

Module Overview

The 7272 module is a two-channel EnDat 2.1 interface module that resides in a Rockwell Automation ControlLogix rack.

This module is capable of connecting up to two independent EnDat output encoders/sensors with max 48-bit resolution for position. This module also has two latching inputs, one for each channel, which can be used to capture the sensor's data.

The 7272 module communicates with the PLC using input and output registers. The Data value, Velocity, Latched Value, and Status information are reported to the Input Registers. All module setup parameters, including Preset Value, Count Direction, Velocity Response Time, as well as the Sensor Logic parameters [Data Type (binary/gray), Data Logic (positive/negative), Number of EnDat Data Bits and Clock Frequency] are programmed through Message Instructions.

The Output registers assigned to the module can be used to Apply the Preset, to send Reset command to the encoder or to send the PLC's *Central System Clock-Time* to the 7272 module. This optional and additional feature causes the module to use this system time and the sensors velocity data to calculate an Interpolated or "Look Ahead" Data value.

The 7272 module stores its parameters in a non-volatile flash memory when power is removed so it is not necessary to program the module at every power up. However, this flash memory is good for a minimum of 10,000 write cycles, so the module must not be programmed during every machine cycle.

The module has two opto-coupler latching inputs that will capture the scaled sensor data on the rising, falling, or both transitions of the input. These inputs can be wired to be sinking or sourcing and will activate when they see a voltage level between 8 and 24Vdc across the + and – latch terminals.

Through the use of different rack Assembly Instances, the 7272 can be configured to operate with one or two of the available channels. Disabling the unused channel is recommended for improving the throughput time.



General Information

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Chapter 1: INSTALLING THE 7272 MODULE

Configuring the ControlLogix System

1. Open RSLogix 5000 and the project in which you want to install the AMCI 7272 module.
2. Right click on I/O Configuration in the Project Tree.
3. Select New Module.
4. Select the following module type and description from the list that appears.

Type = 1756-MODULE

Description = Generic 1756 Module

5. Click on OK.
6. Enter the following module properties.

Name: *Your Choice* (must begin with a letter)

Description: *Your Choice*

Comm Format: *Data-DINT* (must be Data-DINT)

Slot: *location of 7272 module*

7. Enter the Connection Parameters from the following table. Please note that the 7272 module can be configured in two ways, depending on how many channels are being used. Disabling the unused channel is recommended because the module will stop all activities associated with the unused channel, which will improve the throughput time.

Owner Controller			Listen Only	
Parameter	Assembly Instance	Size in 32 bit words	Assembly Instance	Size in 32 bit words
1 Channel				
INPUT	101	10	101	10
OUTPUT	111	2	115	1
CONFIGURATION	1	0	5	0
2 Channels				
INPUT	102	20	102	20
OUTPUT	112	4	115	1
CONFIGURATION	2	0	5	0

The Owner Controller setup will be used in most instances. The Listen Only setup should only be used by the listening processor(s) in systems with more than one PLC. Please note that the RPI time of the Listen Only processor must be greater than or equal to the RPI of the Owner Controller, and the number of channels on the Listen Only processor must match the number of channels on the Owner Controller.

8. Click on Next >
9. Set the RPI (Rate Packet Interval) Time to the desired value. To reduce the PLC scan, the recommended RPI time is 5ms. However, the minimum value for the 7272 module is 0.5ms.
10. Click on Finish >>

The module should now appear in the project tree. The Input data will be referenced as Local:X.I.Data[Y] and the output data will be referenced as Local:X.O.Data[Y] where “X” is the slot number and “Y” is the word number.

Chapter 2: HARDWARE OVERVIEW

Module Specifications

Current Draw: 550ma @ 5Vdc from PLC backplane

Throughput Time: 0.2ms to 1.2ms depending on the EnDat frequency and the number of bits and channels used.

External Power: The 7272 module requires the use of an external +24Vdc power supply that is used power the input isolation circuitry and can also be used to power sensors that operate on 24Vdc

Voltage Range = +24V dc ($\pm 20\%$), I=150mA max

5Vdc supply The 7272 module also uses the external power supply to generate a 5Vdc user power supply that can be used to power encoders and or sensors that run on 5Vdc. This 5Vdc supply generates 500mA ($\pm 5\%$) of current.

Latching Inputs The Latching Input terminals accept an up to 24VDC signal across pins 17-15, 18-16, The latching function is performed as programmed when power is applied/removed, OFF to ON and/or ON to OFF, to/from the input.

Voltage Range: 0 to 30Vdc

On State: 8 to 30Vdc

Off State: 0 to 2Vdc

Current Draw: 10mA @ 24Vdc

The latching inputs must be on for between 0.2ms and 1.2ms, depending on the number of channels being used.

Environmental Conditions Operating Temperature: 0 to 60° C
Relative Humidity: 5 to 95% (non-condensing)
Storage Temperature: -40 to 85° C

EDS File An EDS file for the 7272 module can be downloaded from the Tech Library section of AMCI's website, www.amci.com.

FLASH Memory

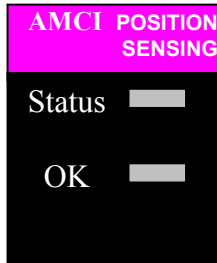
The 7272 module's parameter values are stored in a non-volatile Flash memory. This memory type can store parameter values in the absence of power for over twenty years, but you can only write to it a limited number of times before it will be damaged. The Flash Memory used in the 7272 module is guaranteed for a minimum of 10,000 write cycles.

Encoder Identification

The 7272 module interrogates the EnDat Encoder at every power up. If the encoder is attached later and is different from what is stored in the module's memory, the module will set the Reset Command Fault, the Transducer Fault, and the Encoder Resolution Mismatch status bits and will stop outputting clock pulses.

If this occurs, remove power from and then re-apply power to the module while power is applied to the encoder. This will cause the module to again interrogate the encoder.

Front Panel:



Status LED

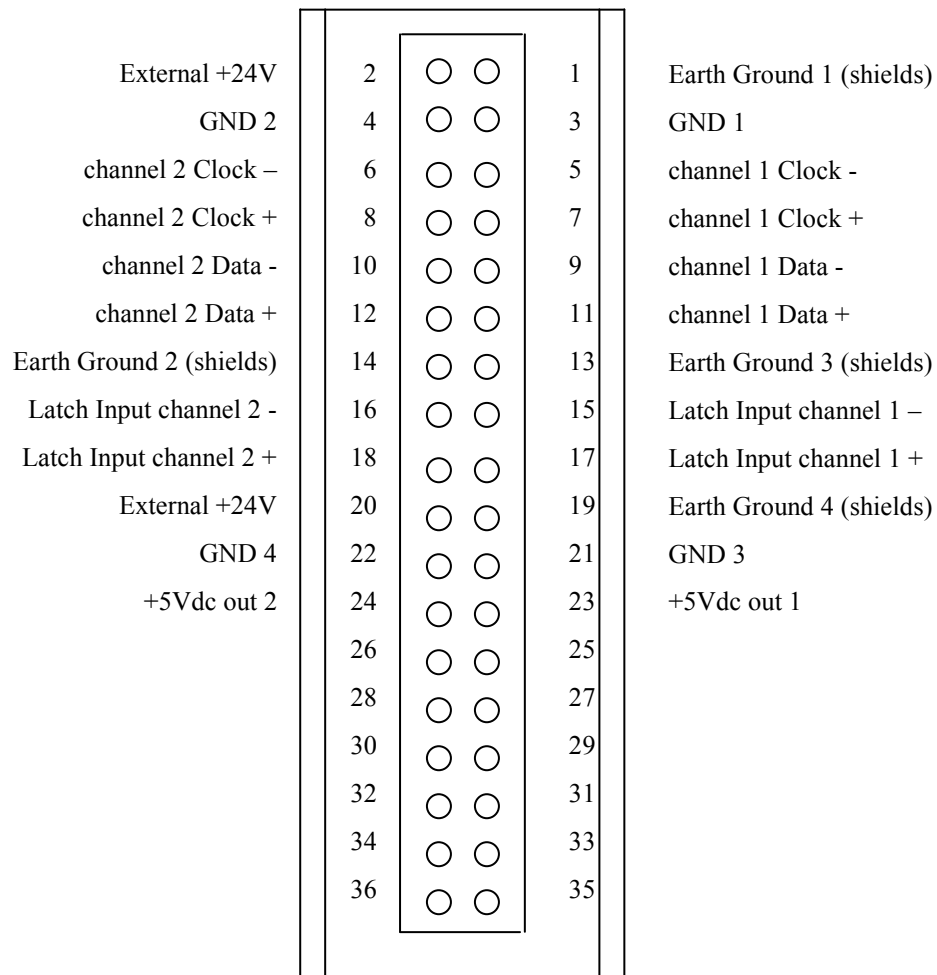
<u>Solid Red</u>	Data Flash Memory Fault
<u>Blinking Red/Green</u>	Module Hardware Comm. Failure
<u>Blinking Red</u>	Data in Output registers is not correct
<u>Solid Green</u>	No motion occurring
<u>Blinking Green</u>	Motion on at least one channel

OK LED

<u>Solid Green:</u>	Module Owned, two-way communication
<u>Blinking Green:</u>	PLC in Program Mode
<u>Blinking Red:</u>	Communication between module and PLC interrupted

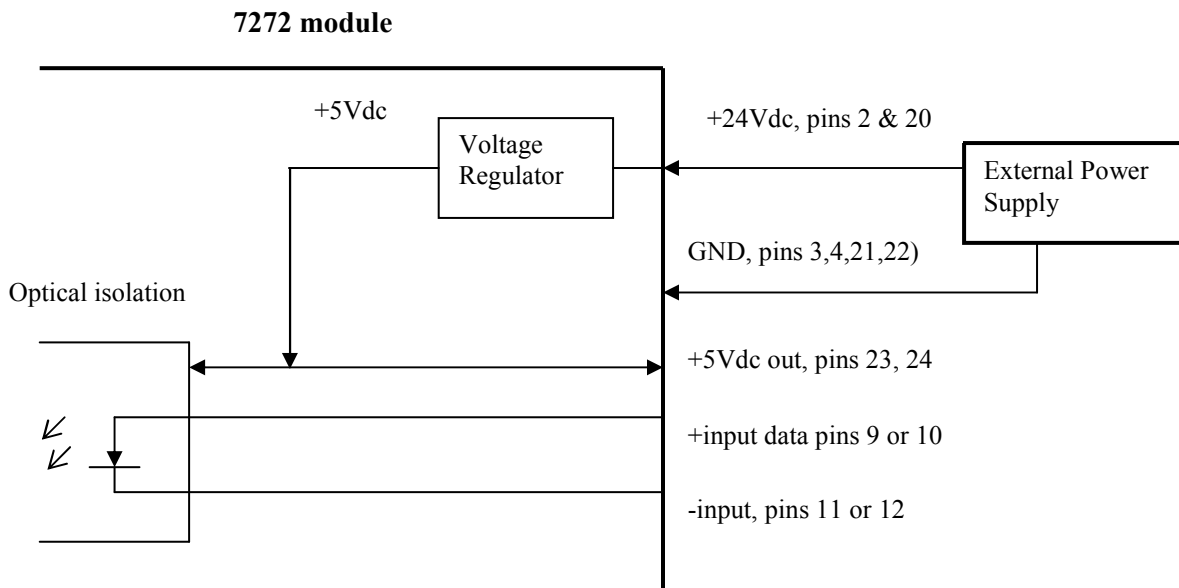
Connector Pin Out:

The input connector consists of a Removable Terminal Block with the Rockwell Automation Part Numbers 1756-TBCH (36 position cage clamp) or 1756-TBS6H (36 position spring clamp). The terminal block is not supplied with the 7272 module.



Wiring Notes

- Use the information provided by the encoder's manufacture to determine the type and maximum length of cable that should be used to connect the sensor to the 7272 module.
- When plugged into the 7272 module, pin 1 is located in the upper right hand corner.
- External +24Vdc (pins 2 and 20) are internally connected together.
- GND1/2/3/4 (pins 3, 4, 21 and 22) are internally connected together and must be connected to the external +24Vdc supply's common.
- The 7272 module uses the external +24Vdc supply to power the isolation circuitry and to generate +5Vdc user power (pins 23 and 24). These two pins, which are internally connected together, can be used to power sensors requiring less than 500 mA of current.



- Earth Grounds 1 through 4 (pins 1, 13, 14 and 19) are internally connected together and are connected to the ControlLogix rack structure. The cable shields of the sensor's cable should be connected to these terminals.
- Transducer signals are generally low voltage, low power signals. If you are using A-B guidelines for cabling installation, treat the transducer cable as a Category 2 cable. It can be installed in conduit along with other low power cabling such as communication cables and low power ac/dc I/O lines. It cannot be installed in conduit with ac power lines or high power ac/dc I/O lines.
- Like all signal and communication cable, the transducer cable should be shielded. These shields must be grounded only at one end of the cable. Because the rack cabinet is typically better grounded than the machine, AMCI recommends that the cable shields be terminated at the 7272 module. However, if your cable shield is attached to the sensor's housing, and the sensor is grounded through its mounting, you must not connect the cable shields to the 7272 module because this will create a ground loop.
- If a junction must be made in the signal cable, treat the shield as a signal-carrying conductor. Do not connect the shield to ground at any junction box or the encoder/sensor.
- If the signal cable must cross power feed lines, it should do so at right angles.
- Route the cable at least five feet from high voltage enclosures, or sources of RF radiation.

EnDat interface and protocol

The EnDat (EncoderData) interface is a digital, bidirectional interface for encoders. It is capable of transmitting position values from the encoder, as well as reading and updating information stored in the encoder, or of saving new information. Thanks to the serial transmission method only four signal lines are required. The data are transmitted in synchronism with the clock signal from the PLC module. The type of transmission (position values, parameters, diagnostics, etc.) is selected by mode commands that the PLC module sends to the encoder.

Without propagation-delay compensation, the clock frequency - depending on the cable length - is variable between 100 kHz and 2 MHz. With propagation-delay compensation the maximum clock frequency is mainly determined by the cables and connecting elements used.

Command set

The command set is the sum of all available mode commands. The EnDat 2.2 command set includes EnDat 2.1 mode commands. When a mode command from the EnDat 2.2 command set is transmitted to EnDat 2.1 encoder, the encoder may generate an error message.

EnDat 2.1 command set:

- Encoder to transmit position value;
- Selection of encoder memory area;
- Encoder to receive parameters;
- Encoder to transmit parameters;
- Encoder to receive reset;
- Encoder to transmit test values.

The current version of AMCI 7272 Module supports EnDat 2.1 set of commands.

Control cycle for transfer of position values

The transmission cycle begins with the first falling clock edge. The measured values are saved and the position value is calculated. After two clock pulses, to select the type of transmission the PLC module transmits the mode command „Encoder transmit position value“. After successful calculation of the absolute position value, the start bit begins the data transmission from the encoder to the PLC module. The subsequent error messages are group signals for all monitored functions and serve as failure monitors. Beginning with the LSB, the encoder then transmits the absolute position value as a complete data word. Its length varies depending on which encoder is being used. The number of required clock pulses for transmission of a position value is saved in the memory area called ‘Parameters of the encoder manufacturer’. The data transmission of the position value is completed with a Cyclic Redundancy Check (CRC).

Parameters and Memory Areas

EnDat encoders provide several memory areas for parameters. These can be read from by the PLC module, and some can be written to by the encoder manufacturer, the OEM, or even the end user. Certain memory areas can be writeprotected. The parameters, which in most cases are set by the OEM, largely define the function of the encoder and the EnDat interface. When the encoder is exchanged, it is essential that its parameter settings are correct. Attempts to configure machines without including OEM data can result in malfunctions. If there is any doubt as to the correct parameter settings, the OEM should be consulted.

Parameters of the Encoder Manufacturer

This write-protected memory area contains all information specific to the encoder, such as encoder type (linear/angular, singleturn/multiturn, etc.), signal periods, position values per revolution, transmission format of position values, direction of rotation, maximum speed, accuracy dependent on shaft speeds, warnings and alarms, part number and serial number. This information forms the basis for automatic configuration. A separate memory area contains the parameters typical for EnDat 2.2, such as: status of additional information, temperature, acceleration, support of diagnostic and error messages,

For more information on EnDat refer to the EnDat Specification and your EnDat encoder documentation.

Chapter 3: Programmable Parameters

The 7272 is configured by programming its Programmable Parameters. These parameters are broken down into three groups: **Module Setup**, **EnDat Setup**, and **Data Setup** parameters.

The 7272 uses two methods for the programming and monitoring of data. Input and Output registers are used to program and monitor data that occurs on a regular schedule, such as reading the data value and status information or setting the system time. Message instructions are used for operations that occur less frequently, such as programming the module set up parameters or reading back the set up data for trouble shooting purposes.

Module Setup Parameters

Latched Input: The 7272 module has two Latch Inputs, one for each channel, that allow you to capture and display the current Data Value whenever the input transitions. This parameter, which is composed of two bits, allows you to capture the input on the 0 to 1 transition, the 1 to 0 transition, or on both transitions. The function of the Latched Input will be disabled if neither bit is set.

To be read by the 7272 module, the latching inputs must be on for between 0.2ms and 1.2ms, depending on the number of channels being used.

The 7272 module reports the status of the Latched input even if the function of the latched input has been disabled.

The Latched Value is not saved through power down. Therefore, the Latched Value displayed in the 7272 module's input registers at power up will be zero.

Interpolated Data value: This additional and optional feature may be useful for customers using the ControlLogix PLC's virtual axis functionality. If used, the 7272 module will take the PLC's *Central System Clock-Time* and the sensor's velocity data to calculate an Interpolated or "Look Ahead" Data value. This has two possible functions. One, the Interpolated Data Value along with the time value can be sent to other ControlLogix modules, for example the AMCI 8213-VA, allowing them to schedule their responses with a high degree of precision. Two, the Interpolated Data Value allows the user to "Look Ahead" to what the Data Value will be at a defined time in the future. Here is the procedure for generating the Interpolation Data Value.

1. Make the PLC the System Time Master by opening the Controller Properties and clicking on the Date/Time tab. Click on the box next to the "Make this controller the Coordinated System Time Master" text so that a check mark appears in the box and accept the changes by clicking on OK. The Interpolated position value will be valid only if this step is performed.
2. Create a GSV instruction in your ladder logic, with the Class Name set to CST and the Attribute Name set to CurrentValue, to read the system time from the PLC. The destination address must be made up of two DINT registers.
3. If desired, add a value to word 0 of the time value read above. This value is entered in 1 μ s increments, every 1000 equals 1ms, and equals the amount of time that you want to "look ahead."
4. Place the time value from step 3 into the output registers. The next time that the Interpolation Transmit bit transitions from either 0 to 1 or 1 to 0, the Central System Time will be sent to the 7272 module.
5. The latest Interpolation Data Value will be located in the input data the next time the module is updated at the normal RPI update.

Limit Switch Position: This two word parameters defines ON and OFF setpoints. If the ON setpoint is less than the OFF setpoint, a bit in the Input Registers, which can be easily interrogated by a relay instruction, will be set when the Data Value is between these two setpoints. If the ON setpoint is greater than then OFF setpoint, then the bit will be set when the Data Value is outside of the these two setpoints. A separate Limit Switch bit based on the same ON/OFF setpoints also exists for the Interpolation Data Value.

EnDat Setup Parameters:

These parameters are used to extract the Data Value from the bit stream. These parameters define the clock speed of the data transfer, the number of data bits (resolution) and the format of the data.

EnDat Clock Frequency: This parameter allows you to set the EnDat clock frequency to one of five values; 125kHz, 250kHz, 500kHz, 1.0MHz, or 2.0MHz. The default value of 125kHz value will work in all applications. Your sensor's user manual should contain information on what EnDat Clock Frequency is appropriate for both the sensor and the type and length of cable used.

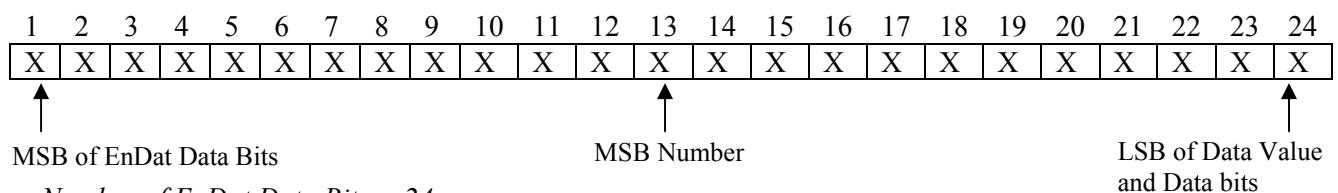
Number of EnDat Data Bits (Encoder Resolution): This value sets the number of position bits that the 7272 will read from the EnDat transducer per interrogation. This parameter has a range of 1 to 48 and must equal the user's EnDat Encoder resolution. The default value is 24 bits.

Note: On power up the 7272 module interrogates the EnDat encoder attached to each channel for its actual resolution. (According to the EnDat 2.1 specifications, this Encoder Manufacturer parameter is located in Word13.) If this value does not match the Number of EnDat Data Bits stored in the 7272 module's memory, the Encoder Resolution Mismatch Fault Bit will be set (see page 19). The module will not output any clock pulses until the correct number of EnDat data bits is programmed into the module.

Most Significant Bit (MSB) Number: This parameter defines the bit location of the first bit of the Data Value in the data bit stream. This parameter has a range of 1 to 48. Any data bits above the MSB value will be masked off when the Data Value is determined.

Example: You have a 24-bit multi-turn EnDat encoder. Bits 1 to 12 are the multiturn position and bits 13 to 24 are the single turn position. You are only interested in the single turn data.

In this example, the 7272 module would be setup using the following data.



Number of EnDat Data Bits = 24
Most Significant Bit number = 13
Resulting Number of Data Bits = 12 (This is the Data Value)

Data Type: This parameter tells the 7272 module to interpret the EnDat data either as a Binary number or as a Gray Code number. The default value is Binary.

Data Logic: This parameter is included to handle situations where the EnDat data is reported with negative logic. If this parameter is set, the 7272 will invert the data bits before performing any scaling and decoding operations. When left in its default value of positive, the 7272 module will use the EnDat data as it is from the sensor.

Data Setup Parameters:

Once the 7272 module has extracted the EnDat data from the data stream, it uses the Data Setup Parameters to convert the raw EnDat data into the Data Value it reports to the PLC.

Preset Value: The zero position of the EnDat encoder's Data Value may not match the zero position of your machine. The Preset Value parameter gives you the ability to offset the Data Value from the actual EnDat data to a value that will be more useful for your application.

Programming the Preset Value parameter does not change the Data Value. It is stored in the 7272 module's memory until the module sees a zero to one transition of the Apply Preset bit.

Apply Preset: Offsetting the Data Value to the Preset Value is a two step operation. First, a Message Instruction must be used to send the Preset Value with the other setup parameters to the 7272 module. Second, setting the Apply Preset in the output registers will change the Data Value to the Preset Value.

Setting the Apply Preset bit causes the module to generate an internal offset value that is applied to the Data Value before it is reported to the PLC. This internal offset is saved in the 7272 module's Flash memory, so it is not necessary to home the module at every power up. Please note that using a Message Instruction to program a channel's setup data will clear the internal offset generated by an Apply Preset operation.



WARNING

The 7272 module's Flash memory is guaranteed for 10,000 write cycles before writing to it will cause it to fault. Therefore continuously applying the Preset should be avoided. If your application requires you to continuously apply the Preset, consider calculating and applying the Preset in your PLC program.

Count Direction: This parameter is useful if your Data Value represents a linear position. It gives you the ability to reverse the direction of motion needed to increase the position count. For simplicity's sake, the two values for this parameter are called *Positive Direction* and *Negative Direction*. When this parameter is set to its default of *Positive*, the Data Value is not changed. When this parameter is set to *Negative*, the Data Value is subtracted from a value equal to the $2^{(\text{Data Bits})}$. You will probably need to Apply the Preset to the Data Value after you program the Count Direction parameter.

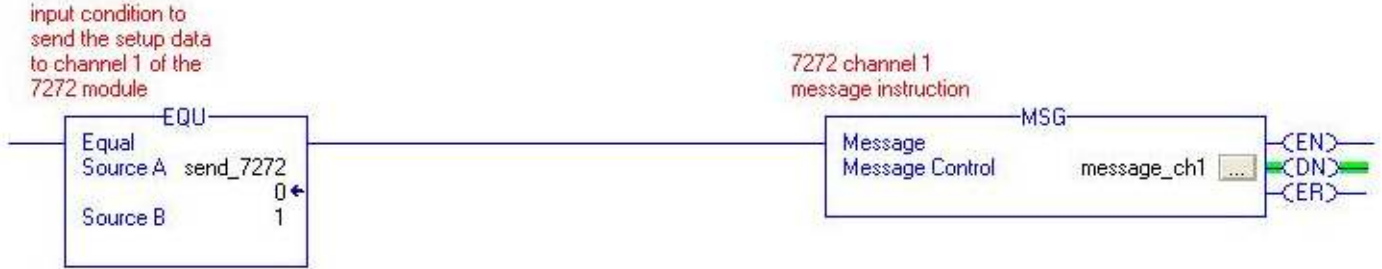
If your Data Value represents a rotary position, you cannot change the count direction with this parameter. However, you can easily reverse the count direction with ladder logic. This can easily be accomplished with two rungs of logic. If the data value is equal to zero, do nothing, and if the data value is not equal to zero, subtract the current data value from the maximum value that your rotary encoder will output.

Velocity Update Time: The Velocity Update Time parameter sets the amount of time between Rate of Change information updates to the PLC. Its can be set to either 60 milliseconds or 120 milliseconds, with 120 milliseconds being the default. Decrease the time between updates for faster response to changes in this value. Increase the time between updates for better averaging of this value. The Velocity update time does not affect the rate at which the position data is updated.

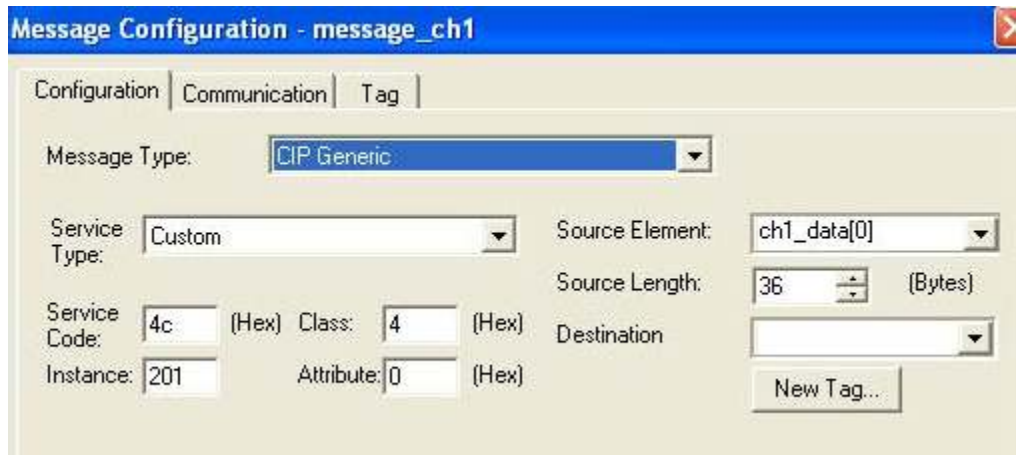
The Velocity data is measured in Counts/Second.

Chapter 4: Message Instructions

The programming of the 7272 module's Setup data requires the use of Message Instructions. The format of this instruction is shown below.



1. A different message instruction is needed for each channel of the 7272 module.
2. The message instruction sends data to or reads data from the 7272 module only when the rung transitions from false to true.
3. The Message Control tag, message_ch1 in this example, used for Message Instruction Control must have the MESSAGE data type.
4. Clicking on the button in the Message Instruction opens the Message Configuration Window, an example of which is shown below. Enter the appropriate data for the channel and operation being performed. When finished, click on the Apply button to accept the new data.



Message Type: CIP Generic

Service Type: Must be Custom

Service Code: 4C to write data to the 7272 module, 4B to read data from the 7272 module

Class: Must be equal to 4.

Instance: Determined by the type of data being transferred, see the table below.

Attribute: Must be set to zero.

Source Element: If the Message Instruction is being used to send data to the 7272 module, then the source parameter will be the first tag of the array that contains the data to be sent to the 7272 module.

If the Message Instruction is being used to read data from the 7272 module, then the source parameter must be left blank.

Source Length: If the Message Instruction is being used to send setup data to the 7272 module, then the Source Length parameter must be equal to 36 bytes.

If the Message Instruction is being used to read data from the 7272 module, then the Source Length Parameter must be set to zero.

Destination: If the Message Instruction is being used to send data to the 7272 module, then the Destination Parameter must be left blank.

If the Message Instruction is being used to read data from the 7272 module, then the Destination Parameter must be set to the first tag of the array where the data will be placed.

The Message Instruction is used with the following information to send Setup Data to the 7272 module.

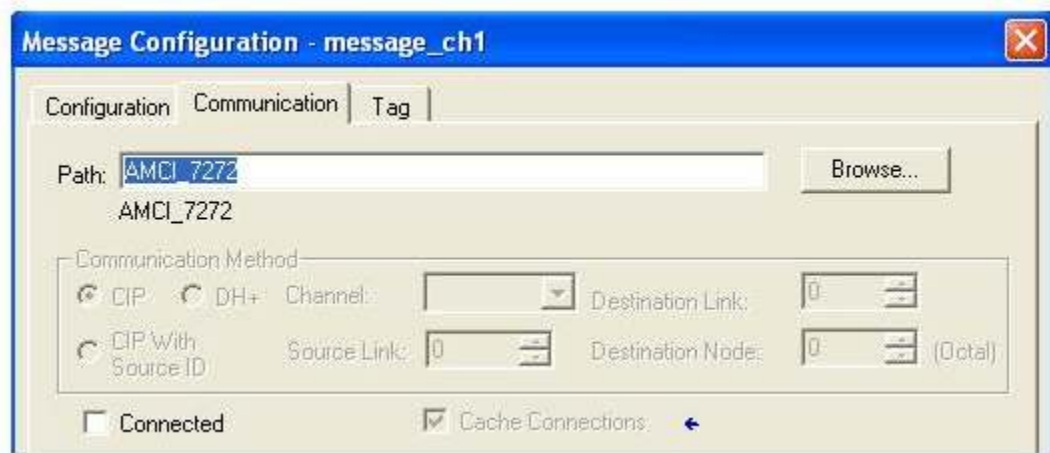
EnDat Channel 1	SERVICE CODE	4C	CLASS	4	Length in [Bytes] 36	Used with assembly instances 101, 102
	INSTANCE	201	ATTRIBUTE	0		
EnDat Channel 2	SERVICE CODE	4C	CLASS	4	Length in [Bytes] 36	Used with assembly instance 102
	INSTANCE	202	ATTRIBUTE	0		

The Message Instruction is used with the following information to read Setup Data from the 7272 module.

EnDat Channel 1	SERVICE CODE	4B	CLASS	4	Length in [Bytes] 0	Used with assembly instances 101, 102
	INSTANCE	201	ATTRIBUTE	0		
EnDat Channel 2	SERVICE CODE	4B	CLASS	4	Length in [Bytes] 0	Used with assembly instance 102
	INSTANCE	202	ATTRIBUTE	0		

Message Configuration – (Communication Tab)

When the Configuration window shown above is completed, click on the Communication tab. The following window will open. Click on the Browse button and set the path parameter to the slot where the 7272 module is located. All of the remaining Communication parameters can remain at their default settings.



Extended Error Codes

The Message Instructions used to send data to the 7272 module have an error register that can be used to obtain diagnostic information from the module. This register's address is *user_tag.exerr*. The following table shows the values that will be displayed in this register if the data sent to the 7272 module is not valid.

Extended Error Codes	
1	Configuration Bits Word Format Error (reserved bits not equal to 0)
2	MSBit Number outside the range of 1 to 48
3	Number of EnDat Data Bits outside the range of 1 to 48
4	Preset Value outside range
5	Limit Switch ON outside range
6	Limit Switch OFF outside range
7	Starting MS Bit Position > Number of Endat Data Bits
10	Channel not used (This will be displayed as 16#0000 000A)
EnDat-Specific Error Codes	
100	Invalid Other
101	Invalid MRS
102	Invalid Parameter Number
104	CRC Error
105	Command Not Supported
106	Encoder Not Responding

- These error codes are only valid when register address *user_tag.err* is equal to 9.
- The Message Instructions Error bit and the Extended Error Code can only be cleared by sending valid data to the 7272 module.

Read EnDat Encoder Parameters

The EnDat module will use Message Instructions with the following information to read parameters data **from** the sensor.

EnDat Channel 1	SERVICE CODE	4B	CLASS	4	Length in [Bytes] 8	Used with assembly instances 101, 102
	INSTANCE	211	ATTRIBUTE	0		
EnDat Channel 2	SERVICE CODE	4B	CLASS	4	Length in [Bytes] 8	Used with assembly instance 102
	INSTANCE	212	ATTRIBUTE	0		

The data send to any channel consists of two 32-bit words (8 bytes) shown in the table below, containing MRS code and parameter number. MRS code is a memory area code, according to the EnDat Specification. The parameter number in the following table, is used to tell the 7272 module which of the sensors parameters to read. Note that the data value in the input registers will be frozen while the parameter is being read from the sensor.

Reading Parameters from the EnDat encoder

Data Type	Word Number	Function
32-bit	0	MRS CODE
32-bit	1	Parameter number

Returned Value

Data Type	Word Number	Function
32-bit	0	Parameter value

List of readable parameters. For details, see the EnDat Specification.

MRS code (hex values)	Parameter number range	Description
0xB9	0-3	Operating Status
0xA1	4-15	Parameters of the encoder manufacturer
0xA3	0-15	
0xA5	0-15	
0xA7	0-15	
0xA9	0-63	OEM Parameters
0xAB	0-127	
0xAD	0-127	
0xB7	0-127	Compensation values of the encoder manufacturer

Write EnDat Encoder Parameters

The EnDat module will use Message Instructions with the following information to modify encoder parameters. The data sent to the channel consists of three 32-bit words (12 bytes) shown in the table below, containing MRS code, parameter number, and parameter value to write. MRS code denotes the memory area, according to the EnDat specification. The parameter number in the following table, is used to tell the 7272 module which of the encoder parameters to read. Note that the data value in the input registers will be frozen while the parameter is being written to the sensor.

EnDat Channel 1	SERVICE CODE	4C	CLASS	4	Length in [Bytes] 12	Used with assembly instances 101, 102
	INSTANCE	211	ATTRIBUTE	0		
EnDat Channel 2	SERVICE CODE	4C	CLASS	4	Length in [Bytes] 12	Used with assembly instance 102
	INSTANCE	212	ATTRIBUTE	0		

Writing Parameters to the EnDat encoder

Data Type	Word Number	Function
32-bit	0	MRS CODE
32-bit	1	Parameter number
32-bit	2	Parameter value

Returned Value

Data Type	Word Number	Function
32-bit	0	Status

List of settable parameters:

MRS code	Parameter number range	Description
0xB9	0-3	Operating Status
0xA7	0-15	Operating Parameters
0xA9	0-63	OEM Parameters
0xA11	0-127	
0xAD	0-127	

Note: Writing may be disabled for the user from the encoder manufacturer. The module will report the ‘raw’ value of the parameter, as it is stored in the encoder’s memory.

Chapter 5: Setup Data

The message instructions described in Chapter 4 above are used to send the setup data to the two channels of the 7272 module (see Chapter 4). This data consists of nine 32 bit words (36 bytes) shown in the following table. Each channel can be programmed with different setup data.

Setup Data for the EnDat Module (Channel 1 or 2)

Data Type	Word Number	Function	Range	Factory Default
32-bit	0	Configuration Bits	See Description Below	0
32-bit	1	MSBit Number	1 to 48	1
32-bit	2	Number of EnDat Data Bits (Resolution)	1 to 48	24
32-bit	3	Preset Value MSWord	0 to 16# 0000_FFFF	0
32-bit	4	Preset Value LSWord	0 to 16# FFFF_FFFF	0
32-bit	5	Limit Switch ON-Position MSWord	0 to 16# 0000_FFFF	0
32-bit	6	Limit Switch ON-Position LSWord	0 to 16# FFFF_FFFF	0
32-bit	7	Limit Switch OFF-Position MSWord	0 to 16# 0000_FFFF	0
32-bit	8	Limit Switch OFF-Position LSWord	0 to 16# FFFF_FFFF	0

All of the data must be present and valid when the message instruction is used to send the data to the 7272 module. If the data is not valid, all of the data will be ignored, the message instruction's error bit will be set, and the extended error code will indicate exactly how the data is invalid. See Chapter 3 for definitions of the set up parameters.

Configuration Bits:

- Bits 0 to 7:** Reserved, must be 0;
- Bit 8:** Program Count Direction (0 = Positive, 1 = Negative)
- Bit 9:** Program Velocity Update (0 = 120ms, 1 = 60ms)
- Bit 10:** Latch position on rising edge of input
- Bit 11:** Latch position on falling edge of input
- Bit 12:** EnDat Data Logic (0=positive, 1=negative)
- Bit 13:** EnDat Data Type (0=Binary, 1=Gray Code)
- Bit 14 to 16:** EnDat Frequency

Bit 16	Bit 15	Bit 14	EnDat Clock Frequency
0	0	0	125kHz
0	0	1	250kHz
0	1	0	500kHz
0	1	1	1MHz
1	0	0	2MHz
1	0	1	reserved
1	1	0	reserved
1	1	1	reserved

- Bits 17.. 31:** Reserved, must be 0;

Note 1: The Velocity Update Time does not affect the update of the Data Value.

Note 2: Programming a channel's setup data will clear the internal offset generated by an Apply Preset Operation.

Note 3: The 7272 module will accept and act on Setup Data sent from a Message Instruction that occurs in a Listen Only Processor.

Chapter 6: Reading Status Data

The message instructions described in Chapter 4 above can be used to read the current setup data from each of channels of the 7272 module. This status data consists of eleven 32-bit words (44 bytes), shown in the following table. The destination address must be made up of a tag array that is at least eleven DINT words long.

It is possible to read only valid data from the 7272 module. The module does not store any Setup Data that caused the Message Instruction's Error bit to be set.

Reading Data from the EnDat Module

Data Type	Word Number	Function
32-bit	0	Configuration Bits (see description below)
32-bit	1	Most Significant Bit Number
32-bit	2	Number of EnDat Data Bits (Resolution)
32-bit	3	Preset Value MSWord
32-bit	4	Preset Value LSWord
32-bit	5	Limit Switch ON-Position MSWord
32-bit	6	Limit Switch ON-Position LSWord
32-bit	7	Limit Switch OFF-Position MSWord
32-bit	8	Limit Switch OFF-Position LSWord
32-bit	9	Internal Offset generated by Apply Preset operation MSW
32-bit	10	Internal Offset generated by Apply Preset operation LSW

Configuration Bits:

Bits 0 to 7: Reserved, must be 0;

Bit 8: Program Count Direction (0 = Positive, 1 = Negative)

Bit 9: Program Velocity Update (0 = 120ms, 1 = 60ms)

Bit 10: Latch position on rising edge of input

Bit 11: Latch position on falling edge of input

Bit 12: EnDat Data Logic (0=positive, 1=negative)

Bit 13: EnDat Data Type (0=binary, 1=Gray Code)

Bit 14 to 16: EnDat Frequency

Bit 16	Bit 15	Bit 14	EnDat Clock Frequency
0	0	0	125kHz
0	0	1	250kHz
0	1	0	500kHz
0	1	1	1MHz
1	0	0	2MHz
1	0	1	Reserved
1	1	0	Reserved
1	1	1	Reserved

Bits 17.. 31: Reserved, will be 0;

Chapter 7: Input & Output Data

Input Registers: (Data sent from the 7272 module to the PLC)

The input data consists of ten (for 1 channel) or twenty (for 2 channels) 32-bit words, and is read by the PLC at the RPI (Requested Packet Interval) Time that is asynchronous to the Ladder Logic Program. The Input data will be referenced as Local:X.I.Data[Y] where “X” is the slot number and “Y” is the word number.

To ensure that the same data is used throughout the entire PLC program, this data should be buffered to internal registers at one place in the program. However, in order to take advantage of the real time availability of the *Interpolation Data value*, the *Interpolation Acknowledge bit*, the *Limit Switch State Bit*, and the *Interpolation Limit Switch State Bit* should be used directly from their respective Input Registers.

The data contained in the input registers consists of Status Word, Data Value, Velocity and any associated Latched or Interpolated Data Values.

Input Data for the 1-Channel Configuration

Channel Number	32 Bit Word	Function	Units/Range
1	0	Status Word1	See descripton below
	1	Data Value 1 MSWord	0 to 0000_FFFF
	2	Data Value 1 LSWord	0 to FFFF_FFFF
	3	Velocity 1	Counts / Second
	4	Latched Data Value 1 MSWord	0 to 0000_FFFF
	5	Latched Data Value 1 LSWord	0 to FFFF_FFFF
	6	Interpolated Data Value 1 MS Word	0 to 0000_FFFF
	7	Interpolated Data Value 1 LS Word	0 to FFFF_FFFF
	8	Actual EnDat Value 1 MSWord	0 to FFFF_FFFF
	9	Actual EnDat Value 1 LSWord	0 to FFFF_FFFF

Input Data for the 2-Channel Configuration

Channel Number	32 Bit Word	Function	Units/Range
1	0	Status Word1	See descripton below
	1	Data Value 1 MSWord	0 to 0000_FFFF
	2	Data Value 1 LSWord	0 to FFFF_FFFF
	3	Velocity 1	Counts / Second
	4	Latched Data Value 1 MSWord	0 to 0000_FFFF
	5	Latched Data Value 1 LSWord	0 to FFFF_FFFF
	6	Interpolated Data Value 1 MS Word	0 to 0000_FFFF
	7	Interpolated Data Value 1 LS Word	0 to FFFF_FFFF
	8	Actual EnDat Value 1 MSWord	0 to FFFF_FFFF
9	Actual EnDat Value 1 LSWord	0 to FFFF_FFFF	
2	10	Status Word2	See descripton below
	11	Data Value 2 MSWord	0 to 0000_FFFF
	12	Data Value 2 LSWord	0 to FFFF_FFFF
	13	Velocity 2	Counts / Second
	14	Latched Data Value 2 MSWord	0 to 0000_FFFF
	15	Latched Data Value 2 LSWord	0 to FFFF_FFFF
	16	Interpolated Data Value 2 MS Word	0 to 0000_FFFF
	17	Interpolated Data Value 2 LS Word	0 to FFFF_FFFF
	18	Actual EnDat Value 2 MSWord	0 to FFFF_FFFF
	19	Actual EnDat Value 2 LSWord	0 to FFFF_FFFF

Description of the Status Word:

- Bit 0:** *APPLY PRESET ACKNOWLEDGE*: This bit will be set when the corresponding Apply Preset Command bit is set in the output registers.
- Bit 1:** *INTERPOLATION ACKNOWLEDGE*: This bit will be set when the corresponding Interpolation Command bit is set in the output registers, after carrying out the INTERPOLATION operation.
- Bit 2:** *VELOCITY AT ZERO*: Set when there has been no motion for the last portion of the Velocity Update Time.
- Bit 3:** *MOTION DIRECTION*: Set when data value is decreasing. The bit remains in the last state when there is no motion.
- Bit 4:** *LATCHING INPUT*: Set when the latching input for respective channel is receiving power. This bit will be set even if the function of the input has been disabled by the channel's programming.
- Bit 5:** *LIMIT SWITCH STATE*: Set when the data value is between the programmed Limit Switch *ON*- and *OFF*-Setpoints.
- Bit 6:** *INTERPOLATION LIMIT SWITCH STATE*: Set when the interpolated data value is between the programmed Limit Switch *ON*- and *OFF*-Setpoints. This bit will only be updated on the 0 to 1 or 1 to 0 transitions of the Interpolation Command Output bit.
- Bit 7:** *ENCODER RESOLUTION MISMATCH FAULT*: Set when the Number of EnDat Data Bits value programmed does not match the actual encoder resolution. The 7272 module will not output clock pulses if this bit is set.
- Bit 8:** *EnDat Reset Command Acknowledge FAULT*: This bit will be set when the corresponding Reset Command bit is set in the output register and the Reset command is executed. This bit will be cleared when Reset command bit in the Output register transitions from 1 to 0 .
- Bit 9:** EnDat 2.1 Error Bit is set by the encoder in the data stream, or Power Not Applied
- Bit 10:** Transducer Fault-Encoder not connected, CRC Error, or Power Not Applied

Bits 11: *Reset Command Fault*. Set when the Reset encoder Command fails due to wiring fault, crc, etc. Cleared when Reset command bit in the Output register transitions from 1 to 0.

Bits 12 to 13: Reserved for future use

Bit 14: *OUTPUT FAULT*: Set when one or more of the unused bits in the corresponding COMMAND WORD are set. This bit will be automatically reset when the incorrect bit(s) are reset.

Bit 15: *BAD CRC Memory Error*: Set when the flash area for the corresponding channel parameters shows corrupt data. It will still be possible to use the 7272, but the module will power up using its default parameters. That is, you will have to use message instructions to program your setup data at every power up. If you do not want to use the module in this way, it must be returned to AMCI for repair.

Bits 16 to 31: Reserved for future use

Input Register Description

Data Value: This register contains the current position data from the sensor.

Velocity: This is the rate of change of the data value in Counts / Second.

Latched Data Value: This register shows what the Data Value was when the Latch Input transitioned, depending on the configuration, from 0 to 1 and or from 1 to 0. The Latched Data Value will be reset to zero at power up. Also, the current Data Value will be placed in this register if the input is configured for the 0 to 1 transition and the input is active at power up.

Interpolated Data Value: This register shows the Data Value based on the Central System Time and the sensor's velocity data. It is not necessary to use this feature if you are only interested in reading the Data Value and Velocity directly from the sensor.

Output Registers: (Data sent from the PLC to the 7272 module)

The output registers are used to execute commands that typically occur during machine operation, while module setup functions are accomplished with the use of Message Instructions. See Chapter 3 and 4 for configuring the 7272 module.

1 Channel configuration

Channel Number	32 Bit Word	Function
1	0	Command Bits
	1	Interpolation CST Value

2 Channels configuration

Channel Number	32 Bit Word	Function
1	0	Command Bits
	1	Interpolation CST Value
2	2	Command Bits
	3	Interpolation CST Value

Command Bits for channels 1 & 2:

Bit 0: *APPLY PRESET COMMAND*: The 0 to 1 transition of this bit changes the respective EnDat channel's Data Value to the Preset Value that was programmed with the channels Setup Message Instruction. The Default Preset Value is zero.

Bit 1: *INTERPOLATION COMMAND*: Both transitions of this bit, (0 to 1) and (1 to 0), causes the respective EnDat channel to read the Current System Time from the output register and calculate the Interpolated Data Value. This Interpolated Data Value will be read by the PLC during the next RPI update of the module.

Bit 2: *APPLY ENCODER RESET COMMAND*: The 0 to 1 transition of this bit causes the module to send the RESET command to the EnDat encoder. This will stop current data transfer from the encoder. Refer to the EnDat Specification for details.

Note: Before the Apply Encoder Reset Command will take affect, it may be necessary to use the Write EnDat Encoder Parameter message instruction to reset the parameter in the error in the encoder itself.

Bits 3 to 31: Reserved for future use.

Apply Preset Programming Cycle

1. The ladder logic program sets the APPLY PRESET COMMAND bit when you want to change the channel's current Data Value to the previously programmed Preset Value.
2. The 7272 module will set the APPLY PRESET ACKNOWLEDGE bit in the input registers to indicate that it has received the command.
3. When the ladder logic program sees that the APPLY PRESET ACKNOWLEDGE bit is set, it will reset the APPLY PRESET COMMAND bit. The programming cycle is now complete.



WARNING

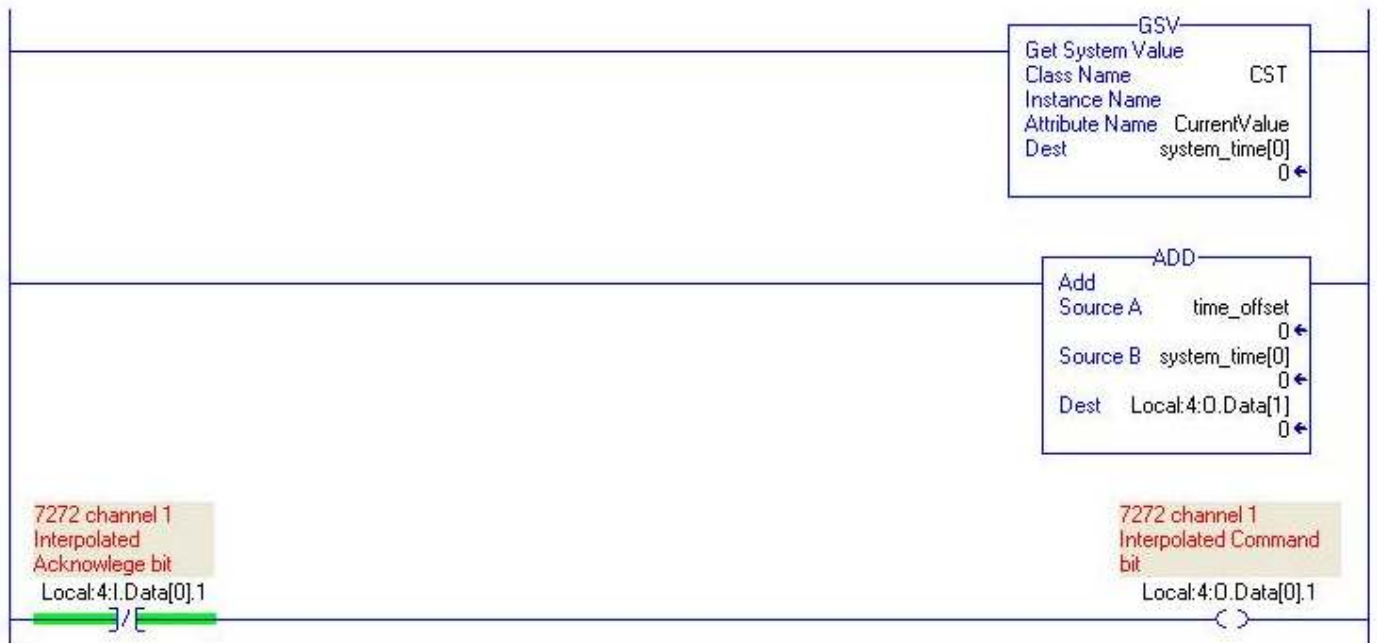
The 7272 module's Flash memory is guaranteed for 10,000 write cycles before writing to it will cause it to fault. Therefore continuously applying the Preset should be avoided. If your application requires you to continuously apply the Preset, consider calculating and applying the Preset in your PLC program.

Interpolation Command Programming Cycle

1. The ladder logic program reads the desired *Central System Time* value from the PLC using a GSV instruction. The Destination tag must consist of at least two DINT registers.
2. If desired, add the amount of time, in microseconds, that you want to "look ahead" to the lower word of Central System Time.
3. Write the desired *Central System Time* value into the *Interpolation CST Value* Output Register.
4. Based on the state of the Interpolation Acknowledge bit, toggle the Interpolation Command bit either on or off.
5. Based on the measured *Velocity* for the corresponding sensor channel, the 7272 module calculates the *Interpolated Data Value* and places it in the respective *Input Register*. The 7272 module then adjusts the *Interpolation Acknowledge Bit* accordingly.

If desired, the user can send the Interpolated Position, along with the system time, to another ControlLogix module each time the Interpolation Acknowledged bit changes state.

The following is an example of the ladder logic that can be used to generate the Interpolation Data Value.



Chapter 8: Manual Revision History

Revision 0.0 was created 05/26/08 and was the initial release of the specifications.

07/21/08 - Velocity Update Time changed from 60/160 ms to 60/120 ms

Revision 1.0

08/08/08 – EnDat-Specific Error Codes added.

Revision 2.0

11/19/08 – Encoder resolution changed to 48-bit

Revision 2.1

1/22/09 – Updated Setup Parameters; Reset Command Bit Added; New fault bits added;

Revision 2.2

4/23/09 – Note added (page 10) on the power up sequence;

Revision 2.3

7/23/09 – added bit 10 - Transducer Fault-Encoder not connected or CRC ERROR; Updated Extended Error Codes – page 14 ; The Name of the parameter Number of Clock bits changed to Number of Data Bits

Revision 2.4

2/26/10 Encoder Parameters section updated. Output Registers section error corrected. Status word bit 8 and 11 updated – added Bit 11- Reset Command Fault.