Your Global Automation Partner

TURCK

Ethernet/IP Manual

RM-105/106
RS-107/108

Manual

Contents

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

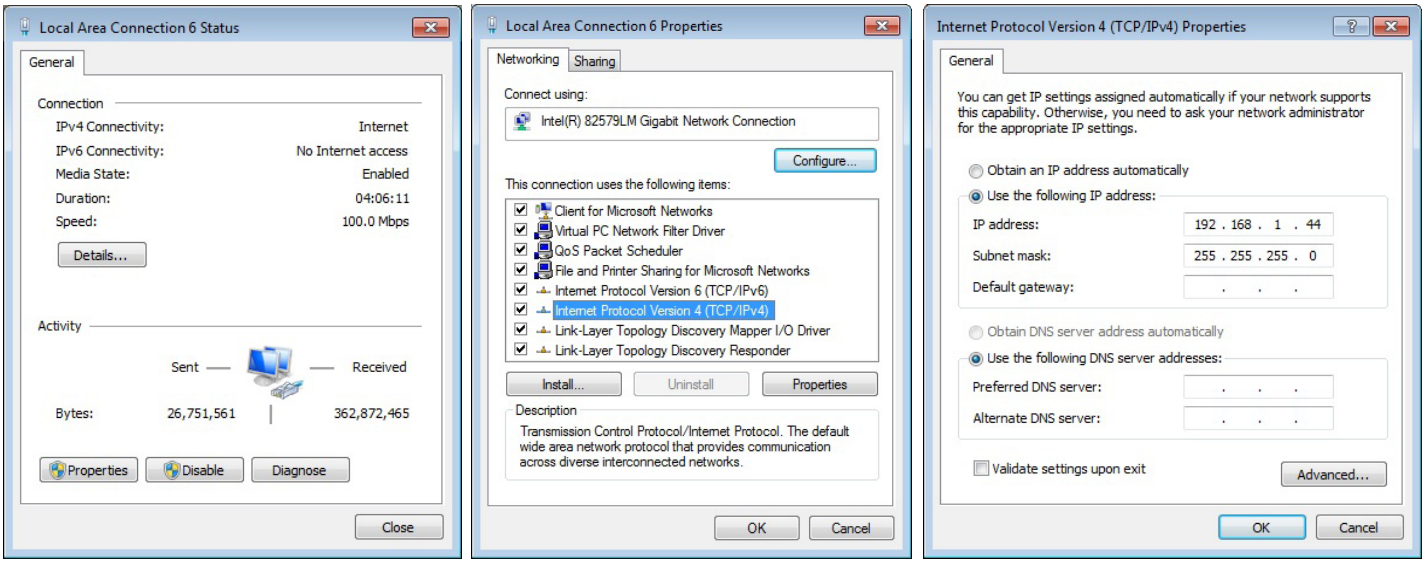
Identification and maintenance functionality

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

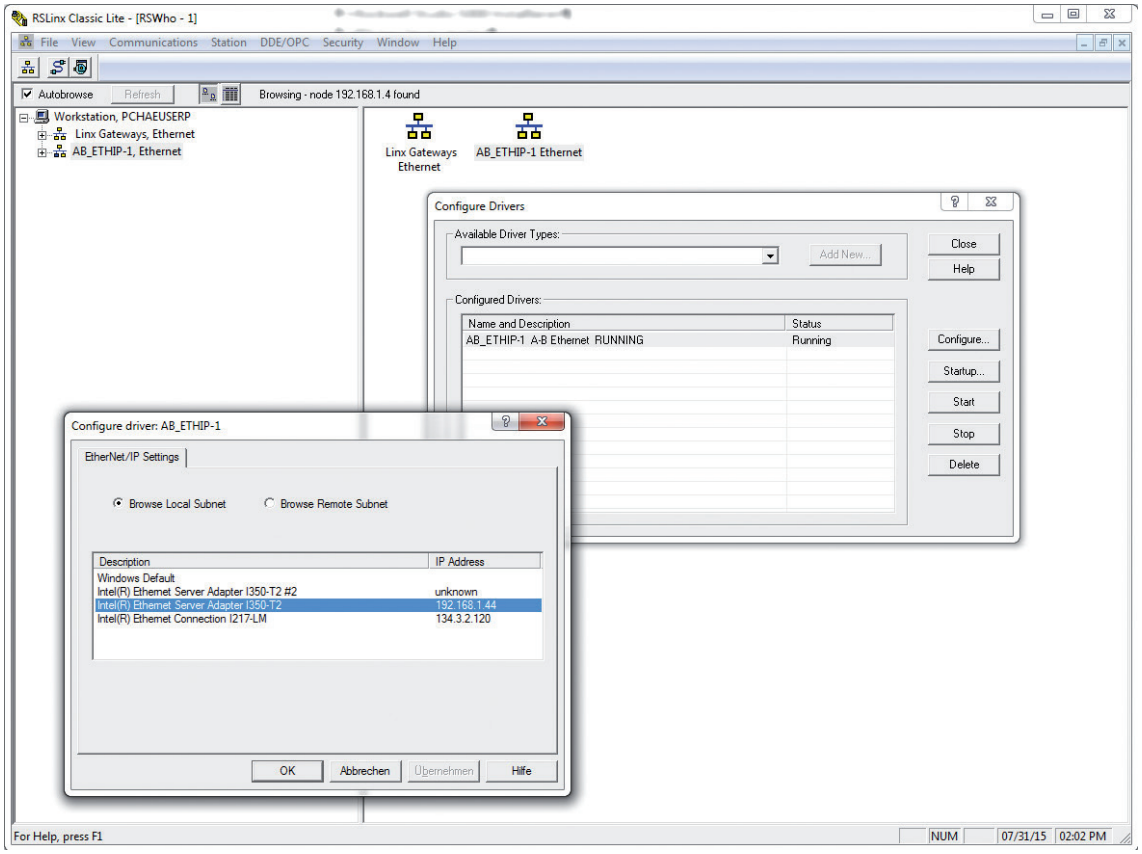
These operating instructions do not contain information about the installation of the RM-105/RM-106, RS-107/RS-108. You will find these in separate installation instructions.

2. Quick Start Guide

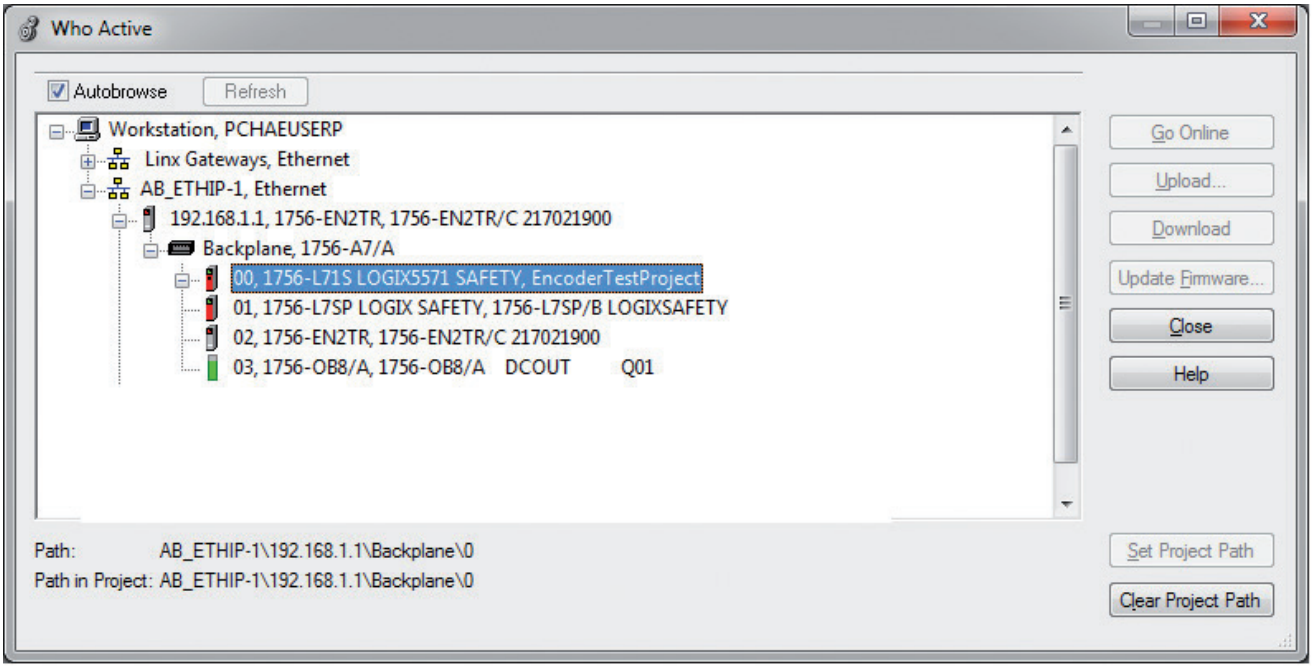
In this chapter, we demonstrate the use of an Allan Bradley EtherNet/IP PLC using the Rockwell Studio 5000 Software (V23.00) with the encoder.
Set up a free IP address on a free EtherNet Network Card as shown. We suggest using an IP address from the 192.168.1.x range, since this is the standard setting of the encoder.



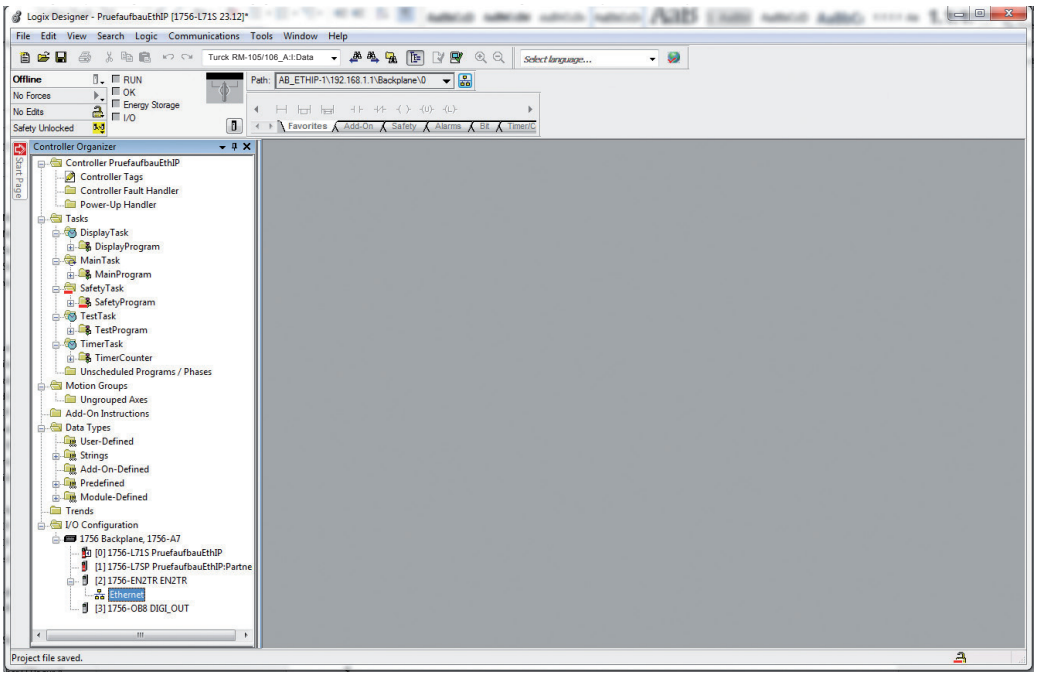
- Install Rockwell Studio 5000
- Start RSLinx Classic and set up the EtherNet/IP driver as shown:



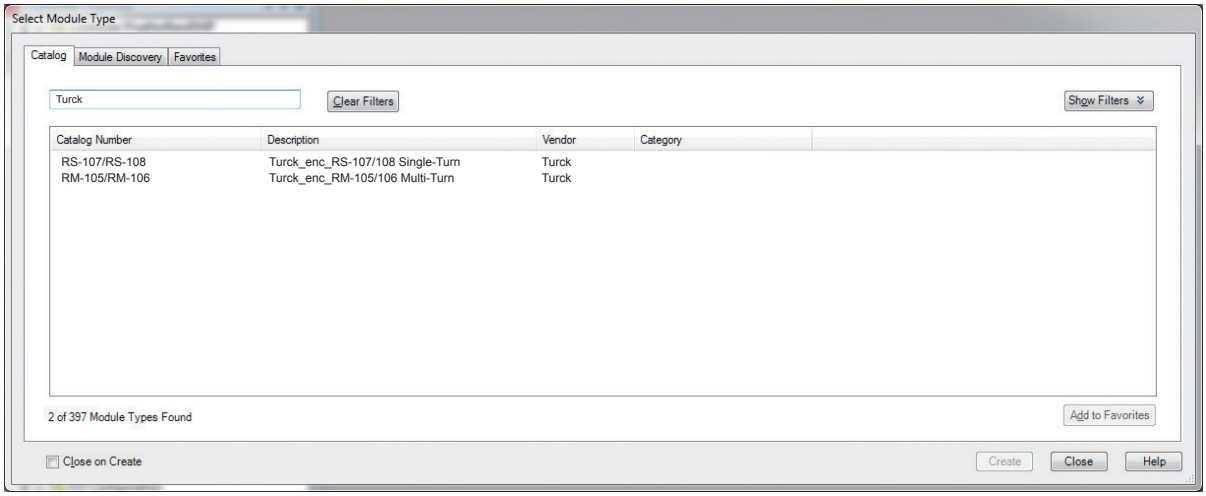
- Start Studio 5000
- Create a new project matching your PLC model
- Use the menu Tools / EDS Hardware Installation Tool to install all needed .EDS Files for your PLC and your Rockwell EtherNet/IP communication module (if applicable). These EtherNet/IP EDS files can be found at http://www.rockwellautomation.com/global/support/networks/eds.page?
- 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



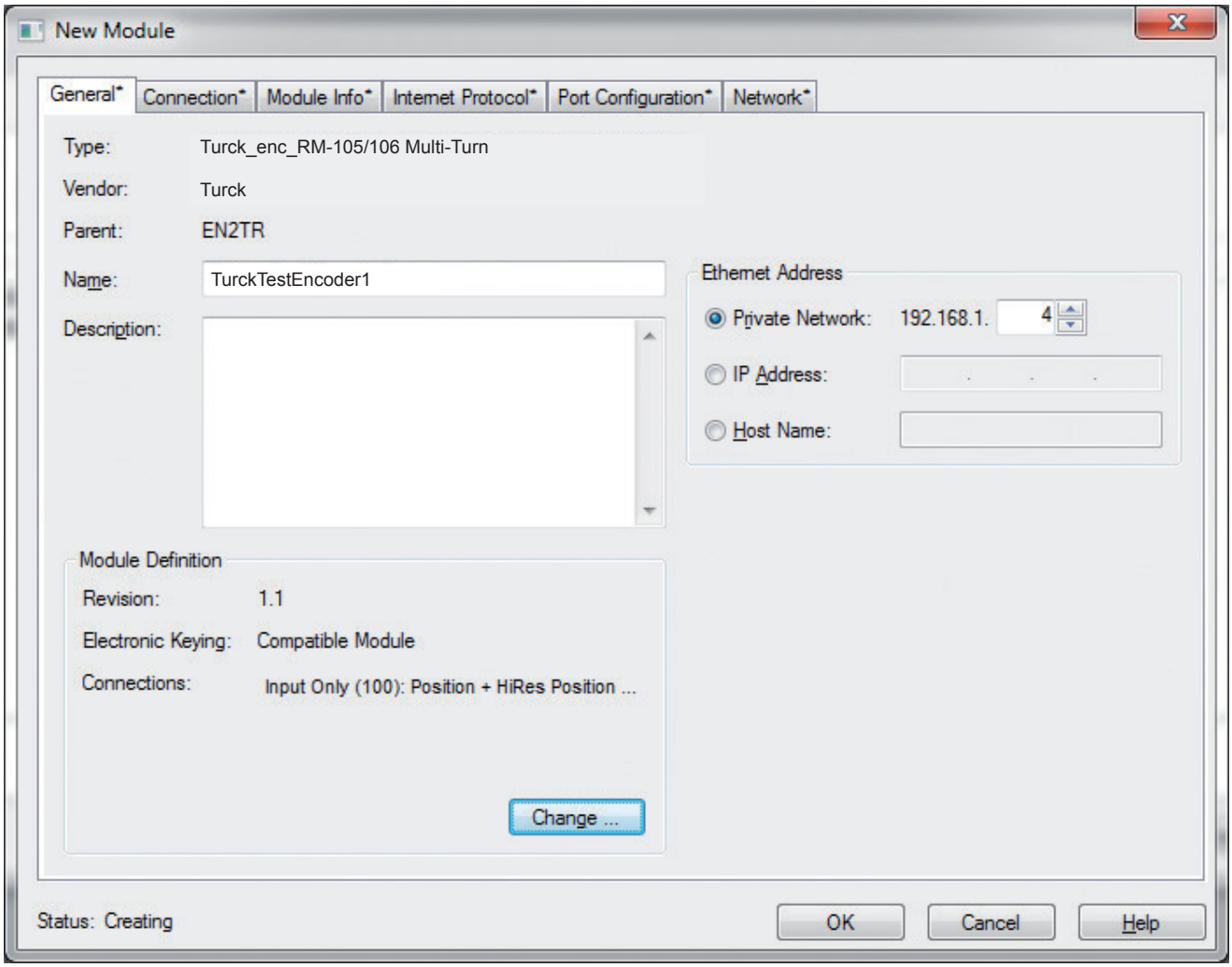
The project path now appears next to "Path:" in your Logix Designer Window.



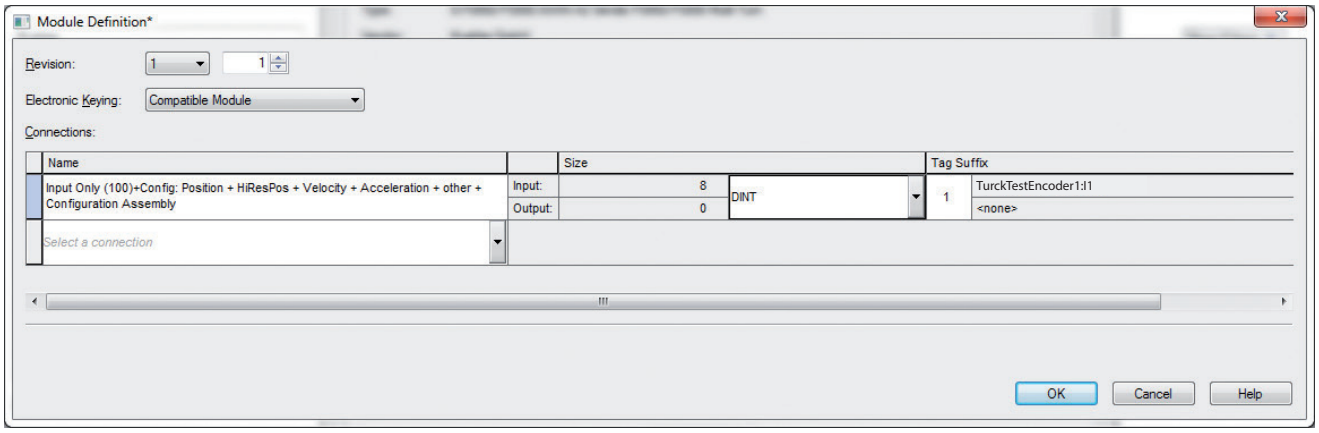
Now right-click on Ethernet in the controller organizer pane and select “New Module”.



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



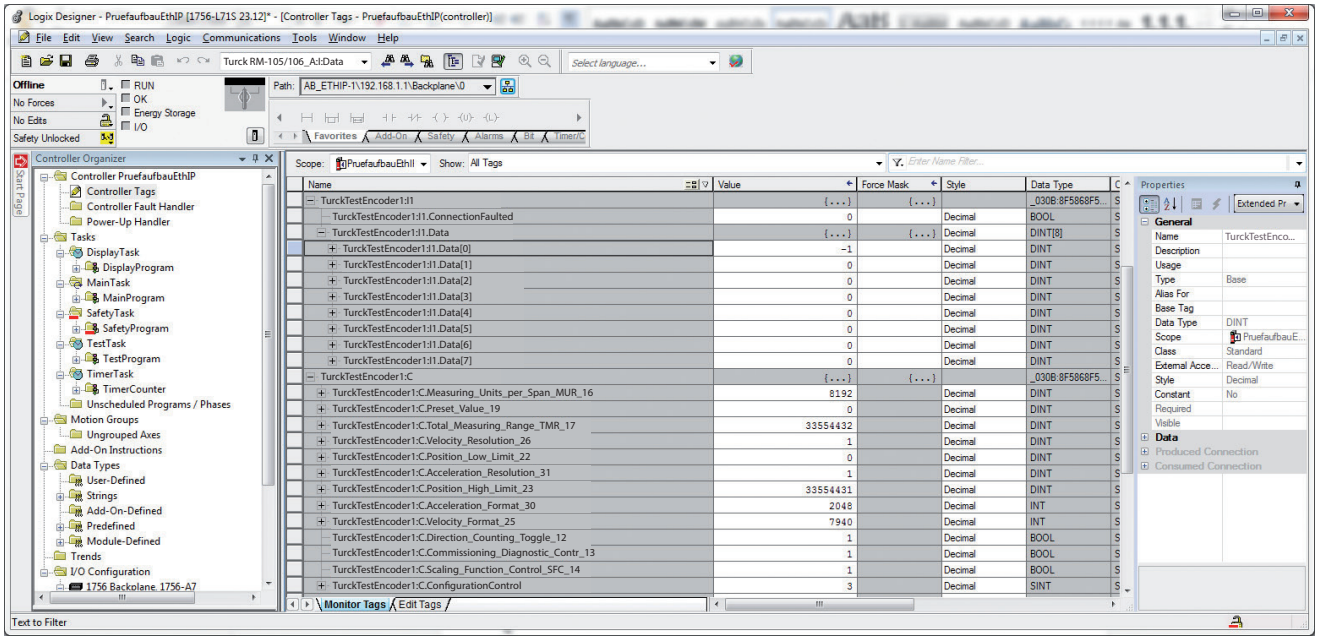
In the general / module definition pane of the "New Module Window", click change and select the connections as shown here:



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.

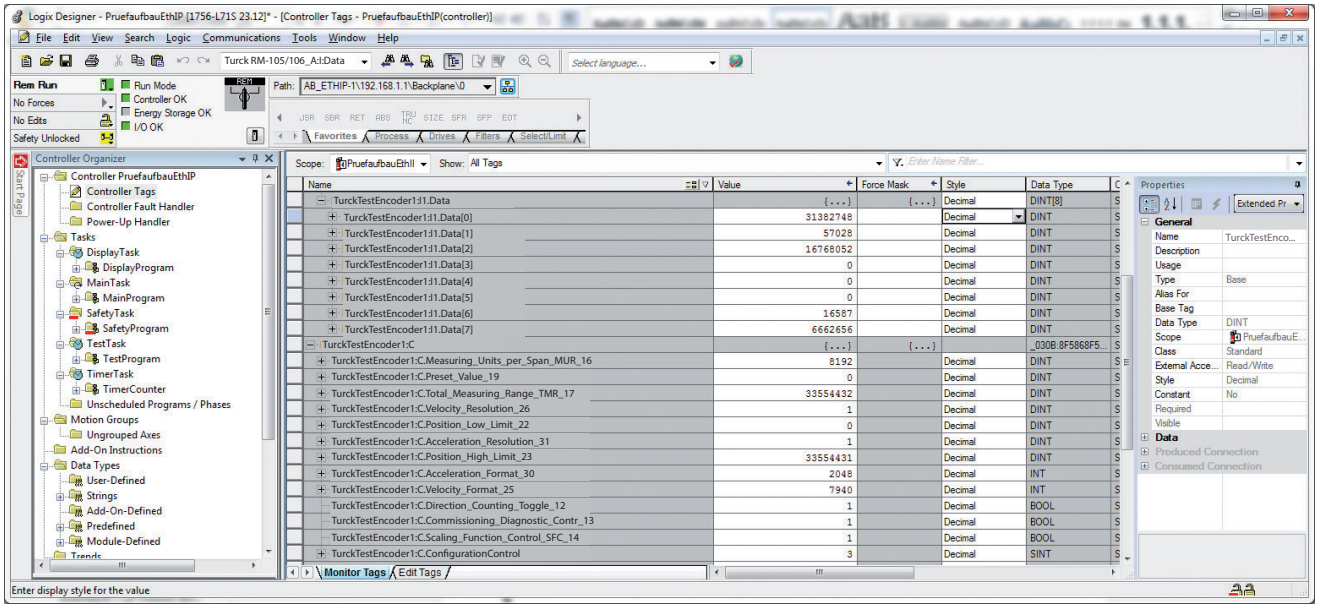
In Logix Designer, you can now see the encoder's config and parameter in the "Controller Tags" section.



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:I1.Data[0], for instance, contains the Position Value data, and TurckTestEncoder1:I1.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.



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.

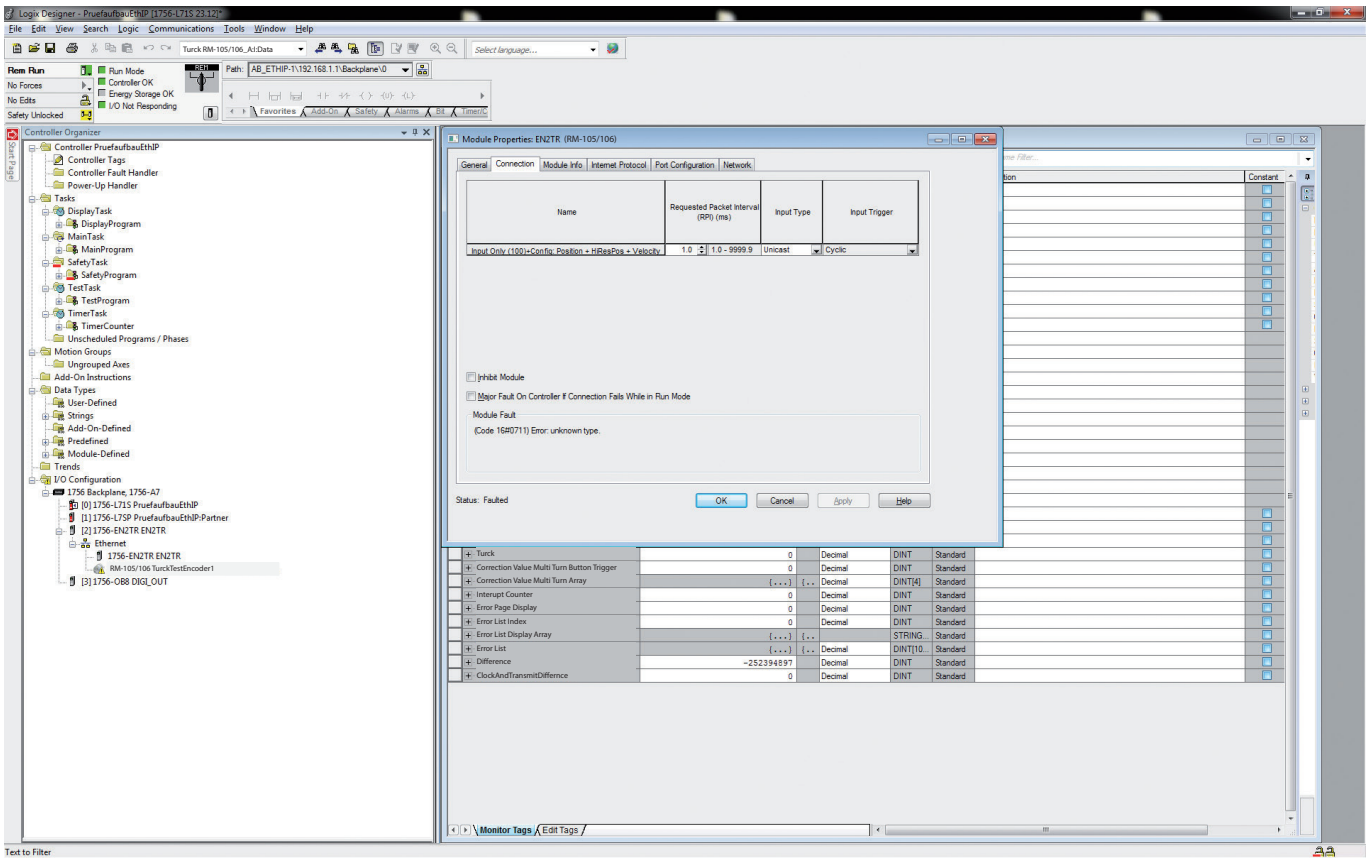
Please be aware that in this setup, you have the config items in clear text tag names such as TurckTestEncoder1:C.Position_Low_Limit_22, but it is not possible to get the data coming from the encoder in clear text tag names using this version of Logix in a simple way.

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:I1.Data[1] and TurckTestEncoder1:I1.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.



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 technology	Optical sensor
Singleturn resolution	524287 steps / revolution (19 bits)
Internal cycle time	1 ms
Multiturn technology	Electronic gear, battery-buffered
Multiturn resolution	Maximum 2^{24} 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™) 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	Position LSB								Scaled position value. The calculation considers among other: Scaling Function control, TMR, MUR, Offset/Preset	3
	1	Position									
	2	Position									
	3	Position MSB									
2	0	Position LSB								See Assembly 1 „Position Value“ 3	3
	1	Position									
	2	Position									
	3	Position MSB									
	4	—	—	—	—	—	—	Warn Flag	Alarm Flag	0, if no is active, otherwise 1 0, if no warning is active, otherwise 1	—
3	0	Position LSB								See Assembly 1 „Position Value“	3
	1	Position									
	2	Position									
	3	Position MSB									
	4	Velocity LSB								Velocity value	24
	5	Velocity									
	6	Velocity									
	7	Velocity MSB									
100	0	Position LSB								See Assembly 1 „Position Value“	3
	1	Position									
	2	Position									
	3	Position MSB									
	4	Hi Res Raw Position Singleturn part LSB								Singleturn raw position unscaled, clockwise, 19 bits unsigned, upper 13 bits always 0. (Value: 0 to 524287)	—
	5	Hi Res Raw Position Singleturn part									
	6	Hi Res Raw Position Singleturn part									
	7	Hi Res Raw Position Singleturn part MSB									
	8	Hi Res Raw Position Multiturn part LSB								Multiturn raw position unscaled, clockwise, 24 bits unsigned, upper 8 bits always 0. (Value: 0 to 16777215)	—
	9	Hi Res Raw Position Multiturn part									
	10	Hi Res Raw Position Multiturn part									
	11	Hi Res Raw Position Multiturn part MSB									

	12	Velocity LSB								Velocity value	24
	13	Velocity									
	14	Velocity									
	15	Velocity MSB									
	16	Acceleration value LSB								Acceleration, format depending on Attribute 25 (Velocity format)	29
	17	Acceleration value									
	18	Acceleration value									
	19	Acceleration value MSB									
	20	0	0	0	0	0	0	Diag-ERR	Sens ERR	Indicates a malfunction: Bit 0: 1 if a Sensor Error occurred reading the position, otherwise 0 Bit 1: 1 if an internal Diagnostic Error occurred in the encoder, otherwise 0 Bits 2 to 11: Always 0 Bit 12: 1 if an internal timeout reading the sensor occurred, otherwise 0. Bit 13: 1 if an internal CRC Error occurred reading the sensor, otherwise 0 Bit 14: 1 if an internal Data Error occurred reading the sensor, otherwise 0 Bit 15: 1 if a "Live Config" connection is active, otherwise 0. A "Live Config" connection should only be used during configuration of the encoder If the alarm bytes are not 0, your encoder may not deliver correct positions and may need replacement! All bits get reset through an encoder software reset or a power cycle.	44
	21	Live Conf. active	Int. Data ERR	Int. CRC ERR	Int. Tim-eout	0	0	0	0		

	22	0	0	0	Batt. Warn	0	0	LED Warn.	0	Indicates a Diagnostic Condition in the encoder: Bit 1: 1 if the internal LED in the sensor is beginning to reach the end of its lifetime, otherwise 0 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 Bit 13: 1 if the Device is running in an overtemperature condition reported by the position sensor, otherwise 0. 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! All bits get reset through an encoder software reset or a power cycle. Other bits: always 0.	—
	23	0	0	Over temp	0	0	0	0	0		
	24	Measurement Timestamp LSB								Position acquisition timestamp, a 16- bit wide counter running at 6. MHz is read at the moment of position acquisition. When reaching 65535, its value goes over to 0 and continues counting without delay.	—
	25	Meausrement Timetamp MSB									
	26	Position State								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 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	21
	27	Alarm Flag								1, if one or more alarms are active (i. e. Attribute 44 „Alarms“ unequal 0), otherwise 0	46
	28	Warning Flag								1, if one or more warnings are active (i. e. Attribute 47 „Warnings“ unequal 0), otherwise 0	49
	29	Life Counter								Position sensor life counter, is incremented by the value 1 once per ms, goes over to 0 after reaching the value 255.	—
	30	Temperature Indicator								Sensor operating temperature indicator. This indicator is not calibrated, the zero point of the scale is not defined. One step corresponds approximately to 1°C.	—
	31	Reserved								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	Meaning	Attribute No.
130 & 131	0	Measuring Units per Span (MUR) LSB								Number of units corresponding to one shaft rotation for the position value (Measuring Units per Span or Measuring Units per Revolution) Single Turn encoder configuration: MUR >= TMR	16
	1	Measuring Units per Span (MUR)									
	2	Measuring Units per Span (MUR)									
	3	Measuring Units per Span (MUR) MSB									
	4	Preset Value LSB								Setting of the position value to a fixed value (preset) The preset value is used according to the „Configuration Control“ bytes - (=preset value 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)	19
	5	Preset Value									
	6	Preset Value									
	7	Preset Value MSB									
	8	Total Measuring Range (TMR) LSB								Number of steps over the whole measuring range of the encoder, can cover 1 or more revolutions, TMR_max = MUR x 16bit	17
	9	Total Measuring Range (TMR)									
	10	Total Measuring Range (TMR)									
	11	Total Measuring Range (TMR) MSB									
	12	Velocity Resolution LSB								Resolution of the measured velocity value in steps.	26
	13	Velocity Resolution									
	14	Velocity Resolution									
	15	Velocity Resolution MSB									
	16	Position Low Limit LSB								Lower working range limit, the position is compared with the working range and influences Attribute 21 „Position State“. Can be used to obtain a status message.	22
	17	Position Low Limit									
	18	Position Low Limit									
	19	Position Low Limit MSB									
	20	Acceleration Resolution LSB								Resolution of the measured acceleration value in steps.	31
	21	Acceleration Resolution									
	22	Acceleration Resolution									
	23	Acceleration Resolution MSB									

	24	Position High Limit LSB	Upper working range limit, the position is compared with the working range and influences Attribute 21 „Position State“.	23
	25	Position High Limit		
	26	Position High Limit		
	27	Position High Limit MSB		
	28	Acceleration Format LSB	Format of the measured acceleration value 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
	29	Acceleration Format MSB		
	30	Verlocity Format LSB	Format of the measured velocity value 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	25
	31	Verlocity Format MSB		
	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	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. 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. Value 0 should only be used for testing purposes.	14
	35	Configuration Control	The Configuration Control byte defines whether and how the configuration data of the encoder is used. Meaning: See following table. If this byte is set e. g. to 0, the configuration is ignored!	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. **This is the recommended default value.**	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
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
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

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

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) 65,536 (16 bit) (singleturn encoder)	Multiturn encoder: 65,536(MUR) pulses * 65,536 rotations Singleturn encoder: 65,536
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

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 connector, 4-pin					
A	N (3 x M12 connector)	Bus Port 1	Signal:	Transmit data+	Receive data+	Transmit data -	Receive data -	 D coded
			Abbreviation:	TxD+	RxD+	TxD-	RxD-	
			Pin:	1	2	3	4	
		Power supply	Signal:	Voltage +	–	Voltage –	–	
			Abbreviation:	+ V	–	0 V	–	
			Pin:	1	2	3	4	
		Bus Port 2	Signal:	Transmit data+	Receive data+	Transmit data -	Receive data -	 D coded
			Abbreviation:	TxD+	RxD+	TxD-	RxD-	
			Pin:	1	2	3	4	

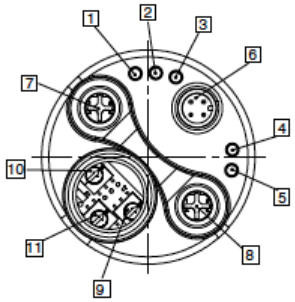
Terminal assignment bus

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



1 LED: Link 1
2 LED: Mod.
3 LED: Net.
4 LED: Encoder
5 LED: Link 2
6 Power
7 Port 1
8 Port 2
9 Switch: x1
10 Switch: x100
11 Switch: x10

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. **Note:** 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 connection times out. The network status indicator shall transition from flashing red to steady green only when all 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.

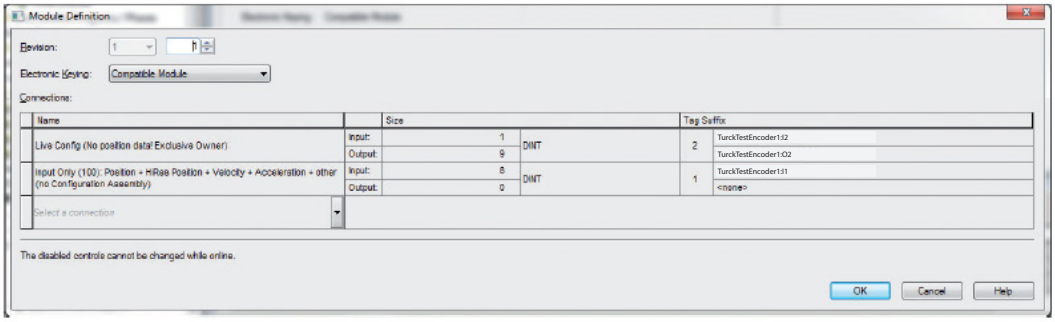
Link 1 / Link 2 LEDs
The Link 1 / Link 2 LEDs light green when the corresponding EtherNet port of a remote station (e. g. switch, hub, SPS, PC…) has been recognized. In addition, they flash yellow when data transfer takes place.

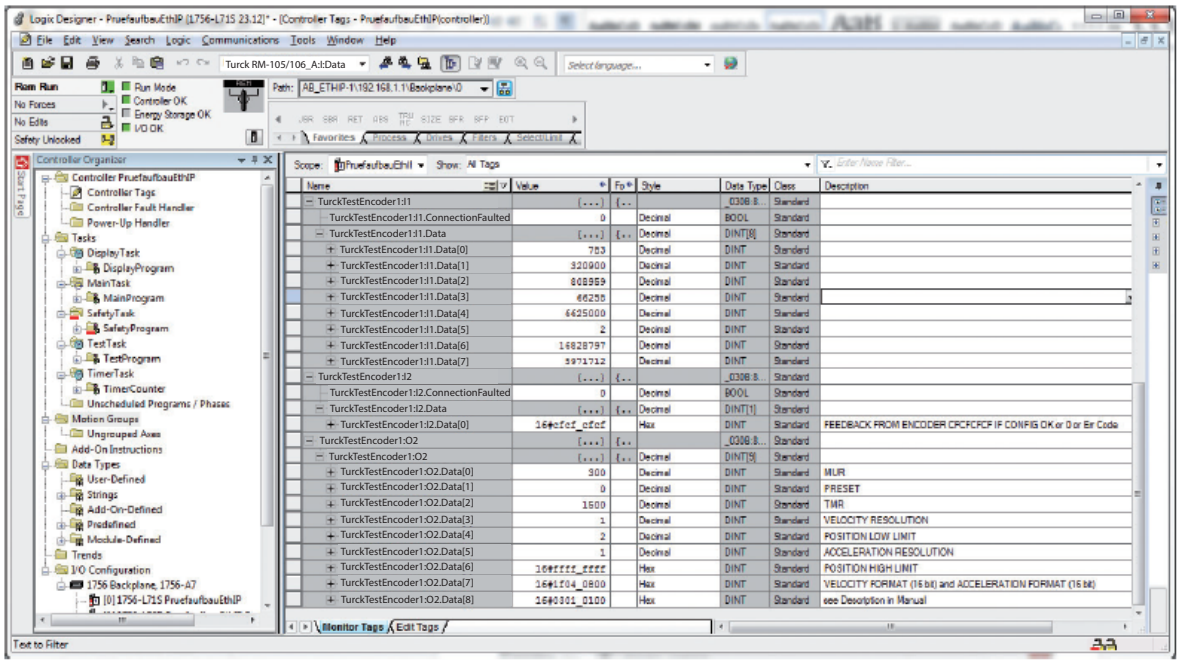
9. Configuration options

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.





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:I1.Data[7], then TurckTestEncoder1:I2.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!

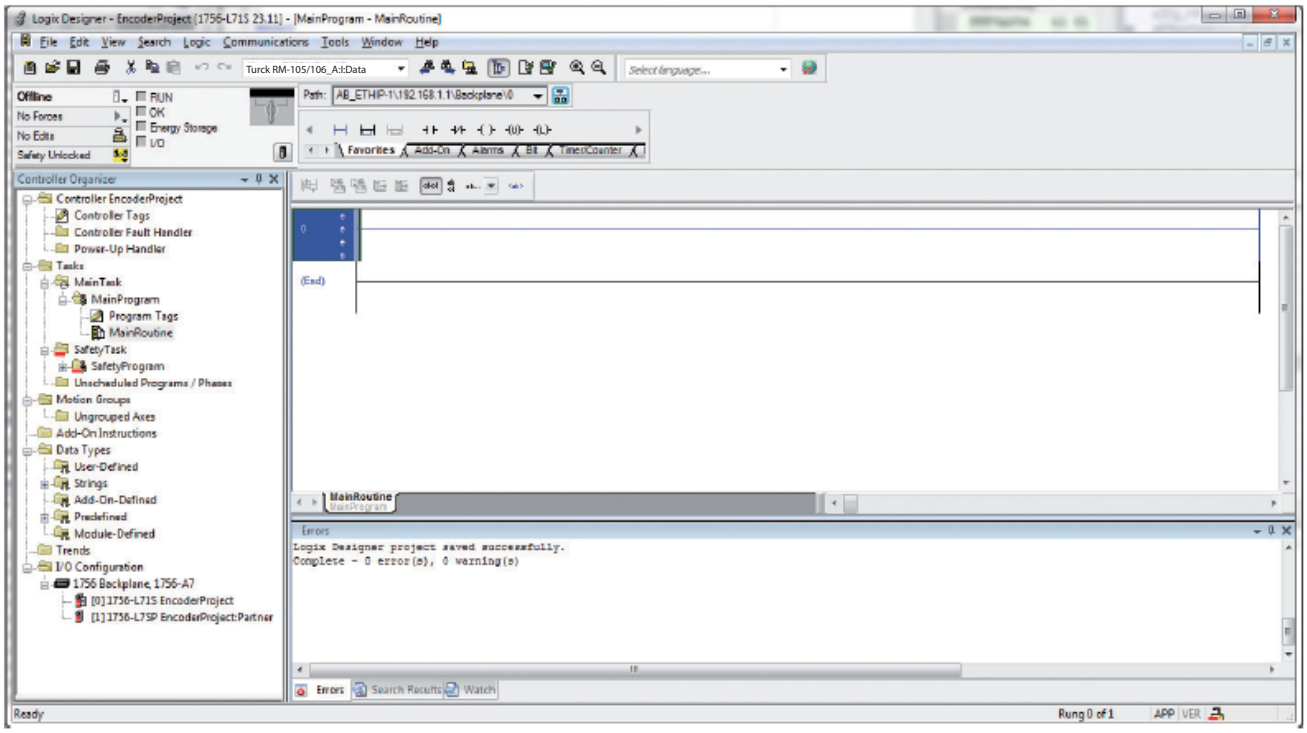
Warning:
The "Live Config" configuration method is only intended for set-up of the encoder in a secure and protected environment where unexpected or invalid measurement values from the encoder do not pose any danger. After the initial setup and saving of the configuration using the Configuration Control 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

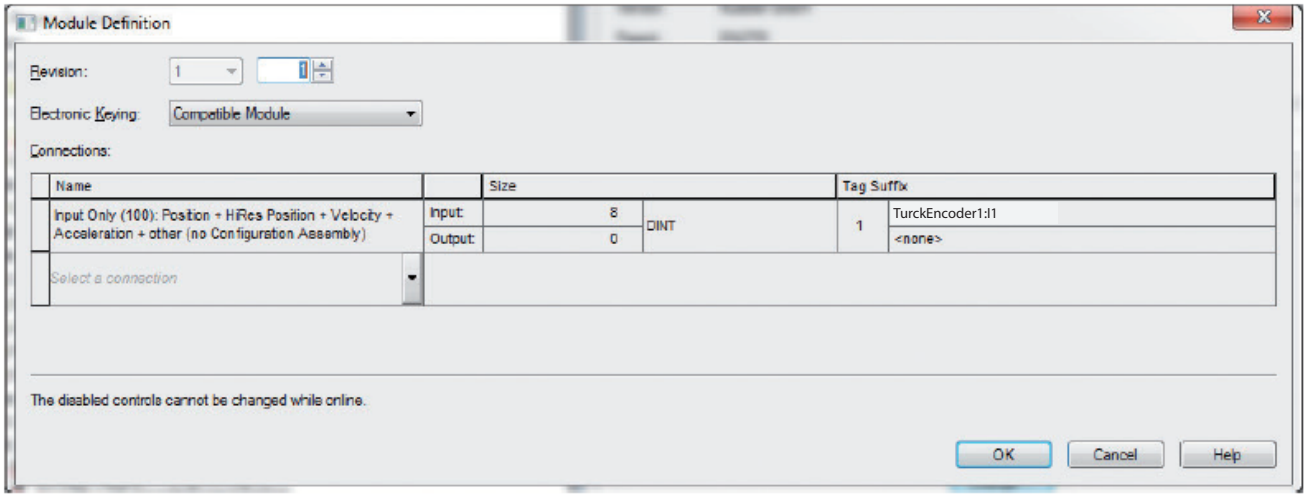
Through the encoder profile (Ladder Logic Example)

1. Create a new empty project for your PLC

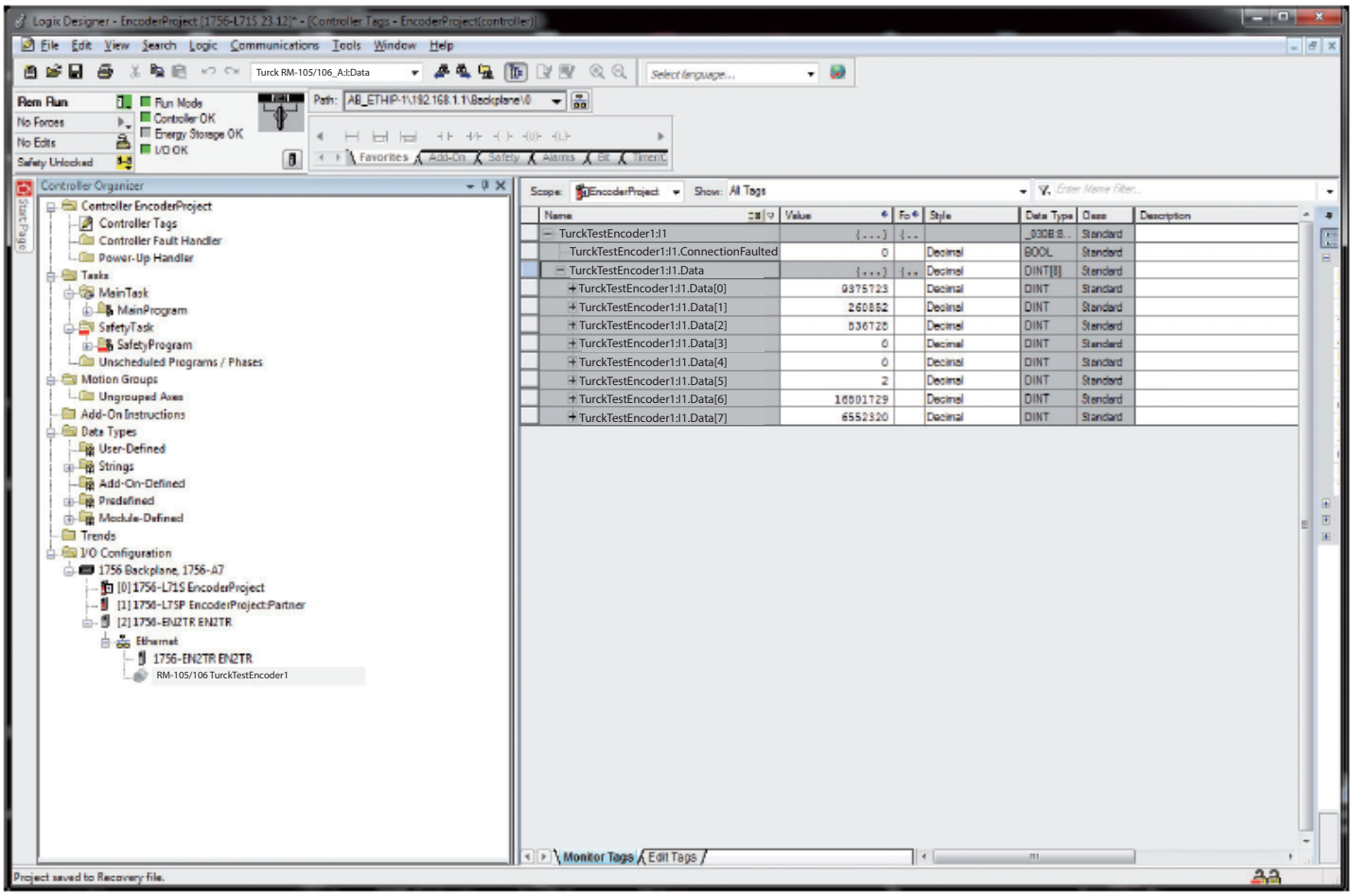


Example project creation

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:



Connection configuration

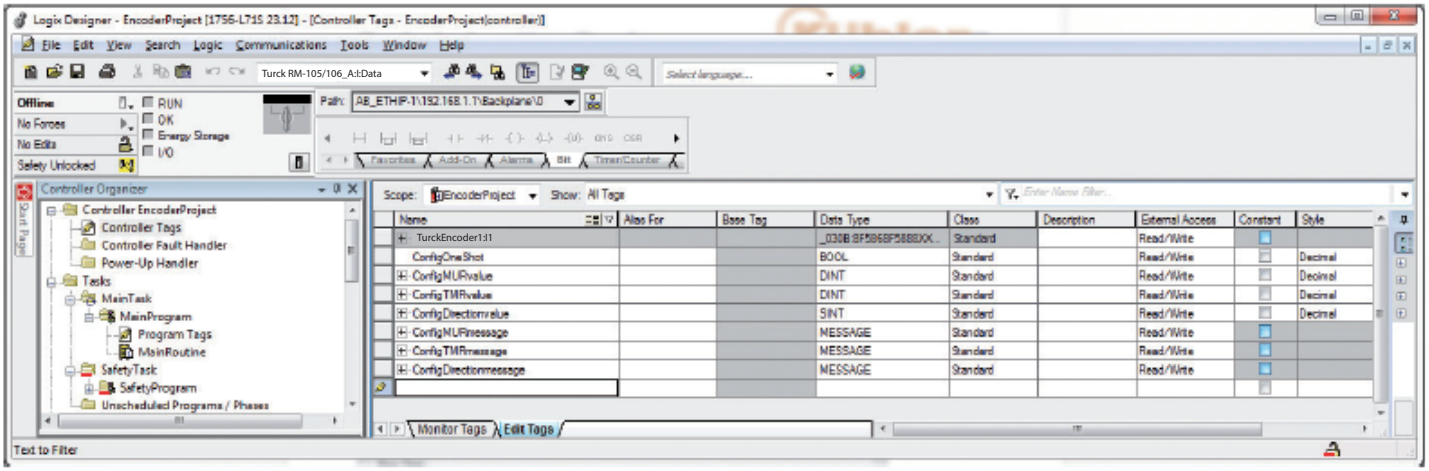


Result of the configuration

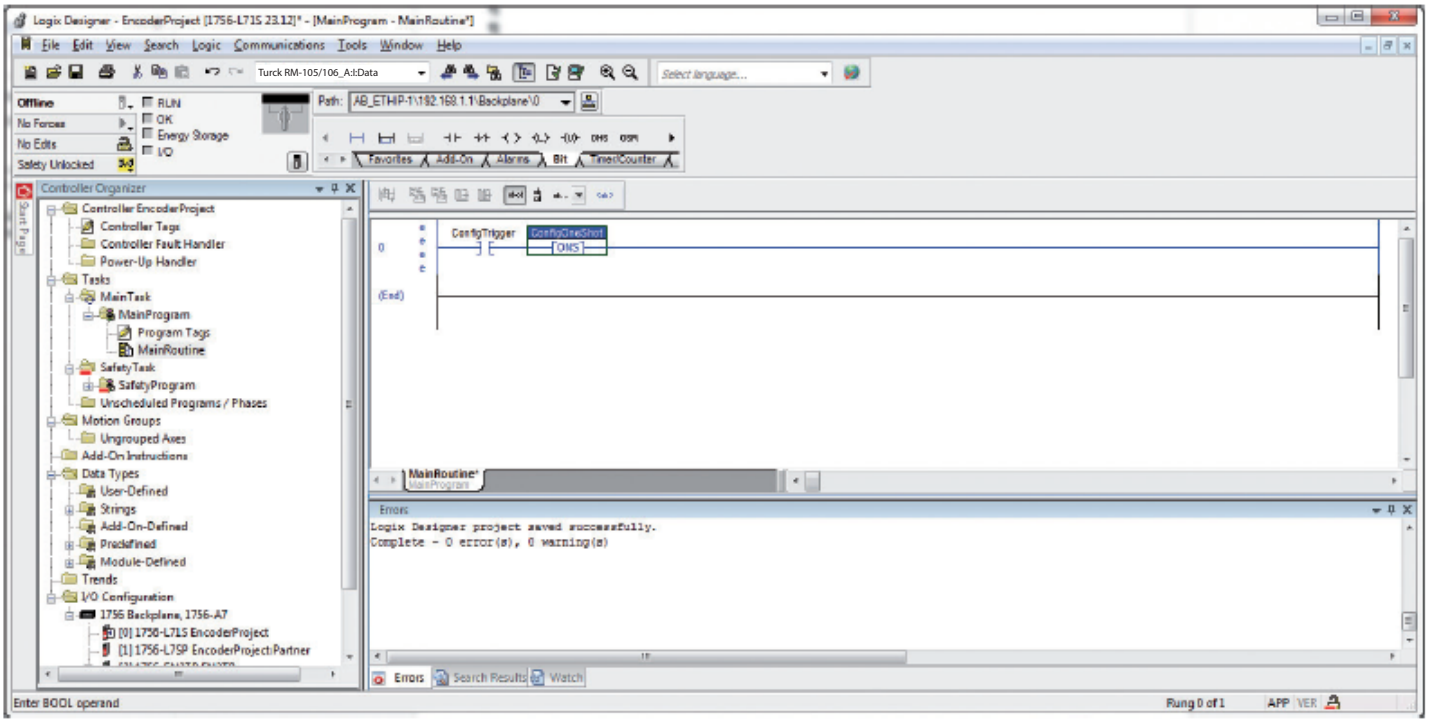
3. Go online. You now get position data from the encoder as seen in tag TurckEncoder1:I1.Data[0] . The position data is based on the configuration in the default values of the encoder if you have a new encoder.

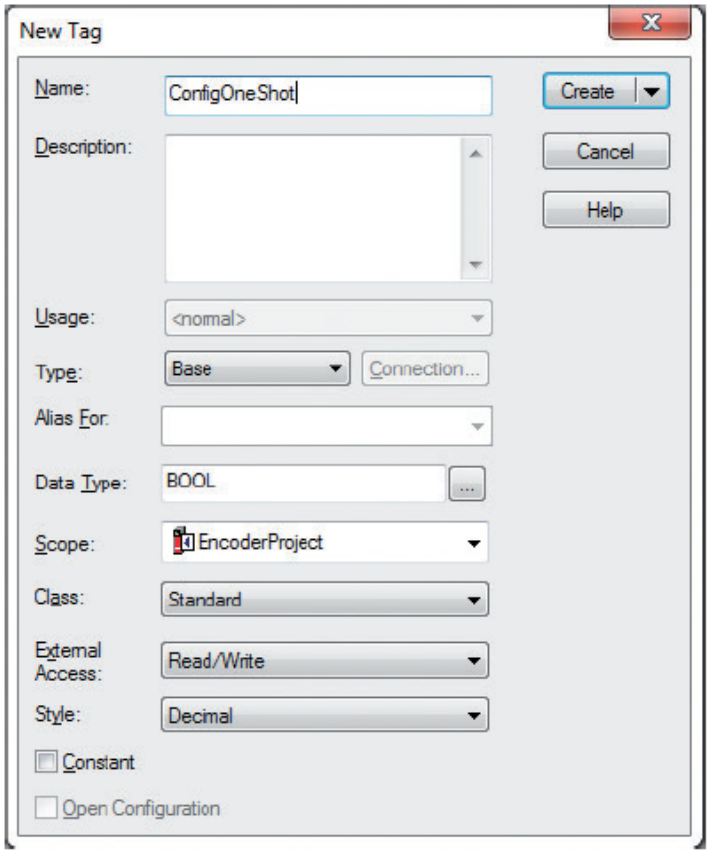
4. Now go offline.

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)



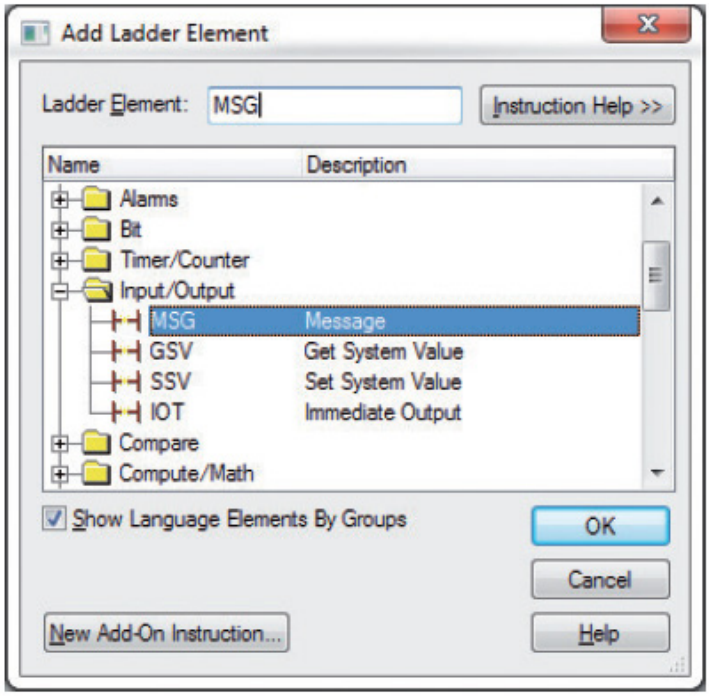
6. Edit your main program to add a new rung and put in a Trigger Block and a One Shot Block as shown in the image. Also create the tags required for both blocks.



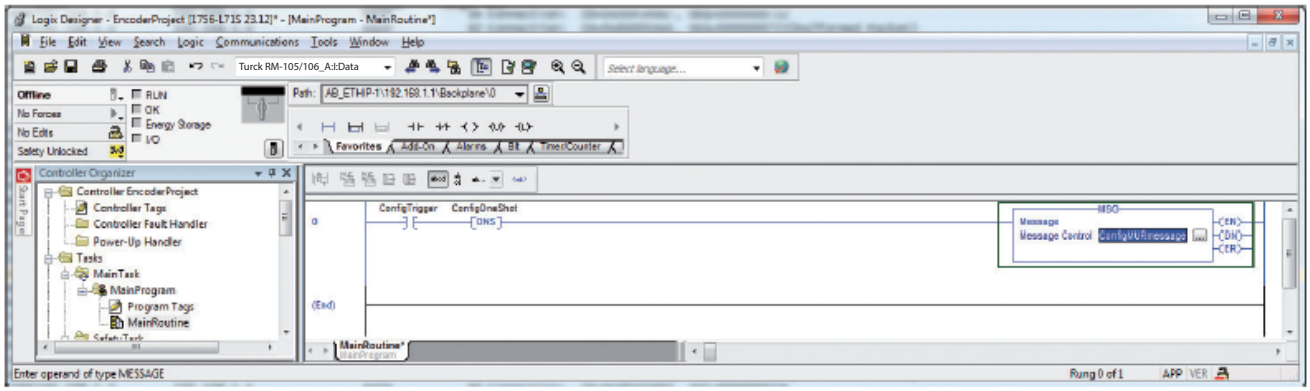


Example how to create the tag for the One Shot Block

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

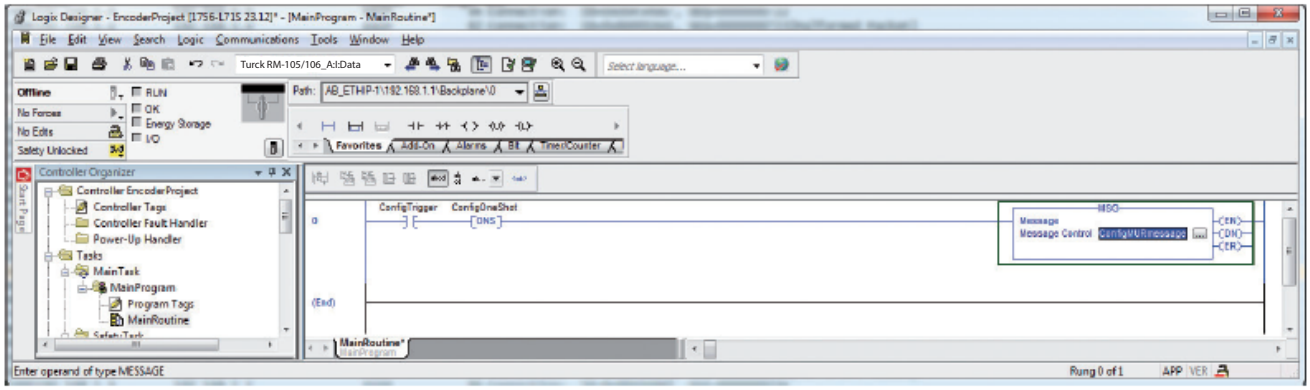


8. Put the name of your desired configuration message into the field “Message Control”, e.g. ConfigMURmessage.

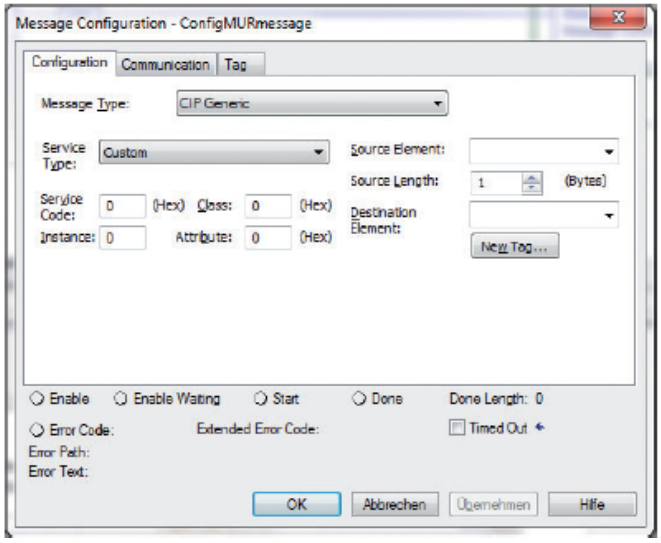


9. Now right-click the chosen name and select the matching message, e.g. “ConfigMURmessage” (or your chosen Name) to link the message to your MSG instruction.

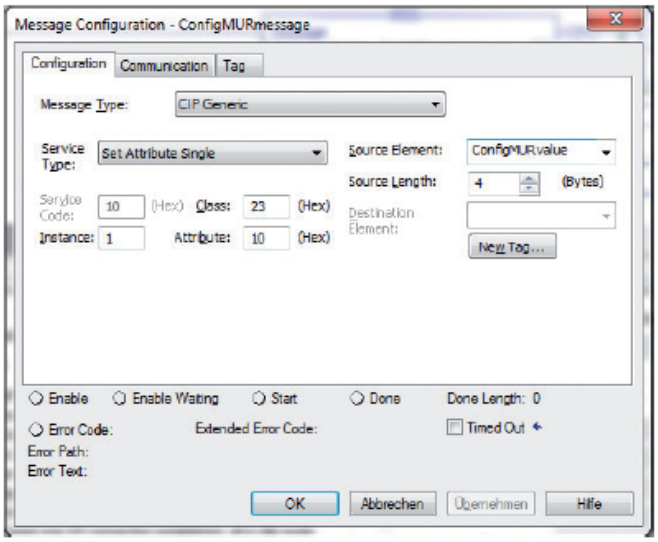
10. In your newly created MSG instruction, click the Icon having the three dots to configure your message.

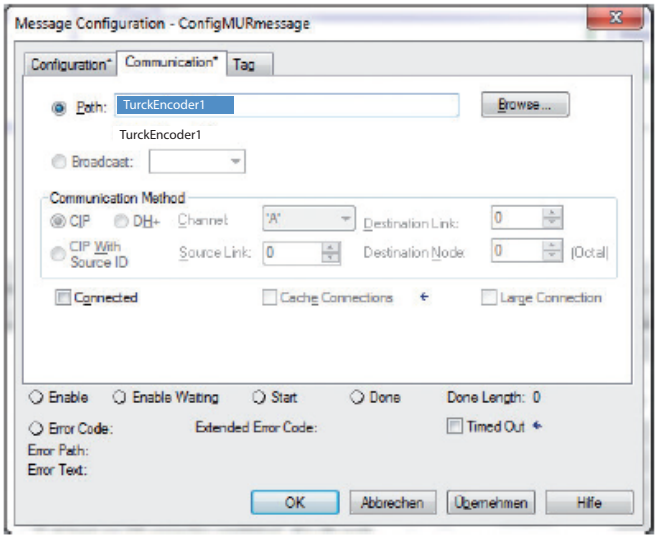


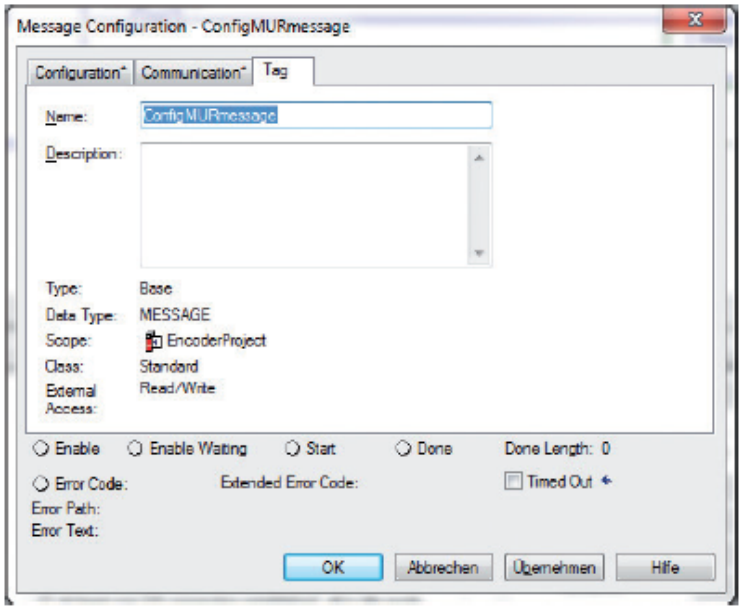
11. The Message Configuration Dialog pops up



12. Configure the message as shown in the next 3 images.
Select the appropriate source element in the configuration tab

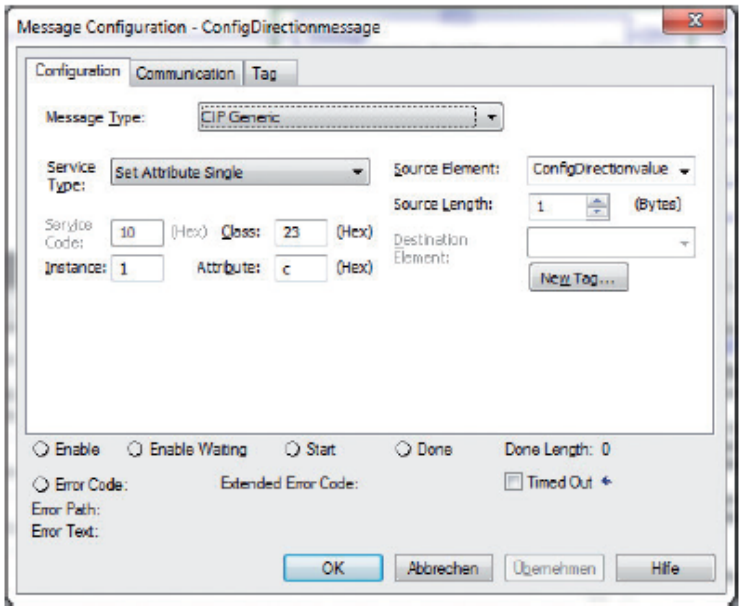


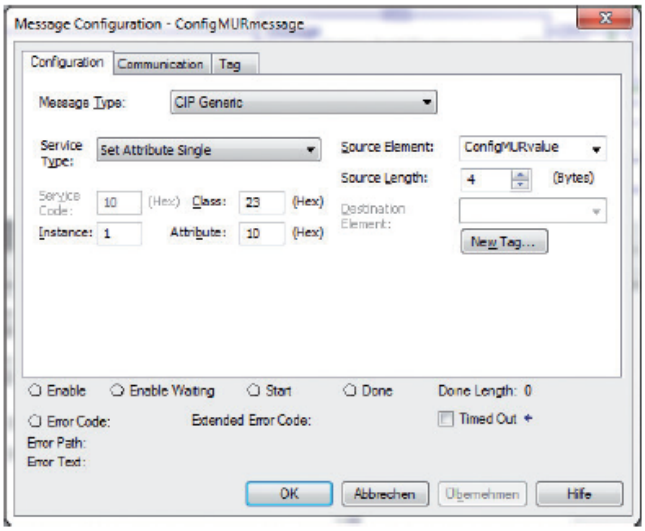


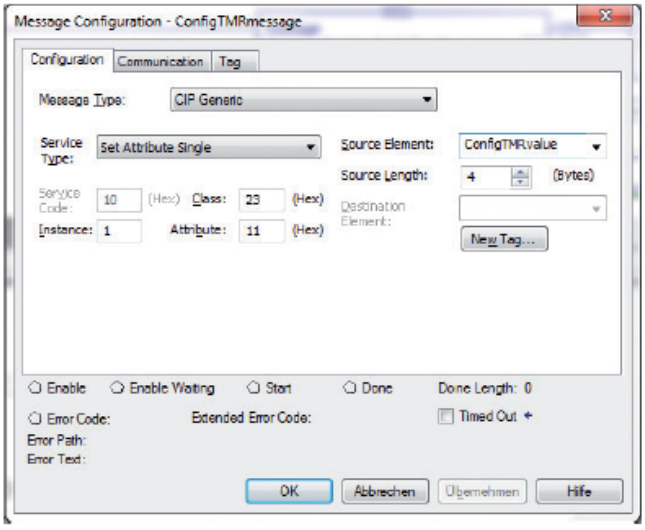


Make sure you do not confuse hex and decimal values!

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.





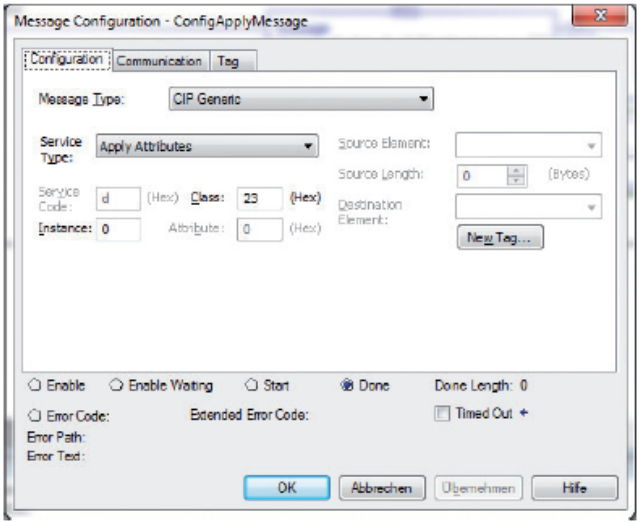


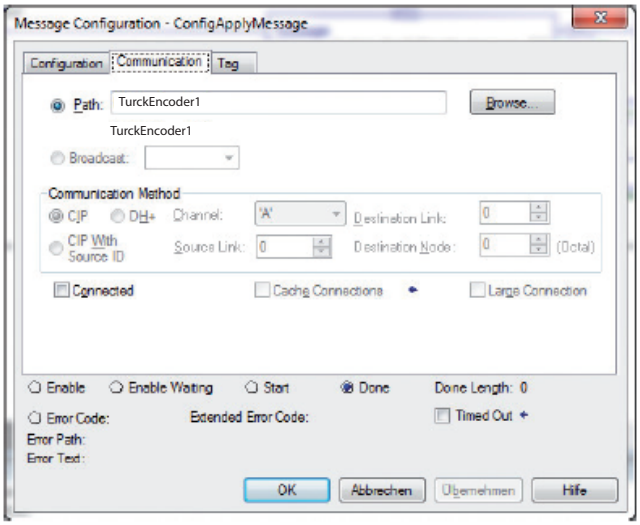
The Class 0x23 stands for the Position Sensor Object that the Turck encoder has. Instance is set to 1 because every encoder has only one Position Sensor Object. The attributes 0x0C, 0x10, 0x11 correspond to the values in column "Attribute ID" shown in table "Position Sensor Object Class Attributes". 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:

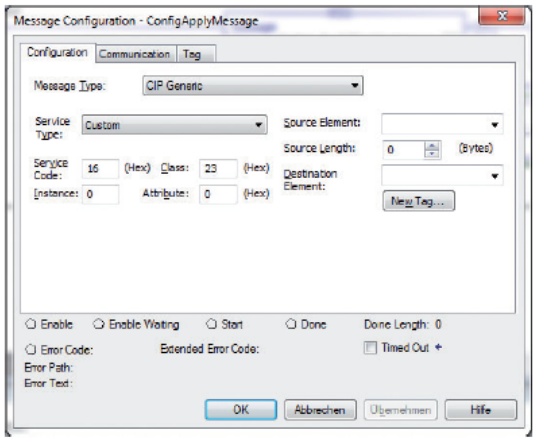




Only after this apply message, the settings are effective.

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:

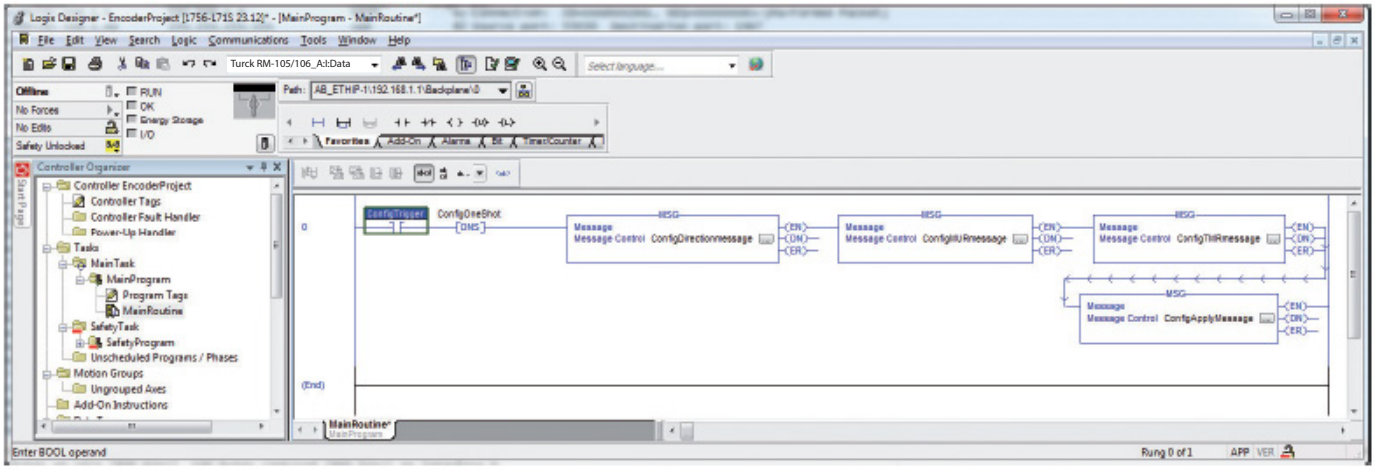


Changing the apply message to a save message

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".

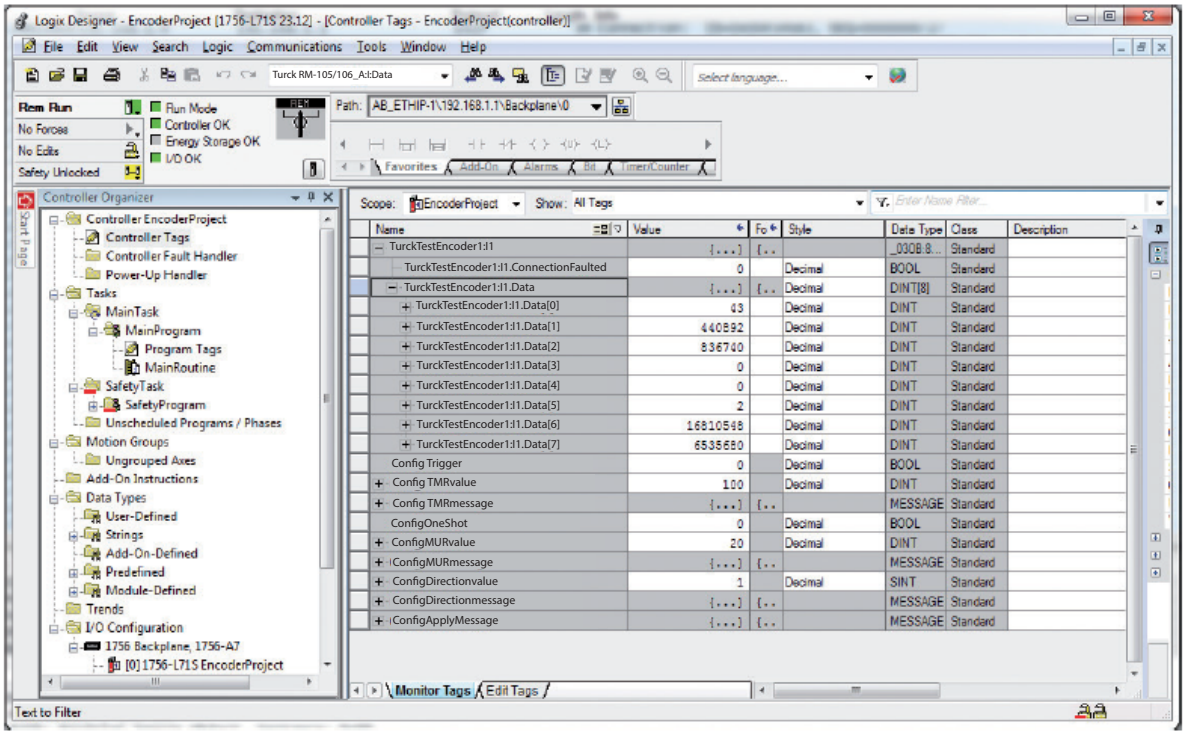
Your finished program to set and apply or save the attributes now looks as follows:

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



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.

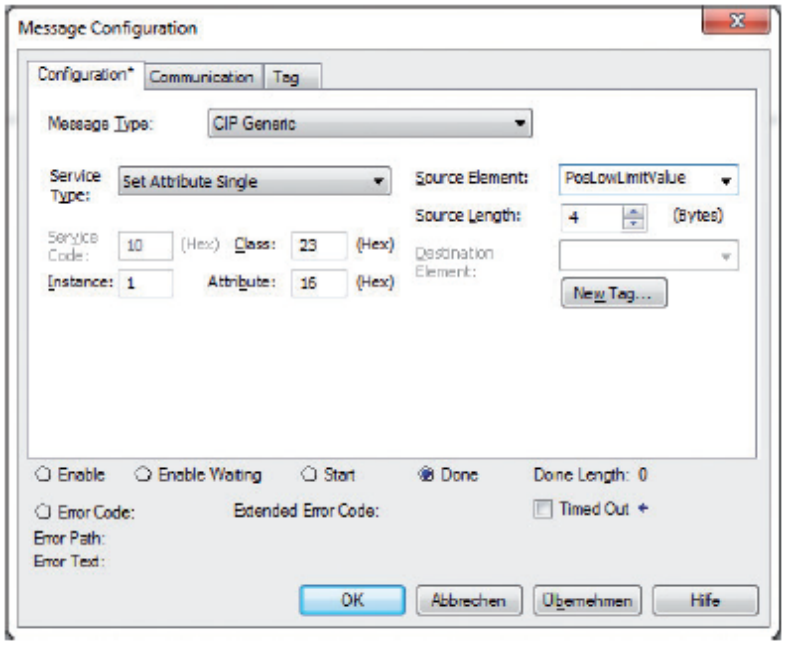
The tags in your program look as follows:



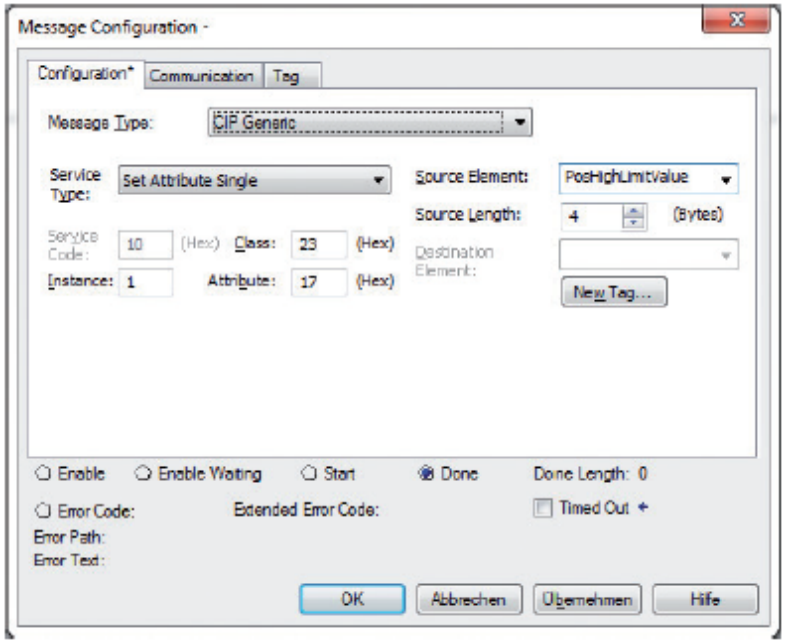
Tags used in sample program

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)!



Position low limit

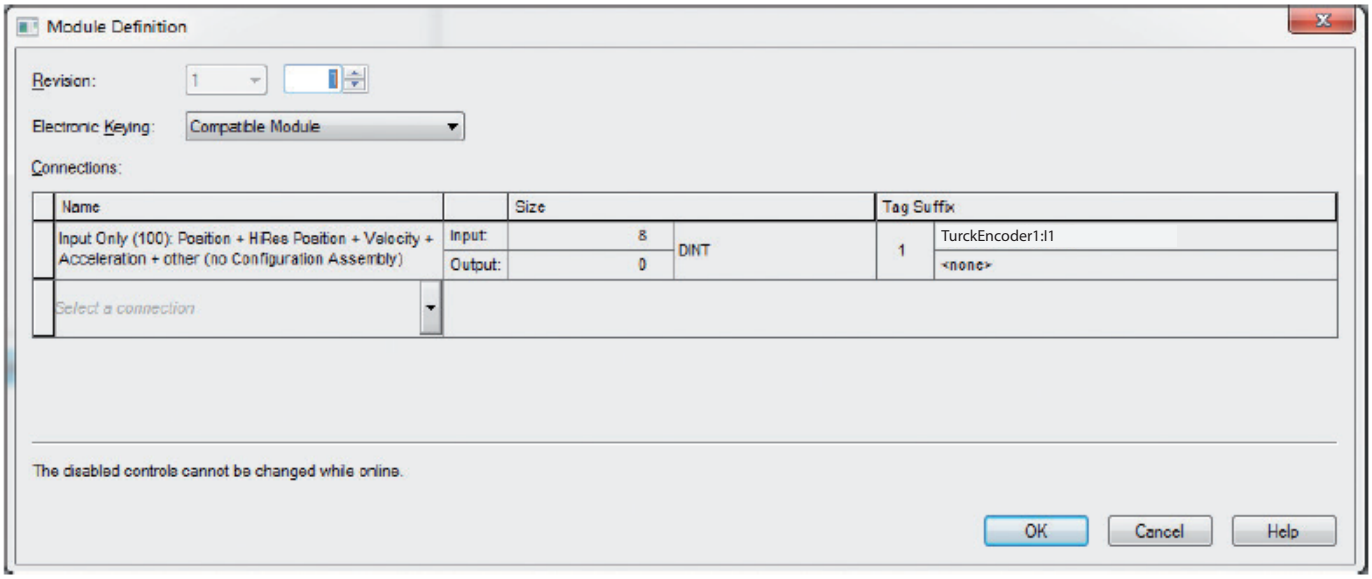


Position high limit

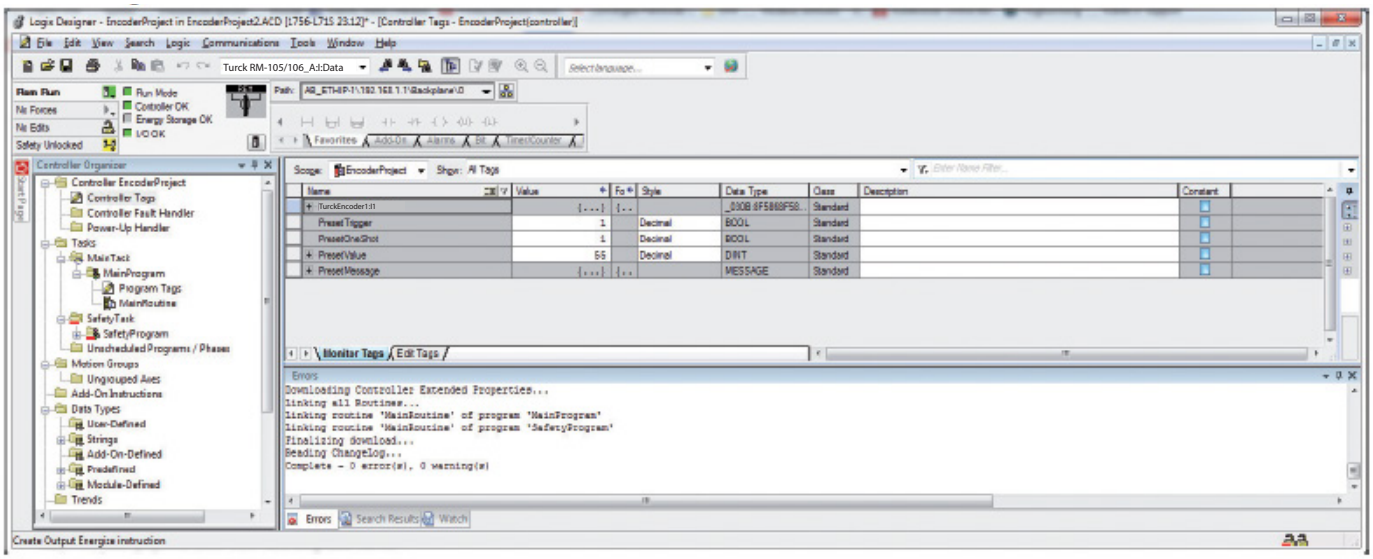
Setting the Preset Value via Explicit Messaging from a Ladder Logic PLC program

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.

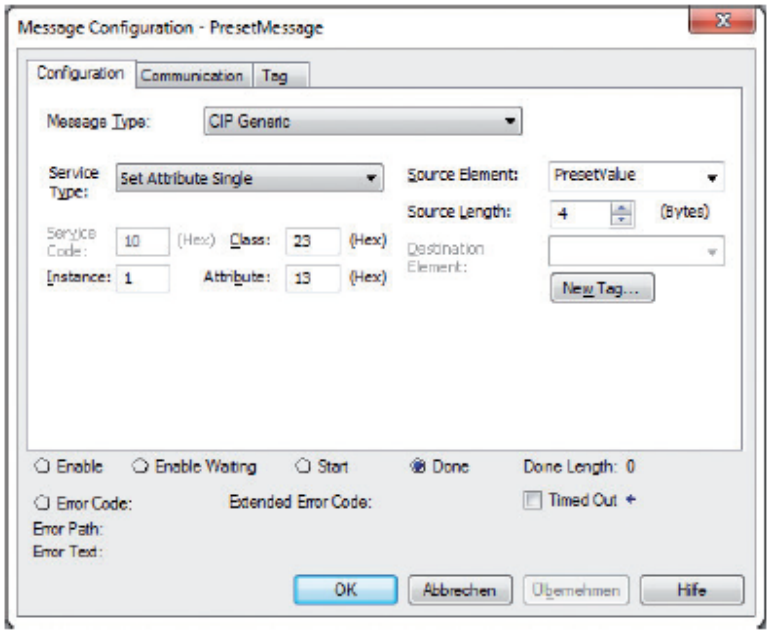
1. Create the encoder in Logix 5000, use the following connection configuration:



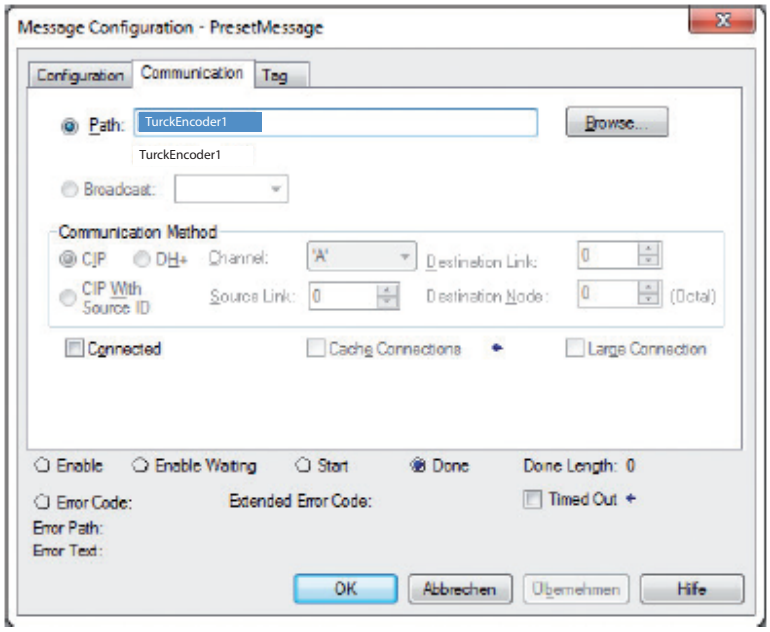
2. Create tags as follows:



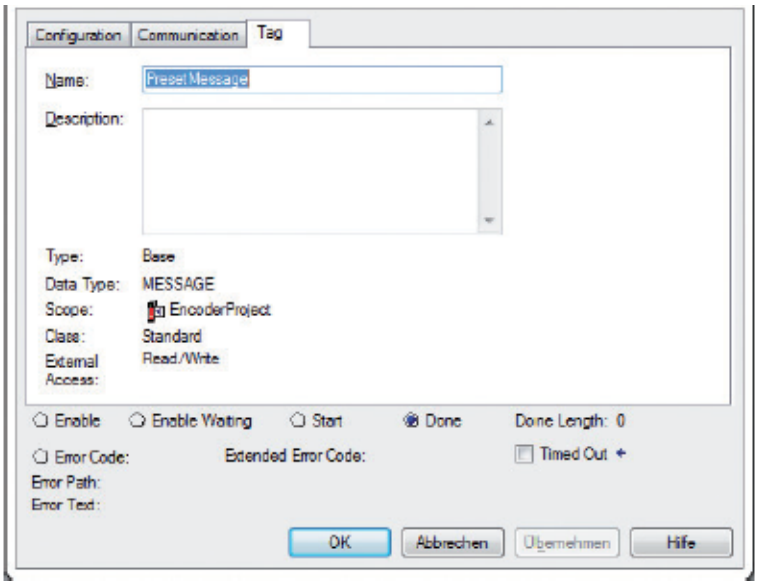
3. Create a routine as follows:
Insert a Trigger Block with corresponding tag, and a One Shot Block with corresponding tag.
Now insert a MSG block with a message as follows:



Preset message config part 1

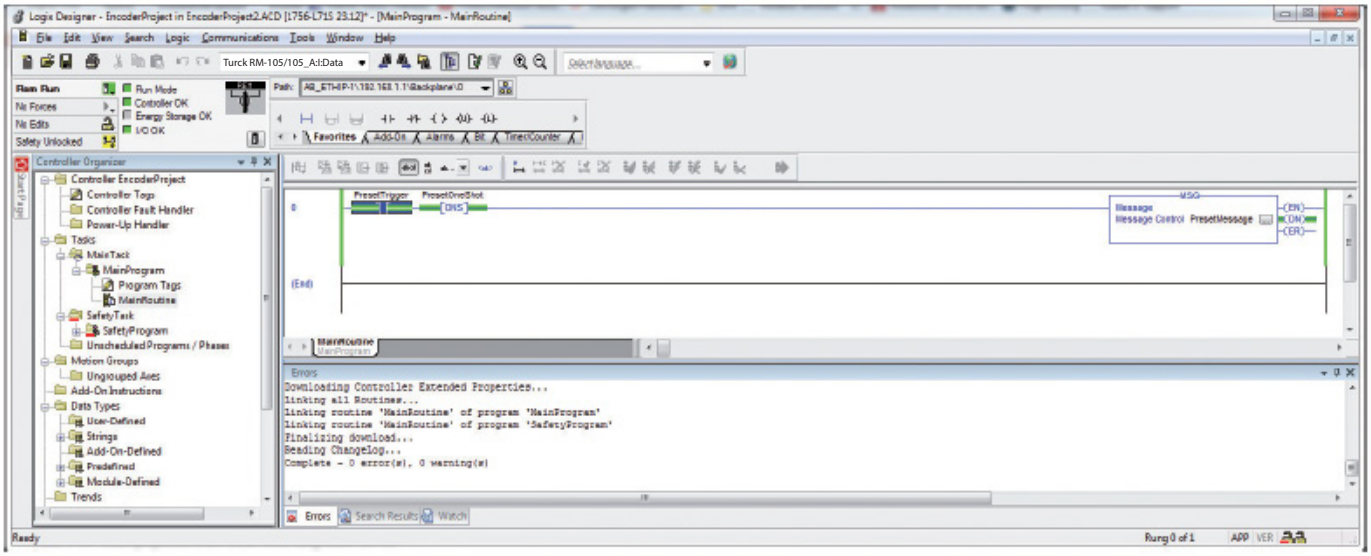


Preset message config part 2



Preset message config Part 3

The result looks as follows:



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:I1.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.

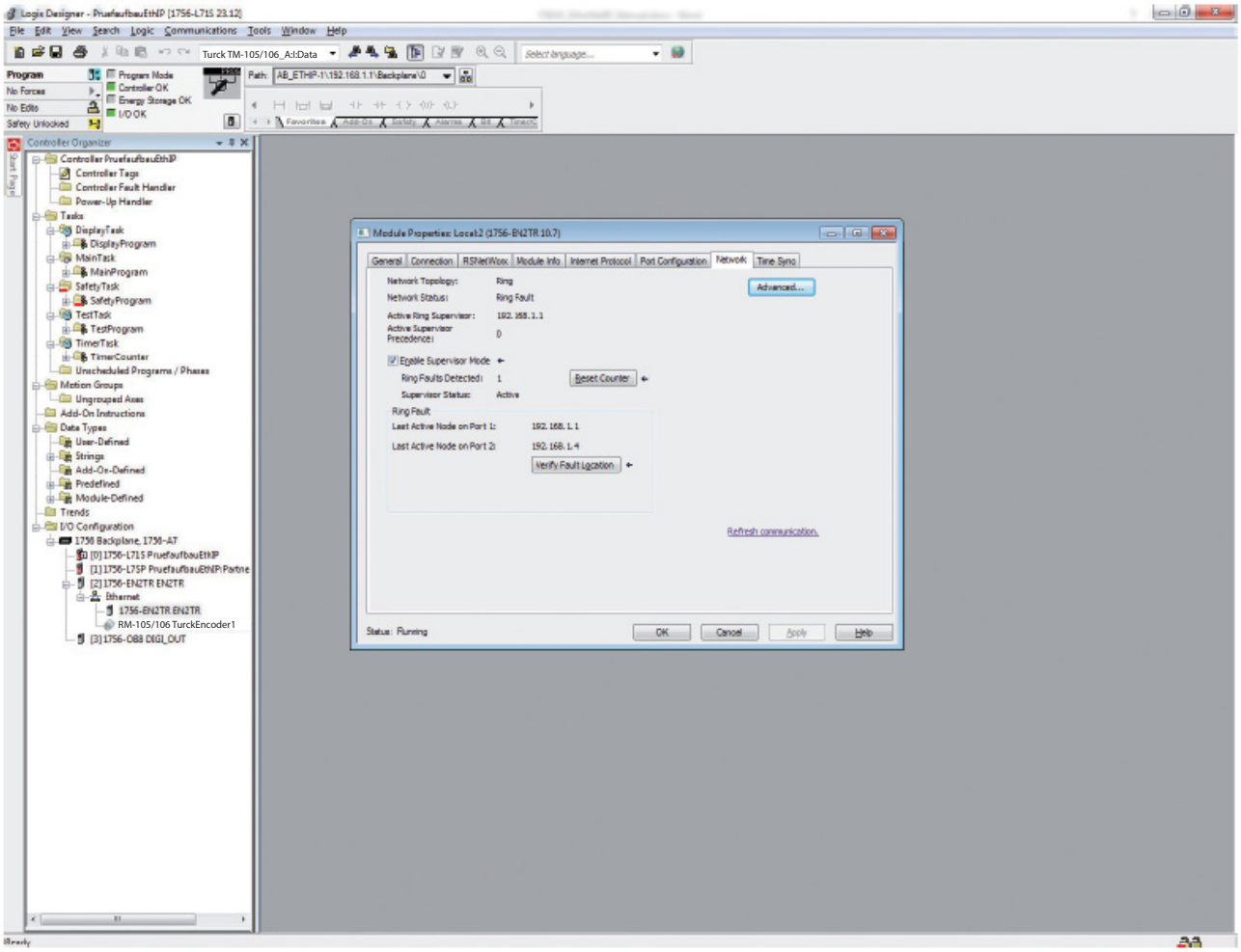
Without the USF function, you can only use a binary scaling divider. Otherwise you get an position error at the end of the total measuring range (TMR).

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.



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

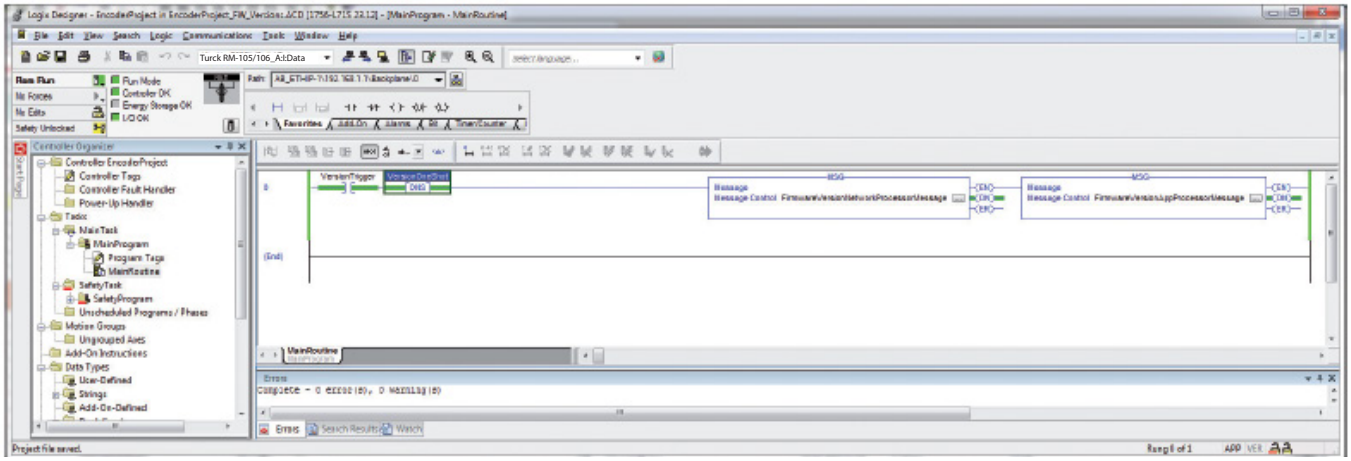
Rotational Axis Mode
This encoder can be set to Rotational Axis Mode.
To activate Rotational Axis Mode, set TMR to a value smaller than MUR.

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.

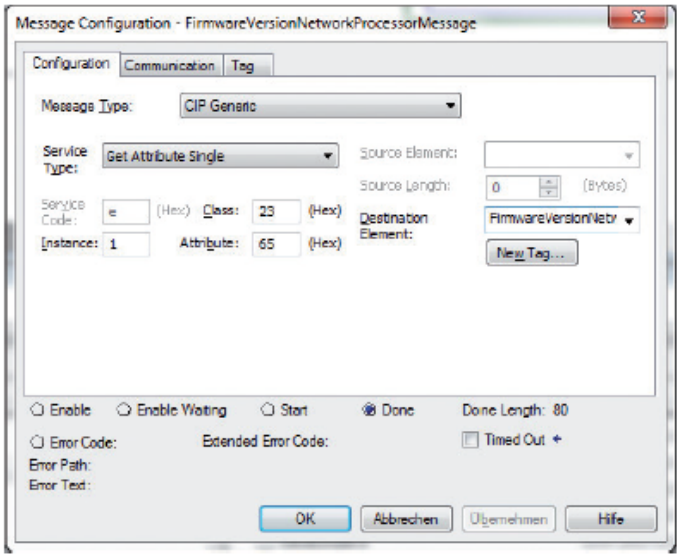
11. Check the Encoder Firmware Versions

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

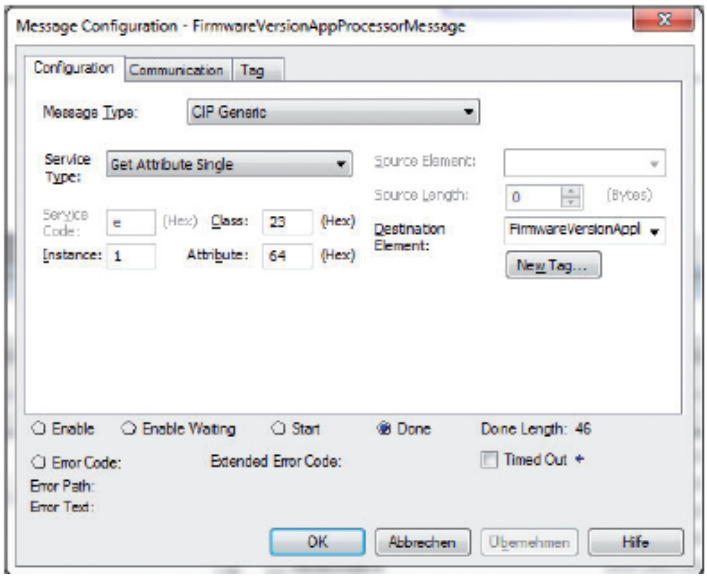
In order to get the Firmware versions of the two processors of the encoder, create a program as follows:



Version read program



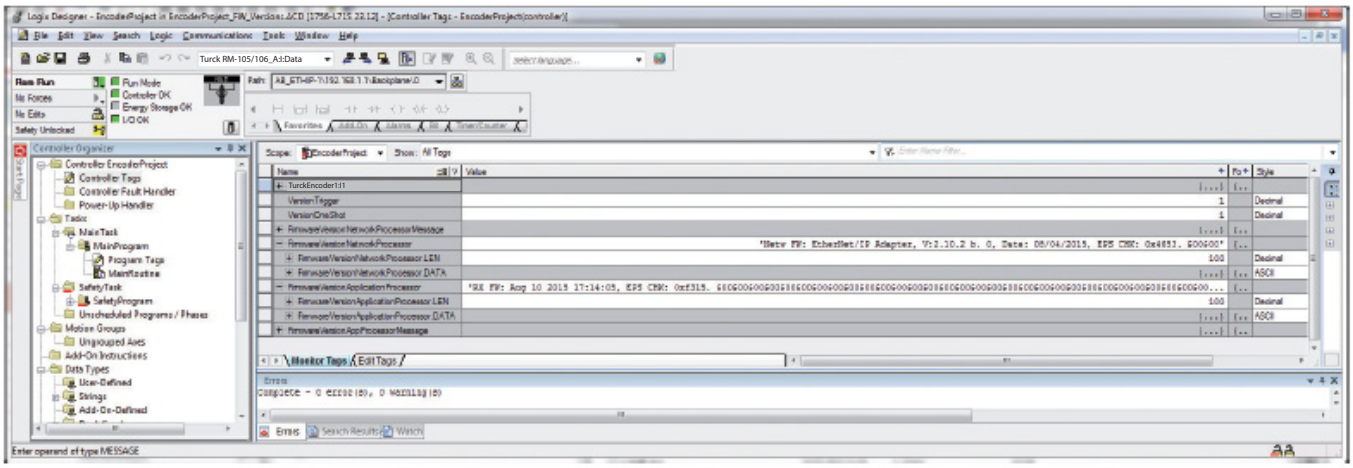
Network processor version Read Message



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:



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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