EtherNet/IP™ Supplemental Manual

BCU Ultrasonic Clamp-On

BROOKS®
INSTRUMENT

Beyond Measure

Essential Instructions
Read before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. These products must be properly installed, operated and maintained to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, operating and maintaining Brooks Instrument products.

- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.

⚠ **WARNING: Do not operate this instrument in excess of the specifications listed in the Instruction and Operation Manual. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.**

- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.

⚠ **WARNING: Prior to installation ensure this instrument has the required approval ratings to meet local and national codes. Failure to heed this warning can result in serious injury and / or damage to the equipment.**

- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- Operation: (1) Slowly initiate flow into the system. Open process valves slowly to avoid low surges. (2) Check for leaks around the flow meter inlet and outlet connections. If no leaks are present, bring the system up to the operating pressure.
- Please make sure that the process line pressure is removed prior to service. When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place to prevent electrical shock and personal injury, except when maintenance is being performed by qualified persons.

⚠ **WARNING: For liquid flow devices, if the inlet and outlet valves adjacent to the devices are to be closed for any reason, the devices must be completely drained. Failure to do so may result in thermal expansion of the liquid that can rupture the device and may cause personal injury.**

ESD (Electrostatic Discharge)

⚠ **CAUTION: This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of internal circuit boards or devices.**

Handling Procedure:
1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit boards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.) Experience has proven that even small amonts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Section 1 General Information

Figures

Tables

BCU Power Supply and Connections

Power needs to be supplied via the M8 connector. See table 1-1.

M8 Power 5-pin B Coded Connector 13.5-27 Vdc

Table 1-1: Pin Labeling of M8 Male Device and Female Mating Cable Connector (BCU)

Pin Label	Function at Remote Connector
V+	Positive Power Supply Voltage
V-	Power Supply Ground
N/C	Not Connected

Figure 1-1: M8 Male Device Connector Pin Layout
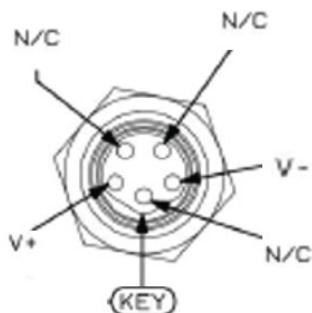
M8 Mating Cable Details

Figure 1-2: M8 Female Mating Cable
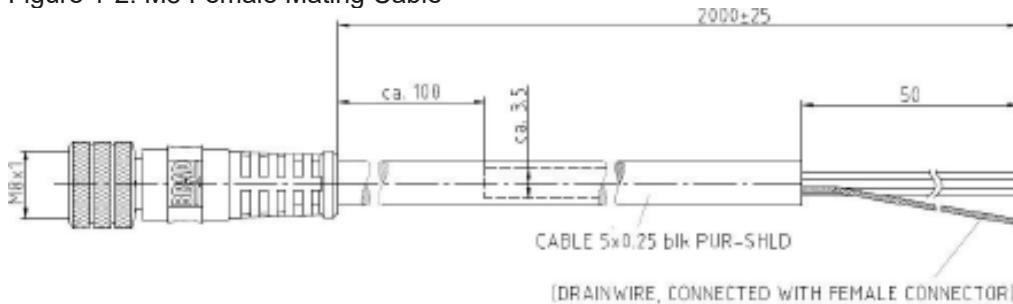
Figure 1-3: M8 Side Female Cable Connector
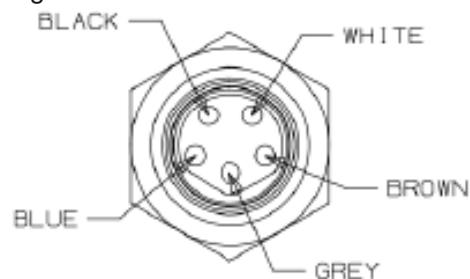
Table 1-2: Wire Labeling of M8 Female Mating Cable Connector

Wire Color	Wire Label	Function at Remote Connector
Blue	V-	Power Supply Ground
Brown	V+	Positive Power Supply Voltage
Black	N/C	Not Connected
White	N/C	Not Connected
Grey	N/C	Not Connected

Communication Notes

Each BCU EtherNet/IP device has 2x M12 Ethernet Connection ports labeled 1 and 2. Network connections can be made to either or both ports, depending on the network topology

The BCU also supports auto-negotiation of the communications link. Both ports support data rates of 10/100 Mbps and Half/Full duplex communications. The device may be directly connected to the Ethernet NIC on a desktop or laptop PC for configuration and commissioning activities.

MOD LED

Table 1-3: MOD LED Indicator Definitions

Indicator State	Summary	Requirement
Off	No Power	No power is supplied to the device.
Solid Green	Device Operational	Device is operating correctly.
Flashing Green	Standby	Device has not been configured.
Flashing Red	Major Recoverable Fault	The device has detected a Major Recoverable Fault (Alarm) The alarm must be enabled for the LED to flash red.
Solid Red	Major Unrecoverable Fault	The device has detected a Major Unrecoverable fault (Error).
Flashing Green / Red	Self-test	The device is performing its power-up testing.

NET LED

Table 1-4: NET LED Indicator Definitions

Indicator State	Summary	Requirement
Off	Not powered, or no IP address.	The device is powered off or is powered on but with no IP address configured.
Flashing Green	No connections	An IP address is configured, but no CIP connections are established with the device.
Steady Green	Connected	An IP address is configured, at least one CIP connection (any transport class) is established with the device.
Flashing Red	Connection Timeout	An IP address is configured, and an Exclusive Owner connection has timed out. The NET indicator will return to steady green when the Exclusive Owner connection is reestablished.
Steady Red	Duplicate IP	The device has detected that its IP address is already in use.
Flashing Green / Red	Self-test	The device is performing its power-up testing.

TCP/IP Network Configuration

The TCP/IP network settings can be configured by following the steps outlined in below. By default, BCU is shipped with the following static TCP/IP connections settings:

- IP Address: 192.168.1.100
- NET Mask: 255.255.255.0
- Gateway Address: 0.0.0.0
- DNS1: 0.0.0.0
- DNS2: 0.0.0.0

To configure the TCP/IP setting using a web browser:

- Connect the device directly to a laptop ethernet interface or onto a network. Make sure the NIC card IP address is set to subnet 192.168.1.xxx and that its IP address is not 192.168.1.100.
- Open a web browser and enter this IP address as the URL.
- Navigate to the Login screen, select the access level "Control", enter the password "control", and press Submit.
    - The Control access level enables full device functionality.
    - The Configure access level allows basic device configuration; the password is "configure".
- The TCP/IP network interface settings can be configured under the Configure and Control access levels.

Class 1 Connection (Cyclic I/O)

The following connection configuration can be used to create a Class 1 connection (also known as I/O Connection or Cyclic Data Connection):

Table 1-5: BCU Exclusive Owner Connection Configuration

Output* Assembly ID	110
Output Assembly Size	16 bytes
Output Assembly RPI	≥ 50 msec
Input* Assembly	150
Input Assembly Size	40 bytes
Input Assembly RPI	≥ 50 msec

*If no configuration data is to be transferred to the device, set the configuration assembly ID to 0 with a data length of 0.

Commonly Configured Attributes

ODVA defines Electronic Data Sheets (EDS) that specify the connections and parameters that are available in the device. The EDS file for the BCU Series EtherNet/IP™ device has been sent to you by email. Your EIP network configuration tool may be able to read EDS files directly to facilitate the configuration process.

The BCU Series meter supports many different configurable attributes. The out-of-box defaults meet the needs of a great majority of applications, but some applications may require the device to report more information or behave differently than is configured with default settings.

This section covers the more common attributes that are configured to meet the unique needs of applications. The terms "attribute" and "parameters" can be used interchangeably and ultimately refer to the same data item within the meter device. The term "parameter" is widely used within the EDS paradigm whereas "attribute" is used within the ODVA specification.

The following tables will reference both the EDS Parameter name (if the configuration software utilizes the EDS sheet) and the EPATH descriptor (class-instance-attribute) for those who are writing custom or have other types of configuration interfaces.

Table 1-6: Flow Meter Status Commonly Configured Parameters

Attribute	EPATH	Default	Semantics
Flow Meter Data Units	[0xA9-1-4]	5137 (0x1411)	See Next Section: Data Units
Status Alarm Mask	[0xB8-1-61]	0xFF000000	All Alarm Bits are masked
Status Warning Mask	[0xB8-1-71]	0x00000000	All Warning Bits are masked
Correction Factor (Tubing Change)	[0XA2-1-97]	1.0	Scaler/gain to correct for slight differences from calibration conditions, such as tubing size or fluid density.

Data Units

The BCU Series meter can report flow in values associated to engineering units. This can simplify user interpretation of information from the device by letting the device perform the calculations necessary to interpret the flow signal from its internal sensor based upon information in the selected calibration.

Table 1-7: Flow Meter Units Commonly Configured Parameters

Attribute	EPATH	Applicable Units Table	Semantics
Flow Data Units	[0xA9-1-4]	Table 1-8 Volumetric Flow Units Table	ml/min
Flow Totalizer Units	[0xA1-1-40]	Table 1-9 Totalizer Flow Units Table	Liters
Temperature Units	N/A	Fixed unit degree C	deg C

Table 1-8: Volumetric Flow Units Table

Units	(hex)	(dec)
ml/s	1407	5127
ml/min	1411	5137
L/s	1406	5126
L/min	1413	5139
L/hr	1414	5140
m^3/sec	1405	5125
m^3/min	1433	5171
m^3/hr	1432	5170
gpm	1409	5129

Table 1-9: Totalizer Flow Units Table

Units	(hex)	(dec)
ml	2E03	11779
L	2E02	11778
m^3	2E01	11777
gal	2E08	11784

Produce Assembly

This assembly is used to send data from the device to the master. From the master scanner perspective these are inputs. Each assembly is defined to be used with a certain type of connection: Exclusive Owner, Input Only, and Listen Only. Refer to the object definitions for more information on parameter in this assembly.

Produce Assembly
- Assembly Instance ID: 150
- Device Type: BCU
- Assembly Size: 40 Bytes / 10 Words

Table 1-10: Produce Assembly

Parameter	Class	Inst	ID	CIP Data Type	CIP Data Size	Description
Flow Value	169	1	6	REAL	4	Flow Sensor Value
Flow Data Units	169	1	4	UDINT	4	Flow Engineering Units
Flow Totalizer	161	1	42	REAL	4	Customer flow sensor totalizer
Flow Totalizer Units	161	1	40	UDINT	4	Totalizer Engineering Units
Flow Time	161	1	43	REAL	4	Customer flow time
Temperature Value	164	1	6	REAL	4	Temperature sensor value
Active Alarms	184	1	60	DWORD	4	Active Alarms
Active Warnings	184	1	70	DWORD	4	Active Warnings
Active Errors	184	1	50	DWORD	4	Active Errors
Device Status	184	1	80	DWORD	4	Device Status

Consume Assembly

This assembly is data that the device retrieves from the master. From the master scanner perspective these are outputs. When the PLC is actively sending Consume data, browser access will be disabled. If you are currently logged in to the web interface, you will be automatically logged out. Each assembly is defined to be used with a certain type of connection: Exclusive Owner and Input Only. Refer to the object definitions for more information on parameter in this assembly.

Consume Assembly
- Instance ID: 110
- Device Type: BCU
- Assembly Size: 16 Bytes / 4 Words

Table 1-11: Consume Assembly

Parameter	Class	Inst	ID	CIP Data Type	CIP Data Size	Description
Totalizer	169	1	200	UDINT	4	Flow Totalizer & Timer
Flow Data Units	169	1	4	UDINT	4	Flow Engineering Units
Totalizer Units	161	1	40	UDINT	4	Totalizer Engineering Units
Initiate Auto Zero	169	1	125	UDINT	4	Initiate Start of Auto Zero Sequence

Zeroing the Meter

Zeroing can be initiated through consume assembly or flow sensor objects.

Table 1-12: Consume Object

Attribute	Tag	Class	Instance	ID	Description
fsZeroEnable	Zero_Op_Enable	169	1	125	Initiate Start of Auto Zero Sequence for fmZeroDuration. Must be set to 0 before setting back to 1 to initiate another Auto Zero Sequence

Zeroing Steps:
- The device should be powered on for 15 minutes before zeroing.
- The tubing should be full of liquid.
- There shouldn't be any air bubbles in the tubing.
- The liquid should not be moving.
- The tubing must be tightly clamped into the device.
- Zeroing can be initiated in the cyclic data or using the browser when logged in with Control access.

Connection Configurations

Table 1-13: Connection Configurations

Connections	Configuration	Consume (Output)	Produce (Input)
Exclusive Owner (XO) w/ Config	100	110	150
Exclusive Owner (XO)	0	110	150
Input Only (IO)	0	238	150

Configuration Assembly Definition

Table 1-14: Configuration Assembly Definition

Tag	Class	Instance	ID	CIP Data Type	CIP Data Size	Description
Flow_Units	169	1	4	UDINT	4	Flow Meter Units
Totalizer_Units	161	1	40	UDINT	4	Totalizer Units
Flow_Correction_Factor	162	1	97	REAL	4	Correction Factor
High_Flow_Alarm_ TripPoint	169	1	17	REAL	4	High Flow Alarm Trip Point
Low_Flow_Alarm_ TripPoint	169	1	18	REAL	4	Low Flow Alarm Trip Point
High_Flow_Alarm_ DelayTime	169	1	20	DINT	4	Flow Alarm Settling Time
Low_Flow_Alarm_ DelayTime	169	1	25	DINT	4	Flow Alarm Settling Time
High_Temp_Warn_ TripPoint	164	1	17	REAL	4	High Temperature Warning Trip Point
Low_Temp_Warn_ TripPoint	164	1	18	REAL	4	Low Temperature Warning Trip Point
High_Temp_Warn_ Delay	164	1	19	DINT	4	Temperature Warning Settling Time
Low_Temp_Warn_ Delay	164	1	20	DINT	4	Temperature Warning Settling Time
Alarms_Mask	184	1	61	DWORD	4	Alarm Bits Mask
Warnings_Mask	184	1	71	DWORD	4	Warning Bits Mask

Accessible Classes

Table 1-15: Accessible Classes

Class	ID	Instances
Identity Object	1 (0x01)	1
Assembly Object	4 (0x04)	3
Device Management Object	100 (0x64)	1
RTB Object	161 (0xA1)	1
Flow Sensor Object	162 (0xA2)	1
Flow Meter Object	169 (0xA9)	1
Temperature Meter Object	164 (0xA4)	1
Status Object	184 (0xB8)	1

Identity Object

Table 1-16: Identity Object

Tag	Class	Instance	ID	Alt ID	R/W	Shared	Default	Description
Vendor_ID	1	1	1		R	Y	246	ODVA Vendor ID for Ethernet/IP
Device_Type	1	1	2		R	Y	43	Indication of general type of product
Product_Code	1	1	3		R	Y	2601	Indentification of a particular product of an individual vendor
Revision	1	1	4	104	R	Y		Revision of the item the Identity Object represents
Major Revision							1	Major Revision
Minor Revision							1	Minor Revision
Status	1	1	5		R	Y	-	Summary Status of the device
Serial_Number	1	1	6		R	Y	-	Device Serial Number
Product_Name	1	1	7		R	Y	BCU	Product Name

Table 1-17: Identity Object Service

Service	Class	Instance	ID	Description
Get Attribute Single	1	1	14	Returns the value of the specified attribute
Get Attribute All	1	1	1	Returns the contents of the instance or class attributes define in the object's definition
Reset	1	1	5	Invokes a Reset action in the device

Assembly Object

Table 1-18: Assembly Object

Attribute	Class	Instance	ID	R/W	Default	Description
assyRevision	4	0	1	R	03	Revision level of this object
Member List	4	X	3	R/W	-	Data

Table 1-19: Assembly Object Service

Service	Class	Instance	ID	Description
Get Attribute Single	1	X	14	Returns the value of the specified attribute
Set Attribute Single	169	X	16	Modifies an attribute value

Device Management Object

Table 1-20: Device Management Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Mfr_Name	100	1	3	SHORT_STRING	-	30	R	ROM	Brooks Instrument	Manufacturer's Name
Mfr_Model	100	1	4	SHORT_STRING	-	16	R	ROM	BCU	Manufacturer's Model
Serial_No	100	1	7	SHORT_STRING	-	16	R	NV	(Device Specific)	Device Serial Number
Model_Code	100	1	8	SHORT_STRING	-	32	R	NV	(Device Specific)	Model Code
Calibration_Date	100	1	230	SHORT_STRING	-	32	R/W	NV	(Device Specific)	
Calibration_Temperature	100	1	231	SHORT_STRING	-	32	R/W	NV	(Device Specific)	
Calibration_Tubing	100	1	232	SHORT_STRING	-	64	R/W	NV	(Device Specific)	
Sensor_FW_Rev	100	1	245	SHORT_STRING		16	R	ROM		u16 to str, ex 0x1234 to 01.02.03.04, 11 char max
Sensor_HW_Rev	100	1	246	SHORT_STRING		16	R	ROM		u16 to str, ex 0x1234 to 01.02.03.04, 11 char max
Sensor_BL_Rev	100	1	247	SHORT_STRING		16	R	ROM		u16 to str, ex 0x1234 to 01.02.03.04, 11 char max
Sensor_Serial_Number	100	1	248	SHORT_STRING		16	R	NV		u32 to number string 10 char max $2^{32} - 1$
Supply_Volts	100	1	190	REAL	Volts	4	R	V	-	External power supply voltage
Supply_Current	100	1	185	REAL	mA	4	R	V		External power supply current
Supply_Volts_Min_Limit	100	1	191	REAL	Volts	4	R/W	NV	13	Low Voltage threshold that will raise a Supply Volts Low warning status
Supply_Volts_Max_Limit	100	1	192	REAL	Volts	4	R/W	NV	28	High Voltage threshold that will reaise a Supply Volts High warning status
Supply_Volts_Settle_Time	100	1	193	UDINT	msec	4	R/W	NV	5000	The amount of time the warning condition must exists before the warning status is raised. This settling time is also applied when the condition transitions from warning to nominal
			220							
Comm_Brd_FW_Rev	100	1	250	SHORT_STRING	-	8	R	ROM		Revision of the Adapter Board Firmware
Comm_Brd_HW_Ver	100	1	251	SHORT_STRING	-	16	R	NV		Part Number & Revision (Version) of the Communication Board Hardware
Comm_Brd_BL_Rev	100	1	252	SHORT_STRING	-	8	R	ROM		Revision of the Adapter Board Bootloader

Table 1-21: Device Management Object Service

Service	Class	Instance	ID	Description
Get Attribute Single	100	1	14	Returns the value of the specified attribute
Set Attribute Single	100	1	16	Returns the value of the specified attribute

RTB Object

Table 1-22: RTB Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Resettable_On_Time	161	1	5	REAL	hours	4	R/W	NV	-	Total hours device is powered on. Can be Reset by writing 0.
Total_Flow_Time	161	1	6	REAL	hours	4	R	NV	-	Total hours of Totalized flow through flow sensor
Overhaul_Due_Hours	161	1	11	UDINT	sec	4	R/W	NV	0	The time remaining in hours until device requires service. When this timer reaches 0, Overhaul Due Warning status shall be set
Cal_Due_Hours	161	1	21	UDINT	hours	4	R/W	NV	8760	The time remaining in hours until the device needs to be recalibrated. When this timer reaches 1, Calibration Due Warning status shall be set. Writing 0 disables this warning.
Totalizer_Units	161	1	40	UDINT	-	4	R/W	NV	11778 (Liters)	The Engineering Units used to report totalizer values
Flow_Totalizer	161	1	41	REAL	Flow_Total_Units	4	R	NV	-	Total liquid flowed through the device. The Flow must exceed the Flow Meter 'Low_Flow_Cutoff' to be totalized.
Cust_Flow_Total	161	1	42	REAL	Flow_Total_Units	4	R	NV	-	Total liquid flowed through the device since the last commanded reset through attribute 'Cust_Flow_Total_Ctrl' (attribute 200). The Flow must exceed the Flow Meter 'Low_Flow_Cutoff' to be totalized.
Cust_Flow_Time	161	1	43	REAL	hours	4	R	NV	-	Time elapsed while 'rtbCustFlowTotalizer' is Running. Runs/Stops/Resets with 'rtbCustFlowTotControl'. Time will elapse even while Flow is below Flow Meter 'Low_Flow_Cutoff'.
Cust_Flow_Total_Ctrl	161	1	200	UDINT	-	4	R/W	V	2	Controls 'Cust_Flow_Total'(attribute 130) 0: No Change (Remains in previous Run or Stop state) 1: Run 2: Stop 3: Reset (Sets both Totalizer Volume and Time to 0 and remains in previous Run or Stop state) All other values are ignored and have no effect

Flow Sensor Object

Table 1-23: Flow Sensor Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Error_Time	162	1	90	UDINT	seconds	4	R/W	NV	3	How long to wait before a disturbed measurement becomes an error. When the measurement is disturbed, such as a large air bubble, the sensor will hold last value. 0 to 9999 sec
Flow_ Correction_ Factor	162	1	97	REAL	-	4	R/W	NV	1	Scaler/gain to correct for slight differences from calibration conditions, such as tubing size or fluid density. All flow measurements are multiplied by this scaler/gain. 0.01 < gain < 100.0 (prevent using to change units)
Zero_Offset	162	1	100	REAL	Flow_ Units	4	R/W	NV	0	Average value of indicated Flow under no flow conditions. Zero Offset is subtracted from Flow, so that Flow reads 0 when there is no flow. Zero Offset can be automatically determined by Enabling the Automatic Zero Operation. Can be adjusted manually if desired.
Zero_Op_ Duration	162	1	120	UDINT	msec	4	R/W	NV	2000	The amount of time to be used by the device to perform a device zero operation. 10 to 65535 ms.
Zero_Op_ Enable	162	1	125	UDINT	-	4	W	-	0	Starts the device zero operation. 1 = Start the Zero Operation If Zero_Op_Enable = 1 and 1 is written to this attribute, the value is ignored until Zero_ Op_Enable = 0
Zero_Max_ Limit	162	1	130	REAL	Flow_ Units	4	R/W	NV	0	Zero will be inhibited if the current flow exceeds +- limit. A 'Bad_Zero_Warning' status will be set if the flow exceeds +- the limit during the zeroing process. The 'Bad_ Zero_Warning' status will be set if, after completion of a zero operation, the resulting zero exceeds +- the limit. If a 'Bad_Zero_ Warning' status occurs, the previous Zero Offset will be restored. A value of 0 disables this diagnostic. 0 to 9999 ml/min
Reverse_ Flow_ Direction	162	1	140	UDINT	-	4	R/W	NV	0	Allows changing so that Postive Flow is Opposite of Flow Arrow marked on lid. 0 = Positive Flow is in direction of Flow Arrow marked on lid (Right to Left) 1 = Positive Flow is opposite of direction of Flow Arrow marked on lid (Left to Right).
Enable_ Negative_ Flow	162	1	141	UDINT	-	4	R/W	NV	1	Allows Negative Flow values to be indicated and included in Totalized Volume calculations, otherwise any Negative Flow will be reported as Zero (0) and Not Reduce Totalized Volume. 0 = Any Negative Flow value will be set to Zero (0) and not effect the Totalized Flow. 1 = Allows Negative Flow Values to be indicated and included in the Totalized Volume..
Enable_ Negative_ Volume	162	1	142	UDINT	-	4	R/W	NV	0	Allows Totalized Volume to go below 0 (Negative). If Negative Flow is Enabled, any Negative Flow will reduce the Totalized Volume, independent of this setting. 0 = Totalized Volume cannot go Negative 1 = Totalized Volume can go Negative if enough Negative Flow Occurs..

Table 1-24: Flow Sensor Object Service

Service	Class	Instance	ID
Get Attribute Single	162	1	14
Set Attribute Single	162	1	16

Flow Meter Object

Table 1-25: Flow Meter Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Flow_Units	169	1	4	UDINT	CIP_ ENGUNIT	4	R/W	NV	5137 (ml/min)	Sets the Engineering Units of 'Flow' and other related attributes in this class
Flow	169	1	6	REAL	Flow_ Units	4	R	V	-	Flow Sensor value
Low_Flow_ Cutoff	169	1	7	REAL	Flow_ Units	4	R/W	NV	0	ABS(Flow) < Low_Flow_Cutoff will be 0
Configured_ Full_Scale (CFS)	169	1	8	REAL	Flow_ Units	4	R/W	NV	0	CFS in fmDataUnits, Model/Size ->CFS (ex. ml/min) 0250->1000, 0375->4000, 0500->5000, 0750->15000, 1375->80000
Flow_ Avg_Num_ Samples	169	1	10	UDINT	-	4	R/W	NV	125	1x disables, choices (1, 2, 4, 8, 16, 32, 64, 125, 250, 500, 1k, 2k, 4k, 8k, 16k)
Flow_Avg_ Type	169	1	11	DWORD	-	4	R/W	NV	1	0 = Arithmetic/Segmented, sum of samples divided by # of samples, Flow updated after # of samples is collected 1 = Moving Average, Flow updated every sample
Vol_Avg_ Num_ Samples	169	1	12	UDINT	-	4	R/W	NV	125	1x disables, choices (1, 2, 4, 8, 16, 32, 64, 125, 250, 500, 1k, 2k, 4k, 8k, 16k)
Vol_Avg_ Type	169	1	13	DWORD	-	4	R/W	NV	1	0 = Arithmetic/Segmented, sum of samples divided by # of samples, Flow updated after # of samples is collected 1 = Moving Average, Flow updated every sample
High_Flow_ Alarm_ TripPoint	169	1	17	REAL	Flow_ Units	4	R/W	NV	450,000	The 'Flow' threshold above which an 'Active_Alarms_High_Flow' status will occur
Low_Flow_ Alarm_ TripPoint	169	1	18	REAL	Flow_ Units	4	R/W	NV	-450,000	The 'Flow' threshold below which an 'Active_Alarms_Low_Flow' status will occur
High_Flow_ Alarm_Time	169	1	20	UDINT	msec	4	R/W	NV	10000	The time that 'Flow' must exceed/ stay within the High Alarm Trip Point threshold before the Status Condition is reported/cleared.
Low_Flow_ Alarm_Time	169	1	25	UDINT	msec	4	R/W	NV	10000	The time that 'Flow' must exceed/ stay within the Low Alarm Trip Point threshold before the Status Condition is reported/cleared.

Table 1-26: Flow Meter Object Service

Service	Class	Instance	ID
Get Attribute Single	169	1	14
Set Attribute Single	169	1	16

Temperature Meter Object

Table 1-27: Temperature Meter Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Temperature	164	1	6	REAL	Celsius	4	R	V	-	Temperature sensor value
High_Temp_ Warn_TripPoint	164	1	17	REAL	Celsius	4	R/W	NV	60	Sets the 'Temperature' threshold above which an 'Active_Warnings_ High_Temp' status will occur
Low_Temp_ Warn_TripPoint	164	1	18	REAL	Celsius	4	R/W	NV	0	Sets the 'Temperature' threshold below which an 'Active_Warnings_ Low_Temp' status will occur
High_Temp_ Warn_Delay	164	1	19	UDINT	msec	4	R/W	NV	10000	Sets the time that 'Temperature' must exceed/stay within the Temperature High Warning Trip Point thresholds before the Warning Status Condition is reported/cleared.
Low_Temp_ Warn_Delay	164	1	20	UDINT	msec	4	R/W	NV	10000	Sets the time that 'Temperature' must exceed/stay within the Temperature Low Warning Trip Point thresholds before the Warning Status Condition is reported/cleared.

Table 1-28: Temperature Meter Object Service

Service	Class	Instance	ID
Get Attribute Single	164	1	14
Set Attribute Single	164	1	16

Status Object

Table 1-29: Status Object

Tag	Class	Instance	ID	CIP Data Type	Units	CIP Data Size	R/W	Storage	Default	Description
Active_Errors	184	1	50	DWORD		4	R	V	-	See Active Error Bit Definitions
Active_Alarms	184	1	60	DWORD	-	4	R	V	-	See Active Alarms Bit Definitions
Active_Warnings	184	1	70	DWORD	-	4	R	V	-	See Active Warnings Bit Definitions
Device_Status	184	1	80	DWORD	-	4	R	V	-	See Device Status Bit Definitions [Dev_Exec]: 0=Safe State, 1=Executing [Flow_Valid]: 0=Flow Reading is Invalid, 1= Flow Reading Valid [Temp_Valid]: 0=Temperature Reading is Invalid, 1=Temperature Reading Valid [Dev_Zeroing]: 0=Device Zero Operation Complete, 1=Device is Zeroing [Zero_Recommend]: 0 = Zero No Recommended, 1 = Zero Device Recommended [Zero_Op_Inhibit]: 0 = Zero Operation Allowed, 1 = Zero Operation Inhibited [Dev_Error]: 0=All 'Active_Error' bits are Clear, 1=One or more 'Active_Error' bits are set [Dev_Alarm]: 0=All 'Active_Alarms' bits are Clear, 1=One or more 'Active_Alarms' bits are set [Dev_Warning]: 0=All 'Active_Warnings' bits are Clear, 1=One or more 'Active_ Warnings' bits are set
Alarms_Mask	184	1	61	DWORD	-	4	R/W	NV	0xFF000000	See Active Alarms Bit Definitions 0 = Alarm Bit is Masked, 1 = Alarm Bit is Active
Warnings_Mask	184	1	71	DWORD	-	4	R/W	NV	0x00000000	See Active Warnings Bit Definitions 0 = Warning Bit is Masked, 1 = Warning Bit is Active
Errors_Test	184	1	151	DWORD	-	4	R/W	V	0x00000000	See Active Errors Bit Definitions 0 = Error Bit changes normally, 1 = Error Bit is Forced On to indicate Error
Alarms_Test	184	1	161	DWORD	-	4	R/W	V	0x00000000	See Active Alarms Bit Definitions Unless Masked, 0 = Alarm Bit changes normally, 1 = Alarm Bit is Forced On to indicate Alarm
Warnings_Test	184	1	171	DWORD	-	4	R/W	V	0x00000000	See Active Warnings Bit Definitions Unless Masked, 0 = Warning Bit changes normally, 1 = Warning Bit is Forced On to indicate Warning
Status_Test	184	1	181	DWORD	-	4	R/W	V	0x00000000	See Device Status Bit Definitions 0 = Status Bit changes normally, 1 = Status Bit is Forced On to indicate Status

Status Object Bit Definitions

Table 1-30: Active Errors Bit Definitions

Bit(s)	Description
0-17	Reserved
18	Internal Communication Error [Int_Comms] (TBD)
19-22	Reserved
23	NV Memory Fail [NV_Mem_Fail] (TBD)
24	Time Measurement Communication Error
25-29	Checksum Errors
30-31	Temperature Errors

Table 1-31: Active Alarms Bit Definitions

Bit(s)	Description
0	Low Flow Alarm [Low_Flow]
1	High Flow Alarm [High_Flow]
22-Feb	Reserved
23	Using Backup NV Memory [Using_Bkup_NV_Mem] (TBD)
24	Sensor Amplitude Alarm (Bubble or Tube Coupling Issue)
25	Signal Search – Trigger Alarm
26	Signal Search – Time Window Alarm
27	Signal Search – Periodicity Alarm
28	Channel Mismatch Alarm
29-30	Reserved
31	Signal Search Restarted Alarm

Table 1-32: Active Warnings Bit Definitions

Bit(s)	Description
0-15	Reserved
16	RTB Bad
17	Calibration Due
18-19	Reserved
20	High Temperature Warning
21	Low Temperature Warning
22-24	Reserved
25	Sensor Flow Out of Range
26-27	Reserved
28	Sensor Temperature Invalid
29	Sensor Zero Adjust in Progress (remapped to Status)
30-31	Reserved

Table 1-33: Device Status Bit Definitions

Bit(s)	Description
0	Reserved
1	[Flow_Valid]
2	Temperature Reading Valid [Temp_Valid]
3	[Dev_Zeroing]
4	[EIP_Connection(s)]
5	[EIP_Owned]
6	[EIP_Run_Mode]
7	[EIP_Conn_Fault]
8	Device Error [Dev_Error]
9	Device Alarm [Dev_Alarm]
10	Device Warning [Dev_Warning]
11	Alarm Masked
12	Warning Masked
13	Testing Error(s)
14	Testing Alarm(s)
15	Testing Warning(s)
16	Testing Status(es)
17-22	Reserved
23	Sensor BUSY
24	Reserved
25	Sensor Warning
26	Reserved
27	Sensor Reset
28	Reserved

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