excel. Refer to the help function in Digiquartz® Terminal for more information.

## 5.3 Command and Response Basics

The Model 735/745 is remotely controlled by serial ASCII command strings. The following basic tasks can be accomplished by sending the appropriate command:

- Take a measurement
- Perform a control function, such as locking the baud rate
- Set an operating parameter, such as integration time
- Read the value of an operating parameter

When setting virtually all parameter values, you must precede the command with an **EW** command. This prevents accidental alteration of stored parameter values. Please refer to paragraphs 5.6 and 5.7.2.1 for more information about the **EW** command.

Measurement commands typically generate a response that contains the measurement data. Parameter-set commands typically generate a response that reports the updated parameter value. Parameter-read commands report the current parameter value.

When a command is received, any command that is in progress will be aborted. This enables you to send an RS-232 command to the Model 735/745 at any time, regardless of its current activity.

## 5.4 Command and Response Format

In general, RS-232 commands and responses are made up of the following:

### **START CHARACTER**

- The start character is an asterisk (ASCII 42).

### **DESTINATION ID**

- The destination ID identifies the device that is to receive the command or response.
- The destination ID is a two-digit integer between 00 and 99. ID 00 is reserved for the serial host, usually a PC.

### **SOURCE ID**

- The source ID identifies the device that is sending the command or the response.

- The source ID is a two-digit integer between 00 and 98. ID 00 is reserved for the serial host, usually a PC.

### **COMMAND OR RESPONSE DATA**

- A wide variety of commands and resulting response data are available. Refer to paragraph 5.7 for detailed information.

### **TERMINATION CHARACTERS**

- The termination characters are carriage return (ASCII 13) and linefeed (ASCII 10).

### **COMMAND FORMAT**

Commands are typically sent in the following format:

\*0100P3CrLf

Where:	* = Start character	Asterisk, ASCII 42
	01 = Destination ID	ID of the Model 735/745 that is to receive the command.
	00 = Source ID	ID of the device that is sending the command (Serial host is ID 00)
	P3 = Command	P3 is an example. Refer to paragraph 5.7 for descriptions of the entire command set.
	Cr = Carriage return	ASCII 13
	Lf = Linefeed character	ASCII 10

### **RESPONSE FORMAT**

Responses are typically received in the following format:

\*000114.4567CrLf

Where: *	= Start character	Asterisk, ASCII 42
00	= Destination ID	ID of the serial host that is to receive the response.
01	= Source ID	ID of Model 735/745 that is responding
14.4567	= Data	Data sent in response to the prior command)
Cr	= Carriage return	ASCII 13
Lf	= Linefeed character	ASCII 10

These examples are typical. Refer to paragraph 5.7 for specific details regarding each available command.

## 5.5 Establishing RS-232 Communications

The following are two methods of establishing and verifying RS-232 communications between the Model 735/745 and a PC.

### USING DIGIQUARTZ® INTERACTIVE 2.0 SOFTWARE

The easiest way to establish RS-232 communications is by using Digiquartz® Interactive 2.0 (DQI 2.0) software.

**Step 1. Connect the Model 735/745 to the PC:** Connect the Model 735/745 RS-232 port to the PC RS-232 port using the serial cable (Paroscientific PN 6409-003) that was provided with the unit. Any other standard RS-232 serial cable intended for use with the PC can also be used.

**Step 2. Install DQI 2.0:** Insert the Digiquartz® CD Library CD into your CDROM drive, and follow the installation instructions.

**Step 3. Run DQI 2.0:** Power up the Model 735/745, and run DQI 2.0. At the Startup screen, select the PC com port number that you are using, and click the Detect button. DQI 2.0 will search for the unit, and establish communications with it automatically. Click the OK button to exit the Startup screen and enter DQI 2.0.

At this point, DQI 2.0 should be able to communicate with the unit. Refer to the DQI 2.0 help feature for more information about using DQI 2.0.

## USING A TERMINAL PROGRAM

A standard terminal program can also be used to establish RS-232 communications with the Model 735/745. Digiquartz® Terminal (DQT) software can be used for this purpose. DQT is provided on the Digiquartz® CD Library CD.

**Step 1. Connect the Model 735/745 to the PC:** Connect the Model 735/745 RS-232 port to the PC RS-232 port using the serial cable (Paroscientific PN 6409-003) that was provided with your unit. Any other standard RS-232 serial cable intended for use with the PC can also be used.

**Step 2. Install DQT:** Insert the Digiquartz® CD Library CD into your CDROM drive, and follow the installation instructions. Any other terminal program already installed on your PC can also usually be used.

**Step 3. Determine the current baud rate and ID settings of your Model 735/745:** Power up your unit, and press the MENU key to enter Configuration Menu mode. From the MAIN MENU, scroll to Aux Menu and select it using the Enter key. Scroll the AUX MENU to Unit ID, and select it using the Enter key. Note the unit ID. Press the MENU key to return to the AUX MENU. Scroll the AUX MENU to Baud Rate, and select it using the Enter key. Note the baud rate; you may change the baud rate using the UP ARROW and DOWN ARROW keys. Press the ENTER key to return to Pressure Display mode.

**Step 4. Configure the terminal program:** Set the com port to the PC com port number that you are using. Set the baud rate to match the Model 735/745. Set the communications protocol to 8 data bits, no parity, and 1 stop bit. If DQT is not being used, it is often necessary to configure the terminal program to append a line feed character to each carriage return character.

At this point, the terminal program should be able to communicate with the unit. Refer to paragraph 5.7 for detailed command and response information. Refer to the DQT reference feature for detailed information about using DQT.

## 5.6 Setting and Reading Parameter Values

The behavior of the Model 735/745 is controlled by several operating parameters. The values of these parameters are stored in non-volatile memory. Commands are provided to set and read the parameters values. Refer to paragraph 5.7.2 for detailed information about the various parameters.

### SETTING PARAMETER VALUES

Each parameter-set command must be preceded with the **EW** enable write command. The purpose of this is to reduce the chance of changing a parameter value by mistake. Parameter set commands will be ignored unless they are preceded with an **EW** command. See paragraph 5.7.2.1 for more information about the **EW** command.

The following is an example of a parameter-set command preceded with the **EW** (enable write) command. For this example, the **UN** (pressure unit) parameter will be set to a value of 1.

Command:       \*0100EW\*0100UN=1CrLf  
Response:       \*0001UN=1CrLf

All other writable parameters are set in the same way. Some parameters are read-only, and cannot be set.

### READING PARAMETER VALUES

All parameters can be read without preceding the command with an **EW** (enable write) command. The following is an example of a parameter-read command. For this example, the **UN** (pressure unit) parameter will be read.

Command:       \*0100UNCrLf  
Response:       \*0001UN=1CrLf

**CAUTION** Repeatedly setting or reading parameter values may temporarily prevent the display from being updated.

## 5.7 Command Reference

### 5.7.1 Measurement Commands

The following commands are used to initiate measurements, and to control measurement integration time. For additional commands associated with Nano-Resolution, please refer to Section 6.

#### 5.7.1.1 Single Measurement Commands

The following commands are used to initiate single measurements. They return the resulting measurement value as soon as it is available.

**P1** Sample and send one pressure period measurement in units of microseconds.

Action: Measure pressure period, send pressure period value, and await next command.

Typical command: \*0100P1

Typical response: \*000128.123456 (Value: 28.123456)

Note: Repeatedly issuing the **P1** command will temporarily prevent the front panel display from being updated.

**P3** Sample and send one pressure measurement in selected engineering units.

Action: Measure temperature period, measure pressure period, calculate temperature-compensated pressure, send pressure value, and await next command.

Typical command: \*0100P3

Typical response: \*000114.71234 (Value: 14.71234)

**Q1** Sample and send one temperature period measurement in units of microseconds.

Action: Measure temperature period, send temperature period value, and await next command.

Typical command: \*0100Q1

Typical response: \*00015.1234567 (Value: 5.1234567)

Note: Repeatedly issuing the **Q1** command will temporarily prevent the front panel display from being updated.

**Q3** Sample and send one temperature measurement in selected engineering units.

Action: Measure temperature period, calculate temperature, send temperature value, and await next command.

Typical command: \*0100Q3

Typical response: \*000122.345 (Value: 22.345)

Note: Repeatedly issuing the **Q3** command will temporarily prevent the front panel display from being updated.

### 5.7.1.2 Sample and Hold Measurement Commands

The following commands are used to initiate and send single sample and hold measurements. Measurement values are held until the next command is received. If the next command is a **DB** command, the measurement value is sent; if it is any other command, the measurement value is lost. If a **DB** command is received before the measurement command is complete, the measurement value will be sent as soon as it is available.

**CAUTION** Sample and hold commands will temporarily prevent the front panel display from being updated until the **DB** command is received or the sample and hold command is cancelled by the next valid command.

- P5** Sample and hold one pressure measurement in selected engineering units.  
Action: Measure temperature period, measure pressure period, calculate temperature-compensated pressure, save pressure value, and await **DB** command.  
Typical command: \*0100P5  
Typical response: No response until **DB** command is received
- P6** Sample and hold one pressure period measurement in units of microseconds.  
Action: Measure pressure period, save pressure period value, and await **DB** command.  
Typical command: \*0100P6  
Typical response: No response until **DB** command is received
- Q5** Sample and hold one temperature measurement in selected engineering units.  
Action: Measure temperature period, calculate temperature, save temperature value, and await **DB** command.  
Typical command: \*0100Q5  
Typical response: No response until **DB** command is received
- Q6** Sample and hold one temperature period measurement in units of microseconds.  
Action: Measure temperature period, save temperature period value, and await **DB** command.  
Typical command: \*0100Q6  
Typical response: No response until **DB** command is received
- DB** Dump Buffer. Send a held measurement value.  
Action: If a measurement value is being held, send it, otherwise do nothing.  
Typical command: \*0100DB  
Typical response: \*000114.12345 (Value: 14.12345)

### 5.7.1.3 Continuous Measurement Commands

The following commands are used to initiate and control continuous measurements. Continuous measurement commands repeatedly take measurement samples and return measurement values until commanded to stop. Continuous measurements are cancelled by sending any valid command.

**P2** Continuously sample and send pressure period measurement values in units of microseconds.

Action: Measure pressure period, send pressure period value, and repeat until commanded to stop.

Typical command: \*0100P2

Typical response: \*000128.123456 (Value: 28.123456)  
\*000128.123457 (Value: 28.123457)  
\*000128.123456 ... (Value: 28.123456)

Note: The **P2** command will temporarily prevent the front panel display from being updated.

**P4** Continuously sample and send pressure measurement values in selected engineering units.

Action: Measure temperature period, measure pressure period, calculate temperature-compensated pressure, send pressure value, and repeat until commanded to stop.

Typical command: \*0100P4

Typical response: \*000114.71234 (Value: 14.71234)  
\*000114.71235 (Value: 14.71235)  
\*000114.71234 ... (Value: 14.71234)

**P7** High-speed continuous pressure measurement in selected engineering units.

Action: Continuously sample and send pressure measurement values, using temperature measurement interval specified by the current value of **PS**. **P7** automatically performs the following sequence:

1. Initially measure temperature period.
2. Measure pressure period.
3. Calculate temperature-compensated pressure using last temperature period measurement.
4. Send pressure value.
5. Do steps 2-4 the number of times specified by **PS**, then measure temperature period.
6. Repeat steps 2-5 until commanded to stop.

Typical command: \*0100P7

Typical response: \*000114.71234 (Value: 14.71234)

\*000114.71235 (Value: 14.71235)

\*000114.71234 ... (Value: 14.71234)

Note: **P7** allows you to maximize the pressure sampling rate by taking temperature measurements at the interval specified by the **PS** command. Each subsequent pressure value is temperature-compensated using the currently stored temperature value. You can take a single initial temperature measurement, or you can take periodic temperature measurements at the interval you select with the **PS** command. Please refer to the **PS** command for more information.

**PS** Set or read the temperature measurement interval used by the **P7** command.

Action: Controls how often temperature measurements are taken during a **P7** pressure measurement sequence.

If **PS=0**, an initial temperature measurement is taken, and all subsequent pressure measurements are compensated using that value.

If **PS=1**, a temperature measurement is taken before each pressure measurement (same as **P4**).

If **PS=n** and  $n > 1$ , an initial temperature measurement is taken, and subsequent temperature measurements are taken after every  $n$  pressure measurements.

Range: 1 to 65535

Typical command: \*0100EW\*0100PS=4

Typical response: \*0001PS=4

Note: When setting virtually all parameter values, you must precede the command with an **EW** (**E**nable **W**rite) command. Please refer to paragraph 5.7.2.1 for more information.

**Q2** Continuously sample and send temperature period measurement values in units of microseconds.

Action: Measure temperature period, send temperature period value, and repeat until commanded to stop.

Typical command: \*0100Q2

Typical response: \*00015.1234567 (Value: 5.1234567)

\*00015.1234568 (Value: 5.1234568)

\*00015.1234567 ... (Value: 5.1234567)

Note: The **Q2** command will temporarily prevent the front panel display from being updated.

**Q4** Continuously sample and send temperature measurement values in selected engineering units.

Action: Measure temperature period, calculate temperature, send temperature value, and repeat until commanded to stop.

Typical command: \*0100Q4

Typical response: \*000122.345 (Value: 22.345)

\*000122.346 (Value: 22.346)

\*000122.345 ... (Value: 22.345)

Note: The **Q4** command will temporarily prevent the front panel display from being updated.

## 5.7.2 Configuration Commands

### 5.7.2.1 Enable Write Command

When setting virtually all parameter values, you must precede the parameter set command with an **EW** (enable write) command. Parameter set commands will be ignored unless they are preceded with an **EW** command.

**EW** Enables the next parameter set command to write a new value into non-volatile memory. You can issue **EW** as a separate command by terminating it with a carriage return/line feed, or you can string the **EW** and parameter set commands together, as shown below.

Typical syntax: \*0100EW \*0100TR=800

Alternate syntax: \*0100EW  
\*0100TR=800

### 5.7.2.2 Measurement Integration Time Commands

The Model 735/745 supports two measurement integration modes: time-based and period-based. Time-based integration samples the transducer pressure and temperature signals for a specified time, and period-based integration samples the signals for a specified number of periods of the

measured signal. See paragraph 7.6 for information regarding the relationships between integration time, resolution, and sampling rate.

The desired integration mode is automatically selected depending on which integration time set command is issued. For example, when a **PI** or **TI** set command is received, the Model 735/745 is configured for time-based integration mode; when a **PR** or **TR** set command is received, the Model 735/745 is configured for period-based integration. The selected integration mode remains in effect until it is changed.

### **PERIOD-BASED INTEGRATION**

**PR** and **TR** are the period-based integration time commands for pressure and temperature signal integration. The advantages of **PR** and **TR** are that they have higher resolution than the time-based integration commands, and that they are compatible with earlier generation Digiquartz® intelligent transmitters and instruments. The resolution of **PR** and **TR** is approximately 3 ms.

### **TIME-BASED INTEGRATION**

**PI** and **TI** are the time-based integration time commands for pressure and temperature signal integration. The advantage of **PI** and **TI** is that the integration time is not a function of measured period, and is consistent from unit to unit. This allows you to precisely synchronize measurements from two or more Digiquartz® intelligent transmitters and instruments that support time-based integration. The resolution of **PI** and **TI** is 10ms. **PI** and **TI** values are rounded to the nearest multiple of 10ms when used.

## TIME-BASED INTEGRATION TIME COMMANDS

- PI** Set or read the time-based pressure measurement integration time  
Units: Milliseconds  
Range: 1 to 65535. Resolution is 10 milliseconds. Values are rounded to the next multiple of 10. Example: A value of 11 results in a pressure integration time of 10 milliseconds, and a value of 15 results in a pressure integration time of 20 milliseconds.  
Default: 670  
Typical set command: \*0100EW\*0100PI=1000  
Typical set response: \*0001PI=1000  
Typical read command: \*0100PI  
Typical read response: \*0001PI=1000  
Note: Whenever the value of **PI** is changed, **TI** is automatically updated with the same value.
- TI** Set or read time-based temperature measurement integration time  
Units: Milliseconds  
Range: 1 to 65535. Resolution is 10 milliseconds. Values are rounded to the next multiple of 10. Example: A value of 11 results in a temperature integration time of 10 milliseconds, and a value of 15 results in a temperature integration time of 20 milliseconds.  
Default: 670  
Typical set command: \*0100EW\*0100TI=1000  
Typical set response: \*0001TI=1000  
Typical read command: \*0100TI  
Typical read response: \*0001TI=1000  
Note: Whenever the value of **PI** is changed, **TI** is automatically updated with the same value. Changing **TI** has no effect on **PI**. **TI** should be set to the value as **PI** for optimum performance in most applications.

## PERIOD-BASED INTEGRATION TIME COMMANDS

**PR** Set or read period-based pressure measurement integration time

Units: None

Range: 1 to 16383

Default: 238

Typical set command: \*0100EW\*0100PR=200

Typical set response: \*0001PR=200

Typical read command: \*0100PR

Typical read response: \*0001PR=200

Note: Whenever the value of **PR** is changed, **TR** is automatically updated with the value of **PR** times 4.

**TR** Set or read period-based temperature measurement integration time

Units: None

Range: 1 to 65535

Default: 952

Typical set command: \*0100EW\*0100TR=800

Typical set response: \*0001TR=800

Typical read command: \*0100TR

Typical read response: \*0001TR=800

Note: Whenever the value of **PR** is changed, **TR** is automatically updated with the value of **PR** times 4. Changing **TR** has no effect on **PR**. **TR** should be set to the value as **PR** times 4 for optimum performance in most applications.

### 5.7.2.3 Data Output Mode Command

The following command controls whether pressure data is continuously output, and whether display data are produced.

**MD** Set or read the data output mode.

Action: **MD** configures the Model 735/745 for continuous serial pressure measurement output and/or display data output whenever power is applied.

<b>MD value</b>	<b>Display data output</b>	<b>Continuous serial pressure data output</b>
0	OFF	OFF
1	ON	OFF
2	OFF	ON
3	ON	ON

Once **MD** is set, the specified data output mode will remain in effect until **MD** is set to a different value, even through a power cycle. Therefore, the Model 735/745 will perform the specified data output function whenever power is applied.

Range: 0-3

Default: 1

Typical set command: \*0100EW\*0100MD=1

Typical set response: \*0001MD=1

Typical read command: \*0100MD

Typical read response: \*0001MD=1

**CAUTION** If **MD** is set to 0 or 2, the front panel display will no longer be updated. For most applications, **MD** should only be set to 1 or 3. **MD** settings of 0 and 2 are supported only for compatibility with other Digiquartz® Intelligent Instruments.

Note: When **MD** is set to a non-zero value, the specified data output mode will be preempted under the following conditions:

- Continuous serial pressure data output is suspended when a measurement command is received. Continuous data output resumes when the measurement command is complete.
- Display data output is suspended when a period measurement command (P1, P2, P6, Q1, Q2, Q6) is received. Display data output resumes when the period measurement command is complete.
- Continuous pressure data output is suspended when a continuous measurement command (P2, P4, P7, Q2, Q4) is received, and resumes when the continuous measurement command is cancelled.

### 5.7.2.4 Engineering Units Commands

Engineering units commands are used to specify the engineering units to be used when calculating pressure or temperature values, and to configure the user-defined pressure unit.

**UN** Set or read the pressure engineering units.

Action: Sets or queries the conversion factor by which all calculated pressure values are multiplied before being output. Setting **UN** to a non-zero value selects one of eight standard pressure units; 0 selects a user-defined unit whose conversion factor is specified by the **UF** command. **UN** also sets the units of the pressure data displayed by an optional Model 715 display.

Range: 0 to 8

<b>UN value</b>	<b>Pressure units</b>	<b>psi multiplied by...</b>
0	User-defined pressure unit	Value of UF
1	psi	1.0000000
2	hPa (mbar)	68.94757
3	bar	0.06894757
4	kPa	6.894757
5	MPa	0.00689476
6	in Hg	2.036021
7	mm Hg (Torr)	51.71493
8	m H <sub>2</sub> O	0.7030696

Default: 1

Typical set command: \*0100EW\*0100UN=2

Typical set response: \*0001UN=2

Typical read command: \*0100UN

Typical read response: \*0001UN=2

**UF** Set or read the user-defined pressure engineering units conversion factor.

Action: When **UN**=0, calculated pressure values (psi) are multiplied by the value of **UF** before being output, thus scaling the pressure values in the desired user-defined pressure units.

Range: -9999999 to 9999999

Default: 1.0000000

Typical set command: \*0100EW\*0100UF=2

Typical set response: \*0001UF=2

Typical read command: \*0100UF

Typical read response: \*0001UF=2.000000

**TU** Set or read the temperature engineering units.

Action: Specifies the temperature units for **Q3**, **Q4**, **Q5**, and displayed temperature data.

Range: 0 = °C

1 = °F

Default: 0

Typical set command: \*0100EW\*0100TU=1

Typical set response: \*0001TU=1

Typical read command: \*0100TU

Typical read response: \*0001TU=1

Note: Temperature is always calculated in °C, but it is converted to °F if **TU**=1.

### 5.7.2.5 Tare and Overpressure Commands

Taring is the process of subtracting a specified value from pressure measurements. You may use a measured pressure as the tare value, or you may specify any desired value. Taring can be enabled, disabled, and locked out through the use of serial commands. RS-232 pressure measurement data can be formatted to include an indication when taring is in effect. Refer to the **ZI** command for more information.

The overpressure command can be used to specify the overpressure alarm setpoint. When the overpressure setpoint is exceeded, the overpressure I/O line changes from logic low (0 VDC) to logic high (5.0 VDC)

**ZS** Set or read the tare state parameter value.

Action: The three states of ZS are as follows:

ZS=0 Taring function is off.

ZS=1 Taring has been requested, but is not yet in effect.

ZS=2 Taring is in effect

**ZS** is set to 0 on power-up. If **ZL**=0 (taring is not locked out), taring can be requested by setting the **ZS** to 1. At the first pressure measurement following a tare request, the following sequence occurs:

- The pressure value is stored in the **ZV** parameter.
- The value of **ZS** is set to 2 to indicate that taring is in effect.
- The value of **ZV** is subtracted from all subsequent pressure values until taring is turned off.

If taring is already in effect when a **ZS**=1 command is issued, the sequence described above occurs, and taring continues using a new value of **ZV**.

Taring can be turned off by issuing a **ZS**=0 command.

Range: 0 to 2

Default: 0

Typical set command: \*0100EW\*0100ZS=1

Typical set response: \*0001ZS=1

Typical read command: \*0100ZS

Typical read response: \*0001ZS=1

**ZV** Set or read the tare value.

Action: Sets or queries the value that is subtracted from pressure measurements when taring is activated. **ZV** can be set to any desired value when taring is in effect (**ZS**=2). Note, however, that if taring is subsequently requested, a new value will overwrite the **ZV** value you have set.

The value of **ZV** is set to 0 on power-up.

Range: -9999999 to 9999999

Default: 0

Typical set command: \*0100EW\*0100ZV=14.7123

Typical set response: \*0001ZV=14.7123

Typical read command: \*0100ZV

Typical read response: \*0001ZV=14.7123

**ZL** Set or read the tare lockout parameter value.

Action: When **ZL**=0, **ZS** can be set to enable and disable taring. When **ZL**=1, taring is locked, and the value of **ZS** cannot be modified via serial commands or the Tare Input I/O line. However, if **ZS**=1 and a **ZL**=1 command is issued, taring will be in effect when the next pressure measurement is taken, but you cannot turn taring off until **ZL** is set to 0.

The value of **ZL** is set to 0 on power-up.

Range: 0 or 1

Default: 0

Typical set command: \*0100EW\*0100ZL=1

Typical set response: \*0001ZL=1

Typical read command: \*0100ZL

Typical read response: \*0001ZV=1

**OP** Set or read the overpressure alarm setpoint value.

Action: When a pressure measurement value is less than the value of **OP**, the overpressure I/O line is at logic low (0 VDC) and the overpressure alert is silent; if it is greater or equal to the value of **OP**, the overpressure I/O line is set to logic high (5.0 VDC), and the overpressure alert sounds.

**OP** is set in the current pressure units, and is scaled accordingly if the engineering units are changed.

Range: -9999999 to 9999999

Default: Maximum rated unit pressure

Typical set command: \*0100EW\*0100OP=15

Typical set response: \*0001OP=15.00000

Typical read command: \*0100OP

Typical read response: \*0001OP=15.00000

### 5.7.2.6 Measurement Data Formatting Commands

These commands are used to alter the format of serial measurement data. The following data formatting functions are available:

- Append engineering units to pressure and temperature measurement data
- Append a taring indication to tared pressure measurement data
- Add underscores to separate the measurement data from the rest of the serial output data string to improve readability
- Add trailing zeroes to the measurement data to create a fixed-length data string to simplify parsing

Formatting commands can be used separately or in any combination.

**US** Set or read the engineering units suffix parameter value.

Action: When **US=1**, an engineering units label is appended to pressure and temperature measurement data. When **US=0**, no engineering units label is appended.

Examples: \*000114.71234 (Pressure measurement, **US=0**)  
\*000114.71234psia (Pressure measurement, **US=1**)  
\*000121.123 (Temp measurement, **US=0**)  
\*000121.123C (Temp measurement, **US=1**)

When **US=1**, a pressure unit label is appended to pressure measurement values, according to the value of **UN**:

<b>UN value</b>	<b>Label</b>
0	Defined by UM
1	psia, psig, or psid
2	hPa
3	bar
4	kPa
5	MPa
6	inHg
7	mmHg
8	mH2O

When **US=1**, a temperature unit label is appended to temperature measurement values, according to the value of **TU**:

<b>TU value</b>	<b>Label</b>
0	C
1	F

Range: 0 or 1

Default: 0

Typical set command: \*0100EW\*0100US=1

Typical set response: \*0001US =1

Typical read command: \*0100US

Typical read response: \*0001US =1

**SU** Set or read the underscore separator parameter value.

Action: When **SU**=1, an underscore separates the measurement data from the address header and the optional engineering units suffix. When **SU**=0, no underscore separators appear.

Examples: \*000114.71234 (SU=0)  
          \*0001\_14.71234 (SU=1)  
          \*0001\_14.71234\_psia (SU=1, US=1)

Range: 0 or 1

Default: 0

Typical set command: \*0100EW\*0100SU=1

Typical set response: \*0001SU=1

Typical read command: \*0100SU

Typical read response: \*0001SU=1

**ZI** Set or read the taring indication parameter value.

Action: When **ZI**=1, a “T” is appended to pressure measurement values when taring is in effect. When **ZI**=0, no taring indication appears, whether taring is in effect or not.

Examples: \*000114.71234 (ZI=0)  
          \*000114.71234T (ZI=1)  
          \*0001\_14.71234T (ZI=1, SU=1)  
          \*000114.71234Tpsia (ZI=1, US=1)  
          \*0001\_14.71234T\_psia (ZI=1, US=1, SU=1)

Range: 0 or 1

Default: 0

Typical set command: \*0100EW\*0100ZI=1

Typical set response: \*0001ZI=1

Typical read command: \*0100ZI

Typical read response: \*0001ZI=1

**DL** Set or read the fixed field data format parameter.

Action: When **DL**=1, measurement data is formatted in a fixed field format. When **DL**=0, measurement data is given in the standard format.

The fixed field format is specified as follows:

\*AAAASDDDDDDDDDD, where

\* = the asterisk character

A = destination and source address characters

S = sign of pressure data, either + or –

D = numeric representation of pressure data, either digits or a decimal point

Examples:	*000114.71234	(Pressure, <b>DO</b> =0)
	*0001+14.7123400	(Pressure, <b>DO</b> =1)
	*000121.123	(Temperature, <b>DO</b> =0)
	*0001+21.1230000	(Temperature, <b>DO</b> =1)

Range: 0 or 1

Default: 0

Typical set command: \*0100EW\*0100DL=1

Typical set response: \*0001DL=1

Typical read command: \*0100DL

Typical read response: \*0001DL=1

Note: The format specification and examples shown above assume that the other formatting commands are disabled. If other formatting commands are used in combination with **DL**, a fixed field format will still result, but the format specification will vary slightly from the one described above.

**UM** Set or read the user-defined engineering units label parameter.

Action: When **UN**=0 and **US**=1, the text value of **UM** is appended to pressure measurements.

Examples: \*000114.71234 (**UN**=0, **US**=0)  
\*000114.71234user (**UN**=0, **US**=1, **UM**=user)

Range: Any text up to four characters, consisting of ASCII 32 to ASCII 127.

Default: user

Typical set command: \*0100EW\*0100UM=test

Typical set response: \*0001UM=test

Typical read command: \*0100UM

Typical read response: \*0001UM=test

### 5.7.2.7 Unit Identification Commands

The Unit Identification commands read various device-specific parameters. These parameters are factory-set, and cannot be modified.

**SN** Read the serial number.

Action: The **SN** parameter contains the device serial number. **SN** is a read-only command.

Typical read command: \*0100SN

Typical read response: \*0001SN=12345

**VR** Read the firmware version number.

Action: The **VR** parameter contains the device firmware version number. **VR** is a read-only command.

Typical read command: \*0100VR

Typical read response: \*0001VR=D1.02

**MN** Read the model number.

Action: The **MN** parameter contains the device model number as a text string. The value of **MN** always contains 16 characters. If the model number is less than 16 characters, the string will be padded with trailing spaces to a length of 16 characters. **MN** is a read-only command.

Typical read command: \*0100MN

Typical read response: \*0001MN=745-15A

**PF** Read the full-scale pressure value.

Action: The **PF** parameter contains the full-scale pressure value in the current pressure units. If the units are changed, the value of **PF** is scaled accordingly. **PF** is a read-only command.

Typical read command: \*0100PF

Typical read response: \*0001PF=30.00000

**PO** Read the pressure transducer type.

Action: The **PO** parameter contains the pressure transducer type. **PO** is a read-only command.

<b>PO value</b>	<b>Transducer type</b>
0	Absolute
1	Gauge
2	Differential

Typical read command: \*0100PO

Typical read response: \*0001PO=0

### 5.7.2.8 Display Data Configuration Commands

The Display Configuration commands allow you to alter the information shown on the display. They also control the display of the optional Model 715 Remote Display.

**DP** Set or read the maximum number of decimal places in the displayed pressure value.

Action: **DP** sets the maximum number of decimal places in the displayed pressure value. Fewer decimal places will be displayed if the pressure resolution and/or pressure unit will not provide the specified number of decimal places. When **DP** is set to 6, the maximum number of decimal places is always displayed, according to current pressure resolution.

Range: 0 to 6

Default: 6

Typical set command: \*0100EW\*0100DP=6

Typical set response: \*0001DP=6

Typical read command: \*0100DP

Typical read response: \*0001DP=6

**DT** Set the text to be displayed on the second line when the External Text display option is selected from the Configuration Menu. Use **DT** when the Model 735/745 is to be controlled by an RS-232 serial host, and the text must be updated frequently.

Action: **DT** allows a serial host (such as a PC) to send text to be displayed on the bottom line. The text sent using **DT** is not stored by the Model 735/745; it is simply transferred to its display. **DT** cannot be queried, and it is not necessary to precede **DT** with an **EW** command. The text is lost when the Model 735/745 is powered off.

Range: 16 characters maximum. Any characters in the range of ASCII 32 to ASICC 127 are legal.

Typical set command: \*0100DT=This is my text

Typical set response: \*0001DT=This is my text

**PL** Read the overpressure indication setpoint. This setpoint is used to determine the pressure at which the overpressure indication is displayed. **PL** is a factory-set, read-only command.

Action: When the Model 735/745 measures a pressure greater than the value of **PL**, an overpressure indication is displayed.

Typical read command: \*0100PL

Typical read response: \*0001PL=120.0000

Note: **PL** is typically factory-set to the overpressure limit as specified in the Specification Control Drawing for the Digiquartz® transducer.

**UL** Set or read the text to be displayed on the second line when the Stored Text display option is selected from the Configuration Menu.

Action: **UL** defines the text to be displayed on the bottom line. The value of **UL** is stored in non-volatile memory, and will therefore be retained even if power is lost.

Range: 11 characters maximum. Any characters in the range of ASCII 32 to ASCII 127 are legal.

Default: 11 space characters

Typical set command: \*0100EW\*0100UL=My label

Typical set response: \*0001UL=My label

Typical read command: \*0100UL

Typical read response: \*0001UL=My label

**CAUTION** Do not use **UL** if it is necessary to update the displayed text often; use the External Text display option and the **DT** command instead. The nonvolatile memory used to store the text data can be written approximately 100,000 times; excessive use of **UL** will eventually result in the inability to change its value.

### 5.7.2.9 Calibration Commands

The calibration commands set and read several parameters that directly affect the measurement accuracy of the device. Refer to Section 10 for more information regarding the use of the calibration parameters.

**CAUTION** Calibration values should be modified only when absolutely necessary, and then with extreme caution. Calibration adjustments should only be performed by a qualified metrology lab.

**PA** and **PM** are used in the following formula to calculate final output pressure:

$$P_{\text{adjusted}} = PM * (P + PA)$$

Where: P = Pressure calculated using original calibration coefficients, in the current pressure units

PM = the current value of the **PM** parameter

PA = the current value of the **PA** parameter

**PA** Set or read the pressure adder parameter.

Action: The pressure adder parameter is used to make zero adjustments to the calibration. PA can also be used to offset absolute pressure measurements by atmospheric pressure to obtain gauge pressure.

Range: -9999999 to 9999999

Default: 0.0

Typical set command: \*0100EW\*0100PA=.0000123

Typical set response: \*0001PA=.0000123

Typical read command: \*0100PA

Typical read response: \*0001PA=.0000123

Note: The value of **PA** is entered in the current pressure units, but is converted to psi prior to being stored. When **PA** is queried, it returns the value scaled to the current pressure units.

**PM** Set or read the pressure multiplier parameter.

Action: The pressure multiplier parameter is used to make span adjustments to the calibration.

Range: -9999999 to 9999999

Default: 1

Typical set command: \*0100EW\*0100PM=1.000123

Typical set response: \*0001PM=1.000123

Typical read command: \*0100PM

Typical read response: \*0001PM=1.000123

Note: The value of **PM** is dimensionless, and is therefore not scaled if the units are changed.

**TC** Read the crystal timebase correction factor.

Action: **TC** is used to normalize the nominal 14.7456 MHz reference crystal frequency to 10 MHz to compensate for the natural variation in reference crystal resonant frequency. **TC** is a read-only command.

Typical read command: \*0100TC

Typical read response: \*0001TC=.6666667

**C1**  
**C2**  
**C3**  
**D1**  
**D2**  
**T1**  
**T2**  
**T3**  
**T4**  
**T5**  
**U0**  
**Y1**  
**Y2**  
**Y3**

Set or read the calibration coefficients. See paragraph 7.8 and Section 10 for more information about calibration and calibration coefficients.

Default: Device-specific

Typical set command: \*0100EW\*0100C1=228.1234

Typical set response: \*0001C1=228.1234

Typical read command: \*0100C1

Typical read response: \*0001C1=228.1234

### **5.7.2.10 Diagnostic Commands**

In the unlikely event of a hardware failure, the diagnostic commands can assist in the troubleshooting process.

**CS** Read the number of unused bytes on the stack since power-up.

Action: **CS** is read-only; it cannot be set. It can be used to determine whether a stack overflow may have occurred.

Typical read command: \*0100CS

Typical read response: \*0001CS=8

**CX** Check timebase crystal frequency.

Action: Puts the timebase frequency divided by 480 on the Tare Output I/O line. The timebase signal is removed from the Tare Output I/O line when the next valid command is received. **CX** cannot be queried. The **CX** set command does not produce a response.

Typical set command: \*0100CX

Typical set response: No response

### **5.7.2.11 Global Commands**

Under certain circumstances, it may be desirable to send a single command to multiple units on a serial loop network. The ID 99 has been reserved for such global addressing. When a Model 735/745 receives a legal command addressed to ID 99, it reacts to that command regardless of its assigned ID value.

When the Model 735/745 receives a global command via RS-232, it retransmits the global command before acting on it. This ensures that all units on a serial loop will receive the global command. Eventually, the global command is retransmitted by the last unit in the serial loop and is received by the serial host. The serial host must be able to disregard the retransmitted command.

Global addressing is often used with sample and hold measurement commands to synchronize measurements from multiple devices. The sample and hold measurement commands are:

**P5** and **P6**

**Q5** and **Q6**

All sampling commands and certain other commands may be either individually or globally addressed:

**P1 through P7**

**Q1 through Q6**

**DB**

**VR**

**EW**

The remaining commands should not be sent as global commands

## 5.8 High Speed Sampling

Use one or more of the following techniques to increase the RS-232 sampling rate.

- Reduce integration time. Refer to **PI**, **TI**, **PR**, and **TR** commands in paragraph 5.7.2.2.
- Use **PR** and **TR** rather than **PI** and **TI** to control integration time. **PR** and **TR** have approximately 1ms resolution, compared to 10ms of **PI** and **TI**. See paragraph 5.7.2.2 for details
- Use a continuous pressure measurement command, such as **P4** or **P7**. See paragraph 5.7.1.3 for details.
- Turn off display data output. Refer to the **MD** command in paragraph 5.7.2.3.
- Increase the baud rate. Refer to paragraph 4.1.4.4.
- Use the continuous pressure period command (**P2**), and post-process data to convert to pressure. Refer to paragraph 7.8 for detailed information about converting period measurements into pressure values.

## 5.9 Networking

The Model 735/745 supports RS-232 serial loop networking. Networking allows you to communicate with up to 98 Digiquartz® Intelligent devices from a single RS-232 serial host.

## 5.9.1 Networking Basics

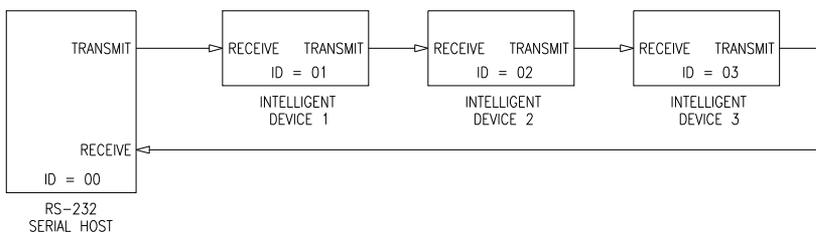
When setting up a network, the following points must be observed.

- If your network includes older Intelligent transmitters that support RS-232 only, set the older devices to PT = N to assure compatibility with the Model 735/745.
- Verify proper operation of each Intelligent device before installing it in a network.
- Set all Intelligent devices to the same baud rate before installing them in a network.
- Each Intelligent device on the network needs to be set to a unique ID.

## 5.9.2 RS-232 Loop Networking

Refer to Figure 4. In an RS-232 serial loop network, the transmit output of the RS-232 host is connected to the receive input of the first device in the loop. The transmit output of the first device is connected to the receive input of the next device. The remaining devices are connected similarly, with their receive input connected to the transmit output of the previous device, and their transmit output connected to the receive input of the next device. The transmit output of the last device is connected to the receive input of the RS-232 host.

The host sends commands to the first device in the loop. If a command is addressed to that device, the command is carried out; if not, the command is resent to the next device. Globally addressed commands are carried out by each device, and are also resent to the next device. When a device responds to a command, the response is addressed to the host, and is therefore resent by each device that receives it until it eventually makes it way to the serial host.



**Figure 4. Serial loop network block diagram**

Keep these points in mind when designing an RS-232 serial loop network:

- As previously described, each device resends any command or response that is addressed to another device. Since each device considers resending to be a higher priority than sending its own response, it is possible that a device can spend all its time resending, and never have an opportunity to send its own response. This occurs only when one or more upstream devices are continuously transmitting. To prevent this situation:
  - Operate your network at 9,600 baud or above
  - Avoid continuous transmission (P2, P4, P7, Q2, and Q4 commands) at extremely low integration times
- It is not possible to precisely synchronize measurements from two or more devices by sending a global measurement command. This is a result of the delay that occurs as the measurement command propagates through the serial loop.
- When a global command is sent, it propagates through the serial loop, eventually making its way back to the host. Therefore, the data received by the host in response to a global command includes the command itself, followed by the individual responses from all devices on the network.

## 5.10 Displaying Data Remotely with Model 715 Display

The Model 715 Display can be used to replicate the Model 735/745 display data at a distance of up to 4000 feet.

The Model 715 display is identical to that of the Model 735/745, with the following exceptions:

- Pressure rate of change data cannot be displayed on the Model 715. If the Model 735/745 is set up to display pressure rate of change, the second line of the Model 715 will not be updated.
- When the Model 735/745 configuration menu is accessed, the Model 715 will not display the configuration menu, but will continue to display pressure values.

Using the Model 715 with the Model 735/745 is simple and easy. Simply connect the units as shown in paragraph 0. Turn on the Model 735/745; then turn on the Model 715. The Model 715 will automatically synchronize its baud rate to that of the Model 735/745; this may take as much as a few minutes. When the Model 715 has synchronized, it will begin to replicate the Model 735/745 display.

# 6 Nano-Resolution Features & Functions

## 6.1 Introduction

With firmware revision D1.06 or later, it is now possible to achieve parts-per-billion resolution (nano-resolution). This feature can be enabled by software command. When disabled, the sensor is backward compatible and works in the standard mode with typical parts-per-million resolution. Nano-resolution is achieved by sub-sampling the pressure at a much higher rate (typically 8 kHz) and applying digital signal processing techniques. Because of the much higher processing requirements, more input power is required. In general, the nano-resolution feature is only useful if the pressure is stable enough over the effective sampling period and if the data acquisition system can handle additional digits. The practical bandwidth of interest is in the infrasound and deep infrasound (10 to 0.001 Hz).

Two methods for nano-resolution are available. The first method processes the sub-samples in a finite time interval (analogous to the integration time of the standard mode). The digital process is an FIR filter (finite impulse response). The resolution can be directly compared to the resolution of the standard mode at the same sampling rate (synchronized). The algorithm performs a least-squares (regression) fit over the sub-samples to estimate the best value of pressure. While the resolution is statistically two orders of magnitude better than the standard mode, it does not suppress aliasing errors.

A second and usually preferred method is the IIR filter (infinite impulse response). It consists of a 5-stage digital low-pass filter acting on the sub-samples. It filters all frequencies with a roll-off of -100 dB/decade above a user selectable cutoff frequency. It is an effective anti-aliasing filter. The inherent resolution depends on the cutoff frequency and not on the sampling period. Typically, the sampling rate is set at twice the cutoff frequency (Nyquist limit).

## 6.2 Enabling Nano-Resolution

Nano-resolution can be enabled and disabled by the XM serial command.

**XM** Set or read the resolution mode.

Range: 0 = Standard Resolution Mode (backward compatible)

1 = Nano-resolution, IIR Filter Mode

2 = Nano-resolution, FIR Filter Mode

Default: 0

Typical set command: \*0100EW\*0100XM=1

Typical set response: \*0001XM=1

Typical read command: \*0100XM

Typical read response: \*0001XM=1

## 6.3 Configuring IIR Filter Mode

### SETTING RESOLUTION

Resolution is a function of the cutoff frequency when operating in IIR mode. The cutoff frequency is user-selectable and is set by the IA command.

**IA** Set or read the cutoff frequency setting.

Range: 0 - 16

Default: 11

Typical set command: \*0100EW\*0100IA=11

Typical set response: \*0001IA=11

Typical read command: \*0100IA

Typical read response: \*0001IA=11

See Table 1 for a list of ranges for IA values, cutoff frequencies, measurement resolution, and the number of digits reported via RS-232.

**Table 1: IIR Filter Mode Typical Resolution Ranges**

<b>IA</b>	<b>(1) Cutoff Frequency</b>	<b>(2) Effective Time Interval</b>	<b>(3) Period Resolution</b>	<b>(4) Measurand Resolution</b>	<b>(4) Measurand Resolution</b>	<b>(5) Pressure &amp; Temp. Digits</b>
	<i>(Hz)</i>	<i>(ms)</i>	<i>(dB)</i>	<i>(dB)</i>	<i>(ppm/ppb)</i>	
0	1400	0.1	-82	-62	790 ppm	6
1	700	1	-94	-74	200 ppm	7
2	350	2	-105	-85	56 ppm	7
3	175	3	-117	-97	14 ppm	8
4	88	6	-127	-107	4.5 ppm	8
5	44	11	-140	-120	1.0 ppm	8
6	22	22	-149	-129	0.35 ppm	9
7	11	44	-157	-137	0.14 ppm	9
8	5.5	89	-167	-147	45 ppb	10
9	2.8	178	-177	-157	14 ppb	10
10	1.4	350	-186	-167	4.5 ppb	11
11	0.7	700	-196	-176	1.6 ppb	11
12	0.35	1400	-203	-183	0.7 ppb	12
13	0.18	2800	-206	-186	0.5 ppb	12
14	0.09	5600	-207	-187	0.4 ppb	12
15	0.045	11200	-207	-187	0.4 ppb	12
16	0.023	22400	-207	-187	0.4 ppb	12

(1) Cutoff frequency is the -3dB point of the low-pass IIR filter.

(2) Effective Time Interval is the recommended minimum time interval between measurements that ensures sampling up to the specified cutoff frequency. The time interval is set using the PI command.

(3) Period Resolution is the resolution of pressure and temperature period measurements.

(4) Measurand Resolution is the resolution of pressure and temperature measurements.

(5) Pressure and Temperature Digits is the total number of digits used to report pressure and temperature measurements. Pressure and temperature period measurements contain one additional digit.

## 6.4 Configuring FIR Filter Mode

### SETTING RESOLUTION

Resolution is a function of the integration time when operating in FIR mode. The integration time is set by the PI command. Refer to page 5.7.2.2 for more information about the PI command.

Table 2 lists various PI values and the resulting measurement resolution for pressure period, pressure, and the number of digits reported via RS-232.

**Table 2: FIR Filter Mode Typical Resolution Ranges**

PI	<sup>(1)</sup> Period Resolution	<sup>(2)</sup> Measurand Resolution	<sup>(2)</sup> Measurand Resolution	<sup>(3)</sup> Pressure & Temp Digits
(ms)	(dB)	(dB)	(ppm/ppb)	
1	-105	-85	56.2 ppm	6
2	-114	-94	19.9 ppm	7
3	-119	-99	10.8 ppm	7
6	-128	-108	3.8 ppm	8
11	-136	-116	1.5 ppm	8
22	-145	-125	544.5 ppb	8
44	-154	-134	192.5 ppb	9
89	-163	-143	66.9 ppb	9
178	-173	-153	23.7 ppb	10
350	-181	-161	8.6 ppb	10
700	-190	-170	3.0 ppb	11
1400	-199	-179	1.1 ppb	11
2800	-206	-186	0.5 ppb	12
5600	-206	-186	0.5 ppb	12
11200	-206	-186	0.5 ppb	13
22400	-206	-186	0.5 ppb	13

<sup>(1)</sup> Period Resolution is the resolution of pressure and temperature period measurements.

<sup>(2)</sup> Measurand Resolution is the statistical resolution limit of the FIR algorithm for pressure and temperature

measurements. The trigger error typically doubles the least resolution.

<sup>(3)</sup> Pressure and Temperature Digits is the total number of digits used to report pressure and temperature measurements. Pressure and temperature period measurements contain one additional digit up to a maximum of 13 digits.

## TEMPERATURE SMOOTHING

The temperature smoothing function is available for additional low-pass filtering of the temperature signal, mostly to avoid very rare and small aliasing errors from digital rounding in the FIR mode. The XT command enables and disables the smoothing function and controls the corner frequency of the low-pass filter. Normally, the default setting should always be XT=1 (no smoothing). If temperature smoothing is desired, a setting of XT=10 is suggested.

Temperature smoothing is performed per the following formula:

$$S_n = \alpha T_n + (1 - \alpha) S_{(n-1)}$$

Where

- $S_n$  = smoothed temperature
- $T_n$  = measured temperature
- $S_{(n-1)}$  = smoothed temperature of previous sample
- $\alpha = 1/(XT)$

**XT** Set or read the number of temperature measurements to use for temperature smoothing in FIR Mode.

Range: 1 - 100

Default: 1 (no smoothing)

Typical set command: \*0100EW\*0100XT=10

Typical set response: \*0001XT=10

Typical read command: \*0100XT

Typical read response: \*0001XT=10

## **6.5 Default Numeric Formats for IIR & FIR Modes**

The default numeric formats used to report period, pressure, and temperature measurement values via the display and/or RS-232 port are as follows, where N = the number of significant digits shown in the resolution tables.

Note: The Model 735/745 can display a maximum of 10 significant digits. Values with greater than 10 digits will be rounded as required.

### **PRESSURE**

The sensor full-scale pressure defines the number of digits reserved for the integer portion of the pressure value. For example, a 1000 psi full-scale unit would have 4 digits reserved (but not necessarily used) for the integer portion of the pressure value, leaving N-4 digits for the fractional portion.

### **TEMPERATURE**

Three digits are reserved (but not necessarily used) for the integer portion of the temperature value, leaving N-3 digits for the fractional portion. Negative temperature values include a sign but the numeric format is otherwise unaffected.

### **PRESSURE PERIOD**

Two digits are used for the integer portion of the pressure period value, leaving N-2 digits for the fractional portion.

### **TEMPERATURE PERIOD**

One digit is used for the integer portion of the pressure period value, leaving N-1 digits for the fractional portion.

## **6.6 Controlling the Numeric Format**

The XN command sets the number of significant digits used to report period, pressure, and temperature measurement values. The XN command overrides the default numeric format.

**XN** Set or read the number of significant digits displayed and/or output.

Range: 0 - 13

Default: 0

Typical set command: \*0100EW\*0100XN=10

Typical set response: \*0001XN=10

Typical read command: \*0100XN

Typical read response: \*0001XN=10

When XN is set to 0, the default numeric formats are used. When non-zero, XN specifies the number of significant digits used to report period, pressure, and temperature measurement values. With the exception of the total number of digits, all default format characteristics apply. The integer portion is never expressed with fewer digits than required regardless of the value of XN. The fractional portion is rounded or padded with zeros as required to fit the specified format. The XN command works with Standard, IIR, and FIR resolution modes.

Note: The Model 735/745 can display a maximum of 10 significant digits. Values with greater than 10 digits will be rounded as required.

# 7 Pressure Measurement Concepts

## 7.1 Measurement Basics

At the heart of all Digiquartz® Intelligent Instruments is a precision Digiquartz® pressure transducer. The outputs from a Digiquartz® pressure transducer are two square wave signals whose period is proportional to applied pressure and internal transducer temperature. The Model 735/745 measures these signals using a technique similar to that of a common laboratory frequency counter. Like the frequency counter, a signal must be integrated, or sampled, for a specified period of time to measure its period. The time over which the signal is sampled determines the resolution of the measurement. Longer sampling times increase resolution, but result in a slower sampling rate.

The Model 735/745 allows you to set the integration time between 0.001 and 65.535 seconds. Pressure and temperature integration times can be set independently. You can use these features to configure the unit according to the data acquisition and resolution requirements of your application.

Refer to paragraph 7.6 for more information about integration time, resolution, and sampling rate.

## 7.2 Measurement Types

One or both of the Digiquartz® pressure transducer output signals are sampled, depending on the type of measurement requested.

Four types of measurements can be taken:

- Pressure
- Internal sensor temperature
- Pressure period
- Temperature period

Pressure measurements are displayed by the Model 735 and 745. The other types of measurements can only be accessed via the RS-232 port.

## **PRESSURE MEASUREMENTS**

Pressure measurements are the most common. Pressure measurement values are displayed on the top line of the Model 735/745 display, and can also be output via RS-232. Pressure measurements are fully temperature-compensated, and therefore require an internal temperature measurement.

When a pressure measurement is made, the following sequence occurs:

- The temperature signal period is measured
- An internal transducer temperature value is calculated using the temperature period and the calibration coefficients
- The pressure signal period is measured
- A temperature-compensated pressure value is calculated using the pressure period, temperature value, and the calibration coefficients
- The pressure value is displayed and optionally output via RS-232

## **INTERNAL SENSOR TEMPERATURE MEASUREMENTS**

Internal sensor temperature is normally only used for temperature compensation of pressure, but can be requested independently for diagnostic and other purposes. Internal sensor temperature measurements can optionally be displayed on the bottom line of the Model 735/745 display, and can also be output via RS-232.

When an internal sensor temperature measurement is made, the following sequence occurs:

- The temperature signal period is measured
- A temperature value is calculated using the temperature period and the calibration coefficients
- The temperature value is optionally displayed and/or output via RS-232

## **PRESSURE AND TEMPERATURE PERIOD MEASUREMENTS**

Period measurements are used mainly for calibration and diagnostic purposes, but may be useful in high-speed sampling applications. Period measurements can only be accessed via the RS-232 port.

When a period measurement is made, the following sequence occurs:

- The pressure or temperature signal period is measured
- The period value is output

Refer to paragraph 5.7 for detailed measurement command descriptions.

### **7.3 Sampling Types**

Measurement data can be sampled via the RS-232 port by the following methods:

- Single measurement
- Continuous measurement
- High-speed continuous measurement
- Sample and hold measurement

#### **SINGLE MEASUREMENT SAMPLING**

Single measurement sampling commands output a single measurement value each time the command is received.

#### **CONTINUOUS MEASUREMENT SAMPLING**

Continuous measurement sampling commands repeatedly output measurement data until commanded to stop.

#### **HIGH-SPEED CONTINUOUS MEASUREMENT SAMPLING**

Similar to regular continuous measurement commands, but internal transducer temperature measurements are taken only occasionally. This type of sampling is useful when sampling rates must be as high as possible, and is particularly effective when internal transducer temperature is not expected to change significantly.

## **SAMPLE AND HOLD MEASUREMENT SAMPLING**

Similar to single measurement sampling, but the measurement value is not output until a separate command is sent. This type of sampling is useful when you need to simultaneously trigger measurements from multiple units, and then read them one by one in a particular order.

Refer to paragraph 5.7 for detailed measurement command descriptions.

## **7.4 Engineering Units**

Pressure values can be expressed in the following engineering units. Refer to the UN command in paragraph 5.7.2.4 for details.

- psi
- hPa (mbar)
- bar
- kPa
- MPa
- in Hg
- mm Hg (Torr)
- m H<sub>2</sub>O
- User-defined pressure units

Temperature values can be expressed in the following units. Refer to the TU command in paragraph 5.7.2.4 for details.

- °C
- °F

## **7.5 Tare Function**

You can configure the Model 735/745 to subtract a value from each subsequent pressure measurement. This process is referred to as taring. You can tare subsequent pressure measurements to the current pressure value, or to any value you specify. Taring can be enabled and disabled through the configuration menu or by serial command. An indicator on the display and/or a special character in the RS-232 measurement data indicates when taring is in effect. Refer to paragraphs 5.7.2.5 and 5.7.2.6 for details.

## **7.6 Resolution, Integration Time and Sampling Rate**

### **7.6.1 Definitions**

#### **RESOLUTION**

Resolution is defined as the smallest change in measured quantity that can be detected.

#### **INTEGRATION TIME**

Integration time is defined as the length of time that a Digiquartz® pressure transducer output signal is sampled to produce a single measurement value.

#### **SAMPLING RATE**

Sampling rate is defined as the number of measurements that can be taken in a given period of time.

### **7.6.2 Interdependencies**

Resolution, integration time, and sampling rate are interdependent. This is due to the method by which the Model 735/745 measures the outputs from the Digiquartz® pressure transducer.

The integration time determines the resolution of the measurement. Longer integration times increase resolution, but reduce the sampling rate. Conversely, shorter integration times decrease resolution, but increase the sampling rate.

Another factor that influences sampling rate is the serial baud rate. For short integration times, faster baud rates enable faster sampling. As integration times increase, the benefit of faster baud rates quickly diminishes. Baud rate has no effect on integration time, and therefore has no effect on resolution.

Tables 1, 2, and 3 illustrate the relationship between integration time, resolution, and sampling rate for the **P2**, **P4**, and **P7** commands at common baud rates.

## P2 Command (Continuous Pressure Period Output)

PR	PI	Resolution (ppm)	Integration Time (s)	9600 baud		19200 baud	
				(Hz)	(s)	(Hz)	(s)
N/A	1	678.168	0.001	73.53	0.014	147.06	0.007
1	3	242.203	0.003	68.49	0.015	136.24	0.007
3	8	80.734	0.008	68.49	0.015	110.62	0.009
4	11	60.551	0.011	68.49	0.015	83.89	0.012
6	17	40.367	0.017	56.56	0.018	56.56	0.018
12	34	20.184	0.034	28.49	0.035	28.49	0.035
24	67	10.092	0.067	14.62	0.068	14.62	0.068
48	134	5.046	0.134	7.37	0.136	7.37	0.136
119	333	2.035	0.333	2.98	0.336	2.98	0.336
238	666	1.018	0.666	1.52	0.660	1.52	0.660
476	1333	0.509	1.333	0.74	1.360	0.74	1.360
1190	3332	0.204	3.332	0.30	3.360	0.30	3.360
2380	6664	0.102	6.664	0.15	6.800	0.15	6.800
4760	13328	0.051	13.328	0.07	13.600	0.07	13.600
9520	26656	0.025	26.656	0.04	26.600	0.04	26.600
16383	45872	0.015	45.872	0.02	45.800	0.02	45.800

**Table 1. Relationship of Integration Time, Resolution, and Sampling Rate for P2 Command**

### P4 Command (Continuous Pressure Output)

PR	PI	Resolution (ppm)	Integration Time (s)	9600 baud		19200 baud	
				(Hz)	(s)	(Hz)	(s)
N/A	1	678.168	0.001	79.62	0.013	159.24	0.006
1	3	242.203	0.003	79.62	0.013	153.37	0.007
3	8	80.734	0.008	60.35	0.017	60.35	0.017
4	11	60.551	0.011	46.08	0.022	46.08	0.022
6	17	40.367	0.017	30.49	0.033	30.49	0.033
12	34	20.184	0.034	15.58	0.064	15.58	0.064
24	67	10.092	0.067	7.96	0.126	7.96	0.126
48	134	5.046	0.134	4.07	0.246	4.07	0.246
119	333	2.035	0.333	1.64	0.608	1.64	0.608
238	666	1.018	0.666	0.82	1.220	0.82	1.220
476	1333	0.509	1.333	0.41	2.440	0.41	2.440
1190	3332	0.204	3.332	0.16	6.080	0.16	6.080
2380	6664	0.102	6.664	0.08	12.160	0.08	12.160
4760	13328	0.051	13.328	0.04	24.300	0.04	24.300
9520	26656	0.025	26.656	0.02	48.600	0.02	48.600
16383	45872	0.015	45.872	0.01	83.600	0.01	83.600

**Table 2. Relationship of Integration Time, Resolution, and Sampling Rate for P4 Command**

### P7 Command (Fast Continuous Pressure Output)

PR	PI	Resolution (ppm)	Integration Time (s)	9600 baud		19200 baud	
				(Hz)	(s)	(Hz)	(s)
N/A	1	678.168	0.001	79.62	0.013	159.24	0.006
1	3	242.203	0.003	79.62	0.013	159.24	0.006
3	8	80.734	0.008	73.53	0.014	107.30	0.009
4	11	60.551	0.011	73.53	0.014	81.97	0.012
6	17	40.367	0.017	55.25	0.018	55.25	0.018
12	34	20.184	0.034	28.25	0.035	28.25	0.035
24	67	10.092	0.067	14.53	0.069	14.53	0.069
48	134	5.046	0.134	7.37	0.136	7.37	0.136
119	333	2.035	0.333	2.98	0.336	2.98	0.336
238	666	1.018	0.666	1.52	0.660	1.52	0.660
476	1333	0.509	1.333	0.74	1.360	0.74	1.360
1190	3332	0.204	3.332	0.30	3.360	0.30	3.360
2380	6664	0.102	6.664	0.15	6.800	0.15	6.800
4760	13328	0.051	13.328	0.07	13.600	0.07	13.600
9520	26656	0.025	26.656	0.04	26.800	0.04	26.800
16383	45872	0.015	45.872	0.02	45.800	0.02	45.800

**Table 3. Relationship of Integration Time, Resolution, and Sampling Rate for P7 Command, PS=0**

## 7.7 High Speed Sampling

See paragraph 5.8 for techniques that can be used to increase sampling rate.

## 7.8 Calculations and Formulas

The Model 735/745 calculates internal sensor temperature and temperature-compensated pressure from period measurements of the Digiquartz® pressure transducer output signals. The equations and coefficients used to perform these calculations are given below. The Model 745 is initialized with its transducer coefficients at the factory; the user must initialize the Model 735 with its transducer coefficients prior to taking pressure measurements.

### TEMPERATURE CALCULATION

The following equation is used to calculate internal sensor temperature:

$$T = Y_1U + Y_2U^2 + Y_3U^3$$

Where: T = Temperature (°C)

$U_0$  = temperature period (microseconds) at 0° C

U = temperature period (microseconds) –  $U_0$  (microseconds)

Temperature coefficients:  $U_0$   $Y_1$   $Y_2$   $Y_3$

### PRESSURE CALCULATION

The following equation is used to calculate pressure:

$$P = C(1 - \tau_0^2 / \tau^2)[1 - D(1 - \tau_0^2 / \tau^2)]$$

Where: P = pressure

$\tau$  = pressure period (microseconds)

U = temperature period (microseconds) –  $U_0$  (microseconds)

$C = C_1 + C_2U + C_3U^2$

$D = D_1 + D_2U$

$\tau_0 = T_1 + T_2U + T_3U^2 + T_4U^3 + T_5U^4$

Pressure coefficients: C<sub>1</sub> C<sub>2</sub> C<sub>3</sub> D<sub>1</sub> D<sub>2</sub> T<sub>1</sub> T<sub>2</sub> T<sub>3</sub> T<sub>4</sub> T<sub>5</sub>

### **FINAL OUTPUT PRESSURE CALCULATION**

The following equation is used with the pressure value calculated above to calculate the final output pressure value:

$$P_{\text{output}} = \text{PM} * (\text{units conversion factor}) * [P + \text{PA}]$$

Where: P<sub>output</sub> = Final output pressure value

P = raw pressure value (from pressure equation above)

PM = Value stored in the **PM** parameter

PA = Value stored in the **PA** parameter

Units conversion factor = Value used to convert psi to the current pressure unit.

The **PM** and **PA** parameters allow you to make minor zero and span adjustments to the raw pressure value. Initially, **PM** (pressure multiplier) is set to 1.0, and **PA** (pressure adder) is set to 0.0. Refer to paragraphs 5.7.2.9 and 10.2 for more information.

## **8 Accessories**

### **8.1 Included Accessories**

#### **AC POWER SUPPLY**

The Model 735/745 is delivered with either a 110VAC or 220VAC wall power supply. If another power supply is to be used, ensure that the AC voltage, DC voltage, current capacity, connector type, and connector polarity match the original unit.

#### **SERIAL CABLE**

The Model 735/745 is delivered with a six-foot serial cable, Paroscientific PN 6409-003. This cable can be used to connect the Model 735/745 to a standard 9-pin PC RS-232 port.

#### **DIGIQUARTZ CD LIBRARY**

The Digiquartz® CD-ROM Library included in your shipment contains programs that allow you to configure and log data from your instrument. These programs will run on any PC with an RS-232 port and the Windows® 95/98/NT/XP operating system. To install the programs, insert the CD-ROM into your drive. A menu will appear on the screen allowing you to select the program you would like to install.

Run the Digiquartz® Interactive program to verify that your hookup is correct and that the instrument is operating properly. Run the Digiquartz® Assistant program to log data from the instrument. Context sensitive help is also available while running each program.

There are a variety of other useful programs that may be found on the CD-ROM. You may also use a standard terminal emulation program to interact with your instrument.

#### **BATTERIES**

Four AA alkaline batteries are provided.

## 8.2 Optional Accessories

### MODEL 715 DISPLAY

The DigiQuartz® Model 715 Display can be used with the Model 735/745 to display pressure measurement data at a remote location. Refer to paragraph 5.10 for detailed information.

### HIGH PERFORMANCE PRESSURE PORT

The high-performance DigiPort is now optionally available for use with the Model 765-16B Portable Barometric Standard and all other DigiQuartz® Barometric Instruments. It provides barometric accuracy of better than 0.08 hPa in strong winds, all wind directions, pitch or tilt angles up to 25 degrees, rain, and freezing conditions. It outperforms open ports, single ports, single disks, shrouded pipes, closely spaced dual-disks, multi-hole probes, probes incorporating spheres or cones, and swiveling pitot tubes with static pressure inlets.



Figure 5. Digiport mounted on a mast

## 9 Maintenance

The Model 735/745 does not require periodic maintenance, other than calibration of the Digiquartz® pressure transducer. If the unit becomes soiled, it may be cleaned using a soft cloth lightly moistened with plain water.

**WARNING** Do not allow liquids to enter the enclosure. Electronic failure may result.

**WARNING** Do not open the enclosure. No user-serviceable parts are located inside. Your warranty will be voided if the enclosure is opened.

# 10 Calibration

## 10.1 Calibration Procedure

Paroscientific transducers measure pressure with a force sensitive quartz crystal whose output period (or frequency) changes with applied load. For a given temperature, true applied pressure will generate a specific crystal period. Therefore, a measure of the crystal period will indicate what pressure is applied, provided the relationship between crystal period and pressure is known. This relationship is usually expressed as the C, D,  $T_0$  equation. C, D, and  $T_0$  are coefficients that are unique to Paroscientific transducers, and are different for each transducer. In addition, these coefficients are characterized for thermal effects. For each temperature, they are expressed as polynomial expansions with coefficients C1, C2, C3, D1, D2, T1, T2, T3, T4, and T5. Typically, it takes between 7 and 10 coefficients to fully describe the relationship, also called the "CD thermal model", between crystal output, temperature, and pressure.

Recalibration is necessary if a user decides that the agreement between true and indicated pressure is outside tolerances set for the particular application. Please see the documents entitled "Recalibration of Paroscientific Transducers - Doc 8140-001" and "Calibration of Digiquartz® Sensors" at [www.paroscientific.com](http://www.paroscientific.com) for recalibration procedures and calibration software support.

## 10.2 Zero and Span Adjustments

The Paroscientific transducer measures a force that is generated by external pressure. Since the quartz crystal is extremely sensitive, any other small force that is transmitted to the sensing element will be added to the pressure measurement. A pressure offset generated in this way is purely additive and is the same at all pressure values. In principle, checking accuracy at a single applied pressure is sufficient to determine an offset. Of course, the offset can be calculated as the average offset of many pressure points.

Span is defined here as the pressure difference from minimum pressure to full-scale pressure. A span error is the difference between the indicated pressure span as measured by the transducer and the true pressure span. If

a transducer is carefully adjusted at minimum pressure, the span error is simply the difference between indicated and true applied pressure at full scale.

The span of a Paroscientific transducer is rarely adjusted since the scale factor of the sensing element is very stable. Differences are sometimes due to different calibration standards. The span of a dead weight tester used as a primary standard depends directly on the piston area and the value of local gravity. Any apparent change of span in a Paroscientific transducer should be carefully checked to ascertain that the pressure is correctly applied and calculated with the correct piston area and gravity constant, and that the piston is vertical. We recommend recording several pressure points over the entire pressure range to establish any span error. The Paroscientific calibration software program RECAL calculates the best span by a least-squares fit optimization.

Please refer to the document entitled "Recalibration of Paroscientific Transducers - Doc 8140-001" at [www.paroscientific.com](http://www.paroscientific.com) for details regarding offset and span adjustment.

Calibration should only be performed by a skilled metrologist.

The **PA** and **PM** commands allow you to make zero and span adjustments. Normally, **PA** (pressure adder) is set to 0.0, and **PM** (pressure multiplier) is set to 1.0.

Adjusted pressure is calculated using the following equation:

$$P_{\text{adjusted}} = PM * (P + PA)$$

Where: P = Pressure calculated using original calibration coefficients, in the current pressure units

PM = the current value of **PM**

PA = the current value of **PA**

Refer to paragraphs 5.7.2.9 and 7.8 for more information regarding **PA** and **PM**.

**CAUTION** **PA** and **PM** directly affect calibration. Use extreme caution when modifying **PA** or **PM**. Improper **PA** and/or **PM** values will result in inaccurate pressure measurements.

### 10.3 Calibrating Other Instruments

The Digiquartz® Model 745 High Accuracy Pressure Standard can be used to calibrate other pressure instruments. Its 0.008% of full-scale accuracy and 0.0001% resolution make the Model 745 ideal for laboratory and metrology applications. When calibrating another pressure instrument, apply the same pressure to the Model 745 and the test instrument. Take the difference in pressure readings between the test instrument and the Model 745. Apply the difference as a correction to the test instrument. For details regarding the calibration of a third party pressure instrument, please review its user documentation or consult the manufacturer.

# 11 Warranty

Paroscientific highly values our customers. Our Quality Assurance System provides consistency in our products and processes from design and development through production, calibration, test, and servicing. Our quality system and commitment to excellence ensure customers of outstanding products and services. As a result, we offer a one-year warranty on all instrumentation systems, and a full five-year limited warranty on all DigiQuartz® transducers that is unmatched in the industry. This policy applies to all DigiQuartz® transducers manufactured by Paroscientific and includes the repair and/or replacement of parts that are required to maintain the unit to the “as purchased” configuration. Excluded from this policy are the following: conversions, product modification, zero adjustments, recalibration, and service analysis charges. This “Extended Limited Warranty” is a supplement to Paroscientific, Inc.’s “Terms and Conditions of Sale”. Shipping charges are the responsibility of the customer.

<b>Months From Shipment</b>	<b>Discount From List Price</b>
0 - 24	100%
25 - 36	75%
37 - 48	50%
49 - 60	25%

## CONDITIONS:

- The warranty period is from the date of shipment from Paroscientific to date of receipt at Paroscientific.
- The customer must authorize the repair or replacement of the warranty claim within 45 days of notification by our Service Department.
- No exceptions to the discount schedule or terms of this policy are allowed.
- This warranty does not apply to units broken due to overpressure or excessive shock.
- Warranty returned units become the property of Paroscientific upon replacement.

- All barometers also have a three year limited warranty on long-term stability. Years 4 & 5 are covered by the above schedule.

## **12 Service and Support**

Technical support is available via our web site ([www.paroscientific.com](http://www.paroscientific.com)) and our sales and application engineers. Product technical information, application notes, software and product manuals are available on our web site. Please check the troubleshooting section of this manual if you are having problems with your instrument. If you need technical assistance, contact our sales and application engineers at [support@paroscientific.com](mailto:support@paroscientific.com) or (425) 883-8700.

If you are sending an instrument to us for service, please check our web site under the service section about the details of how to ship a unit to us for service.

## 13 Troubleshooting

This section will help you to diagnose common problems related to the Model 735/745. If you have taken the recommended action and you are still experiencing difficulty, please contact an Application Engineer at Paroscientific.

### **MODEL 735/745 DOES NOT POWER UP WHEN ON/OFF KEY IS PRESSED**

- If AC adapter is being used, check that the adapter is plugged into the power jack on the rear panel, and is plugged into an appropriate AC outlet.
- If batteries are being used, check that the batteries are fresh, and check that the batteries are installed per the diagram on the inside of the battery compartment.
- If the unit is powered via the DC POWER – I/O terminal block, check that power and ground are connected per the terminal block pinout on the rear panel label, and check that DC power is actually being supplied to the unit.

### **MODEL 735/745 POWERS UP, BUT DOES NOT DISPLAY PRESSURE VALUES**

- Model 735 ONLY: Check that the DigiQuartz® pressure transducer is properly wired to the Model 735 transducer interface. Refer to the interface pinout on the rear panel label.
- Check that the **MD** parameter is set to 1 or 3. If **MD** is set to 0 or 2, the pressure display will not be updated.

### **MODEL 735/745 DISPLAYS INCORRECT PRESSURE VALUES**

- Check that the calibration coefficients are correct. DigiQuartz® Interactive software can be used for this purpose. The proper calibration coefficients are listed in the calibration data sheet that was provided with your Model 745 or DigiQuartz® pressure transducer. If you are unable to locate the calibration data sheet, contact Paroscientific for the calibration coefficients.

## **MODEL 735/745 DISPLAYS “DISPLAY DATA INTERRUPTED”**

- Refer to Section 14.

## **MODEL 735/745 PRODUCES ERRATIC PRESSURE MEASUREMENTS**

- If you are powering multiple units from a common DC power supply, you must run separate power and ground wires from each unit to the power supply. Wire size should be 18 AWG minimum.
- Transducer ground wire(s) should not be connected to the chassis ground terminal. Refer to paragraph 18.1.

## **MODEL 735/745 SECOND LINE DISPLAY DOES NOT UPDATE**

- The Model 735/745 gives priority to RS-232 communications. If you are repeatedly acquiring pressure data via RS-232 with the P3 command, it is possible that the Model 735/745 will not have sufficient time to update the second line of the display. This can be avoided by inserting a short delay between each P3 response and the next command. The length of the required delay is dependant on baud rate. The following table shows the minimum delay for each supported baud rate.

<b>Baud Rate</b>	<b>Delay (ms)</b>
300	42
600	23
1200	14
2400	9
4800	6
9600	5
19200	5

**Table 4. P3 minimum delay**

## **MENUS ARE NOT AS RESPONSIVE AS THEY ONCE WERE**

- The Model 735/745 communicates internally at the same baud rate as the RS-232 port. This can cause the Configuration Menu to react slower at low baud rates. We recommend that you operate the Model 735/745 at a minimum of 9600 baud for optimum responsiveness.

## **RS-232 COMMANDS ARE IGNORED**

- Do not attempt to simultaneously access the Model 735/745 through the RS-232 port and the Configuration Menu. Doing so may cause serial commands or Configuration Menu selections to be ignored.

## **CONFIGURATION MENU SELECTIONS ARE IGNORED**

- Do not attempt to simultaneously access the Model 735/745 through the RS-232 port and the Configuration Menu. Doing so may cause serial commands or Configuration Menu selections to be ignored.

## **DIGIQUARTZ INTERACTIVE (DQI) CANNOT DETECT MODEL 735/745**

- Check that power is being applied to the Model 735/745. If pressure values are being displayed, the unit is being powered.
- Check that the Model 735/745 is connected to the specified com port.
- Check that the RS-232 connections between the Model 735/745 and the PC are correct. If in doubt, use the serial cable that was provided with your Model 735/745.

## 14 “Display Data Interrupted” Message

Under certain circumstances, the Model 735/745 is unable to update its pressure value display. When these conditions occur, “DISPLAY DATA INTERRUPTED” is displayed. Normally, the Model 735/745 resumes pressure value display when the condition is no longer present.

The following conditions will cause the Model 735/745 to display the “DISPLAY DATA INTERRUPTED” message:

- An asterisk is sent to the RS-232 port, but the terminating characters (Cr/Lf) are never sent.
- One of the following RS-232 commands is in effect: **P2, P5, P6, Q2, Q4, Q5, Q6**
- The integration time is increased substantially.
- Parameter values are continuously set or queried via RS-232.
- **MD** is set to 0 or 2 via RS-232.

When the aforementioned conditions are no longer present, the Model 735/745 will resume pressure data display. If none of the conditions are present, and the unit continues to display the “DISPLAY DATA INTERRUPTED” message, the unit may be in need of service. Refer to Section 12 for service and support information.

## 15 Pressure Unit Conversion Table

To use this table:

- Determine original pressure unit and desired pressure unit.
- Using the table, identify the appropriate pressure conversion factor.
- Multiply the original pressure value by the conversion factor to convert it to the desired pressure unit.

Original Pressure Unit	Desired Pressure Unit						
	Meters H <sub>2</sub> O (density = 1.0 gm/cm <sup>3</sup> )	psi	Inches of mercury (in Hg)	mm of Hg or Torr (mm Hg)	Gram/cm <sup>2</sup> (gm/cm <sup>2</sup> )	Millibars (mbar) (hPa)	Newton/m <sup>2</sup> (Pascal) (Pa)
Meters H <sub>2</sub> O	1	1.422334	2.895903	73.5592	100.0000	98.06650	9806.650
psi	.7030696	1	2.036021	51.71493	70.30696	68.94757	6894.757
Inches of Hg	.3453155	.4911541	1	25.40000	34.53155	33.86388	3386.388
mm of Hg, Torr	.01359510	.01933678	.03937008	1	1.359510	1.333224	133.3224
Gram/cm <sup>2</sup>	.01000000	.01422334	.02895903	.7355592	1	.9806650	98.06650
Millibars	.01019716	.01450377	.02952999	.75000617	1.019716	1	100.0000
Newton/m <sup>2</sup>	1.019716 X10 <sup>-4</sup>	1.450377 X10 <sup>-4</sup>	2.952999 X10 <sup>-4</sup>	7.500617 X10 <sup>-3</sup>	.01019716	.01000000	1

## 16 Glossary

The following is a list of definitions related to the Model 735/745

**Digiquartz® Intelligent Instrument** – A Digiquartz® Model 735 Intelligent Display or Model 745 Laboratory Standard.

**Digiquartz® Intelligent Transmitter** – Any Digiquartz® Series 1000, 6000, or 9000 Pressure Transmitter or Intelligent Depth Sensor.

**Digiquartz® Intelligent Device** – Any Digiquartz® Intelligent Instrument or Transmitter.

**Digiquartz® Pressure Transducer** – Any Digiquartz® pressure transducer with frequency outputs.

**Integration Time** – The time over which the Digiquartz® pressure transducer output signals are measured. Also referred to as sampling time.

**Pressure Signal** – The Digiquartz® pressure transducer output whose frequency is related to applied pressure.

**Resolution** – The smallest change in measured quantity that can be resolved.

**Sampling Rate** – The number of pressure measurements taken per a given time unit, often expressed in Hertz (Hz).

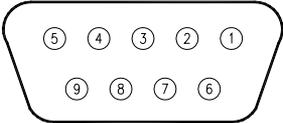
**Sampling Time** – The time over which the Digiquartz® pressure transducer output signals are measured. Also referred to as integration time.

**Temperature Signal** – The Digiquartz® pressure transducer output whose frequency is proportional to internal sensor temperature.

# 17 Connector Diagrams

All connector diagrams in this section are viewed from the mating side.

## 17.1 Model 735/745 RS-232 Port Connector

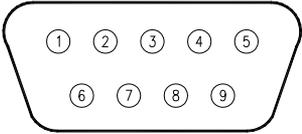


**DB9-F**

Pin	Connection
1	Not used
2	RS-232 TX
3	RS-232 RX
4	Not used
5	Ground
6	Not used
7	Not used
8	Not used
9	Not used

## 17.2 PC RS-232 Port Connector

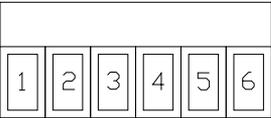
Pin assignments are typical. If in doubt, consult the hardware manual that came with your PC.



**DB9-M**

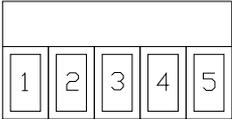
Pin	Connection
1	Data Carrier detect (DCD)
2	RS-232 RX
3	RS-232 TX
4	Data Terminal Ready (DTR)
5	Ground
6	Data Set Ready (DSR)
7	Request To Send (RTS)
8	Clear To Send (CTS)
9	Ring Indicator (RI)

## 17.3 Model 735/745 DC-Power – I/O Terminal Block



Contact	Connection
1	Display Out +
2	Display Out -
3	Ground
4	Overpressure Output
5	Ground
6	+6 to +25 VDC

# 17.4 Model 735 Transducer Interface Terminal Block



Terminal	Signal	Transducer wire color
1	Transducer power	Red
2	Pressure	Blue
3	Ground	Black (twisted with blue)
		Black (twisted with white)
4	Temperature	White
5	Chassis ground	-

**CAUTION** Do not connect transducer ground wire(s) to the chassis ground terminal. Doing so may cause the transducer to produce erratic pressure measurements and/or affect the display. The chassis ground terminal is meant to terminate cable shield only. Refer to paragraph 18.1 for more information about connecting a Digiquartz® Pressure Transducer to a Model 735.

# 18 Wiring Diagrams

## 18.1 Connecting Digiquartz® Pressure Transducer to the Model 735

Connect the Digiquartz® Pressure Transducer to the Model 735 per Figure 6 below. Low-capacitance shielded twisted-pair cable is recommended. Twisted pairs from the transducer should correspond with twisted pairs within the cable. The maximum length of cable that can be used depends on the cable capacitance. Refer to paragraph 17.4 for more information regarding the Transducer Interface Terminal Block.

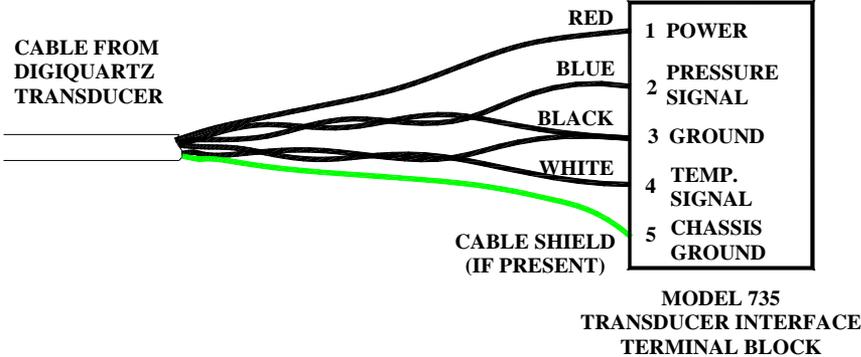


Figure 6. Wiring Digiquartz transducer to Model 735

**CAUTION** Do not connect transducer ground wire(s) to the chassis ground terminal. Doing so may cause the transducer to produce erratic pressure measurements and/or affect the display. The chassis ground terminal is meant to terminate cable shields only.

**Note:** The Digiquartz® Data Storage (DDS) wires (if present) are not connected to the Model 735. Refer to the SCD that was supplied with the Digiquartz® pressure transducer to determine whether DDS wires are present.

## 18.2 RS-232

Connect the Model 735/745 RS-232 port to a PC RS-232 port per Table 5 below. Other RS-232 host devices can be connected to the Model 735/745 in a similar manner; consult the manufacturer’s documentation for RS-232 port specifications.

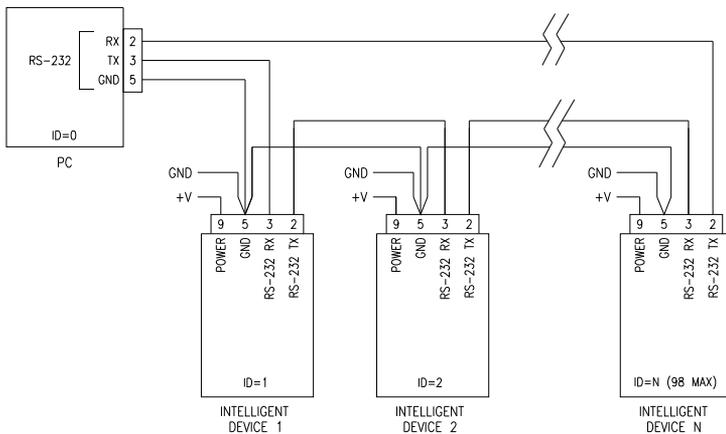
PC		Model 735/745	
Pin	Signal	Pin	Signal
2	Rx (Receive)	2	Tx (Transmit)
3	Tx (Transmit)	3	Rx (Receive)
5	Ground	5	Ground

**Table 5. Model 735/745 RS-232 to PC RS-232 wiring**

## 18.3 RS-232 Serial Loop Network

The diagram in Figure 7 illustrates the wiring for a serial loop network of up to 98 Digiquartz® Intelligent Instruments and/or Transmitters. Refer to paragraph 5.9 for more information about serial loop networking.

**CAUTION** If multiple units are to be connected to a common DC power supply, run separate power wires from each unit to the power supply. This will prevent ground loops that may couple digital switching noise into the Digiquartz® pressure transducer, resulting in erratic pressure measurements.

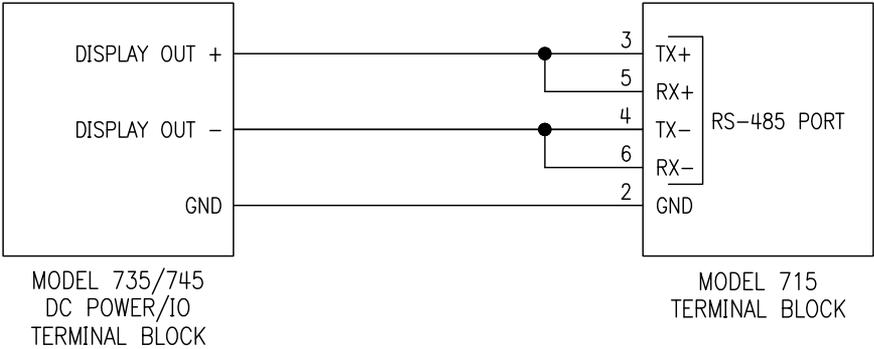


**Figure 7. Serial loop network wiring diagram.**

**Note:** Figure 7 is a generic diagram that is meant to illustrate the concept for all Digiquartz® Intelligent Instruments. Please note that the power connections on a Model 735/745 are located on a separate terminal block adjacent to the RS-232 connector.

# 18.4 Model 715 Display

The diagram in Figure 8 shows how to connect a Model 715 Remote Display to the Model 735/745. Use a shielded twisted pair cable designed for RS-485 communications and ensure that the DISPLAY+ and DISPLAY- signal wires are twisted. With the proper cable, it is usually possible for the Model 735/745 to drive 4,000 feet of cable.



**Figure 8. Model 735/745 to Model 715 wiring diagram.**

## 19 How do I ...?

### 1. How do I configure my instrument?

Refer to paragraph 4.1.4 and Section 5.

### 2. How do I access the menu system?

Refer to paragraphs 4.1.1, 4.1.2, 4.1.3, and 4.1.4.

### 3. How do I change the pressure or temperature unit?

Refer to paragraphs 4.1.4.2 and 5.7.2.4.

### 4. How do I change the pressure sampling rate?

Refer to paragraphs 4.1.4.4 and 5.7.2.2.

### 5. How do I talk to the instrument via the RS-232 interface?

Refer to Section 5.

### 6. What are the RS-232 commands?

Refer to paragraph 5.7 and Section 21.

### 7. How do I tare the unit?

Refer to paragraphs 4.1.4.1 and 5.7.2.5.

### 8. How do I change the look of the display?

Refer to paragraphs 4.1.4.3 and 5.7.2.8.

### 9. How do I change the RS-232 baud rate?

Refer to the Baud Rate menu option in paragraph 4.1.4.4.

### 10. How do I prevent access to the instrument via the front panel?

Refer to the Password menu option in paragraph 4.1.4.4.

### 11. How do I change the number of digits in the pressure display?

Refer to the Decimal Digits menu option in paragraph 4.1.4.4.

### 12. How do I change the unit ID?

Refer to the Unit ID menu option in paragraph 4.1.4.4.

## 20 Menu Tree Reference



# 21 Command and Parameter Reference

COMMANDS	PAGE
<b>CS</b> Check stack.....	5-34
<b>CX</b> Check microprocessor clock.....	5-35
<b>DB</b> Dump buffer.....	5-10
<b>DT</b> Display text on second line.....	5-30
<b>EW</b> Enable write.....	5-14
<b>P1</b> Measure single pressure period.....	5-8
<b>P2</b> Continuously measure pressure period.....	5-11
<b>P3</b> Measure single pressure.....	5-8
<b>P4</b> Continuously measure pressure.....	5-11
<b>P5</b> Sample and hold pressure.....	5-10
<b>P6</b> Sample and hold pressure period.....	5-10
<b>P7</b> Continuously measure pressure at maximum rate.....	5-12
<b>Q1</b> Measure single temperature period.....	5-8
<b>Q2</b> Continuously measure temperature period.....	5-13
<b>Q3</b> Measure single temperature.....	5-9
<b>Q4</b> Continuously measure temperature.....	5-14
<b>Q5</b> Sample and hold temperature.....	5-10
<b>Q6</b> Sample and hold temperature period.....	5-10

PARAMETERS	PAGE
<b>C1</b> C1 coefficient.....	5-34
<b>C2</b> C2 coefficient.....	5-34
<b>C3</b> C3 coefficient.....	5-34
<b>D1</b> D1 coefficient.....	5-34
<b>D2</b> D2 coefficient.....	5-34
<b>DL</b> Data logger (fixed field format) mode.....	5-27
<b>DP</b> Decimal places in displayed pressure value.....	5-30
<b>IA</b> IIR mode cutoff frequency.....	6-2
<b>MD</b> Serial data mode.....	5-18
<b>MN</b> Model number.....	5-29
<b>OP</b> Overpressure alarm setpoint.....	5-24

**PARAMETERS (CONTINUED) PAGE**

<b>PA</b>	Pressure adder.....	5-32
<b>PF</b>	Full-scale pressure.....	5-29
<b>PI</b>	Pressure integration time.....	5-16
<b>PL</b>	Setpoint for overpressure display indication).....	5-31
<b>PM</b>	Pressure multiplier.....	5-33
<b>PO</b>	Pressure transducer type.....	5-29
<b>PR</b>	Pressure resolution.....	5-17
<b>PS</b>	Temperature measurement interval (for P7 command)....	5-13
<b>SN</b>	Serial number.....	5-28
<b>SU</b>	Data separation character enable/disable.....	5-26
<b>T1</b>	T1 coefficient.....	5-34
<b>T2</b>	T2 coefficient.....	5-34
<b>T3</b>	T3 coefficient.....	5-34
<b>T4</b>	T4 coefficient.....	5-34
<b>T5</b>	T5 coefficient.....	5-34
<b>TC</b>	Timebase correction factor.....	5-33
<b>TI</b>	Temperature integration time.....	5-16
<b>TR</b>	Temperature resolution.....	5-17
<b>TU</b>	Temperature unit (C/F).....	5-21
<b>U0</b>	U0 coefficient.....	5-34
<b>UF</b>	User-defined unit factor.....	5-21
<b>UL</b>	Stored text to display on line 2.....	5-31
<b>UM</b>	User-defined pressure unit label.....	5-28
<b>UN</b>	Pressure unit.....	5-20
<b>US</b>	Serial data unit suffix.....	5-25
<b>VR</b>	Firmware version.....	5-28
<b>XM</b>	Resolution mode.....	6-2
<b>XN</b>	Number of significant digits displayed/output.....	6-7
<b>XT</b>	Number of temp. readings to average in FIR mode.....	6-5
<b>Y1</b>	Y1 coefficient.....	5-34
<b>Y2</b>	Y2 coefficient.....	5-34
<b>Y3</b>	Y3 coefficient.....	5-34
<b>ZI</b>	Tare serial indication.....	5-26
<b>ZL</b>	Tare lock.....	5-23
<b>ZS</b>	Tare switch state.....	5-22
<b>ZV</b>	Tare offset value.....	5-23

## **NOTES**

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