

# **IO**-Link

IO-Link Field Device: Rheonics, SME

Doc ID: IOL-OP-2411

Covers sensors: Type-SR and Type-DV



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### **1** Before you begin

#### 1.1 About the manual

This manual provides information on IO-Link support on Rheonics devices. This document specifies all the device-specific features and IO-Link Protocol implementation details. This manual assumes that the following conditions apply:

• The sensor has been installed correctly and completely according to the installation guidelines.

• The installation complies with all applicable safety requirements.

• The user is trained in relevant safety standards.

#### 1.2 Purpose

This manual is designed to complement the SME Installation Manual by providing a complete, clear description of this field device from an IO-Link Communication perspective.

#### 1.3 Who should use this document?

The specification is designed to be a technical reference for IO-Link end users. This document assumes the reader is familiar with IO-Link protocol requirements and terminology.

#### 1.4 Warning

Before connecting the IO-Link adapter in an explosive atmosphere, make sure instruments are ordered and installed in accordance with intrinsically safe or EX classification-specific field wiring practices. Explosions can cause serious injury or death. Review Rheonics Ex Manual at <a href="https://rheonics.com/resources/manuals/">https://rheonics.com/resources/manuals/</a>.

#### 1.5 Nomenclature

Abbreviation (short form)	Full-term	Meaning
SRV	Symmetric Resonator Viscometer	Viscosity sensor
SRD	Symmetric Resonator Densitometer	Density and Viscosity sensor
DVP	Density Viscosity Probe	HPHT inline probe
DVM	Density Viscosity Module	HPHT inline module
RCP	Rheonics Control Panel	Software for data acquisition and configuration
SME	Smart Module Electronics	Sensor electronics
	Table 1 Defined Assessment	

Table 1. Defined Acronyms



#### 1.6 Related Documentation

You can find all product documentation on the USB storage device that is integrated in the sensor or was shipped with the sensors. You can also find them on the website at: <u>https://rheonics.com/resources</u>

For more information on the sensor, refer to the following documents on Rheonics website. Contact the Rheonics Support Team if you cannot find a document online.

Title	Code	Description
IO-Link Communication Manual	IOL-OP	IO-Link integration with Rheonics sensors
Communication Protocol Manuals	Various	Modbus TCP, Modbus RTU, HART, Profinet, Ethernet/IP, etc.
SME Manual	SME-OP	Sensor Module Electronics Operator Manual
RCP Software Manual	RCP-OM	Rheonics Software Installation and User Manual
EX installation Sensor Manual	EX-IM	Installation of Intrinsically Safe Sensors Manual

Table 2: Related documentation



### 2 Product overview

#### 2.1 Process Interface

Rheonics SME is the electronics module of Rheonics sensors. The SME, shown in next Figure, is the device that enables integration with industrial communication protocols. This device provides clients the IO-Link adapter interface through Modbus RTU protocol, hence this manual also contains information on Modbus RTU. For further information review Modbus RTU manual on Rheonics web page.



Figure 1. SME sensor electronics unit.

Rheonics SME is used for the Type-SR (SRV & SRD), Type-DV (DVP, DVM) and other sensor types from Rheonics.



Figure 2: Rheonics sensor probes for viscosity and density measurements.



#### 2.2 IO-Link adapter

An IO-Link adapter enables communication between different protocols. To use IO-Link with Rheonics sensors, Modbus signals are converted to IO-Link via an adapter. The IO-Link adapter comes with a fully prepared connector for easy integration.



Figure 3. Banner IO-Link adapter(See Appendix A)



### **3** IO-Link Wiring

#### 3.1 Instrument overview:

Rheonics has successfully implemented IO-Link communication with its electronics for communication with IO-Link Masters. Depending on the Rheonics sensor type, this allows variables like viscosity, density, temperature, concentration, specific gravity and others to be transmitted in real-time over IO-Link to a device like a PLC or an IO-Link master. The IO-Link integration with Rheonics is composed and delivered with the following items:

o IO-Link master

An IO-Link master is a device used in the industrial automation area to connect and manage communication between IO-Link-enabled sensors or actuators and a higher-level control system, such as a PLC or a PC.

#### o IO-Link Adapter

An IO-Link adapter or converter is a device that facilitates the conversion between different communication protocols. To use IO-Link protocol on Rheonics sensors, Modbus signals are converted to IO-Link using an adapter. A fully prepared connector is delivered with the sensor.

#### o IO-Link cable

Rheonics provides the IO-Link cable that goes from the Rheonics SME to the IO-Link adapter. User must select the length to the IO-Master.

#### o Rheonics SME

Rheonics SME is the ultra-fast and robust sensor electronics that includes comprehensive computational models. Depending on the variant, it can be suitable for mounting on DIN rails, inside cabinets, outdoors installations, local display, and laboratory setups. Rheonics SME is powered by 24 DC Volts and is equipped with an Ethernet port, Modbus RTU RS-485 port, and 3 channels for 4-20 mA Analog outputs as detailed in Figure 1.



#### 3.2 Rheonics Modbus to IO-Link Wiring

Connect the IO-Link adapter from the Rheonics sensor to an IO-Link Master device.



Figure 4. IO-Link wiring diagram



### 4 Modbus RTU Verification

- 4.1 Components Used
  - Rheonics sensor w/ Firmware V03.30/0 or higher
  - Modbus Communication software (e.g. Modbus Poll)
  - Rheonics Control Panel (RCP) Software
  - Windows 10 or higher 64 bit
  - USB-RS485 2-Wire Converter Terminal Block or adapter

#### 4.2 System Connections

Connect the Rheonics sensor to a PC (with RCP and Modbus communication software installed) using the RS485 pins of the sensor electronics. This can be done with the USB-RS485 or RS232-RS485 adapter. If no communication is established check the RS485 Port and check polarity.

#### 4.3 Configure Rheonics SME

In this section, the SME Ethernet configuration is set. We will use a PC with the RCP software and connect it to the SME using USB. Verify the Address, Baud Rate and Polarity of the device. Figure 6 shows a standard configuration that can be used for the correct performance of the system. See the next steps as guidance.

Note: For IO-Link communication always use the default configuration that comes with the sensor.

• Open the RCP software. On Settings Communication Tab, select USB, identify the COM Port of the desired SME to connect and click Apply. Wait for the Status Led to go green.

isurement   Event	ts Settings Sen	ce Diagnostics	Communicatio	n   Temp. Control	Logger	Help	ſ
Operator		Communication					
Name / ID	Rheanics	USB Port	COM25	Autodetect			Status
Client	Rheonics GrabH	U ememat		Port 10001	Noply	Manager	•
Sensor Configural	tion	Units		_		Resolut	ion
iensor Type	SRV	Viscosity 🛞 🕫	NY OF	O di		0.000	~
Import	Export	Density 🔘 🖯	() () again	Outran Outra		0.0000	
	Expert Mode	Temperature 🛞	0.1	0.1		0.00	2
		Pressure 🛞 🛛	O 184	O the O en	One Oe	0.00	
Pressure Gauge		Graph Settings					
Communication	V	Wscesity 😒	) auto ()	tia Min	1 mPa.s N	Ane 40 mPa	1
Device ID	No Sensor	Calc. Density	🕢 otus 💿	the Min	0 kg/m3 N	fax 1.5 kg/m	5
on Sottings		Temperature Scale	• anto •	fia Min	10 °C	fax 40.1	
Logging Interval	10] sec ~	Pressure Scale	🔾 otus 🛞	tia Min	1.bar N	Aax ( 10 ba	i.
Measurement Freque	ncy (Every) 10 sec	Time Scale	🖲 tuli 🔘	fix Range	5 mm ~		
I Log and display 고 Log debug infor	data with error code	Graph Interval	reatine	Same as logging rouenest instead of Vac	osity & Dennity		

Figure 5: USB connection with SME.

• For the RTU communication, verify the Modbus Address, Baud Rate and Parity.

	1.	1			10					
Modbus RTU (RS-485)		8	LCD Di	play (SME	TRD Only)		- 1	Write	and Updat	•
Modbus Address	1		Line 1	Paramet Viscosity	er V	Resol	ution		Write Con	fig
Baud Rate	38400	~	Line 2	Density	~	0.000	<b>v</b>			=
Panty	ODD	×	Line 3	Temperatu	ire 🔍	0.00	~		Load Cont	ig
themet		0	Locatio	n ID	_	-	-		-	
Ethernet MAC	70:83:D5:D2:00:10		Locatio	n ID				Latitude	0.000000	
DHCP	False	2	Locatio	on Name				Longitude	0.000000	
IP	10.5.33.85							Altitude	0	
Subnet	255.255.255.0									
Gateway IP	0.0.0.0		Operati	on History	6	-	-	_	-	
DNS	8.8.8.8		RTC Tir	se	24/08/22 00:51:28			Supply Voltage	23.45	v
Terminal Port	10001	J	Last po	wer Reset	19/08/22 20:52:40			SME Temp.	46.30	*c
Bluetooth LTE 4.0	_						Max. Sense	or Temp. Exposure	32.58	°C
MIC	00.00.00.00.00.00						Max. SME	Temp. Exposure	54.51	°C

Figure 6: Review Modbus RTU Parameters in RCP.

• Click "Write Config" to ensure this is the configuration in the SME. Wait until the button turns green.

easurement Eve	ents	Settings	Service	Diagnost	tics C	ommunication	Temp. Conti	tol Logger	Help	1
Modbus RTU (RS	-485)		0	LCD Dis	play (SME	TRD Only)		8	Write and Updat	te
Modbus Address		1		Line 1	Paramete	a.	Resolution	ution	1	1
Baud Rate		38400	~	Line 2	Density	~	0.000	~	Updatin	9
Parity		ODD	~	Line 3	Temperatu	re v	0.00	~	Load Con	fig
thernet	-	_	0	Location	ID	-	-		_	-
Ethernet MAC	7	0:83:D5:D2:00:00		Location	D			Latitude	0.000000	
DHCP	F	alse	v	Locatio	n Name			Longitu	de 0.000000	
IP	1	92.168.8.30						Altitude	0	
Subnet	2	55.255.255.0								
Gateway IP	1	92.168.8.1		Operatio	on History	1	-	-	_	-
DNS	0	0.0.0		RTC Tim	e	12/08/22 00:04	:47	Supply	Voltage 23.39	v
Terminal Port	1	0001		Last pov	ver Reset	19/07/22 18:19	22	SME T	emp. 48.60	*C
Bluetooth LTE	4.0	_						Max. Sensor Temp.	Exposure 32.58	*C
								Max SMF Temp. Fxt	54.51	1.00

Figure 7. Upload configuration to the SME.

# 5 Modbus Protocol

The structure of the request and response body in Modbus RTU connections, from the function code to the end of the data portion, has the same layout and meaning as in the other MODBUS variants, such as Modbus TCP or Modbus ASCII. The only differences are the form of any 'framing' sequence, error check pattern, and address interpretation.

#### 5.1 Measured Parameters List

The measured parameters are mapped into the Modbus input registers. There is a total of 23 Parameters available from the SME. Table 3 shows the associated variable, Sensor and Error status.

Parameter	Measurement	Description
Parameter 0	Viscosity median	Takes the median of the last E
Parameter 1	Density median	sonsor mossurements points
Parameter 2	Temperature median	sensor measurements points
Parameter 3	Kinematic Viscosity	Measured value divided by density squared
Parameter 4	Density average	Calculates the average of the last 5 measurement points
Parameter 5	Viscosity raw 'process measurement'	Roads the direct measurement
Parameter 6	Density raw	taken by the sensor
Parameter 7	Temperature raw	taken by the sensor.
Parameter 8	Resonant Frequency	Mascurad in Hartz
Parameter 9	Compensated Resonant Frequency	Weasured III Hertz
Parameter 10	Damping	Damping from Measurement
Parameter 11	Coil Temperature	
Parameter 12	Viscosity Last Good	Keeps the last-good median measurement in memory when
Parameter 13	Density Last Good	there is a measurement error
Parameter 14	Displays of mapped value from Modbus register 512	
Parameter 15	Displays of mapped value from Modbus register 514	
Parameter 16	Displays of mapped value from Modbus register 516	
Parameter 17	Estimated Temperature	Calculated from internal temperature Algorithm
Parameter 18	Temperature from PT1000 sensor	Read from internal sensor
Parameter 19	Calculated parameter from viscosity model	
Parameter 20	Calculated parameter from density model	Sat from Advanced Calculations
Parameter 21	Calculated parameter from concentration model	Set from Advanced Calculations
Parameter 22	Sensor Cleanliness Ratio	Used for estimating sensor cleanliness
Sensor Status	Sensor Error Status	Status of the sensor
Error	Error State	Error state of the sensor

Table 3: Measured Parameters List.



6

### Data structure

Rheonics devices offer different modules and parameters through IO-Link. Currently, the following parameters are available in Address 0.

Parameter	Data In	Format
Sensor Status	1	Unsigned Int16
Power Supply	2	Float 32
-	3	-
Parameter 12 Viscosity Last Good	4	Float 32
-	5	-
Parameter 12 Viscosity Last Good -Status	6	Unsigned Int16
Parameter 13 Density Last Good	7	Float 32
-	8	-
Parameter 13 Density Last Good - Status	9	Unsigned Int16
Parameter 2 Temperature Median	10	Float 32
-	11	-
Parameter 2 Temperature Median -Status	12	Unsigned Int16
Parameter 4 Kinematic Viscosity	13	Float 32
	14	
Parameter 4 Kinematic Viscosity- Status	15	Unsigned Int16

Table 4. Address 0 data access point



### 7 Accessing the Data with PACTware

- 7.1 Reading the IO-Link Data from the Rheonics sensor.
  - $\circ$   $\,$  Open PACTware and select the IO-Link device that is connected
  - Scan the devices
     Scan the connected device to display all preconfigured data stored in the Rheonics sensor.
  - Access input registers
     In Output (from PLC), select the address 0 to access the preprogrammed data from the adapter. This will provide access to the Input registers from the sensor. Check the Table 3.
  - In PACTware to visualize data, go to "Process data", and click the cyclic read button.

PACTWORE DC	🛆 Device 🕁 Favor	ites @ Settings		
1. Start	Set device parameter			
2. Connection Parameter	Save as favorite	Clone parameters		
3. Search	Vendor Banner En	gineering Corporation		
4. Select DTM	Product S15C-MG	4-KQ Product of 515C-MGN+KQ   G≥ PG G G G G G S G G G G G G		
5. Device	Manu	Process data v Enable or disable cyclic read		
Read from device	- Identication - Parameter	Input (to PLC)		
	Empress data	Name - Friesday Gale III, meas an postalet valvage	Value	
Write to device	- Events	20 Barren Data las Read Sat Revisitas 02 Malas	1500	
	- kita	BD Draws Data In: Need Cat Register 0.5 Value	200	
Parameter	- Connection info	Read Set Register 04 Value	230	
		Process Data In : Read Set Register 05 Value	0	
		- Process Data In : Read Set Register 05 Value	0	
		Process Data In : Read Set Register 07 Value	2	
		- Process Data In : Read Set Register 08 Value	0	
		Process Data In : Read Set Register 09 Value	16343	
		Process Data In ; Read Set Register 10 Value	9294	
		Process Data In : Read Set Register 11 Value	168	
	/	Process Data In : Read Set Register 12 Value	0	
	N.	Provide Data In Board Set Register 13 Volum	16363	
		10 Descent Date for Band Cat Desirate 141/4/an	(523) (523)	
		Age Process Data In : Heed Set Register 14 value	22.3*	
		Sar Process Data In : Read Set Register 15 Value	24	
		Output (from PLC)		
		Name	Value	
		Trocess Date Out		

Figure 8. Starting cyclic read with Rheonics sensor



# 8 IO-Link integration with S7-1200 with IO-Link Master SM 1278

#### 8.1 Components

o Rheonics SME with IO-Link Adapter

The setup, as covered in Figure 3, consists of an IO-Link adapter that ensures seamless protocol conversion for interoperability between devices in industrial settings, along with the Rheonics SME utilizing the Modbus RTU protocol.

o SM 1278

The SM 1278 module allows data exchange with up to four external IO-Link devices, each connected by a single 3-wire cable. Alternatively, it can connect up to four standard actuators or sensors. Its flexible configuration options enable the controller to be easily adapted to different communication partners, ensuring compatibility and smooth operation across various devices.

o TIA Portal

The Totally Integrated Automation (TIA) Portal is Siemens' comprehensive engineering platform designed to provide a complete suite of automation solutions. It integrates hardware configuration, programming, and diagnostics in a single, user-friendly interface, enabling seamless coordination of devices and systems.

#### 8.2 Hardware connection and block diagram

Connect the IO-Link adapter from the Rheonics sensor to an IO-Link Master device. **Pin 2 on the connector is not used.** 



Figure 9. IO-Link Master SM 1278 with Rheonics sensor SME-DRM



#### 8.3 Integration steps

• Add the IO-Link master SM 1278 from the Hardware catalog in TIA PORTAL. The 4-port IO-Link device is added to the project now.



Figure 10. Adding IO-Link Master device SM 1278 to S7-1200 project

 $\circ$   $\,$  Open the SIMATIC S7 PTC Tool by right-clicking the device just added.



Figure 11. starting the S7-PTC to configure the IO-Link Master device and the IO-Link converter



• A prompt message will appear to start the S7-PTC software.

Siemens - D. Users Administrator Desktop Rhe	nnics SupportIRPS Project_2_IOLINKRPS Project_2_IOLINK			- 8
roject Edit Wew Insert Online Options Ti	ob. Window Help		Totally Integrated Automat	tion
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F B PLC_1 [CPU 1212C DODODC]			• CPU	0
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Engrouped devices	(DD) with an		Communications boards	
b Security settings			Battery boards	
Cross-device functions			- 10 00 1297	
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	General Short designation: SM 1278. 6 × IO-Life NM/STER	-	<ul> <li>Al Energy Meter</li> </ul>	
	Farameter Description: 4-channel serial interface module for connection of IO link devices	0	• <b>A</b> Q	
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	* Ports		AQ 4x14BIT	
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D Lineman and devices			<ul> <li>Weighing modules</li> </ul>	
Security settings			Condition Monitoring System	
Cross device functions			IO link master	~
Common data		v	> Information	10
Portal view	PLC_1		Project RPS Project 2: IOLINK opened.	

Figure 12. Starting the S7-PTC

 Download the IODD file for the IO-Link converter which can be found at <u>https://www.bannerengineering.com/us/en/products/part.809836.html</u> and import this file in S7-PCT.

Re       Re <td< th=""><th>K SIMATIC S7-PCT - PLC_1</th><th></th><th>_ # ×</th></td<>	K SIMATIC S7-PCT - PLC_1		_ # ×
Image:	File Edit View Device	Cptions Help	IO-Link
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Site SAMe or     S			S15C-MGN-KQ
Commentation make			Product name: S15C-MGN-KQ
			Product text Inline converter ID-Link to ModB.
			Firmware rev:
Communitation that the address of th			Hardware rev.:
Communities for addition			Device family. Inline converter
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devices to the catalog.	Communication results		
	Adds new devices to the catal:	ag	

Figure 13. Installing the IODD file.



• Drag and drop the IO-Link converter to the IO-Link Master.

K SINATIC S7-PCT - PLC_	1				_ # ×
File Edit View Device	e Options Help				IO-Link
9 🕒 🖬 🥔 🗶 🗷		1 🖉 🖂 🚱			Port Configuration Tool
* PLC_1*	Ports Addresses Status	I&M Commands		^ Catalog	9 ×
[Skt 2] SM 1278_1	General master	nformation		Search	
	Product name:	SM 1278 IO-Linix Mantee V2 1		Text search	×
	Article cumber	FS7 27L4R010.0x80			tes tes
	Commit			Profile: V	1.0 and V1.1 ~
	Contract			· (#101	nk V10
				- 🗐 10 L	sk V1.1
	Port information				anner Engineering Corp.
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	Courns sider   Toggie			¥	IEMENS AG
	Pot Autosense Mo	s Name	IO-Link version Inspection le	el Backup level	TANDARD
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				Device fam	ly: Inline conveter
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				v <	
Communication results					
Ready			TEP 7 (Integrated) Commissioning		

Figure 14. Adding IO-Link converter for configuration

 $\circ~$  Go to the Addresses tab to verify which PLC address was assigned to the data in IO-Link.

SIMATIC S7-PCT - PLC_	1				_ @>				
File Edit View Device	Options Help				IO-Link				
9 3 🖯 🖓 🎽 X 25		¥ 🗉 0			Port Configuration Tool				
* PIC_1*	Ports Addresses Status	IBM Commands			<ul> <li>Catalog</li> <li>P &gt;</li> </ul>				
Sct 2] SM 1278_1	General master infe		Search						
Classenann	Product name: SM	Act name, SM 1278 K9-Link Medler V2.1							
	Article number: 6ES	7 278-48032 0X80			Tes Les				
	Commont				Profile: V1.0 and V1.1 v				
	A AND A COMPANY OF				IO Link V1.0				
-					• 1 10 Link V1.1				
	Port information				Idaner Logneering Lop.     Idaner Logneering Lop.				
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	Rod Astronom Marks	have	C) bit writes frameric	olaut Radius isud	SIEMENS AG				
		STREWEILKO	Vil Trees	natile v Rackup&Restore v	a contraction				
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	3 Deactiva	ed ~	No ched	01 -					
	4 Deactival	ved 🗸	No check	01					
	Details								
	Vendor name:	Barner Engineering Cop.							
	Vendor URL:	enve barnerensineeths.com/billek							
				more sensors, more sensities					
	380				Device				
	Device name:	S1SC-MSN-HQ							
	Description:	Infine converter IO-Link to ModBue, Device family Inline converter. Release date 2020-07-15							
	Article number	S15C MGN-HQ							
	POD AL AND	Parate Destantes CHE MCM /C 2020215-00001 June			S15C-MGN-KQ				
	looo ke nake.			· · · · · · · · · · · · · · · · · · ·	Destant same				
	Businessile de las IDe				Product least				
	Hepsaceacie device ico				Firmware rev.				
	Competibility:	The device is only compatible with the IO-Link revision 1.1.			Hardware rev:				
	Connect				Device family				
	1000000				Release date: 2020-07-15				
					IODD file name: Banner Engineering S15C-MGN				
					202007154ODD1.1.xml				
					-				
c >					v ( )				
Communication results									
and the second se			STED 7 //atsocrated) Commissioning						

Figure 15. IO-Link Master configuration in Ch1



 $\circ$   $\,$  Click the show addresses button to check the assigned address on the PLC.

	¥ 🖽 🛛			PortC				
Ports Addresses Status	18M Commands			<ul> <li>Catalog</li> </ul>				
General								
Input della 32 Brite Fut southiler								
Output data:	32 Byte			Puella 10 Puella 1				
				VID and VID				
				ID LHK V1.0				
Show PLC addresses	Pack (Byte) Pack (B	0		Barner Ensin				
Port information .	a second s			- Inine con				
Rat land start land on	of Length Colorisation Colorisation Length							
1 80 297	23 Bas 0.0 28 7 21 Bas			SIEMENS A				
2	active out of the							
3								
4								
Contraction and the second second								
Structure of proce	ss data							
All ports	Pot Name	Data type	Address	*				
Create PLC data type acurce file	1 Process Data In - Read Set Register 15 Value	Word	*AW 8					
	1 Process Data In - Read Set Register 14 Value	Word	2/W 10					
	1 Process Data In - Read Set Register 13 Value	Word	12MV 12					
	1 Process Data In - Read Set Register 12 Value	Word	32W 14	Device				
	1 Process Data In - Read Set Register 11 Value	Word	2/W 16					
	1 Process Data In - Read Set Register 10 Value	Word	2/W 18					
	1 Process Data in - Read Set Register 09 Value	Word	SW 20					
	1 Process Data In - Read Set Register 08 Value	Word	13W 22					
	Hocels Lata In - Head Set Hegister 07 Value	word	200 24					
	Process Data In - Read Set Pregister 00 Value	Word	NW 26					
	Process Cata In - Read Set Register US Value      Descent Out a la - Read Set Register US Value	Word	200 20					
	Process Cate in - Read Set Register Of Value	Ward	TW D					
	1 Process Data In , Read Set Resister 02 Value	Word	TIM 34	Product name: 315C				
	1 Process Data In - Read Set Register 01 Value	Word	1.0V 36	Product text Inline				
	1 Process Data in - Counter Value	bite	1/8 38	Permisero rev.				
	1 Process Data in - Register Set To Read	Exte	2/8 39	Hardware rev.				
	1 Process Data In - Register Read Successful	Bool	XI 39.4	Device family: Inline				
	1 Process Data In - Register Write Successful	Bool	31 29.5	Helease date: 2020				
	1 Process Data in - Register Verify Successful	Bool	11 39 6	IODD file name: Bana 2020				
	1 Process Date Out - Write Set Register 15 Value	Word	1QW 8					
	1 Process Data Out - Write Set Register 14 Value	Word	xQW 10					
	1 Process Data Out - Witte Set Register 13 Value	Word	1/2W 12					
-								

Figure 16. IO-Link Master mapping in S7-PTC

• Table 5 below presents in S7-PTC will show a format like this one.

Rheonics Data-Address	Parameter	PLC Address
Process Data In - Read Set Register 15 Value	Parameter 4 Kinematic Viscosity- Status	%IW 8
Process Data In - Read Set Register 14 Value		%IW 10
Process Data In - Read Set Register 13 Value	Parameter 4 Kinematic Viscosity	%IW 12
Process Data In - Read Set Register 12 Value	Parameter 2 Temperature Median - Status	%IW 14
Process Data In - Read Set Register 11 Value		%IW 16
Process Data In - Read Set Register 10 Value	Parameter 2 Temperature Median	%IW 18
Process Data In - Read Set Register 09 Value	Parameter 13 Density Last Good - Status	%IW 20
Process Data In - Read Set Register 08 Value		%IW 22



Process Data In - Read Set Register 07 Value	Parameter 13 Density Last Good	%IW 24
Process Data In - Read Set Register 06 Value	Parameter 12 Viscosity Last Good - Status	%IW 26
Process Data In - Read Set Register 05 Value		%IW 28
Process Data In - Read Set Register 04 Value	Parameter 12 Viscosity Last Good	%IW 30
Process Data In - Read Set Register 03 Value		%IW 32
Process Data In - Read Set Register 02 Value	Power Supply	%IW 34
Process Data In - Read Set Register 01 Value	Sensor Status	%IW 36

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Table 5. Variable mapping in TIA PORTAL

 $\circ$   $\;$  The next step is to map all the variables to the PLC  $\;$ 

piect tree II 4	RPS 1	Project 2 IOLINK	> PLC 1 (CPU 1212C D	DC/DCI > PLC to	ags 🕨 Tag ta	ble 1 [10]						_ 7 = X	Tasks	-
Devices											an Tao	e III liser constants	Ontions	and the second second
		allow to look a										-	opuons	
	20	ं ड र ा	я											
	T.	ag table_1											✓ Find and replace	
RPS Project_2_IOLINK	^	Nome .			Data type	Address	Retain	Acces	Write_	Visibi	Comment		and the second se	
Add new device	10	Parameter -	4 Kinematic Viscosity/Status		Int	94/48							Find	
m Devices & networks	2.1	Parameter -	4 Kinematic Viscosity		Int	%W12								
<ul> <li>III PLC_1 [CPU 1212C DC/DC/DC]</li> </ul>	3	Parameter :	2 Temperature Median -Status	3	Int	%W14		<b>M</b>					Whole words only	
Device configuration	4	• Parameter	2 Temperature Median		Int.	59W18							Dabacherera	
Online & diagnostics	5.	Parameter	13 Density Last Good - Status		Int	NJV/20							i Martin Case	
Program blocks	6	Parameter	13 Density Last Good		Int	94/024							Find in substructures	
<ul> <li>Technology objects</li> </ul>	7	Parameter	12 Viscosity Last Good -Status		Int	%W26			M	M			Find in hidden texts	
External source files	8	Parameter	12 Viscosity Last Good		Int	%W30				<b>_</b>			Use wildcards	
• La PLC tegs	8	Power Supp	h.		kot .	%W84							Children and the second second	
Show all tags	10	Sensor Stat	us(1)		Int	NV36							Three sedmine addressroup	
Add new tag table	11	<5dd news				1		4	M	4			Down	
Default tag table [92]													OII	
Disgnestics [11]													0.00	
SH0002 [117]													Find	
3 Tog table_1 [10]													and the second second second	
Cill PLC data types													Replace with:	
Watch and force tables														
Online backups													(a) Whole document	
Traces													0	
OPC UA communication													O nom current position	
<ul> <li>Device proxy data</li> </ul>													() Selection	
📇 Program info													Replace Replace all	
PLC a larm text lists	2. 1													
Local modules	Para	meter 4 Xinoma	lic Viscosity Status [PLC t	ia)							Properties 1 Info ()	Diagnostics	✓ Languages & resources	
Distributed I/O	1	and a subscription of the	Internet and a second second								The second secon	- regression lineausaina		
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Security settings	1.11		rag											
Cross-device functions			General										Deference la novana:	
Common data													inclusion anguage.	
a fina and a second	-			Name:	Parameter 4 K	nematic Visc	osity-Status					10	English (United States)	
Details view				Data broat	Int	1101020051100						121		
				and the second								100		
			1	Address:	21//8									
			1		Retained									
name Data type Detail	-			Comment!	1							18		
ratameter 2 temperatu Int Silva														
Parameter 2 remperatu Int %IW			History											
Parameter & Runematic Int %(W														
Parameter + Kinemetic Int 11 %IW				Date created:	3/22/2024 6:11	PM								
Patameter 17 topposity int Silk				Instantiad	1022/2024 6:12	PM								
Provide and Parling and Arts				PRATE TO A COMPANY OF A COMPANY		4 999 C								
Parameter 12 Viscosity Int \$104_	-			Cart mounter.										

Figure 17. Added tags for IO-Link communication



• Finally convert the data to correct format.

(2) (2) (2) (2) (2) (2) (2) (2) (2) (2)	E.
Block interface	
• Network 8:	^
Comment	
MOVE         MOVE           EN         EN	
<ul> <li>Notured 0.</li> </ul>	
Comment	
SHL DWord EN EN EN 16 N OUT #tem_Word	
▼ Network 10:	
Comment	
OR DWord         CONV DWord         CONV           #ARRAY[1]         Ferror         ENO         ENO           # ARRAY[1]         N1         **Parameter 12         **Parameter 12           **Parameter 12         **Parameter 12         **Parameter 12           **Dord         N2         **Parameter 12           **Parameter 12         **Parameter 12           **BoothLast         Viscosity Last           OUT         good IO-Link*	
▼ Network 11:	
Comment	
1	100%

Figure 18. Data conversion for Rheonics sensor reading



9

### Sensor status and parameter status

All Rheonics sensors for inline viscosity and density monitoring have sensor status The sensor status which is read at Register 01(See Table 4) will display the following information.

#### 9.1 Sensor Error Status

The sensor status can take any of the following values OR a combination of them:

Bit	Hex	Name	Comment
Bit 0	0x0001	PLL frequency	The PLL frequency does not match the sensor frequency.
		mismatch	Derived from the ASB string (E10)
Bit 1	0x0002	PLL not locked	The PLL is not locked. Derived from the ASB string (E01)
Bit 2	0x0004	PLL lock incorrect	The PLL has locked on a wrong frequency. Derived from the ASB string (E02)
Bit 3	0x0008	ASB communication error	Issues with sensor electronics
Bit 4	0x0010	Temperature sensor failed	The temperature sensor has failed. Derived from the ASB string if temperature is -273.0
Bit 5	0x0020	Sensor too hot	If temperature is above the hardcoded physical temperature limit.
Bit 6	0x0040	ASB communication error	Communication issue between two electronics boards in the SME
Bit 7	0x0080	Serial Changed	
Bit 8	0x0100	Status not clean	Sensor is not clean (only SRV)
Bit 9	0x0200	Status in Air	Determines if sensor is in air
Bit 10 -15	Unused		

Table 6: Sensor error status bit code and description.

#### 9.2 Parameter Status

The Parameter Status can take any of the following values, OR a combination of these states.

For example: If there is a config error, the status value will be 0x0003

If there is a config error and an internal error, the status will take a value of 0x0023.

Bit	Hex	Name	Comment
Bit 0	0x0001	General error	This bit is always set in case there is an issue with the parameter. It can be used by the general user or application programmer to alert an issue with that parameter output. For details check the other bits
Bit 1	0x0002	Config error	The parameter is not configured or there exists a configuration error.
Bit 2	0x0004	Hardware error	The parameter cannot be calculated as the hardware failed. Example: Temperature sensor has failed.
Bit 3	0x0008	Dependent error	A parameter source for a dependent parameter is not available. Example: In case of a free formula a referenced parameter is NAN.
Bit 4	0x0010	Not ready	No result is yet available. Example: No measurement has been taken yet. The algorithm requires a run-in time



Bit 5	0x0020	Internal error	Internal error - Report to Rheonics
Bit 6	0x0040	Calibration Error	Diagnostics
Bit 7	0x0080	Further use	
Bit 8	0x0100	Parameter Calibrated	Triggered when parameter has a calibration/scale factor/coefficient applied to it.
Bit 9	0x0200	Model Loaded	Active when a model has been loaded in script parameters. Only valid for parameters 19,20,21
Bit 10	0x0400	Filtering Active	Active when there is a filter loaded for that parameter
Bit 11	0x0800	Not stable	Parameter result not yet stable Example: Set for example on viscosity if sensor status is not okay.
Bit 12	0x1000	Warning lower	Below lower warning limit (if configured for parameter)
Bit 13	0x2000	Warning upper	Above upper warning limit (if configured for parameter)
Bit 14	0x4000	Alarm lower	Below alarm limit (Hardcoded depending on parameter type)
Bit 15	0x8000	Alarm upper	Above alarm limit (Hardcoded depending on parameter type)

Table 7: Parameter Status bit code and description.

#### 9.3 Which parameters should I read?

Each of the 23 parameters from Rheonics sensor are shown in Section **Error! Reference source not found.** and can be programmed if requested to the Rheonics sales team.

For up-to-date parameters information, please check the pages:

https://support.rheonics.com/support/solutions/articles/81000393235parameter-list-access-for-field-devices



 https://support.rheonics.com/support/solutions/articles/81000393237 

 units-translation-table-for-field-devices



### 10

# **Units table**

Unit	Unit	Unit	Unit
Index	Display	Index	Display
0		35	°Baumé
1	mPa.s	36	°Brix
2	сР	37	%wt/v
3	Pa.s	38	%v/v
4	Poise	39	%vol
5	Reyn	40	Bar
6	mm²/s	41	psi
7	cSt	42	m³/s
8	St	43	sccm
9	m²/s	44	gpm
10	in²/s	45	рН
11	SUS	46	m³
12	VI	47	gal
13	AV	48	STP
14	PV	49	Tref
15	YP	50	n <sub>D</sub>
16	sec	51	%wt
17	μ	52	%Vol
18	η	53	mol/m <sup>3</sup>
19	ν	54	alcohol
20	°C	55	ethanol
21	°F	56	Hz
22	°К	57	rhe
23	refxx∘y	58	°P
24	g/cc		
25	Kg/m <sup>3</sup>		
26	lb/ft <sup>3</sup>		
27	lbm/gal		
28	lbs/gal		
29	ppg		
30	pptf		
31	slug/ft <sup>3</sup>		
32	SG		
33	ρ		
34	°API		

Table 8. Units translation table.



### 11 .

# Troubleshooting

Electronics Issues	
Red or no LED lights in SME, error in display or output signals	<ol> <li>Check power supply and cabling</li> <li>Check Rheonics SME-OP manual online for information</li> </ol>
SME does not power up	<ol> <li>Check power supply and cabling</li> <li>Try with a different power supply</li> </ol>
Sensor Probe Issues	
NaN values are displayed on the display, RCP software or PLC	<ol> <li>Check wiring from the probe to SME is correct</li> <li>Check the probe visually, this may require disassembly from the process</li> <li>Contact Rheonics Support Team</li> </ol>
Converter issues	
No data is visible	<ol> <li>Check the Power led is green on the SME and IO- Link adapter.</li> <li>Check Modbus port is properly wired</li> <li>Try swapping wire A and B from RS485 lines</li> </ol>
Data issues	
Measured value is different from my reference standards	<ol> <li>Viscosity is shear- dependent for non- Newtonian fluids, which means readings differ between sensor technologies</li> <li>Density should be the same under equal temperature and pressure conditions. Contact Rheonics Support Team</li> <li>To verify Rheonics sensors' accuracy,</li> </ol>



	calibration fluids and correct setup should be used. Contact Rheonics Support Team
Wrong readings for each parameter	<ol> <li>Verify each parameter is correctly mapped, some bytes may be swapped</li> <li>Try swapping wire A and B from RS485 lines</li> <li>Verify readings on the RCP software with the sensor connected to the PC via Ethernet or USB</li> </ol>
Sensor Status does not match any bit from the sensor status table	<ol> <li>Sensor status byte is swapped</li> </ol>
	••

https://support.rheonics.com/support/solutions/articles/81000397717modbus-rtu-troubleshooting



#### • Contact Rheonics Support Team at

- o support@rheonics.com
- o <u>https://support.rheonics.com</u>

https://support.rheonics.com/support/home



# **12** Appendix A: IO-Link converter

The S15C-MGN-KQ is a compact Modbus master to IO-Link converter that allows user configuration for reading up to 60 registers and writing up to 15. It automatically transmits predefined Modbus registers over IO-Link. Its flexible design enables direct connection to a sensor or in-line installation, providing both ease of use and versatility.



https://www.bannerengineering.com/us/en/products/part.809836.html

#### DISCLAIMER

Rheonics is not endorsing this product, users should use it at their own risk, and it merely serves for informational and illustration purposes; no rights can be derived from its contents.



# **13 Reviews and approvals**

Version	Nature of	Approval	Doc. ld	FW version	Date
	changes				
1	Original	C. Arroyo	IOL-OP-2411	3.30/15	14.11.2024



# 14 Notes/Errata

Contact Rheonics support for customization of system settings.

Notes