

Application: Custom Curve

Custom curve measurement mode

Based on the measurements and the measurement mode, the XEN-5320 will calculate an output signal. In the HE and the H2 modes, the output signal is the percentage of He in air or H₂ in nitrogen. In the general mode the output signal is simply the relative deviation from the set-zero value, while in the vacuum mode the output percentage is the pressure, relative to atmospheric pressure. In all cases the sensor will correct for the temperature and humidity measured by the humidity sensor.

However, there is another measurement mode, the Custom Curve measurement mode, where a custom curve is used to define the output. This could be, for instance, the curve of a binary gas mixture, where, normally, the range is from 0% of the first gas to 100% of the first gas (and 100% of the second gas to 0% of the second gas). The custom curve can be loaded from computer into the LabView program that communicates with the XEN-5320, and then uploaded into the memory of the XEN-5320.

The Custom Curve look-up table has 23 points, in which the concentration of one gas in another gas is given versus the normalized transfer (output voltage divided by input heating power in V/W, normalized to the set-zero value) of the XEN-5320. The user can enter any look-up table as long as it conforms to the required format.

The format is a two-column text file, in the first row there is the name of the curve, with a limited number of characters (10). The rows 2-24 have 23 pairs of points, with first the concentration of one gas in another gas, and then the associated normalized transfer. See Table 1.

Standard custom curve

Users can make their own Custom curve, by determining the calibration curve for the gas mixture. First the transfer of the XEN-5320 is measured at 11 points: 0%, 10%, 20% 90% and 100% of the first gas with the balance of the second gas. And subsequently, using an EXCEL sheet or another manner of interpolation, 23 points are extracted from the composition-transfer calibration curve. In general, the 23 points custom curve consists of points at 5% intervals, including an extrapolated -5% and a 105% point to allow for slight offset and gain variations.

In Table 1 it can be seen that the normalized-corrected transfer is higher for 100% CO₂ (1.0000) than for CH₄ (0.58993), just as in the CH₄-N₂ curve the transfer is lower for the CH₄ than for nitrogen. As can be seen in Table 1, the corrected transfer can go up or down with increasing output signal, this depends on the thermal conductivity of both gases. In all cases the maximum is 1.0000 at 0% or 100% of the first gas, excepting the extrapolation for offset variation purposes.

However, the user is free to choose the points as he or she seems fit. In order, for instance, to better adjust low H₂ concentrations in air or nitrogen, it is possible to use smaller intervals at low H₂ concentrations, and use intervals of, for instance, 10% at the high H₂ concentrations, see Table 2. If only the 0-10% range for H₂ in N₂ is used in the experiment, one can use many more points in the 0-10% region, and less (or none) in the higher regions.



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Table 1: Custom curves for the CO₂-CH₄ and the CH₄-N₂ mixtures including extrapolated points to allow for offset drift. The left column of the curve shows the fraction of the first listed gas, the right column shows the normalized, temperature-and-humidity-corrected transfer.

Output	Transfer	Output	Transfer
CO2-in-CH4		CH4-in-N2	
1.05	1.03265	1.05	0.80004
1.00	1.00000	1.00	0.80712
0.95	0.96995	0.95	0.81451
0.90	0.94208	0.90	0.82213
0.85	0.91445	0.85	0.82987
0.80	0.88910	0.80	0.83809
0.75	0.86370	0.75	0.84620
0.70	0.84080	0.70	0.85478
0.65	0.81746	0.65	0.86332
0.60	0.79625	0.60	0.87230
0.55	0.77479	0.55	0.88130
0.50	0.75515	0.50	0.89075
0.45	0.73539	0.45	0.90024
0.40	0.71701	0.40	0.91026
0.35	0.69876	0.35	0.92029
0.30	0.68175	0.30	0.93081
0.25	0.66485	0.25	0.94141
0.20	0.64889	0.20	0.95257
0.15	0.63315	0.15	0.96377
0.10	0.61832	0.10	0.97562
0.05	0.60355	0.05	0.98746
0.00	0.58993	0.00	1.00000
-0.05	0.57596	-0.05	1.01253

Table 2: The custom curve for hydrogen in nitrogen, with an extra point at 2% instead of the 95% point.

Output	Transfer
H2-in-N2	
1.05	0.1670
1.00	0.1827
0.90	0.2177
0.85	0.2372
0.80	0.2577
0.75	0.2796
0.70	0.3032
0.65	0.3287
0.60	0.3556
0.55	0.3847
0.50	0.4168
0.45	0.4515
0.40	0.4895
0.35	0.5310
0.30	0.5767
0.25	0.6275
0.20	0.6842
0.15	0.7475
0.10	0.8206
0.05	0.9050
0.02	0.9605
0.00	1.0000
-0.05	1.1200

The custom curves shown above are reasonably standard. And more are available for other binary gas mixtures, please contact Xensor.

The more extreme examples are given in the Application note 'Customizing the Analog Output', where the custom curve is manipulated to get the desired analog output voltage range.

