



Dynapar AI25 EtherNet/IP Encoder User Manual



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1 General Encoder Information

1.1 Introduction

Dynapar Ethernet/IP encoders are used to precisely detect position and velocity (speed) in a wide range of rotating applications. These devices can be used for the following applications: Sensing of angles, distances, tracks, velocity and general motion control.

1.2 Supported Encoder Resolutions

Encoder Type	Multi-Turn Bits	Single-Turn Bits	Transfer format (Total Bits)
Multi-Turn Encoder	12	12	24
	12	13	25
	12	14	26
	12	16	28
	12	17	29
	12	18	30
	12	19	31
	12	20	32
Single-Turn Encoder	0	12	12
	0	13	13
	0	14	14
	0	16	16
	0	17	17
	0	18	18
	0	19	19
	0	20	20
	0	22	22

Table 1: Supported Encoder Resolutions

1.3 Encoder Features

Features	<p>Encoder profile 22h (0x22) defined in the Common Industrial Protocol (CIP™) according to IEC 61784-1</p> <ul style="list-style-type: none"> > RPI 1ms > 32 Bit Resolution Position value > Scaling functionality > Preset functionality > Velocity/Acceleration value > Integrated Dual port switch > EtherNet/IP interface > BOOT-P Protocol (IP-Address Assignment) > TCP/IP- interface (IP-Address Configuration) > Link Interface (Port 1 and 2)
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1.4 Object Model

Dynapar EtherNet/IP Encoders support the following class objects:

Class Code	Object Class	Description	Number of Instances
0x01	Identity object	Provides identification of and general information about the device.	1
0x02	Message router object	Provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.	1
0x04	Assembly object (I/O)	Binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection.	8
0x06	Connection manager object	Contains connection specific attributes for triggering, transport, and connection type.	1
0x23	Position sensor object	Provides device specific data like position and counting direction.	1
0xF5	TCP/IP interface	Contains attributes for configuring the TCP/IP interface.	1
0xF6	Ethernet link object	Contains connection-specific attributes like transmission rate, MAC address, or duplex mode.	2
0x64	Base Encoder object	DYNAPAR specific object class provides basic encoder parameters such as Transfer Format and Resolution.	1
0x65	Production object	DYNAPAR specific object class which contains manufacturer specific parameters.	1
0x67	Loader object (Bootloader)	DYNAPAR specific object class provides Loader functionality to update firmware.	1

Table 2: EtherNet/IP Encoder Object Model

The following figure shows the Object model of the EtherNet/IP Encoder device:

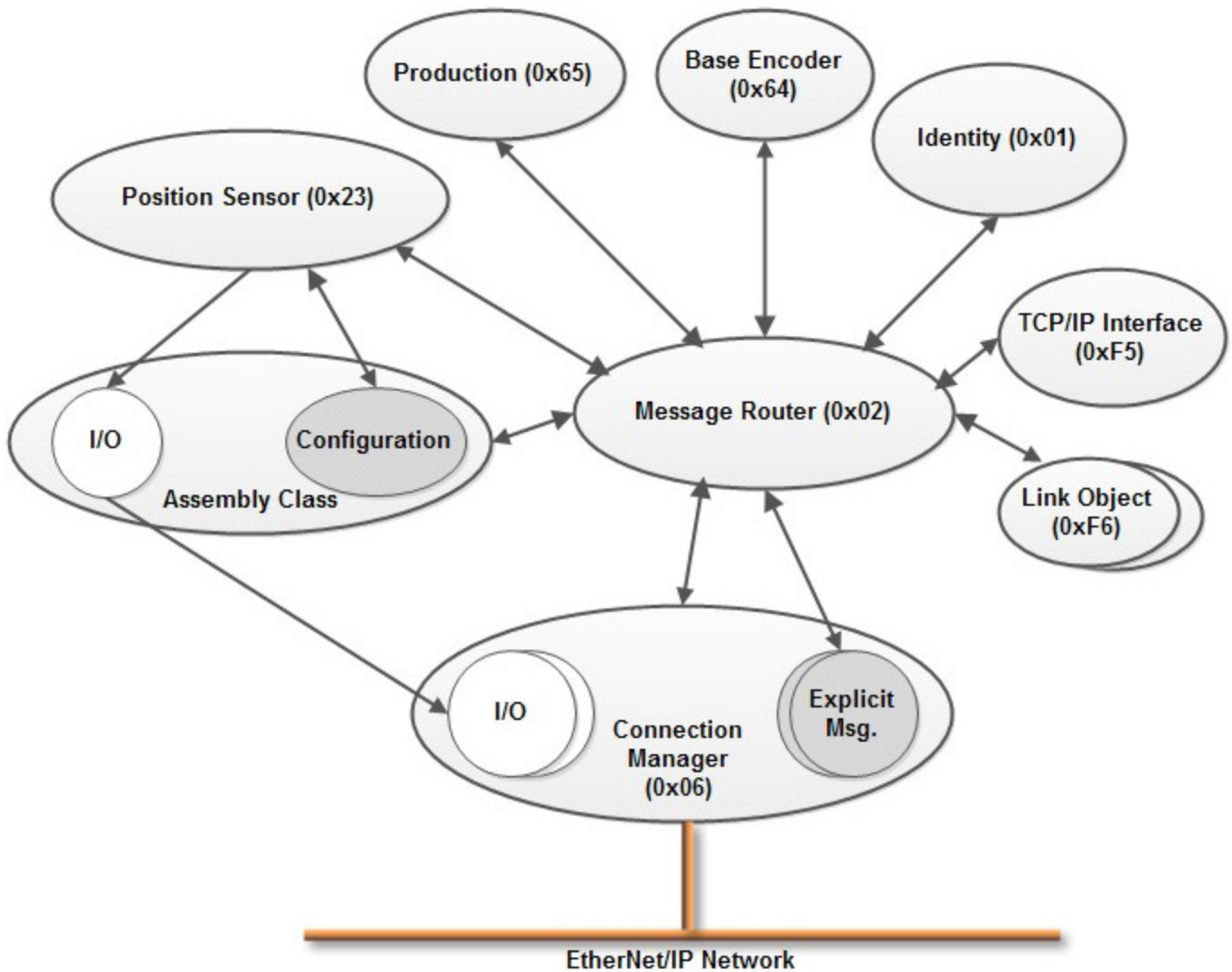


Figure 1: EtherNet/IP Encoder Object Model (all)

1.5 I/O Assembly Instances

The following table identifies the I/O Assembly instances supported.

No.	Type	Description
1	Input Only	Position Value 32 Bit (Unscaled)
100	Input Only	Position Value 32 Bit
101	Input Only	Position Value 32 Bit & WA-Flag
102	Input Only	Position Value 32 Bit & Velocity & WA-Flag 8 Bit
103	Input Only	Position Value 32 Bit & Velocity & Acceleration & WA-Flag
104	Input Only	Position Value 64 Bit
105	Input Only	Position Value 64 Bit & WA-Flag
106	Input Only	Position Value 64 Bit & Velocity & WA-Flag 8 Bit
107	Input Only	Position Value 64 Bit & Velocity & Acceleration & WA-Flag

Table 3: I/O Assembly Instances

Mapping	<p>Detail information about Assembly Data Mapping could be found in following sections:</p> <ul style="list-style-type: none"> • Mapping I/O Assembly Data Attribute Components • Mapping Configuration Assembly Data Attribute
Remark	<p>Configuration assembly parameter could be ignored by setting the Non-Volatile Attribute Parameter Control Priority (Attribute number 113) to 1.</p>

1.6 I/O Assembly Data Format

Following describes the I/O assembly data attributes format.

1.6.1 Profile Specific I/O Assembly Instances:

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	0	Position Value Unscaled (LSB)							
	1	Position Value Unscaled							
	2	Position Value Unscaled							
	3	Position Value Unscaled (MSB)							

Table 4: Profile Specific I/O Assembly

1.6.2 DYNAPAR Specific I/O Assemblies

1.6.2.1 I/O Assembly Instance 100 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
100	0	Position Value (LSB)							
	1	Position Value							
	2	Position Value							
	3	Position Value (MSB)							

Table 5: I/O Assembly Instance 100 Data Format

1.6.2.2 I/O Assembly Instance 101 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
101	0	Position Value (LSB)							
	1	Position Value							
	2	Position Value							
	3	Position Value (MSB)							
	4	-				-		Warning	Alarm

Table 6: I/O Assembly Instance 101 Data Format

1.6.2.3 I/O Assembly Instance 102 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
102	0	Position Value (LSB)							
	1	Position Value							
	2	Position Value							
	3	Position Value (MSB)							
	4	Velocity Value (LSB)							
	5	Velocity Value							
	6	Velocity Value							
	7	Velocity Value (MSB)							
	8		-				-		Warning

Table 7: I/O Assembly Instance 102 Data Format
1.6.2.4 I/O Assembly Instance 103 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
103	0	Position Value (LSB)							
	1	Position Value							
	2	Position Value							
	3	Position Value (MSB)							
	4	Velocity Value (LSB)							
	5	Velocity Value							
	6	Velocity Value							
	7	Velocity Value (MSB)							
	8	Acceleration Value (LSB)							
	9	Acceleration Value							
	10	Acceleration Value							
	11	Acceleration Value (MSB)							
	12								Warning

Table 8: I/O Assembly Instance 103 Data Format
1.6.2.5 I/O Assembly Instance 104 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
104	0	Position Value 64 Bit (LSB)							
	1	Position Value 64 Bit							
	2	Position Value 64 Bit							
	3	Position Value 64 Bit							
	4	Position Value 64 Bit							
	5	Position Value 64 Bit							
	6	Position Value 64 Bit							
	7	Position Value 64 Bit (MSB)							

Table 9: I/O Assembly Instance 104 Data Format

1.6.2.6 I/O Assembly Instance 105 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
105	0	Position Value 64 Bit (LSB)							
	1	Position Value 64 Bit							
	2	Position Value 64 Bit							
	3	Position Value 64 Bit							
	4	Position Value 64 Bit							
	5	Position Value 64 Bit							
	6	Position Value 64 Bit							
	7	Position Value 64 Bit (MSB)							
	8	-				-		Warning	Alarm

Table 10: I/O Assembly Instance 105 Data Format

1.6.2.7 I/O Assembly Instance 106 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
106	0	Position Value 64 Bit (LSB)							
	1	Position Value 64 Bit							
	2	Position Value 64 Bit							
	3	Position Value 64 Bit							
	4	Position Value 64 Bit							
	5	Position Value 64 Bit							
	6	Position Value 64 Bit							
	7	Position Value 64 Bit (MSB)							
	8	Velocity Value (LSB)							
	9	Velocity Value							
	10	Velocity Value							
	11	Velocity Value (MSB)							
	12	-				-		Warning	Alarm

Table 11: I/O Assembly Instance 106 Data Format

1.6.2.8 I/O Assembly Instance 107 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
107	0	Position Value 64 Bit (LSB)							
	1	Position Value 64 Bit							
	2	Position Value 64 Bit							
	3	Position Value 64 Bit							
	4	Position Value 64 Bit							
	5	Position Value 64 Bit							
	6	Position Value 64 Bit							
	7	Position Value 64 Bit (MSB)							
	8	Velocity Value (LSB)							
	9	Velocity Value							
	10	Velocity Value							
	11	Velocity Value (MSB)							
	12	Acceleration Value (LSB)							
	13	Acceleration Value							
	14	Acceleration Value							
	15	Acceleration Value (MSB)							
16		-				-		Warning	Alarm

Table 12: I/O Assembly instance 107 Data Format
1.6.3 Mapping I/O Assembly Data Attribute Components

The following table indicates the I/O Assembly Data Attribute mapping:

Data Component Name	Class		Instance Number	Attribute	
	Name	No.		Name	No.
Position Value	Position Sensor	0x23	1	Position Value	117 / 101
Position Value (unscaled)	Position Sensor	0x23	1	Position Value	3 / 100
Velocity	Position Sensor	0x23	1	Velocity	24
Acceleration	Position Sensor	0x23	1	Acceleration	29
Warning Flag	Position Sensor	0x23	1	Warning Flag	49
Alarm Flag	Position Sensor	0x23	1	Alarm Flag	46

Table 13: Mapping I/O Assembly Data Attribute Components

1.7 Configuration Assemblies

The following tables shows the data format of configuration assemblies:

1.7.1 Configuration Assembly Instance 110 Data Format

Instance No.	Byte Offset	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
110	0	Direction Counting Toggle (CW = 0, CCW = 1)							
	1	Scaling Function Control (OFF = 0, ON = 1)							
	2	Measuring Unit per Span (LSB)							
	3	Measuring Unit per Span							
	4	Measuring Unit per Span							
	5	Measuring Unit per Span (MSB)							
	6	Total Measuring Range (LSB)							
	7	Total Measuring Range							
	8	Total Measuring Range							
	9	Total Measuring Range (MSB)							
	10	Velocity Format (LSB)							
	11	Velocity Format (MSB)							
	12	Scaling Type							
	13	Velocity Calc. Control							

Table 14: Configuration Assembly Instance 110 Data Format

1.7.2 Mapping Configuration Assembly Data Attribute Components

The following table indicates the Configuration Assembly Data Attribute mapping:

Data Component Name	Class		Instance Number	Attribute	
	Name	No.		Name	No.
Direction Counting Toggle	Position Sensor	0x23	1	Direction Counting Toggle	12
Scaling Function Control	Position Sensor	0x23	1	Scaling Function Control	14
Measuring Unit per Span 32 / 64 Bit	Position Sensor	0x23	1	Measuring Unit per Span	16/102
Total Measuring Range 32 / 64 Bit	Position Sensor	0x23	1	Total Measuring Range	17/103
Velocity Format	Position Sensor	0x23	1	Velocity Format	25
Scaling type	Position Sensor	0x23	1	Scaling Type Control	106
Velocity Cal. Control	Position Sensor	0x23	1	Velocity Calculation Control	110

Table 15: Mapping Configuration Assembly Data Attribute Components

Remark	Configuration assembly parameter could be ignored by setting the Non-Volatile Attribute Parameter Control Priority (Attribute number 113) to 1.
---------------	---

2 Position Sensor

The Position Sensor Object models an absolute position sensor in an Encoder device. Behaviors in the object extend the basic position sensor capability to include position value scaling, and position boundary checking (CAM switch).

2.1 Instance Attributes

Following tables shows Position Sensor Object Instance Attributes supported by the DYNAPAR EtherNet/IP Encoder:

2.1.1 Absolute Rotary Encoder Attributes

ID	Name	Description	Data Type	Access	NV	Semantic
3	Position Value Unscaled	Current Position	UDINT	Get	V	Physical position
11	Position Sensor Type	Specifies the device type	UINT	Get	NV	See Semantics section
12	Direction Counting Toggle	Defines the direction of Increasing position value	BOOL	Set	NV	Default = 0. See semantics
14	Scaling Function Control	Turns encoder position scaling on or off.	BOOL	Set	NV	0 = OFF 1 = ON (Default)
15	Position Format	Format of the position value of other attributes.	ENGUNIT	Get	NV	counts
16	Measuring Units per Span	Number of distinguishable steps per one complete span. Less than or equal to Physical Resolution Span (attribute 42).	UDINT	Set	NV	A span equals one revolution.
17	Total Measuring Range in Measuring Units	Steps over the total measuring range.	UDINT	Set	NV	
19	Preset Value	Output position value is set to Preset Value.	DINT	Set	NV	See Semantics section
21	Position State Register	The state of software limit switch (Attribute 3 Position Value Unsigned)	BYTE	Get	V	Bit 0: 1 = Out of Range Bit 1: 1 = Overflow , Bit 2: 1 = Underflow
22	Position Low Limit	Low Limit Position	DINT	Set	NV	See Semantics section
23	Position High Limit	High Limit Position	DINT	Set	NV	See Semantics section
24	Velocity Value	Current speed where the format of this value is defined in attributes 25.	DINT	Get	V	Default is counts per second The meaning of the sign is affected by the value of attribute 12.
25	Velocity Format	Format of the velocity attributes.	ENGUNIT	Set	NV	0x1F04 = counts (Steps) per second (default) See Semantics section
27	Minimum Velocity Setpoint	Value for minimum velocity trigger threshold. Affects Min. Velocity Flag in status <i>Warning</i> Attribute 47	DINT	Set	NV	Default = 0x80000000.
28	Maximum Velocity Setpoint	Value for maximum velocity trigger threshold. Affects Max. Velocity Flag in status <i>Warning</i> Attribute 47	DINT	Set	NV	See Semantics section Default = 0x7FFFFFFF.
29	Acceleration Value	Current Acceleration (Positive value is acceleration, negative is deceleration)	DINT	Get	V	Default is <i>Velocity Value</i> counts per second ²

Table 16 (part 1): Absolute Rotary Encoder 32 Bit Resolution

ID	Name	Description	Data Type	Access	NV	Semantic
32	Minimum Acceleration Setpoint	Value for minimum acceleration trigger threshold.	DINT	Set	NV	Default = 0x80000000.
33	Maximum Acceleration Setpoint	Value for maximum acceleration trigger threshold.	DINT	Set	NV	See Semantics section Default = 0x7FFFFFFF.
41	Operating Status	Encoder diagnostic operating status	BYTE	Get	V	
42	Physical Resolution Span	Number of distinguishable steps per one complete span.	UDINT	Get	NV	A span equals one revolution.
43	Number of Spans	This is equal to the number of turns.	UINT	Get	NV	Default = 1.
44	Alarms	Indicates a malfunction has occurred that could lead to an incorrect position value or require user intervention	WORD	Get	V	See Semantics Section
45	Supported Alarms	Information about supported alarms.	WORD	Get	NV	See Semantics Section
46	Alarm Flag	Indicates that an alarm error occurred.	BOOL	Get	V	0 = OK 1 = Alarm error
47	Warnings	Internal parameters exceeded	WORD	Get	V	See semantics section.
48	Supported Warnings	Information about supported Warnings	DINT	Set	NV	See Semantics section
49	Warning Flag	Indicates that a warning error occurred	BOOL	Get	V	0 = OK 1 = Warning Flag
50	Operating Time	Stores operating time for the encoder in tenths of an hour	UDINT	Get	NV	See semantic
51	Offset Value	The Offset value is calculated by the preset function. Shift position value with the calculated value	DINT	Get	NV	
106	Scaling Type	Scaling type control	USINT	Set	NV	See semantic section
110	Velocity Calc. Control	Velocity Calculation selection	USINT	Set	NV	See semantic section
113	Parameter Control Priority	Identifies if Configuration assembly should be applied (from PLC) or Non-Volatile Parameter.	USINT	Set	NV	See semantic section
117	Position value Scaled 32 Bit	32 Bit Scaled Position value	UDINT	Get	NV	
118	Offset value 32 Bit Scaled	32 Bit Offset value for scaled position value	DINT	Get	NV	
119	Preset value 32 Scaled	32 Bit Preset value for scaled position value	DINT	Set	NV	

Table 16 (part 2): Absolute Rotary Encoder 32 Bit Resolution

ID	Name	Description	Data Type	Access	NV	Semantic
100	Position Value Unscaled- 64 bit	Current Position	ULINT	Get	V	64 Bit Physical position
101	Position value Scaled- 64 Bit	64 Bit Scaled Position value	ULINT	Get	V	64 Bit Scaled Physical position
102	Measuring Units per Span – 64 Bit	Number of distinguishable steps per one complete span. Less than or equal to Physical Resolution Span (attribute 42).	ULINT	Set	NV	A span equals one revolution.
103	Total measuring Range in Measuring Units – 64 Bit	Steps over the total measuring range.	ULINT	Set	NV	See Semantics section
104	Position Low Limit – 64 Bit	Low Limit Position	LINT	Set	NV	See Semantics section
105	Position High Limit – 64 Bit	High Limit Position	DINT	Set	NV	See Semantics section
107	Number of Spans – 64 Bit	This is equal to the number of turns.	UDINT	Get	NV	Default = 1.
108	Offset Value – 64 Bit	The Offset value is calculated by the preset function. Shift position value with the calculated value.	LINT	Get	NV	
109	Preset Value – 64 Bit	Output position value is set to Preset Value.	LINT	Set	NV	See Semantics section

Table 17: 64 Bit Resolution Attributes

2.2 Semantics

2.2.1 Position Value Unscaled - Attribute 3

This attribute is supported only by Absolute Rotary Encoder series and represents the absolute position detected by the position sensor conditioned by the Value Bit Resolution and Zero Offset attributes.

2.2.2 Position Sensor Type – Attribute 11

Following table shows the Attribute 11, Position Sensor Type Value Definitions:

Value	Definition
1	Single-Turn absolute rotary encoder
2	Multi-Turn absolute rotary encoder

Table 18: Position Sensor Type

2.2.3 Direction Counting Toggle – Attribute 12

The Direction Counting Toggle defines the increasing Position Value for rotary devices as clockwise shaft rotation or counter clockwise as viewed facing the mounting face of the encoder (CW = 0, CCW = 1). Changing this value shall change the sign of velocity and position relative to physical movement.

Example: By turning the shaft clockwise the Position Value attribute will increase when Direction Counting Toggle is defined as clockwise (0=CW)

2.2.4 Scaling Function Control – Attribute 14

When the Scaling Function Control attribute is set to ON (1), the Position Value attribute 117- 32 Bit / 101- 64 Bit is converted from the physical resolution of the device to scaled position units as defined by Attributes 16/17 or 102/103.

2.2.5 Measuring Units Per Span - Attribute 16

This attribute sets the scaled number of steps for each revolution of the encoder. This is activated when Attribute 14 is set to On. This value must be equal to or lower than Attribute 42.

2.2.6 Total Measuring Range - Attribute 17

This is the total range of the device set in counts/steps. This sets the multi-turn scaling for the device and must be equal to or lower than Attribute 42 multiplied by Attribute 43.

2.2.7 Preset Value – Attribute 19

This attribute supports adapting a desired position value to an actual position value. At the time a set attribute to #19 is performed, the following occurs:

Attribute #19 (Preset Value) is set to the service data of the request.

Offset Value (Attribute #51) is set to the value resulting from [Preset Value]- [Position Value (unscaled)]

During operation, the formula is immaterial, and the behavior of the device is:

Position Value Attribute 3 = (internal position value) + Offset Value.

2.2.8 Position State Register, Position limits – Attributes 21 to 23

The state of Position State Register (attribute 21) is determined by Position Low Limit (attribute 22), Position High limit (attribute 23) and Position value (unscaled) attribute 3.

The Position Low Limit and Position High Limit attributes configure the actual work area. The Position State Register contains the actual area status of the encoder position. If the position is out of range, a bit will be set in the Position State Register attribute. If the position is lower than the position value set in Position Low Limit, then bit 2 flags the underflow. If the position is higher than the position value set in Position High Limit, then bit 1 flags the overflow. The Position Limits define a configurable work area within the measuring range.

2.2.9 Velocity Value– Attribute 24

Current speed where the format of this value is defined in attribute 25.

2.2.10 Velocity Format– Attribute 25

This Velocity Format attribute identifies the engineering units for the Velocity Value attribute (attribute 24). Default is counts (steps) per second. Following Values are specified:

Velocity Format Value	Velocity Unit
0x1F05	Counts / 1ms
0x0800	Counts / 10ms
0x0801	Counts / 100ms
0x1F04	Counts / second
0x1F0E	RPS (Revolution Per Second)
0x1F0F	RPM (Revolution Per Minute)

Table 19: Velocity Format– Attribute 25

2.2.11 Minimum Velocity Setpoint – Attribute 27

The minimum speed value limit. Speeds lower than this limit will trip the warning flag (attribute 49) and a warning (attribute 47).

2.2.12 Maximum Velocity Setpoint – Attribute 28

The maximum speed value limit. Speeds higher than this limit will trip the warning flag (attribute 49) and a warning (attribute 47).

2.2.13 Acceleration Value – Attribute 29

This is the current acceleration value with units set by attribute 25.

2.2.14 Minimum Acceleration Setpoint – Attribute 32

The minimum acceleration value limit. Accelerations lower than this limit will trip the warning flag (attribute 49) and a warning (attribute 47).

2.2.15 Maximum Acceleration Setpoint – Attribute 33

The maximum acceleration value limit. Accelerations higher than this limit will trip the warning flag (attribute 49) and a warning (attribute 47).

2.2.16 Operating Status – Attribute 41

This attribute contains the operating status of the encoder as following:

Bit	Description	FALSE (0)	TRUE (1)
0	Direction	Increasing	Decreasing
1	Scaling	Off	On
2..4	Reserved by CIP	-	-
5	Diagnostic	Off	On
6	Scaling Type (Attribute 106)	Standard	Free Scaling
7	Reserved	-	-

Table 20: Operating Status Attribute 41

2.2.17 Physical Resolution – Attribute 42

This value contains the resolution of the encoder set by the factory. A read command will show the number of resolutions per one span.

2.2.18 Number of Spans – Attribute 43

This value contains the number of turns (spans) the encoder is able to record. For Single-Turn encoders this value is set to 1. For Multi-Turn encoders the value is a power (exponent) of 2. For example, a 12-bit Multi-Turn encoder would have a Number of Spans set to 4096.

2.2.19 Alarms – Attribute 44

An alarm is set if a malfunction bit is set to true (high). The alarm remains active until the alarm is cleared and the device is able to provide an accurate position value.

Bit	Description	FALSE (0)	TRUE (1)
0	NOT USED	-	-
1	NOT USED	-	-
2..11	Reserved by CIP	-	-
12	Checksum error	NO	YES
13	NOT USED	-	-
14	NOT USED	-	-
15	NOT USED	-	-

Table 21: Alarms – Attribute 44 Bit Definitions

2.2.20 Supported Alarms – Attribute 45

This attribute contains information on supported alarms by the position sensor device. Not all alarms listed in Table 21 are supported by Dynapar EtherNet/IP encoders.

Bit	Description	FALSE (0)	TRUE (1)
0	NOT USED	-	-
1	NOT USED	-	-
2..11	Reserved by CIP	-	-
12	Checksum Error	Not Supported	Supported
13	NOT USED	-	-
14	NOT USED	-	-
15	NOT USED	-	-

Table 22: Supported Alarms – Attribute 45 Bit Definitions

2.2.21 Warnings – Attribute 47

The Warnings attribute indicates that tolerance for certain internal parameters of the device have been exceeded. In contrast to alarms, warnings do not imply incorrect position values. All warnings are cleared if the tolerances are restored to normal parameters.

Bit	Description	FALSE (0)	TRUE (1)
0	NOT USED	-	-
1	NOT USED	-	-
2	NOT USED	-	-
3	Operating Time Limit Warning	NO	YES
4	NOT USED	-	-
5	NOT USED	-	-
6	Minimum Velocity Flag	OK	YES
7	Maximum Velocity Flag	OK	YES
8	Minimum Acceleration Flag	OK	YES
9	Maximum Acceleration Flag	OK	YES
10	Position Limit Exceeded	OK	YES
11-12	Reserved by CIP	-	-
13	NOT USED	-	-

Table 23: Warnings – Attribute 47 Bit Definitions

2.2.22 Supported Warnings – Attribute 48

This attribute contains information on supported warnings by the position sensor device. Not all Warnings listed in Table 23 are supported by Dynapar encoders.

Bit	Description	FALSE (0)	TRUE (1)
0	NOT USED	-	-
1	NOT USED	-	-
2	NOT USED	-	-
3	Operating Time Limit Warning	Not Supported	Supported
4	NOT USED	-	-
5	NOT USED	-	-
6	Maximum Velocity Flag	Not Supported	Supported
7	Minimum Velocity Flag	Not Supported	Supported
8	Maximum Acceleration Flag	Not Supported	Supported
9	Minimum Acceleration Flag	Not Supported	Supported
10	Position Limit Exceeded	Not Supported	Supported
11-12	Reserved by CIP	-	-
13	NOT USED	-	-

Table 24: Supported Warnings – Attribute 48 Bit Definitions

2.2.23 Warning flag – Attribute 49

Indicates that warning error has occurred. This attribute is the logical OR of all the warnings bits in the Warnings attribute (attribute 47).

2.2.24 Operating Time – Attribute 50

This attribute is incremented as long as the encoder is powered. The Operating Time value is presented in tenths (0.1) of an hour.

2.2.25 Offset Value – Attribute 51

The Offset Value attribute is calculated by the preset function and shifts the Position Value attribute with the calculated value. The Offset Value is stored automatically by the device and can be read from the encoder for diagnostic purposes.

2.2.26 Measuring Units Per Span 64 Bit - Attribute 102

This attribute sets the scaled number of steps for each revolution of the encoder. This is activated when Attribute 14 is set to ON. This value must be equal to or lower than Attribute 42.

2.2.27 Total Measuring Range 64 Bit - Attribute 103

This is the total range of the device set in counts/steps. This sets the multi-turn scaling for the device and must be equal to or lower than Attribute 42 multiplied by Attribute 107.

2.2.28 Position limits 64 Bit – Attributes 104 & 105

The state of Position State Register (attribute 21) is determined by Position Low Limit (attribute 104), Position High limit (attribute 105), and Position value (unscaled) attribute 100.

The Position Low Limit and Position High Limit attributes configure the actual work area. The Position State Register contains the actual area status of the encoder position. If the position is out of range, a bit will be set in the Position State Register attribute. If the position is lower than the position value set in Position Low Limit, then bit 2 flags the underflow. If the position is higher than the position value set in Position High Limit, then bit 1 flags the overflow. The Position Limits define a configurable work area within the measuring range.

2.2.29 Scaling Type– Attribute 106

The scaling type defines type of scaling as following:

Bit	Description	FALSE (0)	TRUE (1)
0	Scaling Type	Standard scaling	Free scaling

Table 25: Scaling Type– Attribute 106 Bit Definition

2.2.30 Number of Spans 64 Bit – Attribute 107

This value contains the number of turns (spans) the encoder is able to record. For Single-Turn encoders this value is set to 1. For Multi-Turn encoders the value is a power (exponent) of 2. For example, a 12-bit Multi-Turn encoder would have a Number of Spans set to 4096.

2.2.31 Offset Value 64 Bit – Attribute 108

The Offset Value attribute is calculated by the preset function and shifts the Position Value attribute with the calculated value. The Offset Value is stored automatically by the device and can be read from the encoder for diagnostic purposes.

2.2.32 Preset Value 64 Bit – Attribute 109

This attribute supports adapting a desired position value to an actual position value. At the time a set attribute to #19 is performed, the following occurs:

Attribute #109 (Preset Value) is set to the service data of the request.

Offset Value (Attribute #108) is set to the value resulting [Preset Value]- [Position Value].

During operation, the formula is immaterial, and the behavior of the device is:

Position Value Attribute 100 = (internal position value) + Offset Value.

2.2.33 Velocity Calculation Control– Attribute 110

The Velocity Calculation Control determines if velocity should be calculated either with Physical or scaled Position value.

Select Velocity Calculation Value	Description
0	Disable (Velocity Calculation disabled / OFF)
1	Physical Position value
2	Scaled Position value (applicable if scaling function Control is ON)

Table 26: Select Velocity Calculation Value– Attribute 110 Value Definitions

2.2.34 Parameter Control Priority Attribute 113

Parameter Control Priority determines if the configuration parameter from Configuration Assembly should be used or parameter from Non-Volatile Data. Following values are specified:

Velocity Filter	Description
0	Configuration Assembly Parameter (this option overwrites the Runtime parameter).
1	Non-Volatile Data Parameter (Config Assembly Parameter will be ignored).

Table 27: Parameter Control Priority– Attribute 113 Value Definitions

2.2.35 Position value 32 Bit Attribute 117

This attribute contains the scaled 32 Bit position value.

2.2.36 Offset value 32 Bit Attribute 118

This attribute contains the offset value for the scaled 32 Bit position value (Attribute 117). This is similar to Attribute 51 but is only used when Attribute 14 is set to ON.

2.2.37 Preset value 32 Bit Attribute 119

This attribute contains the Preset value for the 32 Bit scaled position value (Attribute 117). This is similar to Attribute 19 but is only used when Attribute 14 is set to ON.

2.3 Position Sensor Services

The Position Sensor Object provides the following Common and manufacturer specific Services:

Service Code	Service Name	Description
0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x10	Set_Attribute_Single	Modify an attribute value
0x15	Restore	Restore all parameter values from non-volatile storage
0x16	Save / Store	Save all parameters to non-volatile storage
0x66	Store_Attribute_Single	Saves / Stores the specified attribute to non-volatile storage
0x67	Restore_Attribute_Single	Restores the specified attribute form non-volatile storage
0x68	Reset_Attribute_Single	Reset the specified attribute to factory default
0x05	Reset	Resets all parameter values to the factory default

Table 28: Position Sensor Service Definitions

2.4 Position Sensor Behavior

The State Transition Diagram (following figure) provides a graphical description of the events and corresponding state transitions.

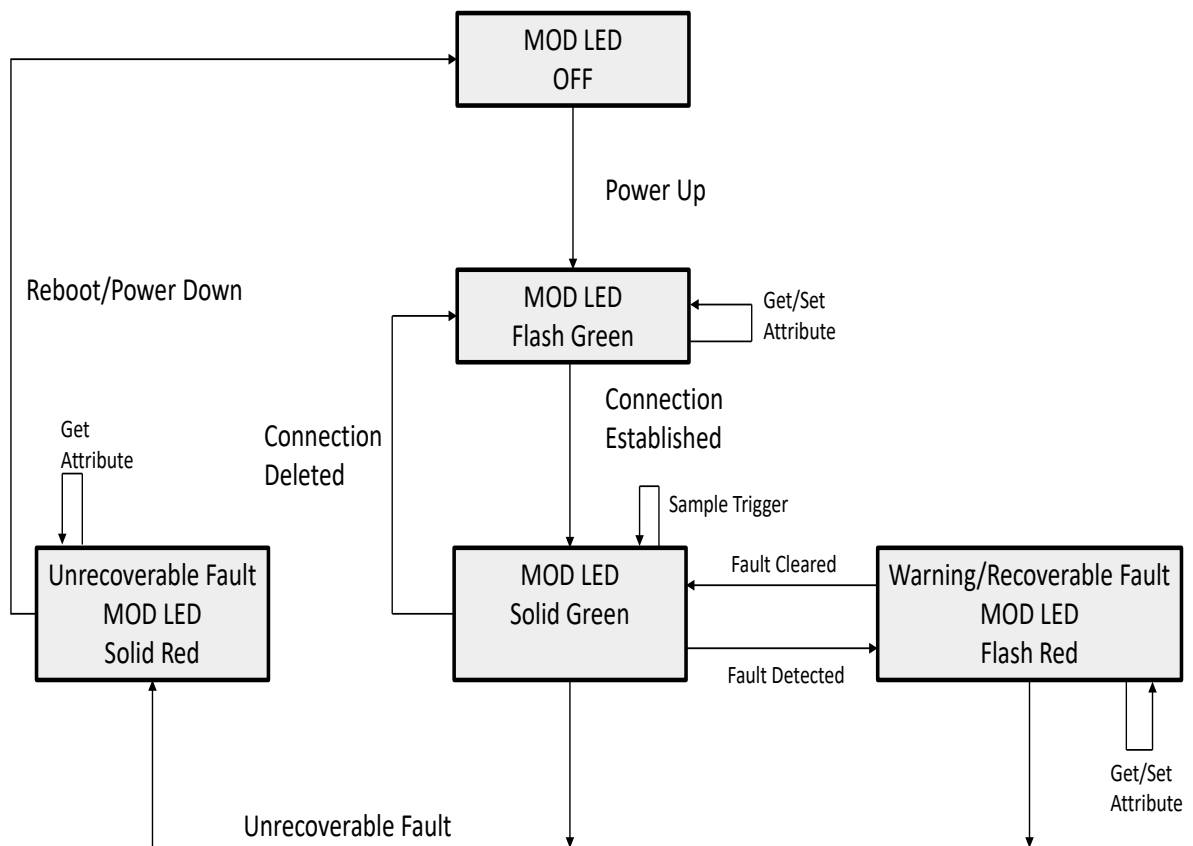


Figure 2: Position Sensor State Transition Diagram

3 Operating Principal of Encoder

3.1 Cyclical Operation

Following figure shows the cyclical operation of Encoder:

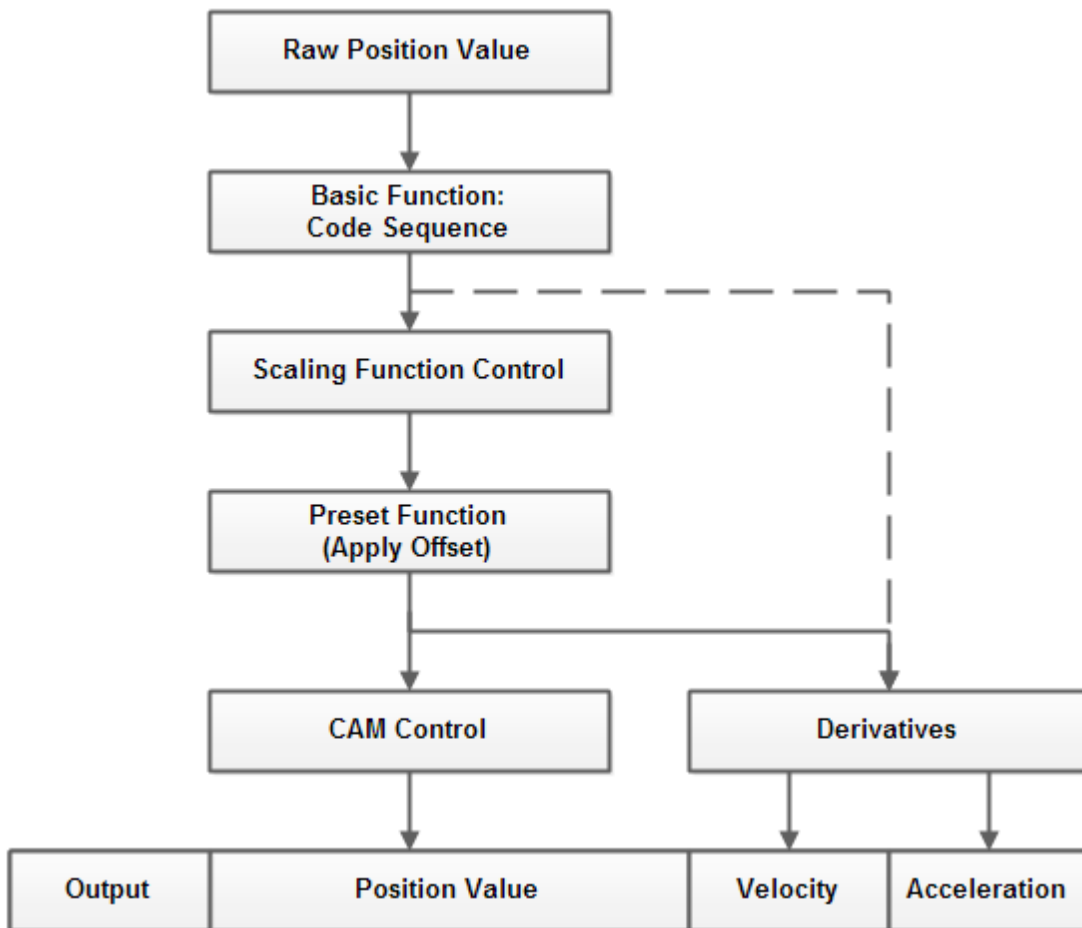


Figure 3: Cyclical Operation of Encoder

3.1.1 Direction Counting Toggle (Code sequence)

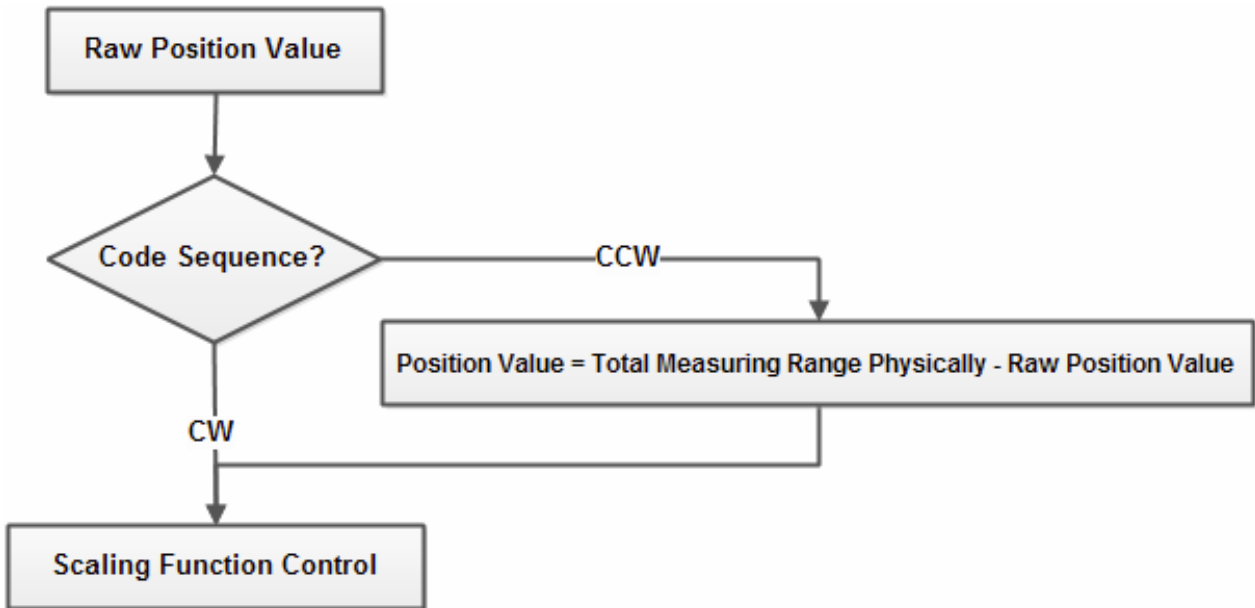


Figure 4: Processing Code-Sequence

3.1.2 Scaling Function Control

Scaling Function Control will be enabled by setting the attribute value to 1. According to Attribute 106 "Scaling Type" configuration (FALSE: Standard Scaling, True: Free Scaling). The encoder has three different operating modes depending on the specified measuring range.

3.2 Acyclical Operation (Set Attribute Value)

Considerations must be taken when setting the configuration parameters: By setting a new Preset Value, the encoder should not be rotating.

3.3 EtherNet/IP Encoder connections

3.3.1 IO-Connection

Max IO Connections = 5

Min. RPI Time = 1000 us = 1 ms

Remark	Limitation: only one IO Connection with RPI time = 1 millisecond supported! (for Multi IO connection Min. RPI time is 2 millisecond)
---------------	---

3.3.2 Explicit Messaging

Max. Connection = 6

Min. Connection read / Write cycle rate = 300 ms

4 Status Indicators

The Module (MOD) LED shows the device status, and the Network (NET) LED shows the status of the CIP connection per the following:

Module LED	Description
OFF	No Power
Solid Green	Device Running (Operational)
Green Flashing	Standby / Device Not Configured / no IP Address assigned
Red Flashing	Warning or Firmware Upgrade in Progress
Solid Red	No IP / Fault / Error / Device Not Operational
Green / Red Flashing	Self-Test at Power On

Table 29: MOD LED Status Definitions

Network LED	Description
OFF	No Power
Solid Green	CIP Connection available
Green Flashing	No CIP Connection
Red Flashing	Connection Timeout
Solid Red	IP-Address Conflict
Green / Red Flashing	Self-Test at Power On

Table 30: NET LED Status Definitions

The Port 1 (P1) & Port 2 (P2) LEDs indicate the port status per the following:

P1 & P2 LED	Description
OFF	No Ethernet Connection
Solid Green	Active Ethernet Connection

Table 31: P1 & P2 LED Status Definitions

5 Commissioning

This commission example was completed using an Allen Bradley 1769-L18ERM-BB1B PLC in conjunction with their Studio 5000 Logix Designer software. Other EtherNet/IP certified PLC's and devices can be found at <http://marketplace.odva.org/>.

5.1 Assigning an IP Address

A BOOTP utility is needed in order to assign an IP address to this encoder. A free version of Rockwell's BootP/DHCP Server 2.3.2 program can be downloaded from the Rockwell website.

Please be advised that the BootP/DHCP 3.01.00 program is not compatible with the Dynapar EtherNet/IP encoder so make sure you download the proper program.

Connect your Dynapar EtherNet/IP encoder to your computer using an ethernet cable. Apply power to the encoder and start the BootP/DHCP Server program. During the initial run the program will ask for network settings. You will only need to set the Subnet Mask to 255.255.255.0 and can leave all other settings as is. It may take a few minutes, but the MAC address of the encoder will show up in the top window of the BOOTP/DHCP Server program. Right click on the address and select "Add to Relation List". Enter in an IP address for the encoder and select OK.

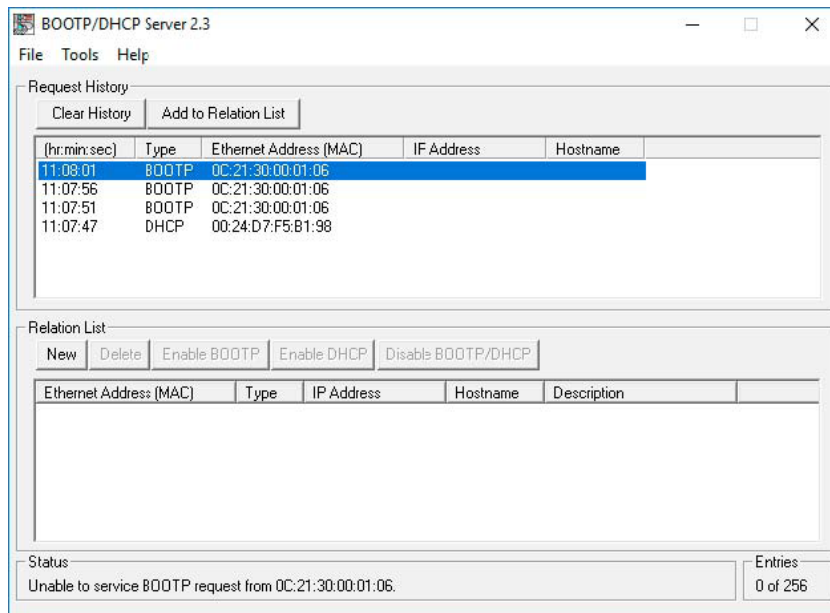


Figure 5: BootP/DHCP Server Device Recognition

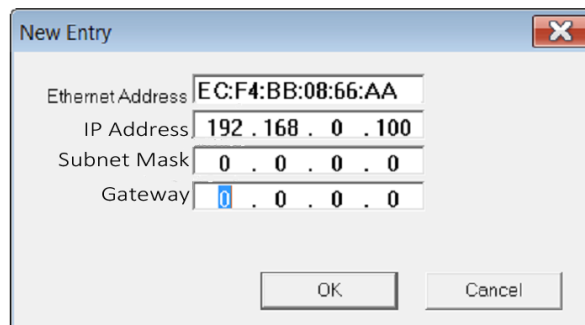


Figure 6: Assigning an IP Address

The MOD LED on the encoder will turn to solid green to indicate a valid IP address has been assigned. This IP address will remain until power to the encoder is removed.
If you would like to lock the IP address, then highlight the IP address in the bottom window of the BOOTP/DHCP Server program and click the Disable BOOTP/DHCP button. It is recommended you save your BootP/DCHP Server settings if you disable BootP on the encoder. This will allow easy access to enable BootP if you decide to change your IP address.

5.2 EDS Installation

After creating a project in Logix Design, you will need to import the Dynapar EDS file. Please contact a Dynapar representative for a copy of this file. The following screen shots will walk you through this procedure.

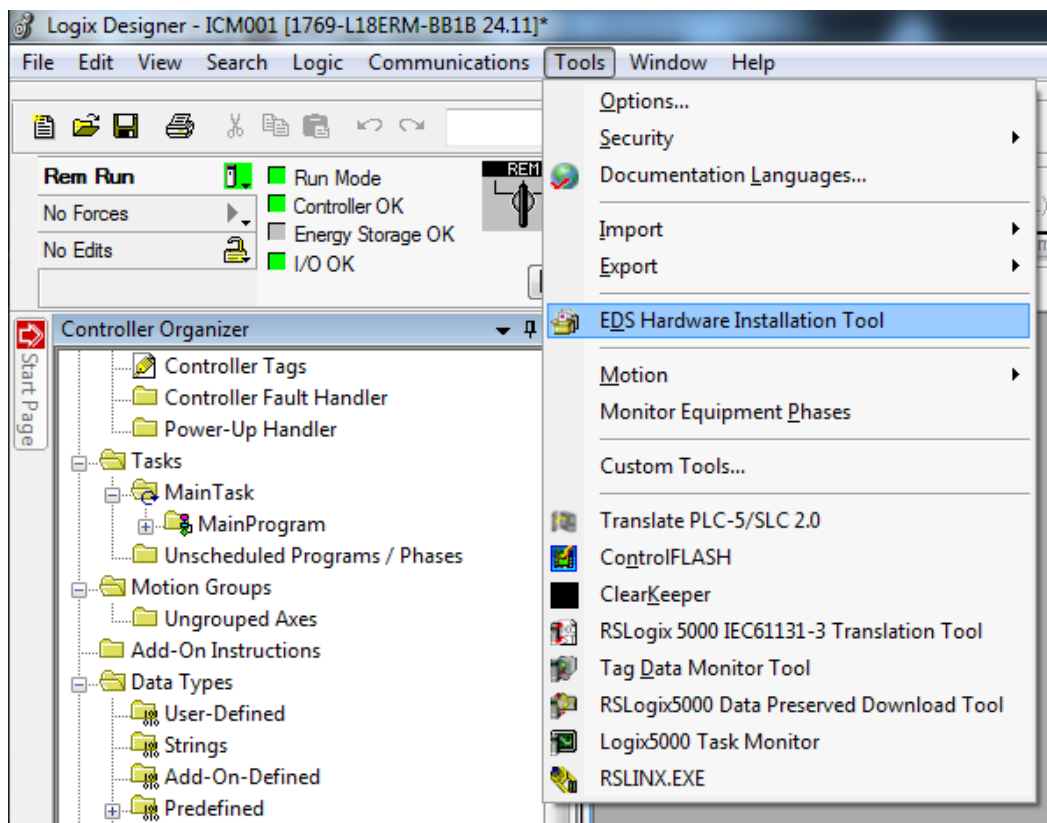


Figure 7: EDS Installation Tool

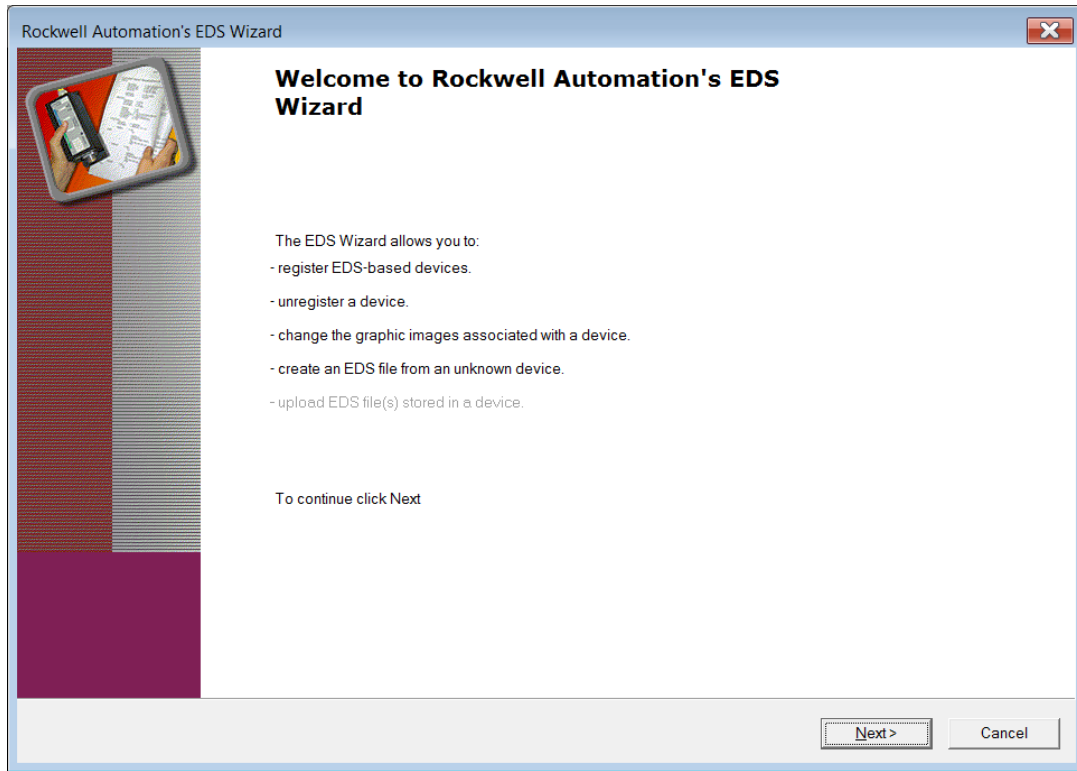


Figure 8: EDS Wizard

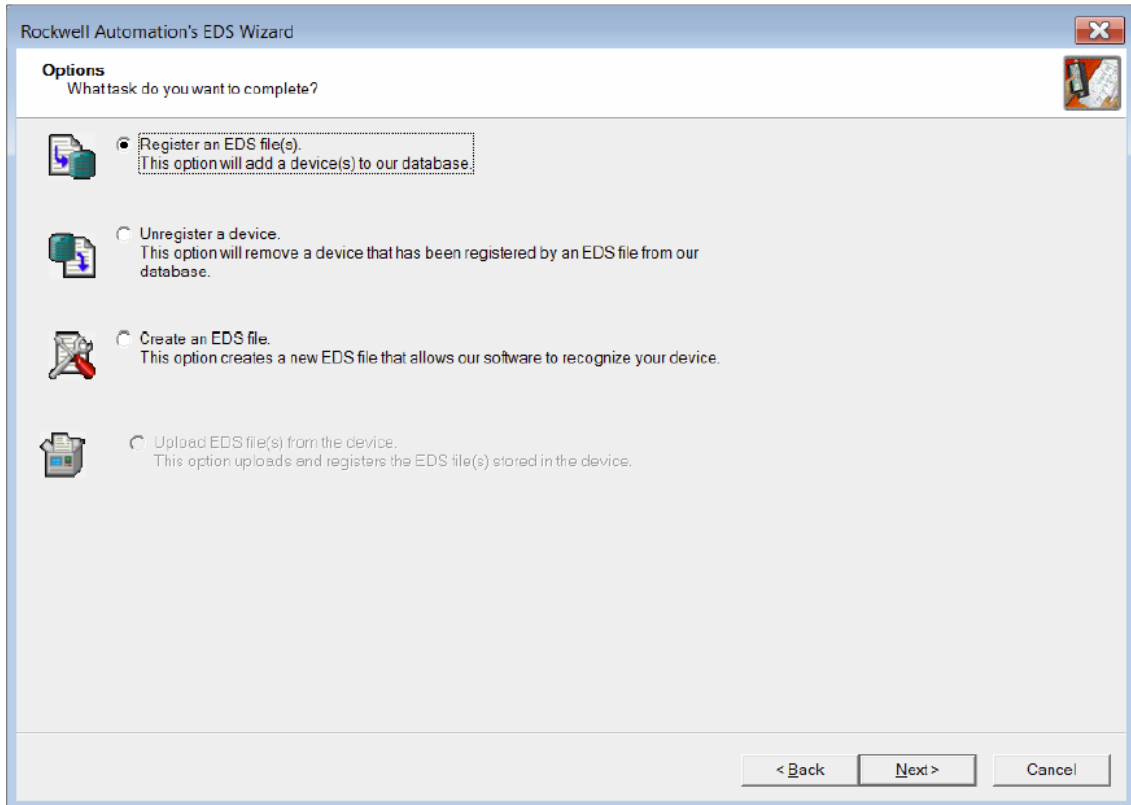


Figure 9: Register EDS File

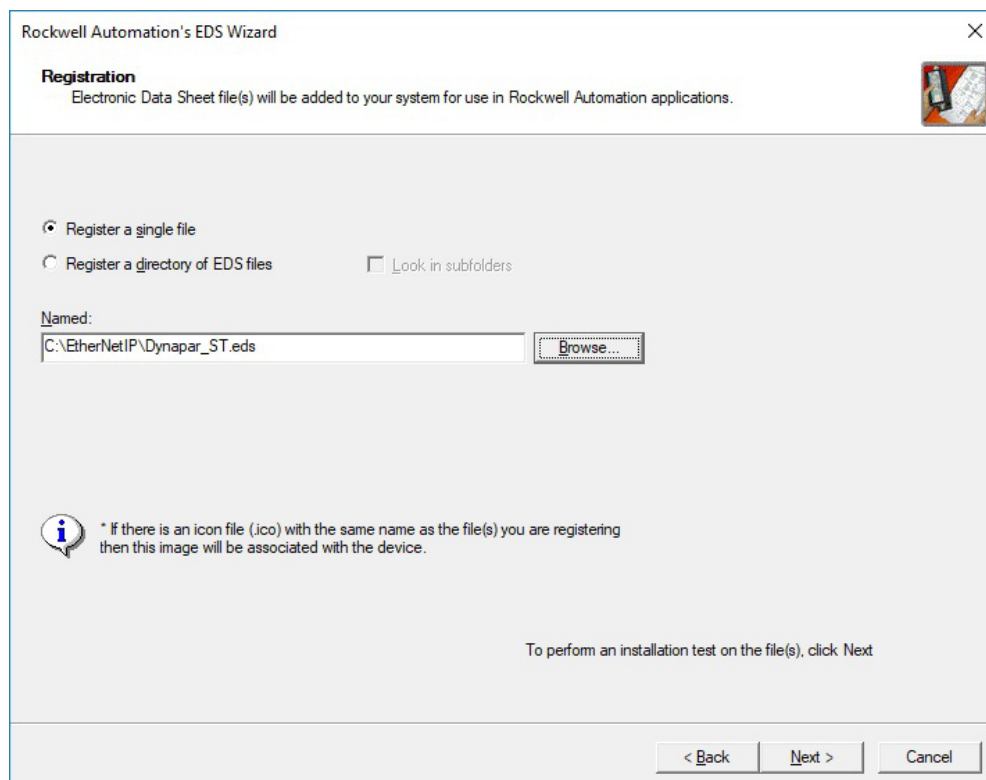


Figure 10: Browse for Dynapar EDS file

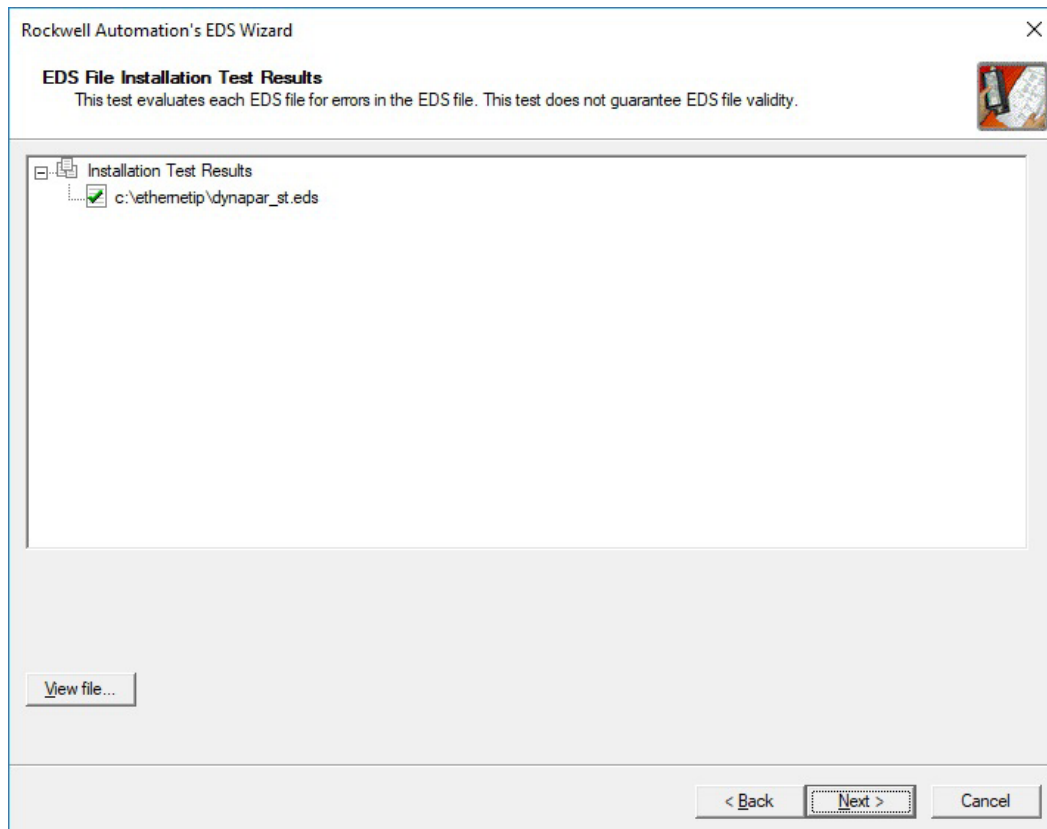


Figure 11: EDS File Installation

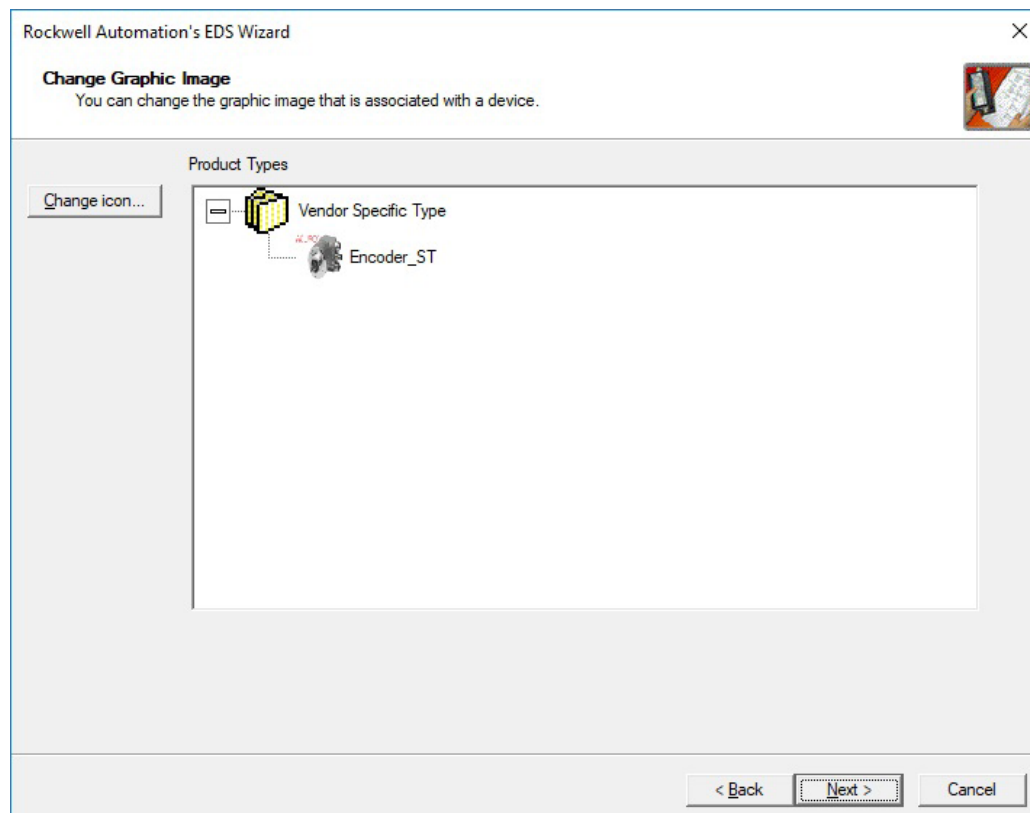


Figure 12: Dynapar EDS File

5.3 Create Encoder Module

This example will guide you through the setup of an EtherNet/IP project using RSLogix Studio 5000 and a PLC running version 30.

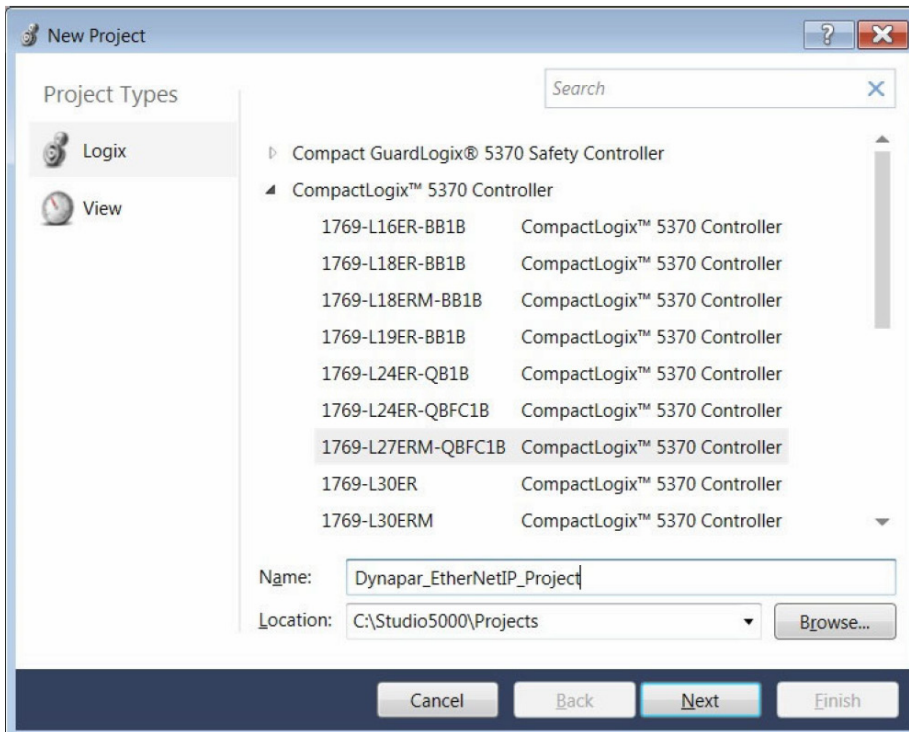


Figure 13 Studio5000 New Project – page 1

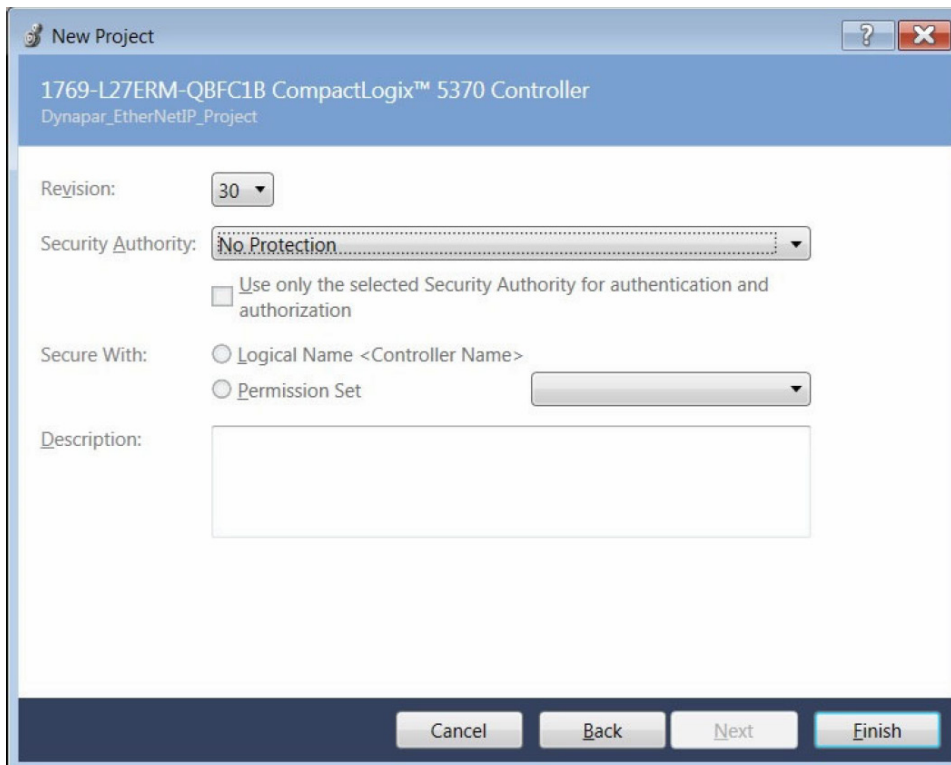


Figure 14: Studio5000 New Project – page 2

Once the project has been created you will need to add a new Ethernet encoder module to your controller. This is shown in Figure 15 through Figure 18. The IP address you assigned in Section 5.1 will be used in the last step Figure 17. After this process has been completed you will have a new Ethernet encoder module as shown in Figure 18.

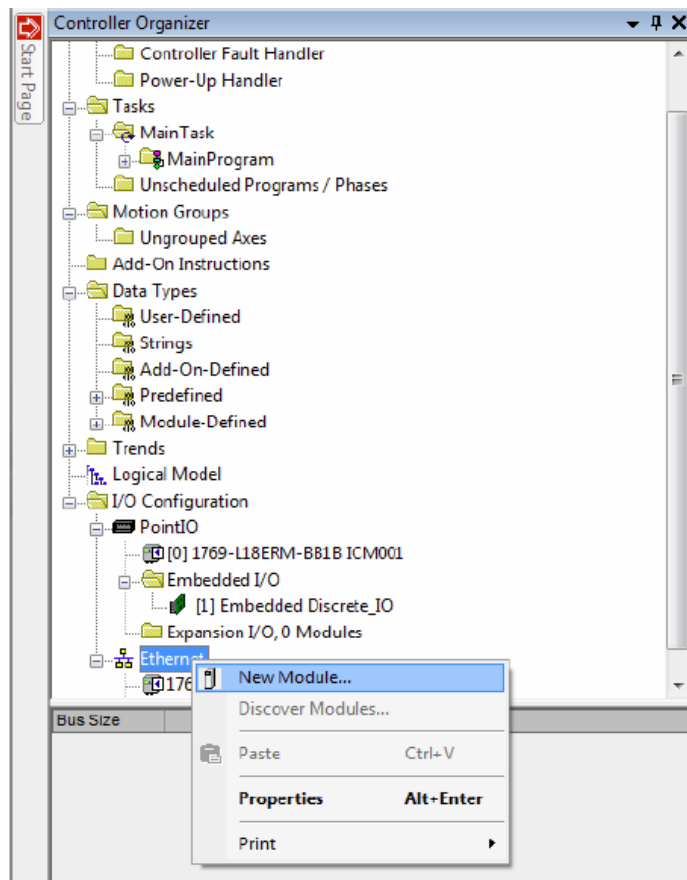


Figure 15: Add New Module

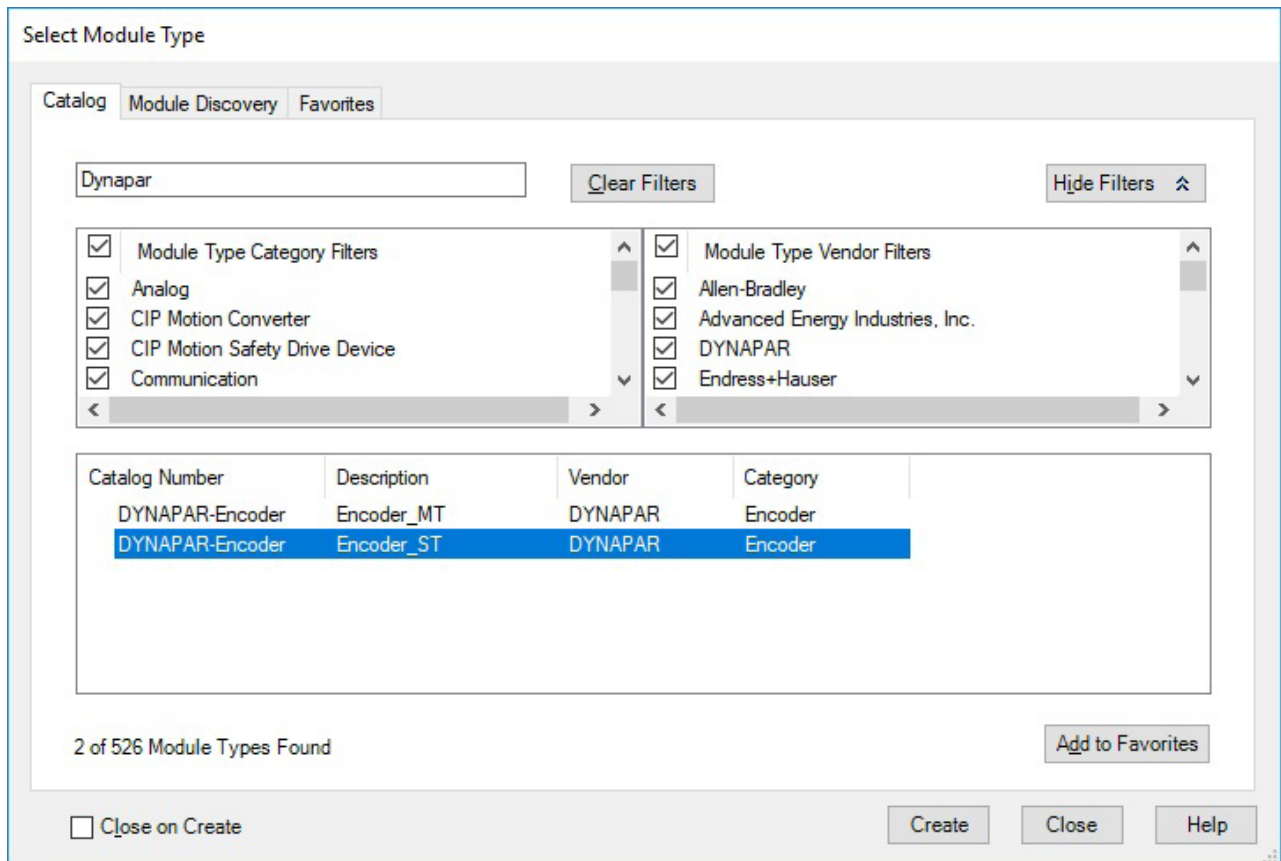


Figure 16: Dynapar Module Type

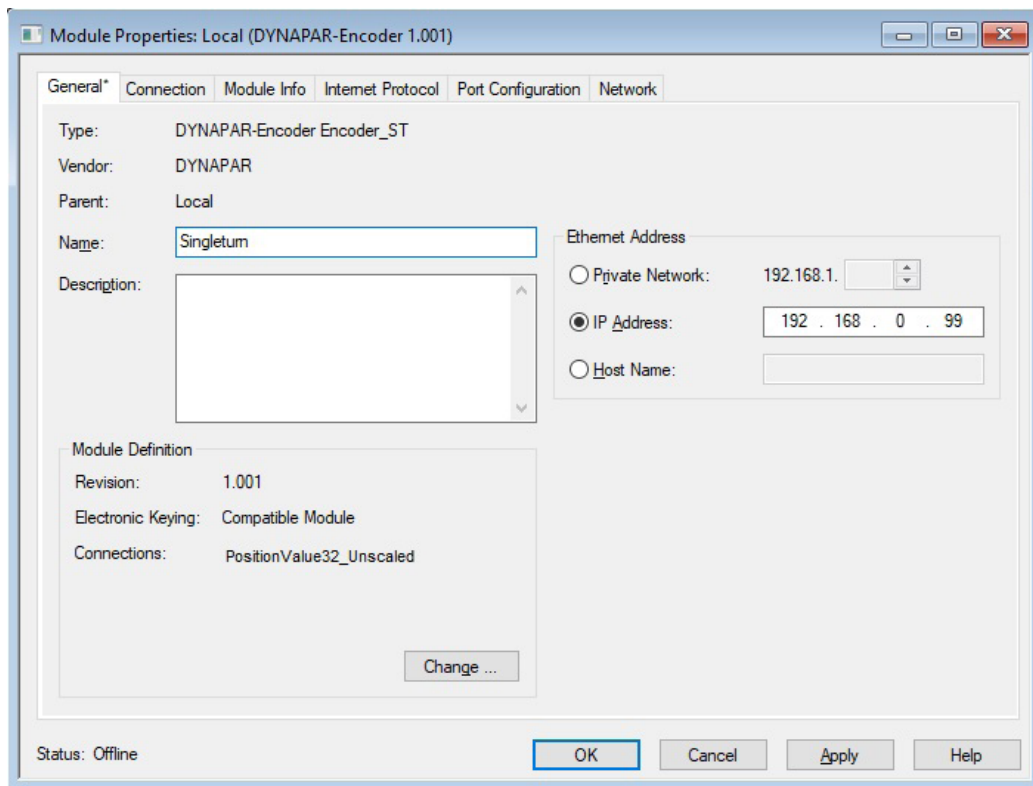


Figure 17: Name New Module

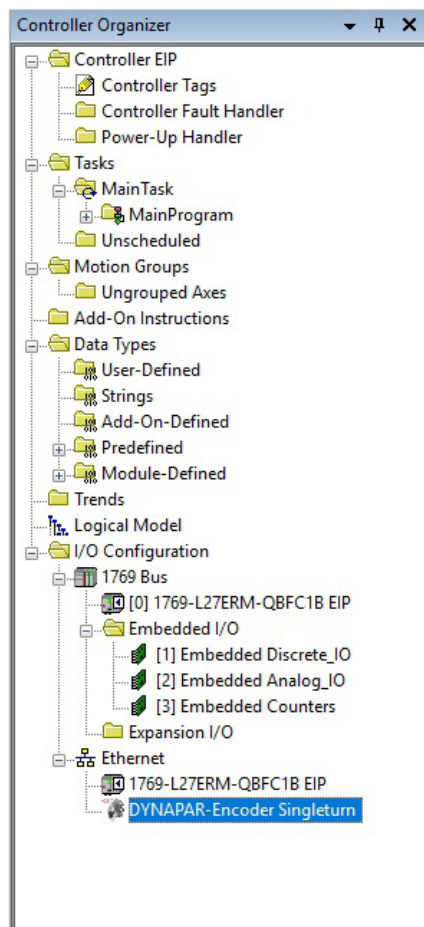


Figure 18: New Dynapar Encoder Module

5.4 IO-Assembly Selection

This section will guide you through the addition of Assembly Instances to your encoder module. You can access these parameters by right clicking on the Dynapar module and selecting Properties. From the General tab, click on Change to add new Assembly Instances.

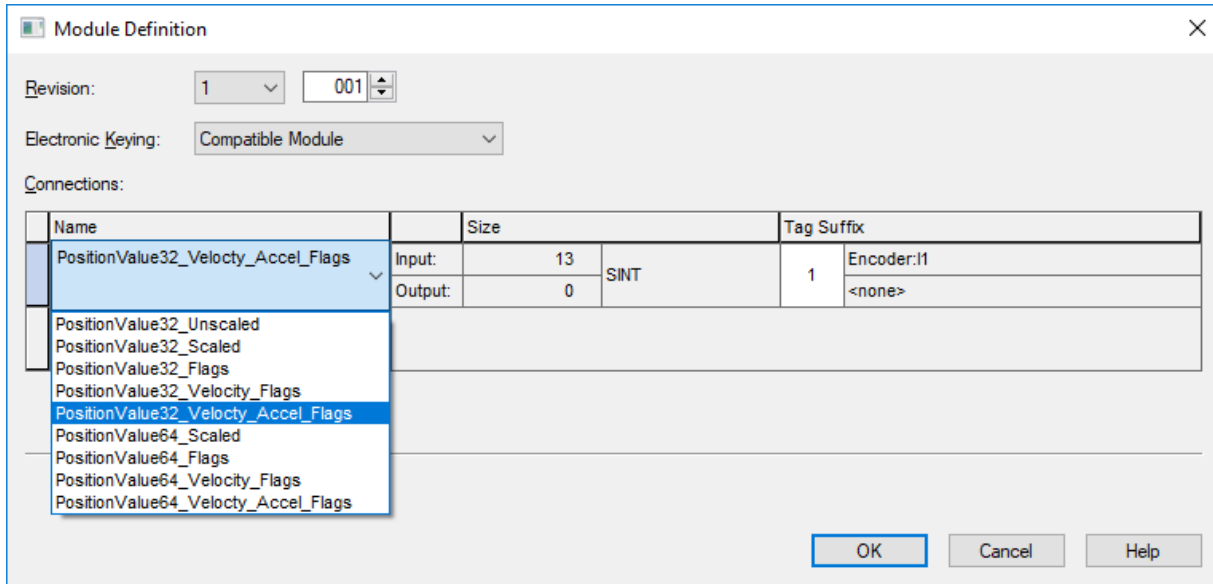


Figure 19: Module Definition

The Request Interval, Input Type and Input Trigger can be modified under the Connection tab in the Dynapar Modules Properties window. In this scenario the setup is using a non-redundant controller so Unicast will be selected. Also, the fastest update rate is required so the RPI is set to 1ms. The Input Trigger must remain Cyclic for the RPI to update every 1ms.

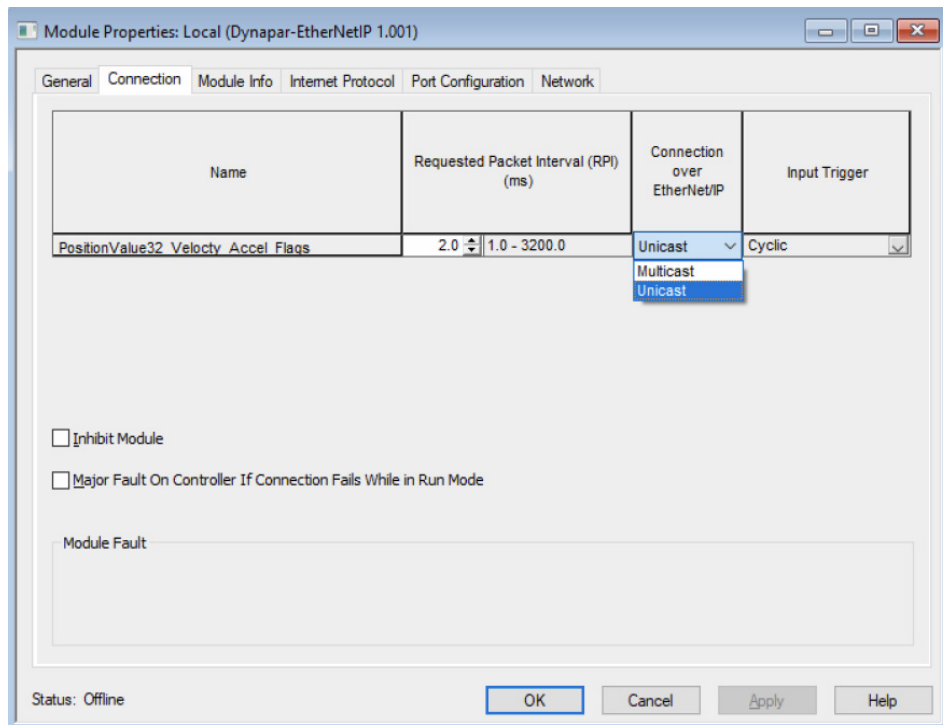
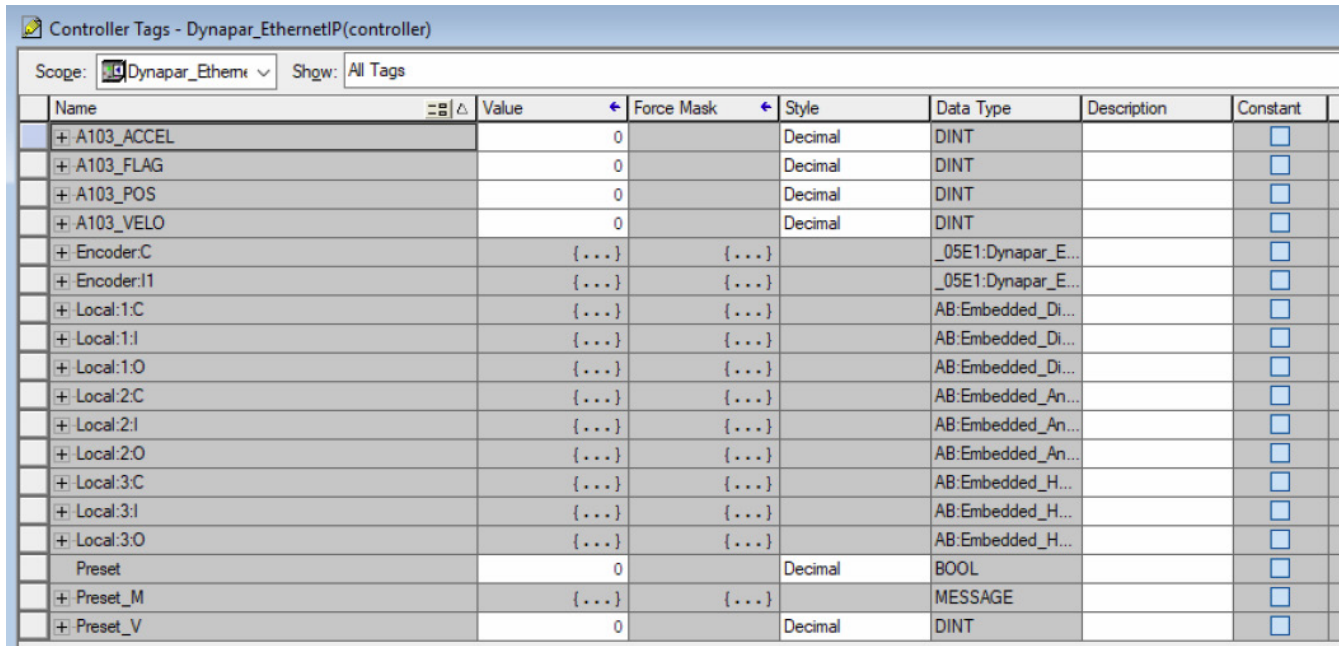


Figure 20: Module Input Type

5.5 Create PLC Program

5.5.1 Controller Tags

Select Controller Tags from the Controller Organizer tree. Select Edit Tags from the bottom of the window and create the following new tag names all with Data Type DINT: A103_ACCEL, A103_FLAG, A103_POS, A103_Velo. The A103 indicates Assembly Instance 103 referenced in section 1.6.2.4. These tags will be used to display data when the PLC is set to run mode.



Name	Value	Force Mask	Style	Data Type	Description	Constant
+ A103_ACCEL	0		Decimal	DINT		<input type="checkbox"/>
+ A103_FLAG	0		Decimal	DINT		<input type="checkbox"/>
+ A103_POS	0		Decimal	DINT		<input type="checkbox"/>
+ A103_VELO	0		Decimal	DINT		<input type="checkbox"/>
+ Encoder:C	{...}	{...}		_05E1:Dynapar_E...		<input type="checkbox"/>
+ Encoder:1	{...}	{...}		_05E1:Dynapar_E...		<input type="checkbox"/>
+ Local:1:C	{...}	{...}		AB:Embedded_Di...		<input type="checkbox"/>
+ Local:1:1	{...}	{...}		AB:Embedded_Di...		<input type="checkbox"/>
+ Local:1:O	{...}	{...}		AB:Embedded_Di...		<input type="checkbox"/>
+ Local:2:C	{...}	{...}		AB:Embedded_An...		<input type="checkbox"/>
+ Local:2:1	{...}	{...}		AB:Embedded_An...		<input type="checkbox"/>
+ Local:2:O	{...}	{...}		AB:Embedded_An...		<input type="checkbox"/>
+ Local:3:C	{...}	{...}		AB:Embedded_H...		<input type="checkbox"/>
+ Local:3:1	{...}	{...}		AB:Embedded_H...		<input type="checkbox"/>
+ Local:3:O	{...}	{...}		AB:Embedded_H...		<input type="checkbox"/>
Preset	0		Decimal	BOOL		<input type="checkbox"/>
+ Preset_M	{...}	{...}		MESSAGE		<input type="checkbox"/>
+ Preset_V	0		Decimal	DINT		<input type="checkbox"/>

Figure 21: Controller Tags

5.5.2 Ladder Program

The ladder program will be used to copy data into the name tags that were created in section 5.5.1. The ladder program can be found in the MainRoutine under the Tasks section. A few copy file commands will be created to perform this operation. Right click on the blue line and select Add Ladder Element. Select “File/Misc” and then chose Copy file.

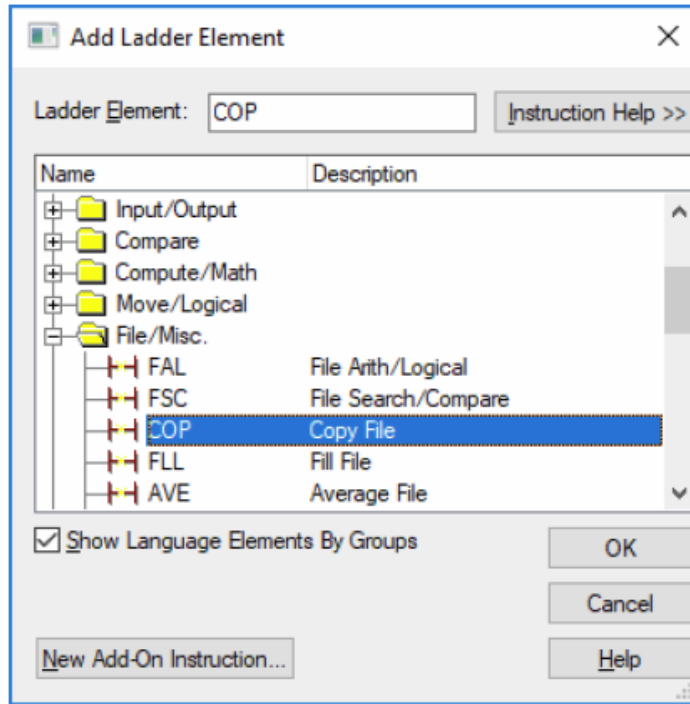


Figure 22: Copy Ladder Element

Double click on the text next to Source and select “Encoder:I1,Data[0]”. This is the location of position data as indicated in the Assembly instance referenced in 1.6.2.4.

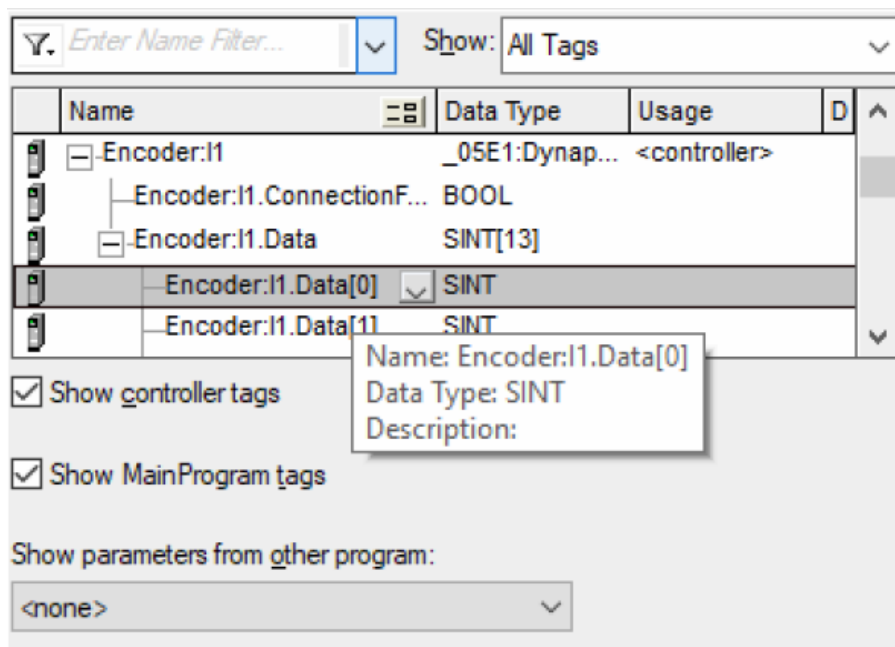


Figure 23: Encoder Position Copy

Select the text next to Dest and chose “A103_POS”. This the destination tag for the data you selected in the previous step.

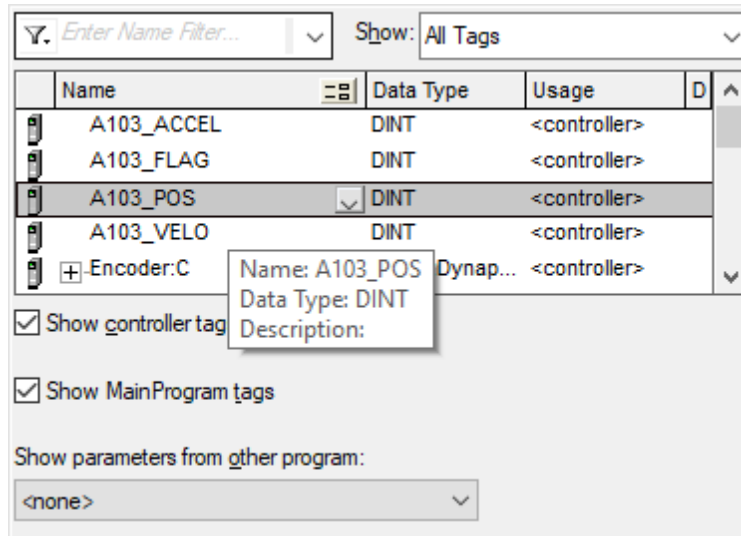


Figure 24: Encoder Position Destination

Finally, set the length to 4. Repeat the previous steps to setup copy operations for velocity, acceleration and flags. Please reference section 1.6.2.4 to determine where the data is stored. For example acceleration starts at Data[8]. You should end up with a ladder program like what is shown below.

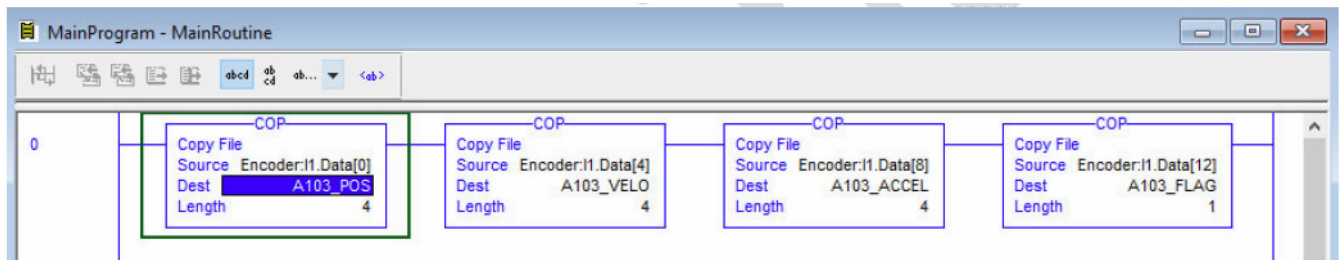


Figure 25: Final Ladder Program

You will then be able to view Position, Velocity, Acceleration and Warning Flags using properly labeled monitor tags.

Name	Value	Force Mask	Style	Data Type
A103_ACCEL	-114200		Decimal	DINT
A103_FLAG	0		Decimal	DINT
A103_POS	561388		Decimal	DINT
A103_VELO	42405		Decimal	DINT
Encoder:C	{...}	{...}		_05E1:Dynapar_E...
Encoder:I1	{...}	{...}		_05E1:Dynapar_E...

Figure 26: Labeled Tags

5.5.3 Preset

Creating a preset function in Studio 5000 can be accomplished by using Tags and the ladder program. First, start out by going to the Edit Tags section and create tags with the following names: Preset, Preset_M, and Preset_V. Preset should be a data type BOOL, Preset_M should have a data type MESSAGE and Preset_V should be data type DINT. You should end up with tags as shown in Figure 27.

Preset	0		Decimal	BOOL
+ Preset_M	{...}	{...}		MESSAGE
+ Preset_V	0		Decimal	DINT

Figure 27: Preset Tags

Next you will need to edit your MainRoutine. Right click on one of the lines and select “Add Rung”. Add an “Examine On” element from the Toolbar. And select Preset as the tag name for this new element.

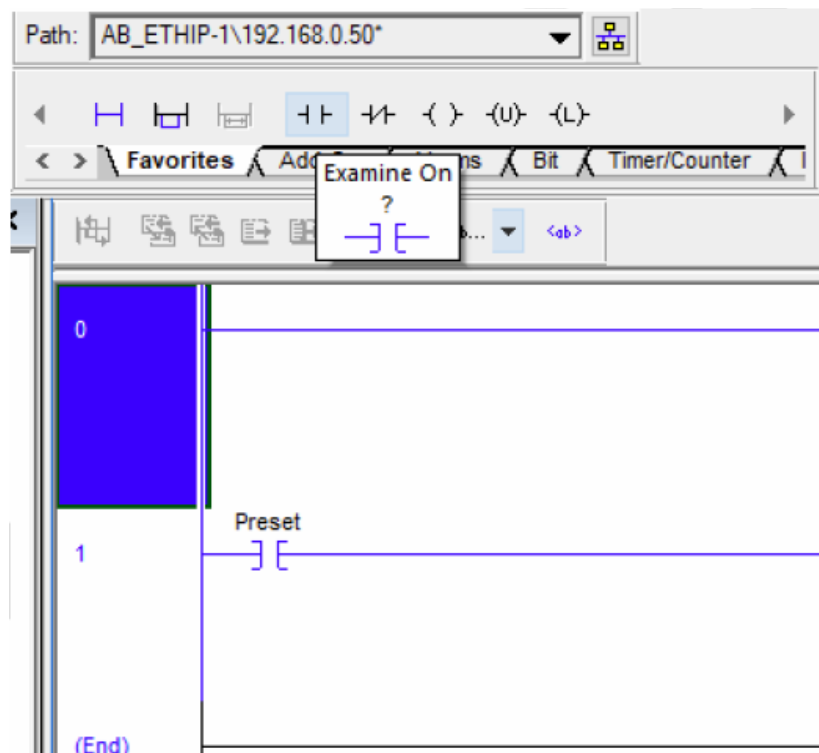


Figure 28: Add Preset Ladder Element

Then add a message element by right clicking on the line to the right of the Examine On element you just added. The MSG element is located under the Input/Output folder. Select Preset_M from the drop down next to Message Control. Then click on the ... box to the right of Preset_M to open the Message Configuration window. Configure the message to match the settings shown in Figure 29.

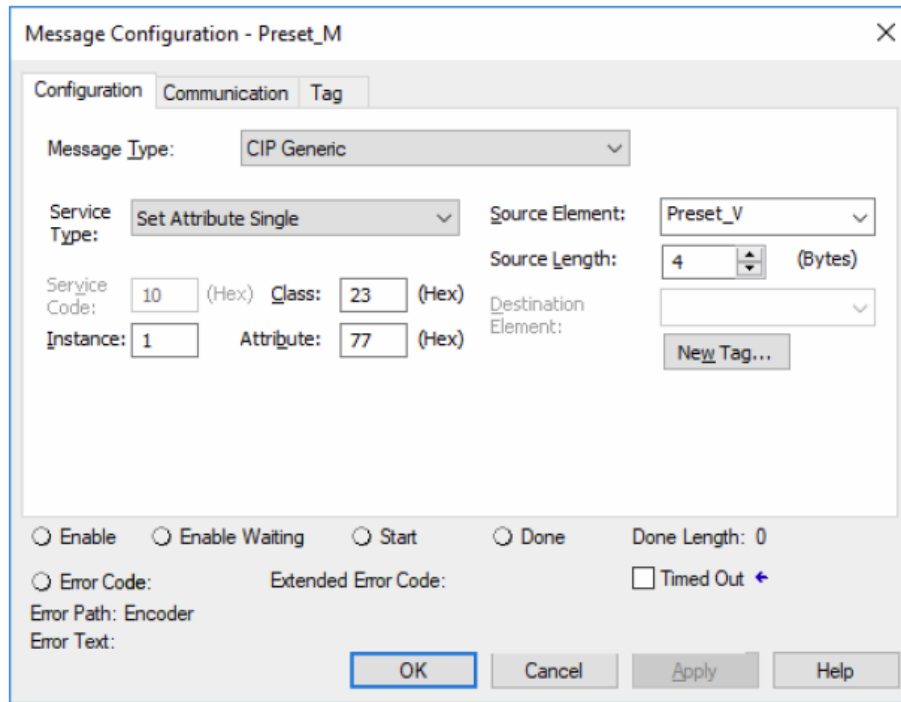


Figure 29: Message Configuration

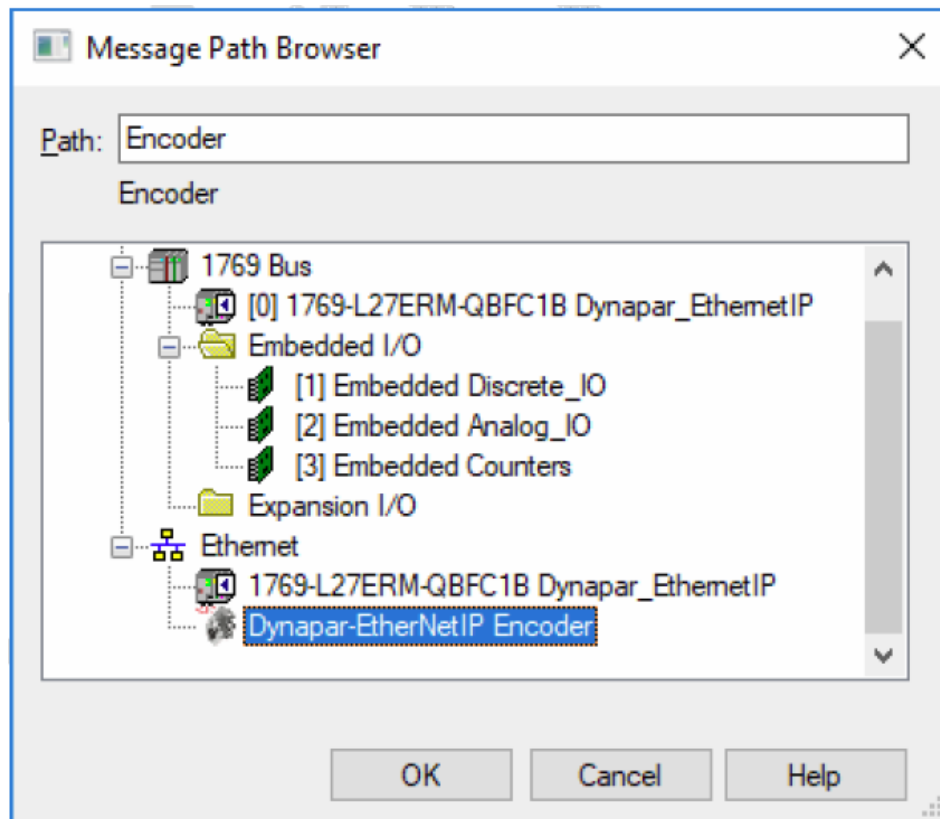


Figure 30: Message Path Setup

Click on OK twice to save the settings. You should end up with a complete ladder program as shown in Figure 31.

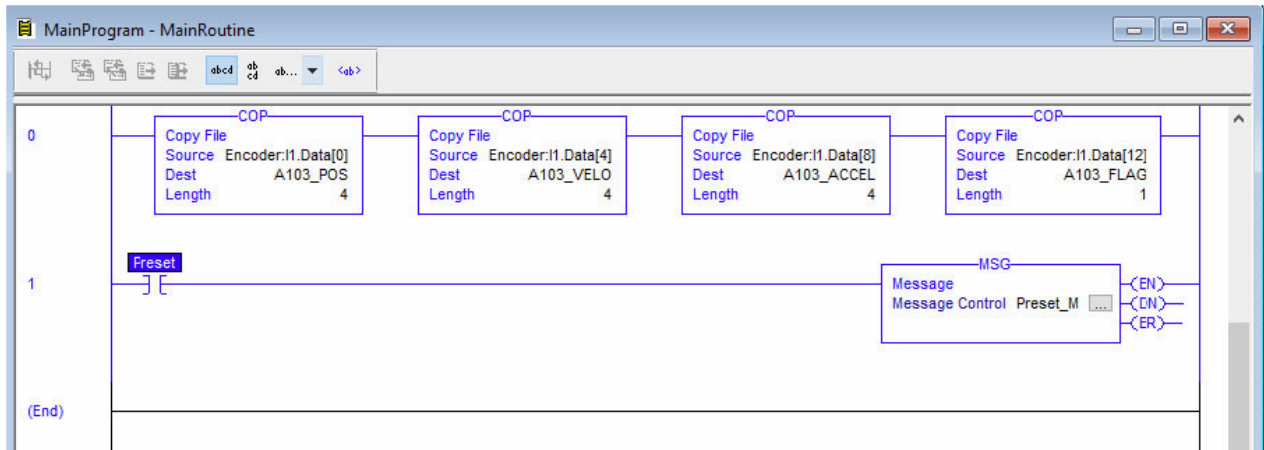


Figure 31: Preset Ladder Program

You can now download your program to the PLC and run it to test out the preset function. In the monitor tags window you can change the Preset value from 0 to 1 to perform a preset to the encoder. When this is performed the position value as shown in A103_POS will change to the value entered into Preset_V.

Name	Value	Force Mask	Style	Data Type
+ A103_ACCEL	0		Decimal	DINT
+ A103_FLAG	0		Decimal	DINT
+ A103_POS	500		Decimal	DINT
+ A103_VELO	0		Decimal	DINT
+ Encoder:C	{...}	{...}		_05E1:Dynapar_E...
+ Encoder:I1	{...}	{...}		_05E1:Dynapar_E...
+ Local:1:C	{...}	{...}		AB:Embedded_Di...
+ Local:1:I	{...}	{...}		AB:Embedded_Di...
+ Local:1:O	{...}	{...}		AB:Embedded_Di...
+ Local:2:C	{...}	{...}		AB:Embedded_An...
+ Local:2:I	{...}	{...}		AB:Embedded_An...
+ Local:2:O	{...}	{...}		AB:Embedded_An...
+ Local:3:C	{...}	{...}		AB:Embedded_H...
+ Local:3:I	{...}	{...}		AB:Embedded_H...
+ Local:3:O	{...}	{...}		AB:Embedded_H...
Preset	1		Decimal	BOOL
+ Preset_M	{...}	{...}		MESSAGE
+ Preset_V	500		Decimal	DINT

Figure 32: Perform Preset

5.5.4 Trend

Trends can be used to visualize the real-time data by presenting it on a graph. You can graph any data being sent out from the encoder but it is easiest to setup trends using Monitor Tags that were previously setup. Right click on Trends in the Controller Organizer window and select New Trend. Name your trend and then right click on it to edit the properties. Select the Pens tab and then click on Add/Configure Tags. Select the tags you want to monitor such as A103_ACCEL, A103_POS and A103_VELO to add them to your trend. Select OK when finished to complete your trend setup. Switch the unit to run mode and click on Run to see the new trend that was created.

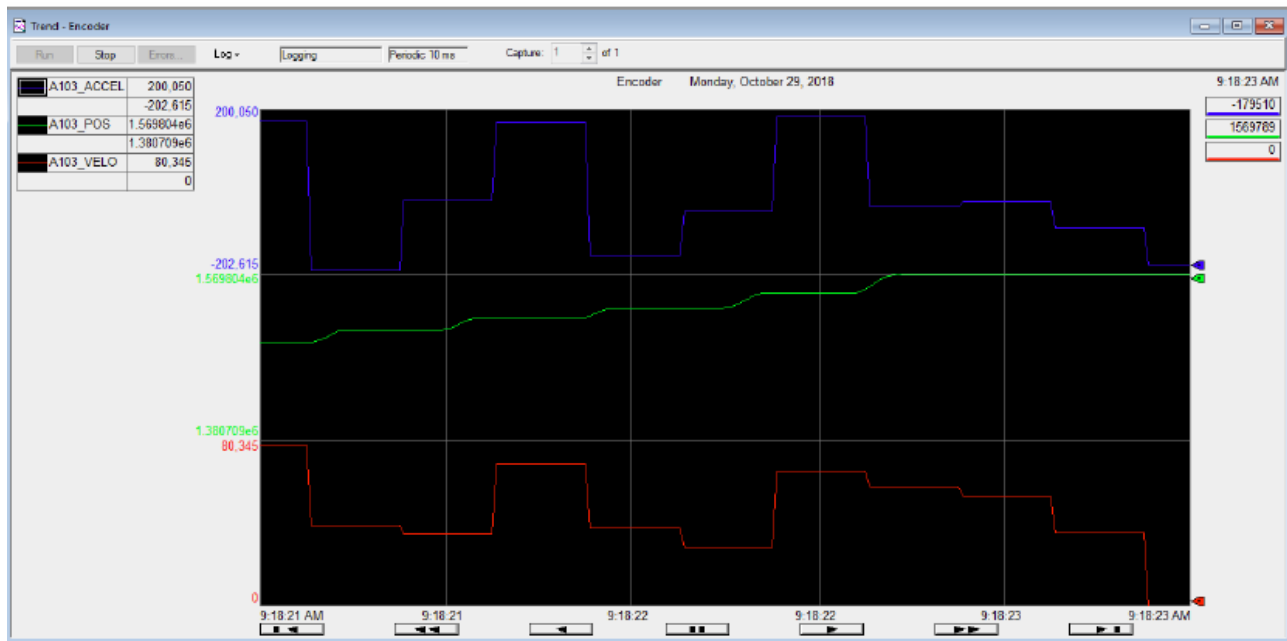


Figure 33: Trend View

5.6 Device Level Ring (DLR)

Device Level Ring is designed to enhance the redundancy within an Ethernet/IP ring network. It has built in network fault detection and fault resolution designed to keep the network operational until the fault is resolved.

All Dynapar EtherNet/IP encoders are capable of operation in a DLR format. For most applications you will need to first connect the encoder and DLR supervisor in a linear arrangement. Completing the DLR ring connections before enabling Supervisor Mode will result in a PLC fault. Once Supervisor Mode is activated you can then make the final connection to the PLC and complete the ring. Please consult your PLC or DLR supervisor manual for further details.

5.7 Address Conflict Detection (ACD)

The encoder can determine if another device on the network has the same IP address. When this happens the NET light will turn solid red to indicate this condition.

6 Appendix A

6.1 Elementary Data Type Reporting

Elementary data types are identified using the identification codes defined in the table below:

Name	Code	Description
BOOL	0xC1	Logical Boolean with values TRUE and FALSE
SINT	0xC2	Signed 8-bit integer value
INT	0xC3	Signed 16-bit integer value
DINT	0xC4	Signed 32-bit integer value
LINT	0xC5	Signed 64-bit integer value
USINT	0xC6	Unsigned 8-bit integer value
UINT	0xC7	Unsigned 16-bit integer value
UDINT	0xC8	Unsigned 32-bit integer value
ULINT	0xC9	Unsigned 64-bit integer value
REAL	0xCA	32-bit floating point value
LREAL	0xCB	64-bit floating point value
STIME	0xCC	Synchronous time information
DATE	0xCD	Date information
TIME_OF_DAY	0xCE	Time of day
DATE_AND_TIME	0xCF	Date and time of day
STRING	0xD0	character string (1 byte per character)
BYTE	0xD1	bit string 8bits
WORD	0xD2	bit string 16bits
DWORD	0xD3	bit string 32bits
LWORD	0xD4	bit string 64bits
STRING2	0xD5	character string (2 bytes per character)
FTIME	0xD6	Duration (high resolution)
LTIME	0xD7	Duration (long)
ITEM	0xD8	Duration (short)
STRINGN	0xD9	character string (N bytes per character)
SHORT_STRING	0xDA	character sting (1 byte per character, 1 byte length indicator)
TIME	0xDB	Duration (milliseconds)
EPATH	0xDC	CIP path segments
ENGUNIT	0xDD	Engineering Units
STRINGI	0xDE	International Character String

Table 32: CIP Data Type Definitions