

1. Introduction

This TI outlines the principles of using two pressure transmitters to calculate Differential Pressure (DP). The General Specification (GS) for the appropriate products should be used to verify the detailed specification.

2. How to Calculate the Error

We will assume both the DP and Gauge Pressure (GP) transmitter has a reference accuracy of $\pm 0.04\%$ of span and use the following worked example to compare the difference between two GP transmitters and one DP transmitter.

- DP span of 100 mBar (or 0.1 Bar)
- GP span of 2 Bar

A GP transmitter will also have a REF ACC $\pm 0.04\%$ of span but based on the span of GP (i.e. 2 Bar). In order to calculate the REF ACC of DP span you need to use two equations. As you will be using two GP transmitters to measure the HP and LP the "REF ACC of Two GPs" must be calculated using equation 1. You then need to convert the % of GP span into % of DP span, "REF ACC of DP", by using equation 2.

3. DP Reference Accuracy of Two GP Transmitters

Equation 1

$$\begin{aligned}\text{REF ACC of Two GPs} &= \pm \sqrt{\text{REF ACC}^2 \times 2} \\ &= \pm \sqrt{0.04^2 \times 2} \\ &= \pm 0.057\% \text{ of span (GP)}\end{aligned}$$

Equation 2

$$\begin{aligned}\text{REF ACC of DP} &= \pm \text{REF ACC of TWO GPs} \times \text{GP SPAN} \div \text{DP SPAN} \\ &= \pm 0.057 \times 2 \div 0.1 \\ &= \pm 1.14\% \text{ of span (DP)}\end{aligned}$$

As modern SMART transmitters can be re-ranged without affecting the REF ACC, the DP transmitter will remain at $\pm 0.04\%$ of DP span.

You can see that the closer the GP span is to the DP span the reference accuracy using two GP transmitters, "REF ACC of Two GPs", gets closer to a DP transmitter. When they are the same the reference accuracy is $\pm 0.057\%$ of DP span compared to $\pm 0.04\%$ of DP span "REF ACC of DP".



4. Options for Outputting the DP Using Two GP Transmitters

You can simply output the GP process variables using an analogue or digital signal (e.g. wireless ISA100) and calculate the difference in a host system or other device. Alternatively, the difference in pressures can be calculated in a Digital Remote Sensors (DRS) which will generate an analogue signal for DP.

Digital Remote Sensors



The individual pressures are not synchronised which could be a problem in level applications when the level is constant and the blanket pressure changes. Synchronisation can be achieved using FF digital protocol and function blocks within the transmitters.

Gauge Pressure Transmitter #1		Gauge Pressure Transmitter #2	
			
Function Blocks	Process Variable	Function Blocks	Process Variable
Analogue Input (AI1)	P1	AI2	P2
		Arithmetic (AR)	P1 – P2
		AI3	DP (P1 – P2)

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
9-3-2, Nakagcho 2-chome, Musashino-shi
Tokyo 180-8750
Japan
www.yokogawa.com

YOKOGAWA CORPORATION OF AMERICA
2 Dart Road
Newman GA 30265
USA
www.yokogawa.com/us

YOKOGAWA EUROPE BV
Euroweg 2
3825 HD AMERSFOORT
The Netherlands
www.yokogawa.com/eu

YOKOGAWA ELECTRIC ASIA Pte. LTD.
5 Bedok South Road
Singapore 469270
Singapore
www.yokogawa.com/sg

YOKOGAWA CHINA CO. LTD.
3F Tower D Cartello Crocodile Building
No.568 West Tianshan Road Changning District
Shanghai, China
www.yokogawa.com/cn

YOKOGAWA MIDDLE EAST B.S.C.(c)
P.O. Box 10070, Manama
Building 577, Road 2516, Bussaiten 225
Muharrag, Bahrain
www.yokogawa.com/bh

Yokogawa has an extensive sales and distribution network. Please refer to the European website (www.yokogawa.com/eu) to contact your nearest representative.

**YOKOGAWA** ◆