Integration Guide
00825-0200-1600, Rev AA
March 2022

Micro Motion™ 1600 Transmitters

EtherNet/IP Rockwell RSLogix Integration Guide

MICRO MOTION™

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Safety messages

Safety messages are provided throughout this manual to protect personnel and equipment. Read each safety message carefully before proceeding to the next step.

Safety and approval information

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EU declaration of conformity for directives that apply to this product. The following are available: the EU declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions. In addition the IECEx Installation Instructions for installations outside of the European Union and the CSA Installation Instructions for installations in North America are available on the internet at www.emerson.com or through your local Micro Motion support center.

Information affixed to equipment that complies with the Pressure Equipment Directive, can be found on the internet at www.emerson.com. For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the configuration manual. Product data sheets and manuals are available from the Micro Motion web site at www.emerson.com.

Return policy

Follow Micro Motion procedures when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Micro Motion will not accept your returned equipment if you fail to follow Micro Motion procedures.

Return procedures and forms are available on our web support site at www.emerson.com, or by phoning the Micro Motion Customer Service department.

Emerson Flow customer service

Email:

- Worldwide: flow.support@emerson.com
- Asia-Pacific: APflow.support@emerson.com

Telephone:

North and South America		Europe and Middle East		Asia Pacific	
United States	800-522-6277	U.K. and Ireland	0870 240 1978	Australia	800 158 727
Canada	+1 303-527-5200	The Netherlands	+31 (0) 70 413 6666	New Zealand	099 128 804
Mexico	+52 55 5809 5010	France	+33 (0) 800 917 901	India	800 440 1468
Argentina	+54 11 4809 2700	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	+39 8008 77334	China	+86 21 2892 9000
Chile	+56 2 2928 4800	Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
Peru	+51 15190130	Russia/CIS	+7 495 995 9559	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

Contents

1 Before you begin

1.1 About this document

This document provides information about how to integrate a Micro Motion 1600 EtherNet/IP transmitter with Rockwell RSLogix 5000.

Important
This manual assumes that:

- The transmitter has been installed correctly and completely according to the instructions in the transmitter installation manual
- Users understand basic transmitter and sensor installation, configuration, and maintenance concepts and procedures
- Users have already set up a Programmable Logic Controller (PLC) project with a working Ethernet network

1.2 Related documentation

You can find all product documentation via the product documentation DVD shipped with the product or at www.emerson.com.

- *Micro Motion 1600 Product Data Sheet*
- *Micro Motion 1600 with Ethernet Transmitters: Installation Manual*
- *Micro Motion 1600 with Ethernet Transmitters: Configuration and Use Manual*
- Hazardous area installation — see the approval documentation shipped with the transmitter, or download the appropriate documentation

2 1600 transmitters in Ethernet networks

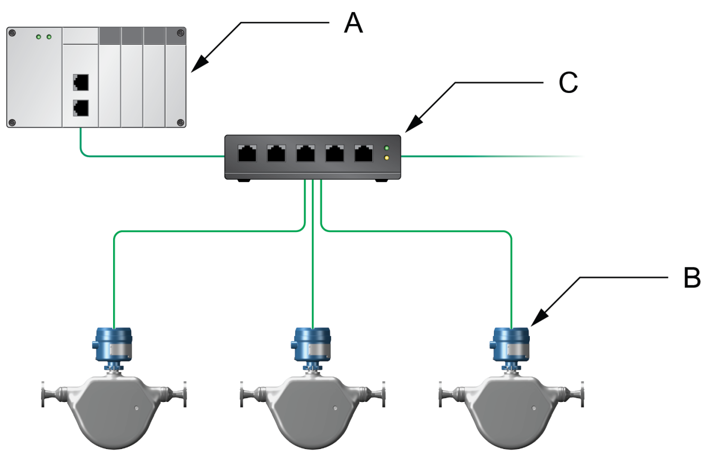
Install the 1600 Ethernet transmitter in a star network using an industrial-rated shielded Ethernet cable.

- Make sure that each cable is no longer than 328 ft (100 m).
- Connect the 1600 Ethernet transmitter to the host system via a LAN (Local Area Network) and not a WAN (Wide Area Network).
- Follow all network security best practices.

2.1 Star topology

1600 Ethernet transmitters are installed in a star network.

Figure 2-1: 1600 star network



A. Programmable Logic Controller (PLC)
B. 1600 with Ethernet output
C. External Ethernet switch

3 Integrate with RSLogix 5000

3.1 Integrate with Rockwell RSLogix 5000 versions 20 and later

If you have Rockwell RSLogix 5000 version 20 or later firmware and programming software, use this section to load the 1600 Electronic Data Sheet (EDS) and commission the device using the RSLogix 5000 programming package.

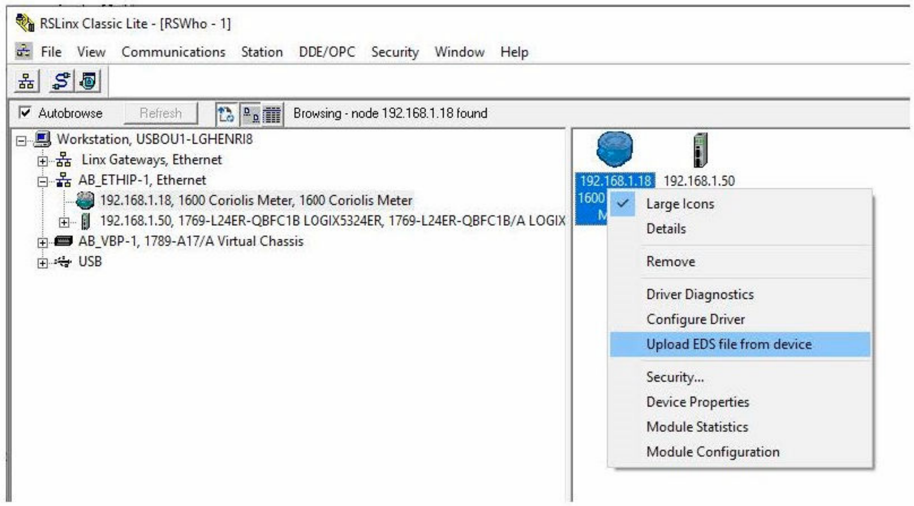
Prerequisites

If you are upgrading the EDS from an older version, unregister the old EDS first using the RSLogix 5000 EDS Hardware Installation Tool at **Tools** → **EDS Hardware Installation Tool**.

Procedure

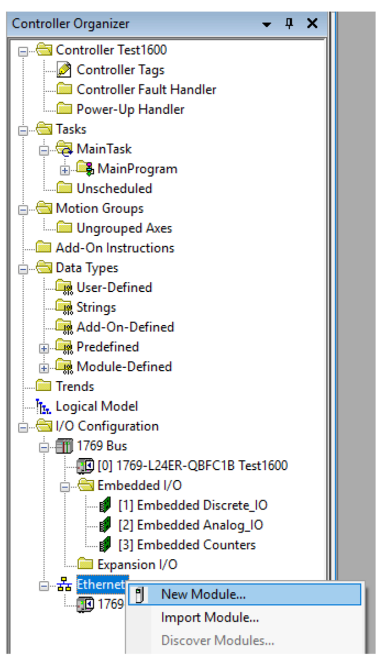
1. Download the EDS file using one of the following methods:

Option	Description
Download the file	a. Download the EDS from the Micro Motion 1600 Ethernet product website. b. Unzip the file to a chosen location. c. In RSLogix 5000, choose **Tools** → **EDS Hardware Installation Tool** and register the 1600 EDS file.
Use RSLinx	a. Using RSLinx, start RSLinx Classic. **Note** The 1600 transmitter must be active on the EtherNet/IP network. b. Choose **Communications** → **RSWho**. c. Expand the appropriate network card in the left panel tree. d. From the device pane, right-click **1600 Transmitter**. e. Choose **Upload EDS File from Device**. f. Follow the prompts from the Rockwell Automation's EDS Wizard to register the EDS.

Option	Description
	

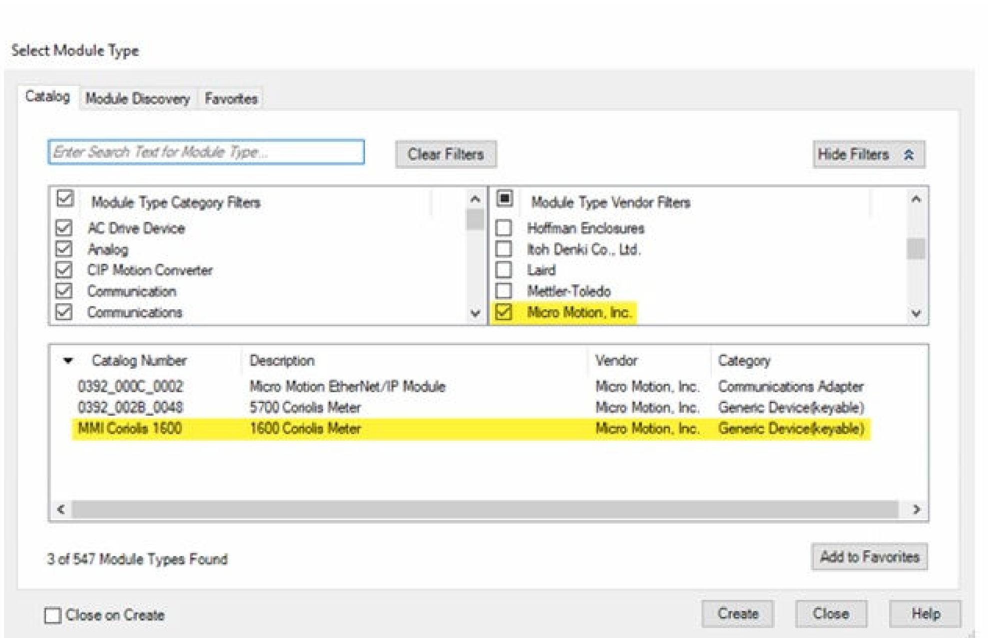
2. To add the 1600 Ethernet device to the RSLogix 5000 Ethernet network, right-click the Ethernet network and select **New Module...**

Example



a) Select the 1600 from the ***Select Module Type*** window and press **Create**.

Example



The *New Module* properties dialog is displayed. The EDS generates an Add On Profile (AOP) for the 1600 that loads all the variables into the controller's input and output image tables as named variables with the correct data types.

b) Enter the **Name** of the module.

c) Enter the **IP Address**.

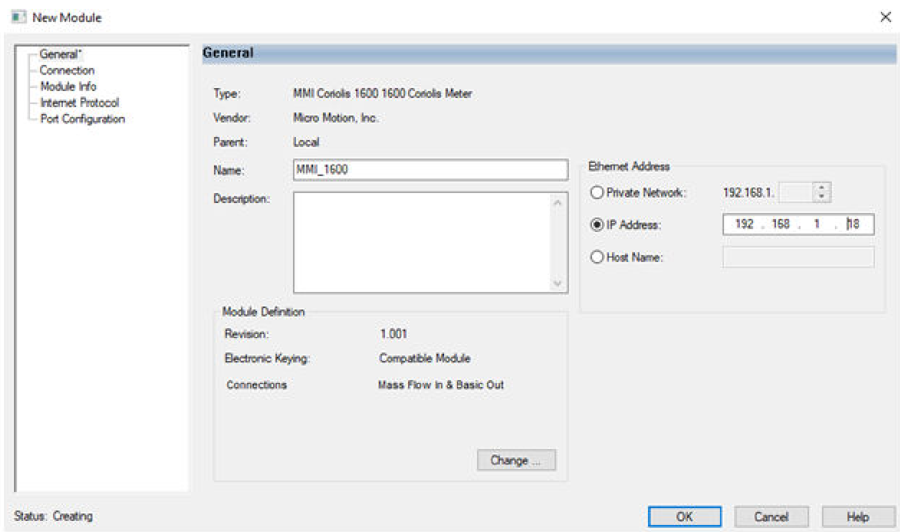
3. Change or keep the current connection type.

Option	Description
To change the connection type	Go to Step 4.
To keep the current connection type	Go to Step 5.

4. From the **General** tab, change the connection type:

   a) Select the **Change...** button.

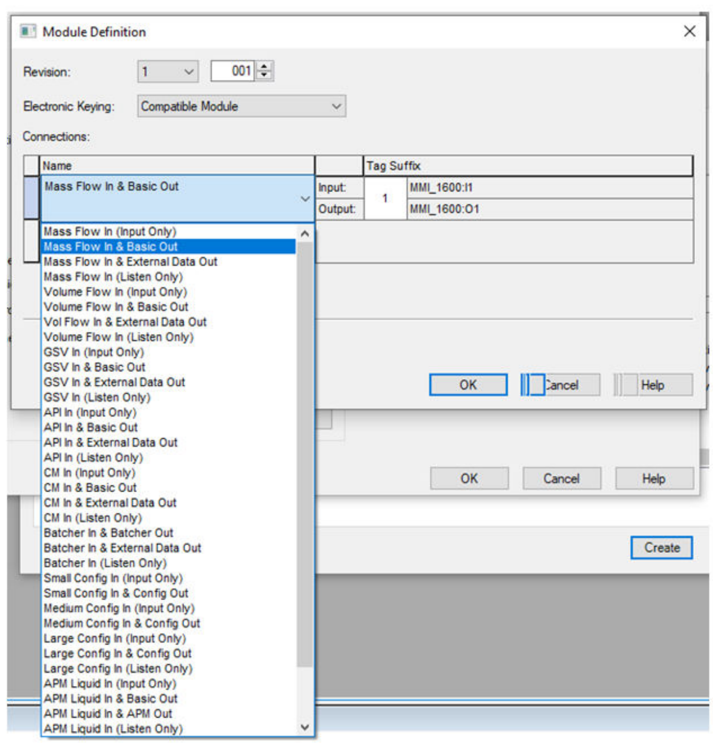
Example



b) Click the current connection.

Default = **Mass Flow In & Basic**

A pull-down menu with all the available connection types is displayed. For descriptions, see Table B-2.



c) Select your appropriate connection, and press **OK**.

Note
If you change the connection after the device goes online, you will need to take the controller offline in order for the change to take effect.

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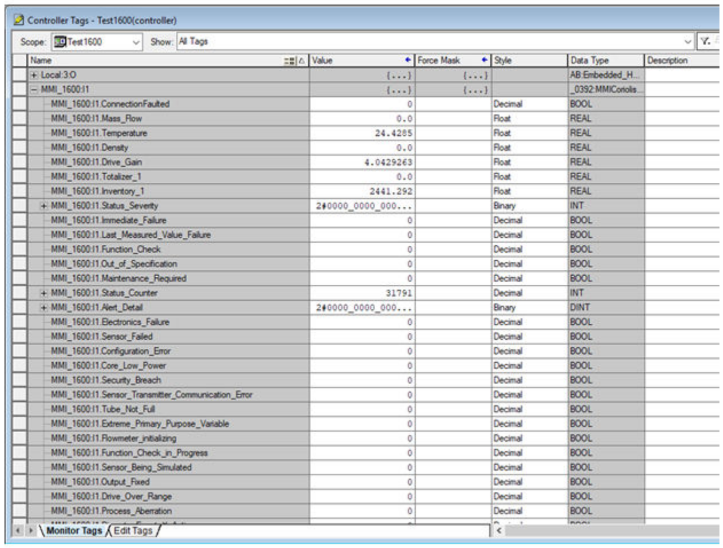
5. On the *New Module* properties dialog, click **OK**.
6. On the *Select Module Type* dialog, click **Close**.
7. Open **Controller Tags** to verify the organization of data.



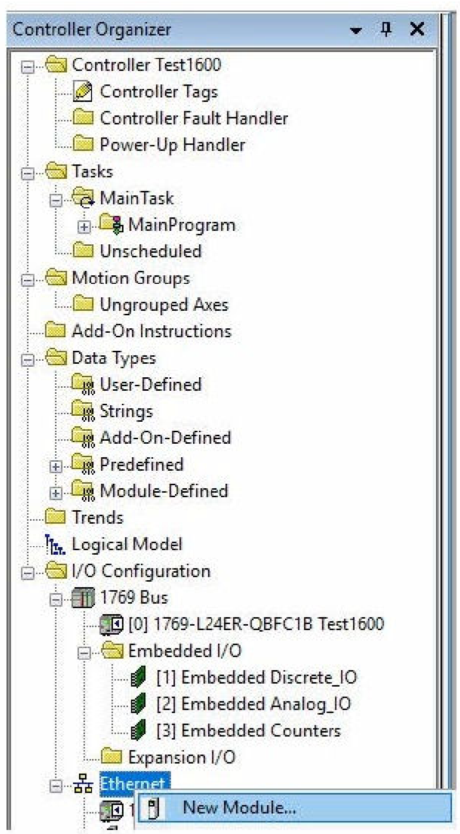
3.2 Integrate with Rockwell RSLogix 5000 versions 19 and earlier

Use this section if you have Rockwell RSLogix 5000 version 19 or earlier firmware and programming software. These early versions do not support the transmitter Electronic Data Sheet (EDS)-generated Add On Profile (AOP). Instead, you must use the generic module hardware tree.

Procedure

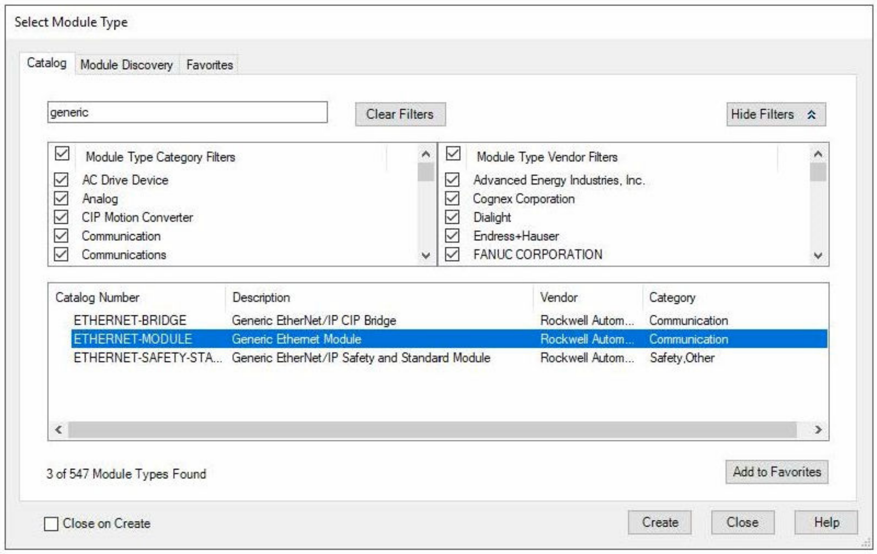
1. Download the EDS file:
   a) Download the EDS from the Micro Motion 1600 Ethernet product website.
   b) Unzip the file to a chosen location.
2. In RSLogix 5000, choose **Tools** → **EDS Hardware Installation Tool** and register the 1600 EDS file.
3. To add the 1600 Ethernet device to the RSLogix 5000 Ethernet Network, right-click the Ethernet network and select **New Module.....**

   Example



4. From the **Catalog** tab, select **ETHERNET-MODULE Generic Ethernet Module**.

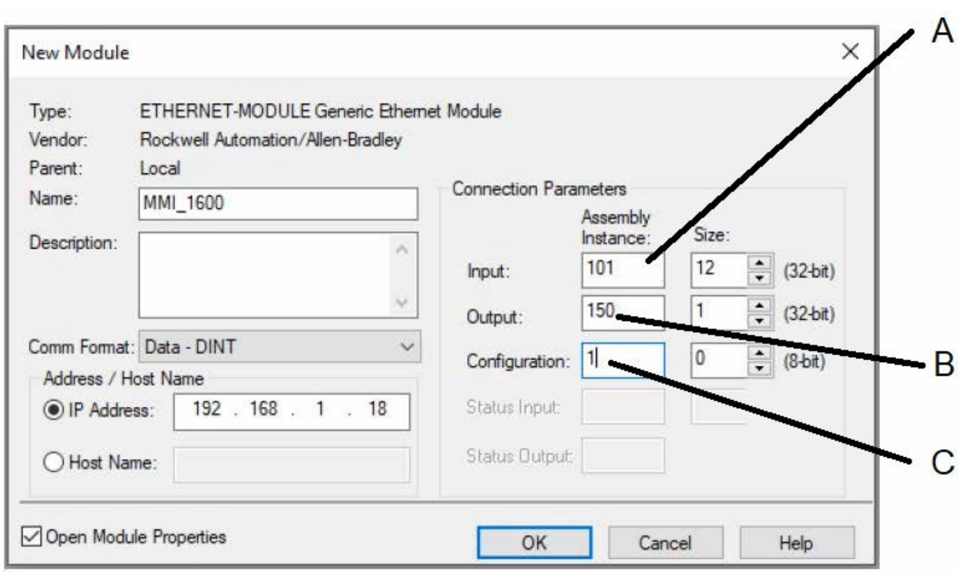
Example



5. Select **OK**.
6. Select **Data-DINT** as the module data type.
7. Select the appropriate assembly instances for your application.

   Enter the assembly numbers in the generic module setup, along with the data sizes that are listed in Table B-1.

Example



a. Input = 101
b. Output = 150
c. Configuration = 1

Note

The 1600 does not use a Configuration instance. Enter `1` in the **Assembly Instance** column, and `0` length for the **Size** column.

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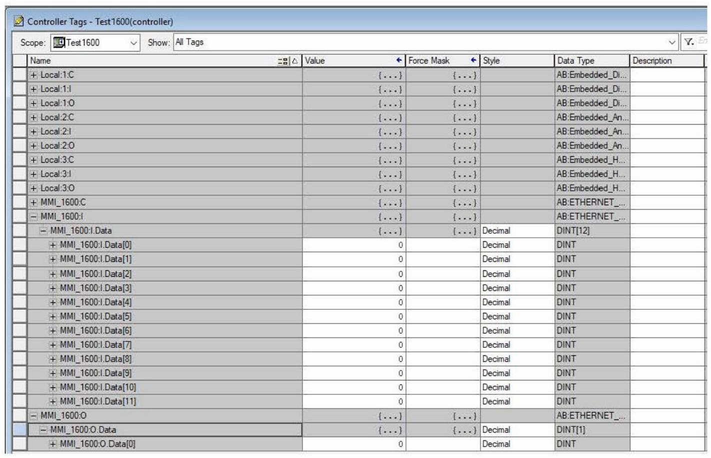
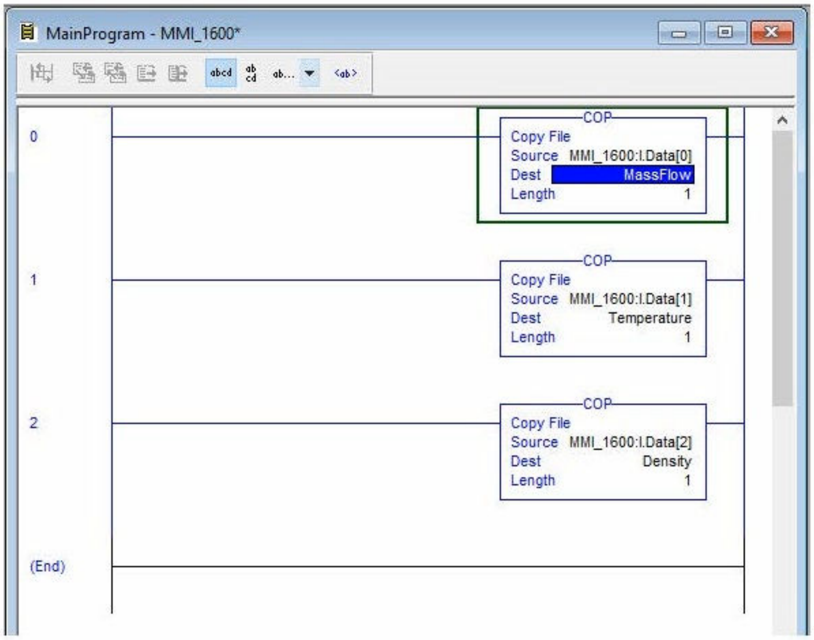
8. Enter the **IP Address** of the transmitter.
9. Press **OK**.
10. Open **Controller Tags** to see the data organization.



11. Use your preferred programming techniques to convert the data from the input and output image tables to the correct data types.
    - The transmitter process variables are generally type *REAL*, use the `COP` command to convert them.
    - The byte ordering is correct, so no byte swapping is needed.

Example


MainProgram - MMI_1600*
0
COP
Copy File
Source MMI_1600:I.Data[0]
Dest MassFlow
Length 1
1
COP
Copy File
Source MMI_1600:I.Data[1]
Dest Temperature
Length 1
2
COP
Copy File
Source MMI_1600:I.Data[2]
Dest Density
Length 1
(End)

4 Use explicit (messaging) using the Modbus Object

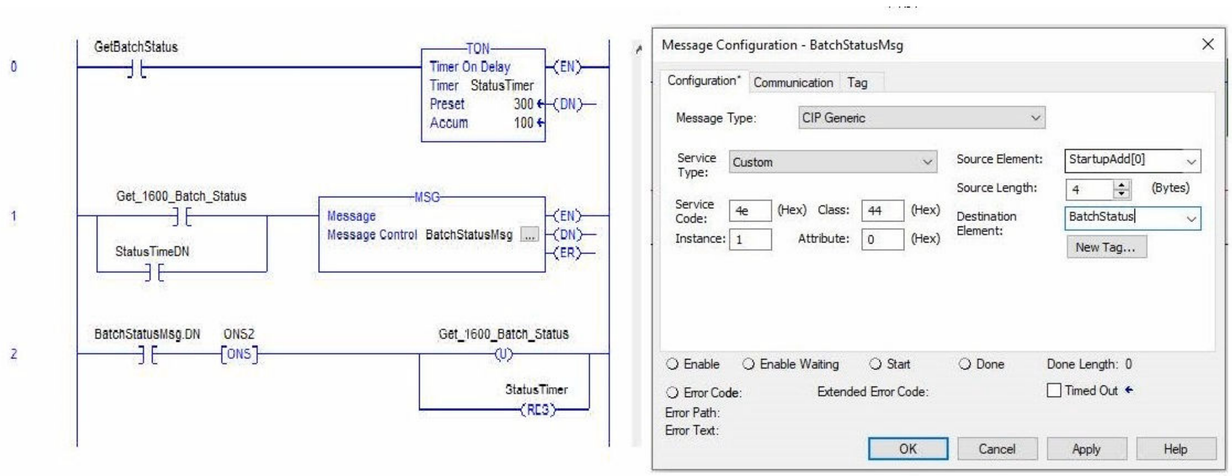
The programming for explicit variables is the same regardless of the controller firmware version. Explicit messaging differs from implicit messaging in that the service code and class refer to a Modbus data type rather than a specific data item. The message source element provides the location of the desired data in the transmitter's database. The only difference is that the Common Industrial Protocol (CIP) message type refers to a type of data in the transmitter's internal database rather than a specific data item. The desired data item is referenced as the Modbus address in the CIP message. The data item does not have to be part of an assembly, so in the example in Figure 4-1, a batcher data item is requested to be read.

For more information about CIP message codes, see Modbus object (44_{HEX} – 1 instance).

Procedure

1. Create the Msg and select it.
2. Select the **Source Element** that was previously created as a controller scope tag.

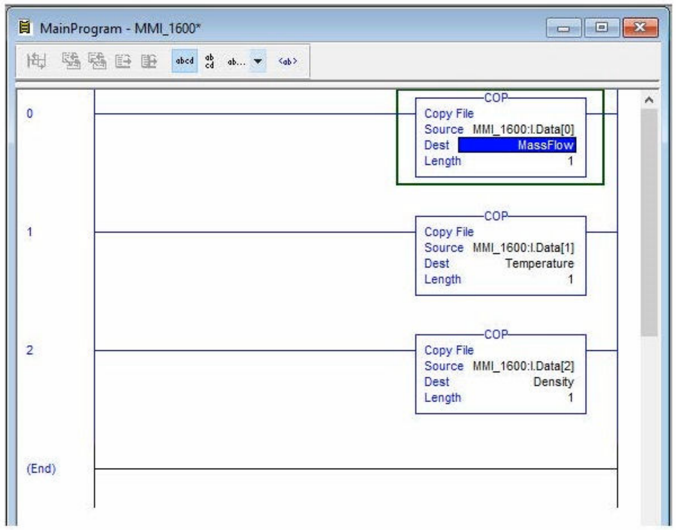
Figure 4-1: Batch status message



Example

The following example shows a message that writes data to the transmitter database.

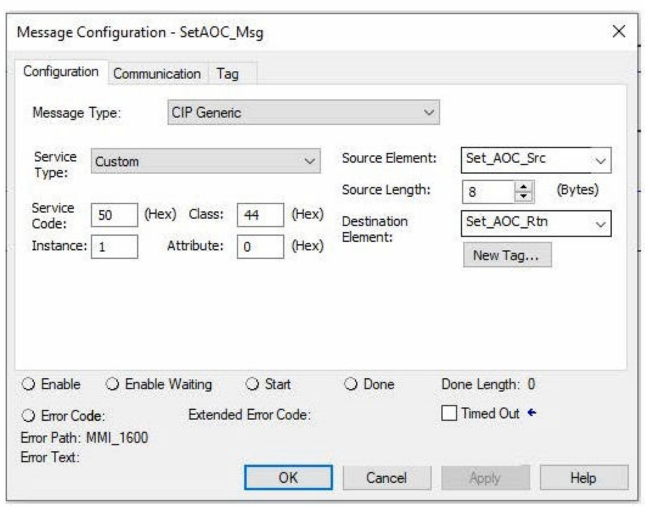
The Automatic Overshoot Compensation (AOC) value is a floating point number that you will need to convert to integer format using a COP command prior to referencing it in the **Source Element** of the message.



Combine the AOC value with the transmitter database (Modbus) address and length to form the message's source element. This can be an array as shown in the following graphic or a user-defined data type (UDT). The first element is the Modbus address (zero based), the second is the length, and finally the data in integer (INT) format.

Set_1600_AOC	0		Decimal	BOOL	
− Set_AOC_Rtn	{...}	{...}	Decimal	INT[2]	
+ Set_AOC_Rtn[0]	0		Decimal	INT	
+ Set_AOC_Rtn[1]	0		Decimal	INT	
− Set_AOC_Src	{...}	{...}	Decimal	INT[4]	
+ Set_AOC_Src[0]	0		Decimal	INT	
+ Set_AOC_Src[1]	0		Decimal	INT	
+ Set_AOC_Src[2]	0		Decimal	INT	
+ Set_AOC_Src[3]	0		Decimal	INT	

The address and data length will be returned if the write is successful. For example, Set_AOC_Rtn.



5 Use explicit (messaging) using the Analog Input Object

As described in the previous chapter, explicit messaging using the Modbus object gives the programmer access to all the data available in the transmitter database. A simpler method than using the Modbus object to access process variable values, engineering units, and status, is to use the standard Common Industrial Protocol (CIP) Analog Input object.

Related information

Analog Input Point object (0AHEX-51 instances)

5.1 Read mass flow value example

The following example shows a message that reads the mass flow value using the mass flow instance of the Analog Input class.

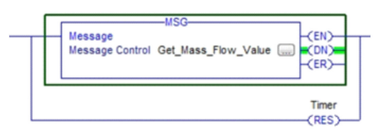
Procedure

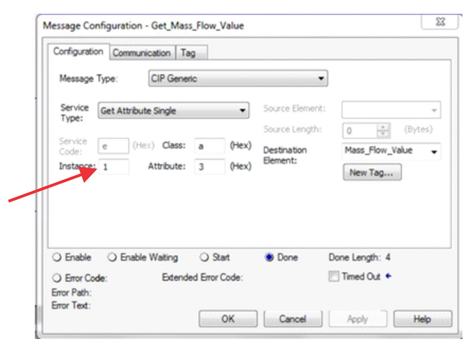
1. Create the Msg and select it.
2. Enter `A` in the **Class** field.

   The `A` comes from the Analog Input object class 0xA.

3. Use Analog Input Point object (0A$_{HEX}$-51 instances) as a reference for the following steps:
   a) Enter the appropriate instance in the **Instance** field as a hexadecimal number.

      In this example, Mass Flow is Instance 1.





   b) Enter the appropriate attribute in the **Attribute** field as a hexadecimal number.

      In this example, the value parameter is Attribute 3.

5.2 Write mass flow example

The following example shows a message that writes the mass flow units using the mass flow instance of the Analog Input class.

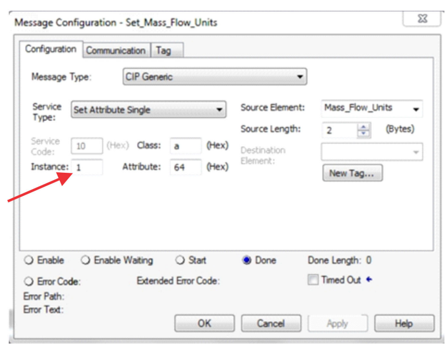
Procedure

1. Create the Msg and select it.
2. Enter `A` in the **Class** field.

   The `A` comes from the Analog Input object class 0xA.

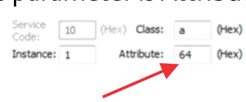
3. Use Analog Input Point object ($0A_{HEX}$-51 instances) as a reference for the following steps:
   a) Enter the appropriate instance in the **Instance** field as a hexadecimal number.

      In this example, Mass Flow is Instance 1.



   b) Enter the appropriate attribute in the **Attribute** field as a hexadecimal number.

      In this example, the engineering units parameter is Attribute 100 (64 Hex).



A Assembly object (04_{HEX} – 16 instances)

A.1 Definitions

Abbreviation	Definiition
USINT	Unsigned short integer (8-bit)
UINT	Unsigned integer (16-bit)
UDINT	Unsigned double integer (32-bit)
SINT	Signed integer (8-bit)
INT	Signed integer (16-bit)
DINT	Signed integer (32-bit)
SHORT STRING*NN*	Character string (1^{st} byte is length; up to *NN* characters
BYTE	Bit string (8-bit)
WORD	Bit string (16-bit)
DWORD	Bit string (32-bit)
REAL	IEEE 32-bit single precisionn floating point

A.2 Class attributes

Class attributes (instance 0)

Attribute ID	Name	Data type	Data value	Access rule
1	Revision	UINT	2	Get
2	Max instance	UINT	255	Get

A.3 Input assemblies

Table A-1: Common input data

Assembly Dword index	Name	Data type
0	Mass Flow	REAL
1	Temperature	REAL
2	Density	REAL
3	Drive Gain	REAL
4	Totalizer 1 (default = Mass Total)	REAL
5	Inventory 1 (default = Mass Inventory)	REAL
6	Status	DWORD

Table A-1: Common input data *(continued)*

Assembly Dword index	Name		Data type
	Severity (bits 0-15)	• Bit #0 = Immediate Failure • Bit #1 = Last Measure Value Failure • Bit #2 = Function Check • Bit #3 = Out of Specification • Bit #4 = Maintenance Required	
	Counter/Heartbeat (bits 16-32)	The PLC will display the counter/ heartbeat as a signed INT, therefore the counter can be negative.	
7	Alert detail	• Bit #0 = Electronics Failure • Bit #1 = Sensor Failed • Bit #2 = Configuration Error • Bit #3 = Core Low Power • Bit #4 = Security Breach • Bit #5 = Sensor-Transmitter Communication Error	DWORD
		• Bit #6 = Tube Not Full • Bit #7 = Extreme Primary Purpose Variable • Bit #8 = Reserved • Bit #9 = Flowmeter Initializing • Bit #10 = Function Check in Progress • Bit #11 = Sensor Being Simulated • Bit #12 = Output Fixed • Bit #13 = Drive Over Range • Bit #14 = Process Aberration • Bit #15 = Discrete Event X Active • Bit #16 = Output Saturated • Bit #17 = Function Check Failed • Bit #18 = Data Loss Possible	
8	Echo Output Data Discrete Actions		DWORD

Table A-2: Liquid volume flow

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9	Volume Flow	REAL
10	Totalizer 2 (default = Volume Total)	REAL
11	Inventory 2 (default = Volume Inventory)	REAL

Table A-3: Gas volume flow

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9	Gas Volume Flow	REAL
10	Totalizer 4 (default = Gas Volume Total)	REAL
11	Inventory 4 (default = Gas Volume Inventory)	REAL

Table A-4: API referral

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9	Volume Flow	REAL
10	Totalizer 2 (default = Volume Total)	REAL
11	Inventory 2 (default = Volume Inventory)	REAL
12	Corrected Density	REAL
13	Corrected Vol Flow	REAL
14	Totalizer 3 (default = Corrected Vol Total)	REAL
15	Inventory 3 (default = Corrected Vol Inv)	REAL
16	Avg Density	REAL
17	Avg Temperature	REAL
18	CTL	REAL

Table A-5: Concentration measurement

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1

Table A-5: Concentration measurement *(continued)*

Assembly Dword index	Name	Data type
9	Volume Flow	REAL
10	Totalizer 2 (default = Volume Total)	REAL
11	Inventory 2 (default = Volume Inventory)	REAL
12	Density at Reference	REAL
13	Std Vol Flow Rate	REAL
14	Totalizer 5 (default = Std Vol Total)	REAL
15	Inventory 5 (default = Std Vol Inv)	REAL
16	Net Mass Flow Rate	REAL
17	Totalizer 6 (default = Net Mass Total)	REAL
18	Inventory 6 (default = Net Mass Inv)	REAL
19	Net Vol Flow Rate	REAL
20	Totalizer 7 (default = Net Vol Flow Total)	REAL
21	Inventory 7 (default = Net Vol Flow Inv)	REAL
22	Concentration	REAL
23	Density - Fixed SG Units	REAL
24	Density - Special Density Units	REAL

Table A-6: Batcher

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-2
9–11	Liquid Volume	
12	Batch Total	REAL
13	Overshoot Compensation Value (Reg 1457)	REAL
14	Batch Fill Time	REAL

Table A-6: Batcher *(continued)*

Assembly Dword index	Name	Data type
15	Fill status and diagnostics • Bit #0 - Primary Fill in progress (reg 2495 bit 0) • Bit #1 - Primary AOC training (reg 2495 bit 9) • Bit #2 = Primary Valve (reg 2495 bit 5 • Bit #3 = Undefined • Bit #4 = Undefined • Bit #5 = Undefined • Bit #6 - Fill Start Not Okay (reg 2496 bit 0) • Bit #7 - AOC Flow Rate Too High (reg 2496 bit 1) • Bit #8 - Maximum Fill Time Exceeded (reg 2496 bit 2) • Bit #9 - Slug Flow (reg 2496 bit 3) • Bit #10 - Tube Not Full (reg 2496 bit 4) • Bit #11 - Drive Overrange (reg 2496 bit 5) • Bit #12 - Critical Sensor Failure (reg 2496 bit 6) • Bit #13 - Critical Transmitter Failure (reg 2496 bit 7) • Bit #14 - Density Out of Limits (reg 2496 bit 8) • Bit #15 - Temperature Out of Limits (reg 2496 bit 9) • Bit #16 - Bit #31 for future expansion	DWORD

Table A-7: Small input configurable data set

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9–16	8 configurable slots	REAL *8

Table A-8: Medium input configurable data set

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9–24	16 configurable slots	REAL *16

Table A-9: Large input configurable data set

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9–40	32 configurable slots	REAL *32

Table A-10: Advanced Phase Measurement (APM) – liquid

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9	Volume Flow	REAL
10	Totalizer 2 (default = Volume Total)	REAL
11	Inventory 2 = (default = Volume Inventory)	REAL
12	Gas Void Fraction	REAL
13	Contract Total 1	REAL
14	Contract Total 2	REAL
15	Contract Total 3	REAL
16	Contract Total 4	REAL
17	Net Oil Flow @ Line	REAL
18	Net Water Flow @ Line	REAL
19	Watercut @ Line	REAL
20	Net Oil Total @ Line	REAL
21	Net Water Total @ Line	REAL
22	Density Oil @ Line	REAL
23	Net Oil Flow @ Ref	REAL
24	Net Water Flow @ Ref	REAL
25	Watercut @ Ref	REAL
26	Net Oil Total @ Ref	REAL
27	Net Water Total @ Ref	REAL

Table A-11: Advanced Phase Measurement (APM) – gas volume

Assembly Dword index	Name	Data type
0–8	Common Input Data	See Table A-1
9	Gas Volume Flow	REAL

Table A-11: Advanced Phase Measurement (APM) – gas volume *(continued)*

Assembly Dword index	Name	Data type
10	Totalizer 4 (default = Gas Volume Total)	REAL
11	Inventory 4 = (default = Gas Volume Inventory)	REAL
12	Contract Total 1	REAL
13	Contract Total 2	REAL
14	Contract Total 3	REAL
15	Contract Total 4	REAL
16	Total time mist detected	DWORD
17	APM Status • BIT #0 – TMR Algorithm Active (reg 433 bit 12)(1) • Bit #1 – BIT #15 currently not defined • BIT #16 – Bit #31 for future expansion	DWORD
18	Liquid Mass Flow Estimate	REAL
19	Watercut @ Ref	REAL

(1) Do not include the parenthesis in the label.

Table A-12: Wet Gas Measurement

Assembly Dword index	Name	Data type
0-8	Common Input Data	See Table A-1
9	Gas Volume Flow	REAL
10	RPO	REAL
11	Live Zero	REAL
12	Tube Frequency	REAL
13	Core Temperature	REAL
14	Inventory 2 (default = Volume Inventory)	REAL
15	Contract Total 1	REAL
16	Contract Total 2	REAL
17	Contract Total 3	REAL
18	Contract Total 4	REAL

Table A-12: Wet Gas Measurement *(continued)*

Assembly Dword index	Name	Data type
19	Total time mist detected	DWORD
20	APM Status • Bit #0 – TMR Algorithm Active (reg 433 bit 12) • Bit #1 – BIT #15 undefined • Bit #16 – Bit #31 for future expansion	DWORD
21	Liquid Mass Flow Estimate	REAL
22	Watercut @ Ref	REAL
23	Gas Mass Flow (Reg 2008)	REAL
24	Liquid Volume Flow (Reg 2261)	REAL
25	Gas to Liquid Ratio (Reg 2255)	REAL
26	Gas to Oil Ratio (Reg 2263)	REAL
27	Net Oil Flow @ Ref	REAL
28	Net Water Flow @ Ref	REAL
29	Net Oil Total @ Ref	REAL
30	Net Water Total @ Ref	REAL

Table A-13: Device Status

Assembly Dword index	Name	Data type
0	Status & Diagnosis • Bit #0 – Smart Meter Verification Running • Bit #1 – Smart Meter Verification Passed • Bit #2 – Smart Meter Verification Failed • Bit #3 – Smart Meter Verification Aborted • Bit #4 – Bit #31 for future expansion	DWORD
1	LPO	REAL
2	RPO	REAL
3	Live Zero	REAL
4	Tube Frequency	REAL
5	Core Temperature	REAL
6	Case Temperature	REAL
7	Core In Volts	REAL

Table A-13: Device Status *(continued)*

Assembly Dword index	Name	Data type
8	Flow Verification Zero	REAL
9	Result 1 (LPO Normalized Stiffness Reg 5782	REAL
10	Result 1 (RPO Normalized Stiffness Reg 5784	REAL
11	Result 3 – Future Use	REAL
12	Result 4 – Future Use	REAL
13	Result 5 – Future Use	REAL
14	Result 6 – Future Use	REAL
15	Data 1 – (Confidence Interval LPO Reg 6360)	REAL
16	Data 2 – (Confidence Interval RPO Reg 6362)	REAL
17	Data 3 – (LPO Std. Dev. Reg 6356)	REAL
18	Data 4 – (RPO Std. Dev. Reg 6358)	REAL
19	Data 5 – (LPO Meter Factor Reg 6371)	REAL
20	Data 6 – (RPO Meter Factor Reg 6373)	REAL
21	Data 7 – Future Use	REAL
22	Data 8 – Future Use	REAL
23	Data 9 – Future Use	REAL
24	Smart Meter Verification Run Number (Reg 5826)	UINT
25	Smart Meter Verification Progress (Reg 3020)	UINT
26	Code 1 (Abort Code Reg 3002)	UINT
27	Code 2 – Future Use	UINT
28	Code 3 – Future Use	UINT

A.4 Output assemblies

Table A-14: Common output data — Discrete actions only

Note
Common output data is required for every output assembly in order to access 1600 functions. Depending on the application, not all functions may be used.

Assembly Dword index	Name	Data type
0	Discrete Actions: • Bit #0 – Start Sensor Zero (trigger start with a 1, no abort) • Bit #1 – Reset All Process Totals (same as setting bits 2-8)v • Bit #2 – Reset Totalizer 1 (Mass Total by default) • Bit #3 – Reset Totalizer 2 (Volume Total by default) • Bit #4 – Reset Totalizer 3 (PM Ref Vol Total by default) • Bit #5 – Reset Totalizer 4 (GSV Total by default) • Bit #6 – Reset Totalizer 5 (CM Ref Vol Total by default) • Bit #7 – Reset Totalizer 6 (CM Net Mass Total by default) • Bit #8 – Reset Totalizer 7 (CM Net Vol Total by default) • Bit #9 – Start All Totals (trigger start with a 1) • Bit #10 – Stop All Totals (trigger stop with a 1) If both start and stop =1, then totals are stopped • Bit #11 – Start Smart Meter Verification (Continue Measuring Mode only) Trigger start with a 1, no abort • Bit #12 – Reset all Inventory Totals • Bit #13 – Bit #31 for future expansion	DWORD

Table A-15: External process data

Assembly Dword index	Name	Data type
0	Common output data	See Table A-14
1	External Pressure	REAL
2	External Temperature	REAL

Table A-16: Batcher

Assembly Dword index	Name	Data type
0	Common output data	See Table A-14

Table A-16: Batcher *(continued)*

Assembly Dword index	Name	Data type
1	Batch Target	REAL
2	Batcher Control – Discrete Actions • Bit #0 – Reserved • Bit #1 – Start Fill • Bit #2 – End Fill • Bit #3 – Pause Fill • Bit #4 – Resume Fill • Bit #5 – Reserved • Bit #6 – Start Training • Bit #7 – Save AOC Calibration • Bit #8 –Reset Batch Total • Bit #9 – Print Batch Ticket • Bit #10 – Reset Preset 1 Inventory • Bit #11 – Reset Preset 2 Inventory • Bit #12 – Reset Preset 3 Inventory • Bit #13 – Reset Preset 4 Inventory • Bit #14 – Reset Preset 5 Inventory • Bit #15 – Reset Preset 6 Inventory • Bit #16 – Inhibit Totalizer • Bit #17 – Inhibit Flow • Bit #18 – Inhibit Batch • Bit #19 – Bit #31 for future expansion	DWORD
3	Maximum Batch Time (Reg 1305)	REAL
4	Batch Preset	UINT

Table A-17: Batcher and external process data

Assembly Dword index	Name	Data type
0–2	External process data	See Table A-14
3	Batch Target	REAL

Table A-17: Batcher and external process data *(continued)*

Assembly Dword index	Name	Data type
4	Batcher Control – Discrete Actions • Bit #0 – Reserved • Bit #1 – Start Fill • Bit #2 – End Fill • Bit #2 – Pause Fill • Bit #4 – Resume Fill • Bit #5 – Reserved • Bit #6 – Start Training • Bit #7 – Save AOC Calibration • Bit #8 –Reset Batch Total • Bit #9 – Print Batch Ticket • Bit #10 – Reset Preset 1 Inventory • Bit #11 – Reset Preset 2 Inventory • Bit #12 – Reset Preset 3 Inventory • Bit #13 – Reset Preset 4 Inventory • Bit #14 – Reset Preset 5 Inventory • Bit #15 – Reset Preset 6 Inventory • Bit #16 – Inhibit Totalizer • Bit #17 – Inhibit Flow • Bit #18 – Inhibit Batch • Bit #19 – Bit #31 for future expansion	DWORD
5	Maximum Batch Time (Reg 1305)	REAL
6	Batch Preset	UINT

Table A-18: Output configurable data

Assembly Dword index	Name	Data type
0	Common output data	DWORD
1	Configurable Slot 1 (Register)	DWORD
2	Configurable Slot 2 (Register)	DWORD
3	Configurable Slot 3 (Register)	DWORD
4	Configurable Slot 4 (Register)	DWORD
5	Configurable Slot 5 (Register)	DWORD

Table A-18: Output configurable data *(continued)*

Assembly Dword index	Name	Data type
6	Configurable Slot 6 (Register)	DWORD
7	Configurable Slot 7 (Register)	DWORD
8	Configurable Slot 8 (Register)	DWORD
9	Configurable Slot 9 (Coil)	DWORD
10	Configurable Slot 10 (Coil)	DWORD
11	Configurable Slot 11 (Coil)	DWORD
12	Configurable Slot 12 (Coil)	DWORD

Table A-19: Advanced Phase Measurement (APM)

Assembly Dword index	Name	Data type
0	Common output data	See Table A-14
1	External Pressure	REAL
2	External Temperature	REAL
3	External Water Cut	REAL

A.5 Output Only Heartbeat (instance 253)

Use of this instance number in place of an input assembly instance number allows I/O connections to only write data to the transmitter without any input data returned.

If not practical, remove this instance.

A.6 Input Only Heartbeat (instance 254)

Use of this instance number in place of an output assembly instance number allows I/O connections to monitor the input data from the transmitter without providing any output data, called an “input only” connection. Conceptually, input-only connections are used when HMIs or monitoring systems need to track input data, while still allowing a Programmable Logic Controller (PLC) to provide the control side, or write the outputs.

This connection type is required per the *Recommended Functionality for EtherNet/IP Devices* document.

For more information about Input Only connections, see *Volume 1 of the ODVA Specification (Common Industrial Protocol)*.

A.7 Listen Only Heartbeat (instance 255)

Much like Input Only connections, Listen Only connections use this instance number in place of an output assembly instance number to open an I/O connection. The I/O connection monitors the input data from the transmitter. Existing I/O connections have dependencies for allocation and timeouts that are different than Input Only connections.

A.8 Usage notes

All output assemblies contain a common data as outlined in assembly instance 150. To maintain proper ownership of the output data (no toggling of outputs between multiple sources), only a single output assembly may be selected for use in I/O messaging. To achieve this, there is an output lock in place to mark all output assemblies as "owned" even though only a single assembly is actually in use.

All input instances can properly co-exist since no ownership is required. While not practical for most applications, multiple PLCs can theoretically open Input Only connections to any or all of the input assembly instances, up to the maximum number of I/O connections supported.

A.9 Common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

B Assembly connections

Table B-1: Input and output assemblies

Input assembly instance	Size (32-bit)	Output assembly instance	Size (32-bit)
For definitions, see Input assemblies		**For definitions, see Output assemblies**	
100 – Basic Data	9	150 – Basic Data	1
101 – Liquid Volume	12	151 – External Process Data	3
102 – Gas Standard Volume	12	152 – Batcher	5
103 – API Referral	19	153 – Batcher and External Process Data	7
104 – Concentration Management	25	154 – Configurable Data Set	13
105 – Batcher	18	155 – APM External Process Data	4
106 – Small Configurable Data Set	17		
107 – Medium Configurable Data Set	25	253 – Output Only Heartbeat	0
108 – Large Configurable Data Set	41	254 – Input Only Heartbeat	0
109 – APM – Liquid Volume	28	255 – Listen Only Heartbeat	0
110 – APM – Gas Volume	20		
111 – Wet Gas Measurement	30		
112 – APM – Device Status	29		

Table B-2: Connection types

ID	Name	Input assembly instance	Output assembly instance
		For definitions, see Input assemblies	**For definitions, see Output assemblies**
1	Mass Flow In & No Out	100 – Basic Data	254 – Input Only Heartbeat
2	Mass Flow In & Basic Out	100 – Basic Data	150 – Basic Data
3	Mass Flow In & External Data Out	100 – Basic Data	151 – External Process Data
4	Mass Flow In (Listen Only)	100 – Basic Data	255 – Listen Only Heartbeat
5	Volume Flow In & No Out	101 – Liquid Volume	254 – Input Only Heartbeat
6	Volume Flow In & Basic Out	101 – Liquid Volume	150 – Basic Data
7	Vol Flow In & External Data Out	101 – Liquid Volume	151 – External Process Data
8	Volume Flow In (Listen Only)	101 – Liquid Volume	255 – Listen Only Heartbeat
9	GSV In & No Out	102 – Gas Standard Volume	254 – Input Only Heartbeat
10	GSV In & Basic Out	102 – Gas Standard Volume	150 – Basic Data
11	GSV In & External Data Out	102 – Gas Standard Volume	151 – External Process Data
12	GSV In (Listen Only)	102 – Gas Standard Volume	255 – Listen Only Heartbeat

Table B-2: Connection types *(continued)*

ID	Name	Input assembly instance	Output assembly instance
		For definitions, see Input assemblies	For definitions, see Output assemblies
13	API In & No Out	103 – API Referral	254 – Input Only Heartbeat
14	API In & Basic Out	103 – API Referral	150 – Basic Data
15	API In & External Data Out	103 – API Referral	151 – External Process Data
16	API In (Listen Only)	103 – API Referral	255 – Listen Only Heartbeat
17	CM In & No Out	104 – Concentration Measurement	254 – Input Only Heartbeat
18	CM In & Basic Out	104 – Concentration Measurement	150 – Basic Data
19	CM In & External Data Out	104 – Concentration Measurement	151 – External Process Data
20	CM In (Listen Only)	104 – Concentration Measurement	255 – Listen Only Heartbeat
21	Batcher In & Batcher Out	105 – Batcher	152 – Batcher
22	Batcher In & External Data Out	105 – Batcher	153 – Batcher and External Data
23	Batcher In (Listen Only)	105 – Batcher	255 – Listen Only Heartbeat
24	Small Config In & No Out	106 – Small Configurable Data Set	254 – Input Only Heartbeat
25	Small Config In & Config Out	106 – Small Configurable Data Set	154 – Configurable Data Set
26	Medium Config In & No Out	107 – Medium Configurable Data Set	254 – Input Only Heartbeat
27	Medium Config In & Config Out	107 – Medium Configurable Data Set	154 – Configurable Data Set
28	Large Config In & No Out	108 – Large Configurable Data Set	254 – Input Only Heartbeat
29	Large Config In & Config Out	108 – Large Configurable Data Set	154 – Configurable Data Set
30	Large Config In (Listen Only)	108 – Large Configurable Data Set	255 – Listen Only Heartbeat
31	APM Liquid In & No Out	109 - APM Liquid	254 – Input Only Heartbeat
32	APM Liquid In & Basic Out	109 - APM Liquid	150 – Basic Data
33	APM Liquid In & APM Out	109 - APM Liquid	155 – APM External Process Data
34	APM Liquid In (Listen Only)	109 - APM Liquid	255 – Listen Only Heartbeat
35	APM Gas In & No Out	110 - APM Gas	254 – Input Only Heartbeat
36	APM Gas In & Basic Out	110 - APM Gas	150 – Basic Data
37	APM Gas In & APM Out	110 - APM Gas	155 – APM External Process Data
38	APM Gas In (Listen Only)	110 - APM Gas	255 – Listen Only Heartbeat
39	Wet Gas In & No Out	111 - Wet Gas	254 – Input Only Heartbeat
40	Wet Gas In & No Out	111 - Wet Gas	150 – Basic Data
41	Wet Gas In & No Out	111 - Wet Gas	155 – APM External Process Data
42	Wet Gas In (Listen Only)	111 - Wet Gas	255 – Listen Only Heartbeat

C Modbus object (44_{HEX} – 1 instance)

The Modbus object provides a “pass through” to the internal Modbus representation of any data point. All validation related to addressing, length, or write validation is handled by the Modbus DLL.

C.1 Modbus class attributes

Attribute ID	Name	Data type	Data value	Access rule
1	Revision	UINT	3	Get

C.2 Instance attributes

No instance attributes are defined.

C.3 Common services

Service code	Implemented for		Service name
	Class level	Instance level	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
$4B_{HEX}$	No	Yes	Read_Discrete_Inputs
$4C_{HEX}$	No	Yes	Read_Coils
$4D_{HEX}$	No	Yes	Read_Input_Registers
$4E_{HEX}$	No	Yes	Read_Holding_Registers
$4F_{HEX}$	No	Yes	Write_Coils
50_{HEX}	No	Yes	Write_Holding_Registers

$4B_{HEX}$ Read_Discrete_Inputs (Modbus FC 0x02)

Table C-1: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin reading from	Zero-based
Quantity of inputs	UINT	Number of inputs to read	1-2000

Table C-2: Response format

Name	Data type	Description	Semantics
Input status	BYTE[*n*]	Input values read	8 inputs are packed into each byte

$4C_{HEX}$ Read_Coils (Modbus FC 0x01)

Table C-3: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin reading from	Zero-based
Quantity of inputs	UINT	Number of coils to read	1-2000

Table C-4: Response format

Name	Data type	Description	Semantics
Coil status	BYTE[*n*]	Input values read	8 coils are packed into each byte

$4D_{HEX}$ Read_Input_Registers (Modbus FC 0x04)

Table C-5: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin reading from	Zero-based
Quantity of input registers	UINT	Number of input registers to read	1-125

Table C-6: Response format

Name	Data type	Description	Semantics
Input register values	WORD[*n*]	Input register values read	Data swap to convert between little endian (CIP) and big endian (Modbus)

$4E_{HEX}$ Read_Holding_Registers (Modbus FC 0x03)

Table C-7: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin reading from	Zero-based
Quantity of input registers	UINT	Number of input registers to read	1-125

Table C-8: Response format

Name	Data type	Description	Semantics
Holding register values	WORD[*n*]	Holding register values read	Data swap to convert between little endian (CIP) and big endian (Modbus)

$4F_{HEX}$ Write_Coils (Modbus FC 0x0F)

Table C-9: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin writing to	Zero-based
Quantity of outputs	UINT	Number of output coils to write	1-2000
Output values	BYTE[*n*]	Output coils values	

Table C-10: Response format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table where writing began	Zero-based
Quantity of outputs	UINT	Number of output coils written	

50_{HEX} Write_Holding_Registers (Modbus FC 0x10)

Table C-11: Request format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table to begin writing to	Zero-based
Quantity of outputs	UINT	Number of output coils to write	1-125
Output values	WORD[*n*]	Output register values	

Table C-12: Response format

Name	Data type	Description	Semantics
Starting address	UINT	Offset in table where writing began	Zero-based
Quantity of outputs	UINT	Number of output resisters written	

D Analog Input Point object ($0A_{HEX}$-51 instances)

Table D-1: Attributes

Attribute ID	Name	Notes
3	Value	Data type = REAL Read Only
4	Status	0 = Good 1 = Alarm State Read Only
8	Value Data Type	1 = REAL Read Only
100	Engineering Units	Data type = UINT (see Engineering units for codes) Read/Write

Table D-2: Services

Service code	Name
0x0E	Get Attribute Single
0x10	Set Attribute Single

Table D-3: Instances

Instance in decimal	Instance in hex	Name
1	0x01	Mass Flow
2	0x02	Volume Flow
3	0x03	Density
4	0x04	Temperature
5	0x05	Gas Standard Volume Flow
6	0x06	Drive Gain (units = % only)
7	0x07	PM: Corrected Density
8	0x08	PM: Corrected Volume Flow
9	0x09	PM: Average Density
10	0x0A	PM: Average Temperature
11	0x0B	CM: Density at Reference
12	0x0C	CM: Standard Volume Flow Rate
13	0x0D	CM: Net Mass Flow Rate
14	0x0E	CM: Net Volume Flow Rate

Table D-3: Instances *(continued)*

Instance in decimal	Instance in hex	Name
15	0x0F	CM: Concentration
16	0x10	BATCHER: Batch Total
17	0x11	Totalizer 1
18	0x12	Totalizer 2
19	0x13	Totalizer 3
20	0x14	Totalizer 4
21	0x15	Totalizer 5
22	0x16	Totalizer 6
23	0x17	Totalizer 7
24	0x18	Inventory 1
25	0x19	Inventory 2
26	0x1A	Inventory 3
27	0x1B	Inventory 4
28	0x1C	Inventory 5
29	0x1D	Inventory 6
30	0x1E	Inventory 7
31	0x1F	APM: Gas Void Fraction (units = % only)
32	0x20	APM: Contract Total 1
33	0x21	APM: Contract Total 2
34	0x22	APM: Contract Total 3
35	0x23	APM: Contract Total 4
36	0x24	APM: Net Oil Flow @ Line
37	0x25	APM: Net Water Flow @ Line
38	0x26	APM: Water Cut @ Line
39	0x27	APM: Net Oil Total @ Line
40	0x28	APM: Net Water Total @ Line
41	0x29	APM: Density Oil @ Line
42	0x2A	APM: Net Oil Flow @ Reference
43	0x2B	APM: Net Water Flow @ Reference
44	0x2C	APM: Water Cut @ Reference
45	0x2D	APM: Net Oil Total @ Reference
46	0x2E	APM: Net Water Total @ Reference
47	0x2F	External Temperature

Table D-3: Instances *(continued)*

Instance in decimal	Instance in hex	Name
48	0x30	External Pressure
49	0x31	External Water Cut (units = % only)
50	0x32	APM: Unremediated Mass Flow
51	0x33	APM: Unremediated Volume Flow

Engineering units

Table D-4: General

Name	Value in hex
Special Units	0x080F
percent	0x1007

Table D-5: Mass Flow

Name	Value in hex
grams per second	0x1437
grams per minute	0x140F
grams per hour	0x1436
kilograms per second	0x1404
kilograms per minute	0x1445
kilograms per hour	0x1410
kilograms per day	0x1444
metric tons per minute	0x1463
metric tons per hour	0x1462
metric tons per day	0x1461
pounds per second	0x140B
pounds per minute	0x140C
pounds per hour	0x140D
pounds per day	0x145C
short tons per minute	0x1482
short tons per hour	0x1481
short tons per day	0x1480
long tons per hour	0x1475
long tons per day	0x1474

Table D-6: Mass

Name	Value in hex
grams	0x2501
kilograms	0x2500
metric tons	0x2503
pounds	0x2505
short tons	0x2506
long tons	0x2507

Table D-7: Liquid Volume Flow

Name	Value in hex
liters per second	0x1406
liters per minute	0x1413
liters per hour	0x1414
million liters per day	0x0802
cubic feet per second	0x1467
cubic feet per minute	0x1402
cubic feet per hour	0x1466
cubic feet per day	0x1465
cubic meters per second	0x0803
cubic meters per minute	0x1433
cubic meters per hour	0x1432
cubic meters per day	0x1431
gallons per second	0x1408
gallons per minute	0x1409
gallons per hour	0x140A
gallons per day	0x1434
million gallons per day	0x1447
imperial gallons per second	0x1443
imperial gallons per minute	0x1442
imperial gallons per hour	0x1441
imperial gallons per day	0x1440
barrels per second	0x1420
barrels per minute	0x141F
barrels per hour	0x141E
barrels per day	0x141D

Table D-7: Liquid Volume Flow *(continued)*

Name	Value in hex
beer barrels per second	0x141C
beer barrels per minute	0x141B
beer barrels per hour	0x141A
beer barrels per day	0x1419

Table D-8: Liquid Volume

Name	Value in hex
liters	0x2E02
cubic feet	0x2E06
cubic meters	0x2E01
gallons	0x2E08
imperial gallons	0x2E15
barrels	0x2E0C
beer barrels	0x2E0E

Table D-9: Gas Volume Flow

Name	Value in hex
normal liter per second	0x1457
normal liter per minute	0x1456
normal liter per hour	0x1455
normal liter per day	0x1454
standard liter per second	0x080C
standard liter per minute	0x1401
standard liter per hour	0x080B
standard liter per day	0x080A
normal cubic meter per second	0x1453
normal cubic meter per minute	0x1452
normal cubic meter per hour	0x1451
normal cubic meter per day	0x1450
standard cubic meter per second	0x1460
standard cubic meter per minute	0x145F
standard cubic meter per hour	0x145E
standard cubic meter per day	0x145D
standard cubic feet per second	0x146C

Table D-9: Gas Volume Flow *(continued)*

Name	Value in hex
standard cubic feet per minute	0x146D
standard cubic feet per hour	0x146E
standard cubic feet per day	0x146F

Table D-10: Gas Volume

Name	Value in hex
normal liter	0x2E19
standard liter	0x0813
normal cubic meter	0x2E22
standard cubic meter	0x2E1A
standard cubic feet	0x2E1E

Table D-11: Density

Name	Value in hex
specific gravity units	0x0804
grams per cubic centimeter	0x2F08
grams per liter	0x2F0F
grams per milliliter	0x2f0E
kilograms per cubic meter	0x2F07
kilograms per liter	0x2F10
pounds per gallon	0x2F0B
pounds per cubic foot	0x2F0C
pounds per cubic inch	0x2F0D
short tons per cubic yard	0x0807
degrees API	0x3000

Table D-12: Temperature

Name	Value in hex
Degrees Celsius	0x1200
Degrees Fahrenheit	0x1201
Kelvin	0x1202
Degrees Rankine	0x1203

Table D-13: Pressure

Name	Value in hex
inches of Water at 60degF	0x0809
inches of Water at 68 degF	0x0800
inches of Water at 4degC	0x080D
feet of water at 68 degF	0x1311
millimeters of Water at 68 degF	0x130F
inches of Mercury at 0 degC	0x1304
millimeters of Mercury at 0 degC	0x1303
millimeters of Water at 4 degC	0x080E
psi	0x1300
bar	0x1307
millibar	0x1308
pascal	0x1309
kilopascal	0x130A
megapascals	0x1312
atmosphere	0x130B
torr	0x1301
gram per square centimeter	0x130C
kilogram per square centimeter	0x1314

Table D-14: Concentration

Name	Value in hex
Degrees Twaddell	0x0810
Degrees Balling	0x320A
Degrees Brix	0x320D
Degrees Baume (heavy)	0x320B
Degrees Baume (light)	0x320C
% solids per weight (% mass)	0x2F2F
% solids per volume (% volume)	0x2F2C
Proof per volume	0x0811
Proof per mass	0x0812
Percent Plato	0x320E

Related information

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