Paroscientific, Inc.
4500 148th Avenue N.E.
Redmond, WA 98052
TEL: (425) 883-8700
FAX: (425) 867-5407

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Paroscientific, Inc.

OPERATION MANUAL

FOR

INTELLIGENT INSTRUMENTS WITH DUAL RS-232 AND RS-485 INTERFACES

SERIES 1000 / 6000 / 9000
INTELLIGENT PRESSURE TRANSMITTER

SERIES 8CDP / 8CB
INTELLIGENT DEPTH SENSOR

MODEL 715 DISPLAY

RS-232 / RS-485 SERIAL INTERFACE BOARD

DOCUMENT NO. 8819-001
REVISION A
JANUARY 2001

CE

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DIGIQUARTZ® PRESSURE INSTRUMENTATION

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1. Introduction

1.1. About this manual

Thank you for your recent DIGIQUARTZ® Intelligent Transmitter or Depth Sensor purchase. This manual describes the operation of the entire line of Paroscientific DIGIQUARTZ® Intelligent Transmitters and Depth Sensors equipped with dual RS-232 and RS-485 serial interfaces. DIGIQUARTZ® Intelligent devices that support RS-232 only are covered by a separate manual, Paroscientific Document Number 8107-001.

1.2. Conventions used in this manual

The following conventions are used throughout this manual:

DIGIQUARTZ® Intelligent Device – Any Series 1000, 6000, or 9000 Intelligent Transmitter, or Series 8000 Intelligent Depth Sensor with dual RS-232 and RS-485 ports.

DIGIQUARTZ® Intelligent Transmitter – Any model from the Series 1000, 6000, or 9000 product lines with dual RS-232 and RS-485 ports.

DIGIQUARTZ® Intelligent Depth Sensor – Any model from the Series 8000 product line with dual RS-232 and RS-485 ports.

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

WARNING is used to draw your attention to a situation that may result in permanent damage to an Intelligent device.

1.3. Safety precautions

DIGIQUARTZ® Pressure Transmitters and Depth Sensors are precision devices, and as such, they should be operated with a certain degree of care to ensure optimum performance.

WARNING It is recommended that the input pressure not exceed 1.2 times the rated full-scale pressure. Calibration can be affected if this limit is exceeded, and permanent damage can result if the unit is sufficiently over-pressured.

WARNING Excessive mechanical shock may cause irreparable damage. Do not drop an Intelligent device, or allow tools to fall on the unit or its pressure port.

1.4. Manual summary

This manual is organized as follows:

Section 1	Introduction to this manual.
Section 2	Descriptions of the hardware covered in this manual.
Section 3	Description of the features and functions common to all DIGIQUARTZ® Transmitters and Depth Sensors.
Section 4	Information needed to quickly connect a DIGIQUARTZ® Intelligent device to a serial host and take pressure measurements.
Section 5	Information about interconnection, serial communications, command and response data format, measurement options, device configuration, and the DIGIQUARTZ® application software.
Section 6	Detailed command descriptions.
Section 7	Explanation of the relationship between resolution, integration time, and sampling rate.
Section 8	Recommendations for maximizing sampling rate.
Section 9	Information regarding the operation of Intelligent devices in RS232 serial loop and RS485 multi-drop networks.
Section 10	Information about interconnecting and operating the Model 715 display with DIGIQUARTZ® Intelligent devices.
Section 11	A functional description of the Tare Input, Tare Output, and Overpressure I/O lines.
Section 12	Connector pin-out diagrams for Intelligent devices, Model 715 Display, power adapter module, and PC RS-232 serial port.
Section 13	Wiring diagrams for simple RS232, simple RS485, RS232 serial loop network, and RS485 multi-drop network systems.
Section 14	Troubleshooting tips.
Section 15	Descriptions of the formulas used by DIGIQUARTZ® Intelligent devices to calculate pressure and temperature.
Section 16	Information about zero and span calibration adjustments.
Section 17	A quick reference list of the commands supported by DIGIQUARTZ® Intelligent devices.

2. Hardware Descriptions

2.1. Intelligent Transmitters (Series 1000 / 6000/ 9000)

DIGIQUARTZ® Intelligent Transmitters consist of a pressure transducer and a serial interface board in an integral package. Commands are sent and measurement data are received via one RS-232 and one RS-485 serial port. Measurement data are provided directly in user-selectable engineering units with a typical total accuracy of 0.01% or better over a wide temperature range. Pressure measurements are fully temperature compensated using a precision quartz crystal temperature sensor. Each intelligent transmitter is preprogrammed with calibration coefficients for full plug-in interchangeability.

2.2. Intelligent Depth Sensors (Series 8CDP, 8CB)

DIGIQUARTZ® Intelligent Depth Sensors consist of a pressure transducer and a serial interface board in a rugged waterproof package. Commands are sent and measurement data are received via one RS-232 and one RS-485 serial port. Measurement data are provided directly in user-selectable engineering units with a typical total accuracy of 0.01% or better over a wide temperature range. Pressure measurements are fully temperature compensated using a precision quartz crystal temperature sensor. Each intelligent depth sensor is preprogrammed with calibration coefficients for full plug-in interchangeability.

2.3. Model 715 Display

The Model 715 is an LCD display unit that can be used with DIGIQUARTZ® Intelligent devices that are equipped with dual RS-232 and RS-485 serial interfaces. It features a two-line, 16 character alphanumeric LCD display that is backlit to ensure readability even in low light conditions. The Model 715 can communicate with an Intelligent device via either RS-232 or RS-485.

The Model 715 is housed in a sturdy metal enclosure that conforms to DIN specifications. It is designed for easy panel mounting, but can also function as a tabletop instrument when used with the optional bench stand.

3. Universal Features and Functions

The following features and capabilities are common to all DIGIQUARTZ® Intelligent Transmitters and Depth Sensors with dual RS-232 and RS-485 ports, except as noted.

3.1. Measurement basics

The outputs from DIGIQUARTZ® pressure transducers are two square wave signals whose period is proportional to applied pressure and internal transducer temperature. The Intelligent electronics 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.

DIGIQUARTZ® Intelligent devices allow you to set the integration time between 0.001 and 65.535 seconds in 0.001 second increments. Pressure and temperature integration times can be set independently. You can use these features to configure the intelligent device according to the data acquisition and resolution requirements of your application.

Refer to Section 7 for more information about integration time, resolution, and sampling rate.

3.2. Measurement types

The outputs from DIGIQUARTZ® pressure transducers are two square wave signals whose period is proportional to applied pressure and internal transducer temperature. One or both of these 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

Pressure measurements are by far the most common. Pressure measurements are fully temperature-compensated, and therefore require an internal temperature measurement.

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

1. The temperature signal period is measured
2. A temperature value is calculated using the temperature period and the calibration coefficients
3. The pressure signal period is measured
4. A temperature-compensated pressure value is calculated using the pressure period, temperature value, and the calibration coefficients
5. The pressure value is output

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.

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

1. The temperature signal period is measured
2. A temperature value is calculated using the temperature period and the calibration coefficients
3. The temperature value is output

Pressure and temperature period measurements

Period measurements are used mainly for calibration and diagnostic purposes, but may be useful in high-speed sampling applications.

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

1. The pressure or temperature signal period is measured
2. The period value is output

Refer to Section 6.1 for detailed measurement command descriptions.

3.3. Sampling types

Four sampling types are available:

- 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 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 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 Section 6.1 for detailed measurement command descriptions.

3.4. Engineering units

Pressure values can be expressed in the following engineering units. Refer to the **UN** command in Section 6.2.3 for details.

- psi
- hPa (mbar)
- bar
- kPa
- MPa
- in Hg
- mm Hg (torr)
- m H_2O
- User-defined units

Temperature values can be expressed in the following units. Refer to the **TU** command in Section 6.2.3 for details.

- °C
- °F

3.5. Serial data output modes

In addition to the sampling types described in Section 3.3, DIGIQUARTZ® Intelligent devices can also be configured to provide continuous pressure measurement data whenever power is applied. Refer to Section 6.3 for details.

3.6. Power management

You can configure a DIGIQUARTZ® Intelligent device to switch to a low power "sleep" state after a user-defined period of serial inactivity, thus conserving power. When serial activity resumes, the unit will "awaken", allowing normal operation. Refer to Section 6.2.4 for details.

3.7. Tare and overpressure

You can configure the DIGIQUARTZ® Intelligent device to subtract a value from each subsequent pressure measurement. This process is referred to as taring. You can tare to the current pressure value, or to any value you specify. Taring can be initiated by contact closure via a dedicated digital input line, or by serial command. A dedicated digital output and/or a special character in the measurement data can be used to indicate whether taring is in effect. Refer to Sections 6.2.5 and 11 for details.

You can configure the DIGIQUARTZ® Intelligent device to indicate whether the measured pressure exceeds a user-specified setpoint. This indication is provided via a dedicated digital output line. Refer to Sections 6.2.5 and 11 for details.

NOTE: Tare and overpressure I/O lines are not available with DIGIQUARTZ® Intelligent Depth Sensors.

3.8. Measurement data formatting

Several serial data formatting options have been provided, and are listed below. Refer to Section 6.2.6 for details.

- **Engineering Unit Suffix:** Appends the engineering unit to pressure and temperature measurement data. See the **US** command for details
- **Underscore Separator:** Adds underscore(s) to pressure and temperature measurement data to separate the measurement value from the address header and optional engineering unit. See the **SU** command for details.

- **Tare Indicator:** Adds an uppercase 'T' character to pressure measurement data to indicate a tared value. See the **ZI** command for details.
- **Data Logger Format:** Converts measurement data to a predictable fixed-length and fixed-position format to simplify parsing by data loggers and other programmable serial hosts. See the **DL** command for details.
- **User-Defined Unit Label:** Lets you define the 4-character unit label to be used when the user-defined pressure unit is selected. See the **UM** command for details.

3.9. RS-232 and RS485 serial communications

DIGIQUARTZ® Intelligent devices are equipped with both RS-232 and RS-485 serial ports. Commands can be sent to either port. Response data, if any, will be output from the port that received the command. Both ports share the same baud rate. Common baud rates between 300 and 115,200 baud are supported. The serial protocol is fixed at 8 data bits, no parity, and 1 stop bit.

Up to 98 units and an RS-232 serial host can be interconnected to form a serial loop network. Refer to Sections 6.2.2, 9.4, and 13 for details. Additionally, up to 98 units and an RS-485 serial host can be interconnected to form a 2-wire or 4-wire RS-485 multi-drop network. Refer to Sections 6.2.2, 9.3, and 13 for details.

You communicate with a specific DIGIQUARTZ® Intelligent device by sending commands to its ID number. You can also send certain commands to all devices on a network by sending the command to the global address. Refer to Sections 5.3, 5.4, and 6.6 for details.

3.10. Differences between the RS-232 and RS-485 ports

Generally, DIGIQUARTZ® Intelligent devices respond identically to commands received on either port, with the following exceptions:

- Global commands received by the RS-232 port are re-transmitted. This enables a global command to be relayed to each device in an RS-232 serial loop network. Refer to Section 9.4 for more information about RS-232 serial loop networking.
- Commands received by the RS-232 port that are addressed for other devices are re-transmitted. This behavior is necessary to support RS-232 serial loop networking. Refer to Section 9.4 for more information about RS-232 serial loop networking.
- Global commands received by the RS-485 port never generate a response. This prevents the data collision that would occur if all devices on a multi-drop network were to respond simultaneously. Refer to Section 9.3 for details.

3.11. Calibration

DIGIQUARTZ® Intelligent devices are shipped fully calibrated. Calibration data are shipped with the unit in printed form, and are stored within the device in non-volatile memory. These values should not be modified unless it is absolutely necessary to do so, and then only with extreme caution. See Section 6.5 for details.

3.12. Unit identification

DIGIQUARTZ® Intelligent devices are shipped with several unit identification values stored in non-volatile memory. These read-only values include:

- Serial and model numbers
- Full-scale pressure
- Transducer type.

Refer to Section 6.2.7 for details.

3.13. Model 715 Display

DIGIQUARTZ® Intelligent devices can be used with the Model 715 Display to display pressure, temperature, and user-defined alphanumeric information. The Model 715 can communicate with DIGIQUARTZ® Intelligent devices via either RS-232 or RS-485. User-defined alphanumeric display information can be stored in the DIGIQUARTZ® Intelligent device, or can be sent directly from the serial host to the Model 715 display. Intelligent devices support several commands that control the Model 715 display. Refer to Section 6.2.8 for details.

DIGIQUARTZ® Intelligent devices with dual RS-232 and RS-485 ports are not compatible with the Model 710 display. Older Intelligent devices with RS-232 only are not compatible with the Model 715 display.

4. Quick Start

This section will help you to quickly connect your DIGIQUARTZ® Intelligent device to the RS-232 serial port of a standard PC, establish communications, and take your first pressure measurements.

This process will be much simpler and easier if you have purchased the RS232/RS485 Installation Kit (110V p/n 1294-001, 220V p/n 1294-002. The kit includes the following items:

- Power adapter module, p/n 6671-003
- 110 or 220 VAC wall power supply, p/n 6024-001 or 6024-002
- 9-pin serial cable, p/n 6409-003

Step 1. Connect up the system

If you have the Installation Kit:

- Connect up the system as shown in Figure 2 in Section 13.
- Plug in the wall power supply.

If you don't have the Installation Kit:

- Connect up the system as shown in Figure 3 in Section 13.

Step 2. Run DIGIQUARTZ® Interactive (DQI)

- Install DIGIQUARTZ® Interactive (DQI) software on your PC. See Section 5.6 for more information.
- Run DQI. When the program starts, the Startup window is displayed.
- Set the Port ID to match the PC COM port you are using, and click Start. DQI will search for your device at various baud rates.
- If your device is not detected, exit DQI, check your power and serial connections, re-run DQI and try again.
- If your device is detected, DQI will display your device's ID, parity setting, and software version. Click OK to proceed. DQI will then display its main window.
- Click the Sampling tab and click Start. DQI will read and display the device's serial number and software version.
- Click Sample and Send Pressure, and click Send. DQI will then send the pressure measurement command to your Intelligent device. When the pressure measurement is complete, the response from your device will be displayed. Refer to Section 5.5 for detailed information about the response data format.

Congratulations! You have taken your first pressure measurement! We encourage you to use DQI and DIGIQUARTZ® Terminal to explore the remaining functions of your DIGIQUARTZ® Intelligent device. Refer to the Help function in DQI and DIGIQUARTZ® Terminal for more information.

5. Getting Started

5.1. Compatible serial hardware

DIGIQUARTZ® Intelligent devices are compatible with any equipment that conforms to the EIA RS-232 and/or RS-485 specifications. They are also backward compatible with earlier Intelligent devices that support RS-232 only, and can be used together in RS-232 serial loop networks.

DIGIQUARTZ® Intelligent devices with dual RS-232 and RS-485 ports are not compatible with the Model 710 display, and DIGIQUARTZ® Intelligent devices with RS-232 only are not compatible with the Model 715 display.

5.2. Serial and power connections

Serial and power connections are made via a male 15-pin high-density D-subminiature connector. Refer to Section 12 for connector pin details.

Refer to section 13 for detailed system wiring diagrams.

It is recommended that you establish communications and verify transmitter operation prior to permanently installing the device. The RS232/RS485 Installation Kit (110V p/n 1294-001, 220V p/n 1294-002) simplifies the task of powering the transmitter and making RS-232 serial connections to a PC or other serial host.

NOTE: The RS232/RS485 Installation Kit is intended for use with DIGIQUARTZ® Intelligent transmitters, and is not compatible with Intelligent depth sensor products.

5.3. Communications

DIGIQUARTZ® Intelligent devices are initially configured for RS232/RS485 communications at 9,600 baud. Both ports operate at the same baud rate. The serial protocol is fixed at 8 data bits, no parity, and 1 stop bit. Each Intelligent device has an ID number, and will only respond to commands sent to its ID number or 99. ID number 99 is reserved as a global address, which can be used to send a single command to multiple devices at once. The ID number is initially configured to 01, but you can set the ID number to any value between 01 and 98.

It is recommended that DIGIQUARTZ® Interactive (DQI) software be used to establish initial communications with your transmitter. Refer to the DIGIQUARTZ® CD library and Section 5.6 for details.

You may also use any terminal program that is configured for the proper baud rate and serial protocol. Your terminal program must also send a line-feed character (ASCII 10) with each carriage return.

5.4. Command basics

DIGIQUARTZ® Intelligent devices are 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 Section 6.2.1 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.

5.5. Command and response format

Commands are typically sent in the following form: *0100P3CrLf

Where:		
	* = start character	(ASCII 42)
	01 = Destination ID	(ID of intelligent device that is to respond to the command)
	00 = Source ID	(Serial host is ID 00)
	P3 = Command	**P3** is an example. Refer to Section 6 for descriptions of the entire command set.
	Cr = Carriage return	(ASCII 13)
	Lf = Linefeed character	(ASCII 10)

Responses are typically received in the following form: *000114.4567CrLf

Where:		
	* = start character	(ASCII 42)
	00 = Destination ID	(ID of serial host)
	01 = Source ID	(ID of device that is responding)
	14.4567 = Data	(Data sent in response to a measurement command)
	Cr = Carriage return	(ASCII 13)
	Lf = Linefeed character	(ASCII 10)

These examples are typical. Refer to Section 6 for specific details regarding each supported command.

5.6. DIGIQUARTZ® Software Programs

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 free of charge with each Intelligent device purchase. The latest versions of these and other software programs are also available at the Paroscientific web site, at www.paroscientific.com.

5.6.1. DIGIQUARTZ® Interactive (DQI)

DIGIQUARTZ® Interactive (DQI) is a Windows program that makes it easy to communicate with and configure DIGIQUARTZ® Intelligent devices. We encourage you to install and use DQI to verify proper device operation, configure your device, take measurements, and experiment with its functions. Refer to the help function in DQI for more information.

5.6.2. 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.

5.6.3. DIGIQUARTZ® Terminal

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.

6. Command Descriptions

6.1. *Measurement commands*

The following commands are used to initiate measurements, and to control measurement integration time.

6.1.1. 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 microseconds.

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

Typical command: *0100P1

Typical response: *000128.123456 (Value: 28.123456)

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 microseconds).

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

Typical command: *0100Q1

Typical response: *00015.1234567 (Value: 5.1234567)

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: 22.34)

6.1.2. 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.

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 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 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)

6.1.3. 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 measurement can be stopped by sending any valid command.

P2 Continuously sample and send pressure period measurement values in 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)

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.

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 Section 6.2.1 for more information.

Q2 Continuously sample and send temperature period measurement values in 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)

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)

6.1.4. Measurement integration time commands

DIGIQUARTZ® Intelligent devices support two measurement integration modes: time-based and period-based. Time-based integration samples the transducer's 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 Section 7 for the relationships between integration time, resolution, and sampling rate.

The desired integration mode is automatically selected whenever an integration time set command is issued. For example, when a **PI** or **TI** set command is received, the intelligent device is configured for time-based integration mode; when a **PR** or **TR** set command is received, the intelligent device is configured for period-based integration. The selected integration mode remains in effect until it is changed.

PI and **TI** are new commands that set the integration time in increments of 0.001 second. The resulting integration times are independent of measured period, and will therefore be consistent from unit to unit. If you are controlling multiple devices in an RS-485 multi-drop network and require synchronized pressure measurements, it is recommended that **PI** and **TI** be used instead of **PR** and **TR**.

Time-based integration time commands

PI Set or read the time-based pressure measurement integration time

Units: Milliseconds

Range: 1-65535

Default: 666

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: 10-65535

Default: 666

Typical set command: *0100EW*0100TI=1000

Typical set response: *0001TI=1000

Typical read command: *0100TI

Typical read response: *0001TI=1000

Note: Changing TI has no effect on PI.

Period-based integration time commands

PR Set or read period-based pressure measurement integration time

Units: None

Range: 1-16383

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: 1-65535

Default: 952

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

Typical set response: *0001TR=800

Typical read command: *0100TR

Typical read response: *0001TR=800

Note: Changing TR has no effect on PR.

6.2. Configuration commands

6.2.1. 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

6.2.2. Communications commands

The following commands are used to configure DIGIQUARTZ® Intelligent devices for serial communications. These commands affect both the RS-232 and RS-485 ports, regardless of which port receives the command.

BR Set the RS-232 and RS-485 baud rate.

Action: The **BR** command is used to set the baud rate of the RS-232 and RS-485 ports. The BR command must be addressed to 99, the global ID; this ensures that all units on a network are set to the same baud rate. It is not possible to read the baud rate value.

BR is unique in that it does not need to be preceded by an EW command.

Values: 300, 600, 1200, 4800, 9600, 19200, 38400, 57600, and 115200

Default: 9600

Typical set command: *9900BR=19200

Typical set response: *9900BR=19200

CAUTION Be careful to only set the baud rate to a value supported by your serial host! If you accidentally set the baud rate to an unsupported value and subsequently lose serial communications, use the DIGIQUARTZ® Terminal program to establish communications and restore the baud rate to the original value.

BL Set or read the Baud Lock parameter.

Action: The **BL** command is used to prevent an accidental change of baud rate. The **BL** command must be preceded with an **EW** command. The **BL** set command must be addressed to 99, the global ID; this ensures that all units on a network are set to the same baud lock state.

Values: 0 = Baud rate can be changed with **BR** command.
1 = **BR** command is ignored.

Default: 0

Typical set command: *9900EW*9900BL=1

Typical set response: *9900EW (Echoed **EW** command)
*0001BL=1 (Response from device)
*9900BL=1 (Echoed command)

Typical read command: *0100BL

Typical read response: *0001BL=1

Note: The response shown above assumes that the RS-232 port is being used. If the RS-485 port were being used, no response would have been sent. Refer to section 9.3 for more information.

ID Set the device ID.

Action: The ID command is used to set the device ID. The **ID** command must be addressed to 99, the global address. The device ID is set to the destination ID + 1. For example, if the command *9900ID were sent, the device would be set to ID=1 (00 + 1).

Range: 01 - 97

Default: 01

Typical set command: *9903ID (to set device ID to 04)

Typical set response: *9904ID (Indicates device ID was set to 04)

Note: The response shown above assumes that the RS-232 port is being used. If the RS-485 port were being used, no response would have been sent. CAUTION Do not send the ID command when multiple devices are connected together in an RS-485 multi-drop network. Doing so will set all devices on the network to the same ID. Refer to Section 9.3 for more information about using the ID command in an RS-485 multi-drop network.

6.2.3. 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: 0-8

UN value	Pressure units	psi multiplied by...
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_2O	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 - 9999999

Default: 1.0000000

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

Typical set response: *0001UF=2

Typical read command: *0100UF

Typical read response: *0001UF=2

TU Set or read the temperature engineering units.

Action: Specifies the temperature units for **Q3**, **Q4**, **Q5**, and temperature data displayed by an optional Model 715 display.

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.

6.2.4. Power management commands

DIGIQUARTZ® intelligent devices can be commanded to enter a low-power "sleep" mode during periods of serial port inactivity. The unit "awakens" 0.6 seconds after a single serial character is received on either port. Since the unit is "asleep" when the wake-up character is received, that character will be lost, and will not be interpreted as being part of a command. It is therefore necessary to send a character and wait at least 0.6 seconds before sending a command to an intelligent device that is "asleep".

CAUTION Power management features are not available if **MD** is set for continuous pressure data output or display data output.

SL Set or read the sleep mode enable state.

Action: Allows sleep mode to be enabled or disabled. When sleep mode is enabled, the device will enter sleep mode when both serial ports have received no characters for the number of seconds specified by the value of **ST**. When sleep mode is disabled, the device cannot enter sleep mode.

Range: 0 = sleep mode disabled
1 = sleep mode enabled

Default: 0

Typical set command: *0100EW*0100SL=1

Typical set response: *0001SL=1

Typical read command: *0100SL

Typical read response: *0001SL=1

Note: If MD is set for continuous pressure data output or display data output, the device will never enter sleep mode regardless of the values of SL or ST.

ST Set or read the sleep mode timeout length.

Action: When **SL**=1, the device enters sleep mode if both serial ports have received no characters for ST seconds.

Units: Seconds

Range: 5 – 255, integer values only.

Default: 10

Typical set command: *0100EW*0100ST=5

Typical set response: *0001ST=5

Typical read command: *0100ST

Typical read response: *0001ST=5

6.2.5. 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. Taring can also be controlled and monitored using I/O lines; please refer to Section 11 for more information. 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 (3.3 VDC). Refer to Section 11 for more information.

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 sending the ZS=1 command. 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: 0-2
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. You can set **ZV** 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 - 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, 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: 0-1
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); if it is greater or equal to the value of **OP**, the Overpressure I/O line is set to logic high (3.3 VDC). Refer to Section 11 for more information.

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

Range: -9999999 - 9999999

Default: Maximum rated device pressure

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

Typical set response: *0001OP=15

Typical read command: *0100OP

Typical read response: *0001OP=15

6.2.6. 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**:

UN value	Label
0	Defined by UM
1	psia, psig, or psid
2	bar
3	hPa
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**:

TU value	Label
0	C
1	F

Range: 0-1

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: 0-1
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, an "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: 0-1
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, **DO**=0)
	*0001+14.7123400	(Pressure, **DO**=1)
	*000121. 123	(Temperature, **DO**=0)
	*0001+21.1230000	(Temperature, **DO**=1)

Range: 0-1
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 – 127.
Default: user

Typical set command: *0100EW*0100UM=test
Typical set response: *0001UM=test
Typical read command: *0100UM
Typical read response: *0001UM=test

6.2.7. Unit identification commands

The Unit Identification commands read various device-specific parameters. These commands 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=R1.00

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=6030A

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

PO Read the pressure transducer type.

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

PO value	Transducer type
0	Absolute
1	Gauge
2	Differential

Typical read command: *0100PO

Typical read response: *0001PO=0

6.2.8. Display configuration commands

The Display Configuration commands configure the DIGIQUARTZ® intelligent device for use with an optional Model 715 display.

DM Set or read the display mode.

Action: The display mode determines which data (if any) is displayed on the second line of an optional Model 715 display. The following table describes the supported display modes:

DM	Display mode
0	Horizontal bar graph indicating measured pressure as a percentage of full-scale pressure.
1	Internal transducer temperature.
2	User-defined text defined by the UL parameter.
3	No data is displayed on second line.
4	User-defined text received with the DT command.

Range: 0 - 4

Default: 0

Typical set command: *0100EW*0100DM=1

Typical set response: *0001DM=1

Typical read command: *0100DM

Typical read response: *0001DM=1

DO Set or read the display output port.

Action: **DO** selects which serial port (RS-232 or RS-485) will produce data for the Model 715 display. The other serial port is normally used for communication with a host device, such as a PC. When **DO**=0, the RS-485 port is used for Model 715 display data; when **DO**=1, the RS-232 port is used.

Range: 0 - 1

Default: 0

Typical set command: *0100EW*0100DO=1

Typical set response: *0001DO=1

Typical read command: *0100DO

Typical read response: *0001DO=1

DP Set or read the number of decimal places in the pressure data sent to the Model 715 display.

Action: **DP** sets the maximum number of decimal places in the pressure display data. Fewer decimal places will be displayed if the pressure resolution is not sufficient to provide the specified number of decimal places.

Range: 0 - 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 line 2 of the Model 715 display when DM=4.

Action: **DT** allows a serial host (such as a PC) to send text to the second line of an optional Model 715 display when **DM**=4. The text sent with **DT** is not stored by the intelligent device; it is simply transferred to the display. Since the text sent with **DT** is not stored, it cannot be queried, and it is not necessary to precede **DT** with an **EW** command.

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

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

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

PL Read the display overpressure indication setpoint. This setpoint is used to determine the pressure at which the intelligent device sends an overpressure indication to an optional Model 715 display.

Action: **PL** is a factory-set, read-only command. The value of the **PL** parameter is used as the overpressure indication setpoint for the Model 715 display.

Typical read command: *0100PL

Typical read response: *0001PL=120.0000

Note: **PL** is typically factory-set to 1.2 times full-scale pressure.

UL Set or read the text to be displayed on line 2 of the Model 715 display when **DM**=2.

Action: **UL** defines the text to be displayed on line 2 of an optional Model 715 display when **DM**=2. The value of **UL** is stored in non-volatile memory, and will therefore be retained even if power is lost. The value of **UL** is sent to the optional Model 715 display each time the pressure data is updated.

Range: 11 characters maximum. Any characters in the range of ASCII 32 – 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

6.3. Serial 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 serial data output mode.

Action: **MD** configures the intelligent device for continuous pressure measurement output and/or display data output whenever power is applied.

MD value	Model 715 display data output	Continuous pressure data output
0	Off	Off
1	On	Off
2	Off	On
3	On	On

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

Range: 0-3

Default: 0

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

Typical set response: *0001MD=1

Typical read command: *0100MD

Typical read response: *0001MD=1

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

- When the intelligent device is running in a continuous pressure data output mode, continuous data output is suspended when a measurement command is received. Continuous data output resumes when the measurement command is complete.

- When the intelligent device is running in a display data output mode, 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.

6.4. 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

6.5. Calibration commands

The calibration commands set and read several parameters that directly affect the measurement accuracy of the device. Refer to Sections 15 and 16 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.

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.

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

$P_{output} = PM * (P + PA)$, where

PM = the value of the **PM** parameter
P = the pressure value calculated using the original calibration data
PA = the value of the **PA** parameter

Range: -9999999 - 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. See the formula in the **PA** command description.

Range: -9999999 - 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 crystal resonant frequency. **TC** is read-only command.

Typical read command: *0100TC
Typical read response: *0001TC=.6666667

C1 Set or read the calibration coefficients.
C2
C3
D1
D2
T1
T2
T3
T4
T5
U0
Y1
Y2
Y3

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

6.6. *Global Commands*

Under certain circumstances, it may be necessary to send a single command to multiple Intelligent devices on a serial loop or multi-drop network. The ID 99 has been reserved for such global addressing. When an Intelligent device receives a legal command addressed to ID 99, the device reacts to that command regardless of its assigned ID value.

To support the unique requirements of RS-232 serial loop and RS-485 multi-drop networking, Intelligent devices react to global commands differently depending on which port received the command. When a global command is received via RS-232, the global command is re-transmitted before acting on the command. This ensures that all devices on a serial loop will receive the global command. When a global command is received via RS-485, the Intelligent device acts on the command but does not send a response. This prevents multiple devices on a multi-drop network from transmitting simultaneously, which would result in data collisions and unintelligible data.

Some commands can only be sent with global addressing:

BR
BL
ID

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

7. Resolution, Integration Time, and Sampling Rate

The outputs from DIGIQUARTZ® pressure transducers are two square wave signals whose period is proportional to applied pressure and internal transducer temperature. The Intelligent electronics measures these signals using a technique similar to that of a common laboratory frequency counter. Like the frequency counter, a signal must be integrated for a specified period of time to measure its period.

The time over which the signal is integrated 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.

Tables 1, 2, and 3 illustrate the relationship between integration time, resolution, and sampling rate for the **P2**, **P4**, and **P7** commands at various baud rates. Integration time is given using both time-based (**PI**) and period-based (**PR**) methods.

NOTE: When using the period-based integration method (**PR/TR**), sampling rates and sample times are estimates, and may vary by up to 20% from unit to unit.

NOTE: Baud rates higher than those shown do not increase sampling rate.

P2 Command (Continuous Pressure Period Output)

Integration Time		Pressure Resolution	Sampling Rate and Sample Time					
			9600 Baud		19200 Baud		57600 Baud	
PI (ms)	PR	(ppm)	(Hz)	(s)	(Hz)	(s)	(Hz)	(s)
3	1	242.203	68.00	0.015	137.00	0.007	340.00	0.003
8	3	80.734	68.00	0.015	105.00	0.010	116.00	0.009
11	4	60.551	64.00	0.016	87.00	0.011	87.00	0.011
17	6	40.367	58.00	0.017	58.00	0.017	58.00	0.017
34	12	20.184	29.00	0.034	29.00	0.034	29.00	0.034
67	24	10.092	14.60	0.068	14.60	0.068	14.60	0.068
134	48	5.046	7.30	0.137	7.30	0.137	7.30	0.137
333	119	2.035	2.90	0.345	2.90	0.345	2.90	0.345
666	238	1.018	1.46	0.685	1.46	0.685	1.46	0.685
1333	476	0.509	0.73	1.368	0.73	1.368	0.73	1.368
3332	1190	0.204	0.29	3.425	0.29	3.425	0.29	3.425
6664	2380	0.102	0.15	6.803	0.15	6.803	0.15	6.803
13328	4760	0.051	0.07	13.605	0.07	13.605	0.07	13.605
26656	9520	0.025	0.04	27.300	0.04	27.300	0.04	27.300
45872	16383	0.015	0.02	47.201	0.02	47.201	0.02	47.201

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

P4 Command (Continuous Pressure Output)

Integration Time		Pressure Resolution	Sampling Rate and Sample Time			
			9600 Baud		19200 Baud	
PI (ms)	PR	(ppm)	(Hz)	(s)	(Hz)	(s)
3	1	242.203	74.00	0.014	121.00	0.008
8	3	80.734	64.00	0.016	64.00	0.016
11	4	60.551	48.00	0.021	48.00	0.021
17	6	40.367	32.00	0.031	32.00	0.031
34	12	20.184	16.00	0.063	16.00	0.063
67	24	10.092	8.00	0.125	8.00	0.125
134	48	5.046	4.00	0.250	4.00	0.250
333	119	2.035	1.60	0.625	1.60	0.625
666	238	1.018	0.81	1.235	0.81	1.235
1333	476	0.509	0.40	2.481	0.40	2.481
3332	1190	0.204	0.16	6.211	0.16	6.211
6664	2380	0.102	0.08	12.361	0.08	12.361
13328	4760	0.051	0.04	24.600	0.04	24.600
26656	9520	0.025	0.02	49.603	0.02	49.603
45872	16383	0.015	0.01	85.600	0.01	85.600

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

P7 Command (Fast Continuous Pressure Output)

Integration Time		Pressure Resolution	Sampling Rate and Sample Time			
			9600 Baud		19200 Baud	
PI (ms)	PR	(ppm)	(Hz)	(s)	(Hz)	(s)
3	1	242.203	74.00	0.014	147.00	0.007
8	3	80.734	74.00	0.014	104.00	0.010
11	4	60.551	68.00	0.015	80.00	0.013
17	6	40.367	55.00	0.018	55.00	0.018
34	12	20.184	28.00	0.036	28.00	0.036
67	24	10.092	14.30	0.070	14.30	0.070
134	48	5.046	7.20	0.139	7.20	0.139
333	119	2.035	2.90	0.345	2.90	0.345
666	238	1.018	1.46	0.685	1.46	0.685
1333	476	0.509	0.73	1.368	0.73	1.368
3332	1190	0.204	0.29	3.425	0.29	3.425
6664	2380	0.102	0.15	6.803	0.15	6.803
13328	4760	0.051	0.07	13.721	0.07	13.721
26656	9520	0.025	0.04	27.405	0.04	27.405
45872	16383	0.015	0.02	47.601	0.02	47.601

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