



analog
signals

Modbus

EtherCAT

PROFI
NET

Bluetooth

VADy

red-y smart series / red-y industrial series

Instruction manual EtherCAT interface for d·flux multi series

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Intro

This manual describes how to use the Vögtlin EtherCAT interface with your EtherCAT system.

EtherCAT is a real-time Industrial Ethernet technology originally developed by Beckhoff Automation. The EtherCAT protocol which is disclosed in the IEC standard IEC61158 is suitable for hard and soft real-time requirements in automation technology, in test and measurement and many other applications.

Please visit www.EtherCAT.org for more information about EtherCAT.

Overview

- Standard Ethernet frame - IEEE 802.3
- Endianness type at Voegtlin Instruments device is **Little Endian**
- Power supply and consumption:

meter:	15-36 VDC / 200mA @ 24VDC
controller:	24VDC / 2000mA @ 24VDC

About this documentation

Content


This documentation contains only descriptions of the communication protocol (EtherCAT).



NOTICE!

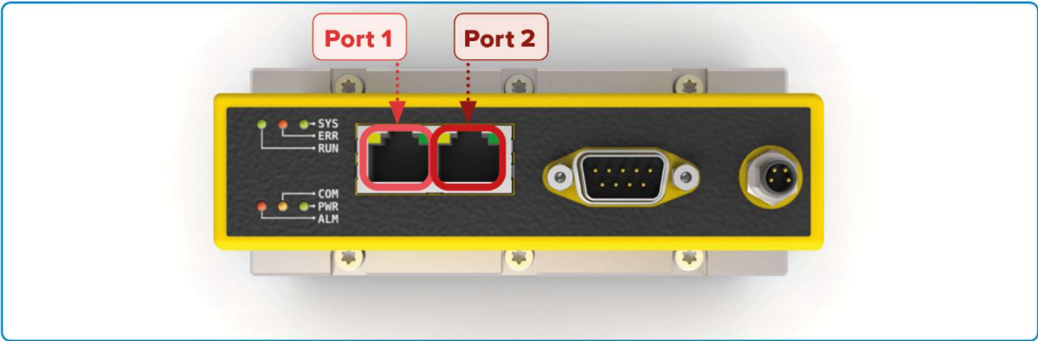
This documentation is a supplement of **d-flux multi series Operating Instructions**. Please visit the Vögtlin website, www.voegtlin.com, and look under the download section to find the manuals.

The information in this documentation is valid for the following device:
d-flux multi series.

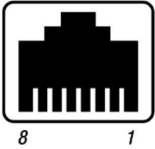
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Connection

The EtherCAT device is equipped with two RJ45 connectors which both can be used to connect the device to an EtherCAT master or switch.



8-pin RJ45 connector female

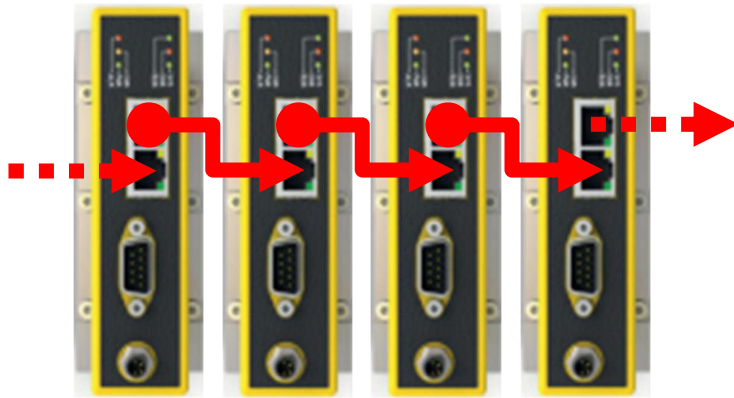
	Pin	Assignment	Wire color
	1	Data (TX+)	Yellow
	2	Data (TX-)	Orange
	3	Data (RX+)	White
	4	not used	
	5	not used	
	6	Data (RX-)	Blue
	7	not used	
	8	not used	

Note: For reliable communication, it is advised to use Cat5E or higher graded cables.

i NOTICE!
For EtherCAT, “Port 0” acts as **Input**, and “Port 1” as **Output**



The devices can be daisy-chained to optimize the cabling:



Note: It is important that each device has a unique name assigned in order to hook-up the devices with each other.

More about daisy chain:

This configuration requires less cabling than alternative star topologies and thus is simpler and more cost-effective to implement. A daisy chain topology can be arranged in two ways:

A linear topology:

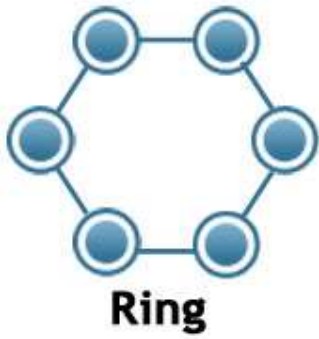
Message must go from one device to another in one direction.



*Inconvenient:
Communication failures in the case of a break in the chain*

Ring topology:

It is formed by all the devices connected by each other through their ends.



Advantage:

This ensures that all the data is transmitted by the devices one after the other and if there is a broken link, then the data is transmitted in the reverse fashion ensuring that the signals are received.

EtherCAT Topology:

EtherCAT is very flexible when it comes to laying out the network.

However, Ring, line, or Tree and Star topologies comes with advantages and disadvantages that need to be considered at the design phase.

Device network setup

The device comes with the following network settings:

Name : D-Flux

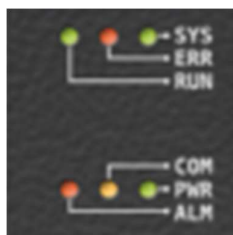
IP address : 192.168.0.50 or 0.0.0.0

Tips: Voegtlin uses following USB- to Ethernet Adapter: **D-Link DUB-E100**







Status LED's





The status LED's are located on top of the device.







SYS – System status

Colour State		Description
	On (green)	EtherCAT Operating system running
	Blinking (red/green)	EtherCAT OS waiting for firmware
	On (red)	EtherCAT bootloader waiting for second stage loader
	Off	Power supply missing or hardware failure



ERR – Bus status

Colour State		Description
	Blinking at 2.5 Hz	Invalid configuration: General Configuration Error Possible reason: State change commanded by master is impossible due to register or object settings.
	Single flash	Local error: Slave device application has changed the EtherCAT state autonomously. Possible reason 1: A host watchdog timeout has occurred. Possible reason 2: Synchronization Error, device enters Safe Operational automatically.
	Double flash	Application watchdog timeout: An application watchdog timeout has occurred. Possible reason: Sync Manager Watchdog timeout.
	Off	No error



RUN – Run status

Colour State		Description
	Blinking 2.5 Hz	PRE-OPERATIONAL state
	Single flash	SAFE-OPERATIONAL state
	On	OPERATIONAL state
	Off	INIT state




COM – Modbus communication status

Colour State		Description
	Flashing (yellow)	Modbus messages are being exchanged
	Off	No communication

PWR – Power status

Colour State		Description
	On	Device is powered and operational
	Off	Device is powered off

ALM – Alarm status

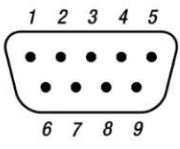
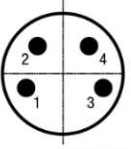
Colour State		Description
	Blinking (red)	Alarm condition occurred. Check alarm status register for more info
	On (red)	Hardware failure. Disconnect the device from the power supply and connect it again. If the fault is still present, please send it to the responsible service center.
	Off	No alarm

Electrical power supply


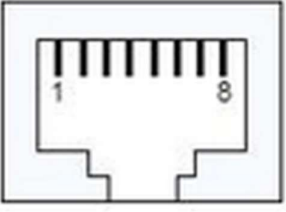
The device can be powered through the Sub-D connector which is located on the side of the device.

- Power supply and consumption: meter: 15-36 VDC / 200mA @ 24VDC
controller: 24VDC / 2000mA @ 24VDC

Sub-D9 and M8 Pin assignment for Modbus RTU, power supply, analog signals

	Pin	Assignment		Pin	Assignment
	1	Analog Ground		1	Supply Power
	2	Supply Ground		2	Not Connected
	3	Supply Power		3	Supply Ground
	4	Analog Out Voltage		4	Output
	5	Setpoint (MFC only)		enclosure	Protective Earth
	6	Valve Mode (MFC only)			
	7	Analog Out Current			
	8	RS485-A			
	9	RS485-B			
		Modbus			

Ethernet RJ45 Pin assignment (Profinet/EtherCAT)

RJ45 Connector	Socket version	Pin	Assignment	Wire Color
	8-pin RJ45 connector 	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	



NOTICE!

More information can be found on **d-flux multi series Operating Instructions**.

Please visit the Vögtlin website, www.voegtlin.com, and look under the download section to find the manuals.

Serial Interface

In addition to the EtherCAT interface, the device has, as standard, a digital interface with the ModBus protocol. This interface enables access to numerous parameters.



NOTICE!

Any changes to the settings through the standard interface Modbus RTU, are not reflected in the EtherCAT PDO's. Please apply a **power reset** after changing the settings through the standard interface.

ESI File

The ESI file contains the facilities/features which the device offers to the EtherCAT master. The file is called: **ESI_Voegtlin_Instruments_0B02_D-Flux_Vx.xx.xml**

The latest ESI file can be downloaded at: <https://www.voegtlin.com/support/downloads/>


The ESI file is an xml file containing:

- Device identification info. This contains general information like:
 - o Vendor (Voegtlin Instruments GmbH)
 - o Vendor ID (0x0B02)
 - o Product family (D-Flux)
- Device Access Point (DAP) contains information about:
 - o Used hardware
 - o Ethernet related settings
 - o Supported features

Note: The EtherCAT interface only supports cyclic data exchange

Alarms

To handle alarms it is necessary to actively poll the available alarm PDO's "**Warnings Status**" & "**Error Status**" in the PLC Program.

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Process Data Objects (PDO's)

PDO's are variables continuously transferred between the Device (slave) and the PLC (master)

The EtherCAT interface supports only one slot for input and one slot for output.

Each slot has its own size. This document describes how the data is encoded in the PDO's.

The order of the registers are fixed.

The tables also show the Modbus registers which are linked to the PDO data. More information about the registers can be found on the Vögtlin website under the download section, look for digital communication.

Read with Input PDO's (slave to master)

Register	Modbus Addr. (zero base)	Data Type	Description
Flow	0x0000	F32	
Temperature	0x0002	F32	
Totalizer	0x0004	F32	
Setpoint Flow	0x0112	F32	
Valve power	0x0162	F32	
Warnings status	0x0301	UINT	
Error status	0x0321	UINT	
Valve mode	0x0160	UINT	
Ramp time	0x0104	UINT	
Flow unit name	0x0054	S16	
Gas name	0x0044	S16	
Serial Number	0x0402	UDW	
Device Type 1	0x0404	S12	
Select Parameter set	0x0131	UINT	
Flow limit	0x00B4	F32	
Device type 2	0x040A	S12	
Totalizer unit	0x0084	S16	
Profile select	0x0032	SINT	
Pressure (ABS)	0x0006	F32	
I/O on/off	0x0343	UINT	
Pressure unit	0x0074	S16	
Temp unit	0x0064	S16	

Write with Output PDO's (master to slave)

Register	Modbus Addr. (zero base)	Data Type	Description
Setpoint Flow	0x0100	F32	
Valve mode	0x0160	UINT	
Ramp time	0x0104	UINT	
Select Parameter set	0x0131	UINT	
Flow limit	0x00B4	F32	
Profile select	0x0032	SINT	
I/O on/off	0x0343	UINT	
Reset Device	0x0600	UINT	
Write Protect	Special	UDW	

Write Protect/Output Enable

At power-up the output PDO's are disabled. This means that any changes to the output PDO will not be executed by the Device. In order to enable writing to the Device, it is necessary to write "Bit weight or the sum of the Bit weight value into Write Protect / Output Enable register. Each bit in this register corresponds to a "Selected output PDO register". The table below gives an overview:

Bit	Selected output PDO register	Bit weight
0	Setpoint Flow	1
1	Valve mode	2
2	Ramp time	4
3	Select Parameter set	8
4	Flow limit	16
5	Profile select	32
6	I/O on/off	64
7	Reset Device	128

Divers examples

Enable writing:

** Input PDO's = Read= Rd and ** Output's PDO's =Write = Wr*

- To **enable writing a value to the set point (flow)**, set bit 0 with “Bit weight = 1”, in writing “Output enable /Write protect” with value = 1

- To **enable writing the Ramp time & set point (flow)**, add both Bit weight, and write “Output enable/Write Protect” with value = 5



NOTICE!

Why the register does not react of values modification?

Nothing will happen, if the register has already value = “0” and you want again to update with this same value.

So we first need to modify the value. In this case it has to be different of “0”, then we can write again value = “0”.

Register Description Input PDO's

FLOW: Current gas flow in the selected engineering unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0000	400001	FLOW_VALUE	R	F32	2	-

Current flow of gas in the engineering unit selected

TEMPERATURE: Current gas temperature in the selected temperature unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0002	400003	TEMP_VALUE	R	F32	2	-

Current Temperature of gas in the engineering unit selected

TOTALIZER: Current totalizer value in the selected totalizer unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0004	400005	TOTALIZER_VALUE	R	F32	2	-

Current totalizer value of gas in the engineering unit selected

SETPOINT FLOW: Current setpoint

Address hex	Address dec	Name	Access	Type	Count	default
0x0100	400257	SETPOINT	R	F32	2	-

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

VALVE POWER: Current valve power

Address hex	Address dec	Name	Access	Type	Count	default
0x0162	400355	VALVE POWER	R	F32	2	-

Reading this register returns the power applied to the valve in %.

WARNING_GLOBAL_STATUS: Available warnings

Address hex	Address dec	Name	Access	Type	Count	default
0x0301	400770	WARNING_GLOBAL_STATUS	R	U16	1	0

ERROR_GLOBAL_STATUS: Which global errors are active/inactive

Address hex	Address dec	Name	Access	Type	Count	default
0x0321	400802	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

VALVE MODE: Current valve mode

Address hex	Address dec	Name	Access	Type	Count	default
0x0160	400353	VALVE MODE	R	F32	2	-

Reading this register returns the current mode of the valve.

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.

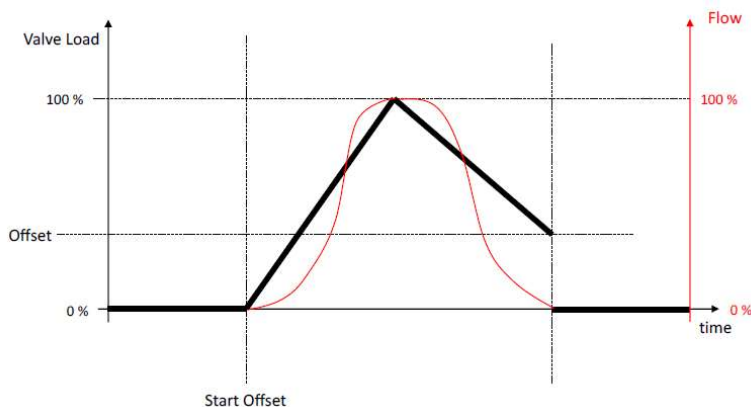
Note:

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.

Min Detect:

The device is capable of detecting the valve minimum automatically.

The following figure depicts the functionality of the minimum detection.



Selecting “Min Detect” in this register will start the detection. Selecting any other mode in this register while the detection is running stops it immediately.

RAMPING TIME

Address hex	Address dec	Name	Access	Type	Count	default
0x0104	400261	SETPOINT_RAMPING_TIME_MS	R	U16	1	-

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

Reading this register returns the ramping time in milli seconds.

Note:

- Ramping is not applied when user setpoint is set to zero.
- 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.

FLOW UNIT NAME: Name of currently selected flow unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0054	400085	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.

GAS NAME: Name of selected gas

Address hex	Address dec	Name	Access	Type	Count	default
0x0044	400069	GAS_NAME	R	STR <16>	8	-

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

SERIAL NUMBER: Serial number of device

Address hex	Address dec	Name	Access	Type	Count	default
0x0402	401027	INFO_SERIAL	R	U32	2	-

Reading this register returns the serial number of the device.

DEVICE TYPE 1: Type code of device part 1

Address hex	Address dec	Name	Access	Type	Count	default
0x0404	401029	INFO_TYPECODE_1	R	STR <12>	6	-

Type code (part 1) as a string.

SELECT PARAMETER SET: Current parameter set

Address hex	Address dec	Name	Access	Type	Count	default
0x0131	400306	PARAMETER_SELECT	R	U16	1	-

Reading this register returns the index of the current selected parameter set.

FLOW LIMIT: Range max of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00B4	400181	FLOW LIMIT	R	F32	2	-

Reading this register returns the effective maximum value excluding the overflow area. This value is in current selected flow unit.

DEVICE TYP 2: Type code of device part 2

Address hex	Address dec	Name	Access	Type	Count	default
0x040A	401035	INFO_TYPECODE_2	R	STR <12>	6	-

Type code (part 2) as a string.

TOTALIZER UNIT: Name of currently selected totalizer unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0084	400133	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.

PROFILE SELECT:

Address hex	Address dec	Name	Access	Type	Count	default
0x0032	400051	PROFILE_SELECT	R	SINT	1	-

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.

I/O ON/OFF: OC switch value in manual mode

Address hex	Address dec	Name	Access	Type	Count	default
0x0343	400836	SWITCH_VALUE	R	U16	1	-

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

PRESSURE UNIT: Name of currently selected pressure unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0074	400117	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.

TEMP UNIT: Name of currently selected temperature unit

Address hex	Address dec	Name	Access	Type	Count	default
0x0064	400101	TEMP_UNIT_NAME	R	STR <16>	8	-

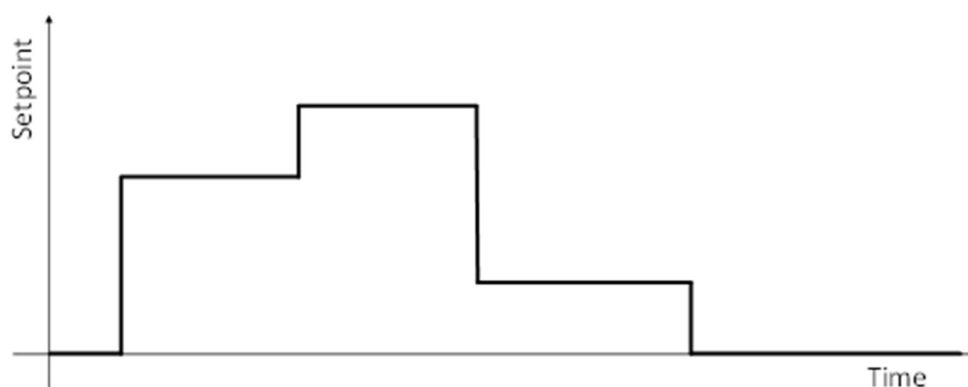
Reading this register returns the name of the current selected temperature unit. Any read request must target the base address of this register and is rejected otherwise.

Register Description Output PDO's

SETPOINT FLOW:

Address hex	Address dec	Name	Access	Type	Count	default
0x0100	400257	SETPOINT	W	F32	2	-

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



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.

VALVE MODE: Current valve mode

Address hex	Address dec	Name	Access	Type	Count	default
0x0160	400353	VALVE MODE	W	U16	1	-

Writing this register sets the current mode of the valve.


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.

RAMP TIME:

Address hex	Address dec	Name	Access	Type	Count	default
0x0104	400261	SETPOINT_RAMPING_TIME_MS	W	U16	1	-

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

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.

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Note:

- Ramping is not applied when user setpoint is set to zero.
- 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.

SELECT PARAMETER SELECT:

Address hex	Address dec	Name	Access	Type	Count	default
0x0131	400306	PARAMETER_SELECT	W	U16	1	-

Writing a zero based index to this register selects the corresponding parameter set. Writing 0 selects the first parameter set, writing a 1 selects the second and so on. Writing an invalid index has no effect. Writing to this register has immediate effect and updates persistent memory.

FLOW LIMIT: Range max of range which is selected and in use for editing

Address hex	Address dec	Name	Access	Type	Count	default
0x00B4	400181	FLOW LIMIT	W	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.

PROFILE SELECT: Active Profile you want to use

Address hex	Address dec	Name	Access	Type	Count	default
0x0032	400051	PROFILE_SELECT	W	S16	1	-

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

I/O ON/OFF: OC switch value in manual mode

Address hex	Address dec	Name	Access	Type	Count	default
0x0343	400836	SWITCH_VALUE	W	U16	1	-

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

RESET DEVICE: Reset device

Address hex	Address dec	Name	Access	Type	Count	default
0x0600	401537	RESET	W	U16	1	-

Writing 0xDEAD to this register resets the device.