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# Ethernet/IP Manual RM-105/RM-106 RS-107/RS-108

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# 1. Contents

This manual contains information about the RM-105/RM-106, RS-107/RS-108 Ethernet/IP encoders on the following topics:

- Firmware and EDS file versions
- Technical details and encoder characteristics •
- Supply voltage and current consumption
- Hardware characteristics
- Supported standards and protocols
- Implemented encoder profile

#### Identification and maintenance functionality

- Hardware installation Electrical installation Status LEDs
- Quick Start Guide
- EtherNet/IP implementation Troubleshooting
- Release information
- Conformity

These operating instructions do not contain information about the installation of the RM-105/RM-106, RS-107/RS-108. You will find these in separate installation instructions.



# 2. Quick Start Guide

In this chapter, we demonstrate the use of an Allan Bradley EtherNet/IP PLC using the Rockwell Studio 5000 Software (V23.00) with the encoder.

Set up a free IP address on a free EtherNet Network Card as shown. We suggest using an IP address from the 192.168.1.x range, since this is the standard setting of the encoder.

🖳 Local Area Connection 6 Status	📮 Local Area Connection 6 Properties	Internet Protocol Version 4 (TCP/IPv4) Properties
General	Networking Sharing	General
Connection	Connect using:	You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
IPv6 Connectivity: No Internet access Media State: Enabled Duration: 04:06:11	Configure This connection uses the following items:	<ul> <li>Obtain an IP address automatically</li> <li>use the following IP address:</li> </ul>
Speed: 100.0 Mbps Details	✓ <sup>™</sup> Client for Microsoft Networks     ✓ <sup>™</sup> Client PC Network Filter Driver     ✓ <sup>™</sup> OS Packet Scheduler     ✓ <sup>™</sup> OS Packet Scheduler     ✓ <sup>™</sup> File and Printer Sharing for Microsoft Networks	IP address: 192 . 168 . 1 . 44 Subnet mask: 255 . 255 . 255 . 0
Activity		Obtain DNS server address automatically     Otse the following DNS server addresses:
Bytes: 26,751,561 362,872,465	Install Uninstall Properties Description Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication	Preferred DNS server: Alternate DNS server:
Properties Disable Diagnose	across diverse interconnected networks.	Validate settings upon exit Advanced

- Install Rockwell Studio 5000
- Start RSLinx Classic and set up the EtherNet/IP driver as shown:

RSLinx Classic Lite - [RSWho - 1]	had and the day fills we also we	
File View Communications Station DDE/OPC Securit	y Window Help	_ 8 ×
<u>*</u>		
Autobrowse Refresh Browsing - node 192.	168.1.4 found	
□	Linx Gateways AB_ETHIP-1 Ethernet Ethernet	
	Configure Drivers	8 23
	Available Driver Types:	Close
	Add New	Help
	Configured Drivers:	
	Name and Description         Status           AB_ETHIP-1         A-8 Ethernet RUNNING         Running	Configure
		Startup
		Start
Configure driver: AB_ETHIP-1		Stop
EtherNet/IP Settings		Delete
Browse Local Subnet     O Browse Remote	Subnet	
The subgrade to the tag an queries ( ) in the sub-second state		
Description	IP Address	
Windows Default Intel(R) Ethemet Server Adapter 1350-T2 #2	unknown	
Intel(R) Ethemet Server Adapter 1350-12 Intel(R) Ethemet Connection 1217-LM	132.165.1.44 134.3.2.120	
ОК Авь	rechen Obernehmen Hilfe	
For Help, press F1		NUM 07/31/15 02:02 PM

- Start Studio 5000
- Create a new project matching your PLC model
- Use the menu Tools / EDS Hardware Installation Tool to install all needed .EDS Files for your PLC and your Rockwell EtherNet/ IP communication module (if applicable). These EtherNet/IP EDS files can be found at http://www.rockwellautomation.com/ global/support/networks/eds.page?
- Use the menu Tools / EDS Hardware Installation Tool to install the EtherNet/IP .EDS File(s) of your Turck encoder(s). The encoder EDS files can be found on the Turck web site at www.turck.com .
- Set the IP address of your EtherNet/IP interface to a free IP address (in this example: 192.168.1.4) using the dials on the PLC or EtherNet/IP interface
- Set the project path for your configuration

🞯 Who Active		
Autobrowse Refresh		
	E	<u>G</u> o Online <u>U</u> pload <u>D</u> ownload Update <u>F</u> irmware <u>Q</u> lose <u>Help</u>
Path: AB_ETHIP-1\192.168.1.1\Backplane\0 Path in Project: AB_ETHIP-1\192.168.1.1\Backplane\0		Set Project Path

The project path now appears next to "Path:" in your Logix Designer Window.





Now right-click on Ethernet in the controller organizer pane and select "New Module".

uick	<u>C</u> lear Filters			Show Filters
Catalog Number	Description	Vendor	Category	
RS-107/RS-108 RM-105/RM-106	Turck_enc_RS-107/108 Single-Turn Turck_enc_RM-105/106 Multi-Turn	Turck Turck		

Select your model of encoder. Set up the encoder as follows in the "New Module" window that appears:

Type:       Turck_enc_RM-105/106 Multi-Turn         Vendor:       Turck         Parent:       EN2TR         Name:       TurckTestEncoder1         Descrigtion:       Image:         Module Definition       Image:         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Vendor: Turck   Parent: EN2TR   Name: TurckTestEncoder1   Description: Image: Image	
Parent: EN2TR   Name: TurckTestEncoder1   Descrigtion: If P Address:   IP Address: If P Address:   IP Address: If P Address:   If P A	
Name: TurckTestEncoder1   Description: Image:	
Description:     Module Definition   Revision:   1.1   Electronic Keying:   Connections:   Input Only (100): Position + HiRes Position	
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	×
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Module Definition         Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Revision:       1.1         Electronic Keying:       Compatible Module         Connections:       Input Only (100): Position + HiRes Position	
Electronic Keying: Compatible Module Connections: Input Only (100): Position + HiRes Position	
Connections: Input Only (100): Position + HiRes Position	
Change	

In the general / module definition pane of the "New Module Window", click change and select the connections as shown here:

Module Definition*  Revision:  I  Compatible Module  Connections:						X
Name	1	Size			Tag Su	iffix
Input Only (100)+Config: Position + HiResPos + Velocity + Acceleration + other + Configuration Assembly	Input: Output:	8	DINT	-	1	TurckTestEncoder1:11 <none></none>
Select a connection						·
•		III				•
						OK Cancel Help

This connection delivers the full process data and allows you to configure the Encoder conveniently using Logix Designer. It is recommended to set "Size" to DINT so you get the values as 32-bit blocks.

Now set the encoder's switches to 004 and power cycle the encoder.

In Logix Designer, you can now see the encoder's config and parameter in the "Controller Tags" section.

Logix Designer - PruefaufbauEthIP [1756-L71S 23.12] File Edit View Search Logic Communication	* - [Controller Tags - PruefaufbauEthIP(controller)]	ana unco unco A38	COM AND	Autor		×
🖺 🗃 🖨 🐇 🗞 🖻 💼 🗠 🖙 Turck RM-	105/106_Al:Data 🗸 🌺 🌺 🏗 📝 💇 🔍 🔍 Select language	- 🧶				
Vio Forces     Image: Constraint of the second	Path:         AB_ETHIP-1\192.168.1.1\Backplane\0         Image: Comparison of the state of th					
Controller Organizer + 4 >	Scope: Cope: Scope: Show: All Tags	-	Y. Enter Name Filter			•
Controller Pruefaufbautthip	Name	E Value    Force	Mask + Style	Data Type 0	<ul> <li>Properties</li> </ul>	ą.
Controller Fault Handler	- TurckTestEncoder1:11	{}	{}	_030B:8F5868F5 S		Extended Pr +
Power-Up Handler	TurckTestEncoder1:I1.ConnectionFaulted	0	Decimal	BOOL S	General	14
- Tasks	TurckTestEncoder1:I1.Data	{}	{} Decimal	DINT[8] S	Name	TurckTestEnco
DisplayTask	+ TurckTestEncoder1:11.Data[0]	-1	Decimal	DINT S	Description	
DisplayProgram	TurckTestEncoder1:11.Data[1]	0	Decimal	DINT S	Usage	
🖨 🙀 MainTask	+ TurckTestEncoder1:11.Data[2]	0	Decimal	DINT S	Туре	Base
🗴 🕞 MainProgram	+ TurckTestEncoder1:11.Data[3]	0	Decimal	DINT S	Alias For	
😑 🔤 SafetyTask	+ TurckTestEncoder1:11.Data[4]	0	Decimal	DINT S	Base Tag	
🖶 📴 SafetyProgram	+ TurckTestEncoder1:11.Data[5]	0	Decimal	DINT S	Data Type	DINT
🖨 🚭 TestTask	+ TurckTestEncoder1:11.Data[6]	0	Decimal	DINT S	Scope	PruetaufbauE
👜 🕞 TestProgram	+ TurckTestEncoder1:11.Data[7]	0	Decimal	DINT S	External Acce	Standard Read (Mrite)
🚊 🚳 TimerTask	- TurckTestEncoder1:C	{}	{}	030B:8F5868F5 S	E Shile	Decimal
🗄 🕞 TimerCounter	+ TurckTestEncoder1:C.Measuring_Units_per_Span_MUR_16	8192	Decimal	DINT	Constant	No
Unscheduled Programs / Phases	+ TurckTestEncoder1:C.Preset_Value_19	0	Decimal	DINT	Required	
👜 🚔 Motion Groups	+ TurckTestEncoder1:C.Total Measuring Range TMR 17	33554432	Decimal	DINT	Visible	
Ungrouped Axes	+ TurckTestEncoder1:C.Velocity_Resolution_26	1	Decimal	DINT	🗈 Data	
Add-On Instructions	+ TurckTestEncoder1:C.Position_Low_Limit_22	0	Decimal	DINT	Produced Cor	nnection
😑 📹 Data Types	+ TurckTestEncoder1:C.Acceleration Resolution 31	1	Decimal	DINT	Consumed Co	nnection
User-Defined	+ TurckTestEncoder1:C.Position High Limit 23	33554431	Decimal	DINT		
Strings	+ TurckTestEncoder1:C Acceleration Format 30	2048	Decimal	INT		
Add-On-Defined	+ TurckTestEncoder1:C Velocity_Format_25	7940	Decimal	INT		
Madels Defined	TurckTestEncoder1:C Direction Counting Toggle 12	1	Decimal	BOOL		
Transfe	TurckTestEncoder1:C.Commissioning Diagnostic Contr 13	1	Decimal	BOOL		
1/0 Configuration	TurckTestEncoder1:C Scaling Function Control SEC 14	1	Decimal	BOOL		
1756 Packalana 1756 A7	TurckTestEncoder1:C ConfigurationControl	3	Decimal	SINT		
< III >			Deciniti	51111	•	
	III Monitor Tags / Edit Tags /	•	7	'		

As you have selected Assembly 100, the data you can see in the TurckTestEncoder1:I1.Data[] Tags corresponds to the format shown in Table "Assembly 100", but in 32-bit blocks.

TurckTestEncoder1:11.Data[0], for instance, contains the Position Value data, and TurckTestEncoder1:11.Data[5] contains the Alarms and the Warnings combined in a single 32-bit value.

You can now switch Logix Designer to "Online" and download your Configuration to your PLC. You can access the Encoder values directly in your PLC program e.g. using Ladder Logic.



Logix Designer - PruefaufbauEthIP [1756-L71S 23.12]* -	[Controller Tags - PruefaufbauEthIP(controller)]	Manage Lanca Manage Ad	B CHIEF MADE	-	- 1.1.1	- • • ×
<u>File Edit View Search Logic Communication</u>	s <u>T</u> ools <u>W</u> indow <u>H</u> elp					- 8 ×
🖺 🗃 🖨 🔏 🗞 🗞 📾 🛍 🗠 🖙 Turck RM-10	05/106_A:LData 👻 🍂 强 🏗 📝 🛒 🔍 🛇 Select language.					
Rem Run     Run Mode       No Forces     Controller OK       No Edts     Energy Storage OK       Safety Unlocked     50	AB_ETHIP-1\152.168.1.1\Backplane\0					
Controller Organizer 🗸 🕂 🗙	Scope: PruefaufbauEthll - Show: All Tags		▼ Enter Name Riter			-
Controller PruefaufbauEthIP	Name	=al ♥ Value ← F	Force Mask + Style	Data Type	C  Properties	<b>P</b>
Controller Tags	- TurckTestEncoder1:11.Data	[]	{} Decimal	DINT[8]		Extended Pr +
Controller Fault Handler	+ TurckTestEncoder1:11.Data[0]	31382748	Decimal	- DINT		
Tarke	+ TurckTestEncoder1:11.Data[1]	57028	Decimal	DINT	S Name	TurckTortEnco
	+ TurckTestEncoder1:11.Data[2]	16768052	Decimal	DINT	5 Description	TurckrestErico
DisplayProgram	+ TurckTestEncoder1:11.Data[3]	0	Decimal	DINT	S Usage	
A MainTask	+ TurckTestEncoder1:11.Data[4]	0	Decimal	DINT	5 Туре	Base
🖞 🚔 MainProgram	+ TurckTestEncoder1:11.Data[5]	0	Decimal	DINT	S Alias For	
🖃 🔤 SafetyTask 📃	+ TurckTestEncoder1:11.Data[6]	16587	Decimal	DINT	Base Tag	
🖶 📴 SafetyProgram	+ TurckTestEncoder1:11.Data[7]	6662656	Decimal	DINT	S Data Type	DINT
🖨 🐯 TestTask	- TurckTestEncoder1:C	{}	{}	_030B:8F5868F5	S Scope	PruetautbauE
🛓 🖳 TestProgram	+ TurckTestEncoder1:C.Measuring_Units_per_Span_MUR_16	8192	Decimal	DINT	S E External Acce	Standard Read (Mrite)
🚊 🐻 TimerTask	+ TurckTestEncoder1:C.Preset_Value_19	0	Decimal	DINT	S Style	Decimal
👜 🕞 TimerCounter	+ TurckTestEncoder1:C.Total Measuring Range TMR 17	33554432	Decimal	DINT	S Constant	No
Unscheduled Programs / Phases	+ TurckTestEncoder1:C.Velocity_Resolution_26	1	Decimal	DINT	S Required	1992
🖨 🚔 Motion Groups	+ TurckTestEncoder1:C.Position_Low_Limit_22	0	Decimal	DINT	S Visible	
Ungrouped Axes	+ TurckTestEncoder1:C.Acceleration Resolution 31	1	Decimal	DINT	B Data	
Add-On Instructions	+ TurckTestEncoder1:C.Position_High_Limit_23	33554431	Decimal	DINT	Produced Cor	nection
🖨 🔄 Data Types	+ TurckTestEncoder1:C.Acceleration Format 30	2048	Decimal	INT	Consumed Co	nnection
User-Defined	+ TurckTestEncoder1:C.Velocity Format 25	7940	Decimal	INT	S	
A LLO D C L	TurckTestEncoder1:C.Direction Counting Togale 12	1	Decimal	BOOL	S	
Add-On-Defined	TurckTestEncoder1:C.Commissioning_Diagnostic_Contr_13	1	Decimal	BOOL	5	
Madula Defined	-TurckTestEncoder1:C.Scaling Function Control SEC 14	1	Decimal	BOOL	S	
Trands	+ TurckTestEncoder1:C.ConfigurationControl	3	Decimal	SINT	5	
< III >	( ) Monitor Tags ( Edit Tags /					
Enter diselau stule fer the value		( and				22
criter display style for the value						<b></b>

To configure the encoder, you can enter your configuration values into the TurckTestEncoder1:C subsections.

Please remember to set the ConfigurationControl Byte to the value shown in table "Values for Configuration Control" according to what you want to do.

As you can see from this table, if you want to set the preset to 0 and also save the config, put "0" into Preset\_Value\_19 and use 6 for configuration control. Power cycle the encoder and set "Configuration Control" to 0 in the end to prevent the preset to be set to 0 on each encoder startup.

You must not forget that in this setup, the encoder only gets any new config values when using this technique if

a) Configuration control is set correctly, e.g. not 0

b) The encoder is reset, e.g. by power cycling it, or by performing a reset from the "Module Info" tab of the encoder config after that

It may be a good idea in this example setup to change the connection of your encoder from the initial setting "Input Only (100)+Config: Position + HiResPos + Velocity + Acceleration + other + Configuration Assembly" to "Input Only (100): Position + HiRes Position + Velocity + Acceleration + other (no Configuration Assembly)" once you have completed your setup and saved it to the encoder's nonvolatile storage. This step removes the "TurckTestEncoder1:C" subsections again.

Please be aware that in this setup, you have the config items in clear text tag names such as TurckTestEncoder1:C.Position\_ Low\_Limit\_22, but it is not possible to get the data coming from the encoder in clear text tag names using this version of Logix in a simple way.

If the encoder refuses the connection from the PLC, the selected config values are invalid, e.g. there is an invalid value for the velocity format data field.

Please note that if you want the maximum resolution (24 bit MT and 19 bit ST), you have to use the raw position data contained in TurckTestEncoder1:11.Data[1] and TurckTestEncoder1:11.Data[2] in our example. In this case, you will have to implement your own conversion for the "Direction" selection in your PLC program, should you need to switch the direction of counting, e.g. by XORing the value with binary all 1s.

If you have specified invalid configuration data and configuration control is not 0, the encoder will not accept this connection. You can get a hint which parameter is wrong by looking at the properties dialog of your encoder in the connection tab. The encoder returns an error code of 0x700 plus the first parameter that is invalid (converted to hex). If, for instance, parameter 17 (Hex 0x11) is incorrect (e.g. 0, which is an invalid value), the encoder will return error code 0x0711 as shown in the following picture. The decimal numbers of the parameters can be found in table "Position Sensor Object Class Attributes", or in the configuration tag names - in this example, the affected tag is called TurckTestEncoder1:C.Total\_Measuring\_Range\_TMR\_17.

After correcting the incorrect parameter, the encoder will either report the next incorrect parameter or, if everything is correct, establish the connection.

♂ Logix Designer - PruefaufbauEthIP [1756-L71S 23:12]*			- 0 - X-
Eile Edit View Search Logic Communications Tools Window Help			
🛅 😂 🖨 🚳 🕺 🖹 🐑 👓 Turck RM-105/106_Ad:Data 🔹 🌲 👫 🌆 🚺 📝	💌 🔍 🔍 Select language 👻 🧶		
Rein Run         Bit         Run Mode         Path         Early         Path         Early         Path         All Charles (%)         Path         Path         All Charles (%)         Path			
Controller Organizer	· · · · · × Module Properties: EN2TR (RM-105/106)		
Controler Friedwardschur Controler Tage Controler	General Connection Module Wo, Internet Protocol Port Configuration Network Requested Peticiet Intervier Input Trips Input Trips	son	Constant A
iù ⊕§ Doplay Program ⊖ ∰ MainTark B ⊕ MainProgram ⊖ ∰ SafetyTark ti û ∰ SafetyProgram	Input Only (1001-Confo: Peakon - HReaPos - Vebocky 1.0 (2) 10 - 5999.9 Unicast v Cyclc v		
	Code 1640711) Enor unknown bpe. Status: Faulted OK Cancel (profy Helo		
🖞 1756-EN2TR EN2TR	Turck     O     Decimal     DINT	Standard	
Wike 105/106 Turckfetthrooder1     [3] 1756-OB8 DIGLOUT		Standard 4) Standard Standard	
		Standard Standard KG Standard	
	• Envictos               ( + -) Electrina               ( + -) Decimal               Diviti                 • Difference               -252394997          Decimal          Divit                 • ClockAndTransmitDifference               0          Decimal          Divit	Standard Standard Standard	
	())\Monitor Tags /Edit Tags /		
Text to Filter	N		22

Error message from the encoder.



# 3. Technical details and encoder characteristics

#### **Mechanical values**

Shock resistance acc. to EN 60068-2-27 2500 m/s2, 6 ms Vibration resistance acc. to EN 60068-2-6 100m/ s2, 55 ... 2000 Hz

**Working temperature range** -40...+80°C

Supply voltage and current consumption 10...30 VDC Max. 250 mA

#### Hardware characteristics

Singleturn technologyOptical sensorSingleturn resolution524287 steps / revolution (19 bits)Internal cycle time1 msMultiturn technologyElectronic gear, battery-bufferedMultiturn resolutionMaximum 2<sup>24</sup> bits revolutions

**EtherNet interface** 100BASE-TX EtherNet transceiver **Function display** and diagnostics by means of LEDs

#### Supported standards and protocols

EtherNet/IP Vol2, Ed 1.17 CIP specification Vol 1, ED. 3.16 CIP position sensor object (0x23) rev. 2 Conformance tested and approved using to CT-12 ODVA test software

#### Convention in this manual

• Hexadecimal values are shown as 0x.... in this manual.

Example: 0x3456 represents the decimal value 13398.

In Logix 5000, hexadecimal values may also be shown or entered into a tag field as 16#0000\_3456 or 16#3456.

Users may switch between the different notation using the "Style" selector in each row of tags.

The hexadecimal notation is often useful when it is necessary to combine different bytes (8 bit values) into a single 32-bit value, e.g. when using the "Live Config" setup method shown in this manual.

Please see section "Converting Hexadecimal Values to Decimal values and back" for examples how to convert numbers.

"Attribute x" in this manual means, unless otherwise stated, attribute x of instance 1 of the Position Sensor Object (class 0x23).

#### EtherNet / IP and CIP

Common network application layers are the key to advanced communication and true network integration. The Common Industrial Protocol (CIP<sup>™</sup>) allows complete integration of control with information, multiple CIP Networks, and Internet technologies.

Built on a single media-independent platform that provides seamless communication from the plant floor through the enterprise with a scalable and coherent architecture, CIP allows companies to integrate I/O control, device configuration and data collection across multiple networks. This ultimately helps minimize engineering and installation time and costs while maximizing Return on Investment (ROI).

#### EtherNet / IP / CIP Position Object

The CIP Position Sensor Object (class code: 23 hex, implemented revision: 0x02) models an absolute position sensor in a product. Behaviors in the object extend the basic position sensor capability to include zero offset, and position boundary checking.

#### Nonvolatile Storage

This encoder has the advantage that it uses a nonvolatile storage unit for all stored non-constant internal and external parameters, application and configuration data which have to be retained even after power cycling the encoder.

The nonvolatile storage unit has been selected to allow continuous encoder reconfiguration at bus speed during the entire life time of the encoder.

As a consequence of using the nonvolatile storage unit, this encoder has the benefit that the users can reconfigure the encoder (e.g. set the preset value) or change the config (e.g. IP Address config, encoder config, etc., ....) as often as they like, even in a cyclic process e.g. through the PLC program in regular operation of the encoder!

The common problem that the storage gets damaged after an excessive number of configuration write cycles (which would make the device useless) does not exist in this encoder.

#### Implemented EtherNet / IP Objects

- Identity Object
- Message Router
- Assembly Object
- Connection Manager
- Parameter Object
- Position Sensor Object
- Qos Object
- Port Object
- TCP / IP Interface Object
- EtherNet Link Object



# 4. Process + configuration data

#### Process data overview

Process data can be requested either through the "Position Sensor Object" per explicit message or through the assembly object of the encoder.

The assemblies contain selected (fixed) process data. Some of the process data is only contained in the assemblies, other process data is only contained in the "Position Sensor Object".

The following assembly instances are implemented with the process data according to the table below for cyclic process data transmission: the descriptions can be found in the following tables.

Assembly Instance no.	Name
1	Position
2	Position + Status
3	Position + Velocity
100	Full process data
101	Configuration feedback (as cyclic data)
130	Configuration (as configuration assembly)
131	"Live Config" configuration (as cyclic data)

"Assembly instances" table

### Detailed process data listings

A precise meaning of the different attributes can be found in section "EtherNet/IP / CIP Position Sensor Object Class Attributes"

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Meaning	Attribute No.
1	0	Posit	ion LS	В						Scaled position value. The calculation	3
	1	Posit	ion							considers among other: Scaling Function	
	2 Position									control, TMR, MOR, Offset/Preset	
	3	Posit	ion MS	5B							
2	0	Posit	ion LS	В						See Assembly 1 "Position Value" 3	3
	1	Posit	Position								
	2	Position								_	
	3	Posit	ion MS	SB					-		
	4	—		_	—	—	_	Warn	Alarm	0, if no is active, otherwise 1 0, if no	
								Flag	Flag	warning is active, otherwise 1	
	_										-
3	0	Position LSB Position							See Assembly 1 "Position Value"	3	
	1										
	2 Position										
	3	Posit	ion MSB								
	4	Veloc	LITY LSI	В						Velocity value	24
	5	veloc	ity							_	
	6	Veloc		. D						_	
	/	veloc		ьВ							
100	0	Posit	ion I S	B						See Assembly 1 "Position Value"	3
	1	Posit	ion								
	2	Posit	ion								
	3	Posit	Position MSB								
	4	Hi Re	s Raw	Positio	on Sing	leturn	part L	SB		Singleturn raw position unscaled,	
	5	Hi Re	s Raw	Positio	on Sing	leturn	part			clockwise, 19 bits unsigned, upper 13 bits	
	6	Hi Re	s Raw	Positio	on Sing	leturn	part			always 0. (Value: 0 to 524287)	
	7	Hi Re	s Raw	Positio	on Sing	leturn	part N	<b>ISB</b>		(value: 0 to 524207)	
	8	Hi Re	s Raw	Positio	on Mul	titurn (	oart LS	В		Multiturn raw position unscaled,	
	9	Hi Re	s Raw	Positio	on Mul	titurn i	oart			clockwise, 24 bits unsigned, upper 8 bits	
	10	Hi Re	s Raw	Positio	on Mul	titurn l	oart			always 0. (Value: 0 to 16777215)	
	11	Hi Re	s Raw	Positio	on Mul	titurn j	oart M	SB			



12	2 Velocit	y LSB							Velocity value	
13	Velocit	у								
14	Velocit	Velocity								
15	Velocit	Velocity MSB								
16	6 Acceler	ration v	alue L	SB					Acceleration, format depending on	29
17	' Acceler	ration v	alue						Attribute 25 (Velocity format)	
18	Acceler	ration v	alue							
19	Acceler	ration v	alue N	1SB						
20	0	0	0	0	0	0	Diag- ERR	Sens ERR	Indicates a malfunction:	44
21	Live Conf. active	Int. Data ERR	Int. CRC ERR	Int. Tim- eout	0	0	0	0	<ul> <li>Bit 0: 1 if a Sensor Error occurred reading the position, otherwise 0</li> <li>Bit 1: 1 if an internal Diagnostic Error occurred in the encoder, otherwise 0</li> <li>Bits 2 to 11: Always 0</li> <li>Bit 12: 1 if an internal timeout reading the sensor occurred, otherwise 0.</li> <li>Bit 13: 1 if an internal CRC Error occurred reading the sensor, otherwise 0</li> <li>Bit 14: 1 if an internal Data Error occurred reading the sensor, otherwise 0</li> <li>Bit 15: 1 if a "Live Config" connection is active, otherwise 0.</li> <li>A "Live Config" connection should only be used during configuration of the encoder</li> <li>If the alarm bytes are not 0, your encoder may not deliver correct positions</li> </ul>	
									All bits get reset through an encoder software reset or a power cycle.	

22	0	0	0	Batt. Warn	0	0	LED Warn.	0	Indicates a Diagnostic Condition in the encoder:	_
23	0	0	Over temp	0	0	0	0	0	<ul> <li>Bit 1: 1 if the internal LED in the sensor is beginning to reach the end of its lifetime, otherwise 0</li> <li>Bit 4: 1 if the buffer battery that keeps the multiturn count during power-off is running low. (RM-105 Multi-Turn and RM-106 Multi-Turn Encoders only!), otherwise 0</li> <li>Bit 13: 1 if the Device is running in an overtemperature condition reported by the position sensor, otherwise 0.</li> <li>This warning is only informational since the temperature sensor has not been calibrated If the warning bytes are not 0, your encoder may not deliver correct positions and may need replacement!</li> <li>All bits get reset through an encoder software reset or a power cycle.</li> </ul>	
									Other bits: always 0.	
24	Meas	surem	nent Timestar	np LSB					Position acquisition timestamp, a 16- bit wide counter running at 6.	-
23	Meat	JSTETT		מכואו קו					MHz is read at the moment of position acquisition. When reaching 65535, its value goes over to 0 and continues counting without delay.	
26	Posit	ion S	tate						Position State with respect to Attributes 22 (Position Low Limit) and 23 (Position High Limit): Bit 0: 1, if the position is currently outside the range, otherwise 0	21
									Bit 1: 1, if the position is currently above the range, otherwise 0	
									Bit 2: 1, if the position is currently below the range, otherwise 0	
27	Alarn	n Flag	9						1, if one or more alarms are active (i. e. Attribute 44 "Alarms" unequal 0), otherwise 0	46
28	Warn	ing F	lag						1, if one or more warnings are active (i. e. Attribute 47 "Warnings" unequal 0), otherwise 0	49
29	Life C	Count	ter						Position sensor life counter, is incremented by the value 1 once per ms, goes over to 0 after reaching the value 255.	
30	Temp	perati	ure Indicator						Sensor operating temperature indicator. This indi- cator is not calibrated, the zero point of the scale is not defined. One step corresponds approximately to 1°C.	
31	Rese	rved							unused	



### **Configuration Assemblies**

The precise meaning of the different attributes can be found in section "EtherNet/IP / CIP Position Sensor Object Class Attributes" The following Assembly instances are implemented for the transmission of the configuration: Assemblies 130 and 131:

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3 Bit2 Bit1 Bit0		Bit0	Meaning	Attribute No.	
130 &	0	Meas	suring	Units p	per Sp	an (Ml	JR) LSI	В		Number of units corresponding to one	16
131	1	Meas	suring	Units p	per Sp	an (Ml	JR)			shaft rotation for the position value	
	2	Meas	suring	Units p	oer Sp	an (Ml	JR)			Units per Revolution) Single Turn encoder	
	3	Measuring Units per Span (MUR) MSB						SB		configuration: MUR >= TMR	
	4	Preset Value LSB								Setting of the position value to a fixed value	19
	5	Prese	et Valu	e						(preset)	
	6	Prese	et Valu	e						Configuration Control" bytes - (=preset value	
	7	Prese	et Valu	e MSB						is set when receiving the Assembly and the offset is adapted accordingly, and both values are stored) or - ignored (=preset value is discarded, no change of the preset/offset)	
	8	Total Measuring Range (TMR) LSBTotal Measuring Range (TMR)Total Measuring Range (TMR)				LSB			Number of steps over the whole measuring	17	
	9								range of the encoder, can cover 1 or more		
	10								$\frac{1}{2}$		
	11	Total	Measu	uring F	Range	(TMR)	MSB				
	12	Velo	city Re	solutic	on LSB					Resolution of the measured velocity value in	26
	13	Velo	city Re	solutic	on					steps.	
	14	Velo	city Re	solutic	on						
	15	Velo	city Re	solutic	on MSE	3					
	16	Posit	ion Lo	w Limi	it LSB					Lower working range limit, the position	22
	17	Posit	ion Lo	w Limi	it					is compared with the working range and	
	18	Position Low Limit							be used to obtain a status message.		
	19	Posit	ion Lo	n Low Limit MSB							
	20	Acce	leratio	n Resc	olution	LSB				Resolution of the measured acceleration	31
	21	Acce	leratio	n Resc	olution					value in steps.	
	22	Acce	leratio	n Resc	olution						
	23	Acceleration Resolution MSB									

24	Position High Limit LSB	Upper working range limit, the position is	23				
25	Position High Limit	compared with the working range and influences					
26	Position High Limit	Attribute 21 "Position State".					
27	Position High Limit MSB						
28	Acceleration Format LSB	Format of the measured acceleration value					
29	Acceleration Format MSB	Depends on Attribute 25 ("Velocity Format"), must always have the value 2048 (0x0800). The Acceleration unit depends on the following values of parameter "Velocity Format": 0x1F04: Pulses per second^2 (1 revolution = 65536 pulses, fixed value ) 0x1F05: Pulses per millisecond^2 (1 revolution = 65536 pulses, fixed value ) 0x1F0E: Revolutions per second^2 0x1F0F: Revolutions per minute^2					
30	Verlocity Format LSB	Format of the measured velocity value					
31	Verlocity Format MSB	0x1F04: Pulses per second (1 revolution = 65536 pulses, fixed value) 0x1F05: Pulses per millisecond (1 revolution = 65536 pulses, fixed value) 0x1F0E: Revolutions per second 0x1F0F: Revolutions per minute					
32	Direction Counting Toggle	Defines the direction of rotation in which the position values increase. 1: Increasing values for clockwise rotation 0: Increasing values for counter-clockwise rotation (External shaft end oriented towards the observer, connections oriented opposite to the observer) The values "Velocity Value" and "Acceleration Value" also become positive or negative accordingly.	12				



33	Commissioning Diagnostic Control	This value must be 0 or 1, it is however ignored. The encoder reports for both settings warnings and alarms via Attributes "Warnings" and "Alarms".	13
34	Scaling Function control	<ul> <li>Value 1: Scaling active: The emitted position data (Position Value, Attribute 3) is calculated from the physical position using the values MUR (Measuring Units per Span (MUR), Attribute 16), TMR (Total Measuring Range (TMR), Attribute 17) and Direction Counting Toggle (Attribute 12). If a preset/offset has been set, it is considered.</li> <li>Value 0: Scaling inactive: The emitted position data (Position Value, Attribute 3) is calculated only from the physical position and from Direction Counting Toggle (Attribute 12). If a preset/offset has been set, it is considered.</li> </ul>	14
35	Configuration Control	<ul><li>The Configuration Control byte defines whether and how the configuration data of the encoder is used.</li><li>Meaning: See following table.</li><li>If this byte is set e. g. to 0, the configuration is ignored!</li></ul>	8

Table "Assembly 130 and 131" (Size: 36 bytes): Configuration data of both Connections "Config: Position + Configuration Assembly" and Connection "Config: Position + HiResPos + Velocity + Acceleration + other", as well as process data of the "Live Config" connection

Configuration Control Value	Meaning	Preset value
0	The config is ignored by the Encoder, it operates with the currently active or saved config.	Do not change the preset value, i.e. ignore the preset value.
1	Write the config to passive storage. Do not apply the other parameters.	Do not change the preset value, i.e. ignore the preset value.
2	Write the config to passive storage. Also apply the other parameters.	Do not change the preset value, i.e. ignore the preset value.
3	Write the config to passive storage. Also apply the other parameters and save them to permanent storage. <b>This is the recommended default value.</b>	Do not change the preset value, i.e. ignore the preset value.
4	Write the config to passive storage. Do not apply the other parameters. Note: This setting can be used to set the preset value without making any other configuration changes active.	The position put into "Preset value" is applied as "Preset" immediately and the resulting offset is saved into permanent storage.
5	Write the config to passive storage. Also apply the other parameters.	The position put into "Preset value" is applied as "Preset" immediately and the resulting offset is saved into permanent storage.
6	Write the config to passive storage. Also apply the other parameters and save them to permanent storage.	The position put into "Preset value" is applied as "Preset" immediately and the resulting offset is saved into permanent storage.
7	Ignore the config, but set and save "Preset value". This value can be used to set the preset value without changing any other parameters. The position put into "Preset value" is applied as "Preset" immediately and the resulting offset is saved into permanent storage.	The position put into "Preset value" is applied as "Preset" immediately and the resulting offset is saved into permanent storage.
other values	Reserved / Ignored	Do not use

Table "Values for Configuration Control"



### EtherNet/CIP Position Sensor Object Class Attributes

Detailed listing of the acyclic process data (Attributes of the Position Sensor Object (Class: 0x23), Instance: 1):

Attribute ID (decimal)	Read/ Write	V= Volatile	Attribute name	Data size in bits	Attribute description	Meaning of attribute
3	R	V	Position Value	32	Current position sensor value (32 bit)	See table "Assembly 1"
11	R	fixed	Position Sensor Type	16	Type of the position sensor	1=Singleturn absolute rotary encoder (order codes RS-107 and RS-108) 11= multiturn absolute rotary encoder with electronic turn count (order codes RM- 105 and RM-106)
12	RW		Direction Counting Toggle	8	Definition of the direction of incrementing counts	See table "Assembly 130"
13	RW		Commissioning Diagnostic Control	8	Encoder diagnostics	See table "Assembly 130"
14	RW		Scaling Func- tion Control	8		See table "Assembly 130"
16	RW		Measuring Units per Span (MUR)	16		See table "Assembly 130"
17	RW		Total Measuring Range (TMR)	32		See table "Assembly 130"
19	RW		Preset Value	32	Output position is set to preset value	Setting of the position value to a fixed value (preset) The preset value is set when writing the data and the offset is adapted accordingly, both data elements are then immediately written in a non-volatile memory, where they are stored. The reading of the preset value does not provide defined results.
21	R	V	Position State	8	The state of the Software Limit Switch	See table "Assembly 100"
22	RW		Position Low Limit	32	Lower working range limit	See table "Assembly 130"
23	RW		Position High Limit	32	Upper working range limit	See table "Assembly 130"
24	R	V	Velocity Value	32	Shaft rotary speed	See table "Assembly 100"
25	RW		Velocity Format	16	Format of the measured velocity value	See table "Assembly 130"
29	R		Acceleration Value	32	Shaft acceleration	See table "Assembly 100"

42	R		Physical Resolution Span	32	Maximum steps per encoder revolution	Fixed value 65535 (i. e. 16-bit resolution). A singleturn resolution of 524287 (i. e. 19 bits) can only be read unscaled via assembly 100.
43	R		Number of Spans	16	Maximum countable encoder revolutions	Fixed value 65535 (i. e. 16-bit resolution). A multiturn resolution of 16777216 (i. e. 24 bits) can only be read unscaled via assembly 100.
44	R	V	Alarms	16	Indicates a malfunction	See table "Assembly 100"
45	R		Supported Alarms	16	Lists the supported Alarm Bits	See table "Assembly 100", "Alarms". Value: always 0x7003
46	R		Alarm Flag	8	Indicates any active alarms	See table "Assembly 100"
47	R	V	Warnings	16	Indicates a warning	See table "Assembly 100"
48	R		Supported Warnings	16	Lists the supported Warning Bits	See table "Assembly 100", "Warnings". Value: always 0x2012
49	R	V	Warnings	16	Indicates a warning	See table "Assembly 100"
50	R		Operating Time	32	Counts the power-on time of the encoder in tenths of hours	Gets incremented by 1 at power-on and afterwards every 6 minutes. This value is stored in nonvolatile storage and cannot be reset.
51	R		Offset value	32	Offset value calculated when setting preset value	When setting a preset, the encoder keeps an internal offset to its internal position that it uses to calculate the position (Attribute 3). The offset can be read using this attribute 51.
26	RW		Velocity Resolution	32	The resolution of the velocity values	This attribute is currently not used and therefore ignored by the encoder, it always returns the value that was last written to it.
31	RW		Acceleration Resolution	32	The resolution of the acceleration values	This attribute is currently not used and therefore ignored by the encoder, it always returns the value that was last written to it.
30	RW		Acceleration Format	16	Format of the measured acceleration value	See table "Assembly 130" 9
9	RW		Auto Zero Control	8	Set the preset of the encoder to 0 when this attribute changes from 0 to 1	When this attribute changes from the value 0 to 1, the preset is set to 0. Changing the value of attribute 9 from 0 to 1 is equivalent to writing 0 to attribute 19
100	R		Version Info Application Processor Firmware	String	Returns Firmware Version Information about the internal application processor of the encoder	This value may be used when contacting Kuebler for service or support
101	R		Version Info Network Processor Firmware	String	Returns Firmware Version Information about the internal Network Processor of the encoder	This value may be used when contacting Kuebler for service or support
102	R		Internal Battery Voltage	16	Internal Battery Voltage	This attribute returns an indication of the voltage of the internal battery that keeps the multiturn count during power-off. The measuring circuit is not calibrated! This value has a meaning only for the RM-105 and RM-106 multiturn encoders!



103	R	Supply Voltage	16	Supply Voltage	This attribute returns an indication of the supply voltage of the encoder measured inside the encoder. The measuring circuit is not calibrated!
104	R	Power Cycle and Reset Counter	32	Counts the Encoder Power Cycles and Resets	Gets incremented by 1 at power-on or reset of the encoder. This value is stored in nonvolatile storage and cannot be reset.
105	RW	Velocity Integration Time	32	Velocity Calculation Interval	Size of time window for speed calculations in milliseconds (used for Attribute 24). Attribute 24 delivers an updated value every <velocity integration="" time=""> Milliseconds. Permitted values: 1 to 2000. Default value: 100</velocity>
106	RW	Acceleration Integration Time	32	Acceleration Calculation Interval	Size of time window for acceleration calculations in milliseconds (used for Attribute 29). Attribute 29 delivers an updated value every <acceleration integration="" time=""> Milliseconds. Permitted values: 1 to 2000. Default value: 100</acceleration>
107	RW	Velocity and Acceleration Smoothing Control	32	Determines if the Velocity and Acceleration Values are smoothed	If this attribute is set to 1, the velocity and acceleration values (attribute 24 and 29) which are acquired in the interval set by attributes 105 and 106, are smoothed by building an average over the last 10 acquisitions. Default value 1. If this attribute is set to 0, no smoothing is performed.

#### Table "Position Sensor Object Class Attributes"

This process data is partly represented in the assemblies and can this way be retrieved cyclically through an I/O "Implicit Message" connection. Other data used less frequently can only be retrieved through "Explicite Message".

#### **Configuration restrictions**

The following restrictions apply to the configuration values and for the configuration process:

- When using explicite messaging: After each change of MUR (attribute 16) and/or TMR (attribute 17) (when applying and/or saving it using explicite messaging, you have to set the preset value once, by using explicite messaging to write to attribute 19.

- When using "Live Config": When changing MUR (attribute 16) and/or TMR (attribute 17), you have to set the preset value once, either by setting the configuration byte to 6 or 7 once, or by writing your desired preset value using explicite messaging to attribute 19 once.

- When using the configuration assembly connection: When changing MUR (Attribute 16) and/or TMR, you have to set the preset value once, either by setting the configuration byte to 6 or 7 (and restarting the encoder) once, or by writing your desired preset value using explicite messaging to attribute 19 once.

#### Principle of configuration of the encoders

The encoder configuration is organized like this: the encoder has three configurations which all exist in parallel.

#### - Passive configuration

This config is stored nonvolatile in the encoder, these values are not in effect (i.e. not active). Whenever a user reads or writes to any of the attributes of the encoder object using explicit messaging, the passive configuration is read or written.

#### - Active configuration

This configuration is active, the Config values are in effect (i.e. active). This config, however, is lost when the encoder is reset or power cycled

#### - Saved configuration

This configuration is saved in nonvolatile storage and is loaded to the passive and also active configuration on every powerup of the encoder.

When using the Configuration option 3 listed in this manual (explicite messaging), a write from "Passive Configuration" to "Active Configuration" can be performed by executing the "Apply" service, please see table "Services of the Position Sensor Object".

The "Save" service in this table first performs a write from "Passive Configuration" to "Active Configuration", and then a write from "Active Configuration" to "Saved Configuration".

When using configuration option 1 or 2, the config that is being input into the system always gets copied to the "Passive Configuration" first for the configuration control byte values of 1,2,3,4,5 and 6.

#### Important note about the preset value

Please note that the preset value (attribute number 19), when written by explicite messaging, is always written and saved to the saved configuration immediately! This is an exception for the preset value only.

The preset value is always linked to the currently active configuration.

So if you want to set the preset value using configuration option 3 after changing MUR (attribute 16), scaling and/or MUR values (attribute 17), you must make sure they are in the active configuration before performing the write to the preset value (attribute 19).

You must set the preset value again after each Change in Scaling Control (attribute number 14), Direction Counting Toggle (attribute number 12), Measuring Units per Span (attribute number 16) and Total Measuring Range (attribute number 17). It is important to set the preset value in this case after performing "Apply" or "Save" service.



# 5. EtherNet / IP / CIP Position Sensor Object Class Services

Detailed listing of the services provided by the encoder for the position sensor Object (Class Code: 0x23 = 35)

Service code	Service name	Implemented for class (Instance = 0)	Implemented for instance = 1	Description of Service
0x05	Reset	Yes	No	Resets all parameter values to the factory default and saves them to nonvolatile storage. Performs a reset of the encoder. Reset Service Parameter Byte = 0: Emulate as closely as possible cycling power. This value is the default if this parameter is comitted. Reset Service Parameter Byte = 1: Return as closely as possible to the out-of-box configuration, then emulate cycling power as closely as possible. This restores IP configuration and encoder parameters to factory defaults. You may have to set a preset value after performing this operation, please see "Important note about the Preset Value"
0x0D	Apply Attributes	Yes	No	Cause the configuration to become active. You may have to set a preset value after performing this operation, please see "Important note about the Preset Value"
0x0E	Get Attribute Single	Yes	Yes	Returns the contents of the specified attribute
0x10	Set Attribute Single	Yes	Yes	Modifies an attribute value (but does not apply it, except "Preset Value")
0x15	Restore	Yes	No	Restores all parameter values from non-volatile storage and applies them immediately. You may have to set a preset value after performing this operation, please see "Important note about the Preset Value"
0x16	Save	Yes	No	Saves all parameters to non-volatile storage and applies them immediately. You may have to set a preset value after performing this operation, please see "Important note about the Preset Value"

Table "Services of the Position Sensor Object"

# 6. Encoder rotary switches

The three rotary switches of the encoder represent a three-digit decimal number, with the hundreds, tens and ones places, as printed on the label of the encoder housing.

Switch position	Meaning
000 (factory setting)	To assign the IP address, use the IP address according to EtherNet/IP or to the CIP Standard stored in the encoder, or DHCP/BOOTP. Stored in delivered condition: see "Encoder factory settings"
1 to 254	Use the saved subnet (standard: 192.168.1.x, mask: 255.255.255.0), the last digit "x" of the IP address is defined by the rotary switches.
333	Fixed use of DHCP to obtain the IP address
350	Fixed use of BOOTP to obtain the IP address
334	Encoder reset to factory setting For resetting, set this switch position, then switch off the operating voltage if necessary, and switch it on for 10 seconds. Then, the encoder can be switched off again, and the switch position required for operation can be set. All adjustable parameters are then reset to factory setting, the encoder objects as well as the TCP/IP settings.
other positions	Reserved, not to be used!

The rotary switches are always selected only immediately when switching the operating voltage on (or when resetting) the encoder.

Changes of the switch position after switching the operating voltage on are only taken into consideration after switching the encoder off and on again.

If a switch position change is nevertheless necessary during operation, take care to move the hundreds switch during operation only between positions 0 and 3, do not select the values 4 to 9 in order to avoid an unintended encoder reset.



# 7. Encoder factory settings

Attribute ID:	Attribute name	Default value	Comment
12	Direction Counting Toggle	0	Clockwise increasing
13	Commissioning Diagnostic Control	1	ON
14	Scaling Function Control	1	ON
16	Measuring Units per Span (MUR)	65,536 (16 bit)	
17	Total Measuring Range (TMR)	4,294,967,296 (32 bit) (multiturn encoder)	Multiturn encoder: 65,536(MUR) pulses * 65,536 rotations
		encoder)	Singletum encoder: 65,556
19	Preset Value	0	
22	Position Low Limit	0	
23	Position High Limit	4,294,967,296 (32 bit) (multiturn encoder) 65,535 (singleturn encoder)	
25	Velocity Format	0x1F04	Counts per second
26	Velocity Resolution	1	Currently not used
31	Acceleration Resolution	1	Currently not used
30	Acceleration Format	0x0800	Fixed value, see description of attribute "Acceleration Format": Acceleration format depends on Velocity Format

#### IP address: Static, 192.168.1.30 , Subnet mask: 255.255.255.0, ACD: Enabled

Table "Factory settings"

# 8. Electrical installation

#### Electrical installation, supply voltage and EtherNet network

#### **Electrical installation**

Switch off the system!

Make sure that the whole system remains switched off during the whole electrical installation. Electrical installation requires connectors or connection cables (see data sheet).

#### **Bus connection**

Interface	Type of connection	Function	M12 connecto	A12 connector, 4-pin					
		Bus Port 1	Signal:	Transmit data+	Receive data+	Transmit data -	Receive data -	12	
			Abbreviation:	TxD+	RxD+	TxD-	RxD-	- €CD¥	D coded
			Pin:	1	2	3	4	4	
		Power	Signal:	Voltage +	-	Voltage –	-	4 3	
Α	N	supply	Abbreviation:	+ V	-	0 V	-		
	(3 x M12 connector)		Pin:	1	2	3	4	1 2	
		Bus Port 2	Signal:	Transmit data+	Receive data+	Transmit data -	Receive data -	12	
			Abbreviation:	TxD+	RxD+	TxD-	RxD-	- (CB))	D coded
			Pin:	1	2	3	4	4	

#### Terminal assignment bus

Respect the maximum line lengths for EtherNet. If possible, mount all cables with traction relief. Check the maximum supply voltage on the device.

#### Function and status LED

The device is equipped with LEDs displaying status and error messages. After switching on the voltage supply, the Mod and Net LEDs carry out a short self-test sequence (every LED blinks once red/green).

#### Rear side connections and display elements





#### Mod LED

Indicator state	Summary	Requirement
Steady Off	No power	If no power is supplied to the device, the module status indicator shall be steady off.
Steady Green	Device operational	If the device is operating correctly, the module status indicator shall be steady green.
Flashing Green	Standby	If the device has not been configured, the module status indicator shall be flashing green.
Flashing Red	Major Recoverable Fault	If the device has detected a Major Recoverable Fault, the module status indicator shall be flashing red. <b>Note:</b> An incorrect or inconsistent configuration would be considered a Major Recoverable Fault.
Steady Red	Major Unrecoverable Fault	If the device has detected a Major Unrecoverable Fault, the module status indicator shall be steady red.
Flashing Green/Red	Self-test	While the device is performing its power up testing, the module status indicator shall perform the test sequence as described in section 9-4.2.4.

#### Net LED

Indicator state	Summary	Requirement
Steady Off	Not powered, no IP address	The device is powered off, or is powered on but with no IP address configured (Interface Configuration attribute of the TCP/IP Interface Object).
Flashing Green	No connections	An IP address is configured, but no CIP connections are established, and an Exclusive Owner connection has not timed out.
Steady Green	Connected	An IP adress is configured, at least one CIP connection (any transport class) is established, and an Exclusive Owner connection (defined in volume 1, chapter 3) has not timed out.
Flashing Red	Connection timeout	An IP adress is configured, and an Exclusive Owner connection (defined in volume 1, chapter 3) for which this device is the target has timed out. The network status indicator shall return to steady green only when all timed out Exclusive Owner connections are reestablished. Devices that support a single Exclusive Owner connection shall transition to steady green when any subsequent Exclusive Owner connection is established. Devices that support multiple Exclusive Owner connections shall retain the O -> T connection path information when an Exclusive Owner connections to the previously timed-out O -> T connection points are reestablished. Timeout of connections other then Exclusive Owner connections shall not cause the indicator to flash red. The Flashing Red state applies to target connections only. Originators and CIP routers shall not enter this state when an originated or routed CIP connection times out.
Steady Red	Duplicate IP	For devices that support duplicate IP address detection, the device has detected that (at least one of) its IP address is already in use.
Flashing Green/Red	Self-test	While the device is performing its power up testing, the network status indicator shall perform a test sequence as described in section 9.

**Note:** when a single indicator is used to represent multiple IP address interfaces the state of any one interface shall be sufficient to modify the indicator state (per the above behavior in the table):

- Transition to flashing green when any one interface receives an IP address
- Transition to steady green when a CIP connection is established on any interface (and Exclusive Owner is not timed out).
- Transition to flashing red when an Exclusive Owner CIP connection times out on any interface
- Transition to steady red when any of the interfaces detects and IP address conflict

#### Encoder LED

The encoder LED lights green when the supply voltage is present.

#### Link 1 / Link 2 LEDs

The Link 1 / Link 2 LEDs light green when the corresponding EtherNet port of a remote station (e. g. switch, hub, SPS, PC...) has been recognized. In addition, they flash yellow when data transfer takes place.

# 9. Configuration options

#### Configuring the encoder using a configuration assembly

The section "Quick Start Guide" describes how to configure the encoder using a configuration assembly using RSLogix 5000 V23.00.

#### Configuring the encoder using the "Live Config" Connection

For this option, select connections without "+ Config", and select the "Live Config" connection.

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#### Now you have the following tags in your controller

- TurckTestEncoder1:I1.Data: This is the process data from the encoder as described in table "Assembly 100", so TurckTestEncoder1:I1.Data[0] contains the processed position data.
- TurckTestEncoder1:O2.Data: This is the encoder config data as described in table "Assembly 130".
  - o Data[0]: MUR
  - o Data[1]: PRESET
  - o Data[2]: TMR
  - o Data[3]: Velocity Resolution (currently: always set to 1)
  - o Data[4]: Position Low Limit
  - o Data[5]: Acceleration Resolution (currently: always set to 1)
  - o Data[6]: Position High Limit
  - o Data[7]: combined data: 0xXXXXYYYY
    - Velocity Format (16 bit, XXXX) and
    - Acceleration Format (16 bit, YYYY, currently: always 0x0800)
  - o Data[8]: combined data: 0xWWXXYYZZ
    - Configuration Control Byte (8 bit, WW, here: 0x03)
    - Scaling Function Control (8 bit, XX, here: 0x01)
    - Commissioning Diagnostic Control (8 bit, YY, here: 0x01)
    - Direction Counting Toggle (8 bit, ZZ, here: 0x00)

#### • TurckTestEncoder1:I2.Data[0] shows the result code from the encoder.

- o If the configuration is OK and accepted, it returns the special value 0xCFCFCFCF (decimal: -808464433).
- o if the configuration Control Byte is 0, the result code is 0, since no action was taken

o Other values indicate a problem with the configuration entered into TurckTestEncoder1:O2.Data. In case of a problem, the result code returns the parameter index (decimal!) of the first value according to table "Assembly 130 und 131" that was found incorrect. So you just have to look up the value in column "Attribute Number of the Position Sensor Object 0x23" of the table to see which attribute is incorrect. For example, if Velocity Format is set to an invalid value in TurckTestEncoder1:12.Data[0] will read 25 (decimal!) and the whole config in the "Live Config" connection will be ignored.

It is recommended to set Configuration Control Byte 0x03 to test and immediately save the configuration, and once you have the encoder configured correctly, set the Configuration Control Byte to 0 so that the configuration does not get changed any more. You may then even delete the "Live Config" connection!

#### Warning:

The "Live Config" configuration method is only intended for set-up of the encoder in a secure and protected environment where unexpected or invalid measurement values from the encoder do not pose any danger. After the initial setup and saving of the configuration using the Configuration Control byte, the "Live Config" connection must be closed, i.e. deleted and the config written to the PLC.

While a "Live Config" connection is active, the "a Live Config Connection is active" alarm bit is set.

#### Configuring the encoder using Explicit Messaging

Through the encoder profile (Ladder Logic Example)

1. Create a new empty project for your PLC

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Example project creation

2. Do all necessary configurations of your Logix Designer Project related to your PLC and add a Turck EtherNet/IP encoder (set the encoder's name to e.g. TurckEncoder1) as described in the Quick Start Guide. Choose a connection that does not have a configuration assembly, e.g. as shown in the following image:

Module Definition						×	
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Input Only (100): Position + HiRes Position + Velocity +		8	DINT	4	TurckEncoder1:I1		
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Select a connection	-						
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Connection configuration



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- Cas Ungrouped Ases	+ TurckTestEncoder1:11.Data[6]	16501729	Decinal DINT	Stendard	
- G Add-On Instructions	+ TurckTestEncoder1:11.Data[7]	6552320	Decimal DINT	Standard	
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🚊 📾 1/0 Configuration					
📥 💷 1756 Backplane, 1756-A7					
- 🛅 [0] 1756-L71S EncoderProject					
1 [1] 1750-LTSP EncoderProject:Partner					
Ethernet					
- 1756-ENZTR ENZTR					
Kivi-103/100 Türcklestencoder1					
					-
	Monitor Tags / Edit Tags /		я <u></u> п		F 2
Project saved to Recovery file.					33

Result of the configuration

3. Go online. You now get position data from the encoder as seen in tag TurckEncoder1:11.Data[0]. The position data is based on the configuration in the default values of the encoder if you have a new encoder.

4. Now go offline.

5. Create the following tags you will need for your configuration as required:

- ConfigMURvalue (DINT type)
- ConfigTMRvalue (DINT type)
- ConfigDirectionValue (SINT type)
- ConfigMURmessage (MESSAGE type)
- ConfigTMRmessage (MESSAGE type)
- ConfigDirectionMessage (MESSAGE type)

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A MainProgram	H: ConfigDirectionvalue			SINT	Standard		Read/Write		Decimal	= E
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- MainRoutine				MESSAGE	Standard		Read/Write			
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BafetyProgram	2									
Unscheduled Programs / Phases	*									-
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6. Edit your main program to add a new rung and put in a Trigger Block and a One Shot Block as shown in the image. Also create the tags required for both blocks.

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Image: Controller Encoder Project     Image: Controller Encoder Project       Image: Controller Fault Handler     Image: Controller Fault Handler       Image: Controller Fault Handle	
An Deta Types	
Link User Defined	- 1 - 2
Image: Add-On-Defined     Logix Designer project saved successfully.       Image: Predationed     Complete - 0 error(s), 0 warning(s)       Image:	
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- 1 (1)1756-L759 EncoderProject/Partner + +	*
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St <u>y</u> le:	Decimal	•	
Constant			

Example how to create the tag for the One Shot Block

7. Add a MSG element e.g. using the "Add Ladder Element" funtion.



8. Put the name of your desired configuration message into the field "Message Control", e.g. ConfigMURmessage.

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9. Now right-click the chosen name and select the matching message, e.g. "ConfigMURmessage" (or your chosen Name) to link the message to your MSG instruction.

10. In your newly created MSG instruction, click the Icon having the three dots to configure your message.

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11. The Message Configuration Dialog pops up

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		Source Length:	1 🌩 (Bytes)
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Attribute:	0 (Hex)	Element:	New Tes
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12. Configure the message as shown in the next 3 images. Select the appropriate source element in the configuration tab

-	on Com	munication Ta	0				
Message	Type:	CIP Gener	c		•		
Service Type:	Set Att	ribute Single		•	Source Element:	ConfigMURvalu	e .
Service					Source Length:	4 🔶	(Bytes)
Code:	10	(Hex) Class:	23	(Hex)	Destination		-
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onfiguration*	Communication*	Tag			
Name:	Config MURmessag	je.			
Description:			4		
Type:	Base				
Data Type:	MESSAGE				
Scope:	EncoderProject	t			
Class:	Standard				
External Access:	Read/Write				
Enable	C Enable Watting	O Start	O Done	Done Length: 0	
) Error Code: ror Path: ror Text:	Extend	led Error Code:		🔲 Timed Out 🍝	

Make sure you do not confuse hex and decimal values!

13. Repeat steps 7 to 13 for the three tags ConfigMURvalue, ConfigTMRvalue and ConfigDirectionValue.

The "Configuration" settings are shown in the following three images, the other settings are as shown in the last three images. Make sure you set the correct values in all three tabs of all three messages.

ontigurati	on Con	nmunication Ta	9		_	
Message	Type:	CIP Gener	c		•	
Service Type:	Set At	tribute Single		Source Elemen	nt: Con	figDirectionvalue 👻
Service	<b>_</b>	1.0.0.0		Source Length	1	(Bytes)
Code:	10		23 (H	Destination		-
Instance:	1	Attribute:	c (H	ex)	Ne	w Tag



onfiguratio	Com	munication Ta	9				
Message	Type:	CIP Gener	ic		•		
Service Type:	Set Attri	ibute Single		•	Source Element:	ConfigMURvalue	•
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Instance:	1	Attribute:	10	(Hex)	Element:	Ne <u>w</u> Tag	
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The Class 0x23 stands for the Position Sensor Object that the Turck encoder has. Instance is set to 1 because every encoder has only one Position Sensor Object. The attributes 0x0C, 0x10, 0x11 correspond to the values in column "Attribute ID" shown in table "Position Sensor Object Class Attributes". Please remember that the dialogs take Hexadecimal numbers, the column in the table shows decimal numbers.

14. Perform steps 7 to 13 for any other Configuration Values you want to change in the encoder. You can use table "Position Sensor Object Class Attributes" for reference.

15. After you have written all the configuration data to your encoder, it is important to save or apply the attributes. The settings only come into effect after apply or save was performed!

To apply the attributes (which means, the encoder will lose the settings after a power cycle so you have to set and apply again), create a MESSAGE Tag called e.g. "ConfigApplyMessage" and add a corresponding MSG block. It should look as follows:

	Con	munication Ta	9			
Message	Type:	CIP Gener	IC	-	•	
Service	Apply A	Attributes		Source Elament		
(Dec)				Source Length:	0	(Bytes)
Service Code :	d	(Hex) Class:	23 (He	x) Destination		
Instance:	0	Atbribute:	0 (He	x) Element:	New T	· .
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	TurckEncoder1				
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@ CIP	ODH+ Char	nnel: 🕅 🕅	Destination	Link 0 🔮	
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D Error Code: Fror Path:	B	dended Error Code:		Timed Out +	

Only after this apply message, the settings are effective.

As an alternative, you may modify the message to be a "Save" Message, which first applies and then saves the settings to nonvolatile storage. Needed settings are as follows:



#### These are the changed settings:

uniguidue	Commu	inication Ta	9					
Message	Type:	CIP Gener	C		•	]		
Service Type:	Custom			•	Source Element:			•
Seryjce Code :	16 ()	Hex) <u>C</u> lass:	23	(Hex)	Source Length: Destination	0	÷	(Bytes)
Instance:	0	Attribute:	0	(Hex)	Element:	Nex	v Tag	1

Changing the apply message to a save message

Service Code 0x16 stands for "Save Attributes" in the CIP specification. The meaning of the service codes "Apply Attributes" and "Save Attributes" for this encoder are shown in table "Services of the Position Sensor Object".

Your finished program to set and apply or save the attributes now looks as follows:

Sample Ladder Logic Program to configure the encoder and apply/save the settings

🦸 Logix Designer - EncoderProject (1756-1715 23.12)" - [MainProgram - MainRoutine"]	
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Controller frogenier     ****       Controller frogenier     ************************************	IESG IESG
Enter BOOL operand	Rung 0 of 1 APP VER

You can see that the apply or save message should usually come last in a series of Configuration Messages to make all settings effective! It is important to do any "Preset Value" setup after sending the apply or save message.

The tags in your program look as follows:

[ Logix Designer - Encoder/Project [1/56-L/15/23.12] - [C 2] Elle Edit View Search Logic Communication 같 같 같 다 요즘 요즘 것 같은 돈 다 그 그 Turck RM-105	Sontroller Lags - Encoder Project (controller)) ns Iools Window Help /106_AttData	Q. Q. Select Inc	2422				(0)	- 8
Image: Non-State State         Image: Non-State         Image: Non-	Path:         AB_ETHIP-1\132.168.1.1\Backplane\0         ▼           4         Hord hard         H + + + + + + + + + + + + + + + + + + +	Timer/Counter						
Controller Organizer - 🗸 🗸	Scope: Scope: Show: All Tags				▼ ¥, Enter Nan	ne Alter		
Controller EncoderProject	Name =8[5]	Value 6	Fo +	Style	Data Type	Class	Description	
Controller Tags	- TurckTestEncoder1:11	[]	1.		0308-8	Standard		
Controller Fault Handler	TurckTestEncoder1:I1.ConnectionFaulted	0		Decimal	BOOL	Standard		
- Power-Op Handler	- TurckTestEncoder1:11.Data	11	1	Decimal	DINT[8]	Standard		
H-G Tasks	+ TurckTestEncoder1:I1.Data[0]	43		Decimal	DINT	Standard		_
	+ TurckTestEncoder1:I1.Data[1]	440892		Decimal	DINT	Standard		_
Program Tags	+ TurckTestEncoder1:11.Data[2]	836740		Decimal	DINT	Standard		_
MainBoutine	+ TurckTestEncoder1:I1.Data[3]	0		Decimal	DINT	Standard		_
- SafetyTask	+ TurckTestEncoder1:I1.Data[4]	0		Decimal	DINT	Standard		_
H-S SafetyProgram	+ TurckTestEncoder1:11.Data[5]	2		Decimal	DINT	Standard		_
- C Unscheduled Programs / Phases	+ TurckTestEncoder1:I1.Data[6]	16810548		Decimal	DINT	Standard		_
E- S Motion Groups	+ TurckTestEncoder1:I1.Data[7]	6535680		Decimal	DINT	Standard		
Digrouped Axes	Config Trigger	0		Decimal	BOOL	Standard		
Add-On Instructions	+ Config TMRvalue	100		Decimal	DINT	Standard		_
📋 📇 Data Types	+ Config TMRmessage	{]	{		MESSAGE	Standard		
User-Defined	ConfigOneShot	0		Decimal	BOOL	Standard		_
B- Chings	+ ConfigMURvalue	20		Decimal	DINT	Standard		(
- Add-On-Defined	+ ConfigMURmessage	11	f		MESSAGE	Standard		
Predefined	+ ConfigDirectionvalue	1		Decimal	SINT	Standard		
Getage Module-Defined	+ ConfigDirectionmessage	11	f		MESSAGE	Standard		
File I/O Confirmation	+ ConfigApplyMessage	()	1	1	MESSAGE	Standard		
H=	Monitor Tags / Edit Tags /		1.					
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#### Tags used in sample program

16. To write the configuration to your encoder, right-Click "ConfigTrigger" and select "Toggle bit" in the pop-up menu. The config is now written to the encoder once and applied / saved in the last MSG block.

#### 17. Add further configuration if required:

Here are the messages to set low limit and high limit which influence your "Position State" output data see table "Assembly 100"). You can see how to create the appropriate tags in the previous examples in this section. Once again do not forget to put these messages before the apply / save message(s)!



Configuratio	n* Co	mmunication Ta	g				
Message	Type:	CIP Gener	c		-		
Service	Set At	tribute Single		•	Source Element:	Posto	wLimitValue
Type:					Source Length:	4	(Bytes)
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Instance:	1	Attribute:	16	(Hex)	Element:	New	Ten
						INC.M	Tay
) Enable ) Error Coc	⊖ E	nable Waiting Extende	⊖ St od Error	ant Code:	1 Done D	one Leng	th:0 Dut +

Position low limit

Configuratio	n* Co Type:	immunication Tr	eg IC		•			
Service	Set At	tribute Single		*	Source Element:	PosHi	ghLimitValu	e 🗸
(The)					Source Length:	4	÷ 0	Bytes)
Seryice Code :	10	(Hez) Class:	23	(Hex)	Destination			
Instance:	1	Attribute:	17	(Hex)	Element:	New	Ter	
						INE M	[1ag	
<ul> <li>Enable</li> <li>Error Col</li> <li>Error Path:</li> </ul>	⊖ E de:	inable Waiting Extende	⊖ St	art Code:	®® Done ⊑ [	None Len	gth: 0 Out +	

Position high limit

#### Setting the Preset Value via Explicit Messaging from a Ladder Logic PLC program

In addition to setting the preset value via the "Live Config" connection, it is also possible to use explicit messaging to set the preset value of the encoder in Logix 5000.

1. Create the encoder in Logix 5000, use the following connection configuration:

ctronic <u>K</u> eying: Compatible Module nections:	•				
Name		Size	1	Tag Su	iffix
Input Only (100): Position + HiRes Position + Velocity +	Input:	8	DINT	1	TurckEncoder1:I1
Acceleration + other (no contriguration Assembly)	Output:	0			<nonc></nonc>

#### 2. Create tags as follows:

ogis Designer - EncoderProject in EncoderProject2.46	CD [1756-L715 23.12]* - [Controller Tags - Enc	oderProject(controller)				_		a 🖾 💌
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📽 🖬 🎂 🔏 🐜 📾 🕫 👓 👓 Turck RM-1	105/106 A:I:Data 📼 🌽 🐴 🌆	VIVOQ	extlanauace.		- 9			
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#### 3. Create a routine as follows:

Insert a Trigger Block with corresponding tag, and a One Shot Block with corresponding tag. Now insert a MSG block with a message as follows:

Configuratio	n Cor	munication 1	ag				
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Preset message config part 1

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Preset message config part 2

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#### Preset message config Part 3

#### The result looks as follows:

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4. You can now enter your desired Preset Value into tag PresetValue, e.g. 55

5. To trigger the preset, Right-Click the Preset Trigger Block and select "Toggle Bit". The program now writes the Preset Message to the encoder once. It is not necessary to apply or save service.

6. After triggering, the encoder position is set to the value specified in our tag "PresetValue". Remember, in our example, the encoder position can be read from TurckEncoder1:11.Data[0].

7. When the encoder changes its position, you can see the encoder takes the starting position we have just written via Preset Value into account.

If you have changed the TMR and/or MUR values, it is very important to send the "Preset Value" Message after sending the "Apply" or "Save" message.



# 10. Addictional Functions

#### **Universal Scaling Function (USF)**

This Encoder has the Turck Universal Scaling Function (USF) always activated. There are no position error at the end of the total measuring range, when using a decimal divider for position scaling.

Without the USF function, you can only use a binary scaling divider. Otherwise you get an position error at the end of the total measuring range (TMR).

#### Address Conflict Detection (ACD) Function

By default, the "ACD" function of EtherNet/IP (Address Conflict Detection) is enabled. If it is not required, it can be switched off by writing 0 to Object 0xF5 (TCP/IP), Instance 1, Attribute 10. This can slightly speed up encoder power-up. Details can be found in the CIP / EtherNet/IP specification.

#### Activating "Device Level Ring" for Redundancy

For protection against a single EtherNet network cable break, the "Device Level Ring" functionality can be activated when building a ring of devices. It is mandatory for all the devices taking part in the ring to have two EtherNet ports.

To use Device Level Ring, all the devices have to be organized in a single ring starting with port 1 of the PLC and ending in port 2 of the PLC, all linked by EtherNet cables.

In the "Properties" Window of your PLC or Network Interface in Logix 5000, go to the "Network" tab, enable e.g. your PLC as a ring supervisor and set the Network topology to "Ring". The Network will now stay operational after only a very short interruption in case of a single cable break in the ring, since the data flow will use the remaining alternative route in the Network after the cable break. The ring supervisor will detect a ring failure by sending beacon frames around the ring on one of its ports, then checking for the beacon frames to arrive on the other port.

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Example of a detected ring fault (set-up with 1 encoder only)

#### **Rotational Axis Mode**

This encoder can be set to Rotational Axis Mode. To activate Rotational Axis Mode, set TMR to a value smaller than MUR.

If, for example, you set TMR (attribute 17) to 1800 and MUR (attribute 16) to 3600, the position values will be in the range from 0 to 1799 for each 180 degrees of rotation.



# 11. Check the Encoder Firmware Versions

When getting technical support, it may happen that the Turck technical support asks you for the Firmware versions of your encoder.

In order to get the Firmware versions of the two processors of the encoder, create a program as follows:

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Version read program

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Application processor version Read Message

You can now toggle the versionTrigger Block to initiate reading.

After reading, the versions ID strings can be found in the tags and may be copied and pasted:

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## 12. Abbreviations used

- LSB Least Significant Bit/Byte
- MSB Most Significant Bit/Byte
- MT Multiturn Encoder, Order Code RM-105 orRM-106
- ST Singleturn Encoder, Order Code RS-107 or RS-108
- MUR Measurement Units per Revolution, the number of units the Encoder counts for one full revolution of the shaft. Also called "Measuring Units per Span". This value is kept in Attribute 16 of the CIP Position Sensor Object.
- **TMR** Total measuring range, the number of units the Encoder counts in total. Also called "Total Measuring Range in Measuring Units". This value is kept in Attribute 17 of the CIP Position Sensor Object.



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