SCADAMETRICS®
APPLICATION NOTE

Configuring Flow-Rate Calculation Parameters within the EtherMeter®

The EtherMeter® calculates flow-rates using the same methods that a person observing a meter with a stopwatch would employ: Namely, by dividing an observed change in totalization by an observed time change. The number of resolution digits is the main factor that affects the method of calculation. Meter registers that provide high-resolution (eg. 8 or 9 digits) are preferable over those that provide medium-resolution (eg. 6-digits); and therefore, whenever possible, the user should employ 8 or 9-digit registers.

Within the EtherMeter Setup Menu, the user must set a few parameters in order to optimize the flow-rate calculation. The purpose of this Application Note is to assist the user in selecting those parameters.

8-Digit Resolution Meter Registers
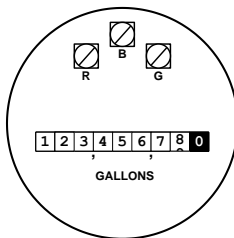
When using a meter register which transmit 8 digits of resolution, the totalization changes rapidly for a properly-sized meter. In these instances, the least significant odometer wheel (the rightmost wheel) may be observed to be turning at a significant RPM rate. Because the EtherMeter requires at least ½ second to complete a register interrogation, and because each register requires a 2-3 second minimum pause between interrogations, it is not feasible to accurately measure the time between single-digit totalization changes.

In such instances, it is desirable to interrogate the register, wait for a fixed time duration (eg SAMPn = 10 seconds), and then interrogate the register again. If the totalization change between samples is, for example, 200 Gallons, then the flow-rate would be calculated as: (200 Gal)/(1/6 Minute) = 1200 Gal/Minute.

In the EtherMeter, this method of flow-rate calculation is termed "Fixed Delta-Time" (FCALCn = DTIME). When the DTIME flow-rate calculation method is selected, the reported flow-rate is updated at fixed time intervals. In the above example, the reported flow-rate is updated every 10 seconds. However, once non-zero flow is observed, the rate is re-calculated by analyzing totalization changes across a sliding time window in order to improve accuracy (4 x SAMPn seconds).

When using this method, the user should select a sampling interval that is neither too short, nor too long. For instance, if the sampling period is too short, then the flow-rate will be updated more frequently, but the accuracy of the flow-rate calculation may suffer. On the other hand, if the sampling period is too long, then the accuracy may marginally improve, but the reported flow-rate will be updated too infrequently.

In order to assist the user in the selection of the SAMPn parameter, the following helper formula is recommended:


For METER(n) (where n denotes the meter channel (1 or 2))...

$$\text{SAMPn (SECS)} = \text{MAX} \left(3 , 300 \times 10^{\text{EXPn}} / (\text{TYPICALFLOWRATEn (UNITS/MINUTE)}) \right)$$

... where TYPICALFLOWRATEn is METERn's typical flow-rate.

This formula ensures that, at typical flow-rates, the least significant meter digit will increment approximately 5 times between samples. If increased flow-rate accuracy is desired (at the expense of timeliness), then SAMPn may be increased above the recommended value. If increased timeliness is desired at the expense of accuracy, then SAMPn may be decreased.

6-Digit Resolution Meter Registers
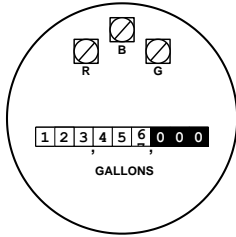
When using a meter register which transmit 6 digits of resolution, the totalization usually changes quite slowly for a properly-sized meter. In these instances, the least significant odometer wheel (the rightmost wheel) may be observed to be turning at a very slow RPM rate.

Were the user to employ the "Fixed Delta-Time" flow-rate calculation method, as demonstrated in the above 8-digit register example, the calculated time delay between samples (and therefore the time delay between flow-rate updates) may be quite long. If the time delay is deemed excessive, then the "Fixed Delta-Total" (FCALCn = DTOTAL) flow-rate calculation method should be employed.

In this method, the register should be interrogated at a high sampling rate, with very brief delays between samples. When a totalization change is detected, the change is time-stamped; and when the next change is detected, that change is also time-stamped. For example, if the totalization changes to 123456000 at 12:03:30, and the totalization changes to 123457000 at 12:05:15, then the flow-rate is subsequently reported as:

(1000 Gal) / (1.75 Minute) = 571.428 Gal/Minute.

In the DTOTAL flow-rate calculation method, the reported flow-rate is updated after each totalization change. However, the EtherMeter must also employ a method of determining "zero" flow. In order to determine zero flow, the EtherMeter employs a timeout calculation that causes the flow-rate to be revert to zero after no totalization changes have been detected within a pre-determined time.

For instance, in the above example, if the EtherMeter's TIMEOUTn parameter is set to 240 seconds (4 minutes), and if the flow stops shortly after the meter total changes to 123457000, then – after the 12:09:15 mark – the EtherMeter will begin to report the flow-rate as 0.000 Gal/Minute thereafter.

When the DTOTAL flow-rate calculation method is selected, the user should select a timeout period that is neither too short, nor too long. For instance, if the selected timeout is too short, then zero flows may be more quickly detected, but at the expense of low flow-rates being prematurely interpreted as zero. If the selected timeout is too long, then lower flows may be better detected and reported, but at the expense of creating longer times to recognize zero flow.

In order to assist the user in the selection of the TIMEOUTn parameter, the following helper formula is recommended:

> **For METERn (where n denotes the meter channel (1 or 2))...**
>
> **TIMEOUTn (SECS) = 60 x (10^{EXPn} / (LOWFLOWRATEn (UNITS/MINUTE)))**
>
> **... where LOWFLOWRATEn is METERn's lowest planned detectable flow-rate.**

Additionally, to assist the user in the selection of the SAMPn parameter, the following helper formula is recommended:

> **For METERn (where n denotes the meter channel (1 or 2))...**
>
> **SAMPn (SECS) = MAX(3 , 1.5 x 10^{EXPn} / MAXFLOWn (UNITS/MINUTE))**
>
> **... where MAXFLOWRATEn is METERn's highest expected flow-rate.**