DATA TRAP^{TM} SERIES

PRECISION QUARTZ PRESSURE GAUGE

MODEL DT- QNL and DT-QNLP
Release 1.1
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AKS LABS
Intelligent Measurement Systems

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INTRODUCTION

Scope

This document provides information needed to install and operate the Data Trap™ Series Precision Quartz Pressure Gauge model DT-QNL and the DT-QNLP.

Summary

The AKS Labs' Precision Quartz Pressure Gauge is a high-quality, high resolution quartz pressure gauge housed in a rugged, hazardous-area approved, industrial enclosure. Pressure and temperature are read digitally from the gauge using a simple serial protocol through a standard RS-485 communications link. The DT-QNLP version adds internal logging functions using a compact flash card to store collected data.

Key Features

High Quality Quartz Pressure Gauge
10,000 PSIA Quartz (2X overpressure) – 0.01 psi resolution, 0.015% FS accuracy over full temperature range. Other pressure ranges available on request.

Process Connections
3/8" F-375 AutoClave, WECO 1502 adapter with autoclave and screen insert (special order)

Communications
Single channel RS-485(multi-drop)/RS232 with command-driven addressing protocol.

Sample Rate
1 reading per second at full resolution and accuracy. (Higher rates are available with slightly reduced resolution).

Internal Data Logging to Compact Flash Card (DT-QNLP)
Readings may be stored on an internal compact flash card. Several hundred thousand readings may be stored on a 128 MB compact flash card. Larger compact flash cards may be used for even greater storage.

Low Power
10VDC to 24VDC

Hazardous Area Application
The Quartz Pressure Gauge is installed in a hazardous area approved (Explosion Proof, Class 1, Div 1) enclosure. IP66 and NEMA 4x.

INSTALLATION

Summary

Installation of the Data Trap Series Precision Quartz Pressure Gauge is straightforward. Mount the Data Trap directly to the process using one of the provided adapters or the optional WECO hammer union. Run the control cable to the gauge and connect the power and communications lines using the internal 4 pin removable screw terminal plug. Close the enclosure, connect the communications lines and power lines and begin reading pressures.

WARNING: When using a hammer union, install the hammer union first, then connect the gauge. ***Do hot hammer on the hammer union while the Data Trap is attached.*** The quartz sensor can be damaged by the excessive impact generated while hammering.

Pressure Fittings and Process Connection

The base pressure gauge comes with a standard 3/8" F-375 female autoclave fitting for connection to the process.

Standard adapters include:
- 1502 WECO hammer union with 3/8" female autoclave fitting and internal screen assembly.
- 3/8" male autoclave to 3/8" male autoclave adapter to connect the gauge to the hammer union.

A 3/8" Autoclave to NPT available on request.

All wetted parts in the sensor are Inconel, fittings are sour-service stainless.

Power and RS-485 Connection

Power and communications lines are connected to the pressure gauge through a 4-pin removable plug. See photo below. Unscrew the cover to gain access to the plug. The power and communications cable must be brought in through one of the two ¾" conduit connectors on the explosion proof case and connected to the screw-down terminals in the plug.
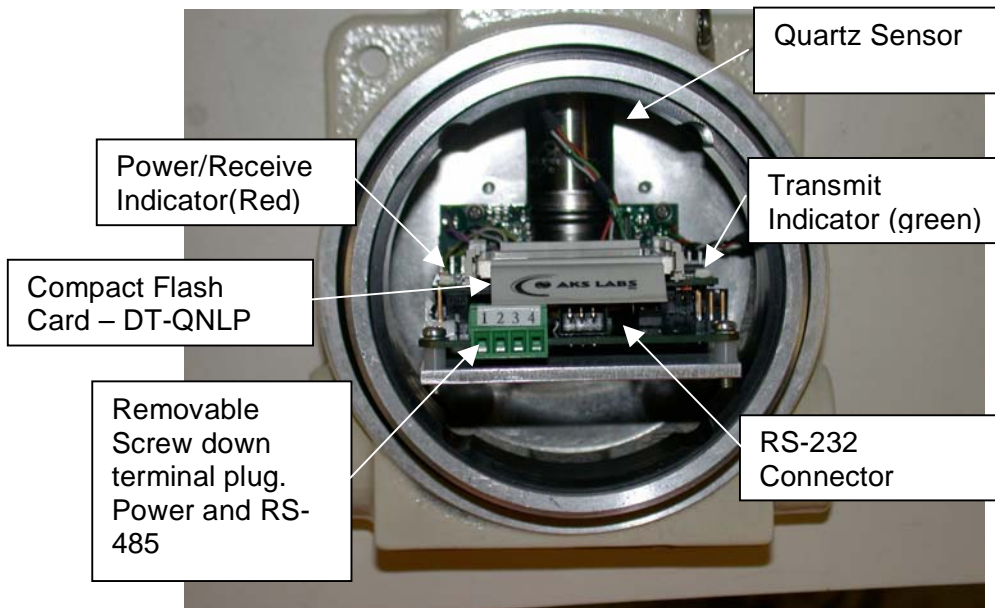
The gauge is powered with an external 10-24 volts DC power supply. Do not supply AC power or DC power outside of this range. Any voltage from 10VDC to 24VDC may be used. The gauge is reverse-polarity protected but will not run with the power leads connected backwards.

Finally, an RS-232 interface is provided through a 6 pin connector next to the Power/RS-485 connector inside the unit. All functions (plus additional low-level system functions) are available through this connector. A standard 9-pin to 6 pin cable is available if an RS-232 connection is needed.

Hazardous Area Installation

Explosion proof certification for application in Class 1 Div 1 areas is pending. However, the entire gauge is housed in an explosion-proof enclosure and the pressure transducer has been approved in the enclosure for application as explosion-proof in Class 1, Div 1, groups B, C, and D areas.   All normal wiring and installation practices for hazardous area installations must be followed to maintain safety.

Power and Data Communications Connection

Quartz Sensor

Power/Receive Indicator(Red)

Transmit Indicator (green)

Compact Flash Card – DT-QNLP

Removable Screw down terminal plug. Power and RS-485

RS-232 Connector

POWER and RS485 CONNECTOR

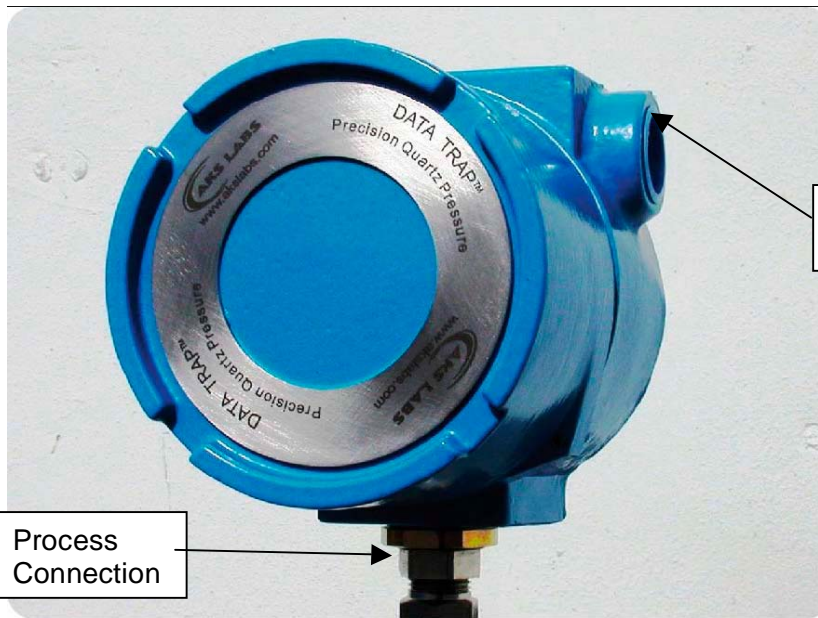Pin 1: GND

Pin 2: +V: 10-24VDC

Pin 3: TD (A)

Pin 4: TD(B)

Cover Removed

Red indicator flashes on power-on and receive data.

Green indicator flashes when data is transmitted

Quartz Pressure Gauge – Ready for Installation

Electrical Connection

Process Connection

OPERATION

Summary

The gauge is on when power is applied. To turn the gauge off, remove the power. Pressure and temperature are read from the gauge by issuing serial commands to the gauge over the RS-485 communications line and reading the gauge reply. There is no analog output available with the gauge. Up to 254 devices may be placed on the multi-drop line and each device is addressable. Address 00 is reserved for broadcast (all devices listen) and addresses 1-254 are for individual devices. The default factory address is 1.

The quartz pressure sensors used in the Data Trap Series Precision Quartz Pressure Gauges are different than strain or piezo sensors used in analog gauges. A standard analog pressure gauge typically provides a voltage that represents the pressure while a quartz pressure gauge measures pressure (and temperature) by reading the frequency of an oscillating crystal. It takes some time to accurately measure the frequency (usually done by counting for a period of time). Therefore, the rate at which the pressure can be measured is limited by how long it takes to count the frequency. Once the frequency is obtained, it must be used to compute the actual pressure using a multi-variable polynomial computation. The AKS Labs' pressure gauge does this all internally and returns the computed pressure and temperature on command. A full resolution measurement takes slightly less than 1 second. However, the AKS Labs' gauge can return readings faster with some loss in resolution(up to 3 measurements per second at 0.015 psi resolution).

AKS Labs' quartz sensors provide outstanding accuracy (0.01%) and resolution (<0.01psia). They do not require frequent re-calibration (years as opposed to months with other types of gauges). In fact, the quartz gauge will provide an excellent, stable, field calibrator for other gauges!

The DT-QNLP model adds an internal compact flash card for storing readings as they are obtained. This can be done with or without the RS-485 communication lines connected, making the QNLP a true data logger and provides for data collection when a PC is not available.

Reading the Pressure and Temperature (Interactive – All Models)

Obtaining a pressure and temperature value is basically done as follows:

Issue Read Command --> Read Returned Data

How often this is done is left to the user software. This allows maximum flexibility in selection of sample rate and resolution. Communication between the user and the Precision Quartz Pressure Gauge is via serial ascii commands over a RS-485 or RS-232 communications link. The commands are simple and AKS provides sample programs illustrating the different operating modes for the pressure gauge. The commands can also be sent interactively using a terminal program (such as Hyperterm) Although this is not recommended for routine operation, it is useful for making sure all the proper connections have been made.The basic commands are listed in the next section.

Operating Commands and Protocol

As mentioned in the last section, all operating commands are sent over an RS-485/RS-232 communications line using a simple ASCII command protocol. Commands can be sent to a specific unit (addressed) or all units (broadcast). Additional system level commands are available for system updates and maintenance.

Command (Ascii)	Action	Result
Start n	Starts a pressure reading	None
Read n SYNC X	Starts a pressure reading, waits for X milliseconds and reads the pressure.	Returns current pressure and temperature after X milliseconds.
Read n ASYNC	Reads the pressure acquired since last read or from start.	Returns the current pressure from the previous read command.
Sysdata n setunit #	Sets the address of the currently connected device	Echoes current setting

n- address from 0 to 254. 0 - broadcast mode (default = 1)
X – value in milliseconds (0 - minimum, 2,200 maximum)
Commands are not case sensitive.

Following a read command, pressure and temperature data is returned in a string with the following format:

Return Format
<STX><pressure (%12.3f)><TAB><temperature (%12.3f)><ETX>\r\n

<STX> is the Start of Transmission Character (02H)
<ETX> is the End of Transmission Character (04H)
\r\n is the carriage return, Line Feed sequence.

In future releases, an 8 bit checksum will be inserted before the <ETX>

Communication Port Settings
Defaults: 38,400 BPS, 8 bits, no Parity, one stop bit, address = 1.
Other protocols and rates can be configured.

Examples

AKS provides example communications software in LabVIEW; other languages are available on request.   In addition, AKS can provide engineering and software support for interface to standard serial ports on RTUs and other logger products.

Working with the Compact Flash Data Card

The compact flash card adds considerable capability to the DT-QNLP:

- Log readings to an ascii file on the card without requiring a PC to collect data.
- Simply transfer large amounts of data to a PC without cables and long download times.
- Remotely configure the DT-QNLP. Program the card, insert in the DT-QNLP, and configuration is done automatically.
- Set up more complex monitoring functions and customized computation functions.
- Update calibrations on the internal quartz sensor.

Note that both 485 communications and logging can be done simultaneously.

The DT-QNLP comes with software to place configuration parameters on the compact flash card. The following screen is a sample configuration screen with optional BHP calculation parameters being shown. Once the configuration parameters are placed on the compact flash card, they are automatically installed when the card is inserted into the DT-QNLP.

All configurations share the log rate and monitor rate selections, while additional parameters may be available depending on the client application.

Inserting, Removing, and Handling the Compact Flash Card

The compact flash cards are rugged and rated for the full industrial temperature range of -40C to +85C. While any standard compact flash card probably will work in in the DT-

QNLP, AKS strongly recommends that pre-tested and certified cards from AKS be used. AKS does not guarantee proper operation with cards other than those provided by AKS.

While the cards can be "Hot Swapped", AKS recommends that the power be removed when changing cards. This guarantees that the old card is properly closed down, and the new card is properly initialized prior to use. If it is necessary to hot-swap cards, it is even more important that cards provided by AKS be used as these have special circuitry to handle hot removal.

SPECIFICATIONS

Pressure Sensor
10,000 PSIA Quartz (2X overpressure). 5K, 10K, 15K available – 25K available on special request.
Accuracy: 0.01% FS
Resolution: <0.01 PSI
Calibrated Temperature Range: -40C to 85C
Process Connection:F-375 AutoClave, ½" NPT, WECO 1502 adapter with membrane(special order)
Process fluids: All wetted components in the gauge are Inconel-625.

Electrical
Power: External 10VDC to 24VDC @ 20-40ma reverse polarity protected
Connection: 4-pin screw plug internal to device

Communications
(1) RS-485 serial communications line. Multi-drop (max 254). Surge protected, Fault-Tolerant, Hot Swapable, +-15KV ESD protected. Distance: 1000 ft minimum.
RS-232 (limited distance).

Environmental
Operating Temperature: -40C to +85C.

Housing and Mechanical
Enclosure: Circular explosion proof instrument housing with or without mounting tabs.
Explosion Proof, Class 1, Div. 1 Groups B, C, D., NEMA 4x, 7BCD, 9EFG, EExd IIC, IP66.
Electrical Connection: (2) ¾" NPT conduit for power and communications cabling.
Dimensions: 5" diameter, 5" tall with lid.
Weight: 5.5 lbs

Interface
Command and poll interface. Ascii serial protocol.
Sample programs and drivers are available.

Options (Model DT-QNLP)
An optional compact flash memory card may be installed to record data independent of reading the gauge over the RS-485/RS-232 communications line. The maximum sample rate for this option is once per second. Cards sizes up to 2 GB are available.

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