fluid
technology
solutions

VSE.flow®

Operating instructions

IO.flow®

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1. IMPORTANT INFORMATION AND LEGAL NOTICES

Dear customer, dear user,

This operating instruction for the IO-Link converter **„IO.flow®** by VSE Volumentechnik GmbH (VSE) contains information required to properly install and commission the device for the intended purpose.

Any installation, commissioning, operation, maintenance and testing may only be carried out by trained and authorized personnel. The operating instructions must be read and followed carefully to ensure a trouble-free, proper and safe operation of the device. In particular, the safety instructions are essential.

These operating instructions must be kept safe and accessible for the authorized personnel at all times. At no time should contents of the operating instructions be removed. A missing manual or missing pages must be replaced immediately if lost. The operating instructions can be requested at any time from VSE or downloaded from our website www.vse-flow.com. The operating instructions must be passed on to each subsequent user of the IO-Link converter „IO.flow®".

This operating instruction is not subject to any modification service by VSE. VSE reserves the right to make technical changes at any time without notice.

VSE makes no warranties, express or implied, with respect to commercial qualities and suitability for a particular purpose.

VSE accepts no liability for damage and malfunctions resulting from operating errors, failure to observe these operating instructions, improper installation, commissioning or maintenance as well as improper use of the IO-Link converter „IO.flow®".

The opening of the IO-Link converter „IO.flow®" is absolutely not permitted. After an unauthorized opening or rebuilding as well as after a single, incorrect connection of the flow circuits of the device, the warranty as well as the product liability by VSE expire.

2. FEATURES

The IO-Flow® Converter enables uncomplicated integration of all VSE flow sensors into IO Link systems. The signals of the preamplifier are measured by the module and converted into the desired unit so that they are available to the IO-Link master or the programmable logic controller (PLC) for direct further processing.
The compact module is connected „in-line" between the flow meter and the evaluation system. This means that it is integrated into the existing cabling with an additional M12 extension cable and thus represents a signal converter. The IO-Link protocol enables simultaneous transmission of the process data volume and flow in the appropriate unit, together with diagnostic and statistical data. Parameters can be changed during operation or adapted to another flow sensor. In addition, integrated signal processing allows filtering and linearization of the volume sensor's measured values.

Main features:

- Accurate frequency measurement and volume counting
- Configurable signal filters (dynamic / smoothed / precise)
- Integrated calculation functions:
  - Unit conversion (pulses, volume, mass)
  - Linearization of flow and volume (20 linearization points)
- Recording of statistical data for maintenance notifications
  - Data backup on power off
- Configurable events for flow monitoring (limit values, invalid states)
  - Teach-in function for parameterization in the field
- Error messages
- Support for data storage for easy exchange of devices
- Two-channel SIO mode for quadrature signals (optional)

3. TECHNICAL DATA

Electrical operating conditions

Parameter	Symbol	Value	Unit	Notes
Operating voltage	U_b	18 – 30	V	U_{nenn} = 24 V
Operating current IO-Link Mode	$I_{b,IOL}$	15	mA	at U_b = 24 V
Operating current SIO-Mode	$I_{b,SIO}$	5	mA	at U_b = 24 V
Max. ambient temperature	T_{max}	50	°C	
Burst (EN 61000-4-4)		2	kV	Criterion A, 5/100 kHz
ESD (EN 61000-4-2)		±4 / ±8	kV	Criterion B, contact and air discharge
Conducted immunity (EN 61000-4-6)		150 kHz - 80 MHz		Criterion A, U_0=10V
Radiated immunity EN 61000-4-3		80 Mhz - 6 GHz		Criterion A, E_0=6-10V/m
Radiated emissions EN 55016-2-3		30 MHz - 1 GHz		

Table 1: Operating conditions (electrical)

Signal input specifications (flowmeter)

Parameter	Symbol	Value	Unit	Notes
Operating voltage (flowmeter)	U_{VS}	U_b	V	Same as operating voltage U_b
Max. allowed current consumption (flowmeter)	$I_{VS,max}$	< 200	mA	Power supply dependent
Maximum input frequency (IO-Link Mode)	$f_{max,IO}$	125	kHz	
Maximum input frequency (SIO-Modus)	$f_{max,SIO}$	250	kHz	IO-Link Wakeup-Request only possible up to 25 kHz with activated SIO-Passthrough
Measurement accuracy of frequency (lower range: 10 kHz)	$e_{r,10k}$	0.013 0.005 0.014	% % %	V_Filter = 2 V_Filter = 1 V_Filter = 0
Measurement accuracy of frequency (upper range: 100 kHz)	$e_{r,100k}$	0.018 0.034 0.300	% % %	V_Filter = 2 V_Filter = 1 V_Filter = 0
Settling time of frequency filter (V_Filter)	t_{rise}	1000 350 10	ms	V_Filter = 2 V_Filter = 1 V_Filter = 0

Table 2: Operating parameters (Signal input)

IO-link specification

The module uses a communication rate of 230,4 kBaud (COM3). The IODD is compatible with the specification version V1.1 and can be found in the download area of our homepage.

www.vse-flow.com/en/downloads

Parameter	Value	Notes
Manufacturer Name	VSE Volumentechnik GmbH	
Manufacturer ID	1654	HEX: 0x0676
Device Name	IO.flow®	
Device ID	4900	HEX: 0x1324
Communication rate	230,4 kBaud	COM3
Minimum cycle time	1 ms	
ISDU DataStorage Block Parameter	supported	
Preoperate M-Seq. Type	TYPE_1_V_8OD	8 byte OD
Operate M-Seq. Type	TYPE_2_V_2OD	9 byte PDin, 1 byte PDout, 2 byte OD
M-Seq. Capability	43	HEX: 0x2B
SIO-Mode	2-channel passthrough mode (dependent on V_SIO-Passthrough)	Pin 2: QA/Pin 4: QB

Table 3: IODD operating parameters for IO.flow®

Identification data of the device

Each IO.flow® converter is equipped with a unique serial number according to the scheme IO********. It can be found as a lasered marking on the device's housing and in digital form in the parameter V_SerialNumber (Index 0x15). Additionally, the manufacturing date of the device is stored in the read-only parameter V_MfgDate (0x4F).

If the device is paired/parametrized with a specific flowmeter, there is a separate label on the back of the device housing. This label contains the serial number and type of the paired flowmeter.

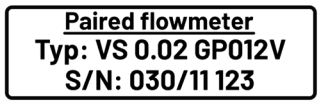
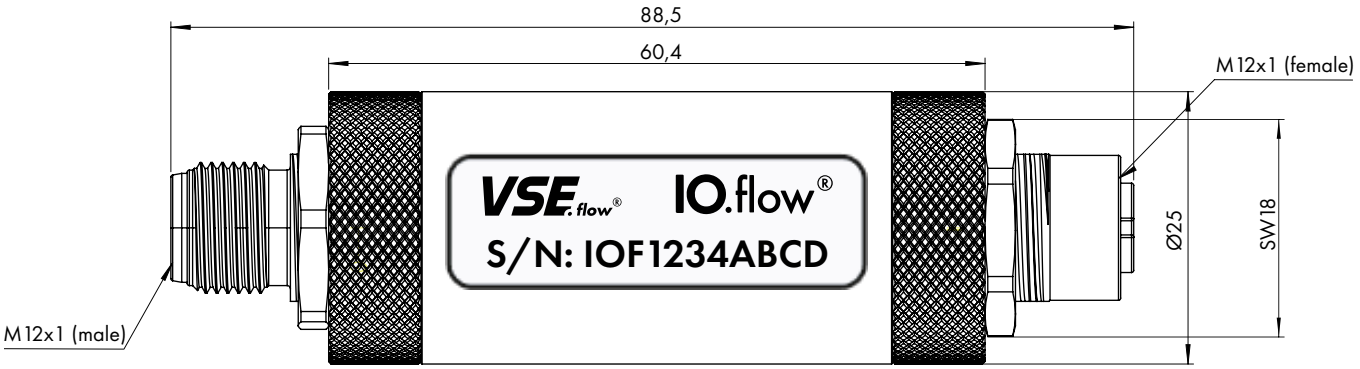


Figure 1: Parameter label for the paired flowmeter

Mechanical properties



Parameter	Symbol	Value	Unit	Notes
Length (total)	l_{ges}	88.5	mm	
Length (main body)	l_{main}	60.4	mm	
Diameter	d	25	mm	
Weight	m	68	g	
Protection against liquid penetration		waterproof		With mated connectors[1]

Table 4: Mechanical properties

[1] *Performed test: Device immersed in water (50 cm depth) for 30 min. No traces of liquid inside the device.*

4. CONNECTION DATA

The two 4-pin connectors are compatible with any existing cabling and enable simple installation of the IO-Link module. Both shielded and unshielded cables are suitable as connection cables.

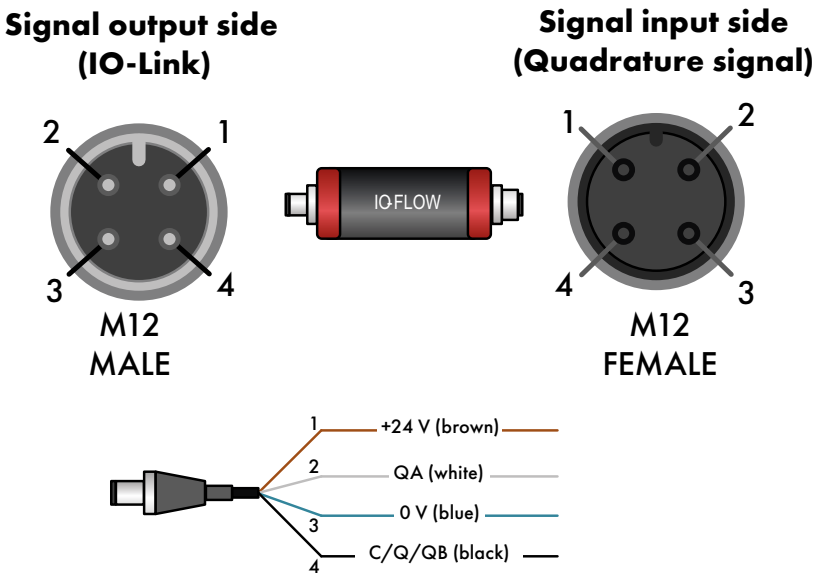


Figure 2: Connector specifications and cable assignment

The signal output side uses a male M12 connector and connects to the IO-Link master. On the signal input side there is a female M12 connector which usually connects to a flowmeter or other device with pulse signal output. In SIO-mode the pin assignment is identical on both connectors. The supply voltage, which is connected to pins 1 and 3 of the male connector, is passed through to the same pins of the female connector. In IO-Link mode, pin 4 represents the communication line and pin 2 is pulled to 0 V.

5. INITIAL SETUP

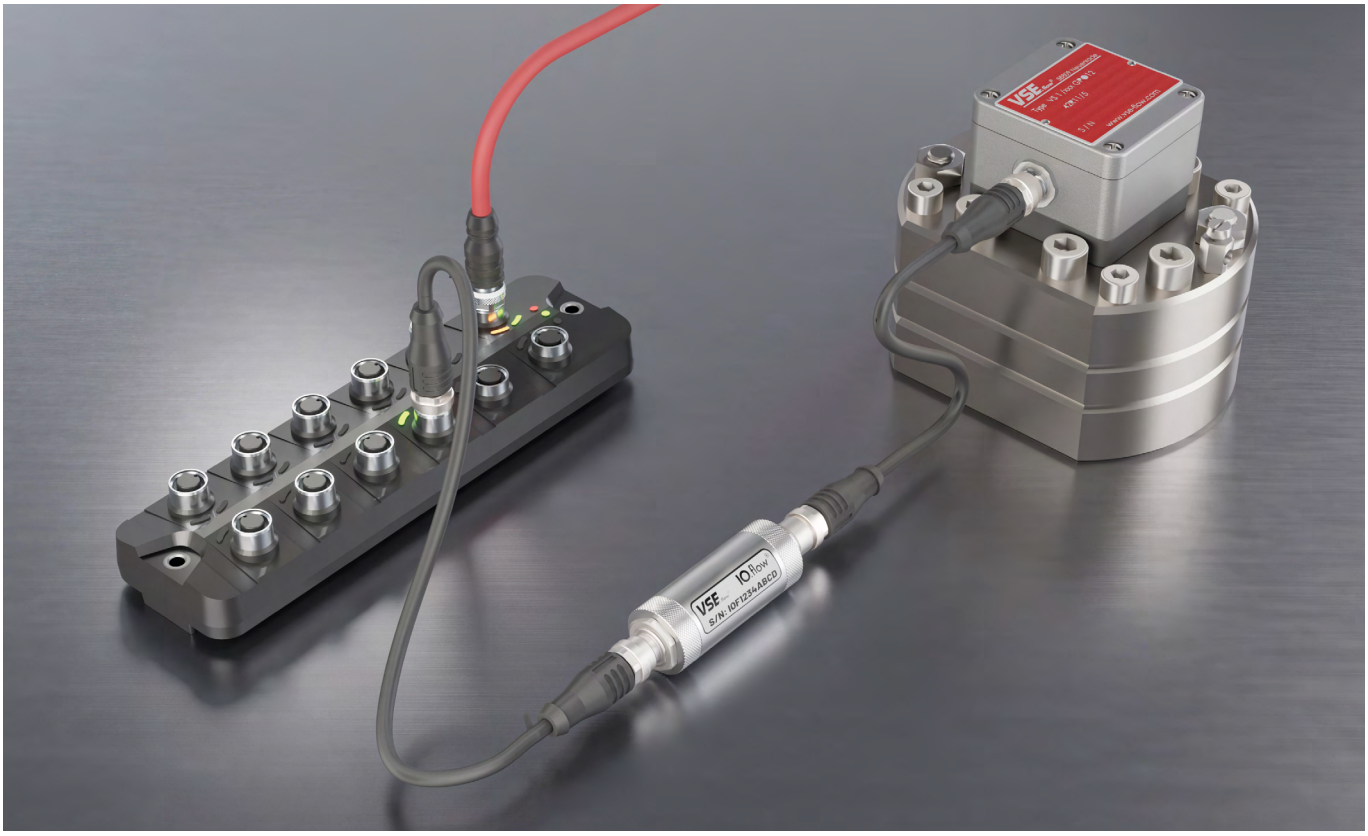


Figure 3: Schematic overview of the IO-Link system with a VSE flowmeter and IO.flow®

The male connector of the device is usually connected to the IO-Link master via a M12 extension cable (male/female). On the signal input side, the preamplifier of the flowmeter is connected with another extension cable to the female connector. The maximum cable length for either side must be below 20 m.

Note
The IO.flow® converter is unshielded per IO-Link specification. For this reason, the connected flowmeter must be grounded via the hydraulic piping or using the earth terminal of the flowmeter.

At start-up, the device works in SIO-mode, in which both quadrature signals of the flowmeter are passed through to the IO-Link side (if SIO-Passthrough is activated, see page 19). A wake-up request from the IO-Link master switches the device to IO-Link mode.
Using the IODD (Download → page 5) the device can be added to the master's configuration software, where parameters can be adjusted and process data can be read.

Before using the device, certain parameters must be set. The setting values depend on the specific flowmeter which is connected on the signal input side. If a flowmeter is purchased together with an IO.flow® converter, the pairing process and configuration can be done by VSE.

The following table lists the parameters that are checked for validity. Relevant parameters should be set when commissioning the device.

The “param error” flag in the process input data will be cleared when a valid configuration is detected. After a successful configuration of these parameters, the device status changes to “Device is operating properly”.

Parameter	Index (HEX)	Unit	Requirement
V_KFactor	0x45	Imp/l	$K_{Factor} \geq 1$ (V_Unit=Hz) $K_{Factor} > 1$ (V_Unit≠Hz)
V_IPF	0x46		IPF > 0
V_Qmax	0x5A	l/min	$Q_{max} > 0$ (V_Unit≠Hz)
V_Lin_enable	0x63		$Lin_{enable} > 0$, but no lin.-points set

Table 5: Parameters with validity check

Example configuration

If the IO.flow® converter is purchased together with a flowmeter, the initial setup is performed by VSE and all necessary parameters regarding the paired flowmeter are already pre-set.

In case of a separate purchase for retrofitting existing systems, the parametrization is usually carried out by the customer using an existing IO-Link master.

An example configuration is shown in the following table:

Parameter	Description	Value
V_FM-SN	Flowmeter serial number	060 / 24 / 110
V_FM-Type	Flowmeter type	VS 0,1/16 GPO 12V-42R11/X
V_CalDate	Flowmeter calibration date	21.06.2022 12:00:00
V_Unit	Process data unit	1 (volume / unit: litre)
V_KFactor	Calibration factor (K-Factor)	160 000 Imp/l
V_IPF	Interpolation factor	16
V_Qmax	Maximum allowed flowrate	10 l/min
V_EncProp	Number of input channels	0 (2-channel flowmeter)

Table 6: Example configuration for a VSE VS 0,1

Data-storage mechanism (device replacement)

If data storage is activated, all parameters that are not affected by the connected flowmeter are backed up in the IO-Link master. In the event of a flowmeter defect, a seamless device replacement is thus possible without manual reconfiguration. This also enables device replacement with a different type of flow meter. All application-specific settings such as filter, unit and limit values are restored. After connecting a new converter to the IO-Link master, the data storage download is started, and the device is ready for use again.

6. ADVANCED FEATURES

Linearization

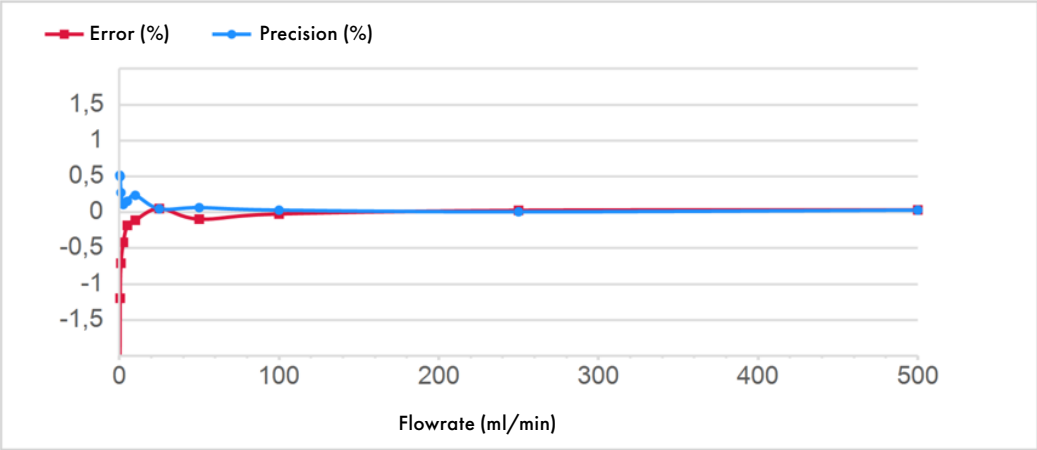


Figure 4: Typical error curve of a positive displacement flowmeter at low fluid viscosity

Every flowmeter based on the positive displacement principle has a K-factor which represents its resolution in the unit of pulses per litre. However, mechanical tolerances, wear and operating conditions, such as low fluid viscosity, mean that this K-factor is not constant over the entire flow range. This can result in measurement errors if not taken care of. To quantify these deviations, a flowmeter can be calibrated. The results of the calibration can then be used to eliminate the device-specific deviations using a linearization table. Using this mathematical correction, the measurement error gets eliminated which leads to a higher measurement quality over the entire measuring range.

By entering the linearization data into the IO.flow converter and enabling it via the parameter V_Lin_enable, the measured flow and volume values will be output as corrected process data values. Depending on the available calibration data, two modes of linearization can be selected (K-Factor or Flowrate). The linearization table supports up to twenty entries. All intermediate values will be linearly interpolated.

Name	Index	Data type	Value = 0	Value = 1	Value = 2
V_Lin_enable	0x63	SingleValue	Linearization disabled (gray)	f-K table (green)	f-Q table

Linearization table X

Subindex 1 .. 20
Contains X-coordinates of the linearization points.
This is the measured frequency value that serves as a reference for the corresponding Y-coordinate.
Unit in Hz.

Linearisierungstabelle Y

Subindex 1 .. 20
Contains Y-coordinates of the linearization points.
Each coordinate represents the frequency dependent process value of the attached flowmeter.
Depending on the table type it can contain K-factors or the actual flowrate values.
f-K-Linearization: Unit in pulses per litre
f-Q-Linearization: Unit in litre per minute

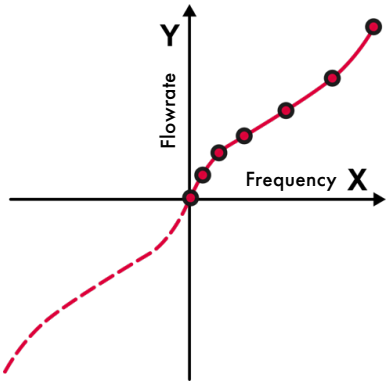


Figure 5: Linearization principle

Frequency filter

Using the parameter V_Filter the measurement can be adapted to the desired accuracy and dynamic requirements. A high filter setting of "2" is set as the default value to ensure the highest possible measurement accuracy. Using a low filter setting, highly dynamic flow phenomena, such as sudden flow peaks, can be detected and measured. The filter properties are further specified in Table 2.

Pulse filter function

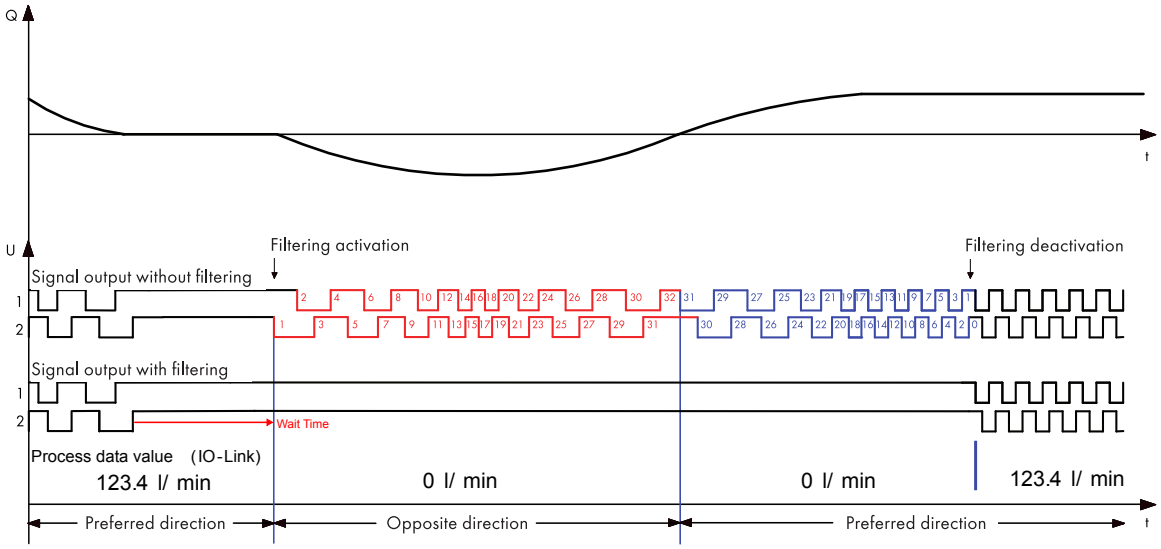


Figure 6: Functionality of the pulse filter function

Oscillations in fluid systems are characterized by cyclic forward and backward movement in the liquid domain (→ Pulsation), which is also detected by the flowmeter and converted into proportional pulse signals and edge sequences. Depending on the application, oscillations or vibrations can occur during standstill or discontinuous flows. The pulses generated during the oscillation phase can be incorrectly interpreted by the downstream evaluation unit or controller as a high flow peak, which can lead to wrong measurements, if not evaluated correctly.

The pulse filter function of the IO.flow converter continuously monitors the output pulses during rapid forward and backward movement of the gears or rotors of the flowmeter. On a direction change, the signals at the channel outputs are suppressed and internally buffered until the flowmeter position is back at the position where the filter action started (see Figure 6). This leads to a steady standstill signal even though the flow is pulsating without losing signal information.

With the parameter V_Impfilter_Enabled the user can set the maximum buffer size for pulses in the negative direction. A value of "1" corresponds to one gear tooth volume. A whole gear revolution is a value of 20 for the average number of teeth on VSE flowmeters.

The so called "preferred direction" is the flow direction where no filtering occurs and are forwarded to the process data directly. If the set buffer size of the pulse filter is exceeded while running in the non-preferred direction, the preferred direction is switched over and the measured value is output again. Simultaneously the counter function adds the suppressed volume to the counter, so that no volume information is lost on a direction change. To inform the user about an exceeded buffer count, the IO-Link event 0x1816 gets triggered. If this event occurs too often in the application, it is advisable to increase the buffer size of the filter.

Change of flow direction

If the displayed flow value is negative although the actual flow direction is positive, the sign of the frequency measurement and pulse counter can be reversed with the parameter V_DirectionInvert.

Encoder properties – number of channels

The V_EncProp parameter is used to set whether the signal evaluation of the flowmeter signals is single-channel or dual-channel. In single-channel mode, a pulse signal is expected on pin 2 (white wire) or pin 4 (black wire). In this case there is no direction detection, and the measurement resolution of the volume is reduced to a quarter of the resolution of the two-channel measurement. Furthermore, other features such as negative flow detection and the pulse filter function will no longer function. Pulsation in the liquid domain at standstill can lead to an unwanted increase in the measured volume in this mode, as each signal edge is added up.

Peak flowrate monitoring

For diagnostic purposes, the peak flowrate value is stored in the parameter V_QPeak. If the flowrate during operation is higher than the nominal flowrate V_Qmax of the flowmeter, this can lead to a mechanical overload and damage to the device. In this case, the IO-Link event 0x8C20 is triggered. Zeroing the value is done with the help of a system command (see page 22).

7. EVENTS

Limits

Using the limit value function, events can be triggered by the IO.flow device when the process data values (volume and flowrate) fall below or exceed predefined limit values. If the corresponding parameter value is ≠ 0, the limit event is activated. The event remains active as long as the condition is fulfilled.

Name	Event Code Hex	Event Code Dec	Type	Duration	Device Status
Volume Notify 1 (≥)	0x1810	6160	Notification	Appear/Disappear	0
Volume Notify 2 (≤)	0x1811	6161	Notification	Appear/Disappear	0
Flowrate Notify 1 (≥)	0x1814	6164	Notification	Appear/Disappear	0
Flowrate Notify 2 (≤)	0x1815	6165	Notification	Appear/Disappear	0

Table 7: Events for limit values

Flow monitoring

The IO.flow® converter has various functions to detect unusual flow events to trigger an IO-Link event. If it makes sense to use these events depends on the specific application.

The standstill detection (V_Standstilldetection_Enabled) generates a permanent event as long as the measured flowrate is zero. The parameter V_WaitTime controls the delay time in milliseconds after which the measured value of the flow is set to zero if no more pulse edges are measured. It can be set between 100 ms and 10000 ms. For example, clogging or a defect of the flowmeter can be detected in the application, if a flow standstill is very unlikely due to other sensor readings in the system (pressure sensors, pump speed).

The negative flow detection (V_NegativeDirectionDetection) generates an event if the sign of the flow value is negative, for example if a flow in negative direction takes place. If the output of the event is inverted, the parameter V_DirectionInvert can be used to change the counting direction and thus swap the polarity of the event. This event can be used, for example, to detect unwanted reverse flows in the fluid system.

If the pulse filter function is activated (V_Impfilter_Enabled > 0), a continuous flow against the preferred direction of the filter leads to a change of the preferred direction and a notification event is generated. If this event occurs too often, the oscillation in the fluid is greater than the set filtered number of teeth and the value of the V_Impfilter_Enabled parameter should be increased.

Standstill detection

This function triggers an event as soon as the flowmeter stops measuring pulses (depending on the V_WaitTime parameter setting). It remains active for the entire duration of the standstill.

Negative flow detection

The negative flow detection triggers an event if the flow direction is negative. It can be used to detect unwanted backflow in the application.

Name	Event Code Hex	Event Code Dec	Type	Duration	Device Status
Standstill	0x1812	6162	Notification	Appear/Disappear	0
Direction negative	0x1813	6163	Notification	Appear/Disappear	0
Pulse filter overrun	0x1816	6166	Notification	Single Shot	0

Table 8: Events for flow monitoring

Maintenance and diagnostic data

In the Diagnostic data menu, maintenance intervals can be set, after which a permanent event is triggered. Two characteristic values for the wear of the device can be used for this purpose:

The parameter V_TotalVolume stores the totalized volume which has flown through the flowmeter in litres (only works after successful parametrization of the device). If, for example, a highly abrasive fluid is measured, an event can be triggered after a predefined volume V_TotalVolNotify, to indicate that a maintenance should soon be scheduled to prevent flowmeter failure or an impaired measurement quality.

A second maintenance-relevant characteristic value are the total operating hours of flowmeter with active flow. The parameter V_OPHours stores a TimeSpan, which is incremented every second if the flowrate V_Flow is ≠ 0. Using the parameter V_OpHoursNotify the timespan is defined after which the event appears.

Name	Event Code Hex	Event Code Dec	Type	Duration	Device Status
Operating hours exceeded	0x1820	6176	Warning	Appear/Disappear	1
Total volume exceeded	0x1821	6177	Warning	Appear/Disappear	1

Table 9: Other events

8. ERRORS

Name	Event Code Hex	Event Code Dec	Type	Duration	Device Status
TEMPERATURE_FAULT_EVENT	0x4000	16384	Error	Appear/Disappear	4
NVM_ERROR_EVENT	0x5011	20497	Error	One Shot	4
PARAM_ERROR_EVENT	0x6320	25376	Warning	Appear/Disappear	3
MEASUREMENT_RANGE_EXCEEDED	0x8C20	35872	Warning	Appear/Disappear	2
NO_MALFUNCTION_EVENT	0x0000	0	Notification	Appear/Disappear	0

Table 10: Error codes

NO_MALFUNCTION_EVENT

After the device has been started, this event is triggered as the result of a successful device self-test. Incorrect or incomplete parameterization can prevent this event from occurring at start-up.

TEMPERATURE_FAULT_EVENT

The temperature of the IO.flow® converter is too high. Causes for this error may be external heat sources, overvoltage or internal heating due to a short circuit. Please check the wiring and supply voltage.

NVM_ERROR_EVENT

If this event occurs, the stored parameters could not be loaded from the remanent data memory (EEPROM) and all parameter changes are lost. The default values are loaded.

PARAM_ERROR_EVENT

The parameter settings of the device are incomplete or invalid. After resetting to factory settings, this error is active by default. The parameters that influence the device status and this error are listed in Table 5.

MEASUREMENT_RANGE_EXCEEDED

The current flowrate has exceeded the flow limit V_Qmax of the flowmeter. To avoid damage to the flowmeter, reduce the flowrate. This error message can also occur with short flow/pressure peaks.

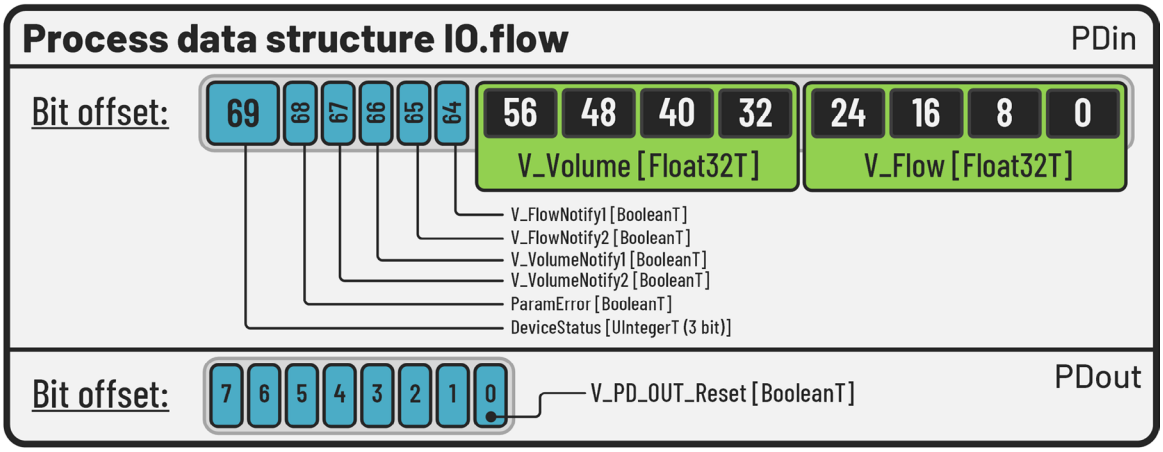
9. PARAMETER DESCRIPTION

Process data structure

For this IO-Link device, both process input and output data are provided. The process data structure is shown in the following figure. The total length of the data packet is 72 bit / 9 byte. In addition to flow rate and volume, the device status and the status of the defined limit values are transmitted as process values.

For process data output a data packet of 8 bit / 1 byte is used.

The volume reset function will only be active if the process output data is valid.



Process data in

Name	Subindex	Datatype	Bit length	Offset
V_Flow	1	Float32T	32	0
Description				**Rights**
Process data: Flowrate value				RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
V_Volume	2	Float32T	32	32
Description				**Rights**
Process data: Volume value				RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
V_FlowNotifyFlag13	3	BooleanT	1	64
Description	**Value: 0**	**Value: 1**		**Rights**
FlowNotify1 Event Status	Event not active	Event active		RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
V_FlowNotifyFlag2	4	BooleanT	1	65
Description	**Value: 0**	**Value: 1**		**Rights**
FlowNotify2 Event Status	Event not active	Event active		RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
V_VolNotifyFlag1	5	BooleanT	1	66
Description	**Value: 0**	**Value: 1**		**Rights**
VolumeNotify1 Event Status	Event not active	Event active		RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
V_VolNotifyFlag2	6	BooleanT	1	67
Description	**Value: 0**	**Value: 1**		**Rights**
VolumeNotify2 Event Status	Event not active	Event active		RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
ParamError	7	BooleanT	1	68
Description	**Value: 0**	**Value: 1**		**Rights**
ParamError Event Status	Event not active	Event active		RO
Name	**Subindex**	**Datatype**	**Bit length**	**Offset**
DeviceStatus	8	UIntegerT	3	69
Description	**Value range**			**Rights**
IO-Link Device Status[2]	0 Device is operating properly 1 Maintenance-Required 2 Out-of-Specification 3 Functional-Check 4 Failure			RO

Process data out

Name	Subindex	Datatype	Bit length	Offset
V_Volume_Reset	0	BooleanT	1	0
Description	**Value range**			**Rights**
Sets the process variable V_Volume to zero if desired	false: V_Volume not reset true: V_Volume reset to zero			RW

[2] *see IOL_Interface-Spec_10002_V113_Jun19 → B.2.20.1 Device Status*

Device parameters

In this chapter all device parameters are described. This includes the name, data type, bit width, storage type and write rights of the respective parameter.

The "storage" field describes whether the parameter is backed up to the master by the data storage functionality.

IDENTIFICATION

VSE specific data

Name	Index	Subindex	Datatype	Default value	Length	
V_VendorName	0x0010	-	StringT	VSE Volumentechnik GmbH	64 characters	
Description					**Storage**	**Rights**
Manufacturer name					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_VendorText	0x0011	-	StringT	High precision flow measurement technology	64 characters	
Description					**Storage**	**Rights**
Manufacturer Text					-	RO

IO.flow®

Name	Index	Subindex	Datatype	Default value	Length	
V_ProductName	0x0012	-	StringT	IO.flow	64 characters	
Description					**Storage**	**Rights**
Product name					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_ProductText	0x0014	-	StringT	Signal Converter from quadrature to IO Link	64 characters	
Description					**Storage**	**Rights**
Product Text					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_SerialNumber	0x0015	-	StringT	IO***	16 characters	
Description					**Storage**	**Rights**
Serial number – Unique manufacturer-specific ID of the device					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_Hardware Revision	0x0016	-	StringT	R*	64 characters	
Description					**Storage**	**Rights**
Hardware revision of the device					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_Firmware Revision	0x0017	-	StringT	IOF-FW-V*	64 characters	
Description					**Storage**	**Rights**
Firmware revision of the device					-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_MfgDate	0x004F	-	TimeT	-	64 bit	
Description					**Storage**	**Rights**
Manufacturing date of the IO.flow® converter at VSE					-	RO

Information of the paired flowmeter

Name	Index	Subindex	Datatype	Default value	Length	
V_FM-SN	0x0051	-	StringT	-	16 characters	
Description					**Storage**	**Rights**
Serial number of the paired flowmeter					-	RW

Name	Index	Subindex	Datatype	Default value	Length	
V_FM-Type	0x0052	-	StringT	-	32 characters	
Description					**Storage**	**Rights**
Type of the paired flowmeter (same as flowmeter's type plate)					-	RW

Name	Index	Subindex	Datatype	Default value	Length	
V_CalDate	0x0050	-	TimeT	-	64 bit	
Description					**Storage**	**Rights**
Date of the last flowmeter calibration					-	RW

Common profile

Name	Index	Subindex	Datatype	Default value	Length	
V_Application-SpecificTag	0x0018	-	StringT	***	32 characters	
Description					**Storage**	**Rights**
Application specific tag					-	RW

Name	Index	Subindex	Datatype	Default value	Length	
V_Location-Tag	0x001A	-	StringT	***	32 characters	
Description					**Storage**	**Rights**
Location tag					-	RW

Name	Index	Subindex	Datatype	Default value	Length	
V_Function-Tag	0x0019	-	StringT	***	32 characters	
Description					**Storage**	**Rights**
Function tag					-	RW

PARAMETER

Process-settings

Name	Index	Subindex	Datatype	Default value	Min	Max
V_Unit	0x0042	-	UInt16T	0	0	2
Description					**Storage**	**Rights**
Unit of the process data (0: pulses, 1: volume, 2: mass)					Yes	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_KFactor	0x0045	-	Float32T	1.0	1.0	+∞
Description				**Unit**	**Storage**	**Rights**
Calibration factor (K-Factor) of the connected flowmeter in consideration of the IPF				Imp/l	-	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_IPF	0x0046	-	UInt16T	1	1	65535
Description					**Storage**	**Rights**
Interpolation factor (IPF) of the connected flowmeter					-	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_Qmax	0x005A	-	Float32T	0.0	0.0	+∞
Description				**Unit**	**Storage**	**Rights**
Maximum allowed flowrate of the flowmeter (see datasheet) – Useful to detect flow peaks that are out of specification				l/min	-	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_Density	0x0047	-	Float32T	1000.0	0.0	+∞
Description				**Unit**	**Storage**	**Rights**
Fluid density for mass flow calculation				kg/m^3	Yes	RW

Teach-functions

Name	Index	Subindex	Datatype	Default value	Min	Max
V_VolumeNotify1	0x005B	-	Float32T	0	-∞	+∞
Description				**Unit**	**Storage**	**Rights**
Volume ≥ Volume limit 1 (0: Disabled)				l/min	Yes	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_VolumeNotify2	0x005C	-	Float32T	0	-∞	+∞
Description				**Unit**	**Storage**	**Rights**
Volume ≤ Volume limit 2 (0: Disabled)				l/min	Yes	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_FlowNotify1	0x005F	-	Float32T	0	-∞	+∞
Description				**Unit**	**Storage**	**Rights**
Flowrate ≥ Flowrate limit 1 (0: Disabled)				l/min	Yes	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_FlowNotify2	0x0060	-	Float32T	0	-∞	+∞
Description				**Unit**	**Storage**	**Rights**
Flowrate ≤ Flowrate limit 2 (0: Disabled)				l/min	Yes	RW

Functions

Name	Index	Storage	Datatype	Default value	Length
V_EncProp	0x004B	-	UIntegerT	0 (2-channel flowmeter)	8 bit
Description		**Value range**			**Rights**
Number of flowmeter channels		2-channel evaluation 1: 1-channel eval. (Pin 2) 2: 1-channel eval. (Pin 4)			RW

Name	Index	Storage	Datatype	Default value	Length
V_Filter	0x004D	Yes	UIntegerT	2 (High precision)	8 bit
Description		**Value range**			**Rights**
Filter dynamic / accuracy		0: Dynamic response (Medium precision) 1: Smooth response (Medium precision) 2: Heavily filtered response (High precision)			RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_WaitTime	0x004E	-	UInt16T	500	100	10000
Description				**Unit**	**Storage**	**Rights**
Wait time – Time to pass without input pulses after which the frequency measurement value is set to zero				ms	Yes	RW

Name	Index	Storage	Datatype	Default value	Storage
V_DirectionInvert	0x0044	Yes	BoolT	false	Yes
Description		**Value: true**		**Value: false**	**Rights**
Invert direction of input signals		Direction inverted		Direction not inverted	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_ImpfilterEnabled	0x0048	-	UInt8T	0	0	255
Description					**Storage**	**Rights**
Pulse filter function – Number of buffered pulses/teeth (0: Disabled)					Yes	RW

Name	Index	Storage	Datatype	Default value	Storage
V_Standstill detectionEnabled	0x0049	Yes	BoolT	false	Yes
Description		**Value: true**		**Value: false**	**Rights**
Standstill detection		Enabled		Disabled	RW

Name	Index	Storage	Datatype	Default value	Storage
V_Negative DirectionDetection	0x004A	Yes	BoolT	false	Yes
Description		**Value: true**		**Value: false**	**Rights**
Negative flow direction detection		Enabled		Disabled	RW

Name	Index	Storage	Datatype	Default value	Storage
V_SIO-Passthrough	0x0059	Yes	BoolT	false	Yes
Description		**Value: true**		**Value: false**	**Rights**
Passthrough mode for quadrature signals (IO-Link-WUR only for f<25 kHz)		Enabled		Disabled	RW

Name	Index	Subindex	Datatype	Default value	Min	Max
V_Lin_enable	0x0063	-	UInt8T	0	0	2
Description					**Storage**	**Rights**
Enabling and choosing the linearization mode for volume and flowrate: 0: Disabled 1: Frequency/K-Factor-Table 2: Flowrate/K-Factor-Table					-	RW

Linearization table

Name	Index	Subindizes	Datatype	Elemente	Min	Max
V_Lin_X	0x0064	1 .. 20	Array of Float32T	20	-∞	+∞
Description					**Storage**	**Rights**
X-Values of the linearization table – dependent on the selected table type: V_Lin_enable=1: Frequency values of the flowmeter V_Lin_enable=2: Flowrate values of the flowmeter					-	RW

Name	Index	Subindizes	Datatype	Elemente	Min	Max
V_Lin_Y	0x0078	1 .. 20	Array of Float32T	20	-∞	+∞
Description					**Storage**	**Rights**
Y-Values of the linearization table → K-Factors of the flowmeter					-	RW

OBSERVATION

Process data (unit: selectable)

Name	Index	Subindex	Datatype	Default value		
V_Flow	0x0040	-	Float32T	0		
Description				**Unit**	**Storage**	**Rights**
Current flowrate value in selected unit				Hz l/min kg/min	-	RO

Name	Index	Subindex	Datatype	Default value		
V_Volume	0x0041	-	Float32T	0		
Description				**Unit**	**Storage**	**Rights**
Current volume in selected unit				pulses litres kilogram	-	RO

Statistical data

Name	Index	Subindex	Datatype	Default value	Min	Max
V_TotalVolume[3]	0x0056	-	Float32T	0	0	+∞
Description				**Unit**	**Storage**	**Rights**
Totalized volume counter (sums up positive and negative volume)				litres	-	RO

Name	Index	Subindex	Datatype	Default value	Length	
V_OPHours[3]	0x0057	-	TimeT	00:00:00.000	64 bit	
Description					**Storage**	**Rights**
Operating hour counter with active flow					-	RO

Name	Index	Subindex	Datatype	Default value	Min	Max
V_QPeak[3]	0x004C	-	Float32T	0.0	0.0	+∞
Description				**Unit**	**Storage**	**Rights**
Highest measured flow value (peak value)				l/min	-	RO

DIAGNOSIS

Diagnosis data

Name	Note
V_TotalVolume	Description see Observation → Statistical data

Name	Index	Subindex	Datatype	Default value	
V_TotalVolNotify	0x0062	-	Float32T	0	
Description				**Storage**	**Rights**
Event on exceeded total volume (0: Disabled)				Yes	RW

Name	Note
V_OPHours	Description siehe Beobachtung / Statistik

Name	Index	Subindex	Datatype	Default value	
V_OPHoursNotify	0x0061	-	TimeSpanT		
Description				**Storage**	**Rights**
Event on exceeded operating hours with flow (0: Disabled)				Yes	RW

Name	Index	Subindex	Datatype	Default value	
V_ErrorCount	0x0020	-	UInt16T	0	
Description				**Storage**	**Rights**
Number of occurred errors of the technology specific application since the last start-up or reset of the device				-	RW

Name	Note
V_QPeak	Description see Observation → Statistical data

[3] Automatic data store on device shutdown

Device status

Name	Index	Subindex	Datatype	Default value	Min	Max
V_DeviceStatus	0x0024	-	UIntegerT	0 (Device OK)	0	4
Description					**Storage**	**Rights**
Display of the status of the device and diagnostics					-	RO

Name	Index	Subindex	Datatype	Element count	
V_DetailedDeviceStatus	0x0025	1 .. 64	Array of OctetStringT	64	
Description				**Storage**	**Rights**
List of all currently pending events of the device				-	RO

SYSTEM COMMANDS

Data resets

System Commands are used to reset the statistical data recorded by the device. Various buttons are provided for this purpose in the Diagnosis → Reset buttons menu.

System Command (Button)	HEX
Reset: total volume	0xA4
Reset: operating hours	0xA5
Reset: peak flowrate value	0xA6
Reset: volume	0xA7
Restore factory settings	0x82
Application reset	0x81

Reset total volume

The total volume counter (V_TotalVolume) will be reset to a value of zero.

Reset operating hours

The operating hour counter (V_OPHours) will be reset to a value of zero.

Reset peak flowrate value

The value of the highest measured flowrate value (V_QPeak) will be reset to a value of zero.

Reset volume

The process value of the volume (V_Volume) will be reset to a value of zero.

Restore factory settings

This function resets the device to factory/default settings. All saved parameter values will be lost. After completion, the device will be restarted.

Application reset

All parameters except those used for IO-Link device identification (e.g., application/location tag) are reset to the default values. No restart will be performed.

Teach functionality

To perform a fast and easy setup of limit values, there are four buttons in the menu Parameter → Limits. When the buttons are pressed, the current process value is saved (→ "teached") to the corresponding limit value parameter. This way, the limit values can be set in the real-world application.

System Command (Button)	HEX
Teach: Volume event 1	0xA0
Teach: Volume event 2	0xA2
Teach: Flowrate event 1	0xA1
Teach: Flowrate event 2	0xA3

10 REVISION HISTORY

Revision	Date	Changes
-	12.01.2022	Preliminary version
a	21.06.2022	Changes for Firmware revision V1.2
b	03.08.2022	Figure updates, new parameter V_SIO_Passthrough, Measured precision values, Firmware revision V1.7
c	29.08.2022	English version, design fixes, figure updates
d	19.09.2022	EMC data update, correction of V_Density, PDout addition, Firmware revision V1.9
e	20.10.2022	Change of data storage parameters, Addition of application reset, Change of ParamError-Flag behaviour, PDout validity, Icon/Logo Changes, Manufacturer Declaration

11. MANUFACTURER DECLARATION

MANUFACTURER'S DECLARATION OF CONFORMITY

We:

VSE Volumentechnik GmbH
Hönnestraße 49
D-58809 Neuenrade

declare under our own responsibility that the product(s):

IO.flow® (IO-Link Device)

to which this declaration refers conform to:

☒ IO-Link Interface and System Specification, V1.1.3, June 2019 (NOTE 1,2)

☒ IO Device Description, V1.1.3, January 2021

☒ IO-Link Common Profile Specification, V1.1, Dec. 2021

The conformity tests are documented in the test reports:

TID-20220907-01_VSE_1654_4900_EMC Test Report.pdf
TID-20220905-01_VSE_1654_4900_IO-Link PhysicalLayer Test Report.pdf
Protocol_Test_Report_IO.flow_Nov22.pdf

Issued at

Authorized signatory

Name: Axel Vedder
Title: *Managing Director*

Signature:

NOTE 1 Relevant Test specification is V1.1.3, January 2021 NOTE 2 Additional validity in Package 2020 and Corrigendum	MD-Version: V1.1.3 / 2022-01

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