Scaling data from the BP-20 Absolute Pressure Sensor

Introduction

The BP-20 is a micromachined electronic absolute pressure sensor. This application note explains how to scale and how to interpret data from a BP-20 sensor used on an NRG Symphonie logger.

There are a variety of units of measure that are customarily used for pressure. The SI unit for Pressure is the Pascal (abbreviated Pa). The BP-20 is an "absolute pressure" or "barometric pressure" sensor. The customary metric unit for barometric pressure is the (now obsolete) bar. Barometric pressure varies around one bar, so the barometer reading is stated in millibars (abbreviated mb). Mercury barometers were traditionally used to measure barometric pressure, so the U.S. customary units for barometric pressure are inches of mercury (abbreviated inHg). Mercury expands and contracts with changes in temperature, so exact conversion factors from Pascals to inches of Mercury depend on the temperature. At 0 °C, the conversions are:
1 kilopascal = 10 millibars = 0.2953 inches of mercury.

In this note, these conversion factors are used to express barometric pressures in customary units as well as the SI units.

Raw Data

The output signal from the BP-20 is an analog voltage proportional to absolute air pressure. A graph of the output voltage of the BP-20 versus absolute pressure is a straight line. The scale factor of the sensor by itself (the slope of the graph) is 0.0459 Volts per kilopascal. This value is precisely calibrated and is the same for all BP-20 sensors.

The useful range of the sensor does not extend all the way to zero pressure (vacuum). The graph of the output extends through zero volts at about 10.55 kPa. This "offset" value varies from sensor to sensor, and is measured when the sensor is calibrated at the factory. The exact offset for your BP-20 is stated on the calibration sheet. The sensor's useful range is from 15 kPa (150 mb or 4.43 inHg) to 115 kPa (1150 mb or 34 inHg).

The Symphonie logger must be equipped with the BP20 SCM card to accept the signal from a BP-20. The SCM amplifies (magnifies) the BP-20 output signal to focus on the useful barometric pressure range. The "raw" data from the logger ranges from 0 to 1023. This range corresponds to about 78 kPa (780 mb or 23 inHg) to about 108 kPa (1080 mb or 32 inHg).

Scaling

Symphonie Data Retriever software uses a Scale Factor and Offset that you configure to scale your raw data to the units you choose. Each BP-20 has a unique offset, so the Offset value you enter is different for each sensor. In addition, the BP20 SCM amplification must be taken into account in calculating the Scale Factor and Offset. The calibration sheet for your BP-20 has a pre-calculated table of Scale Factors and unique offsets you can use to scale your data in kilopascals, inches of Mercury, or millibars for your specific sensor.

Altitude Compensation for Station Pressure

Barometric pressure data may be used for a variety of purposes. For air-density calculations typically required of wind power performance measurements, for example, the absolute pressure is most often used. Use the Slope and Offset given on the BP-20 calibration sheet to scale your data as absolute pressure. ***No other correction is required for absolute pressure data*.**

For weather forecasting, the barometric pressure is normalized to sea level to make comparisons between stations clearer. This "station" pressure measures what the absolute pressure would be at sea level, given the current conditions at the site. Station pressure is the barometric pressure commonly quoted in weather reports. For site altitudes above sea level, the station pressure will be higher than the absolute pressure, since the measured pressure is higher for denser air at lower altitudes. ***To obtain station pressure from the BP-20 requires the correction described below.***

The correction to station pressure is a fixed Offset based on the site's altitude. A table of altitude correction offsets is included below. To use these values, add the Offset given on the sensor calibration sheet to the altitude offset listed in the table. Enter the sum of the two offsets as the Offset parameter. For example, if your barometric pressure sensor is installed at a site 152 meters above sea level, you will need to add 19.2 mb to the calibration sheet offset of 650 mb (as an example) for a total offset of 669.2 mb.

If a nearby airport or other weather observing station is available, you can calculate the exact Offset required for your location by logging data during a period of stable barometric pressure (usually in a long period of fair weather). Record the reported barometric pressure at the observing station. If the scaled values from the data logger are higher than the observing station, reduce the Offset parameter by the difference. If the scaled values are lower than the observing station, increase the Offset parameter by the difference. Using this adjusted offset, your data will be scaled exactly as station pressure.

TABLE 1 ALTITUDE CORRECTIONS

ALTITUDE (FEET)	ALTITUDE (METERS)	DELTA P (mb)	DELTA P (inHg)
0	0	0.00	0.00
100	30	3.9	0.115
200	61	7.7	.229
300	91	11.6	.343
400	122	15.4	.456
500	152	19.2	.569
600	183	23	.681
700	213	26.8	.793
800	244	30.6	.905
900	274	34.3	1.016
1000	305	38	1.127
1100	335	41.8	1.237
1200	366	45.5	1.347
1300	396	49.2	1.456
1400	427	52.9	1.565
1500	457	56.5	1.674
1600	488	60.2	1.782
1700	518	63.8	1.890
1800	549	67.4	1.997
1900	579	71.1	2.104
2000	610	74.7	2.211
2100	640	78.2	2.317
2200	671	81.8	2.423
2300	701	85.4	2.528
2400	732	88.9	2.633
2500	762	92.4	2.738
2600	792	96	2.842