



Application Note

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|------------------------|--|---------------------|------------------------|
| Product Family: | Do-More, Click, and Productivity | Number: | AN-MISC-038 |
| Subject: | Running Averaging (smoothing) Logic for a Data Register | Date Issued: | August 23, 2021 |
| | | Revision: | V1.0 |

There are times that you have an input value coming into the PLC that fluctuates. The fluctuation could be from electrical noise, unstable measurement sensor, or just a value that fluctuates normally. If you want to display the value on an HMI or want a more stable value for internal calculations, you will need to have some smoothing or averaging logic.

There is a simple formula that you can use to help smooth out the variable that you are trying to monitor.

$$AVG = (AVG * \text{Average Weighting}) + (\text{Input Raw} * \text{Input Weighting})$$

- AVG = The running average of the input that you want to smooth
- Input Raw = The incoming input value
- Average Weighting = The weighting of running average (%)
- Input Weighting = Weighting of the incoming value (%)

By adjusting the weighting constants, you can have the average be more dominant or the incoming input be more dominant, it all depends on your application. The weighting constants must add up to a value of 1, so the following ladder examples will calculate the Average Weighting when you adjust the Input Weighting.



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High Average Weighting Example

(Smoothing for an input with large value swings)

- Avg_Weighting = 0.95
- Input_Weighting = 0.05
- Input_Average = 75
- Input_Raw = 75

Now your Input_Raw drops and reads a value of 40. Since the Average has more weighting, the new average (after the computation) would be 73.25. The Input_Raw value can swing from high to low extremes, but the running average will be a more stable number. This would be used for an incoming signal that has wild, extreme swings to it.

Low Average Weighting Example

(Smoothing for a more stable input)

- Avg_Weighting = 0.05
- Input_Weighting = 0.95
- Input_Average = 75
- Input_Raw = 75

Now your Input_Raw drops and reads a value of 40. Since the Input has more weighting, the new average (after the computation) would be 41.75. The average will follow closer to the actual input since the input has higher weighting. This type of weighting can be used for a somewhat stable input, but you just want a rolling average of what the input is.

Along with the weighting, you can also control how fast you perform the calculations. You can run the calculations as fast or slow as your application requires.



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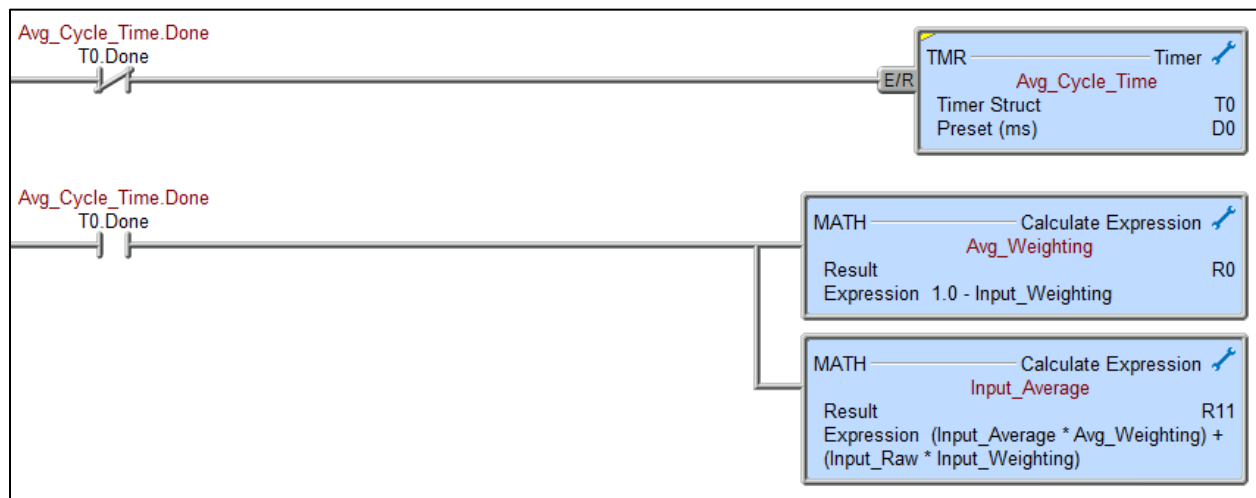
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In the following examples, the averaging constants and timer preset were done using variables. You could use hardcoded constants instead. By using variables, you can use a Data View window to change the weighting and cycle time on the fly, and not have to change constants and reupload code to the PLC. Using variables allow you to tune the filtering logic in real time.

The example also uses a free running timer enabling the math instruction, you can make the averaging operate as fast, or slow, as you want. Adjusting the cycle timer will speed up or slow down the averaging calculation. Finding the right balance of weighting and cycle rate will depend on the variable that you are trying to average.

The examples are for the D-More, Click and Productivity PLCs, but will work with any PLC that supports floating point numbers. You need to use floating point to keep from having rounding errors.

Do-More PLC



- D0 = Filtering time (in milliseconds)
- R0 (Avg_Weighting) = Average Weighting constant
- R1 (Input_Weighting) = Input weighting constant
- R10 (Input_Raw) = Raw input value coming into the PLC
- R11 (Input_Average) = The input average

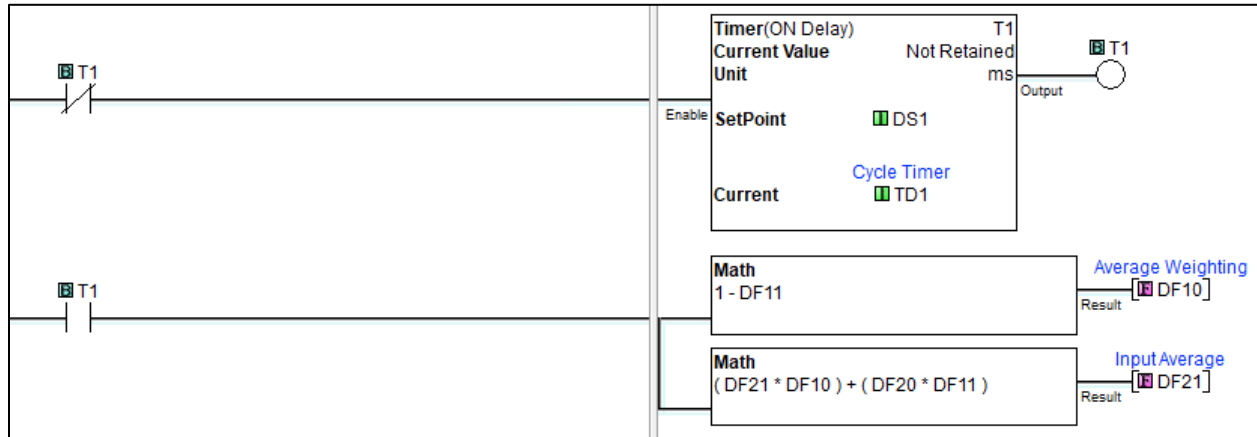
Technical Assistance: If you have questions regarding this Application Note, please contact [Technical Support](#) for further assistance.



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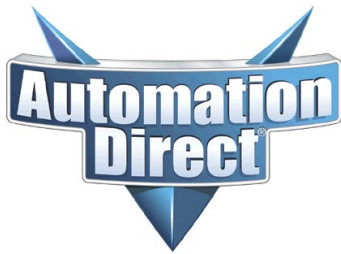
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Click PLC



- DS1 = Filtering time (in milliseconds)
- DF10 (Avg_Weighting) = Average Weighting constant
- DF11 (Input_Weighting) = Input weighting constant
- DF20 (Input_Raw) = Raw input value coming into the PLC
- DF21 (Input_Average) = The input average

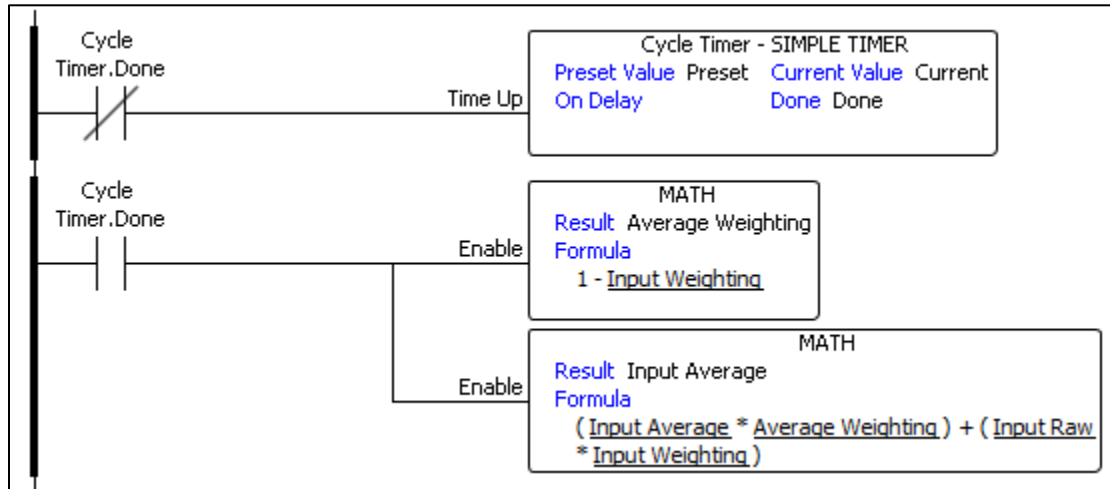
Note: The example registers avoid using DF1 – DF9. This is because if you are using a Click model that has built-in analog IO, those Clicks will use DF1 – DF9 for the default analog registers.



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Productivity PLC



- Cycle Timer.Preset = Filtering time (in milliseconds)
- Average Weighting = Average Weighting constant
- Input Weighting = Input weighting constant
- Input Raw = Raw input value coming into the PLC
- Input Average) = The input average

Make sure that you define your tags as Floating Point to not have rounding errors.