Micro Motion®
Model 2400S Transmitters
for DeviceNet™

Device Profile

Micro Motion®

EMERSON™
Process Management

Contents

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Chapter 1
Introduction

1.1 About this manual

This manual describes the device profile for the Micro Motion® Model 2400S transmitter for DeviceNet™.

1.2 About device profiles

A device profile must contain:

- An object model for the device type
- The I/O data format for the device type
- Configuration data and the public interface(s) to that data

1.2.1 Object models

This section of the device profile defines the grouping of objects used in a device. Each device has a single object model.

An object model specification:

- Identifies all object classes present in the device (required and optional).
- Indicates the number of instances present in each object class. If the device supports the dynamic creation and deletion of instances, then the object model states the maximum number of instances that can exist within the object class.
- States whether or not the object affects behavior of the device. If it does affect behavior, the object model states how.
- Defines the interface to each object. This defines how objects and object classes are linked.

The object model for the Model 2400S DN transmitter is described in detail in Chapter 2.

1.2.2 I/O data format

This section of the device profile defines how a device communicates on the DeviceNet network. This includes an exact specification of the device's I/O data format.

Communicating multiple pieces of data (attributes) across a single I/O connection requires that the attributes be grouped or assembled together into a single block. Instances of the Assembly Object Class perform this grouping. Thus, the definition of a device's I/O data format is equivalent to the definition of the assembly object instances used to group the device's I/O data.

Assemblies are grouped into two categories: Input and Output. From a device perspective:

- An Input Assembly is the data PRODUCED from the device ONTO the network (or can also be viewed as data INPUT to the Master FROM the device).
- An Output Assembly is the data CONSUMED from the network INTO the device (or can also be viewed as the data OUTPUT from the Master TO the device).

The definition of a device's I/O data format:

- Identifies the I/O assembly by instance number, type, and name. For a summary of input assemblies, see Table 3-1. For a summary of output assemblies, see Table 3-2.
- Specifies the I/O assembly data attribute format. Refer to the assembly detail tables in Sections 3.4 and 3.5.
- Maps the I/O assembly data attribute components to other attributes. Refer to the assembly detail tables in Sections 3.4 and 3.5. In these tables, EPATHs are denoted as follows:

  [*Class_ID-Instance_ID-Attribute_ID*]

  For example, the EPATH [0x0A-1-3] specifies the location of the mass flow process variable.

The I/O data format for the Model 2400S DN transmitter is described in detail in Chapter 3.

1.2.3 Configuration data

A device profile includes specification of the device's configurable parameters and the public interface to those parameters.

Definition of a device's configuration includes the following information for each configurable feature:

- Configuration parameter data, also known as attributes
- Description of the services available for use with the attribute
- Public interface to the device's configuration (e.g., bulk configuration via a configuration assembly, full/stub instances of the Parameter Object Class, etc.)
- The configuration data for the Model 2400S DN transmitter is described in detail in Chapter 4.

1.3 Customer service

For customer service, phone the support center nearest you:

- In the U.S.A., phone **800-522-MASS** (800-522-6277) (toll-free)
- In Canada and Latin America, phone +1 303-527-5200
- In Asia:
  - In Japan, phone 3 5769-6803
  - In other locations, phone +65 6777-8211 (Singapore)
- In Europe:
  - In the U.K., phone 0870 240 1978 (toll-free)
  - In other locations, phone +31 (0) 318 495 555 (The Netherlands)

Customers outside the U.S.A. can also email Micro Motion customer service at *FlowSupport@Emerson.com*.

Chapter 2
Object Model

2.1   About this chapter

This chapter describes the object model of the Model 2400S DN transmitter. The following information is provided:

- Object classes – see Section 2.2
- Object diagram – see Section 2.3

2.2   Object classes

Table 2-1 lists and describes all object classes present in the Model 2400S DN transmitter.

Table 2-1   Object classes and descriptions
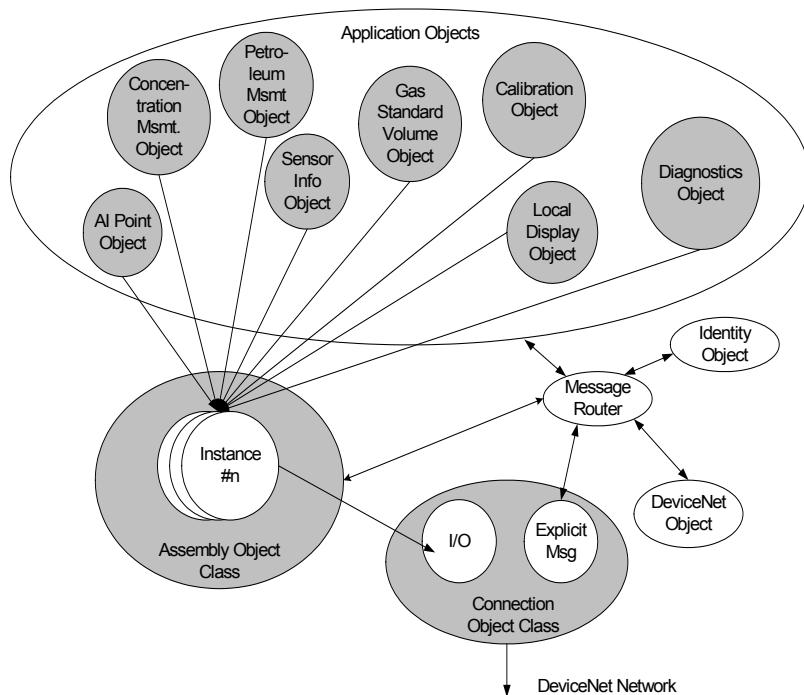
Object	Class ID	Optional/ required	# of instances	Effect on behavior of device
Identity	0x01	Required	1	Supports the Reset service
Message Router	0x02	Required	1	No effect
DeviceNet	0x03	Required	1	Configures port attributes (baud rate, MAC ID, BOI processing)
Connection	0x05	Required	2	One instance for I/O and one for explicit messaging. Contains the number of logical ports into or out of the device
Assembly	0x04	Required	33	Defines I/O data format
Acknowledge Handler	0x2B	Required	1	Affects retries and timeouts for acknowledged Cyclic I/O connection types
Analog Input Point	0x0A	Optional	4	Defines AI values: mass flow, volume flow, density, and temperature. Affects response of these values
Gas Standard Volume	0x64	Optional	1	Affects response of gas standard volume calculation
Calibration	0x65	Optional	1	Affects response of process variable values
Diagnostics	0x66	Optional	1	No effect
Sensor Information	0x67	Optional	1	No effect
Local Display	0x68	Optional	1	Affects behavior of display
Petroleum Measurement	0x69	Optional	1	Affects calculations for the petroleum measurement application
Concentration Measurement	0x6A	Optional	1	Affects calculations for the concentration measurement application

2.3   Object diagram

The object diagram for the Model 2400S DN transmitter is shown in Figure 2-1.

Figure 2-1   Object diagram

Chapter 3
I/O Data Format

3.1 About this chapter

This chapter describes the I/O data format of the Model 2400S DN transmitter. The following information is provided:

- Summary of the input assemblies and output assemblies – see Section 3.2
- Summary of the output assemblies – see Section 3.3
- Detailed descriptions of the input assemblies – see Section 3.4
- Detailed descriptions of the output assemblies – see Section 3.5

3.2 Summary of input assemblies

The Model 2400S DN transmitter input assemblies are summarized in Table 3-1. In this table:

- The Status field is a single byte, reflecting the status of the data from the referenced object (e.g., the Analog Input Point Object, Instance 2). Status values are as follows:
  - 0 = no fault
  - 1 = fault
- The listed data type describes the data type of all other fields in the input assembly.

Table 3-1 Summary of input assemblies

Instance ID	Data description	Size (bytes)	Data type	Notes
1	Status Mass flow	5	BOOL REAL	Mass flow
2	Status Volume flow	5	BOOL REAL	Volume flow
3	Status Mass flow Mass total	9	BOOL REAL REAL	Mass flow and total
4	Status Volume flow Volume total	9	BOOL REAL REAL	Volume flow and total
5	Status Mass flow Temperature Density Volume flow Drive gain	21	BOOL REAL REAL REAL REAL REAL	Basic process variables

Table 3-1   Summary of input assemblies *continued*

Instance ID	Data description	Size (bytes)	Data type	Notes
6	Status Mass flow Mass total Mass inventory Temperature Density	21	BOOL REAL REAL REAL REAL REAL	Mass flow, mass totals and other process variables
7	Status Volume flow Volume total Volume inventory Temperature Density	21	BOOL REAL REAL REAL REAL REAL	Volume flow, volume totals and other process variables
8	Status Mass flow Mass total Temperature Gas standard volume flow Gas standard volume total	21	BOOL REAL REAL REAL REAL REAL	Gas standard volume flow
9	Status Mass flow Temperature Gas standard volume flow Gas standard volume total Gas standard volume inventory	21	BOOL REAL REAL REAL REAL REAL	Gas standard volume flow
10	Status Temperature Drive gain Gas standard volume flow Gas standard volume total Gas standard volume inventory	21	BOOL REAL REAL REAL REAL REAL	Gas standard volume flow
11	Status Gas standard volume flow	5	BOOL REAL	Gas standard volume flow
12	Status Gas standard volume flow Gas standard volume total Gas standard volume inventory	13	BOOL REAL REAL REAL	Gas standard volume flow
13	Status Volume flow Volume total Volume inventory Temperature-corrected volume flow Temperature-corrected volume total	21	BOOL REAL REAL REAL REAL REAL	Petroleum measurement application
14	Status Volume flow Volume total Temperature-corrected density Temperature-corrected volume flow Temperature-corrected volume inventory	21	BOOL REAL REAL REAL REAL REAL	Petroleum measurement application
15	Status Mass flow Mass total Volume flow Volume total Temperature-corrected density	21	BOOL REAL REAL REAL REAL REAL	Petroleum measurement application

Table 3-1 **Summary of input assemblies** *continued*

Instance ID	Data description	Size (bytes)	Data type	Notes
16	Status Temperature-corrected density Temperature-corrected volume flow Temperature-corrected volume inventory Average temperature-corrected density Average temperature	21	BOOL REAL REAL REAL REAL REAL	Petroleum measurement application
17	Status Mass flow Volume flow Temperature Reference density Specific gravity	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
18	Status Mass flow Volume flow Temperature Density Concentration	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
19	Status Mass flow Volume flow Temperature Density Baume	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
20	Status Temperature Density Net mass flow Net mass total Net mass inventory	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
21	Status Temperature Density Net volume flow Net volume total Net volume inventory	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
22	Status Mass flow Temperature Density Reference density Net mass flow	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
23	Status Volume flow Temperature Density Reference density Net volume flow	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application

Table 3-1   Summary of input assemblies *continued*

Instance ID	Data description	Size (bytes)	Data type	Notes
24	Status Mass flow Volume flow Density Reference density Standard volume flow	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
25	Status Mass flow Temperature Density Reference density Concentration	21	BOOL REAL REAL REAL REAL REAL	Concentration measurement application
26	Status User-specified variable 1[1] User-specified variable 2[2] User-specified variable 3[3] User-specified variable 4[4] User-specified variable 5[5]	21	BOOL REAL REAL REAL REAL REAL	Configurable assembly

(1) Default = Mass flow.
(2) Default = Temperature.
(3) Default = Density.
(4) Default = Volume flow.
(5) Default = Drive gain.

3.3   Summary of output assemblies

The Model 2400S DN transmitter output assemblies are summarized in Table 3-2.

Table 3-2   Summary of output assemblies

Instance ID	Data Description	Size (bytes)	Data Type	Notes
0	No output data	0	NULL	No data
50	External pressure	4	REAL	Used for pressure compensation
51	External temperature	4	REAL	Used for temperature correction
52	External pressure External temperature	8	REAL REAL	Used for pressure compensation and temperature correction
53	Start/stop totalizers and inventories	1	BOOL	Totalizer control
54	Reset all totalizers	1	BOOL	Totalizer control
55	Reset all inventories	1	BOOL	Totalizer control
56	Start/stop totalizers and inventories Reset all totalizers	2	BOOL BOOL	Totalizer control
57	Start/stop totalizers and inventories Reset all totalizers Reset all inventories	3	BOOL BOOL BOOL	Totalizer control
58	Start meter verification	1	BOOL	Meter verification

Table 3-2   **Summary of output assemblies** *continued*

Instance ID	Data Description	Size (bytes)	Data Type	Notes
59	External pressure Start meter verification	5	REAL BOOL	Pressure compensation and meter verification
60	External temperature Start meter verification	5	REAL BOOL	Temperature correction and meter verification
61	Start/stop totalizers Start meter verification	2	BOOL BOOL	Totalizer control and meter verification
62	Reset all totalizers Start meter verification	2	BOOL BOOL	Totalizer control and meter verification
63	Reset all inventories Start meter verification	2	BOOL BOOL	Totalizer control and meter verification
64	Start/stop totalizers Reset all totalizers Start meter verification	3	BOOL BOOL BOOL	Totalizer control and meter verification
65	Start/stop totalizers Reset all totalizers Reset all inventories Start meter verification	4	BOOL BOOL BOOL BOOL	Totalizer control and meter verification

3.4   Input assembly details

3.4.1   Detail of Input Assembly 1 – Status and mass flow

- Assembly instance: 1
- Data size: 5 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]

3.4.2   Detail of Input Assembly 2 – Status and volume flow

- Assembly instance: 2
- Data size: 5 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]

3.4.3 Detail of Input Assembly 3 – Status, mass flow, and mass total

- Assembly instance: 3
- Data size: 9 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Mass total	[0x0A-1-100]

3.4.4 Detail of Input Assembly 4 – Status, volume flow, and volume total

- Assembly instance: 4
- Data size: 9 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]
Bytes 5–8	Volume total	[0x0A-2-100]

3.4.5 Detail of Input Assembly 5 – Status and basic process variables

- Assembly instance: 5
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Temperature	[0x0A-4-3]
Bytes 9–12	Density	[0x0A-3-3]
Bytes 13–16	Volume flow	[0x0A-2-3]
Bytes 17–20	Drive gain	[0x66-1-20]

3.4.6 Detail of Input Assembly 6 – Status, mass flow, mass totals, and other process variables

- Assembly instance: 6
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Mass total	[0x0A-1-100]
Bytes 9–12	Mass inventory	[0x0A-1-101]
Bytes 13–16	Temperature	[0x0A-4-3]
Bytes 17–20	Density	[0x0A-3-3]

3.4.7 Detail of Input Assembly 7 – Status, volume flow, volume totals, and other process variables

- Assembly instance: 7
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]
Bytes 5–8	Volume total	[0x0A-2-100]
Bytes 9–12	Volume inventory	[0x0A-2-101]
Bytes 13–16	Temperature	[0x0A-4-3]
Bytes 17–20	Density	[0x0A-3-3]

3.4.8 Detail of Input Assembly 8 – Status, gas standard volume process variables

- Assembly instance: 8
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Mass total	[0x0A-1-100]
Bytes 9–12	Temperature	[0x0A-4-3]
Bytes 13–16	Gas standard volume flow	[0x64-1-1]
Bytes 17–20	Gas standard volume total	[0x64-1-2]

3.4.9 Detail of Input Assembly 9 – Status, gas standard volume process variables

- Assembly instance: 9
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Temperature	[0x0A-4-3]
Bytes 9–12	Gas standard volume flow	[0x64-1-1]
Bytes 13–16	Gas standard volume total	[0x64-1-2]
Bytes 17–20	Gas standard volume inventory	[0x64-1-3]

3.4.10 Detail of Input Assembly 10 – Status, gas standard volume process variables

- Assembly instance: 10
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-4-4]
Bytes 1–4	Temperature	[0x0A-4-3]
Bytes 5–8	Drive gain	[0x66-1-20]
Bytes 9–12	Gas standard volume flow	[0x64-1-1]
Bytes 13–16	Gas standard volume total	[0x64-1-2]
Bytes 17–20	Gas standard volume inventory	[0x64-1-3]

3.4.11 Detail of Input Assembly 11 – Status, gas standard volume process variables

- Assembly instance: 11
- Data size: 5 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Gas standard volume flow	[0x64-1-1]

3.4.12   Detail of Input Assembly 12 – Status, gas standard volume process variables

- Assembly instance: 12
- Data size: 13 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Gas standard volume flow	[0x64-1-1]
Bytes 5–8	Gas standard volume total	[0x64-1-2]
Bytes 9–12	Gas standard volume inventory	[0x64-1-3]

3.4.13   Detail of Input Assembly 13 – Status, petroleum measurement process variables

- Assembly instance: 13
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]
Bytes 5–8	Volume total	[0x0A-2-100]
Bytes 9–12	Volume inventory	[0x0A-2-101]
Bytes 13–16	Temperature-corrected volume flow	[0x69-1-2]
Bytes 17–20	Temperature-corrected volume total	[0x69-1-3]

3.4.14   Detail of Input Assembly 14 – Status, petroleum measurement process variables

- Assembly instance: 14
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]
Bytes 5–8	Volume total	[0x0A-2-100]
Bytes 9–12	Temperature-corrected density	[0x69-1-1]
Bytes 13–16	Temperature-corrected volume flow	[0x69-1-2]
Bytes 17–20	Temperature-corrected volume inventory	[0x69-1-4]

3.4.15 Detail of Input Assembly 15 – Status, petroleum measurement process variables

- Assembly instance: 15
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Mass total	[0x0A-1-100]
Bytes 9–12	Volume flow	[0x0A-2-3]
Bytes 13–16	Volume total	[0x0A-2-100]
Bytes 17–20	Temperature-corrected density	[0x69-1-1]

3.4.16 Detail of Input Assembly 16 – Status, petroleum measurement process variables

- Assembly instance: 16
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-3-4]
Bytes 1–4	Temperature-corrected density	[0x69-1-1]
Bytes 5–8	Temperature-corrected volume flow	[0x69-1-2]
Bytes 9–12	Temperature-corrected volume inventory	[0x69-1-4]
Bytes 13–16	Average temperature-corrected density	[0x69-1-5]
Bytes 17–20	Average temperature	[0x69-1-6]

3.4.17 Detail of Input Assembly 17 – Concentration measurement densities

- Assembly instance: 17
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Volume flow	[0x0A-2-3]
Bytes 9–12	Temperature	[0x0A-4-3]
Bytes 13–16	Reference density	[0x6A-1-1]
Bytes 17–20	Specific gravity	[0x6A-1-2]

3.4.18   Detail of Input Assembly 18 – Concentration measurement concentration

- Assembly instance: 18
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Volume flow	[0x0A-2-3]
Bytes 9–12	Temperature	[0x0A-4-3]
Bytes 13–16	Density	[0x0A-3-3]
Bytes 17–20	Concentration	[0x6A-1-12]

3.4.19   Detail of Input Assembly 19 – Concentration measurement Baume

- Assembly instance: 19
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Volume flow	[0x0A-2-3]
Bytes 9–12	Temperature	[0x0A-4-3]
Bytes 13–16	Density	[0x0A-3-3]
Bytes 17–20	Baume	[0x6A-1-13]

3.4.20   Detail of Input Assembly 20 – Concentration measurement net mass flow and totals

- Assembly instance: 20
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Temperature	[0x0A-4-3]
Bytes 5–8	Density	[0x0A-3-3]
Bytes 9–12	Net mass flow	[0x6A-1-6]
Bytes 13–16	Net mass total	[0x6A-1-7]
Bytes 17–20	Net mass inventory	[0x6A-1-8]

3.4.21 Detail of Input Assembly 21 – Concentration measurement net volume flow and totals

- Assembly instance: 21
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Temperature	[0x0A-4-3]
Bytes 5–8	Density	[0x0A-3-3]
Bytes 9–12	Net volume flow	[0x6A-1-9]
Bytes 13–16	Net volume total	[0x6A-1-10]
Bytes 17–20	Net volume inventory	[0x6A-1-11]

3.4.22 Detail of Input Assembly 22 – Concentration measurement reference density and net mass flow

- Assembly instance: 22
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Temperature	[0x0A-4-3]
Bytes 9–12	Density	[0x0A-3-3]
Bytes 13–16	Reference density	[0x6A-1-1]
Bytes 17–20	Net mass flow	[0x6A-1-6]

3.4.23 Detail of Input Assembly 23 – Concentration measurement reference density and net volume flow

- Assembly instance: 23
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-2-4]
Bytes 1–4	Volume flow	[0x0A-2-3]
Bytes 5–8	Temperature	[0x0A-4-3]
Bytes 9–12	Density	[0x0A-3-3]
Bytes 13–16	Reference density	[0x6A-1-1]
Bytes 17–20	Net volume flow	[0x6A-1-9]

3.4.24 Detail of Input Assembly 24 – Concentration measurement reference density and standard volume flow

- Assembly instance: 24
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Volume flow	[0x0A-2-3]
Bytes 9–12	Density	[0x0A-3-3]
Bytes 13–16	Reference density	[0x6A-1-1]
Bytes 17–20	Standard volume flow	[0x6A-1-3]

3.4.25 Detail of Input Assembly 25 – Status, concentration measurement reference density and concentration

- Assembly instance: 25
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Mass flow	[0x0A-1-3]
Bytes 5–8	Temperature	[0x0A-4-3]
Bytes 9–12	Density	[0x0A-3-3]
Bytes 13–16	Reference density	[0x6A-1-1]
Bytes 17–20	Concentration	[0x6A-1-12]

3.4.26 Detail of Input Assembly 26 – Status, user-selected process variables

- Assembly instance: 26
- Data size: 21 bytes
- Type: Input

Bytes	Description	EPATH
Byte 0	Status	[0x0A-1-4]
Bytes 1–4	Process variable 1 (Default = Mass flow)	[0x04-26-100]
Bytes 5–8	Process variable 2 (Default = Temperature)	[0x04-26-101]
Bytes 9–12	Process variable 3 (Default = Density)	[0x04-26-102]
Bytes 13–16	Process variable 4 (Default = Volume flow)	[0x04-26-103]
Bytes 17–20	Process variable 5 (Default = Drive gain)	[0x04-26-104]

3.5 Output assembly details

3.5.1 Detail of Output Assembly 0 – No output data

- Assembly instance: 0
- Data size: 0 bytes
- Type: Output

3.5.2 Detail of Output Assembly 50 – External pressure

- Assembly instance: 50
- Data size: 4 bytes
- Type: Output

Bytes	Description	EPATH
Bytes 0–3	External pressure	[0x65-1-28]

3.5.3 Detail of Output Assembly 51 – External temperature

- Assembly instance: 51
- Data size: 4 bytes
- Type: Output

Bytes	Description	EPATH
Bytes 0–3	External temperature	[0x65-1-26]

3.5.4 Detail of Output Assembly 52 – External pressure and temperature

- Assembly instance: 52
- Data size: 8 bytes
- Type: Output

Bytes	Description	EPATH
Bytes 0–3	External pressure	[0x65-1-28]
Bytes 4–7	External temperature	[0x65-1-26]

3.5.5 Detail of Output Assembly 53 – Start/stop all totalizers and inventories

- Assembly instance: 53
- Data size: 1 byte
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]

3.5.6 Detail of Output Assembly 54 – Reset all totalizers

- Assembly instance: 54
- Data size: 1 byte
- Type: Output

Bytes	Description	EPATH
Byte 0	Reset all totalizers	[0x0A-0-101]

3.5.7 Detail of Output Assembly 55 – Reset all inventories

- Assembly instance: 55
- Data size: 1 byte
- Type: Output

Bytes	Description	EPATH
Byte 0	Reset all inventories	[0x0A-0-102]

3.5.8 Detail of Output Assembly 56 – Start/stop all totalizers and inventories and reset all totalizers

- Assembly instance: 56
- Data size: 2 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]
Byte 1	Reset all totalizers	[0x0A-0-101]

3.5.9 Detail of Output Assembly 57 – Start/stop all totalizers and inventories, reset all totalizers, and reset all inventories

- Assembly instance: 57
- Data size: 3 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]
Byte 1	Reset all totalizers	[0x0A-0-101]
Byte 2	Reset all inventories	[0x0A-0-102]

3.5.10 Detail of Output Assembly 58 – Start meter verification

- Assembly instance: 58
- Data size: 1 byte
- Type: Output

Bytes	Description	EPATH
Byte 0	Start meter verification	[0x66-1-86]

3.5.11 Detail of Output Assembly 59 – External pressure, start meter verification

- Assembly instance: 59
- Data size: 5 bytes
- Type: Output

Bytes	Description	EPATH
Bytes 0–3	External pressure	[0x65-1-28]
Byte 4	Start meter verification	[0x66-1-86]

3.5.12 Detail of Output Assembly 60 – External temperature and start meter verification

- Assembly instance: 60
- Data size: 5 bytes
- Type: Output

Bytes	Description	EPATH
Bytes 0–3	External temperature	[0x65-1-26]
Byte 4	Start meter verification	[0x66-1-86]

3.5.13 Detail of Output Assembly 61 – Start/stop all totalizers and inventories, start meter verification

- Assembly instance: 61
- Data size: 2 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]
Byte 1	Start meter verification	[0x66-1-86]

3.5.14 Detail of Output Assembly 62 – Reset all totalizers and start meter verification

- Assembly instance: 62
- Data size: 2 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Reset all totalizers	[0x0A-0-101]
Byte 1	Start meter verification	[0x66-1-86]

3.5.15 Detail of Output Assembly 63 – Reset all inventories and start meter verification

- Assembly instance: 63
- Data size: 2 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Reset all inventories	[0x0A-0-102]
Byte 1	Start meter verification	[0x66-1-86]

3.5.16 Detail of Output Assembly 64 – Start/stop all totalizers, reset all totalizers, start meter verification

- Assembly instance: 64
- Data size: 3 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]
Byte 1	Reset all totalizers	[0x0A-0-101]
Byte 2	Start meter verification	[0x66-1-86]

3.5.17 Detail of Output Assembly 65 – Start/stop all totalizers, reset all totalizers, reset all inventories, start meter verification

- Assembly instance: 65
- Data size: 4 bytes
- Type: Output

Bytes	Description	EPATH
Byte 0	Start/stop all totalizers and inventories	[0x0A-0-100]
Byte 1	Reset all totalizers	[0x0A-0-101]
Byte 2	Reset all inventories	[0x0A-0-102]
Byte 3	Start meter verification	[0x66-1-86]

Chapter 4
Configuration Data

4.1 About this chapter

This chapter provides the following information:

- Object summary
- How to use the object tables

4.2 Object summary

The objects described in this chapter are listed in Table 4-1.

Table 4-1 **Object summary**

Object	Description	See
Identity Object (0x01)	Contains information that uniquely describes the device	Section 4.4
Message Router Object (0x02)	Tracks the accessibility of the object classes and instances	Section 4.5
DeviceNet Object (0x03)	Maintains the DeviceNet communications interface	Section 4.6
Assembly Object (0x04)	Contains a list of attributes that data can be written to (sink) or read from (source)	Section 4.7
Connection Object (0x05)	Configures the characteristics and behavior of a logical connection in the device	Section 4.8
Acknowledge Handler Object (0x2B)	Manages retries and timeouts for acknowledged Cyclic I/O connections if an acknowledgment is not received	Section 4.9
Analog Input Point Object (0x0A)	Reports sensor values for mass flow, liquid volume flow, density, and temperature, and contains configuration data for these process variables	Section 4.10
Gas Standard Volume Object (0x64)	Reports sensor values for gas standard volume flow, and contains gas standard volume configuration data	Section 4.11
Calibration Object (0x65)	Contains calibration configuration data and manages calibration procedures	Section 4.12
Diagnostics Object (0x66)	Reports diagnostic data and contains diagnostic configuration data	Section 4.13
Sensor Information Object (0x67)	Contains information related to the sensor	Section 4.14
Local Display Object (0x68)	Contains configuration data for the local display	Section 4.15
Petroleum Measurement Object (0x69)	Contains configuration data and process variables for the petroleum measurement application	Section 4.16
Concentration Measurement Object (0x6A)	Contains configuration data and process variables for the concentration measurement application	Section 4.17

4.3   How to use the object tables

For each object, all instances and all attributes in each instance are described.

For each attribute, the following information is provided:

- Name – The ODVA DeviceNet Specification label
- Data type – The ODVA DeviceNet Data Type. Data types are defined in Section 4.19.
- Available services
- Mem (memory location)
    - **NV** = The value of the attribute is stored in non-volatile memory and its value will be retained after a power cycle
    - **V** = The value of the attribute is in volatile memory and its value will be returned to default after a power cycle
- Description and notes

Additionally, the services provided for each object are described.

Note: The Get Attribute Single (Get) and Set Attribute Single (Set) services are used with many objects and attributes. For simplicity, they are described only once. For details on these two services, see Section 4.18.

Finally, implementation information is provided for specific objects, attributes, or services as required.

4.4   Identity Object (0x01)

The Identity Object contains informational attributes that uniquely describe the device. For example, by using the following set of attributes, this device is uniquely differentiated from any other device:

- Vendor ID
- Device Type
- Product Code
- Serial Number

4.4.1   Identity Object attributes

Table 4-2   Identity Object attributes for Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	V	Revision of this class of object	If updates that require an increase in this value are made, then the value of this attribute increases by 1.

Table 4-3   Identity Object attributes for Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Vendor ID	UINT	Get	V	ID Number assigned to vendor by ODVA	Micro Motion, Inc. ID = 914
2	Device Type	UINT	Get	NV	Numeric identifier indicating the ODVA Device Profile implemented by the device	Device Type = 100 (0x64) MMI Coriolis Mass Flowmeter
3	Product Code	UINT	Get	NV	Identification of a particular product of an individual vendor	1 = 2400S DeviceNet
4	Revision: • Major Revision • Minor Revision	STRUCT of: • USINT • USINT	Get	NV	Revision value used for comparison with the ODVA certificate	
5	Status	WORD	Get	V	Summary status of the device	See Table 4-4 for valid values. Values are bit-oriented.
6	Serial Number	UDINT	Get	NV	Serial number of device	
7	Product Name	Short String	Get	NV	Human-readable Identification	
100	DeviceNet Daughterboard Software Revision	UINT	Get	NV	Software revision of the DeviceNet daughterboard	
101	Daughterboard Diagnostic Code	USINT	Get	V	Evaluation of daughterboard operation performance	
102	ETO Number	UINT	Set	NV	Identifies the Engineering To Order (ETO) software package that may be installed	• 0 = Standard software
103[1]	Feature Key	UINT	Get	NV	Identifies the installed features. The parameter is bit mapped.	• 0x0008 = Petroleum measurement application • 0x0010 = Concentration measurement application • 0x0800 = Meter verification
104	Core Processor Status	USINT	Get	V	Summary status of the core processor	• 0 = No fault • 1 = Recoverable fault • 2 = Non-recoverable fault
105	Hardware Revision	USINT	GET	NV	Revision of the electronics board	

Table 4-3   Identity Object attributes for Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
198[2]	Core Processor Software: • Major Revision • Minor Revision	UINT	Get	NV	Revision of the core processor software	Matches the software version that is displayed on the LCD panel (if present on transmitter)

(1) The petroleum measurement application and the concentration measurement application are mutually exclusive. The meter verification option can be combined with other features.

(2) The major and minor revision values are concatenated into a single value. For example, the rev value 0.19 will be displayed as 0013 in hexadecimal notation, or as 256 in decimal notation.

Table 4-4   Identity Object status definition

Bit	Description
0	Set to 1 when the device has been allocated
1 – 8	Reserved, always zero
9	Minor recoverable fault
10	Major recoverable fault
11	Major unrecoverable fault
12 – 15	Reserved, always zero

4.4.2   Identity Object services

Table 4-5   Identity Object services for Instance 0

Service code	Service name	Service description	Details
0x0E	Get	Returns the contents of the specified attribute	For request and response details, see Tables 4-7 and 4-8.

Table 4-6   Identity Object services for Instance 1

Service Code	Service Name	Service Description	Details
0x0E	Get	Returns the contents of the specified attribute	For request and response details, see Tables 4-7 and 4-8.
0x05	Reset	Resets the DeviceNet interface of the device	

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4.4.3 Reset service details

Table 4-7 Identity Object Reset service request

Parameter name	Data type	Required	Parameter value	Semantics
Type	USINT	N	0	Emulate as closely as possible cycling power on the item the Identity Object represents. This value is the default if this parameter is omitted.
			1	Return as closely as possible to the factory configuration, and then emulate cycling power as closely as possible.

Table 4-8 Identity Object Reset service response

Parameter name	Data type	Required	Parameter value	Semantics
		NO RESPONSE DATA		

4.5 Message Router Object (0x02)

The Message Router is responsible for tracking the accessibility of the Classes and Instances via the DeviceNet network. Functionally (transparent to the user), the object routes explicit messages to the various objects in the device. A list of objects that the device supports can be obtained directly from this class.

4.5.1 Message Router attributes

Table 4-9 Message router attributes for Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV	Text label: Description	Text label: Notes

Table 4-10 Message Router attributes for Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Object List • Number	STRUCT of: • UINT	Get	NV	A list of supported objects • The number of supported classes in the class array	
	• Classes	• Array of UINT			• A list of Class ID codes	

4.5.2   Message Router services

Table 4-11 **Message Router services for Instance 0**

Service code	Service name	Service description
0x0E	Get	Returns the contents of the specified attribute

Table 4-12 **Message Router services for Instance 1**

Service code	Service name	Service description
0x0E	Get	Returns the contents of the specified attribute

4.6   DeviceNet Object (0x03)

The DeviceNet Object is responsible for maintaining and managing the DeviceNet communications interface for the device. Information concerning the MAC ID and baud rate of the device can be found here. This object also is responsible for managing the pre-defined Master/Slave Connection set. Through this object, services are provided to allocate and release connections associated with the connection set.

4.6.1   DeviceNet Object attributes

Table 4-13 **DeviceNet Object attributes for Instance 0**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV	Revision of the DeviceNet Object Class Definition upon which the implementation is based	Range: 1–65535

Table 4-14 **DeviceNet Object attributes for Instance 1**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	MAC ID	USINT	Cond.	NV	The node address of this device	See the following section entitled *MAC ID*.
2	Baud Rate	USINT	Cond.	NV	The communication data rate	See the following section entitled *Baud rate*.
3	BOI	BOOL	Set	V	Bus Off Interrupt	See the following section entitled *BOI*.
4	Bus Off Counter	USINT	Get	V	Number of times CAN went to the Bus-Off-State	Range: 0–255
5	Allocation Information: • Allocation Choice Byte • Master's MAC IDAC	STRUCT of: • BYTE • USINT	Get	V	The current Master/Slave Connection set • Connections that have been allocated • The node address of the current Master	See the following section entitled *Allocation Information*.

Table 4-14   DeviceNet Object attributes for Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
6	MAC ID Switch Changed	BOOL	Get	V	The node address switch(es) have changed since last power-up/reset	See the following section entitled *MAC ID*.
7	Baud Rate Switch Changed	BOOL	Get	V	The baud rate switch has changed since the last power-up/reset	See the following section entitled *Baud rate*.
8	ID Switch Value	USINT	Get	V	Actual value of the node address hardware switches	See the following section entitled *MAC ID*.
9	Baud Rate Switch Value	USINT	Get	V	Actual value of the baud rate hardware switch	See the following section entitled *Baud rate*.

MAC ID

The valid range of values for the MAC ID (node address) is **0** to **63**.

The MAC ID can be configured in either of two ways:

- By setting the two node address hardware switches (labeled **MSD** and **LSD**) on the face of the device to a value between **0** and **63**

- By setting the node address hardware switches to a value in the Program range (an address of 64 or greater), then setting Attribute 1 using the Set service

Note: If the node address hardware switches are not set to the Program range, the Set service will return error code 0x0E ("Attribute not settable").

The current setting of the hardware switches is stored in Attribute 8. Attribute 8 is automatically updated whenever the switch setting is changed.

When the MAC ID has been changed via either method, Attribute 6 is automatically set to 1 (True), and the new MAC ID is *not* implemented. To implement the new MAC ID, you must either power cycle the device or send a Reset service to the Identity Object. When either of these occurs, the new MAC ID will be implemented and Attribute 6 will be automatically set to 0 (False).

Baud rate

The valid values for baud rate (Attribute 2) this attribute are:

- **0** = 125K
- **1** = 250K
- **2** = 500K
- **3** – **9** = Program range

The baud rate can be configured in either of two ways:

- By setting the baud rate hardware switch (labeled **BAUD**) on the face of the device to a value between **0** and **2**

- By setting the baud rate hardware switch to a value in the Program range, then setting Attribute 2 using the Set service

Note: If the baud rate hardware switch is not set to the Program range, the Set service will return error code 0x0E ("Attribute not settable").

The current setting of the hardware switches is stored in Attribute 9. Attribute 9 is automatically updated whenever the switch setting is changed.

When the baud rate has been changed via either method, Attribute 7 is automatically set to 1 (True), and the new baud rate is *not* implemented. To implement the new baud rate, you must either power cycle the device or send a Reset service to the Identity Object. When either of these occurs, the new baud rate will be implemented and Attribute 7 will be automatically set to 0 (False).

If the device cannot determine what its baud rate should be, it defaults to 500K.

BOI

This attribute configures the action that the device will take in processing the Bus Off Interrupt. Valid values are:

- 0 = Hold the CAN chip in its bus-off (reset) state upon detection of a bus-off indication.
- 1 = If possible, fully reset the CAN chip and continue communicating upon detection of a bus-off indication

Allocation Information

Part of the information contained in this attribute indicates the master/slave connections that are currently allocated and active. The bit mapping of this BYTE descriptor is shown in Table 4-15.

Table 4-15 **Master/slave connection BYTE descriptor**

Bit	Description
7	0
6	Acknowledge suppression
5	Cyclic
4	0
3	0
2	0
1	Polled
0	Explicit message

4.6.2 DeviceNet Object services

Table 4-16 **DeviceNet Object services for Instance 0**

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-17 **DeviceNet Object services for Instance 1**

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	

Table 4-17   DeviceNet Object services for Instance 1 *continued*

Service code	Service name	Service description	Details
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4B	Allocate Master/Slave Connection	Requests the instantiation of a Master/Slave Connection	See Section 4.6.3.
0x4C	Release Master/Slave Connection	Releases (deletes) a Master/Slave Connection	See Section 4.6.4.

4.6.3   Service details: Allocate Master/Slave Connection service

Table 4-18   Service arguments

Parameter name	Data type	Required	Parameter value	Semantics
Allocation Choice Byte	BYTE	Y	See Table 4-19	Selects the master/slave connection to be allocated (opened) in the slave device
Allocator's MAC ID	USINT	Y	0 to 63	The MAC ID of the master device issuing this request

Table 4-19   Bits in Allocation Choice byte

Bit	Description
7	0
6	Acknowledge suppression
5	Cyclic
4	0
3	0
2	0
1	Polled
0	Explicit message

Table 4-20   Response

Parameter name	Data type	Required	Parameter value	Semantics
Message Body Format	BYTE	Y		Sets the format of the explicit message body to be used between the client (master) and the slave device. The client can ignore this value.

4.6.4 Service details: Release Master/Slave Connection Service

Table 4-21 Service arguments

Parameter name	Data type	Required	Parameter value	Semantics
Release Choice Byte	BYTE	Y	See Table 4-22	Selects the master/slave connection to be released (closed) in the slave device.

Table 4-22 Bits in Release Choice byte

Bit	Description
7	0
6	Acknowledge suppression
5	Cyclic
4	0
3	0
2	0
1	Polled
0	Explicit message

Table 4-23 Response

Parameter name	Data type	Required	Parameter value	Semantics
		NO RESPONSE DATA		

4.6.5 Rules governing Master/Slave connections

When allocating a connection, note the following:

- When allocating Master/Slave Connections using the Allocate service, the entire allocation request must be valid. If any part of the allocation request is invalid, the allocation request is rejected.

- When allocating any of the Master/Slave I/O Connections, one of the following is required:
  - The Explicit Connection must already be allocated, OR:
  - If the Explicit Connection has not been allocated, it can be allocated in the same allocation request used for the I/O Connections.

- A Master/Slave Connection that is already allocated cannot be allocated again unless it is released. The allocation of a connection that has already been allocated but not released will be considered an invalid request.

- Multiple Master/Slave Connections can be requested in the same allocation request.

- Once a master has made a successful allocation request to a slave, no other master may make allocation requests to the slave until all Master/Slave Connections to this slave are released.

- Any master may release Master/Slave Connections in any slave.

- Allocation of the Master/Slave Cyclic Connection will automatically allocate the Poll I/O Connection if the Poll I/O Connection is not already allocated.

4.7 Assembly Object (0x04)

The Assembly Object contains a list of attributes that data can be written to (sink) and read from (source) via the Data Buffer attribute contained in this object. The Assembly Object is generally assigned as the endpoint of an I/O Connection Object (assigned via the Path attributes in the Connection Object). In this way, large amounts of data can be moved to and from the network quickly.

4.7.1 Assembly Object attributes

Table 4-24 Assembly Object attributes for Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV	Revision of the Assembly Object class	Default = 2

Table 4-25 Assembly Object attributes for Instances 1–25 and 27–120

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Number of members in list	USINT	Get	NV	Lists the number of members in this Assembly instance	
2	Member list: • Member data description • Member path size • Member path	Array: • UINT • UINT • EPATH	Get	V	The member list is an array of DeviceNet paths: • Size of member data (in bytes) • Size of member path (in bytes) • Path to the attribute this member points to	
3	Data buffer	Array of BYTE	Get	V	The data buffer to sink or source the member(s) data	The size of this attribute can be determined by adding together the Member Data Description for each member in the Assembly.

Table 4-26 Assembly Object attributes for Instance 26

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Number of members in list	USINT	Get	NV	Lists the number of members in this Assembly instance	Six members: Status plus the 5 user-selected process variables that are specified in Attributes 100–104.
2	Member list: • Member data description • Member path size • Member path	Array: • UINT • UINT • EPATH	Get	V	The member list is an array of DeviceNet paths: • Size of member data (in bytes) • Size of member path (in bytes) • Path to the attribute this member points to	The member list points to attributes 100–104 (the list of user-specified process variables), not to the location of the data.
3	Data buffer	Array of BYTE	Get	V	The data buffer to sink or source the member(s) data	This buffer will return zeros, not the actual process data.
100	Process variable 1	USINT	Set	NV	Specifies the process variables to be included in the Configurable Assembly. If "None" is specified for an attribute, 0.0 will be returned as the data in that slot.	See Table 4-105 for process variable codes.
101	Process variable 2					
102	Process variable 3					
103	Process variable 4					
104	Process variable 5					

4.7.2 Assembly Object services

Table 4-27 Assembly Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-28 Assembly Object services for Instances 1–120

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.8 Connection Object (0x05)

The Connection Object configures the characteristics and behavior of a logical connection in the device. A Connection is allocated (opened) in the device by the master via the Allocate M/S Connection Request service in the DeviceNet Object. Configuration of the Connection Object attributes for the requested connection is done automatically in the device and generally need no further modification except for setting the Expected Packet Rate attribute (Attribute 9). However, it is within this object that selection of input/output assemblies may be configured. There are two ways to perform this configuration:

- Modification of Attributes 100 through 102 in the M/S Explicit Connection, OR:
- Modification of the Produce Path and Consume Path attributes (Attributes 14 and 16 respectively) in the I/O Connection Objects

Note that Acknowledged and Unacknowledged connections are mutually exclusive. The Acknowledge Suppression bit is set or cleared in the DeviceNet Object (see Section 4.6.3).

4.8.1 Connection Object attributes

Table 4-29 Connection Object attributes for Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV	Revision of this class of object	If updates that require an increase in this value are made, then the value of this attribute increases by 1.

Table 4-30 Connection Object attributes for Instance 1 (Explicit Connection)

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	State	USINT	Get		State of Object	See the section entitled *State*, page 41 Default: 3 (Established).
2	Instance Type	USINT	Get		Indicates type of Connection	Default: 0 (Explicit Connection)
3	Transport Class & Trigger	USINT	Get		Defines behavior of Connection	See the section entitled *Transport class and trigger*, page 41. Default: 0x83
4	Produced Connection ID	UINT	Get		Placed in CAN Identifier Field when the Connection transmits	
5	Consume Connection ID	UINT	Get		CAN Identifier Field value that denotes message to be received	
6	Initial Communication Characteristics	BYTE	Get		Defines the Message Group(s) across which productions and consumptions associated with this Connection occur	See the section entitled *Initial communication characteristics*, page 42. Default: 0x21

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Table 4-30 **Connection Object attributes for Instance 1 (Explicit Connection)** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
7	Produced Connection Size	UINT	Get		Maximum number of bytes transmitted across this Connection	Default: 0xFFFF
8	Consumed Connection Size	UINT	Get		Maximum number of bytes received across this Connection	Default: 0xFFFF
9	Expected Packet Rate (EPR)	UINT	Set		Defines timing associated with this Connection	Unit: milliseconds Default: 2500
12	Watchdog Timeout Action	USINT	Set		Specifies how the Connection will handle inactivity/watchdog timeouts	See the section entitled *Watchdog Timeout action*, page 42. Default: 1 (Auto Delete)
13	Produce Connection Path Length	UINT	Get		Number of bytes in the Produced Connection Path attribute	Default: 0
14	Produce Connection Path	EPATH	Get		Specifies the Assembly Object data to be produced by this Connection	Default: Empty
15	Consume Connection Path Length	UINT	Get		Number of bytes in the Consume Connection Path attribute	Default: 0
16	Consume Connection Path	EPATH	Get		Specifies the Assembly Object to receive data from this Connection	Default: Empty
100	Default Polled I/O Connection Produce Assembly Instance	UINT	Set	NV	Specifies the default Assembly Object instance to be set in the Produce Connection Path when the M/S Polled I/O Connection Object is instantiated	Default: 6
101	Default Polled I/O Connection Consume Assembly Instance	UINT	Set	NV	Specifies the default Assembly Object instance to be set in the Consume Connection Path when the M/S Polled I/O Connection Object is instantiated	Default: 54
102	Default Cyclic I/O Connection Produce Assembly Instance	UINT	Set	NV	Specifies the default Assembly Object instance to be set in the Produce Connection Path when the M/S Cyclic I/O Connection Object is instantiated	Default: 6

Table 4-31   Connection Object attributes for Instance 2 (Polled I/O Connection)

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	State	USINT	Get		State of object	See the section entitled *State*, page 41. Default: 1 (Configuring)
2	Instance Type	USINT	Get		Indicates type of Connection	Default: 1 (I/O Connection)
3	Transport Class & Trigger	USINT	Get		Defines behavior of Connection	See the section entitled *Transport class and trigger*, page 41. Default: 0x82
4	Produce Connection ID	UINT	Get		Placed in CAN Identifier Field when the Connection transmits	
5	Consume Connection ID	UINT	Get		CAN Identifier Field value that denotes message to be received	
6	Initial Communication Characteristics	BYTE	Get		Defines the Message Group(s) across which productions and consumptions associated with this Connection occur	See the section entitled *Initial communication characteristics*, page 42. Default: 0x01
7	Produced Connection Size	UINT	Get		Maximum number of bytes transmitted across this Connection	Defined by the size of the Assembly Object referenced by the Produced Connection Path attribute
8	Consumed Connection Size	UINT	Get		Maximum number of bytes received across this Connection	Defined by the size of the Assembly Object referenced by the Consumed Connection Path attribute
9	Expected Packet Rate (EPR)	UINT	Set		Defines timing associated with this Connection	Must be configured. Once this value is set, the Connection transitions to the Established state.
12	Watchdog Timeout Action	USINT	Set		Specifies how the Connection will handle inactivity/watchdog timeouts	See the section entitled *Watchdog Timeout action*, page 42. Default: 0 (Timed Out)
13	Produce Connection Path Length	UINT	Get		Number of bytes in the Produced Connection Path attribute	Default: 6

Table 4-31 **Connection Object attributes for Instance 2 (Polled I/O Connection)** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
14	Produce Connection Path	EPATH	Conditional		Specifies the Assembly Object data to be produced by this Connection	This attribute is settable only when State = 1 • Default: As defined by Attribute 100 in Instance 1 • Valid values: 1–49 (Input assembly instances)
15	Consume Connection Path Length	UINT	Get		Number of bytes in the Consume Connection Path attribute	Default: 6
16	Consume Connection Path	EPATH	Conditional		Specifies the Assembly Object to receive data by this Connection	This attribute is settable only when State = 1 • Default: As defined by Attribute 101 in Instance 1 • Valid values: 50–59 (Output assembly instances)

Table 4-32 **Connection Object attributes for Instance 3 (Cyclic I/O Connection, Acknowledged)**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	State	USINT	Get		State of Object	See the section entitled *State*, page 41. Default: 1 (Configuring)
2	Instance Type	USINT	Get		Indicates type of Connection	Default: 1 (I/O Connection)
3	Transport Class & Trigger	USINT	Get		Defines behavior of Connection	See the section entitled *Transport class and trigger*, page 41. Default: 0x02
4	Produced Connection ID	UINT	Get		Placed in CAN Identifier Field when the Connection transmits	
5	Consume Connection ID	UINT	Get		CAN Identifier Field value that denotes message to be received	
6	Initial Communication Characteristics	BYTE	Get		Defines the Message Group(s) across which productions and consumptions associated with this Connection occur	See the section entitled *Initial communication characteristics*, page 42. Default: 0x01
7	Produced Connection Size	UINT	Get		Maximum number of bytes transmitted across this Connection	Defined by the size of the Assembly Data Data Object referenced by the Produce Connection Path attribute
8	Consumed Connection Size	UINT	Get		Maximum number of bytes received across this Connection	Default: 0

Table 4-32 Connection Object attributes for Instance 3 (Cyclic I/O Connection, Acknowledged) *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
9	Expected Packet Rate (EPR)	UINT	Set		Defines timing associated with this Connection	Must be configured. Once this value is set, the Connection transitions to the Established state.
12	Watchdog Timeout Action	USINT	Set		Specifies how the Connection will handle inactivity/watchdog timeouts	See the section entitled *Watchdog Timeout action*, page 42. Default: 0 (Timed Out)
13	Produce Connection Path Length	UINT	Get		Number of bytes in the Produced Connection Path attribute	Default: 6
14	Produce Connection Path	EPATH	Get		Specifies the Assembly Object data to be produced by this Connection	This attribute is settable only when State = 1 • Default: As defined by Attribute 102 in Instance 1 • Valid values: 1–49 (Input assembly instances)
15	Consume Connection Path Length	UINT	Get		Number of bytes in the Consume Connection Path attribute	Default: 4
16	Consume Connection Path	EPATH	Get		Specifies the Assembly Object to receive data by this Connection	This attribute is settable only when State = 1 • Default: 0x20 0x2B 0x24 0x1 This sets the path to Instance 1 of the Acknowledge Handler Object • Valid values: 50–59 (Output assembly instances)
17	Production Inhibit Time	UNIT	Set		Specifies the minimum time between data productions, in msec	Default: 0

Table 4-33 Connection Object attributes for Instance 3 (Cyclic I/O Connection, Unacknowledged)

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	State	USINT	Get		State of Object	See the section entitled *State*, page 41. Default: 1
2	Instance Type	USINT	Get		Indicates type of Connection	Default: 1 (I/O Connection)
3	Transport Class & Trigger	USINT	Get		Defines behavior of Connection	See the section entitled *Transport class and trigger*, page 41. Default: 0x00
4	Produced Connection ID	UINT	Get		Placed in CAN Identifier Field when the Connection transmits	

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Connection Object attributes for Instance 3 (Cyclic I/O Connection, Unacknowledged) *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
5	Consume Connection ID	UINT	Get		CAN Identifier Field value that denotes message to be received	
6	Initial Communication Characteristics	BYTE	Get		Defines the Message Group(s) across which productions and consumptions associated with this Connection occur	See the section entitled *Initial communication characteristics*, page 42. Default: 0x0F
7	Produced Connection Size	UINT	Get		Maximum number of bytes transmitted across this Connection	Defined by the size of the Assembly Object referenced by the Produce Connection Path attribute
8	Consumed Connection Size	UINT	Get		Maximum number of bytes received across this Connection	Default: 0 Connection consumes no data
9	Expected Packet Rate (EPR)	UINT	Set		Defines timing associated with this Connection	Must be configured. Once this value is set, the Connection transitions to the Established state.
12	Watchdog Timeout Action	USINT	Set		Specifies how the Connection will handle inactivity/watchdog timeouts	See the section entitled *Watchdog Timeout action*, page 42. Default: 0 (Timed Out)
13	Produce Connection Path Length	UINT	Get		Number of bytes in the Produced Connection Path attribute	Default: 6
14	Produce Connection Path	EPATH	Get		Specifies the Assembly Object data to be produced by this Connection	This attribute is settable only when State = 1 • Default: As defined by Attribute 102 in Instance 1 • Valid values: 1–49 (Input assembly instances)
15	Consume Connection Path Length	UINT	Get		Number of bytes in the Consume Connection Path attribute	Default: 0
16	Consume Connection Path	EPATH	Get		Specifies the Assembly Object to receive data by this Connection	• Default: Empty • Valid values: 50–59 (Output assembly instances)
17	Production Inhibit Time	UNIT	Set		Specifies the minimum time between data productions	Unit: milliseconds Default: 0

Configuration Data

State

Table 4-34 **State descriptions**

Value	State	Description
0	Non-existent	The Connection has not yet been instantiated
1	Configuring	The Connection has been instantiated and is waiting for the following events: 1) To be properly configured, and 2) To be told to apply the configuration.
2	Waiting for connection ID	The Connection is waiting exclusively for the Produce or Consume Connection ID to be set.
3	Established	The Connection has been properly configured and applied.
4	Timed out	The Inactivity/Watchdog has timed out and may have transitioned to this state if the Watchdog Timeout Action attribute has been configured to do so. See Attribute 12.
5	Deferred delete	If the Connection Object is of Explicit Message Connection type (see Attribute 2) and the Inactivity/Watchdog has timed out, the Connection may transition to this state if the Watchdog Timeout Action attribute has been configured to do so. See Attribute 12.

Transport class and trigger

Table 4-35 **Bit descriptions**

Bit	Description
7	Transport role
6	
5	Production trigger
4	
3	
2	Transport class
1	
0	

Table 4-36 **Transport role**

Value	Description
0	Client
1	Server

Table 4-37 **Production trigger**

Bit	Description
0	Cyclic
1	Reserved for Change of State
2	Assembly Object

Table 4-38　Transport class descriptions

Bit	Description
0	Class 0
1	Reserved
2	Class 2
3	Class 3

Initial communication characteristics

Table 4-39　Bit descriptions

Bit	Description
7–4	Initial Produce characteristics
3–0	Initial Consume characteristics

Table 4-40　Initial Produce characteristics

Bit	Description
0	Produce across Message Group 1
1	Produce across Message Group 2 (Destination)
2	Produce across Message Group 2 (Source)
3	Produce across Message Group 3

Table 4-41　Initial Consume characteristics

Bit	Description
0	Consume across Message Group 1
1	Consume across Message Group 2 (Destination)
2	Consume across Message Group 2 (Source)
3	Consume across Message Group 3

Watchdog Timeout action

Table 4-42　Watchdog Timeout actions

Value	Timeout action	Description
0	Transition to Timed Out	The Connection transitions to the Timed Out state and remains in that state until Deleted or Reset. Invalid value for Explicit Connections.
1	Auto Delete	The Connection Class automatically deletes the Connection if an Inactivity/Watchdog timeout occurs.
2	Auto Reset	The Connection remains in the Established State and restarts the Inactivity/Watchdog timer.
3	Deferred Delete	The Connection transitions to the Deferred Delete state if any child connection instances are in the Established state. If no child connection instances are in the Established state the connection is deleted. This value is invalid for I/O Messaging Connections.

4.8.2 Connection Object services

Table 4-43 Connection Object services for Instance 0

Service Code	Service Name	Service Description
	No services supported	

Table 4-44 Connection Object services for Instances 1–4

Service Code	Service Name	Service Description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.9 Acknowledge Handler Object (0x2B)

The Acknowledge Handler Object is used in conjunction with the acknowledged Cyclic I/O Connection type. With this connection type, the Master acknowledges the receipt of data produced by the Slave. The Acknowledge Handler is responsible for managing retries and timeouts if the acknowledgment message from the Master is not received.

4.9.1 Acknowledge Handler Object attributes

Table 4-45 Acknowledge Handler attributes for Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV	Revision of this class of object	If updates that require an increase in this value are made, then the value of this attribute increases by 1.

Table 4-46 Acknowledge Handler attributes for Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Acknowledge Timer	UINT	Set		Time to wait for acknowledge before resending	
2	Retry Limit	USINT	Set		Number of Acknowledge Timeouts to wait before indicating to the producing connection that a timeout has occurred	

4.9.2 Acknowledge Handler Object services

Table 4-47 **Acknowledge Handler Object services for Instance 0**

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-48 **Acknowledge Handler Object services for Instances 1–120**

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.10 Analog Input Point Object (0x0A)

The Analog Input Point Object is responsible for reporting sensor values. The object also contains configuration data related to the sensor.

4.10.1 Instances and attributes

Table 4-49 **Analog Input Point Object (0x0A) – Instance 0**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		
100	Start/stop totals	USINT	Set	V	Starts and stops all totalizers and inventories	• 0 = Stop • 1 = Start
101	Reset process totalizers	USINT	Set	V	Resets all totalizers	• 1 = Reset
102	Reset process inventories	USINT	Set	V	Resets all inventories	• 1 = Reset

Table 4-50 **Analog Input Point Object (0x0A) – Instance 1 (mass flow)**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
3	Value	REAL	Get	V	Current value of mass flow process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report mass flow process variable	• 1 = REAL
100	Process total	REAL	Get Reset	V	Current value of mass total	
101	Inventory total	REAL	Get Reset	V	Current value of mass inventory	

Configuration Data

Table 4-50 **Analog Input Point Object (0x0A) – Instance 1 (mass flow)** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
102	Value engineering units	UINT	Set	NV	Mass flow measurement unit	See Table 4-95 for unit codes.
103	Total engineering units	UINT	Get	V	Mass total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table 4-96 for unit codes
104	Damping	REAL	Set	NV	Flow damping value	• Unit: seconds • Applied to both mass flow and liquid volume flow
105	Cutoff	REAL	Set	NV	Value below which mass flow will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated mass flow	
107	Flow direction	USINT	Set	NV	Determines how flow direction affects reported flow rate and flow totals	• 0 = Forward Only • 1 = Reverse Only • 2 = Bidirectional • 3 = Absolute Value • 4 = Negate/Forward Only • 5 = Negate/ Bidirectional
108	Reset mass total	USINT	Set	V	Resets the mass total	• 1 = Reset
109	Reset mass inventory	USINT	Set	V	Resets the mass inventory	• 1 = Reset

Table 4-51 **Analog Input Point Object (0x0A) – Instance 2 (liquid volume flow)**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
3	Value	REAL	Get	V	Current value of liquid volume flow process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report volume flow process variable	• 1 = REAL
100	Process total	REAL	Get Reset	V	Current value of liquid volume total	
101	Inventory total	REAL	Get Reset	V	Current value of liquid volume inventory	
102	Value engineering units	UINT	Set	NV	Liquid volume flow measurement unit	See Table 4-97 for unit codes.

Configuration Data

Attrib ID	Name	Data type	Service	Mem	Description	Notes
103	Total engineering units	UINT	Get	V	Liquid volume total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table 4-98 for unit codes.
105	Cutoff	REAL	Set	NV	Value below which liquid volume flow will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated liquid volume flow	
108	Reset volume total	USINT	Set	V	Resets the volume total	• 1 = Reset
109	Reset volume inventory	USINT	Set	V	Resets the volume inventory	• 1 = Reset

Table 4-52 **Analog Input Point Object (0x0A) – Instance 3 (density)**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
3	Value	REAL	Get	V	Current value of density process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report density process variable	• 1 = REAL
102	Value engineering units	UINT	Set	NV	Density measurement unit	See Table 4-101 for unit codes.
104	Damping	REAL	Set	NV	Density damping value	Unit: seconds
105	Cutoff	REAL	Set	NV	Value below which density will be reported as 0	
106	Meter factor	REAL	Set	NV	A multiplier to the calculated density	

Table 4-53 Analog Input Point Object (0x0A) – Instance 4 (temperature)

Attrib ID	Name	Data type	Service	Mem	Description	Notes
3	Value	REAL	Get	V	Current value of temperature process variable	Based on Attribute 8
4	Status	BOOL	Get	V	Point status	• 0 = Good • 1 = Alarm state
8	Value data type	USINT	Get	V	Data type used to report mass flow process variable	• 1 = REAL
102	Value engineering units	UINT	Set	NV	Temperature measurement unit	See Table 4-102 for unit codes.
104	Damping	REAL	Set	NV	Temperature damping value	Unit: seconds

4.10.2   Analog Input Point Object Services

Table 4-54 Analog Input Point Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-55 Analog Input Point Object services for Instance 1 (mass flow)

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x32	Reset mass total	Resets the mass total	No data
0x33	Reset mass inventory	Resets the mass inventory	No data

Table 4-56 Analog Input Point Object services for Instance 2 (liquid volume flow)

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x32	Reset volume total	Resets the liquid volume total	No data
0x33	Reset volume inventory	Resets the liquid volume inventory	No data

Table 4-57 Analog Input Point Object services for Instance 3 (density)

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

Table 4-58 Analog Input Point Object services for Instance 4 (temperature)

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.11 Gas Standard Volume Object (0x64)

The Gas Standard Volume Object reports the gas standard volume process values and totals. It also contains gas standard volume configuration data.

4.11.1 Instances and attributes

Table 4-59 Gas Standard Volume Object (0x64) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-60 Gas Standard Volume Object (0x64) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Gas standard volume flow	REAL	Get	V	Current value of gas standard volume flow process variable	
2	Gas standard volume total	REAL	Get Reset	V	Current value of gas standard volume total	
3	Gas standard volume inventory	REAL	Get Reset	V	Current value of gas standard volume inventory	
4	Reference density	REAL	Set	NV	Reference density of gas being measured	
5	Gas standard volume flow units	UINT	Set	NV	Gas standard volume flow measurement unit	See Table 4-99 for unit codes.
6	Gas standard volume total and inventory units	UINT	Get	V	Gas standard volume total and inventory units	Transmitter automatically determines this based on Attribute 102. See Table 4-100 for unit codes.

Table 4-60 **Gas Standard Volume Object (0x64) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
7	Enable gas standard volume	BOOL	Set	NV	Enable or disable gas standard volume measurement[1]	• 0 = Disabled • 1 = Enabled
8	Gas standard volume low flow cutoff	REAL	Set	NV	Value below which gas standard volume flow will be reported as 0	
9	Reset gas standard volume total	USINT	Set	V	Resets the gas standard volume total	• 1 = Reset
10	Reset gas standard volume inventory	USINT	Set	V	Resets the gas standard volume inventory	• 1 = Reset

(1) If gas standard volume measurement is enabled, liquid volume measurement is disabled, and vice versa.

4.11.2 Gas Standard Volume Object services

Table 4-61 **Gas Standard Volume Object services for Instance 0**

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-62 **Gas Standard Volume Object services for Instance 1**

Service Code	Service Name	Service Description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4B	Reset gas standard volume total	Resets the gas standard volume total	No data
0x4C	Reset gas standard volume inventory	Resets the gas standard volume inventory	No data

4.12 Calibration Object (0x65)

The Calibration Object contains calibration configuration data.

4.12.1 Instances and attributes

Table 4-63 Calibration Object (0x65) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-64 Calibration Object (0x65) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Flow calibration factor	REAL	Set	NV	6-character flow calibration factor	
2	Temperature coefficient for flow	REAL	Set	NV	4-character temperature coefficient	
3	Zero time	UINT	Set	V	Duration of the zero calibration procedure	Unit: seconds
4	Zero standard deviation	REAL	Get	NV	The standard deviation result of the zero calibration service	
5	Zero offset	REAL	Set	NV	The offset result of the zero calibration service	
6	Calibration failed value	REAL	Get	V	The value of the calibration parameter if one of the calibration services fails	
7	K1	REAL	Set	NV	Density calibration constant 1	Unit: milliseconds
8	K2	REAL	Set	NV	Density calibration constant 2	Unit: milliseconds
9	FD	REAL	Set	NV	Flowing density calibration constant	Unit: milliseconds
10	K3	REAL	Set	NV	Density calibration constant 3	Unit: milliseconds
11	K4	REAL	Set	NV	Density calibration constant 4	Unit: milliseconds
12	D1	REAL	Set	NV	The line-condition density of D1 calibration service	Unit: g/cm^3
13	D2	REAL	Set	NV	The line-condition density of D2 calibration service	Unit: g/cm^3
14	FD	REAL	Set	NV	The line-condition density of FD calibration service	Unit: g/cm^3
15	D3	REAL	Set	NV	The line-condition density of D3 calibration service	Unit: g/cm^3
16	D4	REAL	Set	NV	The line-condition density of D4 calibration service	Unit: g/cm^3

Table 4-64 Calibration Object (0x65) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
17	Density temperature coefficient	REAL	Set	NV	The DT or TC calibration factor	
18	FTG	REAL	Set	NV	T-Series: flow TG coefficient	
19	FFQ	REAL	Set	NV	T-Series: flow FQ coefficient	
20	DTG	REAL	Set	NV	T-Series: density TG coefficient	
21	DFQ1	REAL	Set	NV	T-Series: density FQ coefficient #1	
22	DFQ2	REAL	Set	NV	T-Series: density FQ coefficient #2	
23	Temperature offset	REAL	Set	NV	Temperature offset	
24	Temperature slope	REAL	Set	NV	Temperature slope	
25	Enable temperature comp	BOOL	Set	NV	Enable or disable temperature compensation	• 0 = Disabled • 1 = Enabled
26	External temperature	REAL	Set	V	The external temperature value from output assembly instance 51 or 52	
27	Enable pressure compensation	BOOL	Set	NV	Enable or disable pressure compensation	• 0 = Disabled • 1 = Enabled
28	External pressure	REAL	Set	V	The external pressure value from output assembly instance 50 or 52	
29	Pressure units	UINT	Set	NV	Units used by external pressure input	See Table 4-103 for unit codes.
30	Pressure factor flow	REAL	Set	NV	The pressure correction factor for flow	
31	Pressure factor density	REAL	Set	NV	The pressure correction factor for density	
32	Flow cal pressure	REAL	Set	NV	The flow calibration pressure	

4.12.2 Calibration Object services

Table 4-65 Calibration Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-66 Calibration Object services for Instance 1

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4B	Zero calibration	Perform or abort zero calibration	See Section 4.12.3.
0x4C	D1 calibration	Perform low-density calibration	No data
0x4D	D2 calibration	Perform high-density calibration	No data
0x4E	FD calibration	Perform flowing-density calibration	No data
0x4F	D3 calibration	Perform third-point calibration (T-Series sensors only)	No data
0x50	D4 calibration	Perform fourth-point calibration (T-Series sensors only)	No data

4.12.3 Zero service details

Table 4-67 Calibration Object Zero service request

Parameter name	Data type	Required	Parameter value	Semantics
Action	USINT	N	0	Abort zero calibration
			1	Start zero calibration

Table 4-68 Calibration Object Zero service response

Parameter name	Data type	Required	Parameter value	Semantics
		NO RESPONSE DATA		

4.13 Diagnostics Object (0x66)

The Diagnostics Object is responsible for reporting diagnostic data. The object also contains diagnostic configuration data.

4.13.1 Instances and attributes

Table 4-69 Diagnostics Object (0x66) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-70 **Diagnostics Object (0x66) – Instance 1**

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Fault behavior	USINT	Set	NV	Specifies the behavior of the process variables when the device is in a fault state	• 0 = Upscale • 1 = Downscale • 2 = Zero • 3 = NAN • 4 = Flow goes to zero • 5 = None
2	Fault timeout	USINT	Set	NV	The amount of time after a fault occurs before the fault behavior (Attribute 1) is implemented	Unit: seconds
3	Slug time	REAL	Set	NV	The amount of time the density is outside the slug low limit and slug high limit before a slug flow condition is declared	Unit: seconds
4	Slug low limit	REAL	Set	NV	The lower limit of a slug flow condition	Unit: g/cm^3
5	Slug high limit	REAL	Set	NV	The upper limit of a slug flow condition	Unit: g/cm^3
6	Discrete event index	USINT	Set	V	The index of the discrete event that is being configured. There are 5 discrete events with the index starting at 0.	0, 1, 2, 3, 4
7	Discrete event type	USINT	Set	NV	The type of the selected discrete event	• 0 = Greater than Setpoint A • 1 = Less than Setpoint A • 2 = In Range ($A=<x<=B$) • 3 = Out of Range ($A>=x$ or $B<=x$)
8	Discrete event Setpoint A	REAL	Set	NV	Setpoint A of the selected discrete event	
9	Discrete event Setpoint B	REAL	Set	NV	Setpoint B of the selected discrete event	
10	Discrete event process variable	USINT	Set	NV	The process variable on which the selected discrete event is defined	See Table 4-105 for process variable codes. All codes are valid except for 52 (Input voltage).
11	Discrete event status	USINT	Get	V	Each bit contains the status of the corresponding discrete event: • 0 = Inactive • 1 = Active	• 0x01 = Event 0 • 0x02 = Event 1 • 0x04 = Event 2 • 0x08 = Event 3 • 0x10 = Event 4

Table 4-70 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
12	Alarm status 1	UINT	Get	V	A collection of status bits	• 0x0001 = NV error (CP) • 0x0002 = RAM error (CP) • 0x0004 = RTI failure • 0x0008 = Sensor failure • 0x0010 = Temperature out of range • 0x0020 = Calibration failed • 0x0040 = Other failure • 0x0080 = Transmitter initializing • 0x0100 = Not used • 0x0200 = Not used • 0x0400 = Simulation mode On • 0x0800 = Not used • 0x1000 = Watchdog error • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Fault
13	Alarm status 2	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Density out of range • 0x0020 = Drive out of range • 0x0040 = CEM communications error • 0x0080 = Not used • 0x0100 = Non-volatile memory error (CP) • 0x0200 = RAM error (CP) • 0x0400 = Sensor failure • 0x0800 = Temperature out of range • 0x1000 = Input out of range • 0x2000 = Not used • 0x4000 = Transmitter not characterized • 0x8000 = RTI failure

Table 4-70   Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
14	Alarm status 3	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Power reset • 0x0004 = Transmitter initializing • 0x0008 = Transmitter/sensor communications fault (A28) • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Transmitter/sensor communications fault (A26) • 0x0100 = Calibration failed • 0x0200 = Calibration failed: Low • 0x0400 = Calibration failed: High • 0x0800 = Calibration failed: Noisy • 0x1000 = Transmitter failed • 0x2000 = Data loss • 0x4000 = Calibration in progress • 0x8000 = Slug flow

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Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
15	Alarm status 4	UINT	Get	V	A collection of status bits	• 0x0001 = Petroleum measurement: Temperature out of range • 0x0002 = Petroleum measurement: Density out of range • 0x0004 = Line RTD out of range • 0x0008 = Meter RTD out of range • 0x0010= Reverse flow • 0x0020 = Factory data error • 0x0040 = ED: bad curve • 0x0080 = LMV override • 0x0100 = ED: Extrapolation error • 0x0200 = Need calibration factor • 0x0400 = Non-volatile memory error (2700) • 0x0800 = RAM error (2700) • 0x1000= Transmitter not characterized • 0x2000 = Non-volatile memory error (CP) • 0x4000 = Non-volatile memory error (CP) • 0x8000 = Non-volatile memory error (CP)

Table 4-70 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
16	Alarm status 5	UINT	Get	V	A collection of status bits	• 0x0001 = Boot sector (CP) • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = D3 calibration in progress • 0x0200 = D4 calibration in progress • 0x0400 = Temperature slope calibration in progress • 0x0800 = Temperature offset calibration in progress • 0x1000 = FD calibration in progress • 0x2000 = D2 calibration in progress • 0x4000 = D1 calibration in progress • 0x8000 = Zero calibration in progress
17	Alarm status 6	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = Discrete event 0 active • 0x0200 = Discrete event 1 active • 0x0400 = Discrete event 2 active • 0x0800 = Discrete event 3 active • 0x1000 = Discrete event 4 active • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Incorrect board type
18	Alarm index	USINT	Set	V	Used to configure or read alarm severity, or to acknowledge alarms	See Table 4-106 for alarm index codes.
19	Alarm severity	USINT	Set	NV	The alarm severity of the alarm that corresponds with the alarm index	• 0 = Ignore • 1 = Info • 2 = Fault
20	Drive gain	REAL	Get	V	The drive gain	%
21	Raw tube period	REAL	Get	V	The tube frequency	Unit: Hz

Table 4-70 **Diagnostics Object (0x66) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
22	Live zero (mass flow)	REAL	Get	V	The unfiltered value of mass flow	Configured mass flow units
23	LPO voltage	REAL	Get	V	The left pickoff voltage	Unit: volts
24	RPO voltage	REAL	Get	V	The right pickoff voltage	Unit: volts
25	Board temperature	REAL	Get	V	The temperature on the board	Unit: ohms
26	Maximum electronics temperature	REAL	Get	V	The maximum temperature of the electronics	Unit: °C
27	Minimum electronics temperature	REAL	Get	V	The minimum temperature of the electronics	Unit: °C
28	Average electronics temperature	REAL	Get	V	The average temperature of the electronics	Unit: °C
29	Maximum sensor temperature	REAL	Get	V	The maximum temperature of the sensor	Unit: °C
30	Minimum sensor temperature	REAL	Get	V	The minimum temperature of the sensor	Unit: °C
31	Average sensor temperature	REAL	Get	V	The average temperature of the sensor	Unit: °C
32	9-wire cable RTD resistance	REAL	Get	V	The resistance of the 9-wire cable	Unit: ohms
33	Meter RTD resistance	REAL	Get	V	The resistance of the meter RTD	Unit: ohms
34	Number of power cycles	UINT	Get	V	The number of transmitter power cycles	
35	Power on time	Unsigned 32	Get Reset	V	The cumulative amount of time the transmitter has been on since the last reset (Class 0x01, Attribute 0x05)	Seconds since last reset
36	Line RTD	REAL	Get	V	The resistance of the process line RTD	Unit: ohms
37	Actual target amplitude	REAL	Get	V	The amplitude the transmitter is attempting to drive the sensor	Unit: mV/HZ
38	Input voltage	REAL	Get	V	The number of volts on the power input terminals	Unit: volts
39	Drive current	REAL	Get	V	The drive current	Unit: milliamps

Table 4-70 Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
40	Alarm 7	UINT	Get	V	A collection of status bits	• 0x0001 = K1/FCF combination unrecognized • 0x0002 = Transmitter warming up • 0x0004 = Low power • 0x0008 = Tube not full • 0x0010 = Meter verification: outputs set to fault • 0x0020 = Meter verification: outputs set to last value • 0x0040 =UI PROM error • 0x0080 = Not used • 0x0100 = Not used 0x0200 = Not used • 0x0400 = Not used • 0x0800 = Not used • 0x1000 = Not used • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Not used
41	Alarm 8	UINT	Get	V	A collection of status bits	• 0x0001 = Not used • 0x0002 = Not used • 0x0004 = Not used • 0x0008 = Not used • 0x0010 = Not used • 0x0020 = Not used • 0x0040 = Not used • 0x0080 = Not used • 0x0100 = Not used • 0x0200 = Not used • 0x0400 = Not used • 0x0800 = Not used • 0x1000 = Not used • 0x2000 = Not used • 0x4000 = Not used • 0x8000 = Not used
42	Alarm status	USINT	Set	V	The status of the alarm selected in Attribute 18. Write 0x00 to acknowledge the alarm selected in Attribute 18.	• 0x00 = Acknowledged, cleared • 0x01 = Acknowledged, active • 0x10 = Not acknowledged, cleared • 0x11 = Not acknowledged, active
43	Alarm count	UINT	Get	V	The number of inactive-to-active transitions of the alarm selected in Attribute 18	
44	Alarm last posted	Unsigned 32	Get	V	The number of seconds since the last reset that the alarm selected in Attribute 18 was posted	Seconds since last reset

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Table 4-70 **Diagnostics Object (0x66) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
45	Alarm last cleared	Unsigned 32	Get	V	The number of seconds since the last reset that the alarm selected in Attribute 18 was cleared	Seconds since last reset
46	Alarm history index	USINT	Set	V	The entry in the alarm history log	Range: 0–49
47	Alarm history alarm number	USINT	Get	V	The alarm number that corresponds to the alarm history entry selected in Attribute 45	1 = A001, 2 = A002, etc.
48	Alarm history alarm status changed	USINT	Get	V	The alarm status change that corresponds to the alarm history entry selected in Attribute 45	• 1 = Posted • 2 = Cleared
49	Alarm history alarm status changed timestamp	Unsigned 32	Get	V	The timestamp of the alarm status change that corresponds to the alarm history entry selected in Attribute 45	Seconds since last reset
54	Meter verification algorithm state	USINT	Get	V	The current state of the meter verification routine	1–18
55	Meter verification abort code	USINT	Get	V	The reason the meter verification routine aborted	• 0 = No error • 1 = Manual abort • 2 = Watchdog timeout • 3 = Frequency drift • 4 = High peak drive voltage • 5 = High drive current standard deviation • 6 = High drive current mean • 7 = Drive loop reported error • 8 = High Delta T standard deviation • 9 = High Delta T value • 10 = State running • 11 = Verification complete • 12 = Wrong verification enable • 13 = No factory air verification • 14 = No factory water verification • 15 = Parameters not set
56	Meter verification algorithm state at abort	USINT	Get	V	The state of the meter verification routine when it aborted	1–18
57	Meter verification percent complete	USINT	Get	V	The progress of the meter verification routine	%

Configuration Data

Table 4-70 **Diagnostics Object (0x66) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
58	Meter verification outputs state	USINT	Set	NV	The state of the outputs when the meter verification routine is running	• 0 = Last value • 1 = Fault
59	Meter verification stiffness limit	REAL	Set	NV	The setpoint of the stiffness limit. Represents percentage.	Unitless
60	Meter verification validation counter	UINT	Get	NV	Indicates the number of times the meter verification routine has successfully completed	
61	Meter verification inlet stiffness out of limits	USINT	Get	V	Is the inlet stiffness out of limits?	• 0 = No • 1 = Yes
62	Meter verification outlet stiffness out of limits	USINT	Get	V	Is the outlet stiffness out of limits?	• 0 = No • 1 = Yes
63	Meter verification – current inlet stiffness, mean	REAL	Get	NV	The current inlet stiffness calculated as a mean	
64	Meter verification - current outlet stiffness, mean	REAL	Get	NV	The current outlet stiffness calculated as a mean	
65	Meter verification – current damping, mean	REAL	Get	NV	The current damping calculated as a mean	
66	Meter verification – current inlet mass, mean	REAL	Get	NV	The current inlet mass calculated as a mean	
67	Meter verification – current outlet mass, mean	REAL	Get	NV	The current outlet mass calculated as a mean	
68	Meter verification – current inlet stiffness, SD	REAL	Get	NV	The current inlet stiffness calculated as a standard deviation	
69	Meter verification – current outlet stiffness, SD	REAL	Get	NV	The current outlet stiffness calculated as a standard deviation	
70	Meter verification – current damping, SD	REAL	Get	NV	The current damping calculated as a standard deviation	
71	Meter verification – current inlet mass, SD	REAL	Get	NV	The current inlet mass calculated as a standard deviation	

Configuration Data

Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
72	Meter verification – current outlet mass, SD	REAL	Get	NV	The current outlet mass calculated as a standard deviation	
73	Meter verification – current inlet stiffness, factory cal of air, mean	REAL	Get	NV	The inlet stiffness calculated as a mean during factory calibration of air	
74	Meter verification – current outlet stiffness, factory cal of air, mean	REAL	Get	NV	The outlet stiffness calculated as a mean during factory calibration of air	
75	Meter verification – current damping, factory cal of air, mean	REAL	Get	NV	The damping calculated as a mean during factory calibration of air	
76	Meter verification – current inlet mass, factory cal of air, mean	REAL	Get	NV	The inlet mass calculated as a mean during factory calibration of air	
77	Meter verification – current outlet mass, factory cal of air, mean	REAL	Get	NV	The outlet mass calculated as a mean during factory calibration of air	
78	Meter verification inlet stiffness, factory cal of water, mean	REAL	Get	NV	The inlet stiffness calculated as a mean during factory calibration of water	
79	Meter verification outlet stiffness, factory cal of water, mean	REAL	Get	NV	The outlet stiffness calculated as a mean during factory calibration of water	
80	Meter verification – current damping, factory cal of water, mean	REAL	Get	NV	The damping calculated as a mean during factory calibration of water	
81	Meter verification – current inlet mass, factory cal of water, mean	REAL	Get	NV	The inlet mass calculated as a mean during factory calibration of water	
82	Meter verification – current outlet mass, factory cal of water, mean	REAL	Get	NV	The outlet mass calculated as a mean during factory calibration of water	

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Table 4-70   **Diagnostics Object (0x66) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
83	Factory flow signal offset at zero flow	REAL	Get	NV	The flow signal offset at zero flow when calibrated at the factory	Unit: microseconds
84	Discrete event action code	USINT	Set	V	The action that will be performed by the event specified in Attribute 85	• 1 = Start sensor zero • 2 = Reset mass total • 3 = Reset volume total • 4 = Reset PM volume total • 5 = Reset ED volume total • 6 = Reset ED net mass total • 7 = Reset ED net volume total • 8 = Reset all totals • 9 = Start/stop all totals • 18 = Increment ED curve • 21 = Reset GSV total
85	Discrete event assignment	USINT	Set	NV	The discrete event that is assigned to the action referenced in Attribute 84	• 57 = Discrete event 1 • 58 = Discrete event 2 • 59 = Discrete event 3 • 60 = Discrete event 4 • 61 = Discrete event 5 • 251 = None
86[1]	Start meter verification and continue measuring outputs	UINT	Set	V	Start a meter verification test with outputs set to Continue Measurement	• 1 = Start
87[1]	SMV datalog index	UINT	Set	V	Record index for the meter verification datalog	0–19 0 = Most recent test
88[1]	SMV datalog run number	UINT	Get	NV	Run number for indexed record	
89[1]	SMV datalog status	USINT	Get	NV	Run status for indexed record	• Bit 7 = Pass/Fail • Bits 6–4 = State • Bits 3–0 = Abort code (abort states are compressed to fit)
90[1]	SMV datalog time initiated	UDINT	Get	NV	Start time for indexed record	

Table 4-70   Diagnostics Object (0x66) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
91[1]	SMV datalog LPO normalized data	REAL	Get	NV	Normalized input value for the indexed record	
92[1]	SMV datalog RPO normalized data	REAL	Get	NV	Normalized output value for the indexed record	
93[1]	Time until first run	REAL	Set	NV	Time until the first scheduled meter verification test	Unit: Hours
94[1]	Time between each run after the first	REAL	Set	NV	After the first test, time between each scheduled meter verification test	Unit: Hours
95[1]	Time until next run	REAL	Get	V	Time remaining until the next meter verification test	Unit: Hours

(1) Requires Smart Meter Verification.

4.13.2   Diagnostics Object services

Table 4-71   Diagnostic Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-72   Diagnostics Object services for Instance 1

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4D	Reset Power On Time		No data
0x4E	Acknowledge All Alarms		No data
0x4F	Reset Alarm History Log		No data

Table 4-72   Diagnostics Object services for Instance 1

Service code	Service name	Service description	Details
0x50	Meter Verification		See Section 4.13.3.
0x51	Master Reset		No data
0x52	Restore Factory Zero		No data

4.13.3   Service Details: Meter Verification service

Table 4-73   Service arguments

Parameter name	Data type	Required	Parameter value
Action	USINT	No	• 0 = Abort meter verification • 1 = Start normal meter verification • 6 = Start meter verification with outputs set to Continue Measurement[1]

(1) Requires Smart Meter Verification.

4.14   Sensor Information Object (0x67)

The Sensor Information Object contains data related to the sensor.

4.14.1   Instances and attributes

Table 4-74   Sensor Information Object (0x67) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-75   Sensor Information Object (0x67) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Sensor serial number	UDINT	Set	NV	The serial number of the sensor	
2	Sensor type	SHORT STRING	Get	NV	A string that represents the type of sensor	For example, F200, CMF025
3	Sensor type code	USINT	Set	NV	The type of sensor	• 0 = Curved Tube • 1 = Straight Tube
4	Sensor material	USINT	Set	NV	The material of the sensor's case	• 0 = None • 3 = Hastelloy C-22 • 4 = Monel • 5 = Tantalum • 6 = Titanium • 19 = 316L stainless steel • 23 = Inconel • 252 = Unknown • 253 = Special

Table 4-75 Sensor Information Object (0x67) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
5	Liner material	USINT	Set	NV	The material of the sensor's liner	• 0 = None • 10 = PTFE (Teflon) • 11 = Halar • 16 = Tefzel • 251 = None • 252 = Unknown • 253 = Special
6	Flange type	USINT	Set	NV	The type of process connection on the sensor	• 0 = ANSI 150 • 1 = ANSI 300 • 2 = ANSI 600 • 5 = PN 40 • 7 = JIS 10K • 8 = JIS 20K • 9 = ANSI 900 • 10 = Sanitary clamp fitting • 11 = Union • 12 = PN 100 • 252 = Unknown • 253 = Special
7	Mass flow high limit	REAL	Get	V	The mass flow high limit of sensor	
8	Mass flow low limit	REAL	Get	V	The mass flow low limit of sensor	
9	Mass flow minimum range	REAL	Get	V	The mass flow minimum range	
10	Temperature high limit	REAL	Get	V	The temperature high limit of sensor	
11	Temperature low limit	REAL	Get	V	The temperature low limit of sensor	
12	Temperature minimum range	REAL	Get	V	The temperature minimum range	
13	Density high limit	REAL	Get	V	The density high limit of sensor	Unit: g/cm^3
14	Density low limit	REAL	Get	V	The density low limit of sensor	Unit: g/cm^3
15	Density minimum range	REAL	Get	V	The density minimum range	Unit: g/cm^3
16	Volume flow high limit	REAL	Get	V	The volume flow high limit of sensor	
17	Volume flow low limit	REAL	Get	V	The volume flow low limit of sensor	
18	Volume flow minimum range	REAL	Get	V	The volume flow minimum range of sensor	

4.14.2   Sensor Information Object services

Table 4-76 Sensor Information Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-77   Sensor Information Object services for Instance 1

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.15   Local Display Object (0x68)

The Local Display Object contains configuration data for the local display.

4.15.1   Instances and attributes

Table 4-78   Local Display Object (0x68) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-79   Local Display Object (0x68) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Scroll rate	USINT	Set	NV	The rate at which each variable will be displayed	Unit: seconds
2	Backlight control	BOOL	Set	NV	Whether the backlight is on or off	• 0 = Off • 1 = On
3	Backlight intensity	USINT	Set	NV	The brightness of the backlight	0 (off) to 63 (full on)
4	Display variable 1	USINT	Set	V	Displays the variable associated with the code on the local display	See Table 4-105 for display variable codes. All codes are valid except for 251 (None).

Table 4-79 **Local Display Object (0x68) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
5	Display variable 2	USINT	Set	NV	Displays the variable associated with the code on the local display	See Table 4-105 for display variable codes. All codes are valid.
6	Display variable 3					
7	Display variable 4					
8	Display variable 5					
9	Display variable 6					
10	Display variable 7					
11	Display variable 8					
12	Display variable 9					
13	Display variable 10					
14	Display variable 11					
15	Display variable 12					
16	Display variable 13					
17	Display variable 14					
18	Display variable 15					
19	Enable start/stop totals	BOOL	Set	NV	Enable or disable the ability to start and stop totals from the local display	• 0 = Disabled • 1 = Enabled
20	Enable reset totals	BOOL	Set	NV	Enable or disable the ability to reset totals from the local display	• 0 = Disabled • 1 = Enabled
21	Enable auto scroll	BOOL	Set	NV	Enable or disable the auto scroll feature. The scroll rate is set using Attribute 1.	• 0 = Disabled • 1 = Enabled
22	Enable offline menu	BOOL	Set	NV	Enable or disable the offline menu	• 0 = Disabled • 1 = Enabled
23	Enable alarm menu	BOOL	Set	NV	Enable or disable the alarm menu	• 0 = Disabled • 1 = Enabled
24	Enable ACK All alarms	BOOL	Set	NV	Enable or disable the ability to acknowledge all the alarms at once	• 0 = Disabled • 1 = Enabled
25	Enable IrDA write protect	BOOL	Set	NV	Enable or disable the write-protect feature on the IrDA port	• 0 = Disabled (reading and writing allowed) • 1 = Enabled (read only)

Table 4-79 Local Display Object (0x68) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
26	Enable offline password	BOOL	Set	NV	Enable or disable the password requirement to access the offline menu	• 0 = Disabled • 1 = Enabled
27	Offline password	UINT	Set	NV	The offline password for entering the offline menu	0–9999
28	Update period	UINT	Set	NV	The period in which the display is updated	Unit: milliseconds
29	Process variable index	USINT	Set	V	The process variable in which the precision will be set in Attribute 30	See Table 4-105 for process variable codes.
30	Process variable precision	USINT	Set	NV	The number of digits displayed to the right of the decimal point for the process variable selected with Attribute 29	0–5
31	Language	USINT	Set	NV	Display language selection	• 0 = English • 1 = German • 2 = French • 3 = Katakana[1] • 4 = Spanish
32	Enable IrDA port	USINT	Set	NV	Enable or disable the IrDA port	• 0 = Disabled • 1 = Enabled

(1) Not available in this release.

4.15.2 Local Display Object Services

Table 4-80 Local Display Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-81 Local Display Object services for Instance 1

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute
0x10	Set Attribute Single	Sets the contents of the specified attribute

4.16 Petroleum Measurement Object (0x69)

The Petroleum Measurement Object is responsible for reporting petroleum measurement process values and totals. The object also contains configuration data for the petroleum measurement application.

4.16.1 Instances and attributes

Table 4-82 Petroleum Measurement Object (0x69) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-83 Petroleum Measurement Object (0x69) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Temperature corrected density	REAL	Get	V	Current value	
2	Temperature corrected (standard) volume flow	REAL	Get	V	Current value	
3	Temperature corrected (standard) volume total	REAL	Get Reset	V	Current value	
4	Temperature corrected (standard) volume inventory	REAL	Get Reset	V	Current value	
5	Batch weighted average density	REAL	Get	V	Current value	
6	Batch weighted average temperature	REAL	Get	V	Current value	
7	CTL	REAL	Get	V	Current value	
8	Reference temperature	REAL	Set	NV	The reference temperature to use in the petroleum measurement calculations	
9	Thermal expansion coefficient	REAL	Set	NV	The thermal expansion coefficient to use in the petroleum measurement calculations	

Table 4-83 **Petroleum Measurement Object (0x69) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
10	API 2540 CTL table type	USINT	Set	NV	The table type to use in the petroleum measurement calculations	• 17 = Table 5A • 18 = Table 5B • 19 = Table 5D • 36 = Table 6C • 49 = Table 23A • 50 = Table 23B • 51 = Table 23D • 68 = Table 24C • 81 = Table 53A • 82 = Table 53B • 83 = Table 53D • 100 = Table 54C
11	Reset reference volume total	USINT	Set	V	Resets the petroleum measurement reference volume total	• 1 = Reset
12	Reset reference volume inventory	USINT	Set	V	Resets the petroleum measurement reference volume inventory	• 1 = Reset

4.16.2 Petroleum Measurement Object services

Table 4-84 **Petroleum Measurement Object services for Instance 0**

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-85 **Petroleum Measurement Object services for Instance 1**

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4B	Reset Reference Volume Total	Resets the petroleum measurement reference volume total	No data
0x4C	Reset Reference Volume Inventory	Resets the petroleum measurement reference volume inventory	No data

4.17 Concentration Measurement Object (0x6A)

The Concentration Measurement Object is responsible for reporting concentration measurement process values and totals. The object also contains configuration data for the concentration measurement application.

4.17.1 Instances and attributes

Table 4-86 Concentration Measurement Object (0x6A) – Instance 0

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Revision	UINT	Get	NV		

Table 4-87 Concentration Measurement Object (0x6A) – Instance 1

Attrib ID	Name	Data type	Service	Mem	Description	Notes
1	Density at reference	REAL	Get	V	Current value	
2	Density (fixed SG units)	REAL	Get	V	Current value	
3	Standard volume flow rate	REAL	Get	V	Current value	
4	Standard volume total	REAL	Get Reset	V	Current value	
5	Standard volume inventory	REAL	Get Reset	V	Current value	
6	Net mass flow rate	REAL	Get	V	Current value	
7	Net mass flow total	REAL	Get Reset	V	Current value	
8	Net mass flow inventory	REAL	Get Reset	V	Current value	
9	Net volume flow rate	REAL	Get	V	Current value	
10	Net volume flow total	REAL	Get Reset	V	Current value	
11	Net volume flow inventory	REAL	Get Reset	V	Current value	
12	Concentration	REAL	Get	V	Current value	
13	Density (fixed Baume units)	REAL	Get	V	Current value	
14	Lock concentration measurement tables	BOOL	Set	NV	Allows the user to write-protect the curves	• 0 = Not locked • 1 = Locked

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Table 4-87 **Concentration Measurement Object (0x6A) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
15	Concentration measurement mode	USINT	Set	NV		• 0 = None • 1 = Density at reference temperature • 2 = Specific gravity • 3 = Mass concentration (density) • 4 = Mass concentration (specific gravity) • 5 = Volume concentration (density) • 6 = Volume concentration (specific gravity) • 7 = Concentration (density) • 8 = Concentration (specific gravity)
16	Active calculation curve	USINT	Set	NV	The number of the curve that is currently active	0–5
17	Curve configuration index (n)	USINT	Set	NV	The number of the curve that is currently being configured	0–5
18	$Curve_n$ temperature isotherm index (x-axis)	USINT	Set	NV	The index on the x-axis	0–5
19	$Curve_n$ concentration index (y-axis)	USINT	Set	NV	The index on the y-axis	0–5
20	$Curve_n$ (6x5) temperature $isotherm_x$ value (x-axis)	REAL	Set	NV	The value on the x-axis	
21	$Curve_n$ (6x5) $concentration_Y$ value (label for y-axis)	REAL	Set	NV	The value on the y-axis	
22	$Curve_n$ (6x5) density @ temperature $isotherm_x$, $concentration_Y$	REAL	Set	NV	The density value of the x,y cell	
23	$Curve_n$ (6x5) coeff @ temperature $isotherm_x$, $concentration_Y$	REAL	Set	NV	The coefficient value of the x,y cell	
24	$Curve_n$ (5x1) $concentration_Y$ value (y-axis)	REAL	Set	NV	The value on the y-axis	

Table 4-87 **Concentration Measurement Object (0x6A) – Instance 1** *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
25	Curve$_n$ (5x1) density at concentration$_Y$ (at reference temperature)	REAL	Set	NV	The density value of the y cell	
26	Curve$_n$ (5x1) coeff at concentration$_Y$ (at reference temperature)	REAL	Set	NV	The coefficient value of the y cell	
27	Curve$_n$ reference temperature	REAL	Set	NV	The reference temperature of the active curve	
28	Curve$_n$ SG water reference temperature	REAL	Set	NV	The SG water reference temperature of the active curve	
29	Curve$_n$ SG water reference density	REAL	Set	NV	The SG water reference density of the active curve	
30	Curve$_n$ slope trim	REAL	Set	NV	The slope trim of the active curve	
31	Curve$_n$ offset trim	REAL	Set	NV	The offset trim of the active curve	
32	Curve$_n$ extrapolation alarm limit	REAL	Set	NV	The extrapolation alarm limit of the active curve	%
34	Curve$_n$ concentration units code	UINT	Set	NV	The units of the concentration process variable	See Table 4-104 for concentration unit codes.
35	Maximum fit order for 5x5 curve	USINT	Set	NV	The maximum fit order for the active curve	2, 3, 4, 5
36	Curve$_n$ curve fit results	USINT	Get	V	The curve fit results of the active curve	• 0 = Good • 1 = Poor • 2 = Failed • 3 = Empty
37	Curve$_n$ curve fit expected accuracy	REAL	Get	V	The accuracy the user can expect for the active curve	
38	Curve$_n$ ASCII string	SHORT STRING	Set	NV	The name of the active curve	24 characters maximum
39	Enable concentration measurement application	BOOL	Set	NV		• 0 = Disabled • 1 = Enabled
40	Curve$_n$ (5x1) special density at concentration$_Y$ (at reference temperature)	REAL	Set	NV	The density value of the y cell of the curve	

Table 4-87 Concentration Measurement Object (0x6A) – Instance 1 *continued*

Attrib ID	Name	Data type	Service	Mem	Description	Notes
41	Curve$_n$ (5x1) special density coefficient at concentration$_Y$ (at reference temperature)	REAL	Set	NV	The coefficient value of the y cell of the curve	
42	Curve$_n$ special density concentration units code	UINT	Set	NV	The units of the concentration process variable of the curve	See Table 4-104 for concentration unit codes.
43	Enable density low extrapolation trigger	BOOL	Set	NV	Enable or disable the detection of low density to trigger extrapolation alarm	• 0 = Disabled • 1 = Enabled
44	Enable density high extrapolation trigger	BOOL	Set	NV	Enable or disable the detection of high density to trigger extrapolation alarm	• 0 = Disabled • 1 = Enabled
45	Enable temperature low extrapolation trigger	BOOL	Set	NV	Enable or disable the detection of low temperature to trigger extrapolation alarm	• 0 = Disabled • 1 = Enabled
46	Enable temperature high extrapolation trigger	BOOL	Set	NV	Enable or disable the detection of high temperature to trigger extrapolation alarm	• 0 = Disabled • 1 = Enabled
47	Reset standard volume total	USINT	Set	V	Resets the standard volume total	• 1 = Reset
48	Reset standard volume inventory	USINT	Set	V	Resets the standard volume inventory	• 1 = Reset
49	Reset net mass total	USINT	Set	V	Resets the net mass total	• 1 = Reset
50	Reset net mass inventory	USINT	Set	V	Resets the net mass inventory	• 1 = Reset
51	Reset net volume total	USINT	Set	V	Resets the net volume total	• 1 = Reset
52	Reset net volume inventory	USINT	Set	V	Resets the net volume inventory	• 1 = Reset

4.17.2 Concentration Measurement Object services

Table 4-88 Concentration Measurement Object services for Instance 0

Service code	Service name	Service description
0x0E	Get Attribute Single	Returns the contents of the specified attribute

Table 4-89 **Concentration Measurement Object services for Instance 1**

Service code	Service name	Service description	Details
0x0E	Get Attribute Single	Returns the contents of the specified attribute	
0x10	Set Attribute Single	Sets the contents of the specified attribute	
0x4B	Reset Standard Volume Total	Resets the standard volume total	No data
0x4C	Reset Net Mass Total	Resets the net mass total	No data
0x4D	Reset Net Volume Total	Resets the net volume total	No data
0x4E	Reset All Curve Information	Reset the configurable data associated with each curve	No data
0x4F	Reset Standard Volume Inventory	Resets the standard volume inventory	No data
0x50	Reset Net Mass Inventory	Resets the net mass inventory	No data
0x51	Reset Net Volume Inventory	Resets the net volume inventory	No data

4.18   Get and Set services

The Get Attribute Single and Set Attribute Single services are used with many objects and attributes. Details of these two services are provided below.

4.18.1   Get service

Table 4-90 **Get service arguments**

Parameter name	Data type	Required	Parameter value	Notes
Attribute ID	USINT	Y	The attribute ID of the attribute to be read	No default

Table 4-91 **Get service response**

Return value	Data type
Attribute value	The data type of the returned attributed

4.18.2   Set service

Table 4-92 **Set service arguments**

Parameter name	Data type	Required	Parameter value	Notes
Attribute ID	USINT	Y	The attribute ID of the attribute to be set	No default
Attribute Value	The data type of the attribute being set	Y	The value to which the attribute will be set	No default

Table 4-93 Set service response

Return value	Data type
No success response data	

4.19   DeviceNet data types

Table 4-94 DeviceNet data types

Data type	Size (bytes)	Description	Range
BOOL	1	True/false represented as 0 = false and 1 = true	0, 1
SINT	1	8-bit signed integer	−128 to +127
USINT	1	8-bit unsigned integer	0 to 255
INT	2	16-bit signed integer	−32768 to +32767
UINT	2	16-bit unsigned integer	0 to 65535
DINT	4	32-bit signed integer	−2147483648 to +2147483647
UDINT	4	32-bit unsigned integer	0 to 4294967296
REAL	4	IEEE single-precision floating-point	−3.8E38 to +3.8E38
DREAL	8	IEEE double-precision floating-point	
ENGUNITS	1	Enumerated value representing an engineering unit of measure	4096 to 65535
BYTE	1	8-bit bitfield	N/A
SHORT STRING	Up to 128 bytes	Character array where the first byte is the number of characters in the array, and the subsequent bytes contain the ASCII characters. This is not a NULL terminated string.	N/A

4.20   Measurement unit codes

Table 4-95 Mass flow measurement unit codes

Code	Description
0x0800	Grams per second
0x140F	Grams per minute
0x0801	Grams per hour
0x0802	Kilograms per second
0x0803	Kilograms per minute
0x1410	Kilograms per hour
0x0804	Kilograms per day
0x0805	Metric tons per minute
0x0806	Metric tons per hour
0x0807	Metric tons per day
0x140B	Pounds per second
0x140C	Pounds per minute

Table 4-95   **Mass flow measurement unit codes** *continued*

Code	Description
0x140D	Pounds per hour
0x0808	Pounds per day
0x0809	Short tons (2000 pounds) per minute
0x080A	Short tons (2000 pounds) per hour
0x080B	Short tons (2000 pounds) per day
0x080C	Long tons (2240 pounds) per hour
0x080D	Long tons (2240 pounds) per day

Table 4-96   **Mass totalizer and mass inventory measurement unit codes**

Code	Description
0x2501	Gram
0x2500	Kilogram
0x2503	Metric ton
0x2505	Pound
0x2506	Short ton (2000 pounds)
0x080E	Long ton (2240 pounds)

Table 4-97   **Liquid volume flow measurement unit codes**

Code	Description
0x0814	Cubic feet per second
0x1402	Cubic feet per minute
0x0815	Cubic feet per hour
0x0816	Cubic feet per day
0x1405	Cubic meters per second
0x080F	Cubic meters per minute
0x0810	Cubic meters per hour
0x0811	Cubic meters per day
0x1408	U.S. gallons per second
0x1409	U.S. gallons per minute
0x140A	U.S. gallons per hour
0x0817	U.S. gallons per day
0x0820	Million U.S. gallons per day
0x1406	Liters per second
0x0812	Liters per minute
0x0813	Liters per hour
0x0821	Million liters per day
0x0818	Imperial gallons per second
0x0819	Imperial gallons per minute
0x081A	Imperial gallons per hour

Table 4-97 Liquid volume flow measurement unit codes *continued*

Code	Description
0x081B	Imperial gallons per day
0x081C	Barrels per second[1]
0x081D	Barrels per minute[1]
0x081E	Barrels per hour[1]
0x081F	Barrels per day[1]
0x0853	Beer barrels per second[2]
0x0854	Beer barrels per minute[2]
0x0855	Beer barrels per hour[2]
0x0856	Beer barrels per day[2]

(1) Unit based on oil barrels (42 U.S gallons).
(2) Unit based on beer barrels (31 U.S gallons).

Table 4-98 Liquid volume totalizer and liquid volume inventory measurement unit codes

Code	Description
0x2E08	Gallon
0x2E02	Liter
0x0822	Imperial gallon
0x2E01	Cubic meter
0x2E0C	Barrel[1]
0x2E06	Cubic foot
0x0857	Beer barrel[2]

(1) Unit based on oil barrels (42 U.S gallons).
(2) Unit based on beer barrels (31 U.S gallons).

Table 4-99 Gas standard volume flow measurement unit codes

Code	Description
0x0835	Normal cubic meters per second
0x0836	Normal cubic meters per minute
0x0837	Normal cubic meters per hour
0x0838	Normal cubic meters per day
0x083D	Normal liter per second
0x1401	Normal liter per minute
0x083E	Normal liter per hour
0x083F	Normal liter per day
0x0831	Standard cubic feet per second
0x0832	Standard cubic feet per minute
0x0833	Standard cubic feet per hour
0x0834	Standard cubic feet per day
0x0839	Standard cubic meters per second

Table 4-99 Gas standard volume flow measurement unit codes *continued*

Code	Description
0x083A	Standard cubic meters per minute
0x083B	Standard cubic meters per hour
0x083C	Standard cubic meters per day
0x0840	Standard liter per second
0x0841	Standard liter per minute
0x0842	Standard liter per hour
0x0843	Standard liter per day

Table 4-100 Gas standard volume totalizer and gas standard volume inventory measurement unit codes

Code	Description
0x0844	Standard cubic feet
0x0845	Normal cubic meters
0x0846	Standard cubic meters
0x0847	Normal liter
0x0848	Standard liter

Table 4-101 Density measurement unit codes

Code	Description
0x0823	Specific gravity unit (not temperature corrected)
0x2F08	Grams per cubic centimeter
0x0828	Grams per liter
0x0826	Grams per milliliter
0x0827	Kilograms per liter
0x2F07	Kilograms per cubic meter
0x0824	Pounds per U.S. gallon
0x0825	Pounds per cubic foot
0x0829	Pounds per cubic inch
0x082A	Short ton per cubic yard
0x082B	Degrees API

Table 4-102 Temperature measurement unit codes

Code	Description
0x1200	Degrees Celsius
0x1201	Degrees Fahrenheit
0x1202	Degrees Rankine
0x1203	Kelvin

Table 4-103 **Pressure measurement unit codes**

Code	Description
0x082D	Feet water @ 68 °F
0x0858	Inches water @ 4 °C
0x0859	Inches water @ 60 °F
0x082C	Inches water @ 68 °F
0x085A	Millimeters water @ 4 °C
0x082E	Millimeters water @ 68 °F
0x1303	Millimeters mercury @ 0 °C
0x1304	Inches mercury @ 0 °C
0x1300	Pounds per square inch
0x1307	Bar
0x1308	Millibar
0x082F	Grams per square centimeter
0x0830	Kilograms per square centimeter
0x1309	Pascals
0x130A	Kilopascals
0x085B	Megapascals
0x1301	Torr @ 0 °C
0x130B	Atmospheres

Table 4-104 **Concentration measurement unit codes**

Code	Description
0x0849	Degrees Twaddell
0x084A	Degrees Brix
0x084B	Degrees Baume (heavy)
0x084C	Degrees Baume (light)
0x084D	% solids per weight (% mass)
0x084E	% solids per volume (% volume)
0x084F	Degrees Balling
0x0850	Proof per volume
0x0851	Proof per mass
0x0852	Percent Plato

4.21 Process variable codes

Table 4-105 **Process variable codes**

Code	Description
0	Mass flow rate
1	Temperature
2	Mass total
3	Density
4	Mass inventory
5	Volume flow rate
6	Volume total
7	Volume inventory
15	Petroleum measurement: Temperature-corrected density
16	Petroleum measurement: Temperature-corrected (standard) volume flow
17	Petroleum measurement: Temperature-corrected (standard) volume total
18	Petroleum measurement: Temperature-corrected (standard) volume inventory
19	Petroleum measurement: Batch weighted average temperature
20	Petroleum measurement: Batch weighted average temperature
21	Concentration measurement: Density at reference temperature
22	Concentration measurement: Density (fixed SG units)
23	Concentration measurement: Standard volume flow rate
24	Concentration measurement: Standard volume total
25	Concentration measurement: Standard volume inventory
26	Concentration measurement: Net mass flow rate
27	Concentration measurement: Net mass total
28	Concentration measurement: Net mass inventory
29	Concentration measurement: Net volume flow rate
30	Concentration measurement: Net volume total
31	Concentration measurement: Net volume inventory
32	Concentration measurement: Concentration
33	Petroleum measurement: CTL
46	Tube frequency
47	Drive gain
48	Case temperature
49	Left pickoff amplitude
50	Right pickoff amplitude
51	Board temperature
52	Input voltage
53	External pressure
55	External temperature
56	Concentration measurement: Density (Baume)
62	Gas standard volume flow rate
63	Gas standard volume total

Table 4-105 **Process variable codes** *continued*

Code	Description
64	Gas standard volume inventory
69	Live zero
251	None

4.22   Alarm index codes

Table 4-106 **Alarm index codes**

Code	Description
1	(E)EPROM checksum error (CP)
2	RAM error (CP)
3	Sensor failure
4	Temperature sensor failure
5	Input overrange
6	Not configured
7	RTI failure
8	Density overrange
9	Transmitter initializing/warming up
10	Calibration failure
11	Zero too low
12	Zero too high
13	Zero too noisy
14	Transmitter failed
16	Line RTD Temperature out-of-range
17	Meter RTD temperature out-of-range
20	Incorrect sensor type (K1)
21	Invalid sensor type
22	NV error (CP)
23	NV error (CP)
24	NV error (CP)
25	Boot failure (core processor)
26	Sensor/transmitter communications error
27	Security breach
28	Core processor exception
29	Core processor communications error
30	Invalid board type
31	Low power
32	Meter verification fault alarm
33	Tubes not full
42	Drive overrange
43	Data loss possible

Table 4-106 **Alarm index codes** *continued*

Code	Description
44	Calibration in progress
45	Slug flow
47	Power reset
56	Petroleum measurement: Temperature out of limits
57	Petroleum measurement: Density out of limits
60	Concentration measurement: Bad fit
61	Concentration measurement: Extrapolation alarm
71	Meter verification info alarm
72	Simulation mode active

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