BUILT-IN "ZERO-MIDSPAN-SPAN" DRIFT CHECK/CALIBRATOR

Introduction

Continuous Emissions monitoring systems (CEMS) have a long term stability verification requirement. Most of the equipment is verified using calibration gas sources substituted for the flue gas which it normally measures. The US EPA (40 CFR Part 60, Appendix B), requires a daily zero-span drift check which is below 25% for the zero and above 75% for the span. The system records its gas concentration once a day, a known concentration is tested at zero and span. Any drift in the gas analyzer, recording equipment or DCS monitoring this would show up as a shift in the daily zero span readings. Any significant deviations from the expected readings must be corrected or justified to the monitoring agency for their periodic audits.

To report total lb/day or Kg/day of a particular pollutant, you must know the total flow as well as the concentration of the pollutant. For the total process flow measurements, it is not practical to provide a 25% and 75% type flow signal simulation. So the EPA accepted an electronics substitution signal representing a zero and span flow. This is done as close to the front end of the flow meter as possible so the maximum amount of the signal processing chain can be checked for drift. By the late 1990's many local air quality agencies also required a middle value be added to the daily check so now we have a zero, middle and span check. The middle value makes it possible to detect non-linearity in the measurement.

How it works

In the MFT B-Series, we have an independent voltage source which can be programmed from 0 to 3.3 V and this is used to drive the 4-20 mA output where 3.3 V is FS. We also have a Modbus registers of this which is in volts (0 to 3.3 V). This independent voltage source is programmable in its value for zero, mid and span and the duration of time spent holding at each value. The zero-mid-span function can be initiated as a sequence from an internal meter timer or an externally provided contact closure to one of the digital inputs. The meter also remembers the recorded values from its previous test which can be accessed by the program menus or a Modbus register.

The independent calibrator is factory calibrated to better than 0.13% FS and can be used at any time to verify the proper calibration of the flow meter.

How to use it

The drift check feature must be configured for its amplitudes, duration and trigger conditions.

> **WARNING:**
> **When the Drift Check is in progress, the 4-20 mA output will represents the percent of Full Scale that the Drift Check was configured, not the process flow reading or temperature..**

Configurable Parameters

Auto Drift check
ON or OFF of the internal timer only. No effect on Modbus or DI triggers.
Zero Drift Check Value
% Full Scale (4-20 mA output current)
Zero Drift Check Duration
xx Seconds
Mid Span Drift Check Value
% Full Scale (4-20 mA output current)
Mid Span Drift Check duration
xx Seconds
Span Drift Check Value
% Full Scale (4-20 mA output current)
Span Drift Check duration
xx Seconds
Interval Time
xx hours (internal timer trigger only)

SETUP

From the *Executive Mode*, press the **P** key to get in to the *Program Mode*. Enter the access code when prompted. Press the **P** key repeatedly until.

```
PRESS E TO CHECK
ZERO-SPAN DRIFT
```

Press the "**E**" key to accept the menu.

```
SELECT TASK ^v
SET DRIFT CHECK
```

At this menu you could select to run the drift check instead of configuring it by using the **^** or **v** keys or see the results of the last check in volts and % difference from previous test.

```
AUTO DRIFT CHECK
^=ON  v=OFF XXX
```

The above menu controls the internal timer only! It has no effect on triggering the function from Modbus or the external digital input. In other words, you can not turn off the Modbus or digital input triggers for the zero span drift check but you can control the internal timer triggers.

```
ENTER ZERO (%)
VALUE = XX.XXX
```

The zero value is a % of the 4-20 mA output span (uses a 0 to 3.3 V input map). You enter a value like 10% which is actually 0.33 V input.

```
ENTER DURATION
IN SEC  XX
```

The duration is the time the 4-20 mA output is at the zero value programmed above before switching to the mid span %.

```
ENTER MIDSPAN(%)
VALUE =  XX.XXX
```

Same as for the zero value

```
ENTER DURATION
IN SEC  XX
```

Same as for the zero value

```
ENTER SPAN (%)
VALUE =  XX.XXX
```

Same as for the zero value

```
ENTER DURATION
IN SEC  XX
```

Same as for the zero value

```
ENTER INTERVAL
IN HOUR  XX
```

The interval is used for the internal timer. If the internal “Auto-drift-check” timer is off, this interval is not active.

Triggering

There are three different ways to trigger the Zero-Mid-Span Drift check. They are Periodic Zero-Mid-Span Check, External Digital Input and MODBUS Write Coil Command. The duration of the zero, mid or span are controlled by the preset duration values.

- **Periodic Zero-Mid-Span Check**
  The Zero-Mid-Span Check can be periodically trigger by the Interval Time (configurable). To select this, the Auto Drift Check must be turned ON. When it is triggered, it will perform the Zero, Mid and Span sequence. Changing the value of the Interval Time can change the frequency.

- **External Digital Input (MFT-B Digital Input 2)**
  This trigger does not require that the Auto Drift Check be turned ON. When the MFT-B digital input 2 changes from high to low, the Zero-Mid-Span Check will start performing the Zero, Mid, Span sequence. While still busy performing the task, it does not accept new command. After the task is done, the next trigger will be when input will transition from high to low.
  If the Auto Drift Check is ON or doing the Periodic Zero-Mid-Span check, and the external input command is ON, it will perform the Drift Check immediately and do another one when the Auto Drift Check interval time is expired.

- **Write Coil Command via MODBUS Protocol**
  Using MODBUS Protocol, the individual Zero, Mid, Span or All can be trigger by writing a 1 to the MODBUS coil #0, coil #1, coil #2 or coil #3 (function code 05) respectively. This trigger does not require that the Auto Drift Check be turned ON. When a 1 is sent to MODBUS coil #0, coil #1, coil #2 or coil #3, the Zero, Mid, Span or Cycle (Zero-Mid-Span sequence) will trigger and start. While still busy performing the task, it does not accept new Drift Check start command. If the Auto Drift Check is ON or doing the periodic trigger, and MODBUS command is ON, it will perform the commanded drift check immediately and do another one when the Auto Drift Check Interval time has expired. The following are the MODBUS write coil commands:

  MODBUS Coil #0 → triggers Zero drift check
  MODBUS Coil #1 → triggers Mid drift check
  MODBUS Coil #2 → triggers Span drift check
  MODBUS Coil #3 → triggers Cycle drift check (Zero, Mid, and Span)
  MODBUS Coil #4 → aborts any of the above states.

Modbus Status Registers

Status Registers are provided via MODBUS (function code 01) to indicate whether Zero, Mid and Span check are busy or idle. The following are the MODBUS status registers to indicate whether the drift check state is busy or idle:

Status Register 0 → status register for Zero drift check, 0=idle or 1= busy

Status Register 1 → status register for Mid drift check, 0=idle or 1=busy

Status Register 2 → status register for Span drift check, 0=idle or 1=busy

Status Register 3 → status register for Cycle check (Zero, Mid and Span) 0=idle or 1=busy While doing a cycle check, both the register 3 and the corresponding zero, mid or span register will be set as it does that part of the cycle. When the cycle is done, all the bits are cleared back to zero or idle.

The above status bits are also at the start of the same block used to report the diagnostic errors on the flow meter, function code 02, permitting fast status poling along with the principle variable poling. See the Modbus command section for more details.

Available Modbus Commands

The triggering is a bit or coil write command with status as described above. The amplitude values (% 4-20 mA scale) for zero, mid and span as well as the duration (seconds) of each are available as read and write registers. The results from a previous drift check (Volts measured from the 3.3 V programmable reference, not 4-20 mA range) and % change are also available as read registers. See the section on Modbus for the specific function codes and registers.

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