

PPT OUTPUT ACCURACY AND RESOLUTION

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Honeywell's Precision Pressure Transducer (PPT) is truly a smart sensor device that provides both a digital and analog pressure output signal. Every PPT unit has both digital and analog outputs and is individually calibrated at the factory for temperature variations throughout the full scale (FS) pressure span across a -40 to 85°C range. Even though there is capability for the user to configure an mx+b null and span correction in the PPT, the stability of less than 0.025% drift/year minimizes calibration concerns. This application note describes the accuracy and resolution specifications of the PPT.

OUTPUT ACCURACY

The PPT is available in different configurations and accuracy grades (see Table 1). The PPT-1 grade provides the best typical accuracy at ±0.05% for the digital output and ±0.06% for the analog output. The maximum accuracy error for this grade is ±0.10% for the digital output and ±0.12% for the analog output.

There is no standard definition for the term 'typical' but it is usually defined at a nominal condition, usually room temperature and a specific pressure input. In order to determine the accuracy over the full temperature range, additional span and zero error terms need to be added.

Honeywell has taken a more rigorous approach to defining the accuracy specifications for the PPT. There are no additional errors that need to be accounted for due to temperature shift. What is specified is simply a typical and maximum error value defined as:

TYPICAL - No PPT shall exceed the typical accuracy error, which is the average of the absolute errors at all tested pressure and temperature measurements.

MAXIMUM - No PPT reading shall exceed the maximum accuracy error, which includes the sum of linearity, repeatability, hysteresis, thermal effects, and calibration errors from -40 to 85°C.

Every PPT unit is tested at selected temperature and pressure values across the specification range. Every reading is recorded for the digital and analog outputs. The error at each reading is compared to the pressure source and an absolute accuracy is determined which are limited by the maximum specified values. The typical accuracy is determined from these data points simply by summing the absolute error at each reading and dividing by the number of readings. If this number exceeds the specified typical accuracy value, the device is rejected. The maximum accuracy error is determined from the same data set to guarantee that no single reading ever exceeds the maximum accuracy specification. These values are usually 2 times the typical values and also represent the full pressure and temperature range of the unit. Honeywell uses a pressure source that is traceable to an NIST standard and certifications are available.

OUTPUT RESOLUTION

The resolution of the PPT is defined as the amount of pressure input change that causes the output to change. The reading resolution varies between the analog and digital output. The digital readings are based on 16+ bit binary arithmetic and provide resolution up to 1 part in 90,000, or 0.0011% resolution. The analog readings are driven from a 12 bit DAC using the 12 most significant bits of this value to provide a 1 part in 4,096, or 0.024% resolution, or 1.22mV per output step.

The digital resolution can be user selected by the Operating Mode Parameters (OP) command. Setting **OP=E** selects the extended mode and uses a resolution of 1:90,000 counts for internal calculations. This is the highest resolution available and is also the default value. Selecting **OP=S** uses a resolution of 1:60,000 counts when less resolution is desired.

		PPT (-1)		PPT (-2)		PPT-R	
Accuracy (%FS)		Typ.	Max.	Typ.	Max.	Typ.	Max.
	Digital	±0.05	±0.10	±0.10	±0.20	±0.10	±0.20
	Analog	±0.06	±0.12	±0.12	±0.24	±0.12	±0.24
Resolution	Digital	0.0011% to 0.01%FS, or 5 significant digits ASCII or binary format (16+ bits)					
	Analog	0.024%FS over 0-5V, 1.22mV steps (12 bits)					

Table 1 - PPT Accuracy and Resolution Specifications

PPT OUTPUT ACCURACY AND RESOLUTION

The actual digital resolution as a percent of full scale (%FS) depends on the full scale range of the PPT. For instance, using the default mode of **OP=E**, a 90psig unit would have 0.001psi internal resolution. A 10psi unit would have an internal resolution of 0.00011psi. In either case, the output, or display, resolution would be 0.001psi since there is only 5 significant digits available - 90.000 and 10.000 are the FS output values. For more specific information on the digital output resolution, see Table 2. Note that the digital accuracy is guaranteed to 0.05% (typical) which is 0.045psi for the FS=90psi unit and 0.005psi for the FS=10psi unit. This results in a 45:1 ratio, or a 5:1 ratio, for the resolution to accuracy outputs for the 90 and 10 psi units respectively.

1:50,000 counts. Also, the analog voltage is driven from a 12 bit DAC that uses 4,080 (instead of 4,096) counts for the full scale value. This allows for factory adjustment and fine tuning. For more specific information on the analog output resolution, see Table 3. The analog output resolution can be increased by using the **O=** and **W=** commands to reduce the full scale pressure span. This is a direct effect so that the resolution will double for a 2x reduction in FS range.

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The analog output resolution is derived from the digital compensated value but has an internal resolution of

Full Scale (psi)	Internal Resolution (psi)		Digital Output Resolution (psi)	Output Resolution (%FS)
	OP=S	OP=E	5 Digits	
10	0.00017	0.00011	0.001	0.01
20	0.00033	0.00022	0.001	0.005
50	0.00083	0.00055	0.001	0.002
90	0.0015	0.001	0.001	0.0011
>90	>0.0015	>0.001	0.01	<0.01
100	0.0017	0.0011	0.01	0.01

Table 2 - PPT Digital Output Resolution

Full Scale (psi)	Internal Resolution (psi)	Analog Output Resolution* (psi/step)	Output Resolution (%FS)
10	0.0002	0.0024	0.024
20	0.0004	0.0048	0.024
50	0.001	0.012	0.024
90	0.0018	0.022	0.024
>90	>0.0018	0.01	0.024
100	0.002	0.024	0.024

* The resolution can be increased by using the **O=** and **W=** commands.

Table 3 - PPT Analog Output Resolution