

Vacuum Reading Conversion

Local application

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The JC Controls IG6600 Ion gauge Controller manual shows the formula used for reporting the vacuum as a voltage.

$$V_{\text{out}} = 2 + (- \text{vac.exponent}) + (1 - (\text{vac.mantissa}/10))$$

where $\text{vac} = \text{vac.mantissa} * 10^{\text{vac.exponent}}$.

The following list of examples is provided:

<i>Torr</i>	<i>Vout</i>
450	0.55
$9.3 * 10^0$	2.07
$4.4 * 10^{-1}$	3.56
$1.0 * 10^{-3}$	5.90

Consider this approach:

```
float v, r, m, vac;  
  
r = 100.0;  
while (v > 1.0)  
{  
    r /= 10.0;  
    v -= 1.0;  
}  
m = (1.0 - v)*10.0;  
vac = r * m;
```

where $v = V_{\text{out}}$, $r = \text{vac.exponent}$, $m = \text{vac.mantissa}$, and $\text{vac} = \text{pressure in Torr}$. After the loop, $v \leq 1.0$, so m is in the range 0 – 10.0.

Trying the examples:

For $v = 0.55$ volts, $r = 100.0$, $m = 4.5$, $\text{vac} = 450$ Torr.

For $v = 2.07$, $r = 1.0$, $m = 9.3$, $\text{vac} = 9.3$.

For $v = 3.56$, $r = 0.1$, $m = 4.4$, $\text{vac} = 0.44$.

For $v = 5.90$, $r = 0.001$, $m = 1.0$, $\text{vac} = 0.001$.

The LA may be called `vacc`. Its parameters are:

<i>Field</i>	<i>Size</i>	<i>Meaning</i>
ENABLE	B 2	usual LA enable Bit#
FORMULA	2	formula index# 1, 2, etc
IONGAGE	C 2	ion gauge Chan#
NCHANS	2	#consecutive channels
VAC	C 2	resultant vacuum Chan#
IVAC	C 2	resultant integer vacuum Chan#, in units of milliTorr

The result `VAC` channels are raw floating point channel in order to handle a wide range. For `IVAC`, see below.

Post implementation notes

During testing, an anomaly was found that required some changes in the above logic. The essence of a new understanding is that the hardware will not provide certain voltages. We cannot expect values Between 0.9 volts and 1.0 volts, which represents 100 Torr, except for imperfect digitization. We therefore need to convert any value in the range 0.9–1.0 volts to be 100 Torr. The same thing happens for voltages in the range 1.9–2.0 volts, which represent 10 Torr, etc.

Another issue that arose stems from the desire to plot the vacuum reading results. We do not as yet support plotting raw floating point channel readings. To make it possible, another parameter was added that can target normal (plottable) integer channels in addition to the raw floating point channels. The raw units are milliTorr, so that the smallest reading of 0.001 Torr is represented as 0x0001. The maximum reading available for such plotting is 32.7 Torr, due to the 2-byte limit.