WOODWARD

**Application Note 51259**
**(Revision NEW, 6/2005)**
**Original Instructions**

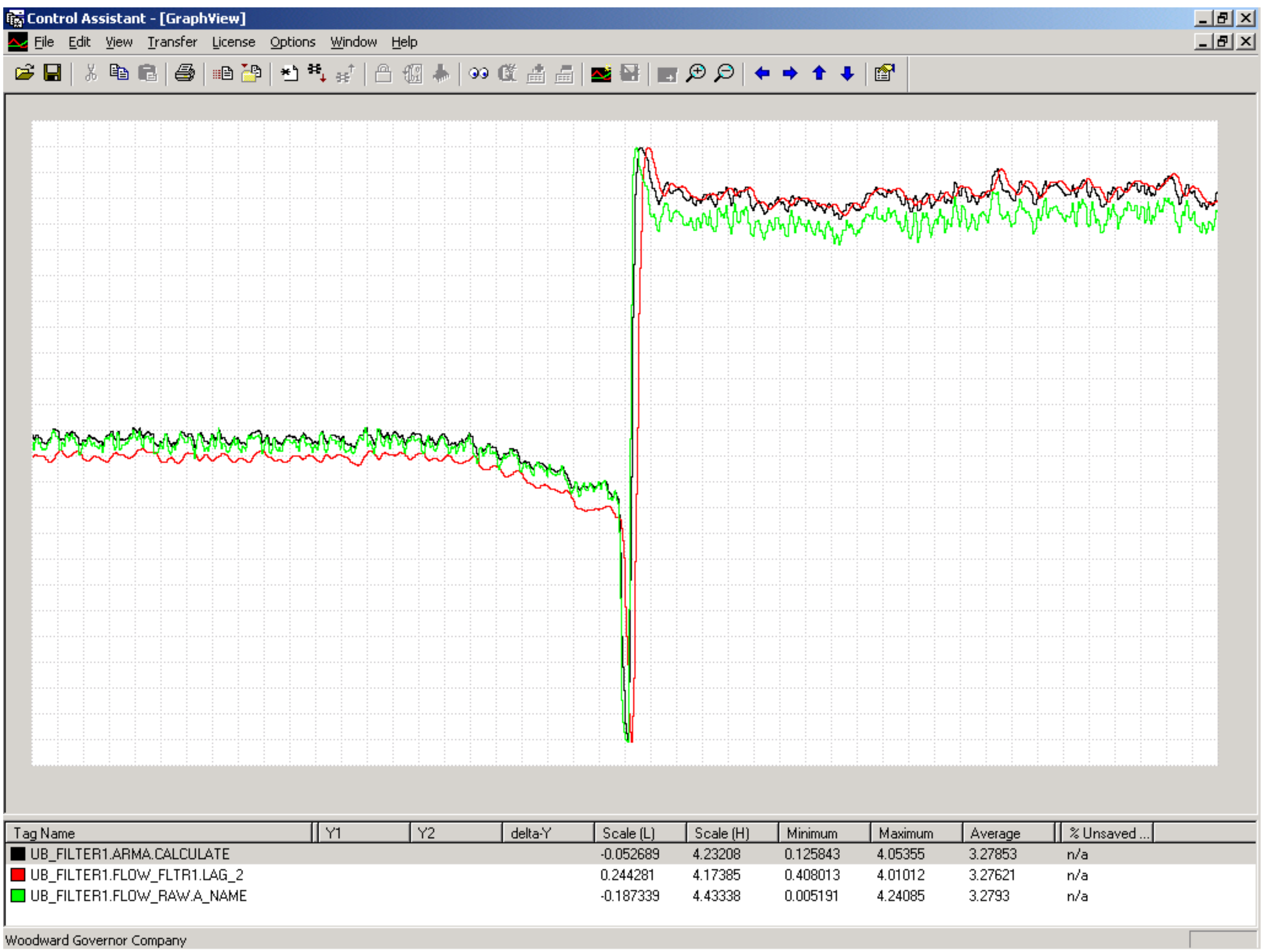
# Woodward's Advanced Flow Signal Filtering

## Compressor Anti-surge Control

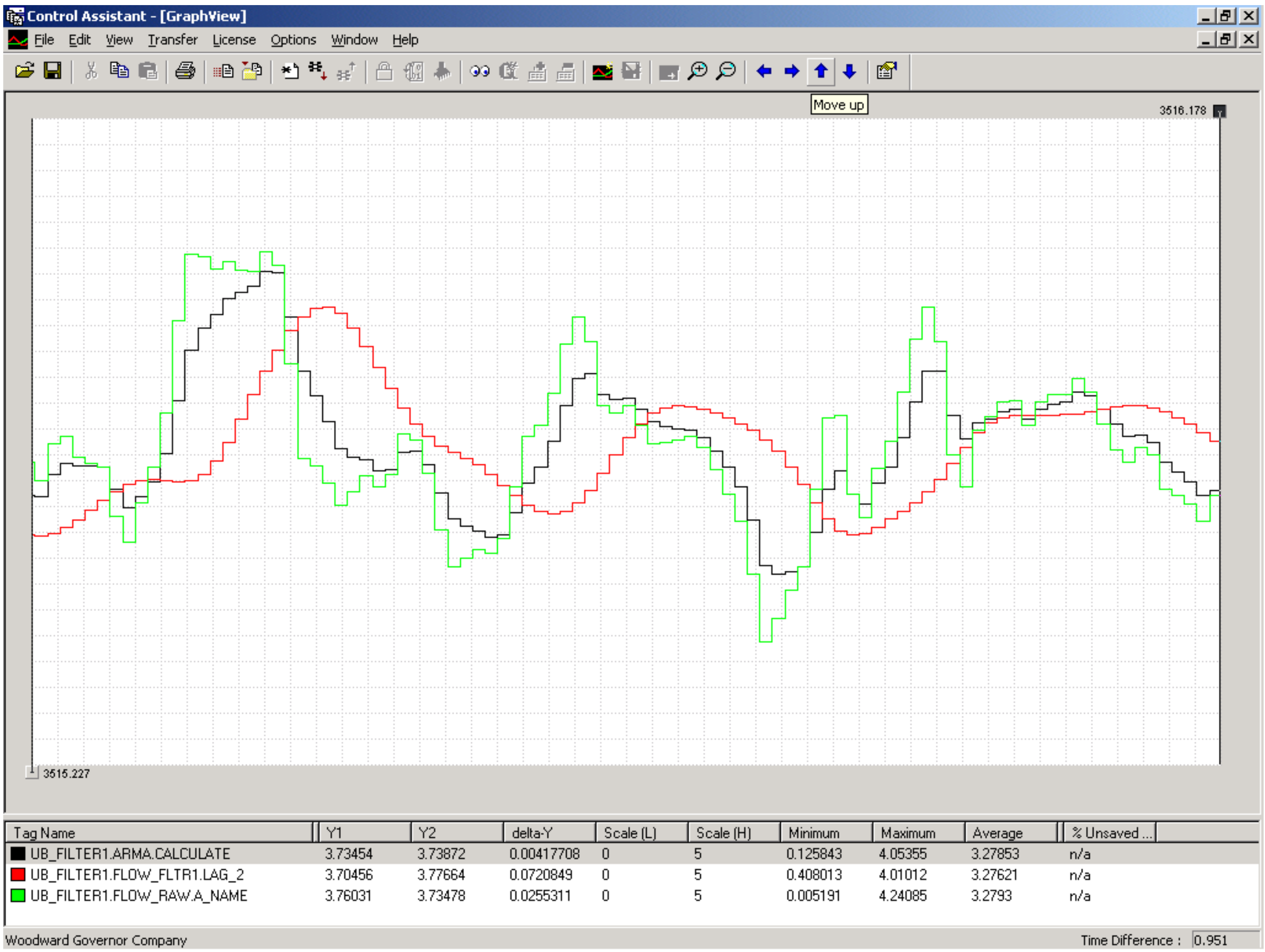
# Woodward's Advanced Flow Signal Filtering Compressor Anti-surge Control

Regardless of their name or manufacturer, all compressor anti-surge control systems bear the same mandate: monitor the flow of gas through a compressor for signs of impending surge and respond accordingly. How effective a given control system can be is often limited by external influences, particularly the accuracy, repeatability, and response time of instrumentation and valves. Of particular interest is the quality of the flow input signal, the fastest and most effective indicator of compressor performance. For all its importance to the compressor's anti-surge control, the flow signal usually presents the most difficulty because of its inherent noise, which makes it one of the most challenging of all process controls. How well and how fast a control system can process this signal will go a long way toward determining its efficacy as an anti-surge controller.

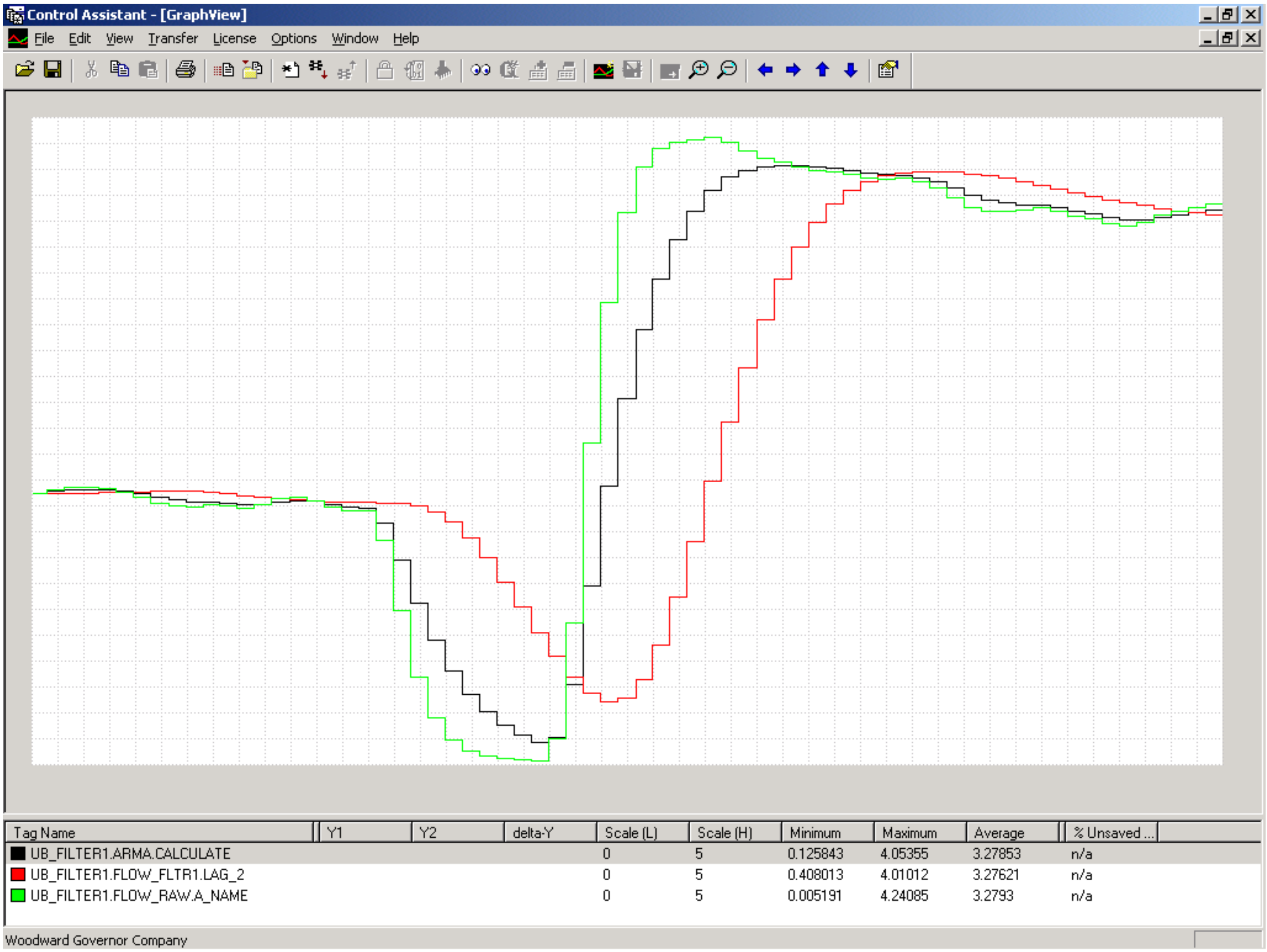
The following trends show a typically noisy flow signal. The green pen is the raw flow signal received directly from the 4–20 milliamp (mA) analog input channel. The red pen is the same signal after processing through a typical $4^{th}$ order lag filter. The black pen is the raw input processed through an auto-regressive moving average, or ARMA, filter. Both filters in this example utilize the same 20 millisecond (ms) time constant. The large disturbance depicts a near-surge event.



Speed is of the essence when processing a flow signal, detecting the surge signature, and initiating open-loop control responses to the anti-surge valve. But, the inherently noisy flow signal compromises the controller's ability to accurately, and quickly, detect an actual flow disturbance from the "white noise" of the sensitive signal. Filtering is a must, but too much filtering, too much lag time, will render the control ineffective. Note the cost of the 4th order lag's smooth signal in the 950 ms steady-state trend below … 80 ms of added delay. Most in the compressor industry regard 50 ms as the benchmark for surge detection. Compare the results of the ARMA … an accurate representation of the raw signal with only 20~30 ms delay, even at the higher noise amplitudes and frequencies. As these amplitudes and frequencies decrease, the ARMA is even faster. And, derivative values, or rates of change, of the noise signal are still reduced by 25~50% in the ARMA's output.



Steady-state conditions as depicted above tell only part of the story. Compare the two filters' outputs during a surge event or other significant flow disruption. In 40 ms, the raw flow input has dropped by 80%. In the same time period, the traditional lag filter has barely responded, dropping a mere 4%, but the ARMA's output has dropped by more than 50%.




Filtering of input signals for compressor anti-surge control is sometimes a necessary, but delicate procedure. The noisier the signal, the more filtering required for effective control--Yet the more lag time introduced, the less effective the control can be. Woodward's ARMA flow signal filter provides the best compromise … a representative flow signal and decreased susceptibility to false surge detections with minimal impact on control system recursion rates.

**We appreciate your comments about the content of our publications.**

**Send comments to: icinfo@woodward.com**

**Please reference publication 51259.**

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