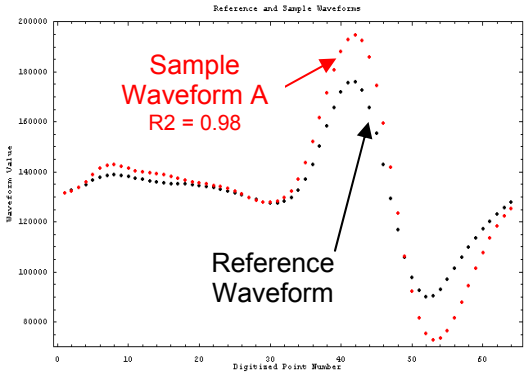
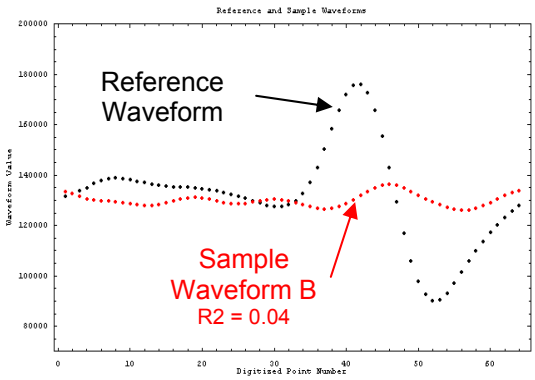
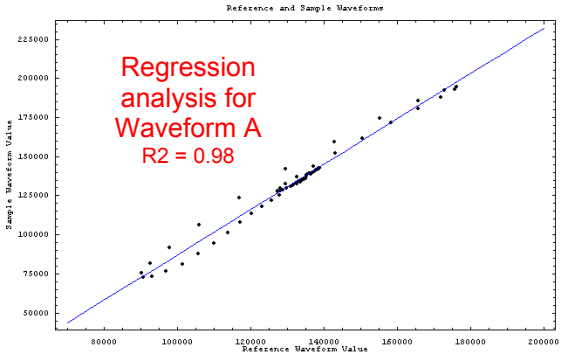
7. Explanation of R^2

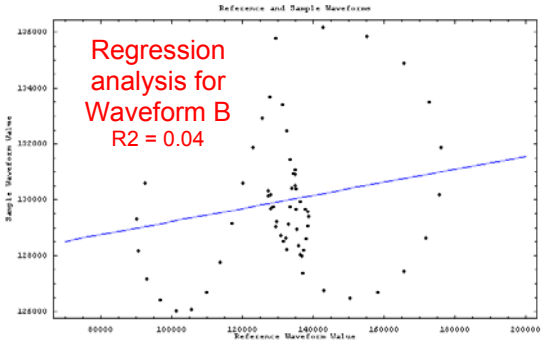
When the **GasFinder** receives the returning laser signal after it has passed through the sample gas, the receiver converts it to the shape of a specific waveform or curve. This is the sample waveform. The **GasFinder** also receives a similar signal after the laser beam has passed through the internal reference cell. These curves are then digitized and compared as two numeric arrays.





An accepted mathematical procedure to compare curves or numeric arrays is the **Linear Least Squares Regression** analysis. This analysis results in a measure of the similarity (**R^2**), between the waveform of the **sample** gas and that of the **reference** cell gas. A perfect similarity would give a value for **R^2** of 1.0, and a total mismatch would be 0.0.

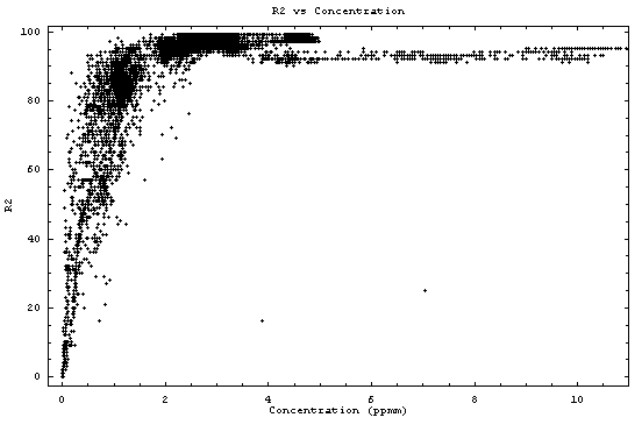




The blue line represents the **Linear Least Squares** fit of the data and is the best fit of a straight line between the reference (X) and sample (Y) data points. The slope is a component in the ratio-metric calculation of gas concentration.

(Explanation of **R^2** continued).

A typical plot of **concentration** versus **R^2** will give the following graph:



With lower levels of sample gas, the **R^2**s decrease, and equal zero when there is no gas present. As the signal from the gas becomes stronger, the effect of noise, both electronic and optical, is reduced and the **R^2**s will increase (i.e., the signal to noise ratio will increase). The general shape of the plot is the same for all gases, however, the x-axis values will depend on the sensitivity of the instrument to the gas species being observed.

Measurement Accuracy

R^2 can also be used as an indication of the accuracy of the gas concentration measurement.
The following data were generated in the laboratory under controlled conditions using a 1m Teflon tube and a permeation source for the generation of target gas.

R^2	Measurement Accuracy
>0.95	±2%
0.9	±5%
0.7	±10%
0.5	±15%
0.4	±20%
0.3	±25%
0.15	±50%
0.1	±70%
<0.05	±100%