

Ion Source Pressure Regulation

Local application analysis

Tue, Jun 8, 2004

This note analyzes the logic in the LOOPPRES closed loop local application. Several parameters can affect the behavior of the loop. The example shown here is taken from the I- source.

IPRES	25.73	Source pressure in μ Torr. (Setting value provides reference.)
ISPTHR	0.2	Threshold. If pressure is less than this far, no regulation.
ISPWIN	8	Window outside of which no regulation is done, unless too hi.
ICPR	5	Course adjustment made when reacting to pressure too high.
ITGOFF	1193	Gas valve off time in μ s.
ITGON	1003	Gas value on time in μ s.

The following logic is executed every 15 Hz cycle. The reference set-point for pressure regulation is taken from the setting field of IPRES. The window value is taken from the setting field of ISPWIN.

To make this complete, there are a few checks made for unusual values of the parameters. If either the set-point or the gas value off time is negative, nothing is done. If sampled values of the set-point or the gas value off time do not match the current values, the average accumulation is restarted, and new samples are taken. (The idea here is that someone else altered one of these values, so we should begin a new average computation.) If the window value is negative, no action is taken.

Beyond these checks, an average of pressure readings over 16 pulses is made, in order to reduce the random fluctuations in the readings by a factor of 4. At the conclusion of a 16-cycle sequence, armed with a new average value of the pressure, if the average pressure is more than the threshold above the set-point, and the latest pressure reading is still within the window, plan to adjust the gas valve off time downwards by 0.1 μ s, which is the resolution of the timer.

But suppose that the average pressure is more than the threshold value *below* the set-point, and the latest pressure reading is still within the window. Then plan to adjust the gas valve off time *upwards* by 0.1 μ s.

If the average pressure is more than the window size above the set-point, then plan to reduce the gas valve off time by the coarse parameter. The idea here is to try to bring down the source pressure more quickly than the more leisurely 0.1 μ s adjustments could.

Before actually making an adjustment, a check is made that the gas valve off time is not less than the gas valve on time. In either case, the latest set-point value and gas valve off time is sampled, and a new average accumulation is begun.

Note that the scaling for the ICPR causes its reading to be misleading. The scaling is 16384, meaning that its actual raw reading is 0x000A, which actually corresponds to 1.0 μ s. The scaling should probably be changed to 3276.8, so that the reading in μ s units is correct.