Technical Bulletin, Dual Pulse Flowmeter Pulse Fidelity Checking

OMNI FLOW COMPUTERS, INC.
12620 West Airport Boulevard, Suite 100
Sugar Land, Texas 77478 United States of America
Phone-281.240.6161 Fax: 281.240.6162
www.omniflow.com

NOTE: User Manual Reference - This Technical Bulletin complements the information contained in Volumes 1, 3, 4, and is applicable to firmware revisions 20/24, 22/26 and 23/27.

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Pulse Fidelity Checking – The dual pulse fidelity checking feature allows you to reduce flowmeter measurement uncertainty caused by added or missing pulses due to electrical transients or equipment failure.

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Scope

Firmware Revisions 20/24, 22/26 and 23/27 of OMNI 6000/OMNI 3000 Flow Computers have the feature of Dual Pulse Fidelity Checking. This feature applies to Turbine/Positive Displacement Liquid and Gas Flow Metering Systems.

Abstract

The object of dual pulse fidelity checking is to reduce flowmeter measurement uncertainty that is caused by added or missing pulses that occur due to electrical transients or equipment failure. Correct totalizing of flow must be maintained whenever possible. This is achieved by correct installation practices and by using flowmeters that provide two pulse train outputs. To accomplish this, an E Combo I/O Module must be installed for each flowmeter and the correct configuration settings must be entered in the OMNI Flow Computer.

The two pulse train signals are called the 'A' pulse and the 'B' pulse. In normal operation, both signals are equal in frequency and count but are always separated in phase or time. The API Manual of Petroleum Measurement Standards (Chapter 5, Section 5) describes several levels of pulse fidelity checking, ranging from Level E to Level A. Level E is the least stringent and simply requires that good quality components are used and that these components are installed in accordance with the manufacturer's instructions. Level A is the most stringent method and requires that flow totalization be unaffected by a complete failure of either pulse train A or B. Totalization should also not be affected by electrical transients and noise that occur simultaneously on both pulse train signals.

Because it continuously monitors and alarms all error conditions the OMNI Flow Computer implements Level A pulse security. Flow totalization is unaffected by failures of either pulse train A or B as long as the other pulse train remains operational. The flow computer also attempts to reject simultaneous transient pulses. No attempt is made to correct for ambiguous errors, such as missing or added pulses. These ambiguous errors are detected, alarmed, and quantified only.

Installation Practices

When using pulse fidelity checking, it is assumed that the user begins with and maintains a perfect noise free installation. The user must ensure that each pulse train input to the flow computer is a clean, low impedance signal which will not be subject to extraneous noise or electromagnetic transients. Any regular occurrence of these types of events must cause the equipment and/or wiring to be suspect and investigated. Pulse fidelity check circuitry is **not** intended to facilitate continued operation with a poor wiring installation which is prone to electrical noise or transients.

How the Flow Computer Performs Fidelity Checking

Hardware on the E Combo I/O Module of the OMNI Flow Computer continuously monitors the phase and sequence of the two pulse trains. It also monitors the frequency of the pulse trains. The flow computer determines the correct sequence of flowmeter pulses based on the time interval between pulses rather than the absolute phase difference. It does this by comparing the leading edges of both pulse trains at a set clock interval of 16 microseconds. Maintaining a minimum phase shift between the pulse trains (Table 1) ensures that related pulse edges of each channel are, in worst case, at least 5 clock samples apart.

Table 1. Phase Trains

Maximum Pulse Input Frequency	Maximum Phase Shift Required
1.5 kHz	45 degrees
3.0 kHz	90 degrees
6.0 kHz	180 degrees

Correcting Errors

Missing or added pulses to either pulse train are considered ambiguous errors and cannot be corrected. However, they are detected with a 100% certainty and will be counted, eventually causing an alarm. Totalizing will continue using the A Pulse Train.

Common Mode Electrical Noise and Transients

Common mode electrical noise and transients occur at the same instant in time (occupy the same clock period) on each pulse channel. They are detected with a certainty of approximately 90%. The certainty can never be 100% because of the slight time difference that it takes each pulse to travel through its associated pulse train input circuitry. These simultaneous transient pulses are not flow totalized but they do increment an error counter and eventually cause an alarm to be raised.

Rejecting Noise Pulses that Coincide with an Actual Flow Pulse

It is possible that a common mode transient pulse could occur during the same sample period as an actual flow pulse. In this case, the transient pulse would be detected, alarmed and rejected for totalizing, causing the flow pulse to also be lost. Statistically though, with a 3 kHz turbine pulse input frequency, the odds of a flow pulse occurring during the same sample period are approximately 20:1. Failing to reject these transient pulses would mean accepting 20 times as many extra flow pulses. The 20:1 ratio is based on the ratio of the periodic time of the flow pulses divided by the periodic time of the sample period (e.g.: 333.3μsec / 16μsec approximately equals 21). At 500 Hz the odds of a flow pulse and transient pulse occurring in the same sample period are approximately 120:1.

Total Failure of a Pulse Channel

A total failure of either pulse train will be detected with a 100% certainty. The flow computer will alarm this condition and continue totalizing with the remaining pulse train as recommended in API MPMS (Chapter 5, Section 5).

Alarms and Displays

To avoid spurious nuisance alarms such as can occur when flow first starts pulse fidelity checking is disabled until the frequency of the incoming pulse train exceeds a user preset value. Any differences in pulse trains A and B will then be accumulated and used to trigger an alarm when a user preset number of error pulses are exceeded. Error accumulations can be displayed or printed at any time. Alarms are time tagged and recorded in the historical alarm log. Pulse fidelity alarms can be configured to be sticky, i.e. once set, they are only cleared at the beginning of a new batch transaction, or they can be configured to automatically clear themselves after a user configurable number of good error free pulses have been received. Even if the required number of good pulses are received, the alarm LED on the flow computer front panel remains lit until the alarm is acknowledged by the operator.

DOCUMENT REVISION HISTORY

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