The Application Note is pertinent to the Mentor II / Quantum III, Unidrive and SE Family

Filtering/Smoothing for Digital Displays

When customer applications employ a Digital Display whether it be a UniOp, CTIU or SCADA screen, unsteady values unfortunately become an annoyance since the displayed numbers tumble rapidly and may swing such that it may appear to be a system that is not regulating so well. Readout complaints can arise when one observes the armature current for example. Normally the drive is responsible for regulating motor speed. In order to regulate speed it may be necessary to command various levels of armature current. When traditional analog meters are employed, natural meter movement damping is achieved that tends to filter or smooth the same displayed value. Digital Panel Meters tend to incorporate a filter for this very purpose.

One can easily smooth a digitally displayed value if the drive uses an MD29 Application Co-processor. This Application Note will show how one can smooth without the need for the MD29 Application co-processor.

Example

Suppose an Operator Interface Unit (keypad/display unit) were being used to display Motor RPM, Motor Voltage and Motor Amps from a Quantum III Drive. To display motor amps , the display unit would be programmed to monitor parameter #5.01 within the drive. The displayed value of Motor Amps may appear to flutter as the drive is regulating speed (current needs to change to keep the motor speed regulated). If this proves to be an annoyance, one could employ a simple LPF (low pass filter) to the signal to be displayed and re-program the display to monitor this filtered value.

CTIU

UniOp
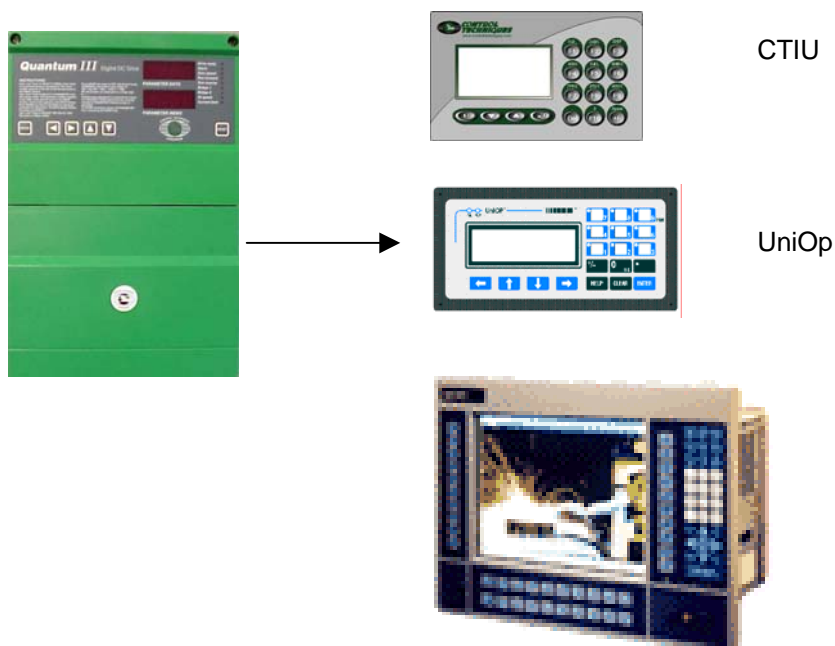
The following shows the external installation of a simple RC filter circuit added to terminal strips TB1 and TB2. The scheme pulls the armature current signal (#5.01) out via DAC #3 (digital to analog converter) as an analog value spanning 0 to 10v (10v = 1000 = 150% at max current). This signal is presented to an RC filter and the filtered signal brought back into the drive via ADC #4 (analog to digital converter). This filtered value can be directed to a free un-used parameter within the drive. The scaled signal is directed to a parameter capable of holding a bi-polar number of this magnitude up in free memory (menu 15.06-15.10 or 16.06-16.10). The parameter that I selected is #15.06. The assignment will become complete after a Drive Reset is performed.
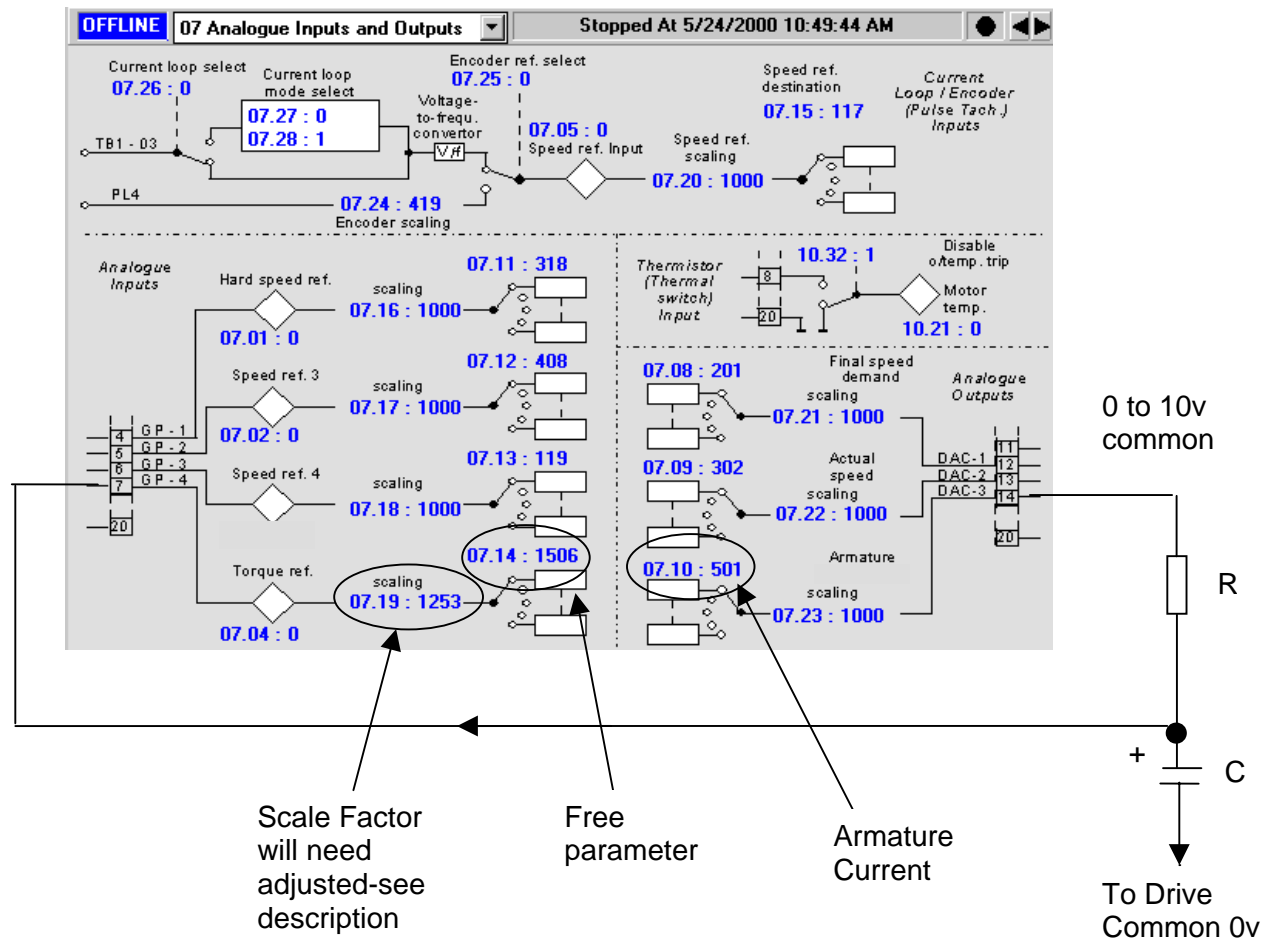
Calculation of Resistor & Capacitor Values

A suitable RC time constant would be about ½ second. Knowing that the input impedance of the ADC's are nominally 100K, I wanted to stay below 30% of this impedance. Therefore, the R value that I selected was to be less than 33K.

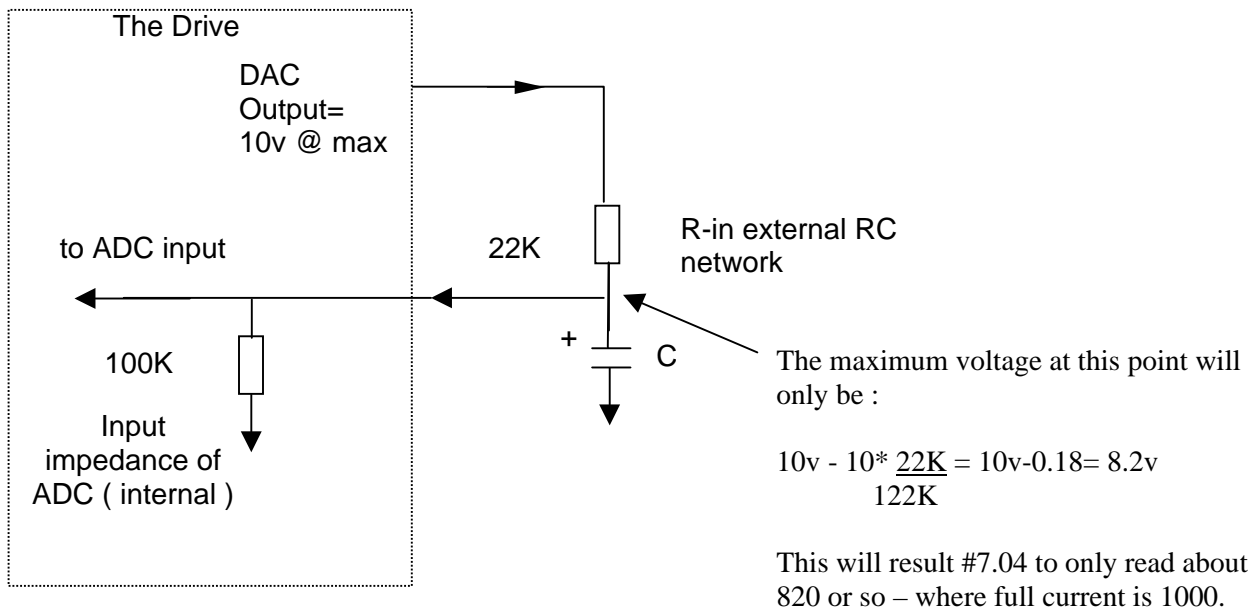Therefore, for t=RC and t = 0.5 I selected a readily available resistor value for R of 22K and Capacitor of 22uF.

Resulting in a time constant of approximately:

$$t = RC = (22 \times 10^3)(22 \times 10^{-6}) = 484 \times 10^{-3} \text{ or } 0.48 \text{sec}$$

(really, the R here becomes the parallel combination of 100K and 22K or 18K, so the time constant is more like 0.4sec – but close enough for our purposes.)

Calibration

Because the Analog Input has an approximate input impedance of 100K, the series R will result in a voltage division (drop) across the R. For this example, it would be approximately:

The Drive

DAC Output= 10v @ max

to ADC input

22K

R-in external RC network

100K

+   C

Input impedance of ADC (internal)

The maximum voltage at this point will only be :

$$10v - 10* \frac{22K}{122K} = 10v-0.18 = 8.2v$$

This will result #7.04 to only read about 820 or so – where full current is 1000.

So we must use the Analog Input Scaler to recover the voltage lost so that 100% current read from #5.01 will be realized when used as the conditioned motor current.

Note: The capacitor used in this circuit should be a low leakage type (tantalum or similar) 15-25vdc rated. The positive lead should go to the DAC output. The circuit shown would be for Unipolar applications only. For bi-polar situations, you would use two caps in series with negative leads connected together (the value of capacitance would need to be doubled as capacitors in series halve their values if the same).

Practical Calibration

A more practical way of calibrating the scaler is to simply set the DAC output to a parameter that is set at 1000. I did this by temporarily changing the output assignment of DAC #3 to read the value in the Max Speed Limit register, parameter #1.06, which is almost always 1000-but I still checked!. (I set #7.10 = 106). This will cause 10v to be generated on the DAC output. Then you would read the Analog Input directly, in this example #7.04. In my circuit, #7.04 read 792 (due to parts tolerances versus theoretical calculated previously). Therefore, the scaling parameter #7.19 would become:

$$\frac{1000}{792} = 1.263 \quad \text{-> set } \#7.19 = 1263$$

in order to bring the 792 reading up to 1000 when directed to #15.06

Practical Calibration con't

After verification that 1263 would cause a reading of 1000 in #15.06. you would then make #7.10 = 501 to read the armature current instead.

One could observe the filtered armature current in #15.06. The digital display unit could now be re-programmed to monitor #15.06 providing a steady/smooth armature amp readout.

Notes

1)   Outputs take effect immediately upon their assignment. So as soon as 501 was placed into the source register #7.10, DAC #3 would output the analog output based on the Armature Current. The scaling parameters are also active as they are adjusted.

2)   Inputs (input assignments) are taken more seriously. They require a purposeful DRIVE RESET to take effect. Therefore, even though #7.14 was set with 1506, #15.06 would not show the value seen in #7.04 until after a RESET.

Conclusion

Although this example was centered around the Mentor II/ Quantum III Drive, this technique could be used to filter any parameter value for the Unidrive or Commander SE. The analog I/O assignments would be different but the philosophy would be the same.

For additional information on this topic click on the link below:
http://www.emersonct.com/download_usa/appNotes/ctan212.pdf
on Creating a UniPolar %Speed Meter Output

Another applicable Application Note might be CTAN 188 Creating % Load Meters
http://www.emersonct.com/download_usa/appNotes/ctan188.pdf

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