



analog  
signals



d-flux multi series operating manual

# Multi-Parameter Mass Flow Meter and Controller for Gases

## IMPORTANT: HOW TO USE THIS MANUAL

This manual contains all relevant, basis and advanced information of the d-flux. It makes it big, but you only have to search on one manual. We do not expect you read it all, we expect you search for something when you need it. You can search in the index. In any pdf format you do this by pressing Ctrl+F on your keyboard.

We do however recommend to read at the very least chapter 6+7 (installation) and 8 (operations)

Links to relevant references are in **fat blue** and chapter number only. To jump to this link press the blue link with your mouse pointer. You can return to your original position by pressing Alt + left arrow



Manual Version: d-flux multi series EN V1.0

Based on d-flux firmware 1.03 and Vogtlin Connect App 1.7.2 For updates see [13.1.1](#))

Before you install and use this product carefully read this manual and become familiar with its features. Avoid danger to facilities and individuals read the basic safety instructions and follow all instructions in the manual carefully.

The manufacturer reserves the right to modify this manual and technical data without prior notice.

For the latest information on our products, see our website at [www.voegtlin.com](http://www.voegtlin.com)

### Trademark

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### E-mail Customer Service:

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# 1 Document information

## 1.1 Document function

Thank you for selecting the Vögtlin device(s) from the d-flux series. This manual contains all required information to safely and correctly install, commission and operate this device. You also find information on Product identification, storage, service, trouble shooting, communication details, specifications and drawings.

Please read through these instructions carefully before installing the devices. Before you start up and start using the unit make sure you are fully familiar with the Safety, Installation and commission instruction (chapters 2, 6 and 10). Our aim has been to write a complete and practical guide. We would be grateful if you would notify us of any shortcomings or mistakes.

Please contact your sales partner if you have questions about any aspect of the products.

## 1.2 Document conventions

### 1.2.1 Copyright and Liability Disclaimer

All rights reserved. No part of this publication may be reproduced in any form or by any means without the publisher's prior written permission.

The content of this manual is provided for information only and may be altered without prior notice. Vögtlin Instruments GmbH assumes no responsibility or liability for any errors or inaccuracies in this manual.

### 1.2.2 Safety symbols



This symbol alerts the user to important operating, maintenance and service information.

### 1.2.3 Other symbols



This symbol indicated that the text in relation to the proper recycling practices

## 1.3 Documentation

### 1.3.1 Standard documentation

The documentation available for this product is:

- Technical Datasheet
- Manual Profinet
- Manual EtherCAT®
- Quick start guide

The documentation can be downloaded from the website [www.voegtlin.com](http://www.voegtlin.com)

### 1.3.2 Supplementary device-dependent documentation

Tri-clamp fittings: See Documentation Tri-clamp fitting (leaflet 329-2134)

All supplementary documentation can be downloaded from the website [www.voegtlin.com](http://www.voegtlin.com)

## 2 Basic safety instructions

### 2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfil the following requirements:

- The installers and operators must be trained, qualified specialists.
- Are authorized by the plant owner/operator
- Are familiar with federal/national regulations
- Before beginning work, the specialist staff must have read and understood the instructions in the operating instructions and supplementary documentation as well as in the certificates (depending on the application)
- Following instructions and basic conditions

### 2.2 Designated use

#### 2.2.1 Application and media

The d-flux as described in this manual is intended only for measurement or control of gas flows. To ensure that the measuring device remains in proper condition for the operation time:

- Carefully follow the general conditions listed in this manual and additional documentation.
- Only use the measuring device in full compliance with the designation as written on the data label and certificate
- Verify on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area (e.g. explosion protection, pressure vessel safety). (See Chapter 4.4)below
- Use this measuring device only for gases against which the process-wetted materials are resistant. (See wetted materials in specifications chapter 3.6 and 17.3)

#### 2.2.2 Incorrect use

The manufacturer is not liable for damage caused by improper or non-designated use. If any part of the flow meter is opened, the accuracy specifications of the measuring device no longer apply. In such situations, the measuring device must be removed and returned for recalibration and to the manufacturer.

## 2.2.3 Warnings



### **Maximum pressure**

Observe the specified maximum process pressure.



### **Fittings**

Risk of injury if the process connection and sensor gland are opened under pressure. The process connection should only be opened in an unpressurized state.



### **Toxic, flammable gases and ATEX**

In the case of toxic and flammable gases, the respective safety guidelines in each country must be followed. This device is NOT Ex certified. In the case of flammable and toxic gases, fittings, cable glands and pipes intended for that purpose must be used. The responsibility for safe operation lies with the user and designer of the facilities



### **Housing**

Do not remove the electronics housing. A damaged hologram seal will void the warranty. There are no serviceable parts inside the unit.



### **Ground**

It is strongly recommended to have this device grounded.



### **Oxygen service**

Vögtlin Instruments GmbH is not liable for any damage or personal injury, whatsoever, resulting from the use of our standard mass flow meters or controllers for oxygen gas. You are responsible for determining if this mass flow meter or controller is appropriate for your oxygen application. You are responsible for cleaning the mass flow meter or controller to the degree required for your oxygen flow application.



### **Power**

If it becomes necessary to remove the instrument from the system the power to the device must be disconnected. Always switch off the power before you disconnect terminal connections in potentially dangerous surroundings to avoid sparks.



### **Safety systems**

This flow meter/controller has built-in advanced diagnostic (See Chapter [8.5](#))



## 2.3 Workplace safety

For work on and with the device: Wear the required personal protective equipment according to federal/national regulations.

For welding work on the piping: Do not ground the welding unit via the measuring device.

## 2.4 Operational safety

### Risk of injury

- Operate the device in proper technical condition and fail-safe condition only
- The operator is responsible for interference-free operation of the device

### Conversions to the device

- Unauthorized modifications to the device are not permitted and can lead to dangers
- If, despite this, modifications are required, consult with the Vögtlin service department
- To ensure continued operational safety and reliability
- Carry out repairs on the device only if they are expressly permitted
- Observe federal/national regulations pertaining to repair of an electrical
- Use original spare parts and accessories from Vögtlin only

## 2.5 Product safety

This measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and left the factory in a condition in which they are safe to operate.

It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Vögtlin confirms this by affixing the CE mark to the device.

### Using the MFC in cooling/ventilation applications:

Please note that the valve in the Mass controller version of this product is NC (Normally Closed). That means that if the power is disconnected the valve will close.

The warning systems in this unit by default will close the valve when a significant failure is detected. (see chapter [8.10.4](#))

## 3 Product description

### 3.1 Functionality

The *d-flux* can be supplied as a gas mass meter (DFM) or a controller (DFC). The measurement principle is a differential pressure-based. The core elements of the *d-flux* mass flow meter are the laminar flow element (LFE), the differential pressure sensor, the temperature sensor and the absolute pressure sensor. By adding a control valve and a PID controller functions we can supply this unit as a controller (For more information see chapter 3.4).

### 3.2 Features

In developing and manufacturing the devices, we have focused primarily on customers and their applications. Our aim is to implement customers' requirements in the form of new developments or enhancements on an ongoing basis. Some of the essential features are:

#### **Flow rates up to 1400 l/min**

Rate for air, other gases according to conversion

#### **Multiple pre-programmed gases**

The unit can contain up to 16 programmed gases. Pre-programmed gases Air, O<sub>2</sub>, N<sub>2</sub> and Argon. More compatible gases can be added at any time.

#### **State-of-the-art communication**

Advanced Modbus communication & analog output / Optional Profinet or EtherCAT® interface. (Ethernet IP under development). Reading of variables and configuration of the units is possible through these digital communications or through Bluetooth® and free Android® app.

#### **Wide application scope IP54**

Suitable for common gases and gas mixtures. Up to 14 bara and from -20 to 60 °C  
Body in stainless-steel 316L (1.4404) / Protection IP54.

#### **Minimum Inlet required**

Compact unit design requires no long straight or special in and outlet sections. Easy and convenient installation in compact machines and tight places

#### **Accuracy**

± 0.5% of customer full scale and ± 1% of measured value

#### **High sample rate and fast response**

Sample rate of 1 msec, updated data every 10 msec and a total response time of 90 msec

## Wireless device access with the free Vögtlin Connect app

Easy access and configuration of many parameters with our free Android® app (Bluetooth®), For more details see chapter 9.

## Custom application profiles

The unit offers up to 16 application profiles which allow the storage of individual application details like gas, range, engineering units, totalizers etc.

## Alarm, warning and diagnostic features

The *d-flux series* integrates advanced diagnostics, monitoring and reporting every part of its operation. The information is accessible via Vögtlin Connect app or Modbus

## Autotare

To minimize uncertainty, the d-flux multi controller detects with an advanced algorithm when there is no flow and will then automatically zero (tare) the units for optimum performance. For the meter this optimization needs to be performed manually.

## 3.3 Real, Standardized and Normalized flow

Gas flow measurements in general (Not instrument specific) can be expressed in one of the following:

- Real Mass flow: (f.i. kg/h). This refers to true mass units per time unit. The *d-flux* measures the volumetric flow and calculates the mass flow by multiplying the density.
- Normalized volumetric flow: Normalized means that the units are “translated” to predefined pressure and temperature conditions. Normalized or Normal Conditions refers to 0°C and 1013.25 mbar absolute. You can select this type of unit from the menu of the *d-flux*. These units are mostly used in Europe and China.
- Standardized volumetric flow: Standardized means that the units are “translated” to predefined pressure and temperature conditions. Standardized or Standard conditions refers to 20°C (68°F) and 1013.25 mbar (=760 mmHg) absolute. You can select these types of units from the menu of the d-flux. These units are mostly used in the USA. Standardized can also refer to other reference conditions (f.i. Natural Gas industry often uses 15°C and 1013.25 mbar absolute. In the semicon world they often use 25°C and 1013.25 mbara). The reference temperature and pressure can be adjusted for standardized volumetric flow.
- Volumetric flow: (f.i. l/min).

Please define and mention these reference condition at the time of your order. The reference condition can also be changed via the *Vögtlin Connect App* or via Modbus.

Please note that reference condition relating to Normalized or Standardized volumetric flow are NOT the operating conditions. According to the ideal gas law, the gas volume will change by 0.35% per K.

### 3.4 The measurement principle

The Vögtlin *d-flux* is a differential pressure-based mass flow meter. It measures the differential pressure over a laminar flow element (LFE), the absolute pressure and the gas temperature. The electronics calculate the mass flow going through the meter.

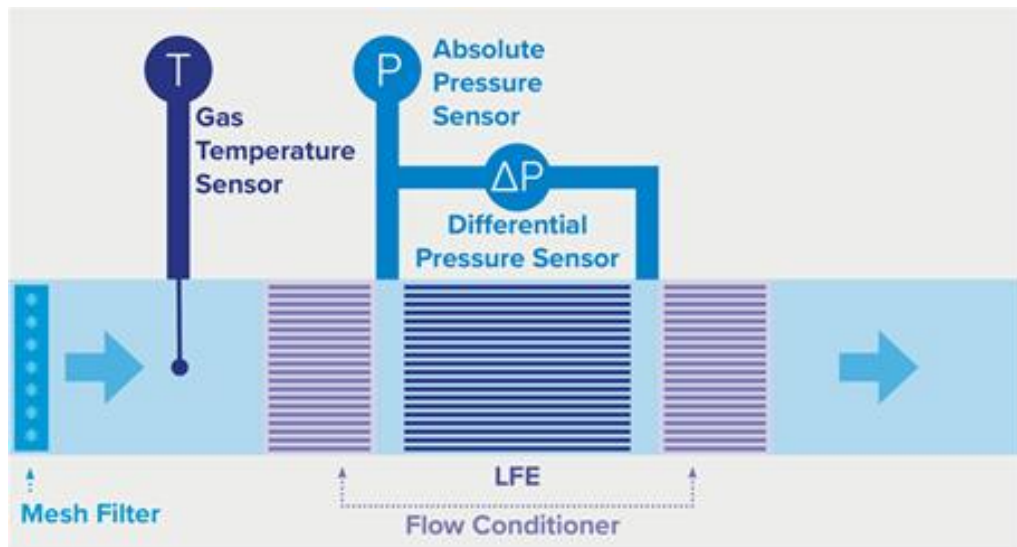


Figure 1: Measurement principle

Laminar flow elements are measurement instruments for the actual volumetric flow and are working according to the law of Hagen-Poiseuille. Flowing through an LFE results in a permanent pressure loss caused by the viscous friction of the gas. The pressure loss is about linear to the average velocity of the gas in the LFE matrix and is only dependent of the viscosity.

$$w * A = \dot{V} \sim \frac{dp}{\eta} \tag{3-1}$$

Where :

- $w$ : Average velocity of the gas
- $A$ : LFE flow area
- $\dot{V}$ : Volume flow
- $dp$ : Differential pressure
- $\eta$ : Viscosity

The Hagen-Poiseuille equation which defines the relationship between the pressure drop and the average velocity in a laminar flow environment is defined as follows (circular duct):

$$\dot{V} = \pi * \frac{r^4}{8 * l} * \frac{dp}{\eta} \tag{3-2}$$

Where:

- $r$ : Radius
- $l$ : Length of the duct

Since  $\pi$ ,  $r$  and  $l$  are constant for a given LFE, the equation (3-2) can be written as:

$$\dot{V} = C * \frac{dp}{\eta} \quad (3-3)$$

In this equation  $C$  is a constant factor that represents the geometry of the LFE. To bypass fabrication tolerances and reach the highest accuracy in flow measurement, the constant  $C$  gets determined during the calibration of the flow meter.

The viscosity  $\eta$  and the density  $\rho$  are calculated continuously from the actual temperature and absolute pressure values. Please note that the viscosity and density data and calculations are based on the NIST refprop database. With the density the volume flow gets transformed into mass flow.

$$\dot{m} = \dot{V} * \rho \quad (3-4)$$

With its knowledge over the operating conditions the flow meter can perform a highly accurate flow measurement which is independent of any changes in temperature or pressure.

### 3.5 Block diagram

The following block diagram shows the structure of the device. The unit can be supplied as a meter (DFM) or as a flow controller (DFC) (See chapter 8.10)

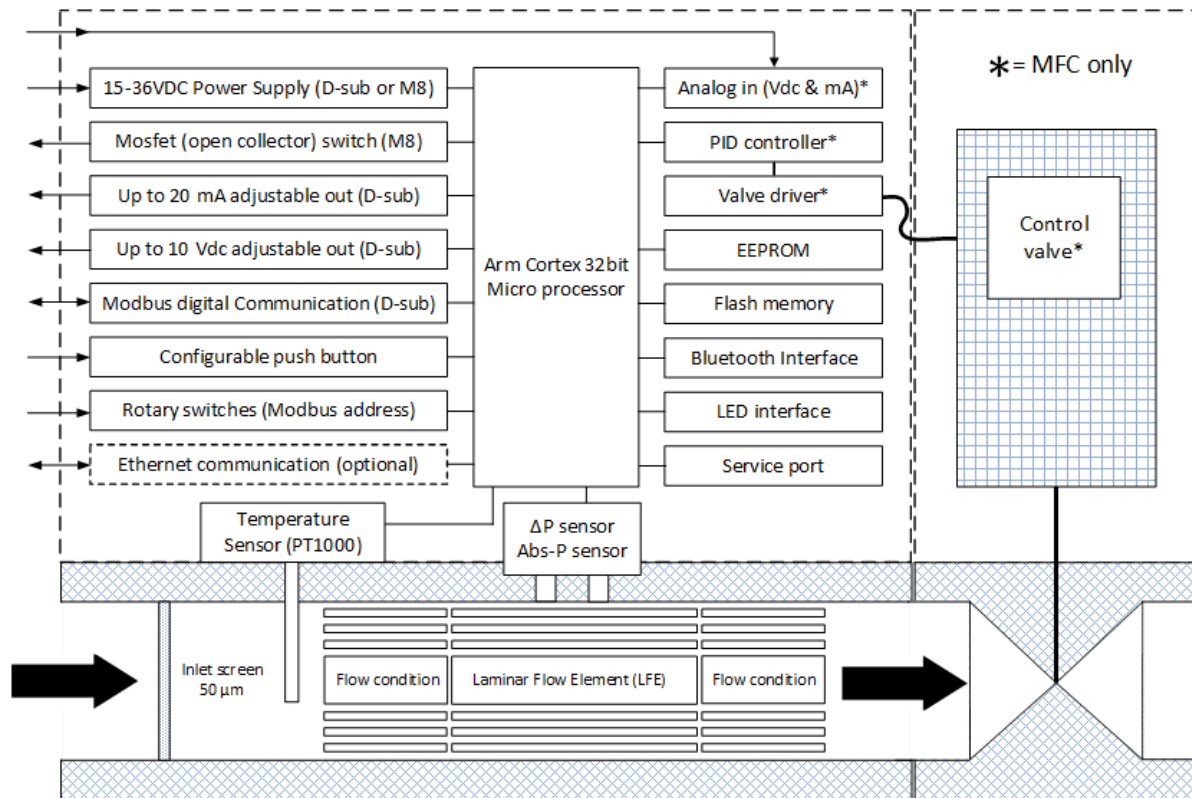


Figure 2: Block diagram



Figure 3: DFC (d-flux multi controller)

## 3.6 General specifications

### Technical data <d-flux multi series>

#### Instrument types



#### **d-flux multi meter essential**

Mass flow meter with analog signals & Modbus interface

#### **d-flux multi meter advanced comms**

Mass flow meter with additional Profinet/EtherCAT interface

#### Measuring ranges

Standard ranges (air/user adjustable)

#### LFE Type

LFE1400  
LFE1000  
LFE700  
LFE500

#### Range (air)

from 0-1000 l<sub>n</sub>/min to 0-1400 l<sub>n</sub>/min  
from 0-700 l<sub>n</sub>/min to 0-1000 l<sub>n</sub>/min  
from 0-500 l<sub>n</sub>/min to 0-700 l<sub>n</sub>/min  
from 0-350 l<sub>n</sub>/min to 0-500 l<sub>n</sub>/min

#### Gases

Air  
Oxygen  
Nitrogen  
Argon

#### Maximum Range

0-1400 l<sub>n</sub>/min  
0-1400 l<sub>n</sub>/min  
0-1400 l<sub>n</sub>/min  
0-1250 l<sub>n</sub>/min

Customer defined gases

Up to total 15 gases or gas mixtures<sup>2</sup>

<sup>1</sup> Unless clearly stated, the specified flow ranges are for an equivalent flow of air at 1013.25 mbar a (760 mmHg) and 0 °C (32 °F). Other common flow, temperature and pressure units can be selected through the Vögtlin Connect app or the digital communication interface. More information available in the d-flux multi operating instructions.

<sup>2</sup> Additional gases or gas mixtures can be added to the above standard list. Stored gases can be replaced by another gas or gas mixture (except for air). Programmed gases/mixtures can be selected through the Vögtlin Connect app or the digital communication interface.

For other gases, gas mixtures and reference conditions please contact the factory. Only suitable for dry and clean gases.

#### Profiles

Customer defined profiles

Up to 15 user programmable profiles

Profiles are pre-set configurations where the customer can set the gas, range, dynamics, totalizers, engineering units and reference conditions for up to 16 different applications

#### Performance data

Accuracy

0,5% of user full scale + 1% of measured value (after tare at operating conditions)

Media

All gases and gas mixtures that are compatible with the selected materials.  
The meter is not suitable for Hydrogen, Helium, corrosive and explosive gases. Contact the factory for more information.

Dynamic range

*Fixed dynamics:* 1:100 for most gases<sup>3</sup>

*VADy® dynamics:* up to 1:1000 (Available on meter only)

VADy® or a fixed dynamic range can be selected during order process. This setting can be changed at any time using the Vögtlin Connect app.

<sup>3</sup> The dynamic range is gas and pressure dependent; higher pressures result in a lower dynamic range.

<b>Response time</b>	90 msec (according to SEMI standard SEMI E17-1011) <sup>4</sup> Update time mass flow value: 10 msec / Sensor sample rate: 1 msec <sup>4</sup> With optimized filter settings. All filter modes and values can be set through the Vögtlin Connect app or the digital communication interface.
<b>Repeatability</b>	± 0.2% of full scale (according to SEMI standard E56-0309)
<b>Longterm stability</b>	Typical < 0.2% of measured value/year after tare
<b>Power supply</b>	Meter: 15-36 Vdc ±10%, (200 mA@24Vdc, regulated) Controller: 24Vdc ±10%, (2000mA@24Vdc, regulated) Power in through M8-4P connection or optionally through D-sub connection (ripple should not exceed 100 mV peak-to-peak)
<b>Operation pressure</b>	1 to 14 bara (for available gases)
<b>Temperature (environment/gas)</b>	-20 to +60 °C (-4 to 140 °F)
<b>Humidity gas</b>	0-95% Rh (non-condensing)
<b>Pressure sensitivity</b>	< 0.08% FFS <sup>5</sup> +0.1% MV per bar (typical air)
<b>Temperature sensitivity</b>	<0.02% FFS <sup>5</sup> per 1 °C of inlet gas temperature @ 7 bara pressure <sup>5</sup> Factory Full Scale (maximum flow range of the device)
<b>Accuracy temperature</b>	Typically ± 0.5 °C (not certified)
<b>Accuracy absolute pressure</b>	<0.5% MV (not certified)
<b>Warm-up time</b>	<2 sec for full accuracy

## Materials

<b>Wetted parts</b>	<i>Selected elastomer materials + Body:</i> 1.4404 / 316L. <i>Other materials:</i> 1.4571 / 316Ti, silicon, gold, glass, silicone encapsulation, PBT 30GF, ceramics, filter, Stainless Steel 1.4401 / 316, fastening 1.4122 / X39CrMo17-1. <i>Valve (Controller only):</i> 1.4401 / 316, 1.4005 / 416, 1.4104 / 430F.
<b>Electronic housing</b>	Powder coated stainless steel
<b>Seals</b>	FKM, optional EPDM
<b>Integrated inlet filter</b>	50 Micron SS316 (1.4401) filter / not customer replaceable/ fastener material SS (1.4122)
<b>Wetted part surface roughness</b>	1.6 Ra µm or better (contact factory for lower Ra values)

## Integration & Installation

<b>Output signals analog</b>	Linear 4–20 mA or customer defined (max 20 mA). User selectable Linear 0–5 VDC or 0-10 VDC or customer defined (max 10 Volt) user selectable Load resistance mA output: 740 ohms maximum Load resistance Volt output: 1000 ohms minimum All analog outputs are galvanically separated and protected. If used with analog signals add 0.2% of FFS to the uncertainty.
<b>Setpoint signals analog</b>	Linear 4–20 mA or customer defined (max 20 mA) user selectable Linear 0–5 VDC or 0-10 VDC or customer defined (max 10 Volt) user selectable (Controller only)
<b>Signals digital</b>	RS-485 (Modbus RTU 2-wire) The Modbus address can be set with 2 rotating switches on the outside of the housing. All Modbus settings can be set through the Vögtlin Connect app. Adjust the Modbus address map of the device to your needs: Any of the existing Modbus registers (up to a maximum of 16 registers in total) can be mapped to a customer defined location in the Modbus address map
<b>Optional Profinet or EtherCAT®</b>	Dual Port RJ45 with integrated switch making it easy to daisy chain the units RJ45 LEDs indicating link and activity on the network Ethernet speed: maximum 100 Mbit <i>Profinet:</i> PROFINET IO specification v2.33 / PROFINET IO devices conformance class B (RT) / Endianness: conform Siemens S7 (big) <i>EtherCAT®:</i> IEC standard IEC61158 / Endianness: little
<b>Configuration interface</b>	Bluetooth® 4.0 (free Vögtlin Connect app available from Google Play store)
<b>Output I/O mosfet</b>	On/off for external shut-off valve or alarm available through M8-4P connector Contact type: mosfet transistor



<b>Electrical connection</b>	Maximum voltage: 36 Vdc, Max current 500 mA (Polyfuse protected) 9 pin D-sub male (power and signals) M8-4P connector (open collector output + power) Optional 2 x RJ45 (EtherCAT®/Profinet)
<b>Process connection</b>	1" BSPP female (1"G). Optional ½" BSPP, 1" Compression or Tri-clamp 50.5mm flange size (ISO) (see accessories page)
<b>Inlet section</b>	None required if standard filter/conditioner is installed. Without filter/conditioner a 10 D straight inlet is recommended. Filter can be deselected at time of order
<b>Pressure drop</b>	Standard 400 mbar at 1400 l/min air venting to atmosphere (with filter / conditioner) Optional: 325 mbar at 1400 l/min air venting to atmosphere (without filter/conditioner) Pressure drop is dependent on operating pressure (higher pressure = lower pressure drop) For more information, please refer to your sales partner
<b>Mounting orientation</b>	All orientations are possible
<b>Weight</b>	Meter: 3.7 kg. Controller: 8.7 kg (excluding ethernet and fittings)

### Safety

<b>Test pressure</b>	21 bara
<b>Maximum overpressure pressure</b>	28 bara
<b>Burst pressure</b>	100 bara
<b>Leak rate</b>	< 1 x 10 <sup>-6</sup> mbar l/s He
<b>Ingress protection class</b>	IP54 if IP54-D-sub is used (see accessories page). For optional EtherCAT®/Profinet: IP40

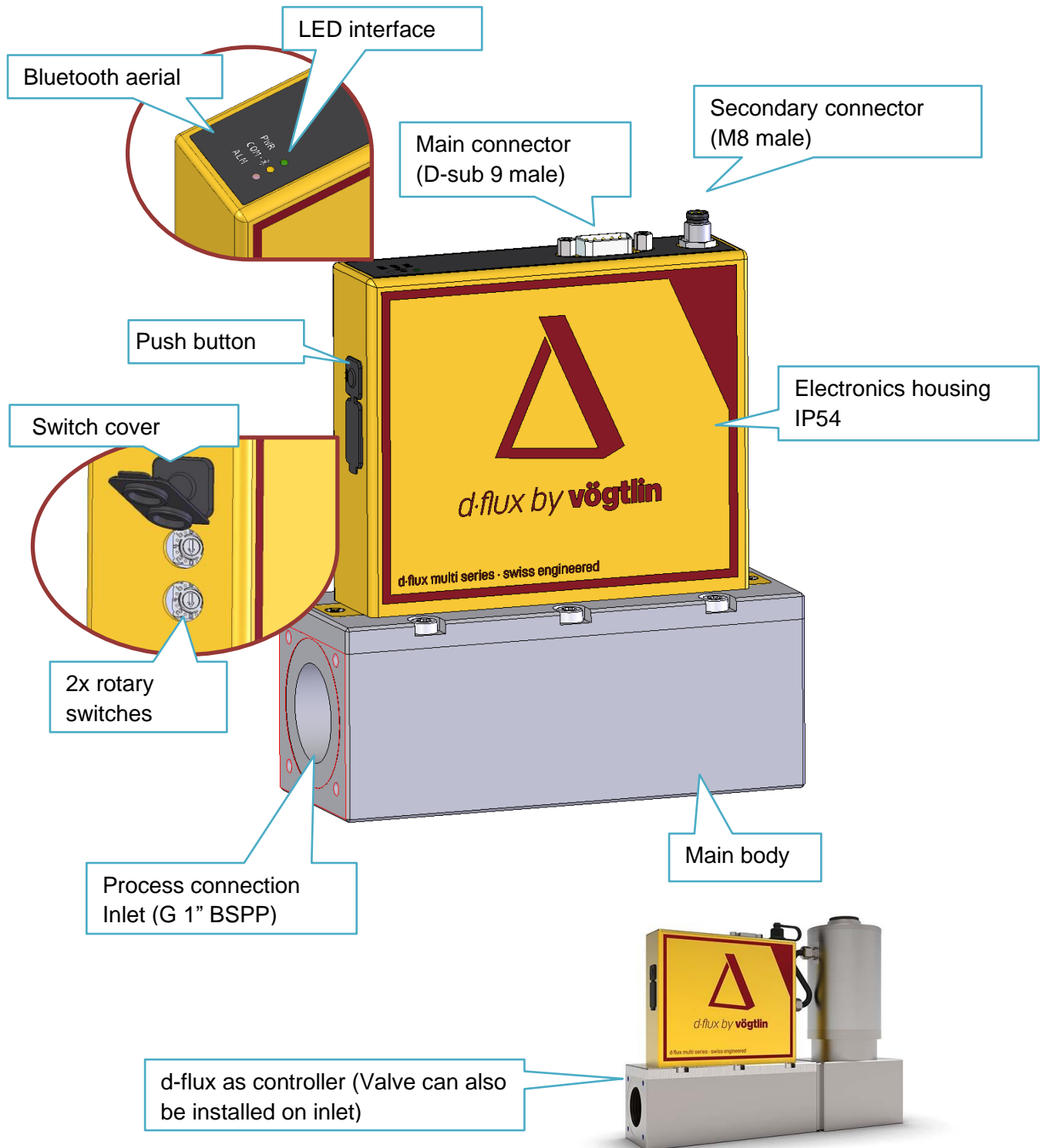
### Certifications

<b>EMC</b>	IEC/EN 61326-1, IEC/EN 61000-6-2/4
<b>ATEX certification</b>	None
<b>Material certificates</b>	Inspection certificate 3.1 available for body and fittings (optional)
<b>FDA compliance</b>	Expected to be released in the future
<b>PED</b>	Fully compliant. Since the unit has 1" process connection, complies with the SEP as defined in article 4, paragraph 3 of the Pressure Equipment Directive (PED) (2014/68/EU)
<b>RoHS/REACH</b>	All components comply with Directive 2002/95/EC (1907/2006) (ROHS) and the REACH guidelines according to 2015/863/EU and 2017/2102/EU (EU directive 2011/65).
<b>Warranty</b>	3 years

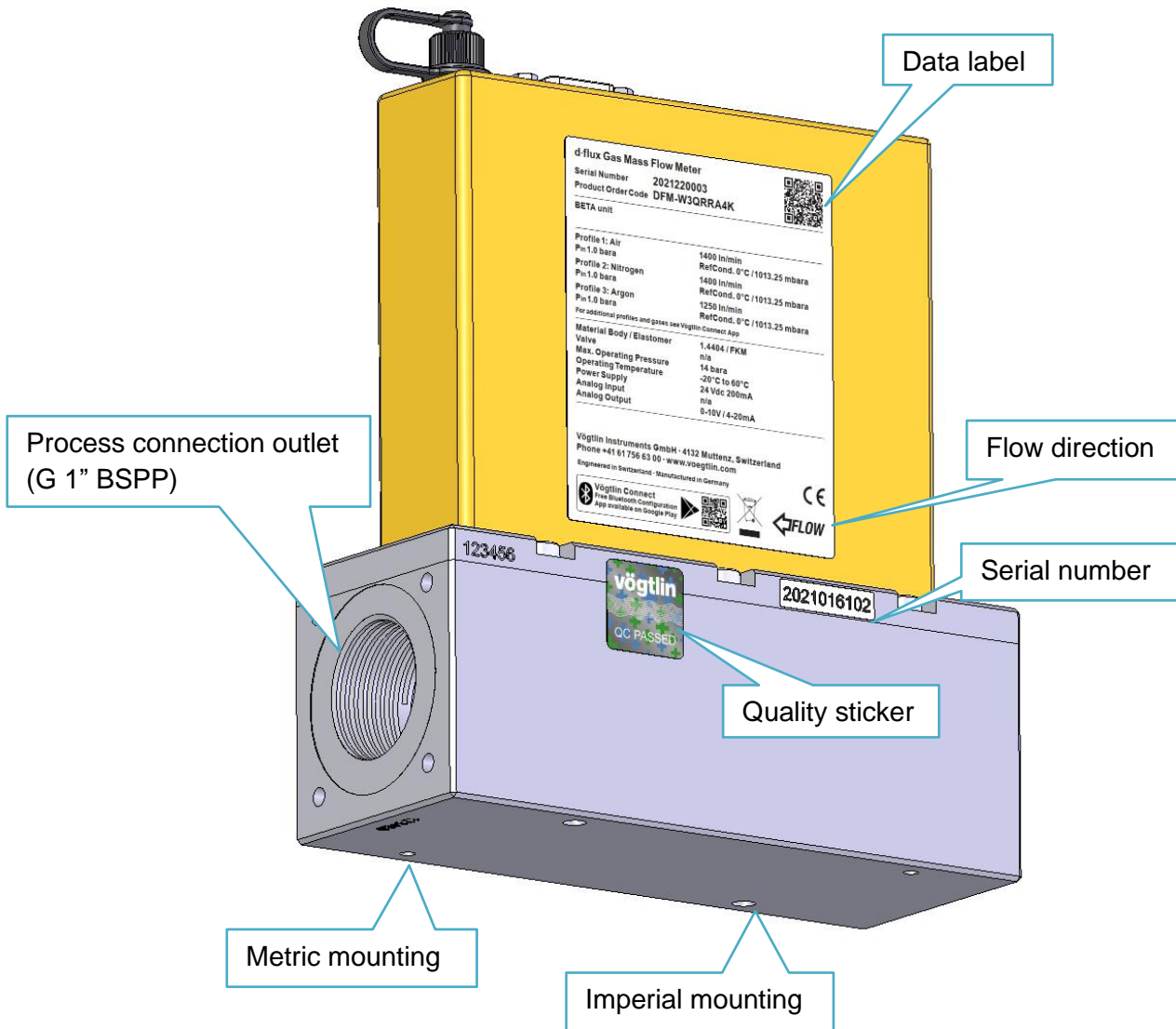
Technical specifications and dimensions subject to change without notice.

## 3.7 Unit overview

### 3.7.1 Front view



### 3.7.2 Back view



## 4 Unpacking and Product Identification

### 4.1 Receipt of your instrument

When receiving the instrument, carefully check the outside packing carton for damage that may have incurred during shipment. If the carton is damaged, notify the local carrier and submit a report to your distributor. Remove the packing slip and check that all ordered components are present and match your specifications (as ordered). Make sure any spare parts, calibration certificate or accessories are not discarded with the packing material. Do not return any equipment to the factory without first contacting one of Vögtlin Technical Support Centres (See [www.voegtlin.com](http://www.voegtlin.com)).

### 4.2 Product identification

The unit model and configuration are defined in the POC (Product Order Code). The POC can be created or translated by your Vögtlin contact. Please note that the factory configuration can be changed by any user using our Vögtlin Connect app.

The serial number is a unique identification number that is different for each unit. If you need a copy of the original certificate, please contact your local distributor and tell him the serial number of the relevant unit.

### 4.3 Product verification

After you unpacked your devices verify that you received the correct instrument(s). The easiest way to do this is to insure you have the correct certificate for each instrument (Serial number) and check the process default on this certificate with your purchase order. You can also verify the data on the instrument label.

## 4.4 Instrument label








Product name	d·flux Gas Mass Flow Meter		QR code to configurator
Unique product number	Serial Number <b>2021220003</b>		
Product identification	Product Order Code <b>DFM-W3QRRRA4K</b>		
Customer defined text	<b>BETA unit</b>		
Profile 1 description	<b>Profile 1: Air</b>	1400 In/min	
Profile 2 description	<b>Profile 2: Nitrogen</b>	1400 In/min	
Profile 3 description	<b>Profile 3: Argon</b>	1250 In/min	
	Pin 1.0 bara RefCond. 0°C / 1013.25 mbara		
	For additional profiles and gases see Vögtlin Connect App		
Product definitions	<b>Material Body / Elastomer</b>	1.4404 / FKM	
	<b>Valve</b>	n/a	
	<b>Max. Operating Pressure</b>	14 bara	
	<b>Operating Temperature</b>	-20°C to 60°C	
	<b>Power Supply</b>	24 Vdc 200mA	
	<b>Analog Input</b>	n/a	
	<b>Analog Output</b>	0-10V / 4-20mA	
Name manufacturer	Vögtlin Instruments GmbH · 4132 Muttenz, Switzerland Phone +41 61 756 63 00 · www.voegtlin.com		
	Engineered in Switzerland · Manufactured in Germany		
Link to Connect app	 Vögtlin Connect Free Bluetooth Configuration App available on Google Play		 CE mark
			 <b>FLOW</b> Flow direction

Figure 2 Label on back of d-flux units

If you communicate by e-mail to us about an instrument, please take a picture of this label and include that in your e-mail. As a bare minimum please provide us with the serial number of your unit.

## 5 Storage, transport and packing

### 5.1 Storage conditions

Observe the following notes for storage:

- Store in the original packaging to ensure protection from shock.
- Do not remove protective covers or protective caps installed on process connections.
- They prevent mechanical damage to the sealing surfaces and contamination in the measuring tube.
- Protect from direct sunlight to avoid unacceptably high surface temperatures.
- Select a storage location where moisture cannot collect in the measuring device
- Store in a dry and dust-free place.
- Do not store outdoors.
- Storage temperature

### 5.2 Transporting the product

Avoid big shocks during transport and meet all storage conditions as defined in 5.1

### 5.3 Packaging disposal

All packaging materials are environmentally friendly and 100% recyclable:

Measuring device secondary packaging: polymer stretch film that conforms to EC Directive 2002/95/EC (RoHS).

Packaging:

- Wood crate, treated in accordance with ISPM 15 standard, which is confirmed by the affixed IPPC logo.

or

- Carton in accordance with European Packaging Directive 94/62EC; recyclability is confirmed by the affixed RESY symbol.

## 6 Mechanical installation

The following four steps will guide you through the installation of your meter or controller. Please follow the sequence to ensure safe, error-free operation.



**During installation, make sure that all power, electrical signals as well as the gas supply are disconnected!**

Please take the ambient conditions into account when installing the unit

The unit is IP54 rated. The meaning of this 5 and 4 is as follows:

- 5X: The unit is dust protected. Ingress of dust is not entirely prevented, but it will not interfere with the operation of the unit.
- X4: The units can handle splashing of water. However, water from a jet, aimed towards the unit could damage the unit

The IP54 rating is only valid if the correct electrical connectors are used. Please also take into account and ensure that the unit is protected from external influences such as:

- Continues high humidity levels
- Temperature below -20 or above +60 C
- Electronic interference beyond the CE EMC norm (such as high voltage systems for plasma generation)
- Mechanical influences (Vibration)
- Vandalism

### 6.1 Installation conditions

#### 6.1.1 Mounting

No specific brackets are supplied or in general required to mount your flow device. We always recommend to mount the units on a flat surface. Below and on the drawings in Appendix [17.1](#) you find the mounting screw details. The unit must be mounted on a solid surface using suitable steel screws. For this purpose, there are 4 mounting holes on the underside of the unit according to the following drawing [dimensions in brackets in inches]:

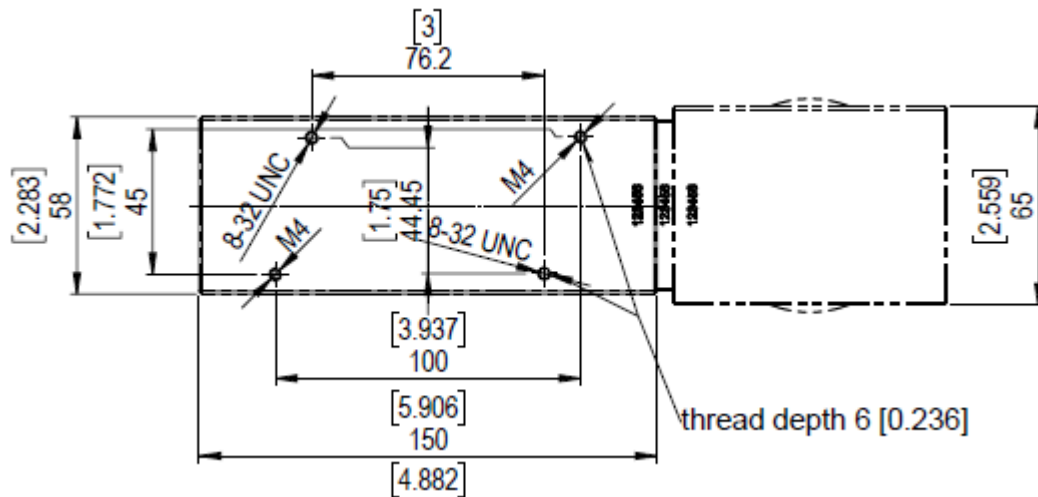


Figure 3: Bottom view, mounting holes

## 6.1.2 Mounting position

We always recommend mounting the unit horizontally with the connectors on the top. This is the easiest way to operate the unit and ensures access to the connections, LEDs and other operating elements. If the installation conditions require it, the unit can also be installed differently, but this needs to be noted at the time of order. The orientation has no influence on the measuring performance of your unit but could influence the valve operation.

## 6.1.3 Environment and process requirements

With regard to mounting location, the following situations can cause problems:

- Wet, polluted or dirty gases
- Strong heat sources, or ambient temperatures outside the specification
- Strong sources of electromagnetic radiation such as spark discharges
- Humid environments and the associated condensation can lead to damage of the electronic components
- Particularly in the case of flow controllers, strong vibrations will cause unstable control
- In general, aggressive environments reduce the service life
- Liquid running backwards can penetrate into the measuring instrument. An elevated mounting location generally helps, or using check valves.

## 6.1.4 Flow direction

Please observe the flow direction arrow in the data label.

## 6.1.5 Block and bypass

Especially for meters and controller with the valve on the inlet, we strongly recommend to mount the flow meter in a so called “Block and Bypass” configuration as shown in the picture below:



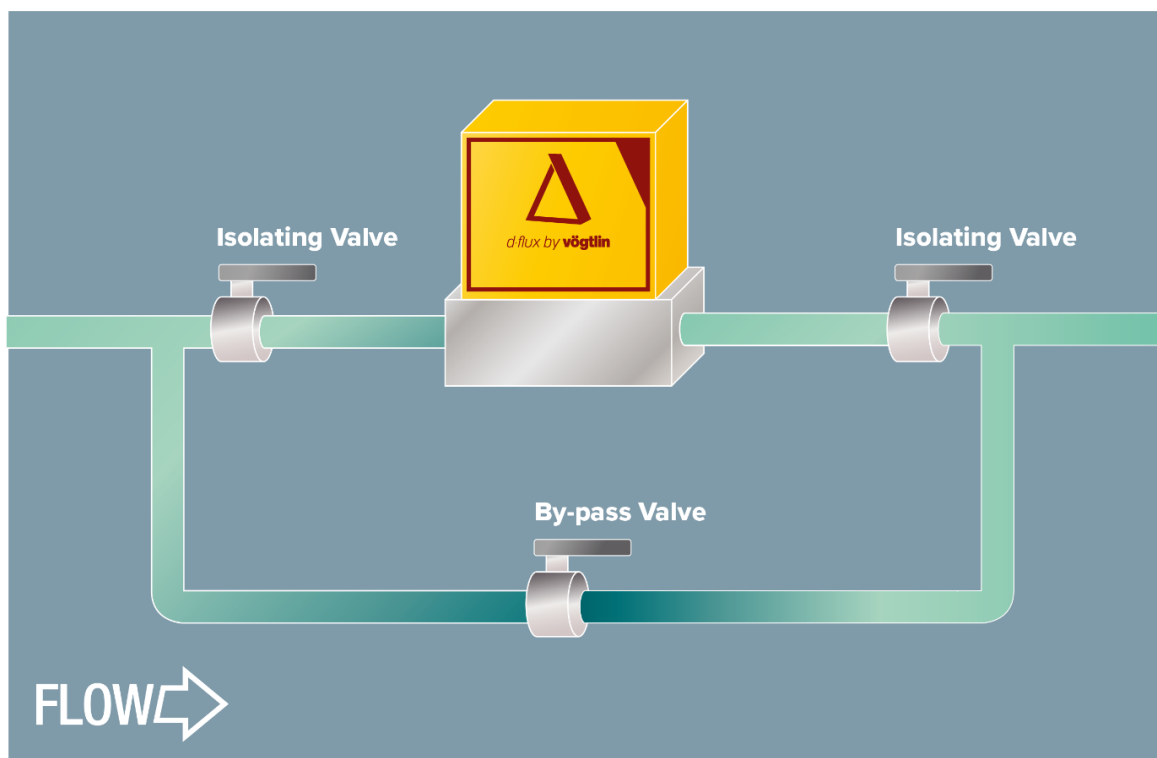


Figure 4 Bypass system example

This system has the following advantages:

- If you ever need to remove the unit for. For instance re-certification or inspection, you can open the bypass valve and close the two isolating valves. You can now remove the flow meter while your process is undisturbed.
- When you want to tare your system, you can open the bypass valve and close the two isolating valves. Inside the flow meter you have your process gas at your operating conditions, but at zero flow. Perfect conditions to tare the unit and optimize the uncertainty.

It is recommended to use ball valves in this application and we suggest some convenient flush fitting for an easy disassembly (Like Tri-clamp or flanges).

### 6.1.6 Pressure drop for d-flux meter (DFM)

For an exact value of the pressure drop for your specific application it is recommended to contact your Vögtlin contact.

On special request and after evaluation of your application we could consider to supply the unit without the inlet filter to reduce the pressure drop.

Measured pressure drop when venting to atmosphere (Air):

	Inlet filter	No inlet filter
<b>LFE1400</b>	410 mbar	325 mbar
<b>LFE1000</b>	380 mbar	340 mbar
<b>LFE700</b>	360 mbar	335 mbar
<b>LFE500</b>	340 mbar	320 mbar

Table 1: Measured pressure drop when venting to atmosphere

## 6.2 Process connections

The d-flux has a G 1" female parallel thread (1" BSPP) at the inlet and outlet as standard. When using fittings, we strongly recommend using the fittings we supply for this instrument which have been tested with this device. The most common causes of faults concern the way that devices are connected to the gas supply. Please note the following points:

- The pipes must be absolutely clean. Please flush them before installing the measuring instruments. Insure there are no pieces of thread sealant (e.g. Teflon tape) in the piping!
- Use appropriate pipe materials (pressure rating, durability)
- Use appropriate fittings.
- Malfunctions can be caused by unstable pressure controllers and compressors of air pressure-amplifier's that pulsate
- The size of the pipe must be matched to the measuring/control device. A diameter that is too small results in an increased pressure drop at higher flow.

For maintenance work, we recommend that a block and bypass system is used. This is particularly important where the gas supply must not be interrupted (see chapter 6.1.5)

To install the unit, please remove the protective caps from the side of the unit. Depending on the configuration, the process connections consist of a cylindrical G 1" threaded connection or the fittings/reductions you ordered. To avoid contamination of the unit, we recommend removing the protective caps just before installation.

When installing the unit, please observe the flow direction, which is marked with an arrow on the type plate of the unit.

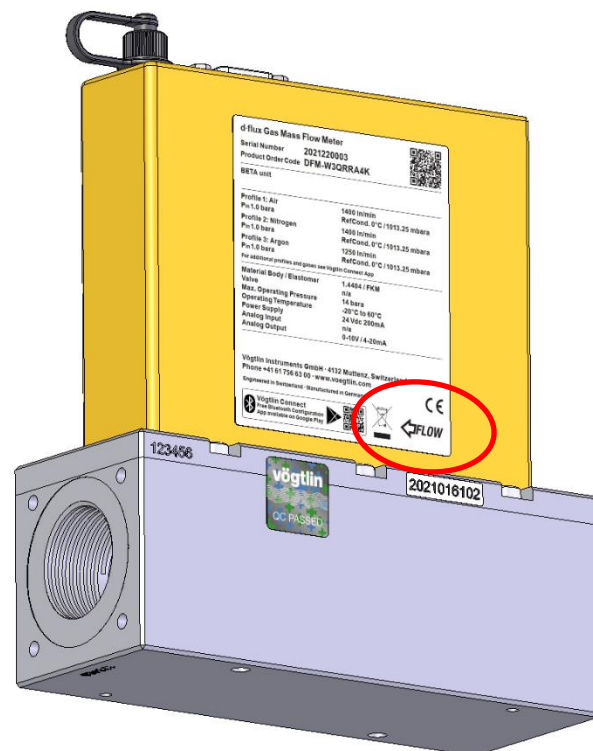


Figure 5 Identification flow direction arrow

To ensure the proper functioning of the meter, we recommend using the fittings from our range. The use of unsuitable or incorrectly fitted connections can lead to problems,

Due to the integrated turbulence filter, no specific inlet distance is required. However, we generally recommend a straight inlet section of 10D (10x pipe diameter).

## 6.2.1 Mounting the fittings

All the connections and fittings supplied by Vögtlin are sealed with an O-ring. If you ordered fittings with the unit, they are mounted and leak tested. If supplied separately (or you remove the supplied fittings) you have to mount and leak test the connections yourself. The sealing rings (O-rings) must not be damaged during assembly. For more information, see the d-flux data sheet for the fittings

### Types

Part No.	Type/Connections	Material
328-1254 / 328-1255	G 1" to 1" Compression Fitting,	Stainless Steel, FKM/EPDM
328-1426 / 328-1427	G 1" to D 50.5 (Tri-clamp),	Stainless Steel, FKM/EPDM
328-2157	G 1" to G 1/2" Reduction,	Stainless Steel, FKM



The design of the devices enables sealing at the ends with O-rings or flat seals. It is essential that you avoid the use of sealing tape to seal threads. Small pieces of sealant material can cause incorrect measurements and malfunctions. If that happens, the device has to be cleaned, checked or recalibrated, there will be an extra charge for the additional cleaning work.



Do not use liquid sealants. Sealing with liquid sealants will incur a higher cleaning charge for cleaning the device in an ultrasonic tank.

Check for any leaks before commissioning the devices. (See chapter 10)

## 6.2.2 Inlet filter

Vögtlin supplies the d-flux with an inlet filter mounted inside the flow meter. It is a fine-mesh sieve (50 microns) which is mounted at the inlet of the device.

In some cases, it is possible after factory evaluation to supply the unit without the integrated inlet filter. This will lower the pressure drop of the flow meter (See Chapter 6.1.6). If you do not use the integrated filter, we recommend you install a separate filter on the inlet. We always recommend that a filter, or at least a fine-mesh sieve (50 microns), is installed before the measuring devices. It often happens that solid matter such as welding residues, metal or plastic chips, rust, sealing tape, etc. affect the function. In pressurized-air applications using compressors, the air must be dry and free of oil. Please ensure that a suitable compressed air conditioning unit is located in the gas supply line to the devices. In the case of gases from cylinders, in general no special filtering is needed, but still make sure your tubing is clean.



## 6.2.3 Connecting Fittings

### Compression Fittings

- Position the instrument with the flow direction arrow pointing in the direction of flow.
- Verify the position of the front and back ferrule. Insert the tubing into the fitting. Be sure that the tubing rests firmly on the shoulder of the fitting and that the nut is finger-tight. Scribe the nut at the six o'clock position.
- While holding the fitting body steady with a backup wrench, tighten the nut 1-1/4 turns, watching the scribe mark make one complete revolution and continue to the nine o'clock position. Do not over-tighten!

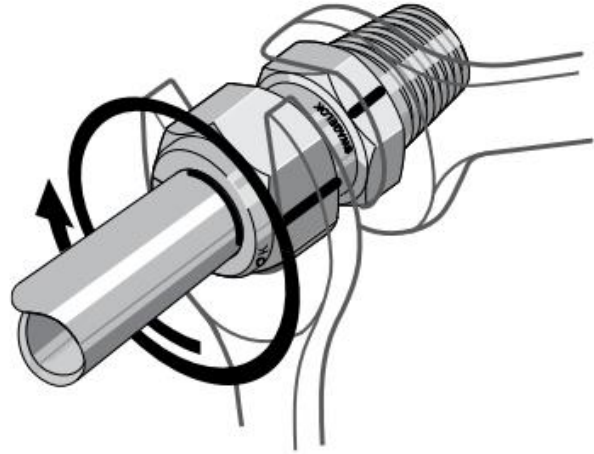


Figure 6 Proper way to tightening a compression fitting

- Check the system's entire flow path thoroughly for leaks. We recommend to not use liquid leak detectors. Instead, monitor pressure decay.

### Tri-clamp fittings

Tri-Clamp fittings are connections for pieces of pipe, which facilitate easy disassembly and cleaning. Tri-Clamp fittings consist of two ferrule ends, a seal and a clamp, assembled as shown:



Figure 7 Assembly Tri-Clamp fitting

Vögtlin only supplied the flange mounted to the flow meter. The seal and the clamp need to be purchased separately and installed according to the manufacturer's instruction.

## 6.3 Post-mounting check

Check for any leaks before commissioning the devices



**CAUTION:** Before use, all plumbing should be checked carefully for leaks, especially at the connecting fittings. All instruments are leak-tested prior to shipping. It is not a requirement to leak test your instrument. Do not use liquid leak detectors such as Snoop® to search for leaks inside or outside the d-flux. Instead, monitor pressure decay.

Verify:

- No sealing tape or liquid sealant can be used to seal threads
- Piping must be cleaned before installation of instrument.

Products in this manual may contain metal or elastomer seals, gaskets, O-rings or valve seats. It is the “user’s” responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process limitations of the device, may result in equipment damage and/or personnel injury or death.

It is recommended that the user check the devices on a regular schedule to ensure that it is leak free as both metal and elastomer seals, gaskets, O-rings and valve seats may change with age and exposure to process gas.

## 7 Electrical connections

The electronic connections are located on the top of the unit. You either have the standard units with Modbus and analog output or the advanced unit with the Ethernet communication (EtherCAT® or Profinet)



**Please note that the unit is only IP54 protected if you use the correct electrical connectors and plug off any un-used connectors (M8-4Pin cap supplied with the unit).**

**If you have an Ethernet unit the unit is never IP54, but IP40.**

### 7.1 Electrical Installation considerations

#### 7.1.1 EMC

Although in most locations the possibility of ESD should not be a problem, ESD should always be considered. Please take precautions to avoid the electronics being damaged by ESD.

The Instrument is fully EMC tested and meets all modern requirements as long as you follow all installation instructions.

#### 7.1.2 Requirements for connecting cable

Please ensure the cable is chemically compatible with the gases and chemicals used in the location. The connecting cables provided by the customer must fulfil the following requirements.

Electrical safety in accordance with applicable local federal/national regulations.

##### **Cable specification:**

Permitted temperature range:  $-20\text{ °C}$  ( $-4\text{ °F}$ )... $\geq 60\text{ °C}$  ( $140\text{ °F}$ )

Minimum requirement for cable temperature range: ambient temperature  $+20\text{ K}$

##### **For meter:**

Current output: For 4-20 mA: Shielded cable recommended. Observe grounding concept of the unit. The cable must be capable of handling 200mA.

### For controller:

Current output: For 4-20 mA: Shielded cable recommended. Observe grounding concept of the unit. The cable must be capable of handling 2000mA.

### 7.1.3 Requirements for connectors

Please ensure that the connectors meet the requirements for the IP rating

## 7.2 Connections



First remove the power supply before you connect/disconnect any of the plugs/terminals.

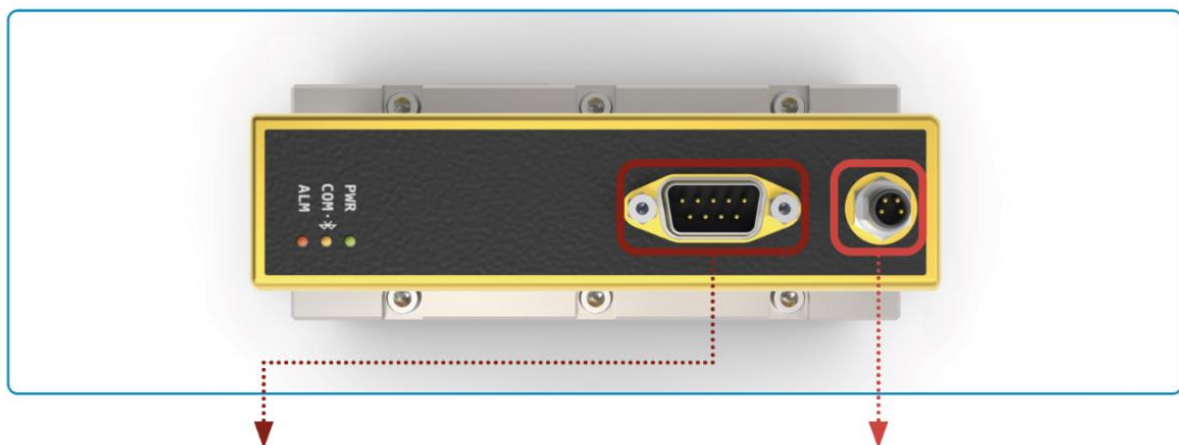
The d-flux has two electrical connectors:

#### M8-4 pin male plug:

This connector can be used as power supply and it gives access to the mosfet (Open collector) pin that can be switched on/off over the digital communication.

#### 9 pin D-sub male connector:

The D-sub connector can also be used to power the unit, but also gives access to the Modbus Modbus and analog



#### D-sub plug pin assignments male

Pin	Assignment
1	Analog Ground
2	Supply Ground
3	Supply Power
4	Analog Out Voltage
5	Setpoint (MFC only)
6	Valve Mode (MFC only)
7	Analog Out Current
8	RS485-A
9	RS485-B

} Modbus

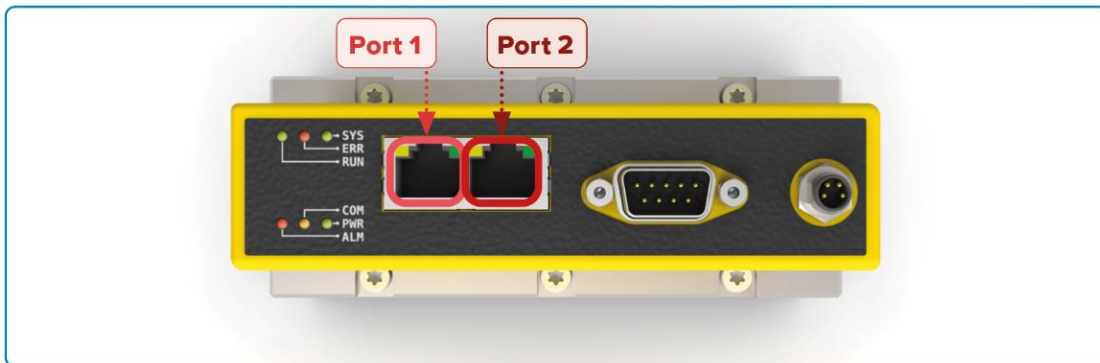
#### M8 plug pin assignments male

Pin	Assignment
1	Supply Power
2	Not Connected
3	Supply Ground
4	Output
enclosure	Protective Earth

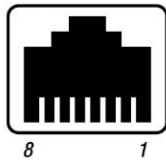
Figure 8 Top view connectors d-flux without ethercat

connectors

## 7.2.1 Profinet and EtherCAT® connections



### 8-pin RJ45 connector female



Pin	Assignment	Wire color
1	Data (TX+)	Yellow
2	Data (TX-)	Orange
3	Data (RX+)	White
4	not used	
5	not used	
6	Data (RX-)	Blue
7	not used	
8	not used	

Figure 9 Top view connectors d-flux with EtherCAT®

## 7.3 Electrical specifications



Only persons with the appropriate training are authorised to connect the unit. Improper connection of the unit can have serious consequences for persons, the unit or the environment, which can lead to injuries, damage or worse! Please verify all electrical specification below and verify that it meets your requirements and is compatible with your system:

### Power supply meter (DFM)

15-36 Vdc  $\pm 10\%$ , (200 mA@24Vdc, regulated)  
Power in through M8-4P connection or optionally through D-sub connection (ripple should not exceed 100 mV peak-to-peak)

### Power supply controller (DFC)

24Vdc  $\pm 10\%$ , (2000 mA@24Vdc, regulated)  
Power in through M8-4P connection or optionally through D-sub connection (ripple should not exceed 100 mV peak-to-peak)

### Output signals analog

Linear 4–20 mA or customer defined (max 20 mA) user selectable



	<b>AND</b>
	Linear 0–5 VDC or 0-10 VDC or customer defined (max 10 Volt) user selectable
<b>Input signals analog</b>	Linear 4–20 mA or customer defined (max 20 mA) user selectable
	<b>OR</b>
	Linear 0–5 VDC or 0-10 VDC or customer defined (max 10 Volt) user selectable
<b>Digital communication</b>	RS-485 (Modbus RTU 2-wire)
	The Modbus address can be set with 2 rotating switches on the outside of the housing. All Modbus settings can be set through the Vögtlin connect app.
	Adjust the Modbus address map of the device to your needs: Any of the existing Modbus registers (up to a maximum of 24 registers in total) can be mapped to a customer defined location in the Modbus address map
<b>Optional Profinet/EtherCAT®</b>	Dual Port RJ45 with integrated switch making it easy to daisy chain the units
	RJ45 LEDs indicating link and activity on the network
	Ethernet speed: maximum 100 Mbit
	<b>Profinet:</b> PROFINET IO specification v2.33 / PROFINET IO devices conformance class B (RT) / Endianness: conform Siemens S7 (big)
	<b>EtherCAT®:</b> IEC standard IEC61158 / Endianness: little
<b>Configuration interface</b>	Bluetooth® 4.0 (free Vögtlin Connect app available from Google Play store) (See Chapter 9)
<b>Valve Mode</b>	With this input you can control the current valve state. By applying this input will override the software control. Going below 1.7VDC will close the valve and going above 3.4VDC will open the valve completely (Purge see chapter 8.10.5. Valve Close see Chapter 8.10.6)
<b>Output I/O mosfet</b>	On/off for external shut-off valve or alarm available through the M8-4P connector Contact type: mosfet transistor. Maximum voltage: 36 Vdc, Max current 500 mA (Polyfuse protected)
<b>Electrical connectors</b>	9 pin D-sub male (power and signals) M8-4P connector (open collector output + power) Optional 2 x RJ45 (EtherCAT®/Profinet)



There are several ways to communicate with the unit:

- Analog signals: Volt and milliamps (Default)
- Digital: Modbus (Default)
- Bluetooth®: Vögtlin connect app (download from Google play®) (Default)
- Ethernet: Profinet®, EtherCAT® (Optional)

For a simple function check, we recommend using the Vögtlin Connect app. For details on analogue and digital communication, please refer to the corresponding chapters.

Congratulations, with the communication with your flow meter, you have successfully completed the installation.

## 7.4 Connecting schematic examples

Determine which electrical connections you will use and identify these in the connection diagram.

Some examples are:

### 7.4.1 Analog output to PLC schematic

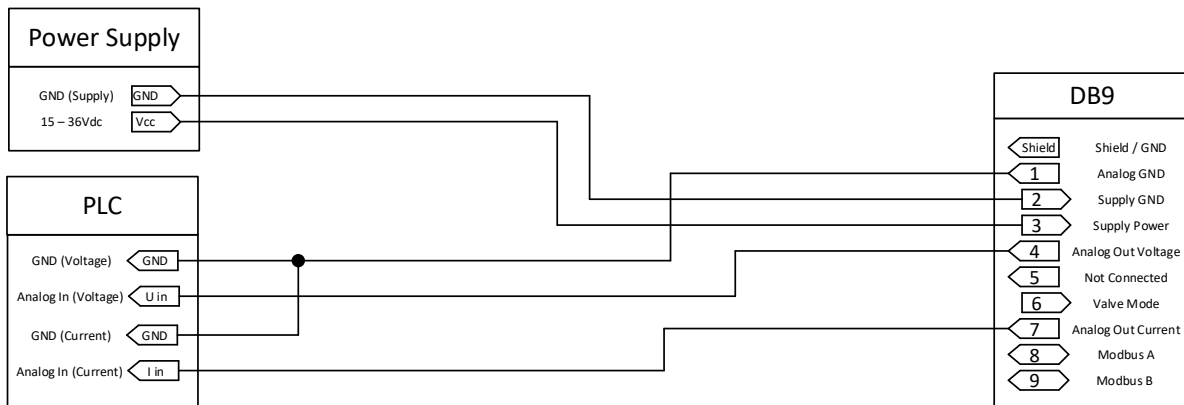


Figure 10 Electrical connection diagram analog with power supply to D9-sub connector

### 7.4.2 Modbus to PLC schematic

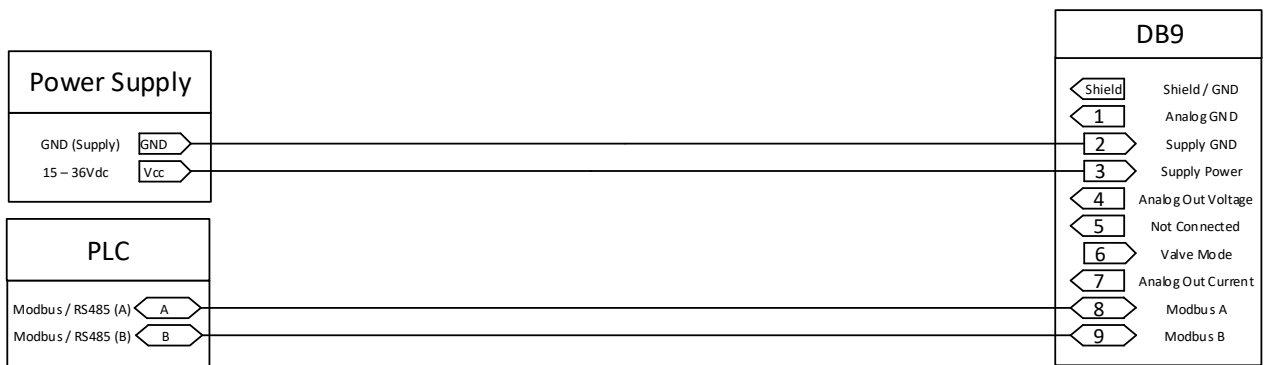


Figure 11 Electrical connection diagram Modbus with power supply to D9-sub connector

### 7.4.3 Modbus (more than one Device) to PLC schematic

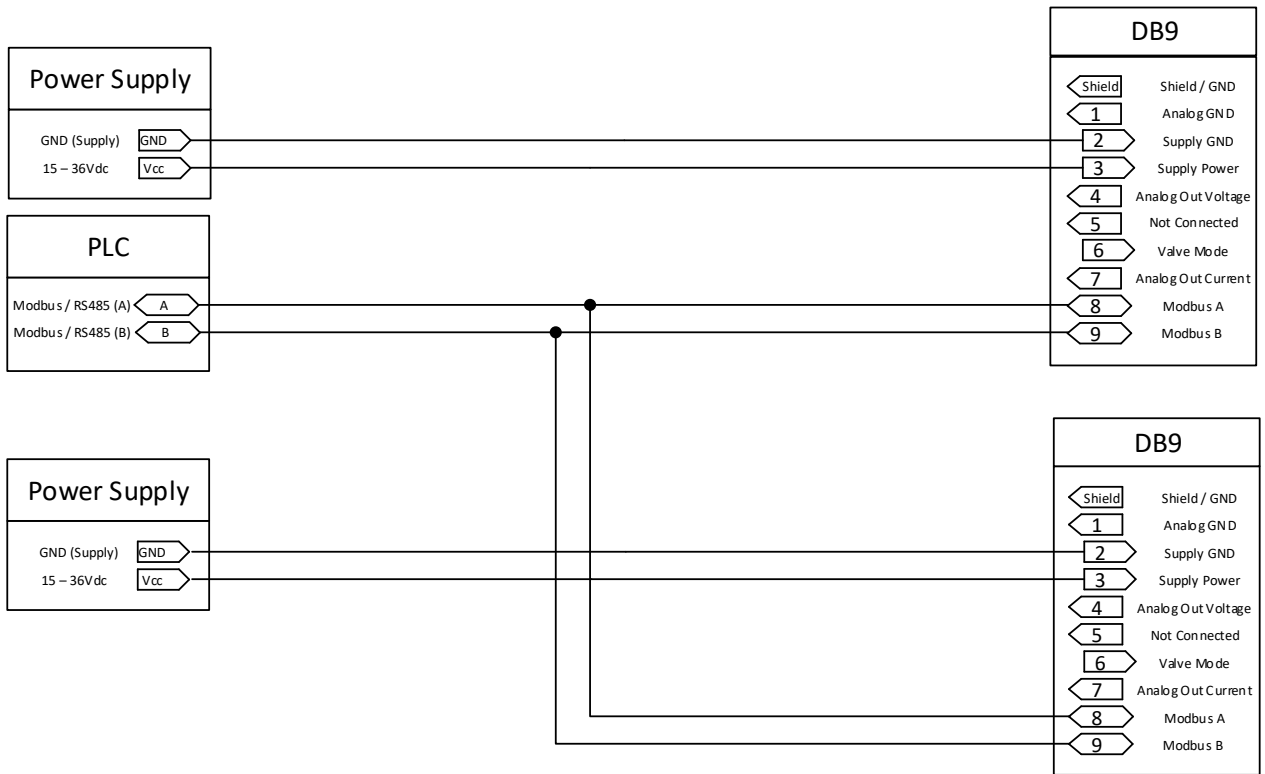


Figure 12 Electrical connection diagram 2 x Modbus with power supply to D9-sub connector

The recommended terminating 120 Ohm resistors are generally not build into the RS485 converter. There is a built-in resistor in the d-flux.

### 7.4.4 Mosfet I/O Switch to PLC schematic

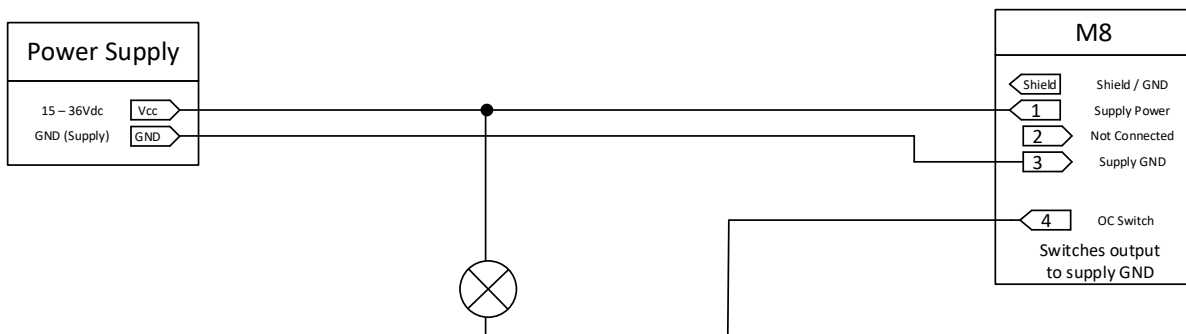


Figure 13: Electrical connection Mosfet I/O Switch when using power of device

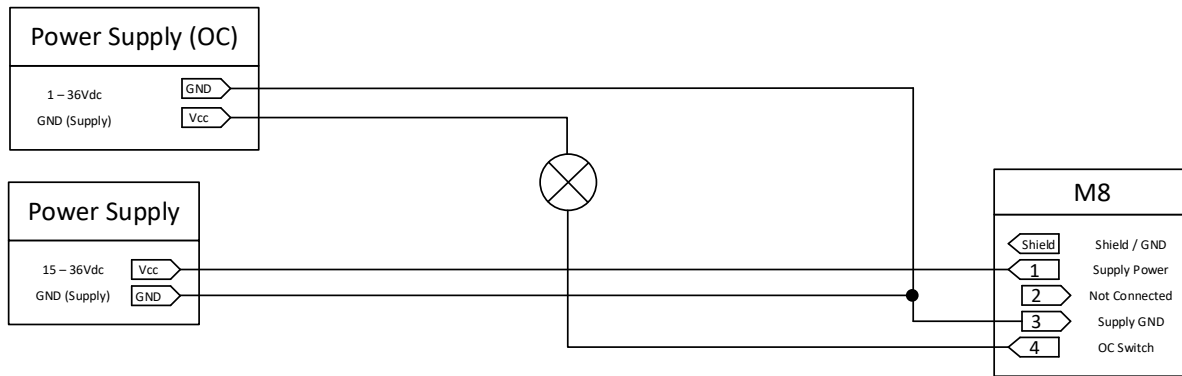


Figure 14: OC Switch when using external power supply

For more information see chapter **0 Flow: No flow although valve is open (MFC only)**

When this warning is activated the digital set-point will be set to zero in 20 seconds. This to avoid the valve getting too warm. If after 30 sec the valve is still open (f.i. due to an analogue setpoint) the unit will force the valve to close. This cannot be changes by the user. (Also see chapter [8.10.4](#))

## 7.5 Grounding

As a ground terminal, use one of the threaded holes on the bottom of the unit. Make sure that the meter is grounded before connecting it to the power supply. The metallic connector housing is connected to the equipment ground. The maximum permissible fault voltage between supply 0 Vdc and grounding must not exceed 24 Vdc peak. Make sure the ground is the same ground as used on the power supply and signal receiver.

## 7.6 Post-connection check

- Are cables or the device undamaged (visual inspection)?
- Are the power supply and signal cables correctly connected?
- Does the supply voltage correspond to the specifications in the connection diagram?
- Do the cables comply with the requirements?
- Do the cables have adequate strain relief? Are they routed securely?
- Is the cable route completely isolated? Without loops and cross-overs?
- Are all the screw terminals firmly tightened?
- Are all the cable glands installed, firmly tightened and leak-tight? Cable run with "water trap"
- Does the supply voltage match the specifications on the transmitter nameplate?
- Is the terminal assignment correct?
- If supply voltage is present, is the device ready for operation and does the green LED on the housing light up?

# 8 Functions

This chapter explains the abilities of the specific functions of the d-flux. The adjustment software refers to the configuration setting that can be made in the Vögtlin Connect App (See Chapter 9). These settings can however also be set through the digital communication (Modbus or Ethernet). To keep it simple we will not mention that in every following chapter and only refer to the Vögtlin Connect Bluetooth app.

## 8.1 Profiles

A profile is set of settings stored in the EEPROM of the unit. You can program and store 15 profiles (See chapter 9.1.4.1). The concept behind it is that you have a different profile for every application you use the unit for.

In the profile menu you can pull down and select profile 1 to 15 and edit these once the password unlocked the screen. Profile 0 is factory set and cannot be edited. The values in Profile 0 are referred to as “Factory settings” and are also the limitations for the user setting.

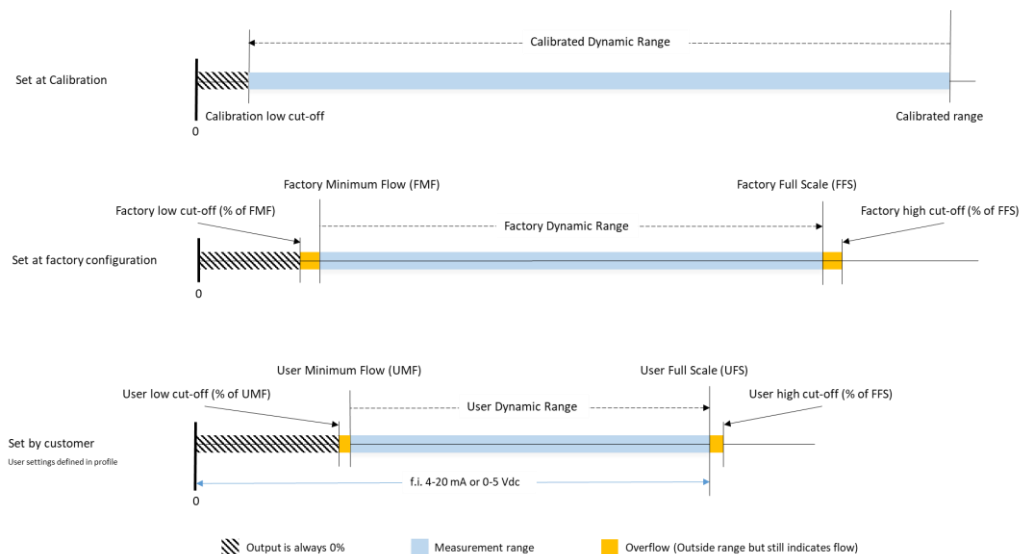
In the next sub-chapters we discuss the possible settings related to a profile. These settings can be adjusted by the Vögtlin connect app or through digital communication.



Figure 15: Screen dump profile screen app (from a big screen android phone)

### 8.1.1 Ranges: factory and user settings

As a user you can only adjust the “user settings”. The factory settings are the limitation for the user settings. As example if the factory full scale is 1400 l/min than the user full scale can never be set to a higher value. The same is valid for the other variables as explained in the diagram below:



## 8.1.2 Full scale setting (Range)

You can adjust the User Full Scale (UFS) from the maximum factory range down to 70% of the maximum Factory Full Scale (FFS).

If the meter does not show what you entered it is most likely that you entered a value outside the Factory values. The units will automatically adjust your entry to what is possible.

Please note that the variables you select in the profiles are stored in the EEPROM of the unit and will be remembered by the units if in the future you recall that profile.

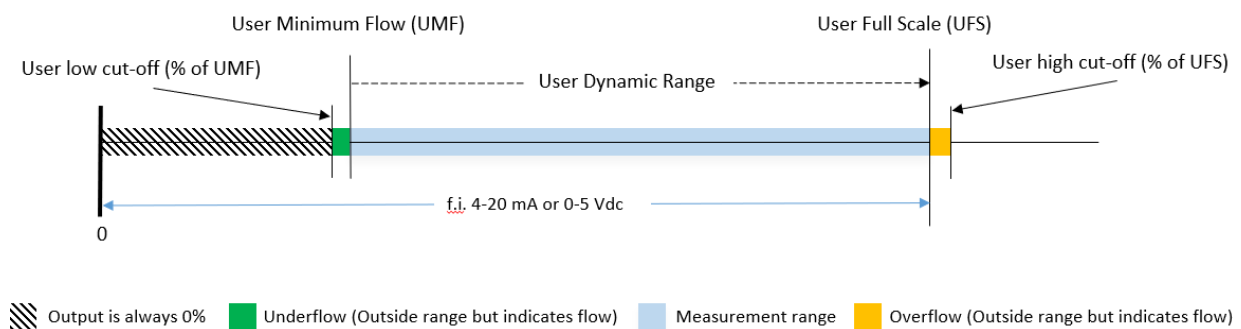
## 8.1.3 Low and high cut-off

The low cut-off is the value below which the meter no longer indicates a value related to the flow. Below that value the output always indicates 0.

The low cut-off is defined as a % of the user minimum flow (Default 8% of UMF)

The high cut-off is the value above which the meter no longer indicates a value related to the flow. Below that value the output always indicates the User high cut-off valve.

The high cut-off is defined as a % above the UFS (Default 8% of UFS)



Flows beyond the cut-off point are no longer measured by the instrument (Neither digital nor analog). As an example, the flow meter always indicates zero (0) if the flow is below this low cut-off point. The user low cut-off can be set in the profile in the app (Advance mode only) or through any digital communication from 0 to 10% of the user minimum flow. For meters it is recommended to make this value 0%.

## 8.1.4 Dynamics and VADy

**Note: VADy (variable dynamics) can only be used for meter (DFM)**

The dynamics of a flow meter is the ratio between the biggest and the smallest flow it is able to measure. For instance, if the highest flow is 1400 l/min and the smallest is 1.4 l/min dynamic range is 1:1000.

However, the possible dynamic range for the d-flux is pressure dependent. If the pressure becomes higher the dynamic range becomes smaller, meaning you cannot measure extreme low flows anymore.

Your maximum dynamic range for air is 1: (1000/pressure in bara). For other gases contact the factor or visit our configurator on <https://configurator.voegtlin.com/>

“Vögtlin Automatic Dynamics” (VADy) is an optional setting for the users who would like to optimized the dynamic range of their d-flux meter.

When you activate the VADy feature, the d-flux will automatically set the low cut-off depending of its internal calculations. It does this by measuring the absolute pressure and using the formula above to calculate the optimum dynamic range:  $1: (1000/\text{pressure in bara})$ .

You can read the calculated dynamic range through the app or any digital communication. If you activate the VADy, your manual defined low cut-off will be ignored and overridden by the calculated value. The d-flux will calculate and update the current dynamic range every 10 milliseconds.

**Dynamics and accuracy:**

High dynamics create the ability to measure flows where the uncertainty is bigger than the measured flow. However with a repeatability of 0.15% you can still get repeatable process settings.

When you de-activate the VADy, the low cut-off value you defined will become active again and will be same under any pressure condition (Fixed, but adjustable)

## 8.1.5 Engineering units

You can select the different engineering units. The totalizer can be a different engineering unit than the flow indication for instance flow: l/min and Totalizer: kg

Below the engineering units you can select in the d-flux. Please note that many of the units are duplicates but written on a different way (e.g. l/min and nlpm).

Flow	total	Pressure	temp
l/min	l	bar a	K
l/s/min	l	mbar a	°C
l/s	ml	Pa a	°F
l/s/s	mls	hPa a	°R
l/h	kg	kPa a	
l/s/h	g	Mpa a	
ml/min	m <sup>3</sup> n	atm a	
mls/min	m <sup>3</sup> s	psi a	
ml/s	ncc	kpsi a	
ml/s/s	scc	psf a	
ml/h	lb	kpsf a	
mls/h	oz	osi a	
kg/min	scf	kosi a	
kg/s		osf a	
kg/h		kosf a	
g/min		Torr a	
g/s		mmHg a	
g/h		cmHg a	
m <sup>3</sup> n/min		inHg a	
m <sup>3</sup> s/min		mmH <sub>2</sub> O a	
nm <sup>3</sup> /s		cmH <sub>2</sub> O a	
sm <sup>3</sup> /s		inH <sub>2</sub> O a	
nm <sup>3</sup> /h		g/cm <sup>2</sup> a	
sm <sup>3</sup> /h		kg/cm <sup>2</sup> a	
nccm			
sccm			
nccs			
sccs			
nml/h			
sml/h			
lb/min			
lb/s			
lb/h			
oz/min			
oz/s			
oz/h			
scfm			

### Remarks and Notes:

If a unit name is "normal" (letter "n" in its description f.i. "ln") than we select 0°C and 101325 Pa as reference conditions. If it is anything else the customer can set the reference conditions in the bottom of the profile page in the app.  
Real mass units (e.g. kg) have no reference settings.

## 8.1.6 Totalizers

Each profile has his own totalizer. The totalizer can be reset individually. The totalizer in Profile 0 adds up all the flows measured in all profile and cannot be reset.

If you prefer that one totalizer measures several profiles, please contact the factory.

## 8.2 Set/Read

Digitally you can read the mass flow, actual volumetric gas flow, absolute pressure, temperature, current selected totalized value and many diagnostic values like warnings or valve load.

You can read out the flow with an analog mA and a Vdc output. The analog signals can be adjusted up to 20mA and 10 Vdc (See Analog out).

If you have a Mass flow controller (MFC) you can give a setpoint (=desired flow of gas) either digitally (Bluetooth Vögtlin connect app, Modbus or Ethernet) or analog either by mA or Volt signals

In the set/read menu in the Vögtlin Connect app (See chapter [9.1.5.2](#)) you can also:

**Store setpoint:** If you “store” the setpoint and if the power fails or the units is restarted, it will recover that last set setpoint and go directly to that value.

**Setpoint at next power cycle:** The setpoint you enter in this line will be start with if the power fails or the units is restarted.

Tare manually: Only use after reading chapter [10.4.4](#)

**Automatic Taring:** ONLY recommended for MFC with valve on the outlet

## 8.3 Tare and Autotare

To “tare” is the process of zeroing the unit. It ensures that the flow meter is providing the most accurate measurements at any given situation. Taring gives the flow meter an optimized zero reference for flow measurements.

If you have a controller with a valve on the outlet you can activate “Autotare”. In this mode the unit will “tare” itself when he is sure that is no flow. (See Chapter [10.4.4](#) for operation and details)

## 8.4 Signal filter

As a user you can select from 3 different signal filter types and adjust the strength of the filter. We recommend to put the unit on automatic but in some specific cases you might like to optimize the filter. The filter options are:

- Moving Average (Also referred to as Boxcar filter)
- Exponential Moving Average (EMA)
- Moving Median



## 8.4.1 Overview filter effects

	Smoothing	Response time	Edge preservation	Spike suppression
<b>Moving Average</b>	Moderate/good (1)	Moderate	Moderate	No
<b>EMA filter</b>	Excellent	Poor	Poor	No
<b>Moving Median</b>	Moderate/good (2)	Moderate/good (2)	Good	Yes

(1): Average on sample

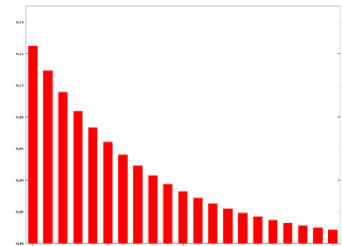
(2): Anti-noise mode

## 8.4.2 Detailed filter descriptions

The **moving average** is a filter that averages a finite number of samples within a moving window. To compute the filter output, it calculates the average of all samples in the window. A larger window size causes a stronger smoothing effect. The moving average filter limits the effects of spikes on the filter output.

**When applied:** This default filter optimizes noise suppression based on the Modbus sampling interval. It is mainly used to average any noisy in the signal.

An **exponential moving average (EMA)** is a first-order infinite impulse response filter that applies weighting factors which decrease exponentially. The weighting for each older sample decreases exponentially, never reaching zero. The graph at right shows an example of the weight decrease.



Typically, you have a stronger smoothing effect compared to a moving average filter.

**When applied:** This filter is similar to the MA filter, but has the added feature that when big flow jumps occur it comes quicker back to the real true value. With this specially modified filter the output is guaranteed to equal the input within a predictable time. Used for flows with high amplitude flow spikes

The **moving median** filter is a non-linear digital filtering technique, often used to remove noise from a signal. Median filtering is very widely used in signal processing because, under certain conditions, it preserves edges while removing noise.

Typically, it is better for removing spikes than a moving average filter and maintains edges for faster response.

**When applied:** This optional filter is stronger in the removal of spikes in the measurement and maintains edges for faster response. If you for instance have pulsations in your flow (f.i. from a compressor) we recommend you try this filter

In general, we recommend to try which filter is most suitable for your specific application, but we expect that in 80% of the cases the Moving average is the best solution.

## 8.5 Warnings and Errors

There is an advanced and effective diagnostics system build in the d-flux where notifications inform the user about the status of this product. The status is indicated with a red LED on the units and details status report can be obtained through the Vögtlin Connect app (See chapter 9)

Notifications are separated in “Warnings” and “Errors”. An error is product related, if there is a product failure (error) the red LED on the unit will be permanently on, the unit most likely stopped working and will take some default actions. (See chapter 8.5.4). In the app, (chapter 9.1.5.2) or over any digital communication you can see in the status screen what is wrong. If there is an issue, the green button in the app “status” screen becomes red. If the button under “Status” is grey, it means that specific warning feature is not activated or not switched on,

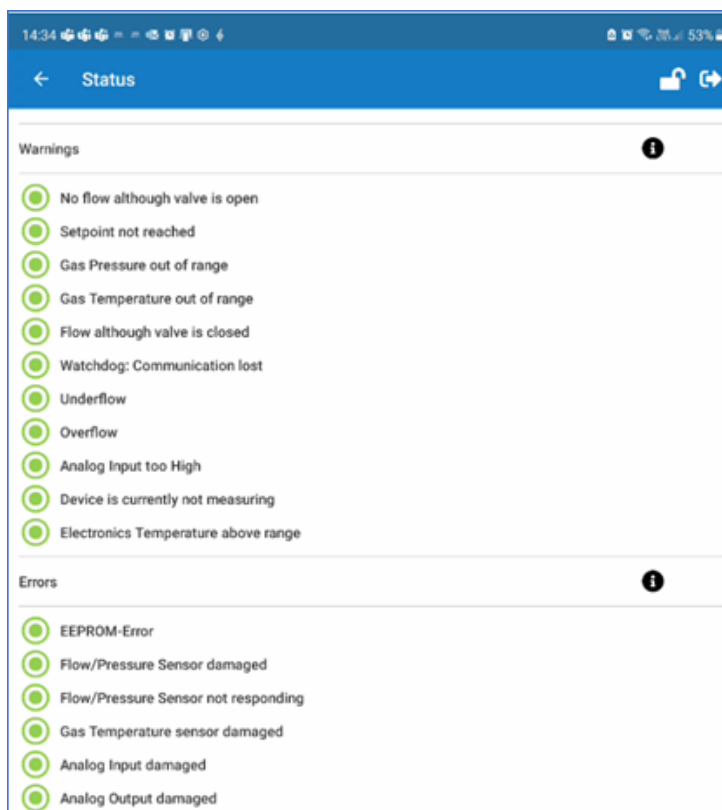


Figure 17 Screen of the Connect app (Status screen)



Figure 16 Top of unit where LED's are located

The “Warnings” are more process related, f.i. temp or pressure too high or flow not reached. If this occurs, the RED LED on the d-flux starts fast flashing (2 x per second). You need to connect with the app to the unit and look at under icon “status” to see what this problem is and investigate the problem is serious. See chapter 9.1.5.2.

Depending on the setting (See 8.5.1) the warning automatically disappears when the specific situation is gone or the LED flashes slower (1 x per second) till you reset the alarm. Some warnings have a predefined action see chapter 8.5.3 as example set the setpoint to zero.

You can reset an alarm through the app or through digital communication. You can optionally set the long push on the external push button to reset a warning (See chapter 8.9).

You have the following possible warning situations:

- Flow: No flow although valve is open (DFM only)
- Setpoint: Setpoint is not reached (DFC only)
- Gas Pressure: Pressure out of range
- Gas Temperature: Temperature out of range
- Valve: Flow measured although valve is closed (DFC only)
- Underflow
- Overflow
- Analog input: Analog input too high (DFC only)
- Measurement Mode: Device not operating in measurement state
- Electronics temperature: Electronics temperature above range

**Errors** are permanent malfunctions of the flow meter. When one of these is detected the light in the app become red. The LED on the outside of the flow meter will burn permanently red.

Possible errors are:

- EEPROM error
- Sensor damage
- Sensor not responding
- Temperature sensor damaged
- Analog Input damaged (DFC only)
- Analog Output damaged
- Bluetooth module not responding

### 8.5.1 Default warning settings

The user can change the settings for the warnings in the warning settings menu of the Vögtlin connect app. (See chapter [9.1.5.2](#))

You can adjust globally (valid for all warnings) or select a specific warning and adjust them individually.

These are the possible adjustments:

- Rise time: How long the error is active before it is reported (default 2000msec)
- Falling time: How long the warning is not active before it is switched off (Default 2000msec)
- Switch warnings off and Recovery mode (What happens if the active warning is no longer there): Automatic, resettable or off

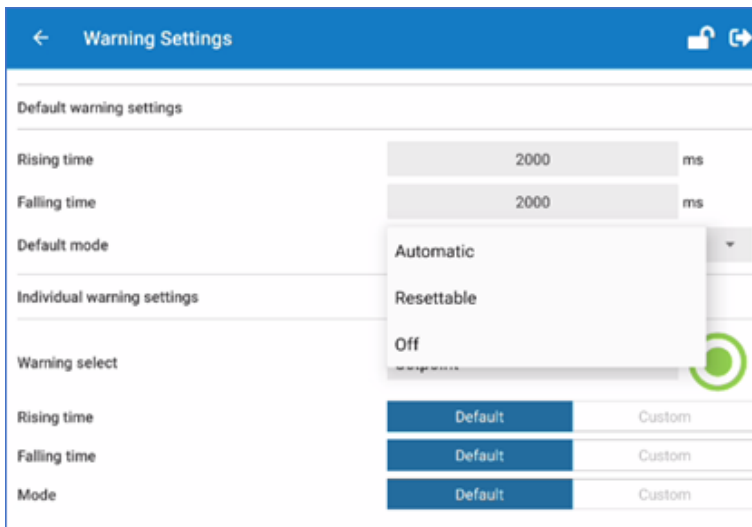


Figure 18 Warning setting screen in app

**Automatic:** Once the warning is no longer there the red LED stops fast flashing. The status indicator goes from red to green again

**Resetable:** Once the warning is no longer there the red LED changes from fast flashing to slow flashing. The status indicator goes from red to orange.

**Off:** No notification

For more information on LED's see chapter 11.2

You can stop the slow flashing LED and the orange app marking by pressing "Reset" (Reset button only shows in the menu if there is something to reset or you can program the external push button (See chapter 8.9) in the unit to "Reset warnings" (Hold several seconds to activate))

## 8.5.2 Individual warning settings and actions

The previous chapter set the variables for all warnings. Below these settings you see the individual alarm settings and the ability to add an action to an activated warning.

As example you can activate the I/O switch (mosfet) upon a warning.

Behind "Warning select" select from the pull-down menu which warning you want to create individual setting for. For instance, "flow"

Select "Custom" on Rising/Falling time and Mode if required and enter your preference.

Select the action from the pull-down list and activate this by selecting a rising or falling activation (or both). Action choices are:

- Device reset: Reset units (See chapter 9.1.8)
- Stop measurement: Stop taking measurements
- Start measurement: Start taking measurements
- Close Valve: Close the valve independent of the setpoint (See chapter 8.10.6)

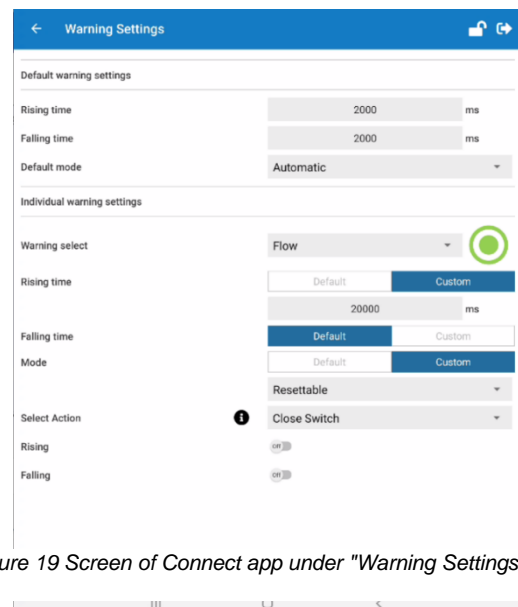


Figure 19 Screen of Connect app under "Warning Settings"

- Open valve: Open the valve to 100% independent of the setpoint (See chapter [8.10.5](#))
- Release valve: Cancel the “Valve open” or “Valve Close” command
- Setpoint 0%: Change the setpoint to 0% (Not if you only use the analog mode)
- Setpoint 100%: Change the setpoint to 100% (Not if you only use the analog mode)
- Setpoint “Power-On” value: Change the setpoint to the value set in the “Power-on” mode
- Close switch (See Chapter [8.6](#))
- Open switch (See Chapter [8.6](#))

### 8.5.3 Factory defined warning actions

To protect the instrument the factory has pre-defined some important user actions on important warnings. These are set as default in the system and you can adapt these if you desire through the warning settings menu on the app.

#### **Flow: No flow although valve is open (DFC only)**

When this warning is activated the digital set-point will be set to zero in 20 seconds. This to avoid the valve getting too warm. If after 30 sec the valve is still open (f.i. due to an analogue setpoint) the unit will force the valve to close. This cannot be changes by the user. (Also see chapter [8.10.4](#))

### 8.5.4 Factory defined error actions

The following actions as a result of an error in the unit are factory set and cannot be changed

If any error is reported, the red led on the d-flux will be permanent on. If you have a controller the error alarm will, with a delay of 2000 msec, make the digital setpoint zero and the valve is forced to close. The I/O mosfet will be opened (Not connected to ground if it was activated)

We could at the factory adjust these definitions in [8.5.3](#) and [8.5.4](#) if required.

## 8.6 Mosfet I/O contact

The unit has a build-in I/O contact consisting of a mosfet that can handle up to 500 mA and from 1 to 36 vdc. The d-flux mosfet output accessible through the M8 connector. A mosfet is like a semiconductor switch. You can control this switch through digital communication or this switch can be driven by an event (f.i. warning or Alarm)

You can use the units power supply or use a separate external power supply as long as the grounds are connected together. If you want a simple indication, put a 1 to 2K $\Omega$  resistor in series with a LED and connect it over pins 1 and 4 of the M8 plug. The mosfet can be activated manually (See [9.1.4](#)) or through an event. (See [8.5.2](#) for action abilities)

For connection examples see [7.4.4](#) (Mosfet I/O Switch to PLC schematic)

## 8.7 Analog output

There are two separate analog outputs. One for current (mA) and one for Voltage (Vdc). They can be used simultaneously is required.

You can switch the analog out on/off and set a pre-set value (0-5 Vdc, 0-10 Vdc, 4-20 mA) or set your own min and max values. You can also create an inverse output (f.i. 10 Vdc at 0 flow and 0 V at UFS).

## 8.8 Analog input (MFC only)

There is one analog input for setting the setpoint of the controller. This input is available for DFC only. You can set the input to be a voltage (Vdc) or a current (Idc) input through the Vögtlin connect app (See Chapter 9.1.2)

## 8.9 Pushbutton

The pushbutton on the side of the d-flux housing is always programmed for short-press (is 1 second or less) to active the Bluetooth® communication.

You can program what will happen if you “press and hold” this button. Default the long push is “No function” and recommend to return it to that setting. through the Vögtlin connect app (See chapter 9.1.2)

### Options are:

No Function:	Pushing the button long does nothing
Device Restart:	The unit will restart (green power light will flash)
Measurement on/off:	The unit will stop/start measuring (No data transmitter analog of digital). Power LED will flash, Diagnostics, analog and digital comms will not update its values.
Warning reset:	The ability to reset the warnings (see chapter 0)
Tare:	Zero the unit (Only use this if you are 100% sure there is no flow and the unit is under operating pressure and temperature with the gas that the meter is intended for. See chapter 10.4.4)

## 8.10 Controller

The d-flux can be supplied as a meter or as a controller. The meter measured the amount of gas that flows through the flow meter. A gas mass flow controller has an integrated control valve and except for measuring the gas, it (with its integral valve) controls the gas flow to a customer defined value (Setpoint). The valve is always Normally Closed (NC) meaning if there is no power to the unit the valve is closed.

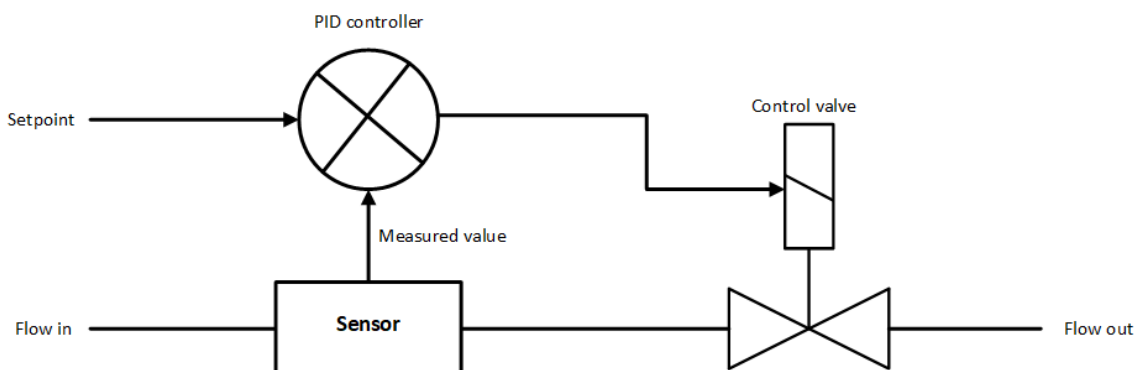


Figure 20 Principle diagram mass flow controller

The position of the valve is depending on the customer setpoint and the measured value. If for example the setpoint is 10 and the measured value is 9 then the valve has to open a bit more. However, the valve should not open too much otherwise the flow becomes 11.

The amount of opening of the valve is calculated in a so-called PID controller. A PID (proportional–integral–derivative) controller compares the Measured value with the Setpoint and with a certain algorithm sends a value to the control valve. That algorithm are basically 3 separate response calculators called proportional–integral–derivative. The settings for these calculators are adjusted at the factory based on the process information that you supplied when you ordered the unit. Through the Vögtlin connect app you can adjust these and many more valve related settings in the menu called “Valve Control”. See chapter 9

### 8.10.1 Setpoint Mode

The setpoint mode determines which setpoint is followed. If you select “Automatic” that any change in setpoint from either any analog or digital input (including Bluetooth) will be followed. You can change this setting to either analog or digital in the Control App (See Chapter 9)

### 8.10.2 Ramping mode

Ramping is a defined slope (rate of change) in the response of the unit. You can make it slow to avoid undesired fast changes in your process. You can either set it “Off” or define the ramping to “constant time” or “constant slope”

- Constant time: The desired setpoint will be reached after a predefined time <sup>1)</sup>
- Constant slope: The desired setpoint will be reached at a defined slope (ln per msec) <sup>1)</sup>

1) Unless the defined time is faster than the response time

### 8.10.3 Valve Offset

The valve needs a minimum amount of power before the valve starts to open. Therefore, the controller will create a starting point above zero. A kind of head start. This first jump is referred to as offset and this will be set at the factory. If your inlet or outlet pressure significantly changes the offset might have to be adjusted to avoid overshoot or very slow responses to setpoints. Please contact your local distributor for support.

### 8.10.4 Valve Protection setting

If you give any mass flow controller a setpoint but do not connect the units to a suitable gas supply, the risk exists that the valve will open 100% but does not generate any flow. In that case the valve gets maximum energy and no internal cooling and will get very hot. If this is done for longer periods of time the valve can be damaged.

To prevent this there are 2 systems to avoid this situation. (Also see 8.5.3)

Under Warnings we have set an action that will make the digital setpoint zero after 20 seconds if there is no flow detected while there is a setpoint. This action will NOT raise a warning. (See Chapter 9).

If you want to receive a warning (red led flashing) you have to ensure the flow warning is active under “Warning settings” (Set on by default)



There is a valve protection build in that will close the valve if the following conditions persist for more than 30 second: Flow = 0 AND the setpoint is bigger than zero AND the valve power is set to 100%.

If the setpoint is set by the analog input the valve will just close. To get the unit working normally again you need to make the analog setpoint zero again or reset the unit.

You **cannot** disable this feature with the Vögtlin Control App (See Chapter 9) under “Valve” (Switch Valve Protection off)

### 8.10.5 Valve Purge

Valve Purge is a way to open the valve 100% independent of the setpoint for a defined period of time. This can sometime be required in application to “blow out” the system to clean or for safety reasons. There are several ways to initiate this purge.

#### Bluetooth Vögtlin connect app

With the Vögtlin connect app under “valve” (Select under Valve mode see Chapter 9). If you activate purge this way the purge will only last for the time you set in Vögtlin connect app under “valve” in “Valve Purge Duration” (in milliseconds)

#### D-sub connector

By connecting Pin 6 of the D-sub connector to voltage of 3.7 volt or higher (See chapter 0)

#### Digital communication

Active the command through your digital communication

Note: if you apply a purge the outlet pressure on the MFC will most like become the same as the inlet pressure. Make sure you have no components of equipment that are sensitive for high pressure or pressure shocks,

### 8.10.6 Valve Close

With “Valve close” you can close the valve independent of the current setpoint. There are several ways to activate “Valve Close”

#### Bluetooth Vögtlin connect app

With the Vögtlin connect app under “valve” (Select under Valve mode). If you active purge this way the purge will only last for the time you set in Vögtlin connect app under “valve” in “Valve Purge Duration” (in milliseconds)

#### D-sub connector

By connecting Pin 6 of the D-sub connector to voltage of 3.7 Volt or higher (See chapter 0)

#### Digital communication

Active the command through your digital communication

### 8.10.7 Control parameters (PID)

A PID controller continuously calculates an error value  $e(t)$  as the difference between a desired setpoint and a measured process variable and applies a correction based on proportional, integral, and derivative terms (denoted P, I, and D respectively), hence the name.



In practical terms, PID automatically applies an accurate and responsive correction to a control function. An everyday example is the cruise control on a car, where ascending a hill would lower speed if constant engine power were applied. The controller's PID algorithm restores the measured speed to the desired speed with minimal delay and overshoot by increasing the power output of the engine in a controlled manner.

You can, if required, adjust these PID values to optimize the unit for your process with the Vögtlin Control App (See Chapter 9)

Control parameters		
Proportional	1.0	Fixed ▼
Integral	0.5	Fixed ▼
Differential	0	Fixed ▼

Figure 21 Screen from connect app showing PID setting under the "control" icon

The values you see are not the actual PID value but factor by which you can increase or reduce the PID setting.

Instead of fixed PID control you can also select Adaptive PID control. With the Fixed PID the PID values are the same over the whole range.

With the Adaptive PID control we use different PID factors for different flow values. For example. If you give a setpoint from 0-10% we add a multiplier of 1.5. From 10-30% factor 1.35, etc. The advantage is that the response of the valve to small steps in the lower end of the operational range becomes faster.

## 8.11 Valve mode (Controller only)

With this I/O input on the d-sub connector you can control the current valve state. By applying this input will overwrite the software control. Going below 1.7 Volt will close the valve and going above 3.4 Volt will open the valve completely. (To control the valve digitally see chapter 8.10.5 and 8.10.6)

## 8.12 Modbus communication settings

The most Modbus settings can be set through digital communication either by the Vögtlin Connect app or the digital communication. There is a way to override the Modbus slave address through external switches on the d-flux. The Modbus setting in the Vögtlin connect app (See Chapter 9) where it can be found under the Modbus icon on the main page.

Currently active MODBUS settings	
Slave Address	247
Baudrate	9600
Parity	EVEN

MODBUS settings at device restart	
Slave Address	247
Baudrate	9600
Parity	EVEN

You can adjust the Slave address, baudrate and the parity. Changes in Modbus setting require a restart of the unit.

This setting can be overridden by setting the 2 rotary switches on the d-flux housing.

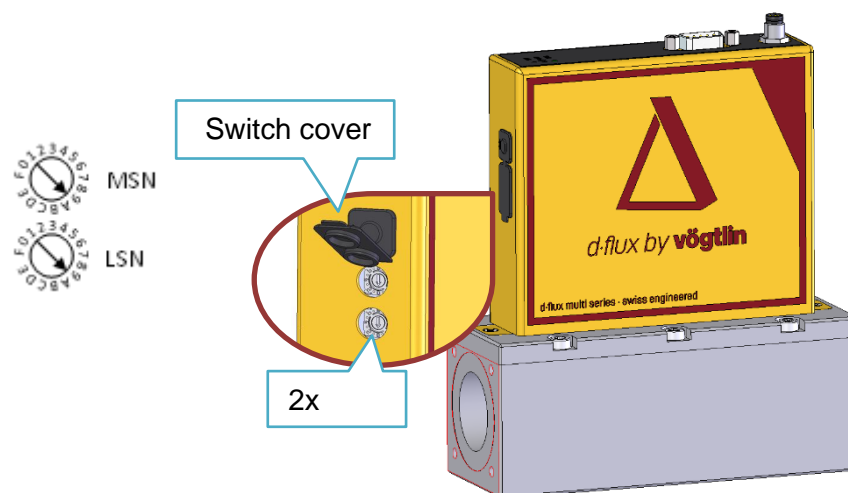
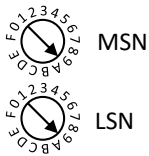


Figure 22 Location Modbus slave address rotary switches

- 00 setting:** If the rotary switches are set to 00 or greater than 0xF7, the unit uses the slave address set by digital communication (App, Modbus or Ethernet)
- FF setting:** If the rotary switches are set to FF you get the Default Modbus Setting (247, Even, 9600bits/s)

- c) **Other setting:** If the rotary switches are set to 01 to F7 you get slave address Address 01 to 247. (parity and baudrate determined by digital settings)

### 8.12.1 Rotary Switch



MSN (Most Significant Number) and LSN (Least Significant Number) are used to build two bytes that build the “Node Number”. If for example the MSN is set to 0xE and the LSN is set to 0x2 this would result in the slave address 0xE2 (226 in decimal). If both rotaries are set to zero or the value of the rotaries is greater than 0xF7 the slave address cannot be defined by the rotaries.

If the rotary switches select 0xFF the device boots with default Modbus settings. The configured Modbus settings are not changed by doing that: The current Modbus settings get active again upon reset if rotaries are changed to other values.

Example: If you want to set the address of the device to (decimal) 171... which is (hex) 0xAB

### 8.12.2 Baud rate and parity

The baud rate can be set as index (single digit) or as the baud rate value:

- 0: 300
- 1: 600
- 2: 1200
- 3: 2400
- 4: 4800
- 5: 9600 (Default)
- 6: 19200
- 7: 38400
- 8: 57600
- 9: 115200

The baud rate can also be set by the digital communication (Including through the Vögtlin Control App) (See Chapter 9).

You can choose from the following parity settings:

- None
- Even
- Odd
- Mark
- Space

For more information in the Modbus settings see chapter 0

## 8.13 Device information

In this menu you find details about your units like model, serial and version numbers of the firm and hardware.

## 9 Communication

The d-flux multi is a flexible instrument with many convenient settings that can optimize this instrument for your application. These settings can be accessed and adjusted through the digital communication (for instance Modbus or Ethernet) but it is more convenient to use the unit Bluetooth® connection. In this chapter we explain how to access the meter with the Android® Vögtlin connect app.

### 9.1 Bluetooth® communication

Please note:

- The screen in the app on your phone is sometimes bigger than what you see. Scroll down to see all details.
- There is a basic and advance mode. We explain as is we are in the advance mode
- When you activate the Bluetooth® do a “short press” on the button, longer than one second press has other functions (See chapter 8.9)
- Currently there is no iOS version available.

#### 9.1.1 How to connect to Bluetooth®

To access the setting, you need:

An Android® phone with Bluetooth® ability. Minimum requirement Bluetooth® 4.0 and Android® Version 5.0 Lollipop (API v21)

Access to the Internet to do download the Vögtlin Connect app

You need to access the Google Play Store (<https://play.google.com/>) and search for “Vögtlin connect” on your phone. (You can also scan the QR code on this page with your camera of your phone to directly go to the Vögtlin connect App.)



1. Install the program on your telephone and open the program. You see this screen on the right (Fig 1).
2. Next, power up your d-flux. Press “How does it work?” on the home screen of your app, follow the instructions to activate the Bluetooth® on your d-flux.
3. If the blue led flashes after you shortly (<0.5 sec) pushed the Bluetooth® button on the side of the d-flux, you tap the magnifying glass blue button in the centre of your app.
4. If the d-flux Bluetooth® is active now see the meter in the listing of your app.
5. Select that meter that is shown by tapping it once. The blue flashing LED in the d-flux will become a permanent blue LED.
6. The app will read all the variables from the meter (15 seconds) and automatically show the main page.
7. If you are asked for a password, initially enter 0000

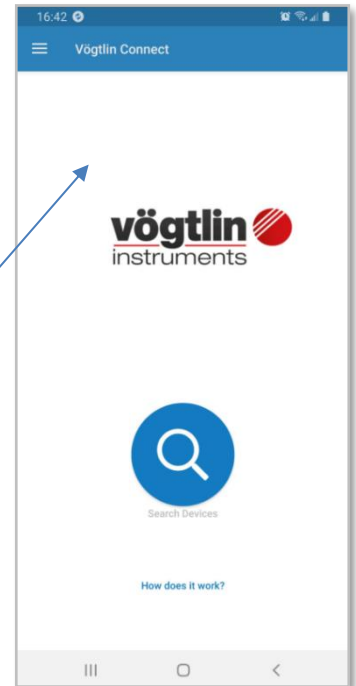
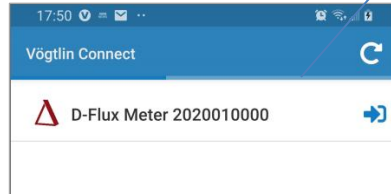


Figure 23: Home screen connect app

Note: The distance between the unit and your phone should initially be 1 meter. Some phones can go up to 5 meters, but that is phone and environment depended.

### 9.1.2 Vögtlin Connect app settings

On the main page you find 3 horizontal lines in the top left corner of the app. If you press these you enter the information and Preferences for the app. You can find the version of the app you are using on the bottom of the page and links to our website and social media where you can see the latest news and be informed about new firmware releases. (The version you are currently using is on the bottom of this screen)

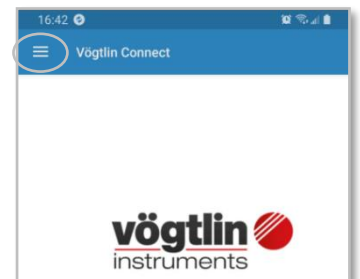


Figure 24: Connect app settings access

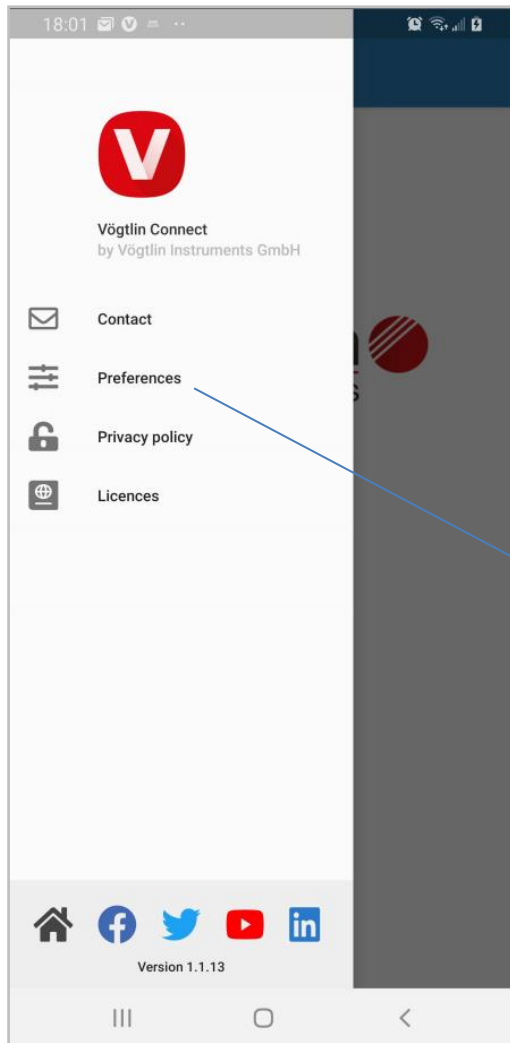


Figure 25: Connect app preference settings

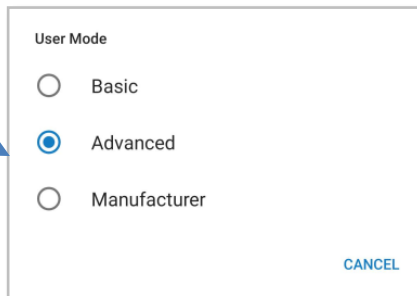
### 9.1.2.1 Language

Once you select “preferences” you can adjust the language of the app and the user mode (access level) that you want to operate under.

The languages are currently limited but will grow over time.

### 9.1.2.2 User level

In the user mode you find the following options. The



Basic and Advanced mode can be freely accessed. The “Manufacturer” mode is only accessible by the manufacturer and requires a password.

### 9.1.2.3 Graph time base

Below the user mode you find your setting for the time base of the graphs used in the app. Adjustable from 10 seconds to one hour.

### 9.1.2.4 Vögtlin connect app basic mode

In the basic mode you cannot adjust many features and the operation risk is relatively low. There are limited possibilities to set wrong values.

### 9.1.2.5 Vögtlin connect app advance mode

In advanced mode you not only have more possibilities to adjust the values, but you can set more values. You will see more icon buttons in the menu.

### 9.1.2.6 Vögtlin connect app factory mode

The manufacturer mode is factory only and is protected with a regularly changing password code.

## 9.1.3 Vögtlin app updates

The Vögtlin connect app will be updated on regular intervals. This will go fully automatically if you make no special setting in your phone. If you want to be informed about what is changing, please follow us on [LinkedIn](#).

## 9.1.4 Structure and function of the operating menu

### 9.1.4.1 Structure of the operating menu

After you successfully connected your phone to the flux with Bluetooth® you see the home page with 13 icons (in basic mode). In advanced mode 3 additional icons are shown.

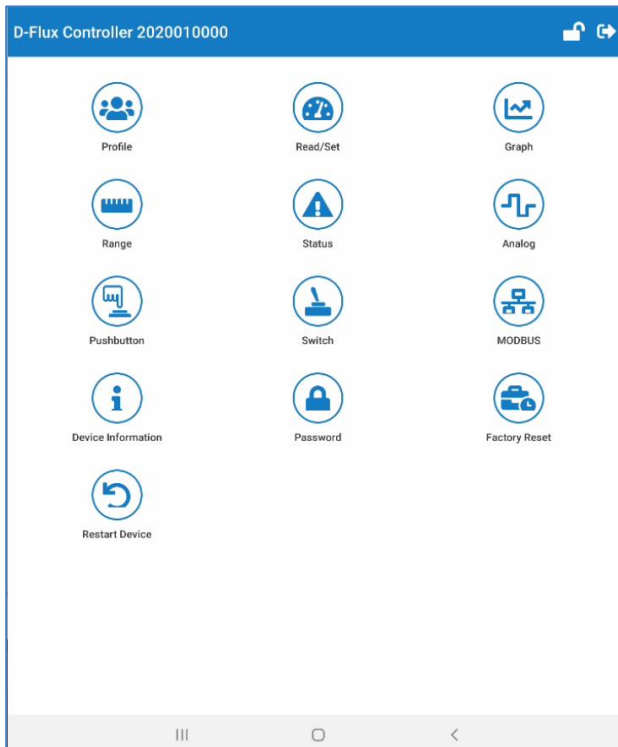


Figure 27 Home screen for basic

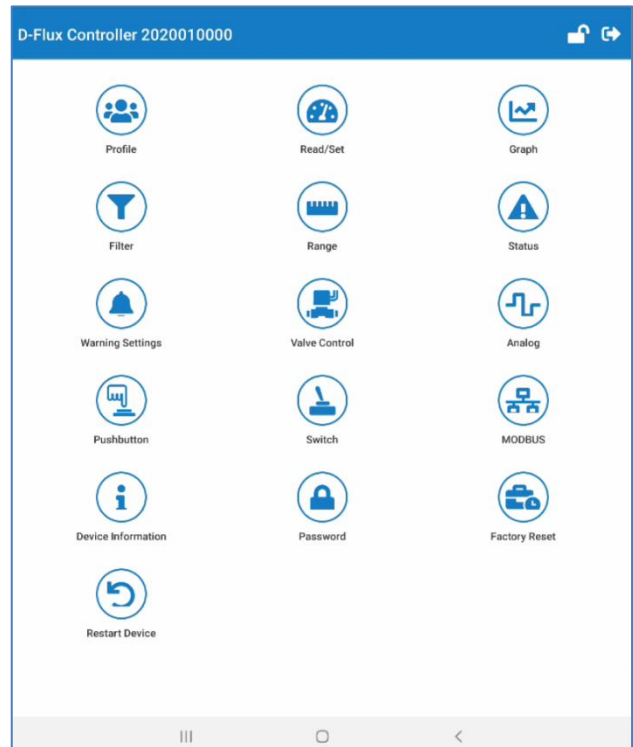













Figure 26 Home screen for advanced









If you have a d-flux meter the “Valve Control” Icon will not show,

Below a short description of each Icon:

 <p>Profile</p>	<p>A profile is a set of application configurations. A collection of settings you define for a specific application. You can for instance set the gas, range, units, dynamics for each of the 15 available profiles. Profiles are stored in the unit and can be re-called or adjusted at any time. You can select and set a profile with this app or through your digital communication. For more information see chapter <a href="#">8.1</a></p>
 <p>Read/Set</p>	<p>Under Read/Set you can see the current readings of the unit. (Flow, pressure temperature, totalizer and expected analog outputs) If you have a Mass flow controller you can give a setpoint if required. In this screen you can also disable the measurement, tare (Set automated tare if applicable, see chapter <a href="#">8.3</a>), define start-up setpoint.</p>


 <p>Graph</p>	<p>In the graph menu you can see graphs of the flow pressure and gas temperature. You can select one of these graphs to fill the whole screen. By Pinching you can zoom in/out and by sliding move the graph vision. The time base can be selected from 10 sec to 1 hour in the preferences menu (Go to main screen to go to preferences, see chapter <a href="#">9.1.2</a>)</p> <p>Under each graph you see a 3-button menu. Below the meaning of each:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Pause</p> </div> <div style="text-align: center;">  <p>Restart graph</p> </div> <div style="text-align: center;">  <p>Make graph big</p> </div> </div>
 <p>Filter</p>	<p><u><i>This setting is only available in advanced mode</i></u></p> <p>The filters remove undesired noise and pulsations in your flow. There are 3 type of filters that you can set: Moving Average, Exponential Moving Average and Moving Median. More information under chapter <a href="#">8.4</a>.</p>
 <p>Range</p>	<p>In this menu you can see what the factory settings are for your unit. These setting define many of the limitations for your settings.</p>
 <p>Status</p>	<p>This status icon provides you with a list of warnings and errors. Normally these are all green. In default mode when a warning becomes active the red LED on top of the d-flux will flash. You can adjust all this in advance mode and for instance switch the red LED off. If an error becomes active the red LED will burn permanent. See chapter <a href="#">11.2</a> for more details</p>
 <p>Warning Settings</p>	<p><u><i>This setting is only available in advanced mode</i></u></p> <p>In this Warnings Settings you can adjust the behaviour of the warnings generated by the device. For instance, warning delay and automatic or manual reset'</p> <p>You can also define what action need to happen when an warning occurs</p> <p>First you select the action (for instance close or open switch or reset the unit), next what warning should trigger that action.</p>
 <p>Valve Control</p>	<p><u><i>This setting is only available in advanced mode and for mass flow controllers only</i></u></p> <p>In this setting you can configure the valve and how it is driven. Here you can define the setpoint mode, Ramping, Valve offset, Valve protection, purge time and the PID settings for your flow controller. For additional information see chapter <a href="#">8.10</a></p>



 <p>Analog</p>	<p>Analog output and input settings.</p> <p>The analog output is fully configurable through this menu option you can adjust the mA and Vdc output. More information in chapter <a href="#">8.7</a>.</p> <p>The analog input (Only for Mass flow controllers) is fully configurable through this menu option you can adjust the mA or Vdc input. More information in chapter <a href="#">8.8</a></p>
 <p>Switch</p>	<p>The unit has a mosfet switch that can be controlled manually (App) through Modbus or through events. Ideal for alarm visualization or for switching a positive shut off valve. (See <a href="#">8.6</a> for details)</p>
 <p>Pushbutton</p>	<p>The button on the side of the unit activates the Bluetooth if you give it a short press (&lt;1 sec). (If you do not push nobody can access your meter over Bluetooth) With this menu option you can add a function for the long press of this button (for instance tare, warning reset or restart) (See chapter <a href="#">8.9</a> for more information)</p>
 <p>MODBUS</p>	<p>With this icon you can set the communication preferences for the Modbus (Slave address (Node), baud rate and parity. This setting can be overridden by the two rotary switches under the pushbutton. See chapter <a href="#">8.12</a>.</p>
 <p>Device Information</p>	<p>In this menu you find details about your units like model, serial and version numbers of the firm- and hardware'</p>
 <p>Password</p>	<p>The password is activated when you receive the unit. The password by default is 0000. Through this icon you can change or disable the password. The password must be 4 numerical digits. For more information see chapter <a href="#">9.1.6</a>.</p>
 <p>Factory Reset</p>	<p>Reset all variables back to the setting as you received it from the factory. Any profile you set up yourself will be deleted. For more information see chapter <a href="#">9.1.7</a></p>
 <p>Restart Device</p>	<p>This icon restarts the units, but all your setting stay as you programmed them in the unit. For more information see chapter <a href="#">9.1.8</a></p>

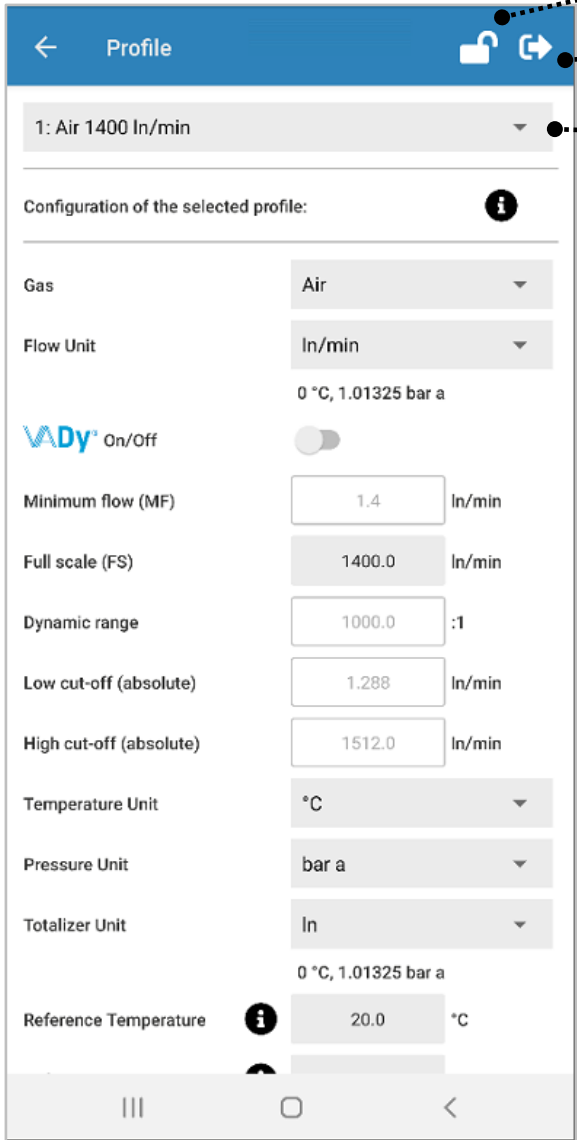
## 9.1.5 Access to the operating menu via Vögtlin Connect App

### 9.1.5.1 Operational interface

Once you gained access to the correct menu, you will find the screens intuitive. Beside this you find a lot of info icons that look like this: 

By pushing this icon you get more information about specific functions.

### 9.1.5.2 Navigation view



The screenshot shows the 'Profile' settings screen in the Vögtlin Connect App. The interface includes a blue header with a back arrow, the title 'Profile', and icons for a lock and a refresh/disconnect button. Below the header, a dropdown menu shows '1: Air 1400 In/min'. The main content area is titled 'Configuration of the selected profile:' and contains various settings: Gas (Air), Flow Unit (In/min), a status bar (0 °C, 1.01325 bar a), a VADy On/Off toggle, and several numerical input fields for Minimum flow (MF), Full scale (FS), Dynamic range, Low cut-off (absolute), and High cut-off (absolute). At the bottom, there are settings for Temperature Unit (°C), Pressure Unit (bar a), Totalizer Unit (In), and Reference Temperature (20.0 °C). Callout boxes with dotted lines point to the lock icon ('Unlocked, changes possible'), the refresh/disconnect icon ('Disconnect and return to home.'), and the profile dropdown ('Select profile (Pull down)'). A large blue bracket on the right side of the settings area is labeled 'Profile settings'. A large blue arrow at the bottom right points downwards, labeled 'Scroll down to see more'.

Unlocked, changes possible


Disconnect and return to home.

Select profile (Pull down)

Profile settings

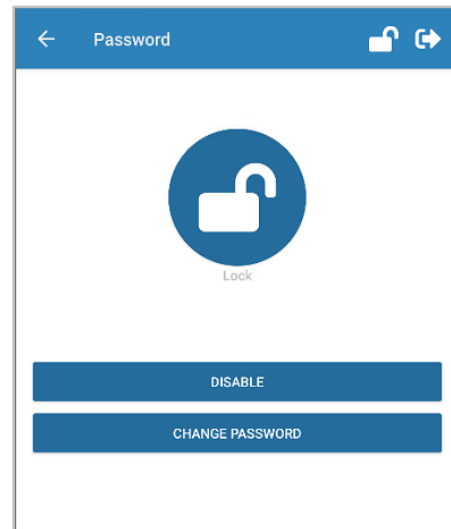
Scroll down to see more

## 9.1.6 Password

In this menu you can access, change or disable the password protection. If the password is active you see a lock on the top right of your screen  and you cannot make any changes to the d-flux until you enter the correct 4 digit code. You can however still log it through the Vögtlin Connect app (Bluetooth®) and read the values of the settings.

The password is activated when you receive the unit. The password by default is 0000. Through this button you can change or disable the password. The password must be 4 numerical digits.

If you lost your password, please contact your local distributor who will be able to help you if you have the app of TeamViewer® on your phone.



## 9.1.7 Factory reset

Reset all variables back to the setting as you received it from the factory. Any profile or other settings (Including communication) you set up yourself will be deleted and set to the default as you ordered the unit.

A reset will take about 20 seconds, during which the green power light is flashing. After that your app will be connected again to the d-flux. You will have to enter your password again. Resetting the unit to factory setting will not override the password for Bluetooth® protection. If you stored a new password, it will remain the same.

## 9.1.8 Restart device

This button restarts the units, but all your setting stay as you programmed them in the unit.

## 9.2 Modbus

### 9.2.1 Introduction

#### 9.2.1.1 What is Modbus?

Modbus is an industrial digital communication protocol standard that was created by Modicon in the late 1970's. It was designed for communication with and between programmable logic controllers (PLCs). Modbus remains the most widely available protocol for connecting industrial devices. The Modbus protocol specification is openly published and use of the protocol is royalty-free. See [https://modbus.org/docs/Modbus\\_over\\_serial\\_line\\_V1\\_02.pdf](https://modbus.org/docs/Modbus_over_serial_line_V1_02.pdf)

#### 9.2.1.2 RTU Transmission Mode

When devices communicate on a MODBUS serial line using the RTU (Remote Terminal Unit) mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode for the same baud rate. Each message must be transmitted in a continuous

stream of characters. The format (11 bits) for each byte in RTU mode is : Coding System: 8-bit binary Bits per Byte: 1 start bit 8 data bits, least significant bit sent first 1 bit for parity completion 1 stop bit Even parity is required, other modes ( odd parity, no parity ) may also be used. In order to ensure a maximum compatibility with other products, it is recommended to support also No parity mode. The default parity mode must be even parity.

Remark: the use of no parity requires 2 stop bits.

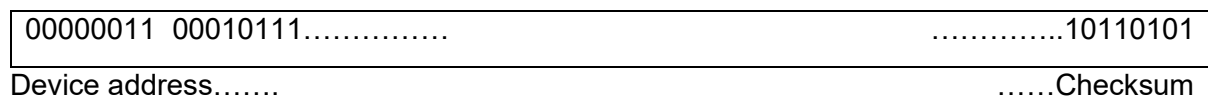
Modbus protocol is defined as a master/slave protocol, meaning a device operating as a master will poll one or more devices operating as a slave. This means a slave device cannot volunteer information; it must wait to be asked for it. The master will write data to a slave device's registers, and read data from a slave device's registers. A register address or register reference is always in the context of the slave's registers.

### 9.2.1.3 d-flux Modbus protocol

The d-flux uses the most commonly used form of Modbus protocol: RTU over RS-485.

Modbus RTU is a relatively simple serial protocol that can be transmitted via traditional UART technology over 2 wires. Data is transmitted in 8-bit bytes over these wires, one bit at a time, at baud rates (speed) ranging from 300 bits per second (baud) to 115200 bits per second.

Example:



A Modbus RTU network has one Master and one or more Slaves. Each slave has a unique 8-bit device address or unit number. Packets sent by the master include the address of the slave the message is intended for. The slave must respond only if its address is recognized, and must respond within a certain time period or the master will call it a "no response" error.

Each exchange of data consists of a request from the master, followed by a response from the slave. Each data packet, whether request or response, begins with the device address or slave address, followed by function code, followed by parameters defining what is being asked for or provided. The exact formats of the request and response are documented in detail in the Modbus protocol specification. The general outline of each request and response is illustrated below.

Data is transferred between the master and the slave in a message. A request message from the master contains the following fields:

Message structure:

Slave address	Function code	Data	Checksum
---------------	---------------	------	----------

**Slave address:** The slave address can be in the range 1 to 247. The slave address 0 (broadcast message) is used to transmit a message to be received by all slaves

**Function code:** The function code defines the read, write or test action that is to be executed via the Modbus protocol.

**Data:** The values listed below, amongst others, can be transmitted in this data field depending on the function code: – Register starting address (from which the data is transmitted) – Number of registers – Read/write data – Data length – etc.

**Checksum:** (CRC or LRC check) The message checksum forms the end of the message.

The master can send another message to the slave as soon as it receives a response to the previous message or after the time-out set for the master has elapsed. This time-out can be specified and changed by the user and depends on the slave's response time. If an error occurs during data transmission or if the slave cannot execute the command requested by the master, the slave sends an error message (exception response) to the master.

#### 9.2.1.4 Where does that data go?

Modbus data inside the Slave is most often read and written as "registers" which are 16-bit pieces of data. Most often, the register is either a signed or unsigned 16-bit integer. If a 32-bit integer or floating point is required, these values are actually read as a pair of registers. The most commonly used register is called a Holding Register, and these can be read or written. The other possible type is Input Register, which is read-only.

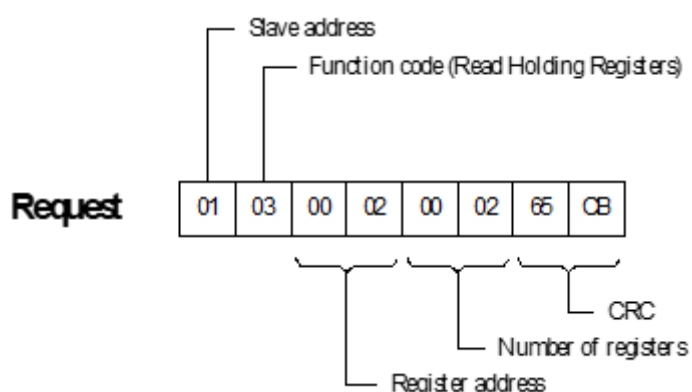
The exceptions to registers being 16 bits are the coil and the discrete input, which are each 1 bit only. Coils can be read or written, while discrete inputs are read-only. Coils are usually associated with relay outputs.

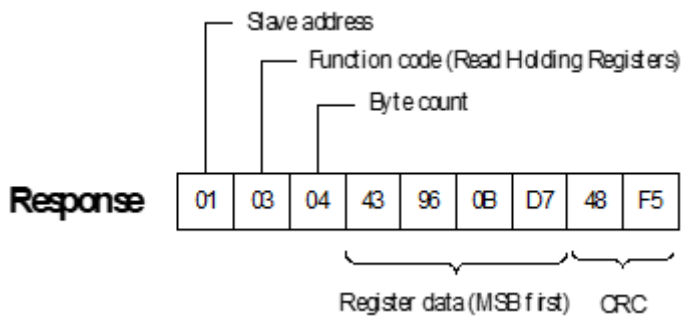
The type of register being addressed by a Modbus request is determined by the function code. The most common codes include 3 for "read holding registers", and may read 1 or more. Function code 6 is used to write a single holding register. Function code 16 is used to write one or more holding registers.

#### Endianness

Register data is sent via Modbus *big-endian*: Most significant byte (MSB) is transmitted first.

Example request to a Modbus slave having slave address 0x01:





Notes:

- Data returned in this example is 0x43960BD7
- The interpretation of the data depends on the Modbus register
- In this example Modbus register has F32 type: 0x43960BD7 = 300.0925
- CRC is transmitted *little-endian*: Least significant byte is transmitted first

### 9.2.1.5 Modbus function codes

The following function codes are supported:

Function code	Subfunction code	Name
0x03	-	Read Holding Registers
0x06	-	Write Single Register
0x10	-	Write Multiple Registers
0x08	0x0000	Diagnostics: Return Query Data

Notes:

- Access to 32-bit registers must be aligned. That means:
  - The request must be directed to the base address of the register to read or write.
  - The entire register must be read or written. Requests for upper or lower word are rejected.
- Misaligned accesses are rejected for safety purpose. This is to prevent inconsistent data when reading or writing lower and upper part of a register using multiple requests. In this case it is not guaranteed that the register is modified in an atomic way:
  - Reading the register may result in inconsistent data because its value might change during requests.
  - Writing a register may cause improper function between requests.
- Accessing strings requires requests being aligned to the base address.

### 9.2.1.6 Exception codes

The device may respond with the following Modbus exception codes:

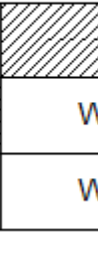
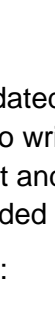
Exception code	Name	Conditions
0x00	OK	Request successfully executed
0x01	ILLEGAL FUNCTION	Returned in the following cases: <ul style="list-style-type: none"> <li>▪ Function code not supported by device</li> </ul>

		<ul style="list-style-type: none"> <li>▪ Subfunction code not supported by device</li> <li>▪ Bad function code (zero or greater 0x7F)</li> <li>▪ Broadcast reading request</li> </ul>
0x02	ILLEGAL DATA ADDRESS	Returned in the following cases: <ul style="list-style-type: none"> <li>▪ No such register found</li> <li>▪ Misaligned register address</li> <li>▪ Read access to write-only register</li> <li>▪ Write access to read-only register</li> <li>▪ Insufficient privilege to access register</li> <li>▪ Register not available in current operating mode of the device</li> <li>▪ Request exceeds 16-bit address range</li> </ul>
0x03	ILLEGAL DATA VALUE	Returned in the following cases: <ul style="list-style-type: none"> <li>▪ Bad register count or quantity</li> <li>▪ Misaligned register count or quantity</li> </ul>
0x04	DEVICE ERROR	Returned in the following cases: <ul style="list-style-type: none"> <li>▪ Bad register implementation</li> <li>▪ Modbus stack error</li> <li>▪ Firmware error</li> </ul>
0x06	DEVICE BUSY	Returned in the following cases: <ul style="list-style-type: none"> <li>▪ Modbus stack busy</li> </ul>

### 9.2.1.7 Volatile and persistent updates

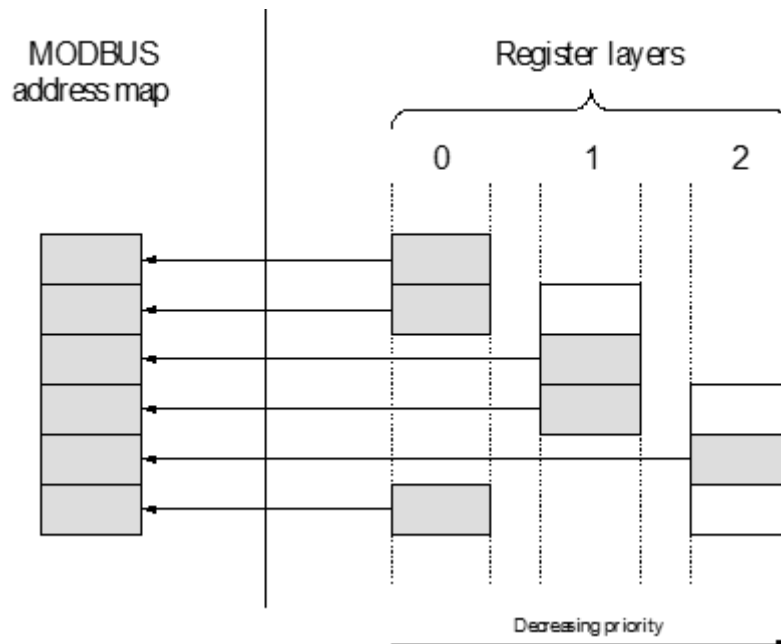
One can choose for many settings if they are written volatile only or are also updated in persistent memory. When updating a setting frequently it is often beneficial not to write to persistent memory to increase its lifetime. A volatile update has immediate effect and is active until next power-cycle. On start up the setting kept in persistent memory is reloaded again.

To support volatile and persistent updates two registers are defined for a setting:

	<REG>	<REG>_STORE
Write active value only (change value volatile)	Write	
Write persistent value but do not change active value		Write
Write active value and update persistent value	Write	Write

## Register layers

Modbus registers are associated to register layers. These register layers can be enabled and disabled individually. Doing this includes or excludes the associated set of Modbus registers into/from the Modbus address map. The Modbus address map is a superposition of all register layers enabled. In case multiple enabled register layers contain Modbus registers at identical Modbus addresses the register contained in highest priority register layer is accessed. The register layer at index 0 has highest priority and can't be disabled.



### 9.2.1.8 API - Application Programmers Interface

API means Application Programmer's Interface: Historically that is the function interface offered by an operating system to application developers (that build applications running on that operating system). In our case the «application programmer» is the customer that want to build applications with our instruments.

There is an instruction to install the Python API and how to use it at: [api.voegtlin.com](http://api.voegtlin.com)

Please contact the factory for additional information.

### 9.2.1.9 Register list explanation

Below here you find the list with registers as used in the d-flux you find the following table;

**Variable:** The name of the command as used in the API (Application Programming Interface). See [9.2.1.8](#)

**Hex Address:** The register address in HEX format

**Decimal Address:** The register address in Decimal format

**Access Man:** R = read only (You can only read this register), W = write only (You can only write to this register. RW = Read and Write (You can both read and write to this register)

**Type:** The type of data that is valid for this specific register:

- **U8:** The 8-bit unsigned integer type. Unsigned whole or natural numbers ranging from 0 to +255.



- **U16:** The 16-bit unsigned integer type. Unsigned whole or natural numbers ranging from 0 to +65535.
- **U32:** The 32-bit unsigned integer type. Unsigned Binary Coded Decimal value ranging from 0 to +99999999
- **F32:** A 32-bit floating point type (specifically, the “binary32” type defined in IEEE 754-2008).  
This type can represent a wide range of decimal numbers, like 3.5, 27, -113.75, 0.0078125, 34359738368, 0, -1. So unlike integer types (such as i32), floating point types can represent non-integer numbers, too.  
However, being able to represent this wide range of numbers comes at the cost of precision: floats can only represent some of the real numbers and calculation with floats round to a nearby representable number. For example, 5.0 and 1.0 can be exactly represented as f32, but 1.0 / 5.0 results in 0.20000000298023223876953125 since 0.2 cannot be exactly represented as f32.
- **S16:** The 16-bit signed integer type. Signed Integers ranging from -32768 to +32767.
- **STR<XX>:** String where the XX indicates the length (f.i. 20 or 16). Each character is a U8 (ASCII Code)

**Count:** Count are the number of registers that contain the data. Each register has place for 2 bytes (2 x U8 or 1 x U16)

**Default:** If there is a default value it is mentioned here.

**Min:** Minimum value for a register

**Max:** Maximum value for a register

**Default unit:** The value (Default, min, max) is defined in the Default unit. If the unit is changing the Default, min and max are changing.

## 9.2.2 Overview of Registers

Variable	Hex Address	Decimal Address	Access	Type	Count	Default Values	Min	Max	Default Unit
<b>Main Readings</b>									
FLOW_VALUE	0x0000	0	R	F32	2	-	0	1400	l/min
VOLUMETRIC_VALUE	0x000A	10	R	F32	2	-	0	1400	l/min
TEMP_VALUE	0x0002	2	R	F32	2	-	-20	60	°C
PRESSURE_VALUE	0x0006	6	R	F32	2	-	1	14	bar a
DENSITY_VALUE	0x0008	8	R	F32	2	-	0	2000	kg/m3
TOTALIZER_VALUE	0x0004	4	R	F32	2	-	0	infinity	l
WARNING_GLOBAL_STATUS	0x0301	669	R	U16	1	-	0	0xFFFF	-
<b>Maintenance</b>									
PRESS_NULL	0xE100	57600	W	U16	1	-	-	-	-
RESET	0x0600	1536	W	U16	1	-	-	-	-
WATCHDOG_SELECT	0x0620	1568	RW	U16	1	0	0	4	-
<b>Profile Editing</b>									
FLOW_UNIT_SELECT	0x0052	82	RW	S16	1	0	0	36	l/min
TEMP_UNIT_SELECT	0x0062	98	RW	S16	1	0	0	3	-
PRESSURE_UNIT_SELECT	0x0072	114	RW	S16	1	0	0	25	-
TOTALIZER_UNIT_SELECT	0x0082	130	RW	S16	1	0	0	12	-
REFERENCE_TEMPERATURE	0x00D0	208	RW	F32	2	20.0	-20.0	60.0	°C
REFERENCE_PRESSURE	0x00D2	210	RW	F32	2	1.01325	0.0	14.0	bar a
<b>Profile Configuration</b>									
PROFILE_SELECT	0x0032	50	RW	S16	1	0	0	15	-
PROFILE_NAME	0x0034	52	R	STR<16>	8	Air 1400 l/min	0	16	char
GAS_SELECT	0x0042	66	RW	S16	1	0	0	15	-
GAS_NAME	0x0044	68	R	STR<16>	8	Air	0	16	char
FLOW_UNIT_SELECT	0x0052	82	RW	S16	1	0	0	36	-
FLOW_UNIT_NAME	0x0054	84	R	STR<16>	8	l/min	0	16	char
TEMP_UNIT_SELECT	0x0062	98	RW	S16	1	0	0	3	-
TEMP_UNIT_NAME	0x0064	100	R	STR<16>	8	K	0	16	char
PRESSURE_UNIT_SELECT	0x0072	114	RW	S16	1	0	0	25	-
PRESSURE_UNIT_NAME	0x0074	116	R	STR<16>	8	bar a	0	16	char
TOTALIZER_UNIT_SELECT	0x0082	130	RW	S16	1	0	0	12	-
TOTALIZER_UNIT_NAME	0x0084	132	R	STR<16>	8	nl	0	16	char
RANGE_MIN	0x00B2	178	RW	F32	2	14	14	1000	l/min
RANGE_MAX	0x00B4	180	RW	F32	2	1400	1000	1400	l/min
RANGE_DYNAMIC	0x00BA	186	RW	F32	2	100	0	inf	to 1
RANGE_UNDERFLOW	0x00B6	182	RW	F32	2	0	0	100	%
RANGE_OVERFLOW	0x00B8	184	RW	F32	2	8	0	inf	%
RANGE_LOWER	0x00BC	188	R	F32	2	14	-	-	l/min

RANGE_UPPER	0x00BE	190	R	F32	2	1512	-	-	ln/min
RANGE_AUTO_DYNAMIC	0x00C1	193	RW	U16	1	0	0	0xFFFF	-
<b>Analog Output #0 - Voltage</b>									
ANALOG_OUTPUT_0_RANGE	0x0261	609	RW	S16	1	1	0	32767	V
ANALOG_OUTPUT_0_READ	0x0262	610	R	F32	2	0-10	0	10	V
ANALOG_OUTPUT_0_LOWER	0x026A	618	RW	U32	2	0	0	10	V
ANALOG_OUTPUT_0_UPPER	0x026C	620	RW	U32	2	10	0	10	V
ANALOG_OUTPUT_0_UNIT	0x026E	622	R	STR<4>	2	V	-	-	char
<b>Analog Output #1 - Current</b>									
ANALOG_OUTPUT_1_RANGE	0x0271	625	RW	S16	1	-1	-32768	-1	-
ANALOG_OUTPUT_1_READ	0x0272	626	R	F32	2	4-20	0	20	mA
ANALOG_OUTPUT_1_LOWER	0x027A	634	RW	U32	2	0	0	20	mA
ANALOG_OUTPUT_1_UPPER	0x027C	636	RW	U32	2	20	0	20	mA
ANALOG_OUTPUT_1_UNIT	0x027E	638	R	STR<4>	2	mA	-	-	char
<b>Analog Input #1 - Voltage</b>									
ANALOG_INPUT_N_RANGE	0x0211	529	RW	S16	1	-1	-32768	-1	-
ANALOG_INPUT_N_READ	0x0212	530	R	F32	2	0-10	0	10	V
ANALOG_INPUT_N_LOWER	0x021A	538	RW	F32	2	0	0	10	V
ANALOG_INPUT_N_UPPER	0x021C	540	RW	F32	2	10	0	10	V
ANALOG_INPUT_N_UNIT	0x021E	542	R	U8	2	V	-	-	char
<b>Controller</b>									
SETPOINT	0x0100	256	RW	F32	2	1400	0	1400	ln/min
SETPOINT_STORE	0x0102	258	RW	F32	2	-	-	-	
SETPOINT_RAMPING_TIME_MS	0x0104	260	RW	U16	1	0	0	100000	ms
SETPOINT_RAMPING_MODE	0x0106	262	RW	U16	1	0	0	2	
CONTROLLER_OUTPUT	0x0114	276	RW	F32	2	0	0	108	%
CONTROLLER_TERMS	0x0116	278	RW	F32	6	[20;1;0]	[0;0;0]	[inf;inf;inf]	[P;I;D]
CONTROLLER_OFFSET	0x0120	288	RW	F32	2	0	0	100	%
<b>Tare</b>									
TARE_NULL	0x0902	2306	RW	U16	1	0	0	1	-
TARE_STATUS	0x0903	2307	RW	U16	1	1	0	2	-
TARE_DURATION	0x0904	2308	RW	U16	1	1000	100	65536	ms
TARE_DELAY	0x0905	2309	RW	U16	1	3000	0	65536	ms
TARE_THRESHOLD	0x0906	2310	RW	F32	2	0.005	0	inf	-
TARE_RANGE_MIN	0x0908	2312	RW	F32	2	0.05	0	inf	-
TARE_RANGE_MAX	0x090A	2314	RW	F32	2	1	0	inf	-
<b>Valve</b>									
VALVE_MODE	0x0160	352	RW	U16	1	0	0	4	-
VALVE_STATUS	0x0161	353	R	U16	1	0	0	3	-
VALVE_LOAD	0x0162	354	R	F32	2	0	0	100	%
VALVE_VALUE	0x0164	356	RW	F32	2	0	0	100	%
VALVE_VALUE_STORE	0x0166	358	RW	F32	2	0	0	100	-
VALVE_PURGE_TIME_MS	0x0174	372	RW	U32	2	5000	100	65536	ms
VALVE_FEATURE	0x0176	374	RW	U16	1	0	0	1	-
VALVE_SELECT	0x0177	375	RW	S16	1	0	-1	1	-

VALVE_N_FREQUENCY	0x0178	376	RW	U32	2	7000	0	50000	Hz
<b>Bluetooth®</b>									
BLUETOOTH®_PAIRING	0x0801	2049	RW	U16	1	0	0	1	-
PUSHBUTTON_SHORT	0x0700	1792	RW	U16	1	0	0	1	-
<b>Device Information</b>									
INFO_DEVICE_FUNCTION	0x0400	1024	R	U32	2	0x81031A15	0	0xFFFFFFFF	-
INFO_SERIAL	0x0402	1026	R	U32	2	0x7866E810	0	0xFFFFFFFF	-
INFO_TYPECODE_1	0x0404	1028	R	STR<12>	6	DFM00000	0	12	char
INFO_TYPECODE_2	0x040A	1035	R	STR<12>	6	0	0	12	char
INFO_VERSION_SOFTWARE	0x0410	1040	R	U16	1	0x001	0	0xFFFF	-
INFO_VERSION_BOOTLOADER	0x0411	1041	R	U16	1	0x001	0	0xFFFF	-
INFO_VERSION_HARDWARE	0x0412	1042	R	U16	1	0x002	0	0xFFFF	-
INFO_VERSION_MECHANICS	0x0413	1043	R	U16	1	0x001	0	0xFFFF	-
INFO_DEVICE_NAME	0x0420	1056	RW	STR<32>	16	d-flux	0	32	char
<b>Filtering</b>									
OUTSTAGE_0_ENABLE	0x00F00	3840	RW	U16	1	1	0	1	-
OUTSTAGE_0_SELECT	0x00F01	3841	RW	U16	1	1	0	2	-
OUTSTAGE_0_RESIZE	0x00F02	3842	RW	U16	1	10	0	0xFFFF	Samples
OUTSTAGE_0_CONFIG	0x00F03	3843	RW	U16	1	2	0	3	-
OUTSTAGE_0_RESET	0x00F04	3844	RW	U32	1	0	0	1400	In/min
OUTSTAGE_0_DECIMATOR	0x00F06	3847	RW	U16	1	0	0	64	-
<b>Push Button</b>									
PUSHBUTTON_SHORT	0x0700	1792	RW	U16	1	1	0	5	-
PUSHBUTTON_LONG	0x0701	1793	RW	U16	1	0	0	5	-
<b>OC Switch</b>									
SWITCH_STATE	0x0340	832	R	U16	1	0	0	1	-
SWITCH_MODE	0x0342	834	RW	U16	1	1	0	1	-
SWITCH_VALUE	0x0343	835	RW	U16	1	0	0	1	-
SWITCH_VALUE_STORE	0x0344	836	RW	U16	1	0	0	1	-
<b>Totalizer</b>									
TOTALIZER_RESET	0x1F10	7952	W	U16	1	-	0	0xFF	-
TOTALIZER_AUTOZERO	0x1F20	7968	W	U16	1	-	0	0xFF	-
TOTALIZER_N_RESET	0x1F50	8016	W	U16	1	0	0	1	-
TOTALIZER_VALUE	0x0004	4	RW	F32	2	0	0	infinity	-
TOTALIZER_STATE	0x1F11	7953	RW	U16	1	0xFF	0	0xFF	-
<b>Factory Backup</b>									
MANAGE_BACKUP_RESTORE	0xFFFC	65532	W	U16	1	-	-	-	-
<b>Warning and Errors</b>									
WARNING_GLOBAL_STATUS	0x0301	769	R	U16	1	0	0	0xFFFF	-
WARNING_GLOBAL_MODE	0x0303	771	RW	U16	1	1	1	3	-
WARNING_GLOBAL_RESET	0x0304	772	W	U16	1	-	-	-	-
ERROR_GLOBAL_STATUS	0x0321	801	R	U16	1	0	0	0xFFFF	-
WARNING_GLOBAL_OFF	0x030A	778	RW	U16	1	0	0	1	-
<b>Modbus Settings</b>									

<b>Modbus_ADDR</b>	0x0510	1296	RW	U16	1	247	1	247	-
<b>Modbus_PARITY</b>	0x0511	1297	RW	U16	1	1 (Even)	0=None, 1=Even, 2=Odd, 3=Mark, 4=Space	-	-
<b>Modbus_BAUDRATE</b>	0x0512	1298	RW	U32	2	5 (9600)	0=300, 1=600, 2=1200, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400, 8=57600, 9=115200	-	Bits/s

## 9.2.3 Detailed information of Modbus registers

### 9.2.3.1 Main Readings

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
FLOW_VALUE	0x0000	0	R	F32	2	-	0	1400	l/min
VOLUMETRIC_VALUE	0x000A	10	R	F32	2	-	0	1400	l/min
TEMP_VALUE	0x0002	2	R	F32	2	-	-20	60	°C
PRESSURE_VALUE	0x0006	6	R	F32	2	-	1	14	bar a
DENSITY_VALUE	0x0008	8	R	F32	2	-	0	2000	kg/m3
TOTALIZER_VALUE	0x0004	4	R	F32	2	-	0	infinity	ln
WARNING_GLOBAL_STATUS	0x0301	669	R	U16	1	0	0	0xFFFF	-

For available units see chapter: [8.1.5](#) (Profile Editing)

#### 9.2.3.1.1 FLOW\_VALUE: Current gas flow in the selected engineering unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0000	0	FLOW_VALUE	R	F32	2	-

Current flow of gas in the engineering unit selected

#### 9.2.3.1.2 VOLUMETRIC\_VALUE: Current volumetric gas flow in l/min

Address hex	Address dec	Name	Access	Type	Count	default
0x000A	10	VOLUMETRIC_VALUE	R	F32	2	-

Current volumetric flow of gas in l/min. Unit cannot be changed for this reading

**9.2.3.1.3 TEMP\_VALUE:** Current gas temperature in the selected temperature unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0002	2	TEMP_VALUE	R	F32	2	-

Current Temperature of gas in the engineering unit selected

**9.2.3.1.4 PRESSURE\_VALUE:** Current pressure in the selected engineering unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0006	6	PRESSURE_VALUE	R	F32	2	-

Current pressure of gas in the engineering unit selected

**9.2.3.1.5 DENSITY\_VALUE:** Current density in kg/m3

Address hex	Address dec	Name	Access	Type	Count	default
0x0008	8	DENSITY_VALUE	R	F32	2	-

Current density of selected gas in kg/m3

**9.2.3.1.6 TOTALIZER\_VALUE:** Current totalizer value in the selected totalizer unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0004	4	TOTALIZER_VALUE	R	F32	2	-

Current totalizer value of gas in the engineering unit selected

**9.2.3.1.7 WARNING\_GLOBAL\_STATUS:** Available warnings

Address hex	Address dec	Name	Access	Type	Count	default
0x0301	669	WARNING_GLOBAL_STATUS	R	U16	1	0

Warnings: Please see corresponding chapter 0 for details.

**9.2.3.2 Maintenance**

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
PRESS_NULL	0xE100	57600	W	U16	1	-	-	-	-
RESET	0x600	1536	W	U16	1	-	-	-	-
WATCHDOG_SELECT	0x620	1568	RW	U16	1	0	0	4	-

### 9.2.3.2.1 PRESS\_NULL: Tare (See Tare the unit)

Address hex	Address dec	Name	Access	Type	Count	default
0xE100	57600	PRESS_NULL	W	U16	1	-

Writing a 1 to his register tares the device.

### 9.2.3.2.2 RESET: Reset device

Address hex	Address dec	Name	Access	Type	Count	default
0x0600	1536	RESET	W	U16	1	-

Writing 0xDEAD to this register resets the device.

### 9.2.3.2.3 WATCHDOG\_SELECT: Select trigger source for watchdog

Address hex	Address dec	Name	Access	Type	Count	default
0x0620	1568	WATCHDOG_SELECT	RW	U16	1	0

- 0: Disable watchdog
- 1: WATCHDOG\_TRIGGER register writes requests with correct trigger key (contact factory for more details)
- 2: Read or write requests via Modbus
- 3: Read or write requests via Bluetooth®
- 4: Read or write requests via Ethernet communication

**Be very careful in using this!!**

### 9.2.3.3 Profile Editing

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
FLOW_UNIT_SELECT	0x0052	82	RW	S16	1	0	0	36	-
TEMP_UNIT_SELECT	0x0062	98	RW	S16	1	0	0	3	-
PRESSURE_UNIT_SELECT	0x0072	114	RW	S16	1	0	0	25	-
TOTALIZER_UNIT_SELECT	0x0082	130	RW	S16	1	0	0	12	-
REFERENCE_TEMPERATURE	0x00D0	208	RW	F32	2	20.0	-20.0	60.0	°C
REFERENCE_PRESSURE	0x00D2	210	RW	F32	2	1.01325	0.0	14.0	bar a

### 9.2.3.3.1 FLOW\_UNIT\_SELECT: Flow unit selection of active profile

Address hex	Address dec	Name	Access	Type	Count	default
0x0052	82	FLOW_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active flow unit by index (zero based).

Writing the register sets the current active flow unit by index. If the index written is invalid the current active flow unit does not change. Otherwise writing the register has immediate effect: The current active flow unit is changed and the value written is also stored in persistent memory.

Changing the flow unit causes an internal restart of measurement. During restart no measurement values (e. g. flow) are available. These are the available flow units with index:

Index	Einheit	Remarks
0	ln/min	Volume/Norm *(1)
1	ls/min	Volume/Standard *(2)
2	ln/s	Volume/Norm *(1)
3	ls/s	Volume/Standard
4	ln/h	Volume/Norm *(1)
5	ls/h	Volume/Standard
6	mln/min	Volume/Norm *(1)
7	mls/min	Volume/Standard *(2)
8	mln/s	Volume/Norm *(1)
9	mls/s	Volume/Standard *(2)
10	mln/h	Volume/Norm *(1)
11	mls/h	Volume/Standard *(2)
12	kg/min	Mass
13	kg/s	Mass
14	kg/h	Mass
15	g/min	Mass
16	g/s	Mass
17	g/h	Mass
18	m3n/min	Volume/Norm *(1)
19	m3s/min	Volume/Standard *(2)
20	m3n/s	Volume/Norm *(1)
21	m3s/s	Volume/Standard *(2)
22	m3n/h	Volume/Norm *(1)
23	m3s/h	Volume/Standard *(2)
24	nccm	Volume/Norm *(1)
25	sccm	Volume/Standard *(2)
26	nccs	Volume/Norm *(1)
27	sccs	Volume/Standard *(2)
28	nml/h	Volume/Norm *(1)
29	sml/h	Volume/Standard *(2)
30	lb/min	Mass
31	lb/s	Mass
32	lb/h	Mass
33	oz/min	Mass
34	oz/s	Mass
35	oz/h	Mass
36	scfm	Volume/Standard *(2)

\*(1) Reference conditions for "Norm" is always 0°C and 101325 Pa

\*(2) Reference conditions for "Standard" can be set with "REFERENCE\_TEMPERATURE" and "REFERENCE\_PRESSURE" registers.

Default "Standard" conditions are 20°C and 1013.25 mbar a



### 9.2.3.3.2 TEMP\_UNIT\_SELECT: Temperature unit selection of selected profile

Address hex	Address dec	Name	Access	Type	Count	default
0x0062	98	TEMP_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active temperature unit by index (zero based).

Writing the register sets the current active temperature unit by index. If the index written is invalid the current active temperature unit does not change. Otherwise writing the register has immediate effect: The current active temperature unit is changed and the value written is also stored in persistent memory. These are the available temperature units with index:

Index	Einheit	Unit
0	Kelvin	K (Kevin)
1	Degree Celsius	°C (Degrees Celsius)
2	Degree Fahrenheit	°F (Degrees Fahrenheit)
3	Degree Rankin	°R (Degrees Rankine)

### 9.2.3.3.3 PRESSURE\_UNIT\_SELECT: Pressure unit selection of selected profile

Address hex	Address dec	Name	Access	Type	Count	default
0x0072	114	PRESSURE_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active pressure unit by index (zero based).

Writing the register sets the current active pressure unit by index. If the index written is invalid the current active pressure unit does not change. Otherwise writing the register has immediate effect: The current active pressure unit is changed and the value written is also stored in persistent memory. These are the available pressure units with index:

Index	Einheit	Remarks
0	bar a	Bar absolute
1	mbar a	Millibar absolute
2	Pa a	Pascal absolute
3	hPa a	Hectopascal absolute
4	kPa a	Kilopascal absolute
5	MPa a	Megapascal absolute
6	atm a	Atmosphere
7	at a	Technical atmosphere
8	psi a	Pound force per square inch absolute
9	kpsi a	Kilo pound force per square inch absolute
10	psf a	Pounds per square foot absolute
11	kpsf a	Kilo pounds per square foot absolute
12	osi a	Ounces force per square inch absolute
13	kosi a	Kilo ounces force per square inch absolute
14	osf a	Ounces force per square foot absolute
15	kosf a	Kilo ounces force per square foot absolute
16	Torr a	1 Torr = 1 Millimeter of Mercury, 1 atm = 760 Torr
17	mTorr a	Milli Torr absolute
18	mmHg a	Millimeter of Mercury absolute, Millimeter of Hg absolute
19	cmHg a	Centimeter of Mercury absolute, Centimeter of Hg absolute
20	inHg a	Inches of mercury absolute, Inches of Hg absolute
21	mmH2O a	Millimeter H2O absolute
22	cmH2O a	Centimeter H2O absolute
23	inH2O a	Inches H2O absolute
24	g/cm2 a	Gram per square centimeter absolute
25	kg/cm2 a	Kilogram per square centimeter absolute

### 9.2.3.4 TOTALIZER\_UNIT\_SELECT: Totalizer unit selection of selected profile

Address hex	Address dec	Name	Access	Type	Count	default
0x0082	130	TOTALIZER_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active totalizer unit by index (zero based).

Writing the register sets the current active totalizer unit by index. If the index written is invalid the current active totalizer unit does not change. Otherwise writing the register has immediate effect: The current active totalizer unit is changed and the value written is also stored in persistent memory.

Negative indices refer to user defined totalizer units stored in EEPROM. Positive indices and zero refer to factory defined totalizer units stored in flash memory.

These are the available totalizer units with index:

Index	Einheit	Remarks
0	ln	Volume/Norm *(1)
1	ls	Volume/Standard *(2)
2	mln	Volume/Norm *(1)
3	mls	Volume/Standard *(2)
4	kg	Mass
5	g	Mass
6	m3n	Volume/Norm *(1)
7	m3s	Volume/Standard *(2)
8	ncc	Volume/Norm *(1)
9	scc	Volume/Standard *(2)
10	lb	Mass
11	oz	Mass
12	scf	Volume/Standard *(2)

\*(1) Reference conditions for "Norm" is always 0°C and 1013.25 mbar a

\*(2) Reference conditions for "Standard" can be set with "REFERENCE\_TEMPERATURE" and "REFERENCE\_PRESSURE" registers.

Default "Standard" conditions are 20°C and 1013.25 mbar a

#### 9.2.3.4.1 REFERENCE\_TEMPERATURE: Reference Temperature for "Standard" Unit Calculation

Address hex	Address dec	Name	Access	Type	Count	default
0x00D0	208	REFERENCE_TEMPERATURE	RW	F32	2	-

Reading this register returns the reference temperature in the current selected temperature engineering unit. This setting is only valid for the active profile which is being edited.

Writing this register sets the reference temperature in the current selected temperature unit. The change has immediate effect and no restart of device is needed.

### 9.2.3.4.2 REFERENCE\_PRESSURE: Reference Pressure for "Standard" Unit Calculation

Address hex	Address dec	Name	Access	Type	Count	default
0x00D2	210	REFERENCE_PRESSURE	RW	F32	2	-

Reading this register returns the reference ambient pressure in the current selected pressure engineering unit. This setting is only valid for the active profile which is being edited.

Writing this register sets the reference pressure in the current selected pressure engineering unit. The change has immediate effect and no restart of device is needed.

### 9.2.3.5 Profile Configuration

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
PROFILE_SELECT	0x0032	50	RW	S16	1	0	0	15	-
PROFILE_NAME	0x0034	52	R	STR<16>	8	Air 1400 ln/min	0	16	char
GAS_SELECT	0x0042	66	RW	S16	1	0	0	15	-
GAS_NAME	0x0044	68	R	STR<16>	8	Air	0	16	char
FLOW_UNIT_SELECT	0x0052	82	RW	S16	1	0	0	36	-
FLOW_UNIT_NAME	0x0054	84	R	STR<16>	8	-	0	16	char
TEMP_UNIT_SELECT	0x0062	98	RW	S16	1	0	0	3	-
TEMP_UNIT_NAME	0x0064	100	R	STR<16>	8	-	0	16	char
PRESSURE_UNIT_SELECT	0x0072	114	RW	S16	1	0	0	25	-
PRESSURE_UNIT_NAME	0x0074	116	R	STR>16>	8	-	0	16	char
TOTALIZER_UNIT_SELECT	0x0082	130	RW	S16	1	0	0	12	-
TOTALIZER_UNIT_NAME	0x0084	132	R	STR<16>	8	-	0	16	char
RANGE_MIN	0x00B2	178	RW	F32	2	14	14	1000	ln/min
RANGE_MAX	0x00B4	180	RW	F32	2	1400	1000	1400	ln/min
RANGE_DYNAMIC	0x00BA	186	RW	F32	2	100	0	inf	to 1
RANGE_UNDERFLOW	0x00B6	182	RW	F32	2	0	0	100	%
RANGE_OVERFLOW	0x00B8	184	RW	F32	2	8	0	inf	%
RANGE_LOWER	0x00BC	188	R	F32	2	14	-	-	ln/min
RANGE_UPPER	0x00BE	190	R	F32	2	1512	-	-	ln/min
RANGE_AUTO_DYNAMIC	0x00C1	193	RW	U16	1	0	0	0xFFFF	-

### 9.2.3.5.1 PROFILE\_SELECT: Active Profile you want to use

Address hex	Address dec	Name	Access	Type	Count	default
0x0032	50	PROFILE_SELECT	RW	S16	1	-

Reading this register returns the current active profile index (zero based).

Writing the register changes the current active profile. Writing 0 selects the first profile, writing 1 selects the second profile and so on. Writing an invalid index has no effect. Writing the register changes current selected profile and changes are written into persistent memory. Changes are active immediately.

### 9.2.3.5.2 PROFILE\_NAME: Name of active profile

Address hex	Address dec	Name	Access	Type	Count	default
0x0034	52	PROFILE_NAME	RW	STR <16>	8	-

Reading this register returns the current active gas name in ASCII code.

### 9.2.3.5.3 GAS\_SELECT: Gas of active profile (EEPROM and RAM)

Address hex	Address dec	Name	Access	Type	Count	default
0x0042	66	GAS_SELECT	RW	S16	1	-

Reading this register returns the current active gas slot by index (zero based).

Writing the register sets the current active gas slot by index. If the index written is invalid the current active gas slot does not change. Otherwise writing the register has immediate effect: The current active gas slot is changed and the value written is also stored in persistent memory.

Changing the gas causes an internal restart of measurement. During restart no measurement values (e. g. flow) are available.

### 9.2.3.5.4 GAS\_NAME: Name of selected gas

Address hex	Address dec	Name	Access	Type	Count	default
0x0044	68	GAS_NAME	R	STR <16>	8	-

Reading this register returns the current active gas name in ASCII code.

### 9.2.3.5.5 FLOW\_UNIT\_SELECT: Flow unit select in active profile (EEPROM and RAM)

Address hex	Address dec	Name	Access	Type	Count	default
0x0052	82	FLOW_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active flow unit by index (zero based).

Writing the register sets the current active flow unit by index. If the index written is invalid the current active flow unit does not change. Otherwise writing the register has immediate effect: The current active flow unit is changed and the value written is also stored in persistent memory.

Negative indices refer to user defined flow units in EEPROM. Positive indices and zero refer to factory defined units stored in flash memory.

Changing the flow unit causes an internal restart of measurement. During restart no measurement values (e. g. flow) are available.

#### 9.2.3.5.6 FLOW\_UNIT\_NAME: Name of currently selected flow unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0054	84	FLOW_UNIT_NAME	R	STR <16>	8	-

Reading this register returns the name of the current selected unit. Any read request must target the base address of this register and is rejected otherwise.

#### 9.2.3.5.7 TEMP\_UNIT\_SELECT: Temperature unit select in active profile (EEPROM and RAM)

Address hex	Address dec	Name	Access	Type	Count	default
0x0062	98	TEMP_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active temperature unit by index (zero based).

Writing the register sets the current active temperature unit by index. If the index written is invalid the current active temperature unit does not change. Otherwise writing the register has immediate effect: The current active temperature unit is changed and the value written is also stored in persistent memory.

Negative indices refer to user defined temperature units in EEPROM. Positive indices and zero refer to factory defined temperature units stored in flash memory.

#### 9.2.3.5.8 TEMP\_UNIT\_NAME: Name of currently selected temperature unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0064	100	TEMP_UNIT_NAME	R	STR <16>	8	-

Reading this register returns the name of the current selected temperature unit. Any read request must target the base address of this register and is rejected otherwise.

#### 9.2.3.5.9 PRESSURE\_UNIT\_SELECT: Pressure unit select in active profile (EEPROM and RAM)

Address hex	Address dec	Name	Access	Type	Count	default
0x0072	114	PRESSURE_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active pressure unit by index (zero based).

Writing the register sets the current active pressure unit by index. If the index written is invalid the current active pressure unit does not change. Otherwise writing the register has immediate effect: The current active pressure unit is changed and the value written is also stored in persistent memory.

Negative indices refer to user defined pressure units stored in EEPROM. Positive indices and zero refer to factory defined pressure units stored in flash memory.

#### 9.2.3.5.10 PRESSURE\_UNIT\_NAME: Name of currently selected pressure unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0074	116	PRESSURE_UNIT_NAME	R	STR <16>	8	-

Reading this register returns the name of the current selected pressure unit. Any read request must target the base address of this register and is rejected otherwise.

### 9.2.3.5.11 TOTALIZER\_UNIT\_SELECT: Totalizer unit select in active profile (EEPROM and RAM)

Address hex	Address dec	Name	Access	Type	Count	default
0x0082	130	TOTALIZER_UNIT_SELECT	RW	S16	1	-

Reading this register returns the current active totalizer unit by index (zero based).

Writing the register sets the current active totalizer unit by index. If the index written is invalid the current active totalizer unit does not change. Otherwise writing the register has immediate effect: The current active totalizer unit is changed and the value written is also stored in persistent memory.

Negative indices refer to user defined totalizer units stored in EEPROM. Positive indices and zero refer to factory defined totalizer units stored in flash memory. List of totalizer units:

Index	Name
0	Nl
1	S1
2	Nm1
3	Sm1
4	kg
5	g
6	Nm3
7	Sm3
8	Ncc
9	ScC
10	lb
11	oz

### 9.2.3.5.12 TOTALIZER\_UNIT\_NAME: Name of currently selected totalizer unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0084	132	TOTALIZER_UNIT_NAME	R	STR <16>	8	-

Reading this register returns the name of the current selected totalizer unit. Any read request must target the base address of this register and is rejected otherwise.

### 9.2.3.5.13 RANGE\_MIN: Range min of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00B2	178	RANGE_MIN	RW	F32	2	-

Reading this register returns the effective minimum value excluding the underflow area.

Writing this register sets the minimum value of the current range type in use. This value is in current selected flow unit.

### 9.2.3.5.14 RANGE\_MAX: Range max of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00B4	180	RANGE_MAX	RW	F32	2	-

Reading this register returns the effective maximum value excluding the overflow area. Writing this register sets the maximum value of the current range type in use. This value is in current selected flow unit.

#### 9.2.3.5.15 RANGE\_UNDERFLOW: User Underflow

Address hex	Address dec	Name	Access	Type	Count	default
0x00B6	182	RANGE_UNDERFLOW	RW	F32	2	-

Reading this register returns the effective underflow (in percent of minimum value).

Writing this register sets the underflow of current range type in use (in percent of minimum value). The value is internally limited to maximum of 100.

#### 9.2.3.5.16 RANGE\_OVERFLOW: User Overflow

Address hex	Address dec	Name	Access	Type	Count	default
0x00B8	184	RANGE_OVERFLOW	RW	F32	2	-

Reading this register returns the effective overflow (in percent of maximum value). By default, the overflow is 8% which means the upper limit is 8% above the maximum value.

Writing this register sets the overflow of current range type in use (in percent of maximum value).

#### 9.2.3.5.17 RANGE\_DYNAMIC: Dynamic of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00BA	186	RANGE_DYNAMIC	RW	F32	2	-

Reading this register returns the effective dynamic value. Writing this register adjusts the minimum value of the current range type in use to realize the given dynamic value. This register reads +Infinity in the following special cases:

- Maximum value (RANGE\_MAX) is +Infinity
- Minimum value (RANGE\_MIN) is zero

If the device supports auto dynamic (see RANGE\_AUTO\_DYNAMIC register) writing zero into this register enables auto dynamic. Writing any other value first disables auto dynamic and then adjusts the minimum value of the current range type as stated above. While auto dynamic is enabled reading this register returns zero.

#### 9.2.3.5.18 RANGE\_LOWER: Lower value of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00BC	188	RANGE_LOWER	RW	F32	2	-

Reading this register returns the effective lower limit (which includes the underflow area). This value is in current selected flow unit.

#### 9.2.3.5.19 RANGE\_UPPER: Upper value of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00BE	191	RANGE_UPPER	RW	F32	2	-

Reading this register returns the effective upper limit (which includes the overflow area). This value is in current selected flow unit.

### 9.2.3.5.20 RANGE\_AUTO\_DYNAMIC: Auto dynamics

Address hex	Address dec	Name	Access	Type	Count	default
0x00C1	193	RANGE_AUTO_DYNAMIC	RW	F32	2	-

Writing this register enables or disables auto dynamic. It is device specific if auto dynamic is available.

Writing zero disables auto dynamic and writing non-zero enables auto dynamic. Writing the register has immediate effect and the state is also stored in persistent memory. Reading the register returns the current state (0 or 1).

While auto dynamic is enabled reading RANGE\_DYNAMIC register returns zero. The underflow alarm is disabled while auto dynamic is enabled.

A typical auto dynamic implementation disables user range minimum and adjusts the minimum of calibration range and factory range depending on pressure measurement.

### 9.2.3.6 Analog Output #0 – Voltage output

The unit has separate current and voltage outputs and are always active at the same time.

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
ANALOG_OUTPUT_0_RANGE	0x0261	609	RW	S16	1	1	0	32767	V
ANALOG_OUTPUT_0_READ	0x0262	610	R	F32	2	0-10	0	10	V
ANALOG_OUTPUT_0_LOWER	0x026A	618	RW	U32	2	0	0	10	V
ANALOG_OUTPUT_0_UPPER	0x026C	620	RW	U32	2	10	0	10	V
ANALOG_OUTPUT_0_UNIT	0x026E	622	R	STR<4>	2	V	-	-	char

#### 9.2.3.6.1 ANALOG\_OUTPUT\_0\_RANGE: Voltage Range

Address hex	Address dec	Name	Access	Type	Count	default
0x0261	609	ANALOG_OUTPUT_0_RANGE	RW	S16	1	-

Selects the analog range to be used. The analog range behaves proportional to the flow range. These changes are immediately active and are stored in persistent memory. The following ranges are valid:

Range	Effect
0	0 ... 5 V
1	0 ... 10 V
32767	Custom Voltage

#### 9.2.3.6.2 ANALOG\_OUTPUT\_0\_READ: Value of Analog Voltage

Address hex	Address dec	Name	Access	Type	Count	default
0x0262	610	ANALOG_OUTPUT_0_READ	R	F32	2	-



When operating in automatic or manual mode reading this register returns the value that is currently driven at the analog output. These changes are immediately active.

#### 9.2.3.6.3 ANALOG\_OUTPUT\_0\_LOWER: Max Value of Voltage Range

Address hex	Address dec	Name	Access	Type	Count	default
0x026A	618	ANALOG_OUTPUT_0_LOWER	RW	U32	2	-

Reading this register returns the lower limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

#### 9.2.3.6.4 ANALOG\_OUTPUT\_0\_UPPER: Min Value of Voltage Range

Address hex	Address dec	Name	Access	Type	Count	default
0x026C	620	ANALOG_OUTPUT_0_UPPER	RW	U32	2	-

Reading this register returns the upper limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

#### 9.2.3.6.5 ANALOG\_OUTPUT\_0\_UNIT: Unit of Voltage

Address hex	Address dec	Name	Access	Type	Count	default
0x026E	622	ANALOG_OUTPUT_0_UNIT	R	STR <4>	2	-

Reading this register returns the unit of the analog output signal as a string.

### 9.2.3.7 Analog Output #1 – Current output

The unit has separate current and voltage outputs and are always active at the same time.

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
ANALOG_OUTPUT_1_RANGE	0x0271	625	RW	S16	1	-1	-32768	-1	-
ANALOG_OUTPUT_1_READ	0x0272	626	R	F32	2	4-20	0	20	mA
ANALOG_OUTPUT_1_LOWER	0x027A	634	RW	U32	2	0	0	20	mA
ANALOG_OUTPUT_1_UPPER	0x027C	636	RW	U32	2	20	0	20	mA
ANALOG_OUTPUT_1_UNIT	0x027E	638	R	STR <4>	2	mA	-	-	char

#### 9.2.3.7.1 ANALOG\_OUTPUT\_1\_RANGE: Current Range

Address hex	Address dec	Name	Access	Type	Count	default
0x0271	625	ANALOG_OUTPUT_1_RANGE	RW	S16	1	-

Selects the analog range to be used. The analog range behaves proportional to the flow range. These changes are immediately active and are stored in persistent memory. The following ranges are valid:

Range	Effect
-32768	Custom Current
-1	4 ... 20 mA

#### 9.2.3.7.2 ANALOG\_OUTPUT\_1\_READ: Value of Analog Current

Address hex	Address dec	Name	Access	Type	Count	default
0x0272	626	ANALOG_OUTPUT_1_READ	R	F32	2	-

When operating in automatic or manual mode reading this register returns the value that is currently driven at the analog output.

#### 9.2.3.7.3 ANALOG\_OUTPUT\_1\_LOWER: Max Value of Current Range

Address hex	Address dec	Name	Access	Type	Count	default
0x027A	634	ANALOG_OUTPUT_1_LOWER	RW	U32	2	-

Reading this register returns the lower limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

#### 9.2.3.7.4 ANALOG\_OUTPUT\_1\_UPPER: Min Value of Current Range

Address hex	Address dec	Name	Access	Type	Count	default
0x027C	636	ANALOG_OUTPUT_1_UPPER	RW	U32	2	-

Reading this register returns the upper limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

#### 9.2.3.7.5 ANALOG\_OUTPUT\_1\_UNIT: Unit of Current

Address hex	Address dec	Name	Access	Type	Count	default
0x027E	638	ANALOG_OUTPUT_1_UNIT	R	STR <4>	2	-

Reading this register returns the unit of the analog output signal as a string.

### 9.2.3.8 Analog input #1 – Current input

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
ANALOG_INPUT_N_RANGE	0x0211	529	RW	S16	1	-1	-32768	-1	-
ANALOG_INPUT_N_READ	0x0212	530	R	F32	2	0-10	0	10	V
ANALOG_INPUT_N_LOWER	0x021A	538	RW	F32	2	0	0	10	V
ANALOG_INPUT_N_UPPER	0x021C	540	RW	F32	2	10	0	10	V
ANALOG_INPUT_N_UNIT	0x021D	542	R	U8	2	V	-	-	char

#### 9.2.3.8.1 ANALOG\_INPUT\_N\_RANGE

Address hex	Address dec	Name	Access	Type	Count	default
0x0211	529	ANALOG_INPUT_N_RANGE	RW	S16	1	-

Selects the analog range to be used. The analog range behaves proportional to the flow range. Depending on the type of the selected analog input (see ANALOG\_INPUT\_TYPE) the following ranges are valid (X = can be used):

Range	Effect	Voltage (Type = 01)	Current (Type = 10)	Both (Type = 11)
-32768	Custom Current		X	X
-1	4 ... 20 mA		X	X
0	0 ... 5 V	X		X
1	0 ... 10 V	X		X
32767	Custom Voltage	X		X

Changing the range index sets the values stored in ANALOG\_INPUT\_N\_RAW, ANALOG\_INPUT\_N\_VALUE and ANALOG\_INPUT\_N\_VALUE\_STORE to zero.

#### 9.2.3.8.2 ANALOG\_INPUT\_N\_READ

Address hex	Address dec	Name	Access	Type	Count	default
0x0212	530	ANALOG_INPUT_N_READ	R	F32	2	-

Reading this register returns the value that is currently applied to the analog input.

#### 9.2.3.8.3 ANALOG\_INPUT\_N\_LOWER

Address hex	Address dec	Name	Access	Type	Count	default
0x021A	538	ANALOG_INPUT_N_LOWER	RW	F32	2	-

Reading this register returns the lower limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

If voltage mode (“Custom Voltage”) and current mode (“Custom Current”) are supported there are two values: One value associated with voltage mode and one value associated with current mode. This register always contains the value corresponding to the selected mode (see ANALOG\_INPUT\_N\_RANGE register).

#### 9.2.3.8.4 ANALOG\_INPUT\_N\_UPPER

Address hex	Address dec	Name	Access	Type	Count	default
0x021C	540	ANALOG_INPUT_N_UPPER	RW	F32	2	-

Reading this register returns the upper limit of the selected range. Writing this register is ignored as long as the selected range is not the custom range. If the selected range is the custom range writing this register has an immediate effect and the value is stored in persistent memory.

If voltage mode (“Custom Voltage”) and current mode (“Custom Current”) are supported there are two values: One value associated with voltage mode and one value associated with current mode. This register always contains the value corresponding to the selected mode (see ANALOG\_INPUT\_N\_RANGE register).

#### 9.2.3.8.5 ANALOG\_INPUT\_N\_UNIT

Address hex	Address dec	Name	Access	Type	Count	default
0x021E	542	ANALOG_INPUT_N_UNIT	R	U8	2	-

Reading this register returns the unit of the analog input signal as a string. The unit depends on the device type and the selected range.

Voltage output: V

Current output: mA

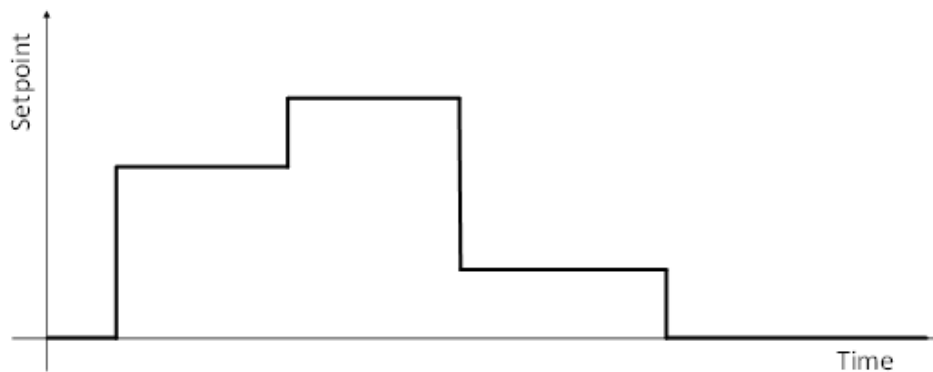
### 9.2.3.9 Controller

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
SETPOINT	0x100	256	RW	F32	2	1400	0	1400	Nl/min
SETPOINT_STORE	0x102	258	RW	F32	2	-	-	-	
SETPOINT_RAMPING_TIME_MS	0x104	260	RW	U16	1	0	0	100000	ms
SETPOINT_RAMPING_MODE	0x106	262	RW	U16	1	0	0	2	
SETPOINT_AUTOSAVE	0x107	263	RW	U16	1	0	0	1	-
CONTROLLER_OUTPUT	0x114	276	RW	F32	2	0	0	108	%
CONTROLLER_TERMS	0x116	278	RW	F32	6	[1;1;0]	[1;1;0]	[1;1;0]	[P;I;D]
CONTROLLER_OFFSET	0x120	288	RW	F32	2	0	0	100	%

#### 9.2.3.9.1 SETPOINT

Address hex	Address dec	Name	Access	Type	Count	default
0x0100	256	SETPOINT	RW	F32	2	-

As can be seen in the figure the setpoint is applied to the controller input.



Reading this register returns the user setpoint in current selected flow unit.

Writing this register updates the user setpoint in current selected flow unit.

This register is volatile only and any value written is not stored in persistent memory.

#### 9.2.3.9.2 SETPOINT\_STORE

Address hex	Address dec	Name	Access	Type	Count	default
0x0102	258	SETPOINT_STORE	RW	F32	2	-

This value is applied to the controller input at the power-on of the device.

Reading this register returns the user setpoint that is stored in persistent memory in current selected flow unit.

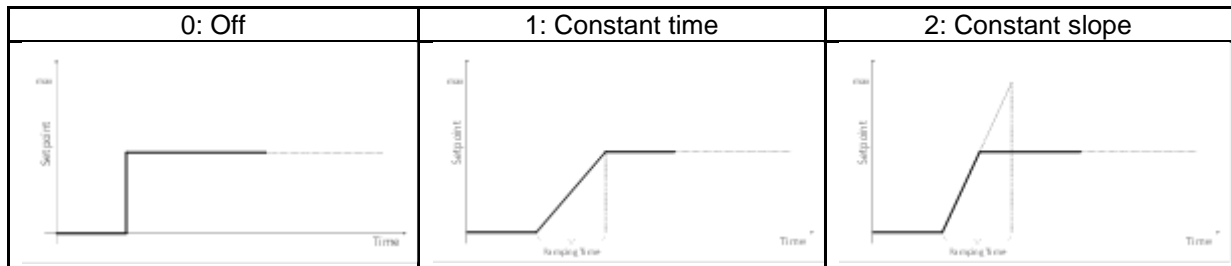
Writing this register updates the setpoint in persistent memory without changing the currently used setpoint of the control loop.

### 9.2.3.9.3 SETPOINT\_RAMPING\_TIME\_MS

Address hex	Address dec	Name	Access	Type	Count	default
0x0104	260	SETPOINT_RAMPING_TIME_MS	RW	U16	1	-

Setpoint ramping can be used to protect the process from rapid changes in the setpoint.

The figure illustrates how the ramping is applied to the user setpoint depending on the selected ramping mode (see SETPOINT\_RAMPING\_MODE):



Reading this register returns the ramping time in milli seconds.

Writing any non-zero value in this register updates the ramping. Writing zero disables the ramping. The written value is interpreted as time in milli seconds. Writing this register has volatile effect and the written value is additionally stored in persistent memory.

Note:

- If constant slope is selected as mode the given ramping time is applied to the maximum range value to determine the slope. In other words, the ramping time determines how long it would take the ramp if the setpoint was the maximum range starting from zero.

### 9.2.3.9.4 SETPOINT\_RAMPING\_MODE

Address hex	Address dec	Name	Access	Type	Count	default
0x0106	262	SETPOINT_RAMPING_MODE	RW	U16	1	-

Reading this register returns the current mode of the ramping.

Index	Description
0	Off
1	Constant time
2	Constant slope

Writing this register sets current active ramping mode. Writing an invalid value in this register has no effect and the current ramping mode does not change. Writing this register has volatile effect and the written index is additionally stored in persistent memory.

### 9.2.3.9.5 SETPOINT\_AUTOSAVE

Address hex	Address dec	Name	Access	Type	Count	default
0x0107	263	SETPOINT_AUTOSAVE	RW	U16	1	-

Reading this register returns current autosave setting:

- If autosave feature is disabled reading the register returns zero (0)
- If autosave feature is enabled reading the register returns a non-zero value (1)

If autosave feature is enabled writing the SETPOINT register causes both, a volatile and persistent update of the setpoint. In that case any setpoint written is also stored in persistent memory.

Writing this register enables or disables the autosave feature:

- Writing zero disables autosave feature
- Writing any non-zero value enables autosave feature

### 9.2.3.9.6 CONTROLLER\_OUTPUT

Address hex	Address dec	Name	Access	Type	Count	default
0x0114	276	CONTROLLER_OUTPUT	R	F32	1	-

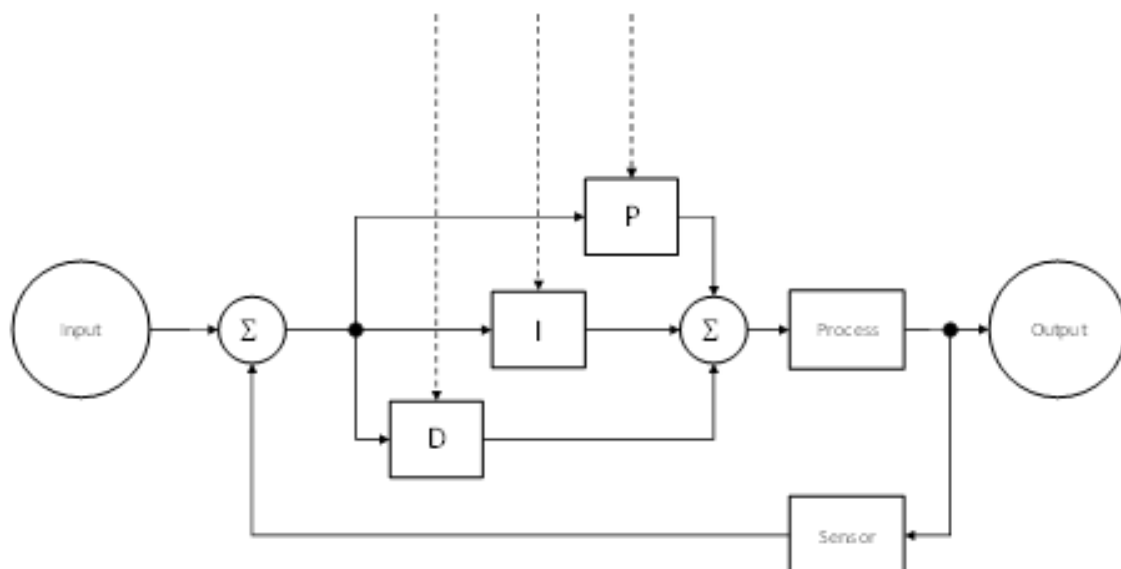
This register holds the output of the control loop. The output is applied to the valve of the device.

Reading this register returns the controller output in percent.

### 9.2.3.9.7 CONTROLLER\_TERMS

Address hex	Address dec	Name	Access	Type	Count	default
0x0116	278	CONTROLLER_TERMS	R	F32	6	-

Currently used PID values in the control loop [P, I, D]



The PID values depend on the currently selected parameter set.

### 9.2.3.9.8 CONTROLLER\_OFFSET

Address hex	Address dec	Name	Access	Type	Count	default
0x0120	288	CONTROLLER_OFFSET	RW	F32	1	-

Reading this register returns the output offset.

Writing this register updates the output offset.

Writing this register has immediate effect and the value is additionally stored in persistent memory.

The CONTROLLER\_OFFSET value is the initial value where the CONTROLLER\_OUTPUT starts to control the valve. The spring inside the valve pushes down the valve seat to make sure the valve is closing properly. To overcome this initial force there is the possibility to make the controller start regulating at an increased CONTROLLER\_OUTPUT by setting a CONTROLLER\_OFFSET. At ambient pressure (at inlet) the valve needs a load of 30% to start to open. With higher pressures the down force increases even more.

The CONTROLLER\_OFFSET gets adjusted in the factory to the ordered operating pressure.

Adjusting the CONTROLLER\_OFFSET:

- Apply your operating pressure
- Set the lowest flow setpoint and wait until the flow is stable
- Read the register CONTROLLER\_OUTPUT and subtract 7%
- Write this value in the register CONTROLLER\_OFFSET
- Test if you have an immediate start of the flow when you set the setpoint to 20% of full-scale flow

If the flow overshoots decrease the CONTROLLER\_OFFSET value

### 9.2.3.10 TARE

TARE									
TARE_NULL	0x0902	2306	RW	U16	1	0	0	1	
TARE_STATUS	0x0903	2307	RW	U16	1	1	0	2	
TARE_DURATION	0x0904	2308	RW	U16	1	1000	100	65536	
TARE_DELAY	0x0905	2309	RW	U16	1	3000	0	65536	
TARE_THRESHOLD	0x0906	2310	RW	F32	2	0.005	0	inf	
TARE_RANGE_MIN	0x0908	2312	RW	F32	2	0.05	0	inf	
TARE_RANGE_MAX	0x090A	2314	RW	F32	2	1	0	inf	



### 9.2.3.10.1 TARE\_NULL

Address hex	Address dec	Name	Access	Type	Count	default
0x0902	2306	TARE_NULL	RW	U16	1	-

Writing any non-zero value manually tares the device. Writing zero has no effect. Writing this register triggers a tare if valve is closed and has no effect while valve is driven (controller device only). If the device is a meter device writing a non-zero value always triggers a tare. User must ensure proper conditions. Improper conditions can degrade quality of measurement after tare.

Reading this register returns the number of tares successfully completed since this counter was read previously. This includes manually and automatically triggered tares. This is a volatile value which is reset to zero when read or upon device reset. It is typically used to check if an auto-tare has occurred or a manually triggered tare has been completed.

### 9.2.3.10.2 TARE\_STATUS

Address hex	Address dec	Name	Access	Type	Count	default
0x0903	2307	TARE_STATUS	RW	U16	1	-

Reading this register returns the current auto-tare status:

- 0: Disabled
- 1: Inactive (ready)
- 2: Tare running (after automatic or manual trigger)

Writing this register enables and disables auto-tare function: Writing non-zero enables auto-tare function, writing zero disables auto-tare function. Auto-tare does not trigger while disabled. This has no effect on manual tare which can't be disabled.

### 9.2.3.10.3 TARE\_DURATION

Address hex	Address dec	Name	Access	Type	Count	default
0x0904	2308	TARE_DURATION	RW	U16	1	-

Length (in ms) of pressure measurement during auto-tare (in ms). The value written is limited internally to the lowest duration possible.

### 9.2.3.10.4 TARE\_DELAY

Address hex	Address dec	Name	Access	Type	Count	default
0x0905	2309	TARE_DELAY	RW	U16	1	-

Delay (in ms) after valve is closed and before auto-tare starts. This value is used for automatic triggered tare only.

### 9.2.3.10.5 TARE\_THRESHOLD

Address hex	Address dec	Name	Access	Type	Count	default
0x0906	2310	TARE_THRESHOLD	RW	F32	1	-

Cumulative standard deviation threshold below which the pressure value is considered stable. If set to zero (or any non-finite value) this feature is disabled and the pressure value is always considered stable. This threshold is used only during auto-tare. For manually triggered tare this threshold is ignored. User has to ensure stable pressure conditions for manually triggered tare.

### 9.2.3.10.6 TARE\_RANGE\_MIN

Address hex	Address dec	Name	Access	Type	Count	default
0x0908	2312	TARE_RANGE_MIN	RW	F32	1	-

Minimum value of valid pressure range. Auto-tare can be triggered while pressure value is within that range. Any non-finite value disables minimum boundary (it is set to zero). Negative values are internally mapped to the positive axis.

After tare the compensated pressure value is zero. If (e.g. due to drift) the pressure value exceeds the minimum range another auto-tare can be triggered.

### 9.2.3.10.7 TARE\_RANGE\_MAX

Address hex	Address dec	Name	Access	Type	Count	default
0x090A	2314	TARE_RANGE_MAX	RW	F32	1	-

Maximum value of valid pressure range. Auto-tare can be triggered while pressure value is within that range. Any non-finite value disables maximum boundary (it is set to +infinity). Negative values are internally mapped to the positive axis.

After tare the compensated pressure value is zero. If (e.g. due to drift) the pressure value exceeds the minimum range another auto-tare can be triggered.

### 9.2.3.11 Valve

Valve									
VALVE_MODE	0x0160	352	RW	U16	1	0	0	4	
VALVE_STATUS	0x0161	353	R	U16	1	0	0	3	
VALVE_LOAD	0x0162	354	R	F32	2	0	0	100	
VALVE_VALUE	0x0164	356	RW	F32	2	0	0	100	
VALVE_VALUE_STORE	0x0166	358	RW	F32	2	0	0	100	
VALVE_PURGE_TIME_MS	0x0174	372	RW	U32	2	5000	100	65536	
VALVE_FEATURE	0x0176	374	RW	U16	1	0	0	1	
VALVE_SELECT	0x0177	375	RW	S16	1	0	-1	1	
VALVE_N_FREQUENCY	0x0178	376	RW	U32	2	7000	0	50000	

#### 9.2.3.11.1 VALVE\_MODE

Address hex	Address dec	Name	Access	Type	Count	default
0x0160	352	VALVE_MODE	RW	U16	1	-

Reading this register returns the current mode of the valve.

The following modes are available:

Index	Mode	Description
0	Idle	Valve closed.
1	Control (default)	Valve controlled automatically by PID Controller.
2	Manual	Valve can be controlled manually by user.
3	Min Detect	Valve minimum detection is applied.
4	Purge	Valve purge is applied.

Writing this register has volatile effect only and is not stored in persistent memory.

Note:

If the valve mode is "Idle" or "Manual" the green LED on the device flashes with 1 Hz (500 ms on, 500 ms off). Otherwise the LED is constantly on.

#### 9.2.3.11.2 VALVE\_STATUS

Address hex	Address dec	Name	Access	Type	Count	default
0x0161	353	VALVE_STATUS	RW	U16	1	-

Reading this register returns the current status of the valve.

The following statuses are available:

Value	Status
0	Normal
1	Protected
2	Forced

Note:

If the valve status is "Forced" the green LED on the device flashes with 1 Hz (500 ms on, 500 ms off). Otherwise the LED is constantly on.

### 9.2.3.11.3 VALVE\_LOAD

Address hex	Address dec	Name	Access	Type	Count	default
0x0162	354	VALVE_LOAD	RW	U16	1	-

Reading this register returns the current load of the valve in percent.

### 9.2.3.11.4 VALVE\_VALUE

Address hex	Address dec	Name	Access	Type	Count	default
0x0164	356	VALVE_VALUE	RW	U16	1	-

Reading this register returns the valve value for manual mode in percent.

The value stored in this register is used to drive the valve if VALVE\_MODE is set to “manual” mode. In this case any value written to this register has immediate effect. Otherwise the value written is stored but has no effect until VALVE\_MODE is changed to “manual” mode.

Writing a value in percent to this register drives the valve to the entered value. Numbers below zero are clamped to zero. Values above 100 are clamped to 100.

Writing this register has volatile effect only. Values written are not stored in persistent memory. On device startup the value of this register is set to the value of the VALVE\_VALUE\_STORE register.

Note:

The valve minimum and maximum are not applied if the valve is controlled manually.

### 9.2.3.11.5 VALVE\_VALUE\_STORE

Address hex	Address dec	Name	Access	Type	Count	default
0x0166	358	VALVE_VALUE_STORE	RW	U16	1	-

Writing this register sets and stores the initial value of VALVE\_VALUE register in persistent memory. Reading the register returns that value.

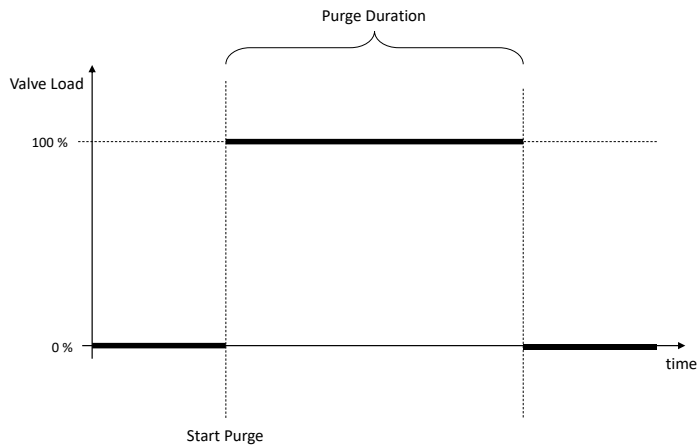
On each device startup this value is written to the VALVE\_VALUE register.

### 9.2.3.11.6 VALVE\_PURGE\_TIME\_MS

Address hex	Address dec	Name	Access	Type	Count	default
0x0174	372	VALVE_PURGE_TIME_MS	RW	U16	1	-

The device can purge the valve for a certain time.

The following figure describes the valve purge behaviour:



Reading this register returns the valve purge duration in milli seconds. Writing 5000 to this register means 5 seconds purge time. Writing this register has volatile effect and the value is additionally stored in persistent memory.

Reading this register returns the valve purge duration in milli seconds.

Please note that the purge function can create huge unexpected high flows.

### 9.2.3.11.7 VALVE\_FEATURE

Address hex	Address dec	Name	Access	Type	Count	default
0x0176	374	VALVE_FEATURE	RW	U16	1	-

Reading this register returns the supported features of the valve.

The following features are available:

Bit #	Feature
0	Valve Protection
1	Auto min

Writing a 1 bit enables the corresponding feature, writing a 0 bit disables the corresponding feature. Writing unsupported bits has no effect. Writing this register has volatile effect and the value is additionally stored to persistent memory.

#### Valve Protection

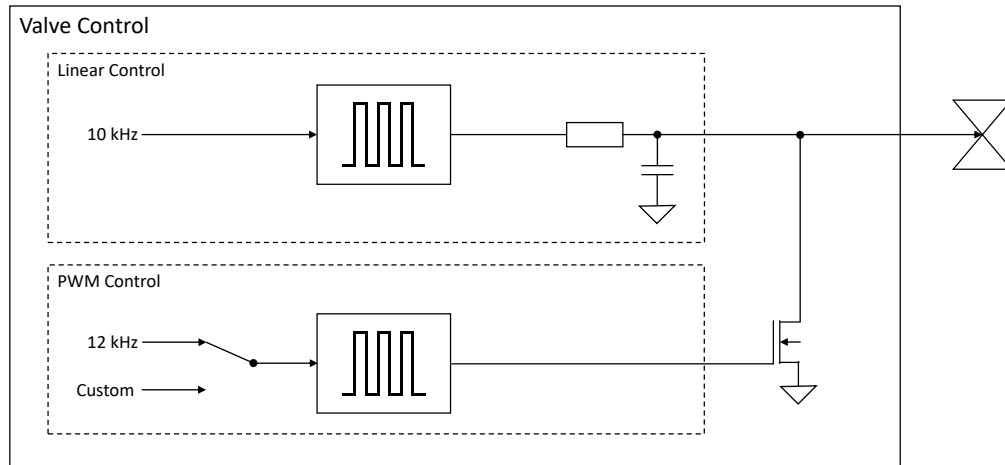
The valve protection prevents the valve from overheating which could lead to a permanent damage of the valve. The protection is activated when there was no flow measured for a certain time although the valve is fully is opened by the PID controller. While in protection mode the valve will be closed till a new setpoint is given. (The system also makes the digital setpoint zero)

**Enabling the valve protection is strongly recommended!**

### 9.2.3.11.8 VALVE\_SELECT

Address hex	Address dec	Name	Access	Type	Count	default
0x0177	375	VALVE_SELECT	RW	U16	1	-

The figure illustrates the types of valve control.



Writing this register stores the selected valve control type in persistent memory. The following values are accepted:

Value	Description
-1	PWM with custom frequency (in Hz)
0	PWM
1	Linear control

Writing an invalid value has no effect. This register does not change the current valve control. Instead changing this setting is applied at system restart.

Reading this register returns the valve control type stored in persistent memory.

### 9.2.3.11.9 VALVE\_N\_FREQUENCY

Address hex	Address dec	Name	Access	Type	Count	default
0x0178	376	VALVE_N_FREQUENCY	RW	U16	1	-

Reading this register returns the PWM frequency of the selected valve control type.

Writing this register stores the PWM frequency of the selected valve control type in persistent memory. If a valve control type with positive index is selected writing this register has no effect.

Changing this setting is applied at system restart.

### 9.2.3.12 Bluetooth

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
BLUETOOTH@_PAIRING	0x0801	402050	RW	U16	1	0	0	1	-
PUSHBUTTON_SHORT	0x0700	401793	RW	U16	1	0	0	1	-

#### 9.2.3.12.1 BLUETOOTH\_PAIRING: Bluetooth Pairing Mode Status

Address hex	Address dec	Name	Access	Type	Count	default
0x0801	2049	BLUETOOTH_PAIRING	RW	U16	1	-

Reading this register returns whether the Bluetooth module is currently paired with another device.

Value	Description
0	Not paired
1	Paired

If Bluetooth module is currently not paired writing any non-zero value in this register will start Bluetooth advertising.

If Bluetooth module is currently paired writing any non-zero value will disconnect the Bluetooth module from the paired device and put the Bluetooth module in RESET.

#### 9.2.3.12.2 PUSHBUTTON\_SHORT: Bluetooth activation/deactivation

Address hex	Address dec	Name	Access	Type	Count	default
0x0700	1792	PUSHBUTTON_SHORT	RW	U16	1	-

See chapter [8.9](#)

### 9.2.3.13 Device Information

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
INFO_DEVICE_FUNCTION	0x0400	401025	R	U32	2	0x81031A15	0	0xFFFFFFFF	-
INFO_SERIAL	0x0402	401027	R	U32	2	0x7866E810	0	0xFFFFFFFF	-
INFO_TYPECODE_1	0x0404	401029	R	STR<12>	6	DFM00000	0	12	char
INFO_TYPECODE_2	0x040A	401035	R	STR <12>	6	0	0	12	char
INFO_VERSION_SOFTWARE	0x0410	401041	R	U16	1	0x001	0	0xFFFF	-
INFO_VERSION_BOOTLOADER	0x0411	401042	R	U16	1	0x001	0	0xFFFF	-
INFO_VERSION_HARDWARE	0x0412	401043	R	U16	1	0x002	0	0xFFFF	-
INFO_VERSION_MECHANICS	0x0413	401044	R	U16	1	0x001	0	0xFFFF	-
INFO_DEVICE_NAME	0x0420	401057	RW	STR<32>	16	d-flux	0	32	char

#### 9.2.3.13.1 INFO\_DEVICE\_FUNCTION: Functions of device

Address hex	Address dec	Name	Access	Type	Count	default
0x0400	1024	INFO_DEVICE_FUNCTIONS	R	U32	2	-

Reading the register returns the current configuration.

Bitmask that encodes the device functions available:

- Bit #0: Flow measurement
- Bit #1: Flow controller
- Bit #2: Temperature measurement
- Bit #3:
- Bit #4: Pressure measurement
- Bit #5: Pressure controller
- Bit #6: Reverse flow detection
- Bit #7: Reverse flow measurement
- Bit #8: Analog input
- Bit #9: Analog output
- Bit #10:
- Bit #11: External switch
- Bit #12: Pushbutton
- Bit #13: Display
- Bit #14:
- Bit #15:
- Bit #16: Totalizer
- Bit #17: Safety Features (see timeout function)
- Bit #18:
- Bit #19:
- Bit #20:
- Bit #21:
- Bit #22:
- Bit #23:
- Bit #24: Modbus
- Bit #25: Profibus
- Bit #26: EtherCAT®
- Bit #27: Profinet
- Bit #28:
- Bit #29:
- Bit #30:
- Bit #31: Bluetooth®



### 9.2.3.13.2 INFO\_SERIAL: Serial number of device

Address hex	Address dec	Name	Access	Type	Count	default
0x0402	1026	INFO_SERIAL	R	U32	2	-

Reading this register returns the serial number of the device.

### 9.2.3.13.3 INFO\_TYPECODE\_1: Type code of device part 1

Address hex	Address dec	Name	Access	Type	Count	default
0x0404	1028	INFO_TYPECODE_1	R	STR <12>	6	-

Type code (part 1) as a string.

### 9.2.3.13.4 INFO\_TYPECODE\_2: Type code of device part 2

Address hex	Address dec	Name	Access	Type	Count	default
0x040A	1034	INFO_TYPECODE_2	R	STR <12>	6	-

Type code (part 2) as a string.

### 9.2.3.13.5 INFO\_VERSION\_SOFTWARE: Software version

Address hex	Address dec	Name	Access	Type	Count	default
0x0410	1040	INFO_VERSION_SOFTWARE	R	U16	1	-

Reading this register returns the software version. The version is encoded by the hex representation of the value. E.g., 0x321 means software version 3.2.1.

### 9.2.3.13.6 INFO\_VERSION\_BOOTLOADER: Bootloader version

Address hex	Address dec	Name	Access	Type	Count	default
0x0411	1041	INFO_VERSION_BOOTLOADER	R	U16	1	-

Reading this register returns the bootloader version. The version is encoded by the hex representation of the value. E.g., 0x321 means bootloader version 3.2.1.

### 9.2.3.13.7 INFO\_VERSION\_HARDWARE: Hardware version

Address hex	Address dec	Name	Access	Type	Count	default
0x0412	1042	INFO_VERSION_HARDWARE	R	U16	1	-

Reading this register returns the hardware version. The version is encoded by the hex representation of the value. E.g., 0x321 means hardware version 3.2.1.

### 9.2.3.13.8 INFO\_VERSION\_MECHANICS: Mechanics version

Address hex	Address dec	Name	Access	Type	Count	default
0x0413	1043	INFO_VERSION_MECHANICS	R	U16	1	-

Reading this register returns the mechanics version. The version is encoded by the hex representation of the value. E.g., 0x321 means mechanics version 3.2.1.

### 9.2.3.13.9 INFO\_DEVICE\_NAME: Device name

Address hex	Address dec	Name	Access	Type	Count	default
0x0420	1056	INFO_DEVICE_NAME	R	U16	1	-

User defined device name (e.g., to name metering point) as a zero terminated string.

### 9.2.3.14 Filtering

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
OUTSTAGE_0_ENABLE	0x00F00	403841	RW	U16	1	1	0	1	-
OUTSTAGE_0_SELECT	0x00F01	403842	RW	U16	1	1	0	2	-
OUTSTAGE_0_RESIZE	0x00F02	403843	RW	U16	1	10	0	0xFFFF	Samples
OUTSTAGE_0_CONFIG	0x00F03	403844	RW	U16	1	2	0	3	-
OUTSTAGE_0_RESET	0x00F04	403845	RW	U32	1	0	0	1400	ln/min
OUTSTAGE_0_DECIMATOR	0x00F06	403847	RW	U16	1	0	0	64	-

The following registers are only related to the flow measurement

More details on the filters in chapter [8.4](#)

#### 9.2.3.14.1 OUTSTAGE\_0\_ENABLE: Enable or disable flow filtering

Address hex	Address dec	Name	Access	Type	Count	default
0x0F00	3840	OUTSTAGE_0_ENABLE	RW	U16	1	-

Writing a non-zero value enables the corresponding outstage. Writing a zero value disables the corresponding outstage. Initially outstage is enabled.

Writing has volatile effect only and values written are not stored in persistent memory. To update persistent memory, write OUTSTAGE\_0\_STORE register afterwards.

Reading this register returns whether the outstage is enabled (0) or disabled (1).

#### 9.2.3.14.2 OUTSTAGE\_0\_SELECT: Selecting filter type of flow filtering

Address hex	Address dec	Name	Access	Type	Count	default
0x0F01	3841	OUTSTAGE_0_SELECT	RW	U16	1	-

Writing the register selects the active DFU (data filtering unit) used by given outstage.

Reading the register returns the current active DFU.

This register selects the filter to use:

- 0: Moving average
- 1: Exponential moving average (EMA)
- 2: Moving median

Writing has volatile effect only and values written are not stored in persistent memory. To update persistent memory, write OUTSTAGE\_n\_STORE register afterwards.

### 9.2.3.14.3 OUTSTAGE\_0\_RESIZE: Number of elements for flow filtering

Address hex	Address dec	Name	Access	Type	Count	default
0x0F02	3842	OUTSTAGE_0_RESIZE	RW	U16	1	-

Writing the register resizes the output buffer capacity (in number of elements) to the specified value. The output buffer stores filter output values until being read. They are removed from buffer when corresponding value register is read. The maximum output buffer capacity is device specific. A larger value is limited internally to the maximum output buffer capacity.

Writing has volatile effect only and values written are not stored in persistent memory. To update persistent memory, write OUTSTAGE\_0\_STORE register afterwards.

Reading the register returns the current capacity (in number of elements). The value written is internally limited to the maximum capacity of the output buffer.

### 9.2.3.14.4 OUTSTAGE\_0\_CONFIG: Selected filter configuration for flow filtering

Address hex	Address dec	Name	Access	Type	Count	default
0x0F03	3843	OUTSTAGE_0_CONFIG	RW	U16	1	-

Writing the register sets the current configuration value. The meaning of this value depends on selected DFU:

- 0: Moving average: Window size (in samples)
- 1: Exponential moving average (EMA): Alpha factor as 1/value
- 2: Moving median: Window size (in samples)

The maximum window size possible is configured if the value written exceeds the internal buffer capacity. A value of zero configures DFU dependent filter modes:

- Moving average: Zero enables „average on sample” feature
- Moving median: Zero enables anti-noise mode

Writing has volatile effect only and values written are not stored in persistent memory. To update persistent memory, write OUTSTAGE\_0\_STORE register afterwards.

Reading the register returns the current configuration value.

### 9.2.3.14.5 OUTSTAGE\_0\_RESET: Selected flow filter reset with a defined value

Address hex	Address dec	Name	Access	Type	Count	default
0x0F04	3844	OUTSTAGE_0_RESET	RW	U32	2	-

Writing this register resets the outstage to the specified flow value in the set engineering unit. Reading the registers pops and returns next element from outstage. This can be used when changing to another filter to start where the last filter ended to avoid spikes and dips.

Writing has volatile effect only and values written are not stored in persistent memory. To update persistent memory, write OUTSTAGE\_0\_STORE register afterwards.

### 9.2.3.14.6 OUTSTAGE\_0\_DECIMATOR: Smoothens the filter value

Address hex	Address dec	Name	Access	Type	Count	default
0x0F06	3846	OUTSTAGE_0_DECIMATOR	W	U16	1	-

Writing this registers enables and configures the decimation filter. The decimation filter is used to reduce the sampling rate before samples are being processed by the DFU stage.

Increasing the value increases smoothing performance but decreases reaction time. The value written is internally limited to the maximum size possible. Writing zero or 1 disables the decimation filter. Any value written has immediate effect and is stored in persistent memory.

Reading this register returns the current decimation filter setting.

### 9.2.3.15 Push Button

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
PUSHBUTTON_SHORT	0x0700	41793	RW	U16	1	1	0	5	-
PUSHBUTTON_LONG	0x0701	41794	RW	U16	1	0	0	5	-

#### 9.2.3.15.1 PUSHBUTTON\_SHORT: Function of push button short press

Address hex	Address dec	Name	Access	Type	Count	default
0x0700	1792	PUSHBUTTON_SHORT	RW	U16	1	-

This register holds the index of pushbutton short press function. Writing this register will have an immediate effect. Additionally, the new value will be written to persistent memory.

The following functions are available:

Index	Function
0	None
1	Bluetooth® advertising mode (default)
2	Device Reset
3	Measurement On/Off
4	Alarm Reset
5	Tare*

\* Tare on d-flux means set zero pressure (equivalent to PRES\_NULL register)

### 9.2.3.15.2 PUSHBUTTON\_LONG: Function of push button long press

Address hex	Address dec	Name	Access	Type	Count	default
0x0701	1793	PUSHBUTTON_LONG	RW	U16	1	-

This register holds the index of pushbutton long press function. Writing this register will have an immediate effect. Additionally, the new value will be written to persistent memory.

The following functions are available:

Index	Function
0	None (default)
1	Bluetooth® advertising mode
2	Device Reset
3	Measurement On/Off
4	Alarm Reset
5	Tare*

\* Tare on d-flux means set zero pressure (equivalent to PRES\_NULL register)

### 9.2.3.16 Switch

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
SWITCH_STATE	0x0340	832	R	U16	1	0	0	1	-
SWITCH_MODE	0x0342	834	RW	U16	1	1	0	1	-
SWITCH_VALUE	0x0343	835	RW	U16	1	0	0	1	-
SWITCH_VALUE_STORE	0x0344	836	RW	U16	1	0	0	1	-

#### 9.2.3.16.1 SWITCH\_STATE: OC switch status

Address hex	Address dec	Name	Access	Type	Count	default
0x0340	832	SWITCH_STATE	R	U16	1	-

Reading this register returns the current state of the open collector (MOSFET) switch.

The switch has two states:

- 0: Open (floating connection)
- 1: Closed (connected to ground)

### 9.2.3.16.2 SWITCH\_MODE: OC switch mode (off or manual)

Address hex	Address dec	Name	Access	Type	Count	default
0x0342	834	SWITCH_MODE	RW	U16	1	-

Reading this register returns the current mode of the open collector switch.

The following modes are available:

Index	Mode	Description
0	Off	The switch cannot be controlled and is floating.
1	Manual	The switch can be operated by SWITCH_VALUE or "Safety Features" (default).

The mode is set to "manual" by default.

Writing this register sets the current active mode.

Writing an invalid value in this register has no effect.

Writing this register has immediate effect and the value is additionally stored in persistent memory.

### 9.2.3.16.3 SWITCH\_VALUE: OC switch value in manual mode

Address hex	Address dec	Name	Access	Type	Count	default
0x0343	835	SWITCH_VALUE	RW	U16	1	-

Reading this register returns the value of the open collector switch for "manual" mode.

Writing this register sets the value of the open collector switch for "manual" mode.

Writing a non-zero value to this register sets the value to 1.

Writing zero to this register sets the value to zero.

Writing this register has volatile effect only.

### 9.2.3.16.4 SWITCH\_VALUE\_STORE: OC switch persistent memory

Address hex	Address dec	Name	Access	Type	Count	default
0x0344	836	SWITCH_VALUE_STORE	RW	U16	1	-

Reading this register returns the default value of the open collector switch in persistent memory.

Writing this register sets the default value of the open collector switch in persistent memory only.

Writing a non-zero value to this register sets the value to 1.

Writing zero to this register sets the value to zero.

### 9.2.3.17 Totalizer

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
TOTALIZER_RESET	0x1F10	7952	W	U16	1	-	0	0xFF	-
TOTALIZER_AUTOZERO	0x1F20	7968	W	U16	1	-	0	0xFF	-
TOTALIZER_N_RESET	0x1F50	8016	W	U16	1	0	0	1	-
TOTALIZER_VALUE	0x0004	5	RW	F32	2	0	0	infinity	-
TOTALIZER_STATE	0x1F11	7953	RW	U16	1	0	0	1	-

### 9.2.3.17.1 TOTALIZER\_RESET: Reset totalizers 0-15

Address hex	Address dec	Name	Access	Type	Count	default
0x1F10	7952	TOTALIZER_RESET	W	U16	1	-

Writing this register can resets multiple totalizers at once via a bit field from 0 to 15.

Profile/Totalizer	15	14	...	5	4	3	2	1	0
Reset	1	1	0	0	0	0	1	0	Locked

In this case writing: 1100 0000 0000 0100 = 0xC004 resets totalizer 2, 14 and 15.

Each bit in this register is associated with a single totalizer. Writing a 1 bit resets the corresponding totalizer, writing a 0 bit has no effect. This is a bit field from 0 to 15. Writing bits not associated with a totalizer has no effect.

It is possible to reset a totalizer in disabled state. If a totalizer is not configured to be resettable writing its corresponding bit has no effect.

Profile "0" totalizer cannot be reset by default. Profile "1-15" totalizers can be reset by default.

### 9.2.3.17.2 TOTALIZER\_AUTOZERO: Totalizer automatically resets after a restart

Address hex	Address dec	Name	Access	Type	Count	default
0x1F20	9768	TOTALIZER_AUTOZERO	R(W)	U16	1	-

Writing this register enables/disables the auto zero function. If auto zero function is enabled the corresponding totalizer is reset on startup of device and is no longer written to persistent memory

Profile/Totalizer	15	14	...	5	4	3	2	1	0
Enable Auto Zero	1	1	0	0	0	0	1	0	Locked

In this case writing: 1100 0000 0000 0100 = 0xC004 will activate auto zero for totalizer 2, 14 and 15.

Each bit in this register is associated to a totalizer. Writing a 1 bit enables the auto zero function for the corresponding totalizer, writing a 0 bit disables the auto zero function for the corresponding totalizer. Bits not associated with a totalizer are ignored and have no effect. The value written to this register is stored in persistent memory.

Reading this register returns the current state of auto zero function.

Profile "0" totalizer cannot be reset by default. Profile "1-15" totalizers can be reset by default.

### 9.2.3.17.3 TOTALIZER\_N\_RESET: Resets active totalizer

Address hex	Address dec	Name	Access	Type	Count	default
0x1F50	8016	TOTALIZER_N_RESET	W	U16	1	-

Writing this register has no effect except for writing zero. Writing a 1 resets the selected totalizer. It is possible to reset a totalizer in disabled state. If a totalizer is not configured to be resettable writing 1 has no effect.

#### 9.2.3.17.4 TOTALIZER\_VALUE: Value of active totalizer

Address hex	Address dec	Name	Access	Type	Count	default
0x0004	5	TOTALIZER_VALUE	RW	F32	2	-

Reading this register returns the value of the selected totalizer.

Writing this register has no effect except for writing zero. Writing zero resets the associated totalizer. It is possible to reset a totalizer in disabled state. If a totalizer is not configured to be resettable writing zero has no effect.

#### 9.2.3.17.5 TOTALIZER\_STATE: State of active totalizer

Address hex	Address dec	Name	Access	Type	Count	default
0x1F11	7953	TOTALIZER_STATE	RW	U16	1	-

Writing this register enables/disables the current selected totalizer. Writing a non-zero value enables the current selected totalizer, writing a zero value disables the current selected totalizer.

Reading this register returns the active enable/disable state of associated totalizer.

### 9.2.3.18 Factory Backup

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
MANAGE_BACKUP_RESTORE	0xFFFC	65532	W	U16	1	-	-	-	-

#### 9.2.3.18.1 MANAGE\_BACKUP\_RESTORE: Restore Factory Backup

Address hex	Address dec	Name	Access	Type	Count	default
0xFFFC	65532	MANAGE_BACKUP_RESTORE	W	U16	1	-

Writing this register restores the factory backup with given index (zero based). If no factory backup is available at the given index or if the index written is invalid writing the register has no effect.

When a factory backup is performed the totalizers will not be reset and keep their value.



### 9.2.3.19 Warnings and Errors

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
WARNING_GLOBAL_STATUS	0x0301	769	R	U16	1	0	0	0xFFFF	-
WARNING_GLOBAL_MODE	0x0303	771	RW	U16	1	1	1	3	-
WARNING_GLOBAL_RESET	0x0304	772	W	U16	1	-	-	-	-
ERROR_GLOBAL_STATUS	0x0321	801	R	U16	1	0	0	0xFFFF	-
	0x030A	778	RW	U16	1	0	0	1	-

#### 9.2.3.19.1 WARNING\_GLOBAL\_STATUS: Which alarms are active

Address hex	Address dec	Name	Access	Type	Count	default
0x0301	769	WARNING_GLOBAL_STATUS	R	U16	1	-

This register shows which warnings are currently active. Warnings are reported in a bit mask. Only available warnings are considered and reported with a 1.

The following warnings exist:

Bit	Warning
0	No flow although valve is open. (MFC only)
1	Negative flow
2	Setpoint is not reached. (MFC only)
3	Pressure out of range
4	Temperature out of range
5	Flow measured although valve is closed. (MFC only)
6	Watchdog
7	Underflow
8	Overflow
9	Analog input above range. (MFC only)
10	
11	
12	
13	
14	
15	

Example:

Warning	15	14	...	5	4	3	2	1	0
Available	0	0	0	0	1	0	0	0	0

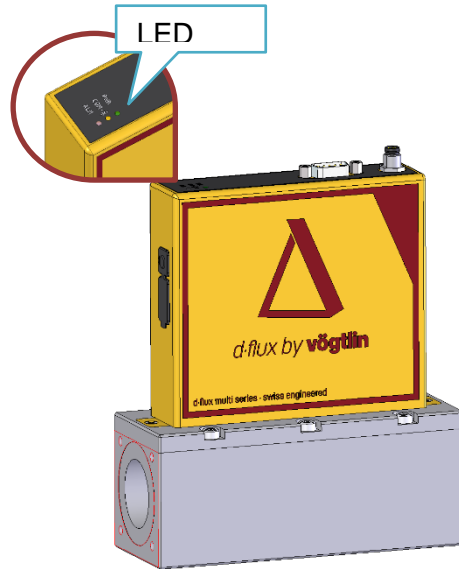
In this case reading: 0000 0000 0001 0000 = 0x0010 (Temperature out of range).

### 9.2.3.19.2 WARNING\_GLOBAL\_MODE: How warnings are handled

Address hex	Address dec	Name	Access	Type	Count	default
0x0303	771	WARNING_GLOBAL_MODE	RW	U16	1	-

The LEDs are located on the top of the device:

Writing this register sets the behavior of LED and “WARNING\_GLOBAL\_STATUS” if a



warning is reported. The following values are valid:

Value	Mode
1	Automatic (Warning disappears when situation is no longer present)
2	Sticky (Warning stays present until reset)
3	Off (All warnings are not reported)

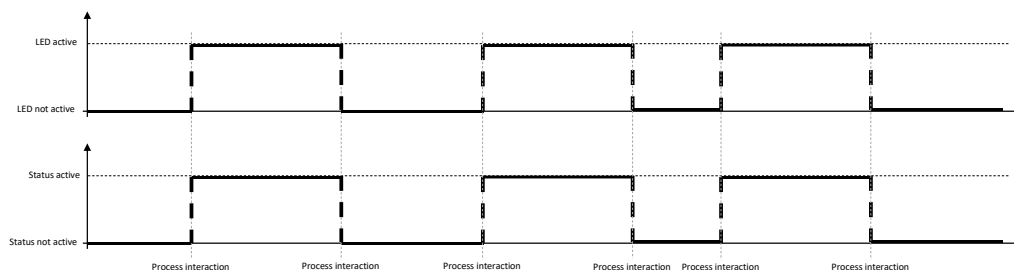
Writing an invalid mode has no effect.

Writing to this register has immediate effect and is additionally stored to persistent memory.

Reading this register returns the global LED mode for warnings.

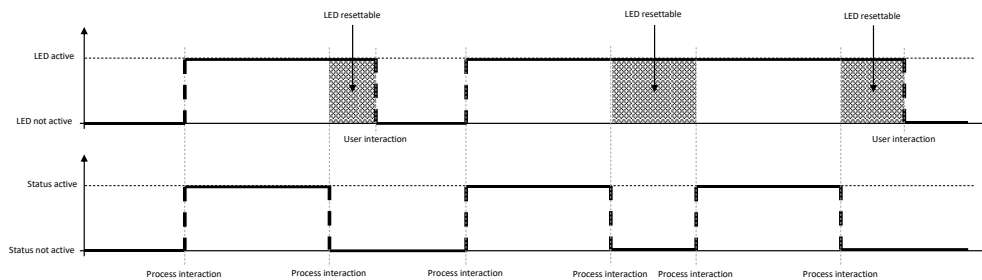
#### Automatic:

In automatic mode the LED and “WARNING\_GLOBAL\_STATUS” follows the status for rising and falling edges.



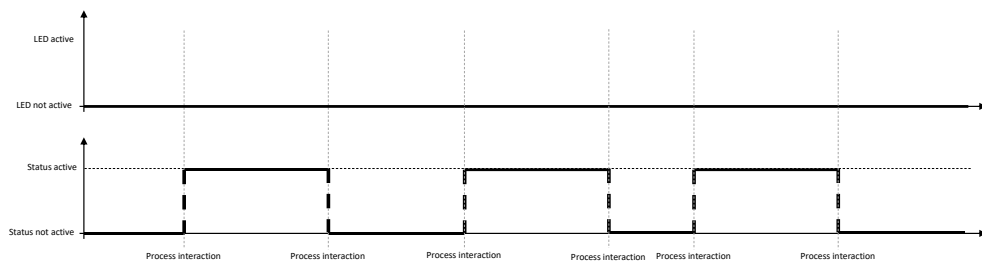
### Sticky:

In sticky mode the LED and “WARNING\_GLOBAL\_STATUS” follows the status for rising edges only.



### Off:

If mode is off the LED and “WARNING\_GLOBAL\_STATUS” is constantly off and is never updated by the individual status.



### 9.2.3.19.3 WARNING\_GLOBAL\_RESET: Reset global warnings

Address hex	Address dec	Name	Access	Type	Count	default
0x0304	772	WARNING_GLOBAL_RESET	W	U16	1	-

Each bit in this register is associated with a warning.

Bit	Warning
0	No flow although valve is open. (MFC only)
1	Negative flow
2	Setpoint is not reached. (MFC only)
3	Pressure out of range
4	Temperature out of range
5	Flow measured although valve is closed. (MFC only)
6	Watchdog
7	Underflow
8	Overflow
9	Analog input above range. (MFC only)
10	
11	
12	
13	
14	
15	

Writing this register only has an effect if LED mode is set to **sticky**.

Writing a 1 bit resets the corresponding bit for the LED.

Writing a 0 bit has no effect. Writing bits not associated with a warning has no effect.

#### 9.2.3.19.4 ERROR\_GLOBAL\_STATUS: Which global errors are active/inactive

Address hex	Address dec	Name	Access	Type	Count	default
0x0321	801	ERROR_GLOBAL_STATUS	R	U16	1	-

This register shows which errors are currently active.

Active errors are associated with a 1 bit. Only **available** errors are considered.

Index	Error
0	EEPROM error
1	
2	Sensor incompatible
3	Sensor damaged
4	Sensor not responding
5	Temperature sensor damaged
6	
7	Analog Input damaged
8	Analog Output damaged
9	Bluetooth® module not responding
10	
11	
12	
13	
14	
15	

#### 9.2.3.19.5 WARNING\_GLOBAL\_OFF: Turns off the reporting of global warnings

Address hex	Address dec	Name	Access	Type	Count	default
0x030A	776	WARNING_GLOBAL_OFF	RW	U16	1	-

Each bit in this register is associated with a warning.

Writing a 1 bit sets the mode of corresponding LED to off.

Writing a 0 bit has no effect. Writing bits not associated with a warning has no effect.

Reading this register returns whether the corresponding LED mode is off (non-zero) or not (zero).

### 9.2.3.20 Modbus Settings

Variable	Hex Address	Decimal Address	Access Man	Type	Count	Default	Min	Max	Default Unit
MODBUS_ADDR	0x0510	1296	RW	U16	1	247	1	247	-
MODBUS_PARITY	0x0511	1297	RW	U16	1	1 (Even)	0=None, 1=Even, 2=Odd, 3=Mark, 4=Space	-	-
Modbus_BAUDRATE	0x0512	1298	RW	U32	2	5 (9600)	0=300, 1=600, 2=1200, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400, 8=57600, 9=115200	-	Bits/s

#### 9.2.3.20.1 MODBUS\_ADDR: Modbus Address

Address hex	Address dec	Name	Access	Type	Count	default
0x0510	1296	MODBUS_ADDR	RW	U16	1	-

Reading this register returns the current Modbus slave address that the device is responding at.

There are several ways to define and set the Modbus slave address of the device.

The following hierarchy is implemented:

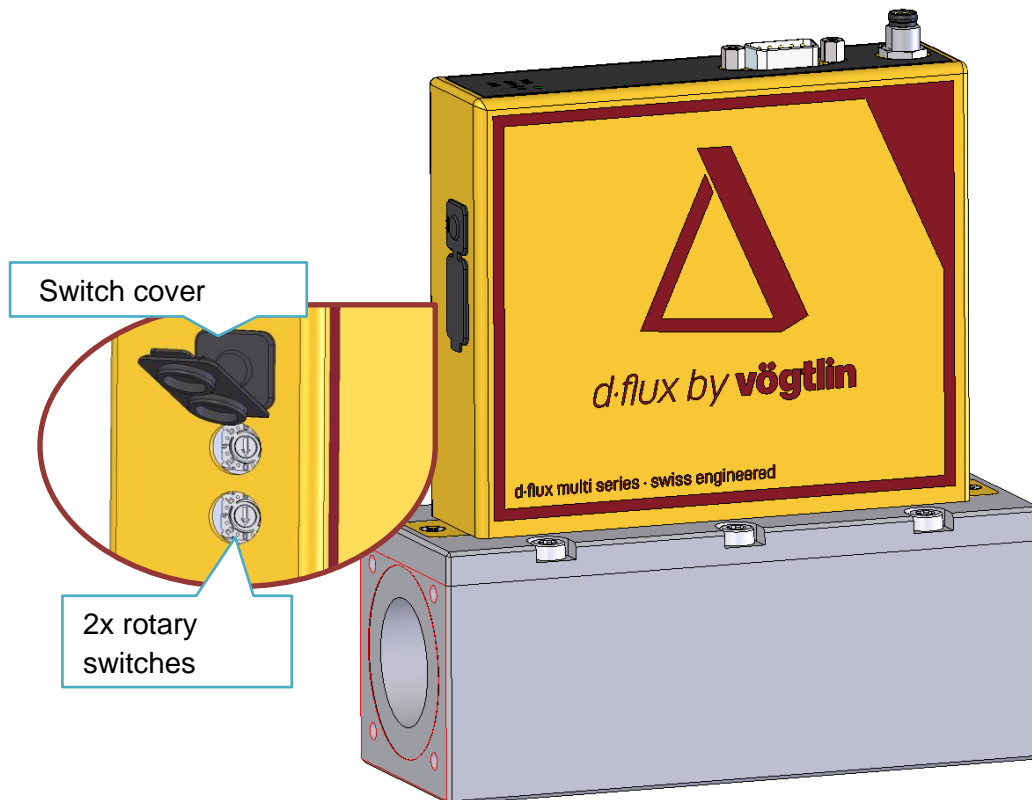
- Rotary switches settings:
  - FF: Default Modbus Setting (247, Even, 9600bits/s)
  - 01 to F7: Address 01 to 247 as set via rotary switch
  - 00: Address = Modbus setting (default 247)
- Digital Settings Apply (Modbus\_ADDR)
- Digital Settings (Modbus\_ADDR) = 0x00 -> Address = 247
- Digital Setting can also be set via “Bluetooth® App”

#### Rotary Switch:



MSN (Most Significant Number) and LSN (Least Significant Number) are used to build two bytes that build the “Node Number”. If for example the MSN is set to 0xE and the LSN is set to 0x2 this would result in the slave address 0xE2 (226 in decimal). If both rotaries are set to zero or the value of the rotaries is greater than 0xF7 the slave address cannot be defined by the rotaries.

If the rotary switches select 0xFF the device boots with default Modbus settings. The configured Modbus settings are not changed by doing that: The current Modbus settings get active again upon reset if rotaries are changed to other values.



The rotary switches are located on the side of the device.

Example: If you want to set the address of the device to (decimal) 171... which is (hex) 0xAB

1. You can set the rotary switches MSB: A and LSB: B

**Or**

2. You can set the Modbus address via Modbus by writing (dec) 171 or (hex) 0xAB to Modbus address 0x0501.

### 9.2.3.20.2 MODBUS\_PARITY: Modbus Parity

Address hex	Address dec	Name	Access	Type	Count	default
0x0511	1297	MODBUS_PARITY	RW	U16	1	-

Writing this register sets the parity setting. This can be one of the following values:

Index	Parity
0	None
1	Even
2	Odd
3	Mark (always 1)
4	Space (always 0)

Writing an invalid value has no effect.

There's always one stop bit, two stop bits are not supported. "Mark" parity however is equivalent to no parity ("None") having two stop bits. With parity enabled using one stop bit instead of two stop bits typically works without problems.

Writing this register has no immediate effect and updates persistent memory only. That means that the parity setting written is applied on device reset/restart.

### 9.2.3.20.3 MODBUS\_BAUDRATE: Modbus Baud Rate

Address hex	Address dec	Name	Access	Type	Count	default
0x0512	1298	MODBUS_BAUDRATE	RW	U32	2	-

Writing this register sets the baud rate. It is possible to set the baud rate by index or by value to any customer defined baud rate. Values 0 to 15 select the baud rate by index:

Index	Baud rate
0	300
1	600
2	1200
3	2400
4	4800
5	9600
6	19200
7	38400
8	57600
9	115200

The baud rates available by index are device specific. Writing an invalid index has no effect.

Writing any value greater than 15 sets the value written as baud rate.

Writing this register has no immediate effect and updates persistent memory only. That means that baud rate written is applied on device reset/restart.

## 9.3 EtherCAT®

### 9.3.1 Intro

EtherCAT® is an optional digital communication interface. EtherCAT® has a separate dedicated manual. See [www.voegtlin.com](http://www.voegtlin.com).

## 9.4 Profinet

### 9.4.1 Intro

Profinet is an optional digital communication interface. Profinet has a separate dedicated manual. See [www.voegtlin.com](http://www.voegtlin.com).

## 9.5 Ethernet IP

### 9.5.1 Intro

Ethernet is an optional digital communication interface that will be available later in 2022. Please contact us on [www.voegtlin.com](http://www.voegtlin.com) or through your local Vögtlin contact.



# 10 Commissioning

In this chapter we explain how initialize the d-flux and adapt it for your application

## 10.1 Switching on the measuring device

Before you switch on the unit, please ensure the connections are leak free. Verify that your process conditions are identical to the description in the data-label on the unit. Verify the electrical connections and insure you use the correct supply voltage.

When you apply power the green power LED on the unit will flash 3-4 times. If there are no red LED's showing on the unit the unit is ready for use. We suggest you connect your unit to your Vögtlin connect app (See [9.1](#)) and verify if the correct setting is selected for your application.

## 10.2 Function check

You can perform a function check by reading the diagnostics (Warnings and errors) of the meter, this can be done through digital communication, the Vögtlin connect app or looking the status led's of the unit. See chapter [8.5.1](#)

## 10.3 Setting the operating language

The operating language is selected in the Vögtlin connect app. See [9.1.2](#)

## 10.4 Configuring the measuring device

Before you put the unit in operation you have to configure the unit for your specific application. You can change the setting through digital communication or do this through the Vögtlin connect app (See [9.1.5](#)). Please follow the steps below to make sure your unit is correctly configured.

### 10.4.1 Profiles

The d-flux works with Profiles. A profile is set of settings stored in the EEPROM of the unit. You can program and store 15 profiles. The concept behind it is that you have a different profile for every application you use the unit for.

In the profile menu you can pull down and select profile 1 to 15 and edit these once the password unlocked the screen. Profile 0 is factory set and cannot be edited. The values in Profile 0 are referred to as "Factory settings" and are also the limitations for the user setting.

### 10.4.2 Selecting the gas type

For the meter to measure correctly you have to select the correct gas or gas mix. There are up to 15 gases (Gas 0 is always air) available, but not every gas slot might be programmed, that depends what you selected when you ordered the unit. If the gas you want to measure in not available in the unit, please contact your local distributor to find a solution. In the profile you can select the gas you are using. See Modbus chapter [9.2.3.5.1](#).



**Do not use the meter for other gases than are programmed and selected**

### 10.4.3 Selecting the engineering units

For every profile you can select your individual engineering units. See the list in chapter [8.1.5](#) with all stored units for flow, temperature, pressure and totalizer. Make sure you set the correct units before you start to measure.

### 10.4.4 Tare the unit

To “tare” is the process of zeroing the unit. It ensures that the flow meter is providing the most accurate measurements at any given situation. Taring gives the flow meter a good zero reference for flow measurements.

The flow is measured by measuring the pressure drop over a restriction with a highly accurate and stable differential pressure sensor. However, no sensor is 100% perfect and there could be a slight shift in the zero if you apply a higher static pressure on the flow meter (Static pressure is the pressure that is applied to both sides of the differential pressure sensor). To optimize this, it is recommended to tare the unit.

The tare optimizes the differential sensor (=flow) and therefore effects all profiles.

#### When to tare to get optimum accuracy?

- After you installed and are ready to use the flow meter
- After significant changes in temperature or pressure
- When you move the unit to a new location or application
- After you changed the profile to a profile with a different gas
- Once per year

#### 10.4.4.1 How to tare?

Before taring the flow meter make sure nothing is flowing through the device and that the meter is under operating conditions. It is recommended to mount as a minimum a positive shut off valves after the flow meter so you can perform a Tare when you are sure there is no flow. (See Chapter [6.1.5](#)). However first fill up the flow meter with the gas you are intending to use under operating conditions.

The flow meter can be tared via Modbus or via push button:

**Connect app:** The tare button can be found in the Readout menu. You will be informed about the consequences and need to confirm before the tare takes place. See [9](#)

**Push button:** The push button is by default not configured to tare the flow meter. Change configuration with the Vögtlin Connect App or via Modbus. See [8.9](#)

**Modbus:** To tare the unit over Modbus, write a 1 (U16) to register 0xE100. (Also possible for Ethernet) See [9.2.3.10](#)

**Ethernet/Profinet** See Chapter [9.4](#)

#### 10.4.4.2 Autotare

A controller has a built-in valve that can stop the flow of gas if closed. If the valve is mounted on the outlet and it is 100% closed then the meter part of the MFC will be under (or close to) operating pressure. An ideal situation to tare the unit. The units can do this automatically if that option is activated in the Vögtlin connect app (Under Menu Valve see chapter or through digital communication (see [8.3](#)))

#### 10.4.4.3 What if I do not tare?

If you do not tare the unit at operating condition, you should expect an additional uncertainty. If you use air and tare the unit at atmospheric conditions and use the unit at the maximum of 14 bar a, the possibility exists you have a zero shift of maximum 1% (0.08%FS/bar see datasheet)

This can be more for other gases than air and this effect will be different for each sensor, please contact your distributor for additional information.

Note: If you tare the units at higher pressure and after that reduce the pressure again, zero flow might be elevated. You might see a flow while there is no flow and your totalizer keeps on counting when there is no flow. This can be solved on two ways:

1. Tare the meter at these new conditions
2. Create a high low cut-off (Small dynamic range)

### 10.4.5 Configuring the analog output

The d-flux supports a current and a voltage output that can run simultaneously. The analog output can be configured via Modbus or via the Vögtlin Connect App (see chapter [9.1](#)). The maximum analog output is always connected to the max flow range.

### 10.4.6 Configuring the switch output

The switch output can be configured via Modbus or via the Vögtlin Connect App (see chapter [9.2.3.15](#))

# 11 Diagnostics and troubleshooting

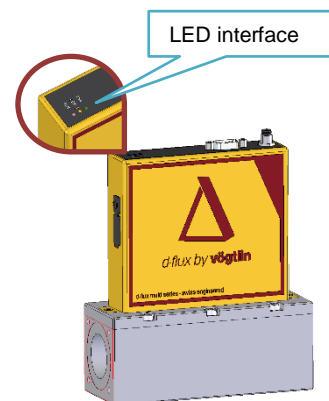
## 11.1 Filter cleaning

The unit is standard provided with a 50 micron inlet filter that partly also serves as a flow conditioner. This is critical since the LFE spacing is 0.15 mm. The filter cannot be removed or replaced by the user.

If you need to clean the filter soak it in iso-propanol alcohol and blow clean/dry air from the outlet to the inlet.

## 11.2 LED status

The device without Ethernet has three LEDs, located on the top left corner of the instrument:



The LEDs are used to indicate the following operations:

Type	Usage
Green	Device power or start up mode
RGB	Device communication (may be white, blue or yellow)
Red	Device status

The states are described as:

State	Description
On	LED is permanently on
Off	LED is permanently off
Fast Flashing	LED is flashing at 2 Hz with equal on- and off times (2 flashes per second)
Slow Flashing	LED is flashing at 1 Hz with equal on- and off times (1 flash per second)

LED behaviour0

**Power Off:** All LEDs are off when there is no power.

**Switch Power On:** If the device is powered on all LEDs switched on immediately for less than a second

**Bootloader mode:** The green and the red LED are switched on, while the RGB LED is switched off.

**Start Up:** The green LED is fast flashing while the other LEDs are switched off.

**Normal:** The green LED is on while the other LEDs are switched off.

### Under operation:

If the device is operating mode each LED behaves as follows

### Green:

The green LED indicates the current state of the device.

State	Function
Off	-
Fast Flashing	Measurement is disabled
Slow Flashing	Control is not automatic (only available for controllers)
On	Normal mode (measuring and/or controlling)

### Red:

The red LED indicates the current status of the device.

State	Function
Off	No warnings/errors
Fast Flashing	Warning
Slow Flashing	There was a warning that is no longer active
On	Error

### RGB:

The RGB LED indicates if device is currently communicating

The following colours can be shown by the RGB LED:

### Blue:

The blue colour indicates the Bluetooth® status of the device.

State	Function
Off	Bluetooth® is off
Fast Flashing	Bluetooth® is advertised
Slow Flashing	Bluetooth® damaged
On	Bluetooth® is connected

### Yellow:

The yellow colour indicates digital communication of the device.

### RGB LED Yellow

The device is designed for Modbus communication. To indicate some communication between the device and a master, we use the yellow colour (yellow LED in the following).

There are some requirements for the yellow LED to blink:

- The request is a valid Modbus request.
- Correct CRC
- Correct read/write function etc.
- The request is aimed to the device.
- Correct address.

Unless the requirements are not fulfilled the LED should not blink.

## 11.3 General troubleshooting

1. Check the power supply
2. Connect the app and look at the warning and errors
3. Reset the flow device (See chapter [11.49.1.7](#))
4. Call the Vögtlin service department (See Chapter [12](#))

If the above points do not help with your problem please consider the following points

What is not working?	Most probable cause	Bugfix
No flow value for measurement	Connection	Check the following: <ul style="list-style-type: none"> <li>▪ Power supply connected 24 Vdc</li> <li>▪ Connector is fastened to the device either d-sub or M8</li> </ul>
	Device parameters	Check the following: <ul style="list-style-type: none"> <li>▪ Correct setting of the analog output Compare the values on the type code with the digital setting via Vögtlin Connect App or Modbus</li> </ul>
Control not stable	Control parameters	Based on user specific settings in the ordering process the PID parameters are set and checked by the factory accordingly. If the situation asks for it the PID parameters have to be set the new conditions.
	Interference	Pulsating elements before or after the device can influence the control of the valve. This can be countered by using a gas buffer to reduce these pressure peaks.
Controller overshoots or needs a long time to open valve initially	Controller offset	Check the following: <ul style="list-style-type: none"> <li>▪ Check if current inlet and outlet pressure is the same as the pressure on the type sticker</li> <li>▪ Adjust controller offset for correct opening point of valve. See <a href="#">CONTROLLER_OFFSET</a></li> </ul>
Controller setpoints keeps on changing to zero	Default action to prevent the valve over heating	See <a href="#">8.5.3</a> . The d-flux controller will set the setpoint to zero if the set flow cannot be obtained to protect the valve. Check that you have sufficient inlet pressure and that your outlet pressure is not too high. Make sure there is no closed valve or huge restriction in your gas lines.

## 11.4 Resetting the measuring device

Reset the flow device can be done over Modbus, by configuring the push button if programmed (See chapter [8.9](#)) or over the app (See chapter [9.1.7](#))

## 12 Repair and service

### 12.1 Spare parts

There are no replaceable parts in this flow meter. If you replace the fittings, you have to perform a proper leak test for you use the unit again.

### 12.2 Vögtlin services

Please contact your local distributor if you require service or have questions about your flow meter. Our service department in [service@voegtlin.com](mailto:service@voegtlin.com) if you require any service.

## 13 Maintenance

### 13.1 Maintenance tasks

#### 13.1.1 Firmware update

The is constantly improved and additional features are added. We publish these improvements and it is very easy to install any improved firmware on your unit. The unit has a so-called boot loader and all you have to do is to connect the unit over Modbus (Converter from Modbus to a USB connector available as accessories on our website. (IP20-RS485 to USB). Then download the service tool from our [website](#) under “downloads” (.EXE program). Next start the d-flux in the boot-mode (see below in [13.1.1.1](#)) and run this program on your PC. The program will check the current version and after your approval update the d-flux to the latest firmware.



The unit cannot be updated over Bluetooth. For Connect app updates see [9.1.2.3](#)

#### **13.1.1.1 Boot-mode**

This program must be run when the d-flux is in the so-called boot-mode. To activate the boot-mode disconnect the power, hold the push button (Keep it pushed in) and apply the power again. All three LED will light up for 3-4 seconds and after that the PWR and ALM (Green and Red) will burn. Only then let go of the push button. Now run the service tool and update the firmware. Restart the unit after the update.

#### **13.1.2 Exterior cleaning**

Please clean the external with a cloth and non-aggressive cleaning agent

#### **13.1.3 Interior cleaning**

See [11.1](#)

### **13.2 Measuring and test equipment**

Please only use a certified DVM meter to verify the voltage and milliamp signal

## **14 Return**

### **14.1 Contact the factory**

In case you need to return the unit to the factory, please contact our service department for instructions. [service@voegtlin.com](mailto:service@voegtlin.com)

Please ensure that if you return the unit to use the original packaging or make sure that the units are extremely well packed. We take no responsibility for units that arrive with transport damage.



## 15 Disposal

### 15.1 Removing the measuring device

Please remove and power and ensure that gas supply is disconnected. Ensure the pressure inside the flow meter is 0 bar g and in case of dangerous or aggressive gases flush the flow meter for at least 24 hours with clean, inert gas.

### 15.2 Disposing of the measuring device

The units contain no batteries or dangerous materials. Please dispose of the flowmeter in an environmental friendly way.

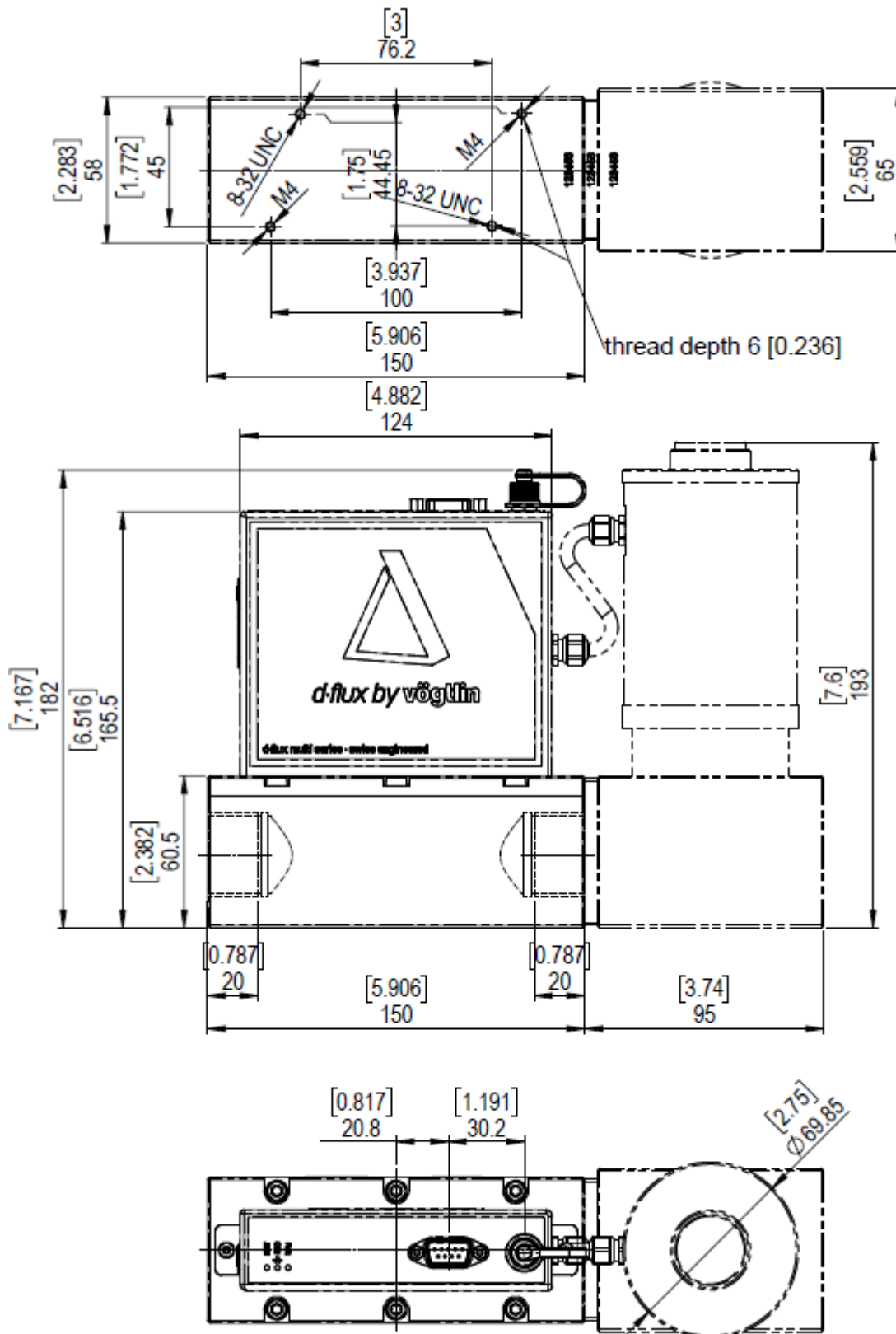
## 16 Technical data

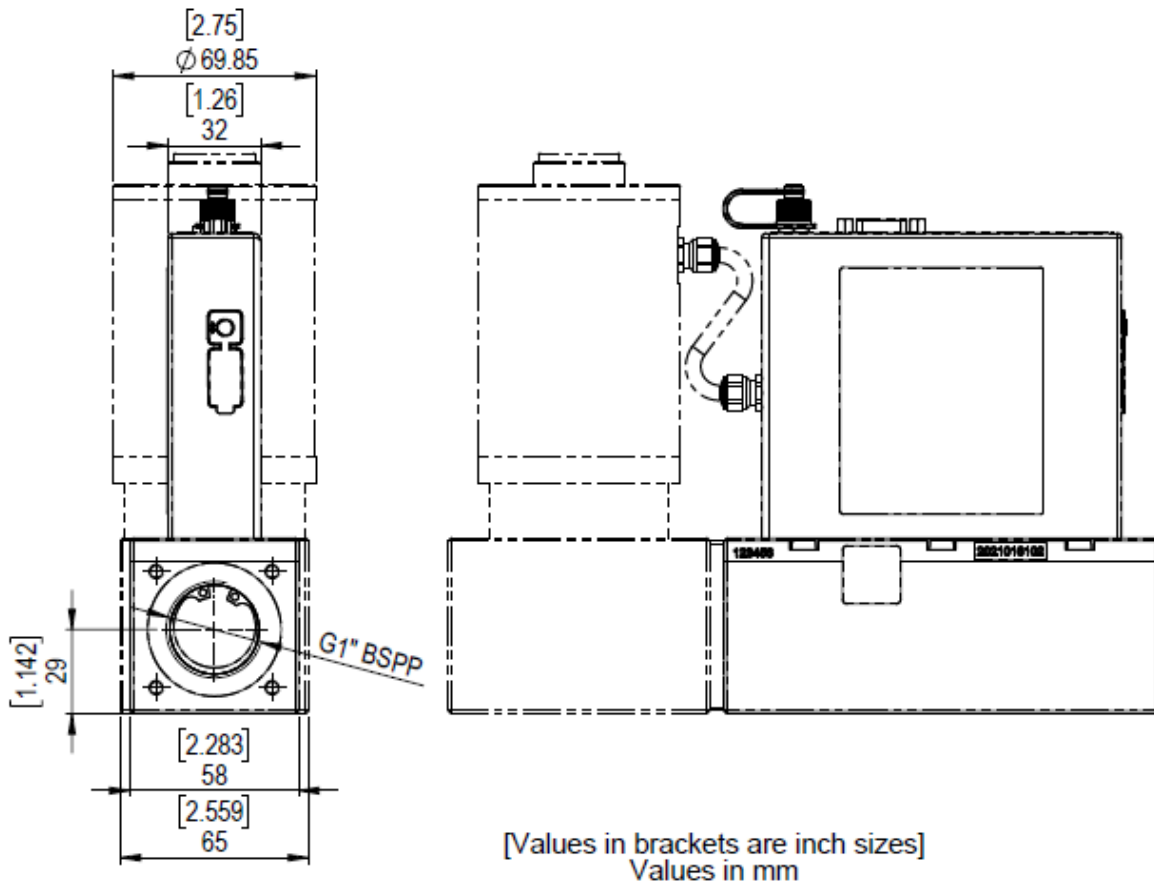
See Chapter [3.6](#) General specifications

# 17 Appendix

## 17.1 Dimensional drawings

### 17.1.1 Dimensional drawings in mm and inches





Valve can be mounted on the outlet of on the inlet.

#### Dimensions with fittings:

Face-to-face 50.5 Tri-clamp: 196 mm

End-to-end 1" Compression fittings: 234 mm (Face-to-Face)

End-to-end 1" Compression fittings: 172 mm (Tube-to-Tube)

End-to-end 1" to ½" Reducer: 172 mm

You can find detailed information as well as 3D models for the individual products on our homepage [www.voegtlin.com](http://www.voegtlin.com)

If additional information is needed, please consult your sales partner. The contact list for our distributors can be found on our website.

## 17.2 Glossary

Below a list with an explanation of terms used in this manual

- VADy: Vögtlin Automatic Dynamic (See [8.1.4](#))
- Dynamic Range: Ratio between min and max "measurable value" (See [8.1.4](#))
- Low cut-off: A value below which the meter always indicates zero (See [8.1.3](#))
- Zero Band: Alternative name for low cut-off
- Tare: Zeroing (See [10.4.4](#))

- Profile: a set of configurations set and selected by the user (See 10.4.1)
- Underflow: The flow below the official lowest measurable value (See 8.1.1)
- Overflow: The flow above the official maximum measurable value (See 8.1.1)
- Warning: A process related failure (See 8.5)
- Error: A product related failure (See 8.5)
- MFM: Mass Flow Meter
- MFC: Mass Flow Controller
- DFM: d-flux meter (=MFM)
- DFC: d-flux controller (=MFC)

## 17.3 Wetted materials

Instrument Gerät	d-flux
Body Grundkörper	1.4404 (316L)
Body: O-rings Grundkörper: O-ringe	FKM (Standard), EPDM (option)
Flow divider Strömungsteiler	1.4404 (316L)
Inlet filter Eingangs Filter	SS316 (1.4401), fastening SS (1.4122)
Control valve Regelventil	N/A
Control valve: O-rings Regelventil: O-ringe	N/A
Sensor material Sensormaterialien	SS316Ti (1.4571), silicon, gold, glass, silicone encapsulation, PBT 30GF, ceramics
PT element thermowell	1.4404 (316L)

Abbreviation Kurzbezeichnung	Designation Bezeichnung	Remarks Bemerkungen
EPDM	–	Ethylene-propylene-diene-monomer rubber Ethylen-Propylen-Dien-Kautschuk
Epoxy	–	Adhesive for sensor fixation, protection for wire bonding Klebstoff für Sensorfixierung, Schutz für Bonddrähte
FKM	–	Fluor rubber Fluor-Kautschuk

For units with EPDM O-rings, it will be in the future possible to get an FDA compatible materials statement. Please contact the factory or your local distributor for additional information.

## 17.4 Type code overview

### Configuration matrix <d-flux multi series>

<b>Functionality</b>	<input type="checkbox"/> d-flux multi meter	
	<input type="checkbox"/> d-flux multi controller	
<b>Gas(es) to measure</b>	<input type="text"/>	
<b>Temperature of the gas (range from/to)</b>	<input type="text"/>	
<b>Flow range / flow units (f.i. l/min)</b>	<input type="text"/>	
<b>Dynamic range</b>	<input type="checkbox"/> Fixed dynamics* (default 1:100) See configurator to determine dynamics for process conditions	
	<input type="checkbox"/> VADy* (max. 1:1000) customer adjustable (available for meter only)	
<b>Pressure</b> (please state absolute or gauge)	Pressure inlet (P1) <input type="text"/> Pressure outlet (P2) <input type="text"/>	
<b>Control valve</b>	The valve type, orifice, springs and position (inlet or outlet) will be determine by the factory	
<b>Body material</b>	Stainless steel 316L (1.4404)	
<b>Elastomers</b>	<input type="checkbox"/> FKM <input type="checkbox"/> EPDM	
<b>Analog Signals</b> <small>For the output there is one Vdc and one separate mA signal. For the setpoint there is only one analog input signal. These signals can be adapted through the Vogtlin Connect app.</small>	<i>Output signals</i>	<i>Setpoint signal (controller only)</i>
	<input type="checkbox"/> 4-20 mA + 0-5V*	<input type="checkbox"/> 4-20 mA*
	<input type="checkbox"/> 4-20 mA + 1-5V	<input type="checkbox"/> 0-20 mA
	<input type="checkbox"/> 4-20 mA + 0-10V	<input type="checkbox"/> 0-5 Vdc
	<input type="checkbox"/> 4-20 mA + 2-10V	<input type="checkbox"/> 1-5 Vdc
	<input type="checkbox"/> 0-20 mA + 0-5V	<input type="checkbox"/> 0-10 Vdc
	<input type="checkbox"/> 0-20 mA + 1-5V	<input type="checkbox"/> 2-10 Vdc
	<input type="checkbox"/> 0-20 mA + 0-10V	
	<input type="checkbox"/> 0-20 mA + 2-10V	
	<b>Digital Communication</b>	<input type="checkbox"/> Modbus communication*
	<input type="checkbox"/> Modbus & EtherCAT (unit becomes IP40)	
	<input type="checkbox"/> Modbus & Profinet (unit becomes IP40)	
<b>Fittings</b> <small>All fittings are mounted &amp; full assembly He leak tested</small>	<input type="checkbox"/> None (1" BSPF female connection)*	
	<input type="checkbox"/> 1" Compression fitting stainless steel 316L (1.4404)	
	<input type="checkbox"/> Tri-clamp 50.5 mm flange (ISO) stainless steel 316L (1.4404)	
	<input type="checkbox"/> Reducer to 1/2" BSPF female stainless steel 316L (1.4571)	
<b>Calibration Certificate</b>	<input type="checkbox"/> Factory calibration 5 points*	
	<input type="checkbox"/> Factory calibration protocol 20 points	
<b>Additional Services</b>	<input type="checkbox"/> Certificate of compliance 2.1 according to EN10204	
	<input type="checkbox"/> Test report 2.2 according to EN10204	

\*default

## 17.5 Overview default settings

See Modbus overview table in chapter [9.2.2](#)

## 17.6 Warranty

Warranty for the *d-flux* product line extends to material and manufacturing defects only. Maximum warranty covers product replacement free of charge. The following causes of faults/damage are not covered under warranty:

- Use outside the operating limits
- Damage due to corrosion
- Damage due to leaking batteries
- Mechanical damage in general
- Contamination due to improper sealing
- Contamination due to impure gases or penetration of liquids
- Damage to electronic components due by over-voltage or electrostatic discharges, and corrosion damage due to aggressive environments.
- Functional failure due to incorrect operation or faulty parameterization
- If the unit has been opened or otherwise tempered with.
- Drift in the calibration

## 17.7 Contamination statement

When returning equipment to us, please complete all sections of the following declaration. In particular, the reason for return, in the case of contamination the nature of the residues and the cleaning, as well as information on any possible hazards. Include this with shipment.	
<b>Device(s)</b>	
Model code:	
Serial number(s):	
<b>Reason for return:</b>	
<b>Type of contamination</b>	
Device was in contact with:	
It was cleaned by us with:	
To protect our employees and for general safety during transport, it is vital to clean devices properly and to use appropriate packaging.	
Can you provide further information on the contamination?	Inert (no hazard) Corrosive Caustic/acid Must not come into contact with moisture Oxidizing Toxic Other hazards: _____
<b>Legally binding declaration</b>	
We hereby confirm the correctness and completeness of the above information.	
Company:	
Address:	
Phone:	
Contact person:	
e-mail address:	
Date:	
Signature:	



## 17.8 CE Declaration

The d-flux is fully CE tested and complies with all requirements

Certifications	
<b>EMC</b>	IEC/EN 61326-1, IEC/EN 61000-6-2/4
<b>ATEX certification</b>	None
<b>Material certificates</b>	Inspection certificate 3.1 available for body and fittings (optional)
<b>FDA compliance</b>	To be released in 2022
<b>PED</b>	Fully compliant. Since the unit has 1" process connection, complies with the SEP as defined in article 4, paragraph 3 of the Pressure Equipment Directive (PED) (2014/68/EU)
<b>RoHS/REACH</b>	All components comply with Directive 2002/95/EC (RoHS) and the REACH guidelines
<b>Warranty</b>	3 years

## 17.9 History change manual

Date	Version	Replaces	FW	Author	Note
12/07/2021	V0.1	-		PdW	Preliminary version
14/07/2021	V0.2	V0.1		PdW/KUP	Paul K. formula's/PdW Moved Pdrop and fix fonts
25/08/2021	V0.4			PdW/SIN	Prepared preliminary release
27/08/2021	V0.5			MHU	Layout adaptations
06/09/2021	V0.7	V0.5		PdW	Prepared for preliminary release
20/02/2022	V1.0	V0.7		PdW	Release
25/02/2022	V.1.1	V1.0	1.03	PdW	General corrections and improvements/Added Trademarks

## 17.10 Trademarks

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