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Using Vögtlin Smart series mass flow controllers with Omega

1 Nomenclature

MFC - Mass Flow Controller. Unit to control the flow of gas.

MFM - Mass Flow Meter. Unit to measure the flow of gas.

Everything in Omega is treated as MFC, even if the unit is MFM, just that MFM will not be able to control the flow.

In this manual, words like instrument, device, MFC and MFM are interchangeable.

2 USB data cable drivers and COM ports

Vögtlin MFCs come with USB data cables that may need Windows to install the correct drivers.

The correct drivers are identified automatically by Windows in most cases, but in case where Windows itself cannot find or install them automatically, the it may be required for the user to install the correct drivers

In such case, the drivers can be found from

- http://www.ftdichip.com/Drivers/VCP.htm

The correct drivers are called VCP (do **not** use the D2XX type drivers). VCP stands for virtual com port, so the USB cable will pose and act as a COM port.

Download the correct file and install the drivers.

Once the installation is done, go to windows device manager (control panel->system -> device manager) and list the COM ports. By unplugging and re-plugging the USB to MFC cable a port should disappear and re-appear. Figure out and write down the port name, such as COM6.

3 Device Modbus address

One COM port can host one device, or a network of devices. In order for the system to be able to differentiate individual devices, each must have a unique Modbus address. If two devices share the same address, problems will ensue. Instrument address may be printed on the instrument. In any case the address can be found by using Red-Y software with autoscan/search on the correct COM port when the device is plugged in and powered on. Also it is possible to change the address in that software to resolve address conflicts should the need arise.

Figure out and write down the instrument Modbus address.

4 Autosearch

Autosearch is not available for MFCs in Omega, the available space to search is just too large to scan (each COM port for 256 addresses for any possible type of instrument would take hours). Instead, the instrument details are entered by hand to the device configuration file.

5 Omega device configuration file

The .odc file example entry for Vögtlin Smart series MFC r MFM is

```
COM6
                    MassFlowController GSC COM6 ADDR:2
```

Where both appearances of COMxxx is the port earlier verified

The ADDR:yyy is the Modbus address of the mass flow controller/meter. This address is usually 1, 2 or 247. If unsure, it can be found by using Vögtlin get-red-Y software, or by asking NORECS.

Note that even for MFM the terms used will be MAssFlowController and GSC. In Omega both types of devices are addressed the same way, just that MFM will not be able to control the flow.

If more than one MFC is on the same COM port, they must have different addresses, otherwise they will not work. The address can be changed in Vögtlin get-red-Y software. Connect only one device to the computer, find the instrument in Vögtlin get-red-Y software, then right click on the list and select 'Change Modbus address'. https://www.voegtlin.com/en/mass-flow-meters-and-controllers-for-gases/software-get-red-y/

Alternatively, by changing the address in the configuration file, reloading the file in Omega, and performing "validate" (device setup) in Omega, until a device is found.

6 Node types

6.1 .FL node

.FL node type is used to read flow and setpoint values from the device. MFM will have setpoint of 0.

The unit of the flow, such as g/min or mln/hour, is same as the instrument is configured to use.

One can check, and change the unit in the Red-Y software, and write this information down. It is also possible to check the flow unit in Omega, in the Tools tab -> mass flow. Make sure any measurements are paused, and then select a device and click read values. Changing the values will only work for MFC.

6.2 .AU node

.AU (Action) node is used to change the setpoint value. Unit is same as the instrument is configured to use. Refer to Omega main manual how to write expressions to create dynamic setpoint, or just type in the static setpoint in the .AM1 expression and the Max-field.

7 Plots for gas flow

Plotting a gas flow when the gas used is same as the device calibration used is trivial. Just plot $Nx.FL and the unit is same as the device is using.

8 Plots for gas mixtures

Most flow-device manufacturers calibrate their instruments with one gas, and use correction factors to calculate what the flow would be should the gas be different from the calibration gas.

Vögtlin uses real gas calibrations and the device stores these device-specific curves for the gases that were indicated when the device was ordered. This is more accurate (and costs more). But there is no reason the user cannot do the correction factor trick other manufacturers use, in order to be able to get flows of uncalibrated gases or mixtures. This will not be as accurate as the real gas calibration, but will be as accurate as other device brands, provided the calculations are done correctly.

In Omega user can use math expressions in the plotter, so the prerequisites for this type of use are in place.

The devices internal unit is always mass, It's a mass flow controller after all. Mass of the gas is constants, volume on the other hand depends on pressure and temperature. Most volumetric units are normalized, meaning the gas flow would be some volume, if the normalization conditions were true. There are wide range of different standard conditions, such as 0°C at 1013.25 mbar. But the gas is never at those conditions, so the actual volume of gas flows and the instrument reported normalized flow will never match. Use ideal gas law to convert from standardized volume to actual volume and vice versa.

For accuracy, all the calculations and as much of the thinking should therefore be done in mass, for convenience of intuition, volume.

Say the mixture sent is 50% (partial pressure) gas with molar mass of 30, and 50% (partial pressure) of gas with molar mass of 10. The final molar mass of the mixture would be (0.5 x 30 + 0.5 x 10) 20.

Say the device only has calibration curve for gas with molar mass of 30.

If we report the flow as g/min, the reading is still very close to the truth, but if the MFC is measuring with volumetric units, the conversion from mass to (standardized) volume will be wrong by factor of 20/30.

9 Correction needs matrix

Calibration used	Gas used	Result	Correction
Gas A	Gas A	Correct mass and individual calibration	No need, accuracy is as specified
Gas A	Gas B with exact same molar mass as gas A	Correct mass but lose individual calibration	No need, accuracy same as other instrument brands using correction factors
Gas with molar mass (MM) 30	Gas with molar mass 20	Correct mass but lose individual calibration	Needed for volumetric units. Say the device is sensing 30 units of mass per minute, thinking it is gas that has 1 unit of volume for every 30 units of mass but it is actually gas with 1 unit of volume for every 20 units of mass. The device would report 30/30 units of volume per minute where the actual flow would be 30/20 units of volume. Reported flow F_r must be corrected to get actual flow F_a $F_a = F_r$*Calibration molar mass/Actual gas molar mass $F_a=F_r*30/20$ $F_a=F_r*1.5$
MM=20	MM=30	Correct mass but lose individual calibration	Needed for volumetric units. $F_a=F_r*20/30$ $F_a=F_r$

10 Molar mases of mixtures

Molar mass of any gas mixture is just the molar mass of each component multiplied by their content fraction i.e. partial pressure.

For example, synthetic air, 21%O2 + 79%N2 molar mass is 0.21*2*15.9994+0.79*2*14.0067 = 28.85

11 Expressions in Omega

Refer to other resources for writing expressions in Omega.