Processing Very Tiny and Huge Monster Peaks In the Same Chromatogram

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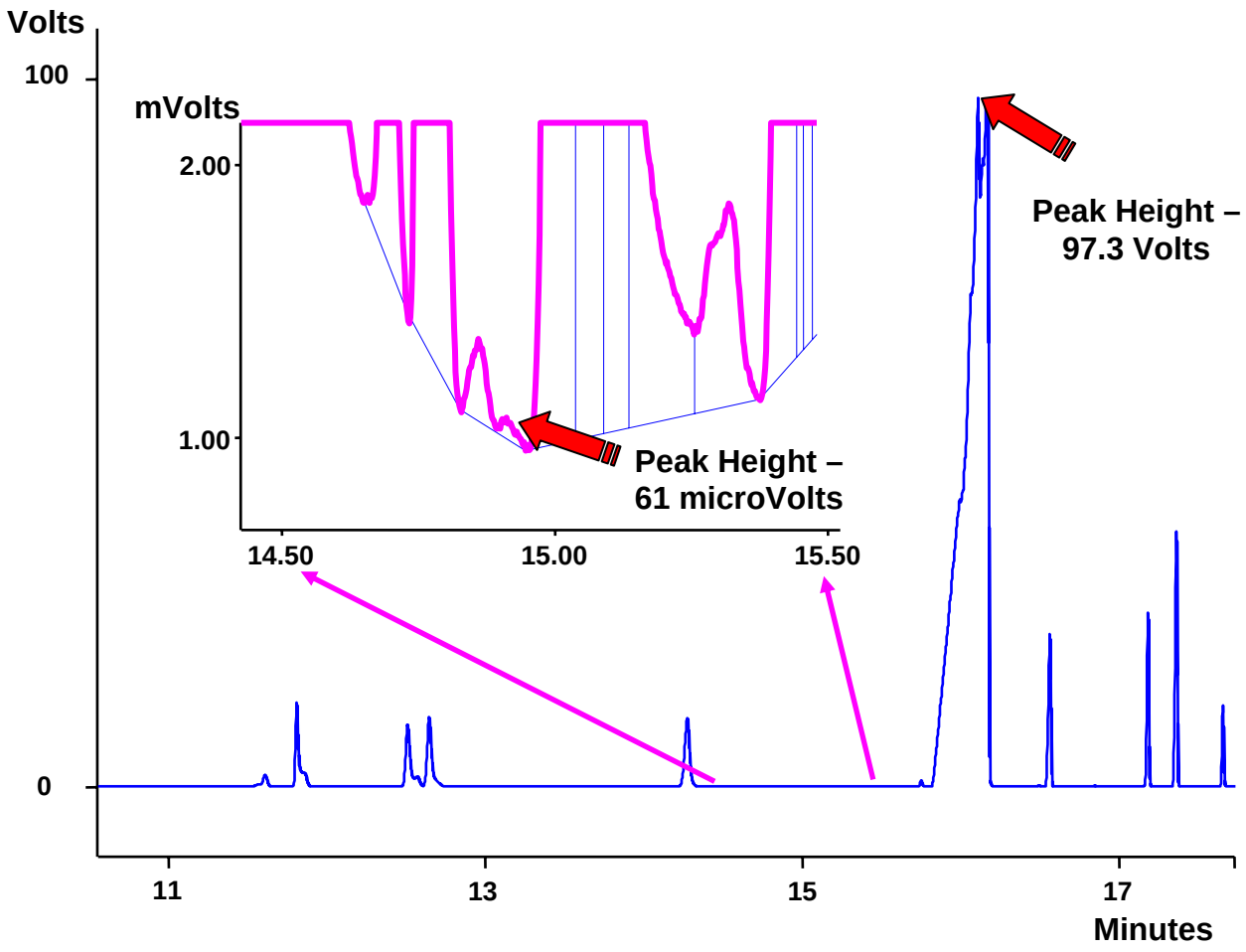
The Flame Ionization Detector in gas chromatography undoubtedly has one of the widest linear ranges of any detector in analytical chemistry. A good performing Flame Ionization Detector is capable of measuring methane from less than 50 ppb V/V to in excess of 50% V/V with a single 1 ml injection – a dynamic range of 10,000,000 or 10^7.

This detector combusts methane, and other hydrocarbons, to generate ions that can create a current from near 10^{-14} amperes to over 10^{-6} amperes. These ions are collected and processed through an electrometer to convert the current signal into a voltage to be displayed either through a strip chart recorder, or through an analog-to-digital converter to yield a number to then be processed by a data system. Since most detector electrometers and analog-to-digital converters can handle signals to +10 volts maximum, they are unable to properly yield the wide range available with the Flame Ionization Detector, as the full range signal can be from 10 microvolts (noise levels) to nearly 1000 volts. To put the signal voltage within the range of the common electrometer and analog-to-digital converter, the electrometer usually has range settings to alter the current to voltage conversion. Since the Model 1740 introduction in 1968, Varian has provided range settings of 10^{-12} A/mv, 10^{-11} A/mv, 10^{-10} A/mv, and 10^{-9} A/mv that now are labeled on the Varian 3800 as simply 12, 11, 10 and 9, with 12 being the most sensitive.



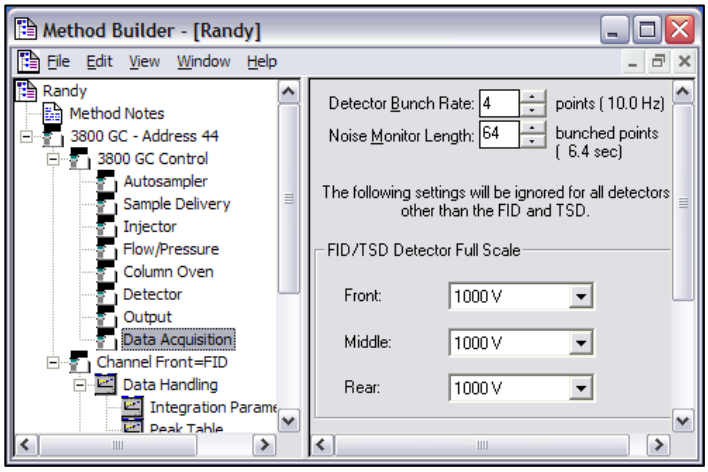
The major issue becomes what range to select for an upcoming chromatographic run – will the peak need a sensitive range to see it? Or will it be huge and require a less sensitive range to keep it on scale? If the guess is wrong, then a new guess is inputted and the sample reinjected – a time-consuming process and a definite loss in productivity, especially if the second guess is wrong as well. And the situation definitely turns south when both petite peaks and humongous peaks are to be measured on the same chromatogram.

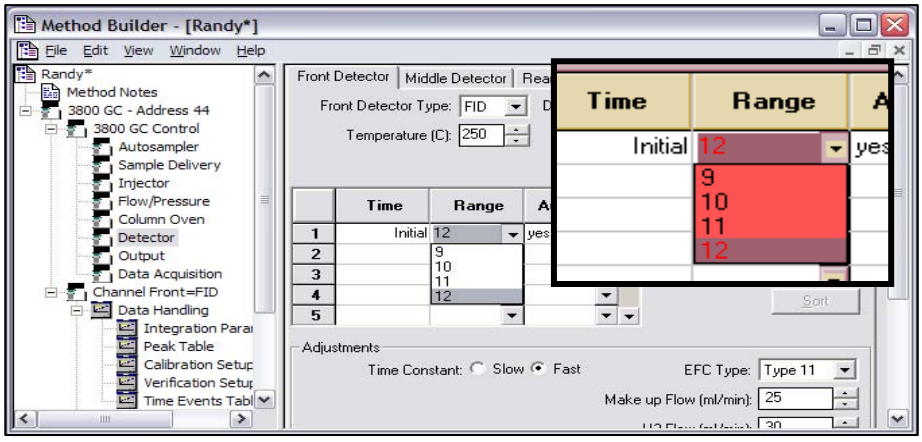
Varian solved this conundrum by implementing a special variation of the electrometer for its 3800 and 3900 Gas Chromatographs, where the detector signal current is converted directly to a number, bypass the voltage conversion step. Since numbers readily can be handled from 1 to 10,000,000 (and even more!), this electrometer can be set to the most sensitive setting – range 12 – and still be able to monitor peak heights that would represent 1000 volts! Now one range setting can handle the full operating range of the Flame Ionization Detector.

By simply zooming in on the data system's chromatogram display, extremely small peaks – less than 100 microvolts can be seen on the same chromatogram as huge peaks – up to 1000 volts. And the big range of numbers for the peak areas or heights is readily handled through the number-crunching capabilities of modern computers.

The guess work for choosing a proper range to keep peaks detectable is eliminated. The operator simply sets the range to the most sensitive setting of 12 and the FID/TSD Detector Full Scale parameter to 1000 volts in the Workstation method…

AND ALL IS PRESERVED!





This feature also applies to signal processing with a Thermionic Specific Detector (TSD), and with a Valco Pulsed Discharge Detector using the Varian 3800/3900 electrometer.

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