PROFINET RT interface

Revision :   **3**
Date rev: **2023-01-17**

1   Contents

2 Scope of the document

These instructions are supplementary to the standard FOCUS-1 Manual. They provide additional user information on how to connect the device to a PROFINET IO network.

To ensure safety, please read this document carefully before installation and follow the instructions herein.

3 Used abbreviations

DAP	Device Access Point
GSD	General Station Description
GSDML	General Station Description Markup Language
I&M	Information & Maintenance
I/O	Input Output
PLC	Programmable Logic Controller
RT	Real Time
PID	Proportional Integral Differential controller

4 PROFINET IO general information

PROFINET IO is an Ethernet based communication protocol. The device connects to a Profinet master via a dedicated Ethernet port.
conformance class B PROFINET IO

Name	FOCUS-1 Device
Conformance Class	CC-B

Basic function	PROFINET IO with RT communication
	-Cyclic data in the form of process values, statuses and alarms
	- Direct Valve control
	- Indirect Valve control via
	    - Flow control
	    - Pressure control (inlet or outlet)
	    - Pressure drop control

Cabling	IEC 61784-5-3 Copper
Typical application	Process automation

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender

5   Electrical connections

Connections to both Ethernet and PROFINET RT are done via one M12 Connector located at the back of the device on the electronics cabinet. Both ethernet protocols are communicated via one cable saving on wiring for the customer.

6   Physical Connection to ethernet and Profinet.

The FOCUS-1 device for Profinet provides two 4-wire ethernet connections:
- a TCP/IP connection for the dashboard usage (supporting HTTP) and service maintenance (SSH)
- a dedicated TCP connection for Profinet communication.
Both connections have their own MAC address and can be assigned separate IP addresses

The FOCUS-1 device is equipped with a single 8 pin female M12 connector, via which both TCP connections are available.
The M12 connector has 8 pins, enough for 2 pairs ethernet and 2 pairs PROFINET. The wires are arranged as follows:

Depending on the hardware selection on customer side, we suggest to use a 8 wire cable like the example below.
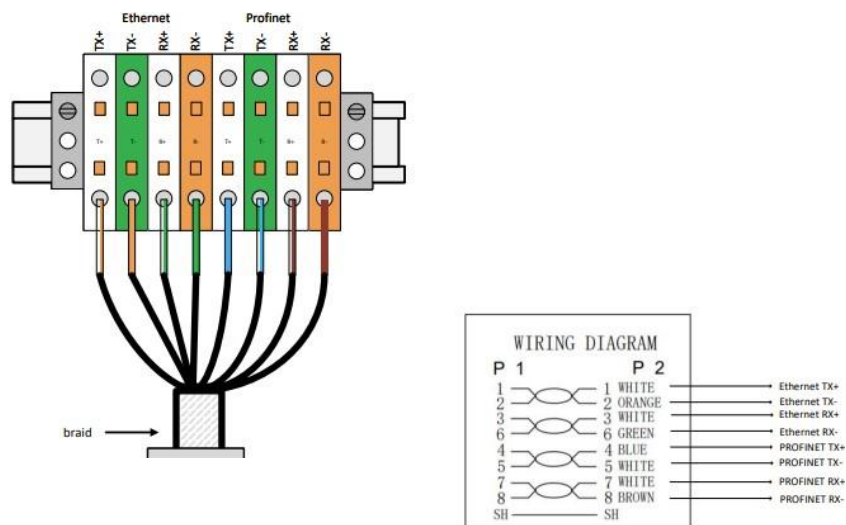

Figure 1 Wiring diagram

To make use of the wired ethernet functionality next to the PROFINET functionality, a so called ethernet splitter is needed to create a PROFINET and a ethernet RJ45 connector.

This splits the 8 wires so that one RJ45 connector can be used for PROFINET and the other for normal TCP/IP traffic including dashboard access.

Figure 3: M12 to RJ45 cable example
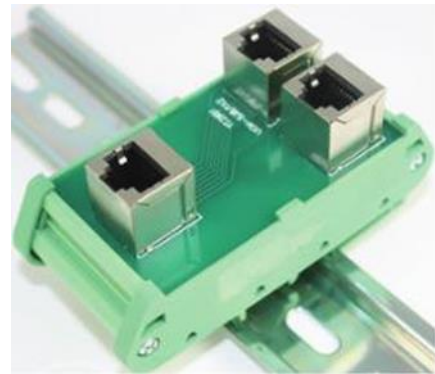
Figure 2 RJ45 splitter example
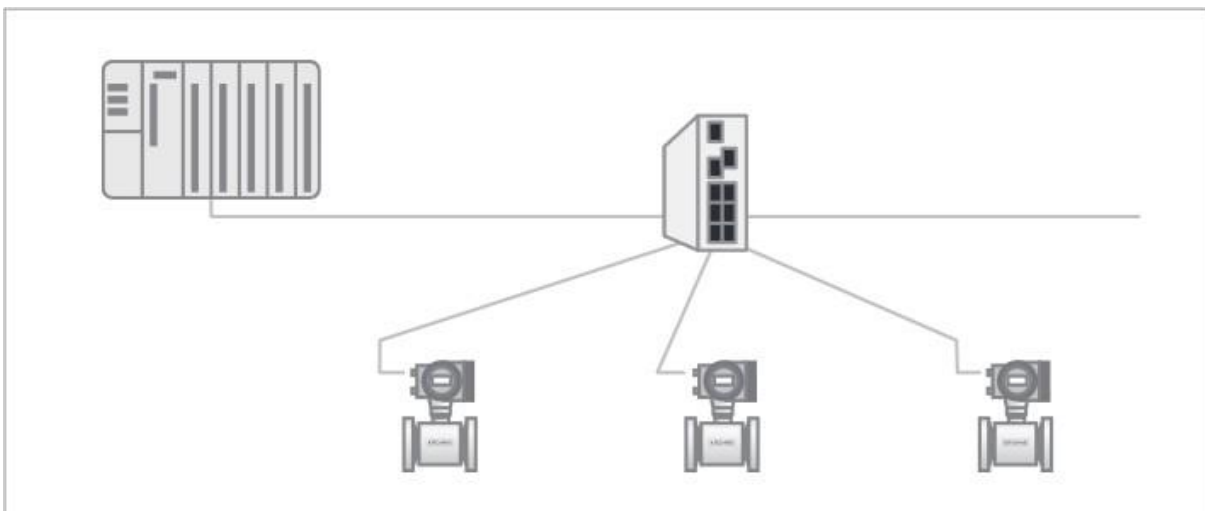
Figure 3-3: Point-to-point or star topology

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender

7   System integration

After physically connecting the Profinet wires to your Profinet infrastructure, the Focus-1 device needs to be assigned an IP address. This is typically arranged using the tooling from your PLC vendor: Siemens TIA Portal, Siemens Step 7 or Siemens Proneta.

The Profinet GSDML file is required for system integration. The file contains a device description written in the GSD Markup Language.

The GSDML file can be downloaded from the device documentation folder on the Focus-1 device.
See the quick start on how to connect to the device and download the GSDML file.

Currently, the Focus-1 device supports dynamically one of the GSDML files as listed below, to be configured on the device. Older versions of the GSDML files are available for backward compatibility reasons.

Software release	GSDML	Notes
v1.1	GSDML-V2.41-FocusOn-Focus1-20220401	Support for process values device status and alarms
v1.2	GSDML-V2.42-FocusOn-Focus1-20221128	Additional support for setpoints and external sensor
v1.3	GSDML-V2.42-FocusOn-Focus1-20230515	Improved submodule structure
v1.4	GSDML-V2.42-FocusOn-Focus1-20230915	Added new alarms

It is important to ensure that the configured GSDML file in the Focus-1 dashboard matches the GSDML file loaded/configured into your PLC.

7.1 Device identification

Manufacturer Name :	FOCUS-ON V.O.F.	Model Name :	FOCUS-1
Manufacturer ID code:	0x100 (HEX)	Device Type Code :	00
Manufacturer ID code:	640 (DEC)		
Profinet GSDML protocol revision:	2.41/2.42	Device Revision	1.4

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender

8 Configuration

Release v1.4.1 of the FOCUS-1 software has the following configuration options

Option	Description
Enable/Disable	For systems supporting Profinet this option allows the customer to (temporarily) disable Profinet and suppress possible alarms concerning Profinet configuration or communication.[1]
GSDML	Release v1.4.1 comes with a new GSDML file, but also supports the GSDML file from releases v1.1.0, v1.2.0 and v1.3.1 This option allows the customer to select the active GSDML, which must match the one loaded in the PLC.[2]
Setpoint source	Since release v1.2.0, FOCUS-1 supports reading of a setpoint from Profinet.[1,2]
Setpoint Type	When Profinet is selected as setpoint source, the system can interpret the Profinet setpoint as: - ValveSetpoint - VolumeFlowSetpoint - InletPressureSetpoint - OutletpressureSetpoint - External sensor Setpoint
Setpoint unit	When Profinet is selected as a setpoint source, the customer can indicate what the unit is of the setpoint. These units differ per type. Volume Flow: - m3/day, m3/h, m3/min, m3/s (cubic meters) - l/h, l/min, l/s, (liters) - ft3/h, ft3/min, ft3/s, (cubic feet) - gal/day, gal/h, gal/min, gal/s, (US gallon) - IG/day, IG/h, IG/min, IG/s, (Imperial gallon) - barrel/day, barrel/h Pressure: - bar, - psi, - Pa, kPa, MPa, - torr, - atm, - mmHg, inHg, - mmH2o, inH2o Temperature: - deg. Celsius, deg. Fahrenheit, Kelvin

[1] Options *Enable* and *Setpoint Source* have an interdependency: If the *Setpoint Source* is set to Profinet, while Profinet is disabled (*Enabled* is OFF), then the system will raise a *Profinet Configuration Alarm.*

[2] Options *Setpoint Source* and GSDML have an interdependency: If the *Setpoint Source* is set to Profinet, while the GSDML file *GSDML-V2.41-FocusOn-Focus1-20220401.xml* is configured (i.e. no support for setpoints) then the system will raise a *Profinet Configuration Alarm.*

9   Data module

9.1   Submodule 1: Status information

Submodule byte offset	ID	Description
0	DeviceStatus	Single byte status, indicating the operator setting: 0 = Unknown 1= Operational 2 = Maintenance 3 = Safety
1	AlarmStatus	0 = OK 1 = Maintenance required 2 = Out-of-spec 3 = Function Check[3] 4 = Failure[4]

9.2   Submodule 2: Alarms

The Alarms submodule consists of 10 bytes, each byte representing a group of alarms:

Submodule byte offset	ID	Description
0	DeviceEvent, namur:0, severity:1, category:3	Device Alarm, namur:OK, severity:High, category:Device-indicative
1	DeviceEvent, namur:1, severity:1, category:3	Device Alarm, namur:Maintenance-required, severity:High, category:Device-indicative
2	DeviceEvent, namur:2, severity:1, category:0	Device Alarm, namur:Out-of-spec, severity:High, category:Process-critical
3	DeviceEvent, namur:2, severity:1, category:1	Device Alarm, namur:Out-of-spec, severity:High, category:Process-indicative
4	DeviceEvent, namur:2, severity:1, category:3	Device Alarm, namur:Out-of-spec, severity:High, category:Device-indicative
5	DeviceEvent, namur:2, severity:2, category:3	Device Alarm, namur:Out-of-spec, severity:Medium, category:Device-indicative
6	DeviceEvent, namur:2, severity:3, category:1	Device Alarm, namur:Out-of-spec, severity:Low, category:Process-indicative
7	DeviceEvent, namur:2, severity:4, category:0	Device Alarm, namur:Out-of-spec, severity:Warning, category:Process-critical
8	DeviceEvent, namur:4, severity:2, category:1	Device Alarm, namur:Failure, severity:Medium, category:Process-indicative
9	DeviceEvent, namur:4, severity:2, category:2	Device Alarm, namur:Failure, severity:Medium, category:Device-critical

[4]In case DeviceStatus equals 2 (Maintenance), then AlarmStatus is automatically set to 3 (Function Check)
[5] In case DeviceStatus equals 3 (Safety), then AlarmStatus is automatically set to 4 (Failure)

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)   **TD-088(3)**
Date (rev.)   17-01-2024
Author   JP Diender
Process owner   JP Diender

Within these 10 groups, the following alarms have been defined:

Name	Byte offset	Bit offset	Description
FalseMediumSettings	0	0	Medium Settings are not filled in correctly.
PositionerStatusMaintenance	1	0	Positioner NAMUR status is Maintenance required.
SensorFailure2	1	1	Two or more sensors are failing. The device is still able to control with the current settings. Please plan maintenance as soon as possible.
SetpointDeviation	2	0	Current process value deviates too much from setpoint. Consider the autotuning function and check the process conditions.
EmptyPipe	3	0	No medium detected. Process pipe is empty or containing a severe amount of gas flow.
FlowSensorFailure	4	0	The ultrasonic flow measurement is failing. Flow value is calculated based on the pressure sensor and valve position information. Device specifications can no longer be guaranteed. Please plan short term maintenance.
PressureSensor1Failure	4	1	The upstream pressure sensor is failing. The pressure value is calculated based on flow measurement, valve position and the downstream pressure sensor. Device specifications can no longer be guaranteed. Please plan a short term maintenance.
PressureSensor2Failure	4	2	The downstream pressure sensor is failing. The pressure value is calculated based on flow measurement, valve position and the upstream pressure sensor. Device specifications can no longer be guaranteed. Please plan a short term maintenance
InternalLeakage	5	0	Possible Internal Leakage. Please plan long term maintenance.
PositionerStatusOutOfSpec	5	1	Positioner NAMUR status is Out of Specification.
Cavitation	6	0	Severe level of cavitation present in the valve. Cavitation may negatively affect the flow measurement. Device specifications can no longer be guaranteed. Cavitation causes wear to the valves body and plug/seat. This will decrease the lifetime of the device. Possible ways to preclude cavitation: increase pressure, decrease flow speed.
Flashing	6	1	Severe level of flashing present in the valve. Flashing may negatively affect the flow measurement. Device specifications can no longer be guaranteed. Flashing also causes wear to the valve body and plug/seat. This will decrease the lifetime of the device. Possible ways to preclude flashing are: increasing pressure, decreasing flow speed.
AmbientTemperatureTooHigh	7	0	Ambient temperature is exceeding maximum limit. Life time of electronics will be strongly affected. Device specifications are no longer guaranteed. Try to reduce the ambient temperature.

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)   **TD-088(3)**
Date (rev.)   17-01-2024
Author   JP Diender
Process owner   JP Diender

Name	Byte offset	Bit offset	Description
AmbientTemperatureTooLow	7	1	Ambient temperature is exceeding minimum limit. Life time of electronics will be strongly affected. Device specifications are no longer guaranteed. Try to increase the ambient temperature.
AirPressureTooHigh	7	2	Air pressure is exceeding maximum limit. Air pressure is exceeding maximum limit. Too high air pressure results in a higher change of broken springs or ruptured membrane in the actuator. Try to decrease the supply air pressure.
AirPressureTooLow	7	3	Air pressure is below the minimum limit. Controllability of the device is becoming at risk. Try to increase supply air pressure. Device specifications are no longer guaranteed.
MediumTemperatureTooHigh	7	4	Medium temperature is exceeding maximum limit. Try to decrease the medium temperature. Device specifications can no longer be guaranteed. Lifetime of the device is strongly affected.
MediumTemperatureTooLow	7	5	Medium temperature is below the minimum limit. Try to increase the medium temperature. Device specifications can no longer be guaranteed. Lifetime of the device is strongly affected. Try to increase the medium temperature. Device specifications can no longer be guaranteed. Lifetime of the device is strongly affected.
PressureTooHigh	7	6	Pressure is exceeding the maximum limit. Try to decrease the pressure. Device specifications can no longer be guaranteed. Lifetime of the device is strongly affected.
FalseMediumSettingsFailure	8	0	Medium Settings are not filled in correctly. This leads to incorrect process values.
AirPressureLoss	9	0	No supply air pressure available. No control possible. Device is in safety position. Check air supply.
AnalogInputError	9	1	No DCS Input connected to the device. No control possible. The device is in safety position. Please check DCS input or plan maintenance as soon as possible.
PositionerError	9	2	Connection Lost with the positioner. No communication possible with the positioner. Device is in safety position. Please plan maintenance as soon as possible.
PositionerStatusFailure	9	3	Positioner NAMUR status is Failure.
SensorFailure	9	4	Two or more sensors are failing. The device is not able control with the current settings. The device is still able to control on valve position. Please plan maintenance as soon as possible.
FirmwareFailure	9	5	System firmware is not fully operational. A power cycle operation may be needed. Please plan maintenance.

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender

9.3 Submodule 3: Positioner Process Values

Submodule byte offset	ID	Description	Unit
0-3	DeviceValue:x_SSPActValvePosExtRef, unit:%, factor:1, offset:0.0	Actuator Valve Position	% Open
4-7	DeviceValue:p4_SSPActDrivingAirPressureExtRef, unit:Pa, factor:1, offset:0.0	Actuator Driving Air Pressure	Pa
8-11	DeviceValue:p3_SSPActSupplyAirPressureExtRef, unit:Pa, factor:1, offset:0.0	Actuator Supply Air Pressure	Pa
12-15	CalculatedValue:ValvePositionSetpoint, unit:, factor:1, offset:0.0"	ValvePosition Setpoint	% Open
16-19	DeviceValue:t1_SSPActTemperatureExtRef, unit:K, factor:1, offset:0.0	Actuator Temperature	K

9.4 Submodule 4: Flow sensor Process Values

Submodule byte offset	ID	Description	Unit
0-3	CalculatedValue:VolumeFlowOPV, unit:, factor:1, offset:0.0	Volume Flow*	m3/h
4-7	DeviceValue:Gain, unit:dB, factor:1, offset:0.0	Flow meter Gain	dB
8-11	DeviceValue:SNR, unit:dB, factor:1, offset:0.0	Flow meter Signal/Noise Ratio	dB
12-15	DeviceValue:Velocity of Sound, unit:m/s, factor:1, offset:0.0	Velocity of Sound	m/s

9.5 Submodule 5: Pressure/Temperature sensor Process Values

Submodule byte offset	ID	Description	Unit
0-3	CalculatedValue:Pressure1OPV, unit:Pa, factor:1, offset:0.0	Inlet Pressure*	Pa
4-7	CalculatedValue:Pressure2OPV, unit:Pa, factor:1, offset:0.0	Outlet Pressure*	Pa
8-11	CalculatedValue:TemperatureOPV, unit:K, factor:1, offset:0.0	Medium Temperature*	K

(*)Redundant regarding sensor failure: These values will be based on multiple sensor inputs. If one of the sensors fails, the other sensors fill in dynamically, possibly at a lower precision.

E.g. Pressure2 (outlet pressure) can be measured by the sensor, or computed from inlet sensor, flow sensor and valve position in case of sensor failure.

E.g. Temperature can be measured by the upstream Inlet temperature sensor. If that sensor fails, the Temperature is computed from the downstream Outlet temperature sensor

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)   **TD-088(3)**
Date (rev.)   17-01-2024
Author   JP Diender
Process owner   JP Diender

9.6 Submodule 6: External sensor Process Values

Focus-1 supports interpretation of the analog input as an external sensor value, in case the setpoint is acquired from an alternative source (i.e. dashboard, Profinet or EtherNet/IP).
This external sensor value (as incoming 4..20 mA signal) must be mapped to an alternative range, and must be used for control purposes: the setpoint applies to the external sensor actual value. There is no formal unit assigned to this range, as the external sensor can measure any value and scale it to the 4..20 mA range. For display reasons, the unit can be specified and can be entered, but it is not conveyed over Profinet.
This mapped value is conveyed in the External Sensor submodule, or is 0 (zero) when not applicable.
The configuration of the external sensor feature is available for specific applications. It is highly recommended to consult Focus On Service & Consultancy before implementing this application.

Submodule byte offset	ID	Description	Unit
0-3	DeviceValue:ExternalSensor, unit:, factor:1, offset:0.0	Converted value of the external sensor	-

9.7 Submodule 7: Setpoint Process and Setting Values

Submodule byte offset	ID	Description	Unit
0-3	DeviceValue:Setpoint, unit:, factor:1, offset:0.0		-
4	Setting, name:SetpointSource, map:1=Analog;2=Profinet;3=Dashboard	Source for the setpoint, as a single byte number	-
5	Setting, name:ControlTypeIdentifier	Type of the setpoint*, as a single byte number	-
6	Setting, name:UnitTypeIdentifier	Unit of the setpoint**, as a single byte number	-

[*] Type of setpoint
The Type of setpoint can be configured in the Focus1 dashboard and currently offer the options as listed below. Each of the options has a single byte identifier as defined in the HART-7 standard. This identifier is conveyed in this Profinet submodule.

Setpoint Control type	Identifier (decimal)
Valve Position	244
VolumeFlow	72
Inlet Pressure	113
Outlet Pressure	65
Delta Pressure	112
External sensor	111

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender

[**] Unit of setpoint

The Unit of the setpoint can be configured in the Focus1 dashboard and currently offer the options as listed below. The unit options are different for each type. Each of the options has a single byte identifier as defined in the HART-7 standard. This identifier is conveyed in this Profinet submodule.

Setpoint Control type	Available units	Unit identifier (decimal)
Valve Position	%	244
VolumeFlow	m3/h	19
	ft3/min	15
	gal/min	16
	l/s	24
	m3/day	29
	m3/min	131
	m3/s	28
	l/h	138
	l/min	17
	ft3/h	130
	ft3/s	26
	gal/day	235
	gal/h	136
	gal/s	22
	IG/day	31
	IG/h	30
	IG/min	18
	IG/s	137
	barrel/day	135
	barrel/h	134
Inlet Pressure Outlet Pressure Delta Pressure	Pa	11
	kPa	12
	MPa	237
	bar	7
	psi	6
	torr	13
	atm	14
External sensor	–	252

FOCUS-ON VoF | A SAMSON & KROHNE COMPANY

Kerkeplaat 12, 3313 LC Dordrecht,
The Netherlands
K.v.K. 74863223

Changing the flow forever
www.focus-on-process.com

Document (rev.)	**TD-088(3)**
Date (rev.)	17-01-2024
Author	JP Diender
Process owner	JP Diender