Dynasonics®
Ultrasonic Flow Meters

Transit Time Ultrasonic Flow Meters

TFX-5000 Meter BACnet/IP Ethernet Protocol

Badger Meter

User Manual

CONTENTS

SUPPORTED FEATURES

TFX-5000 meters have an optional Ethernet card that supports commands for commonly used parameters.

For further information on the proper installation of the transmitter or communication card, see the TFX-5000 user manual.

WIRING

Ethernet

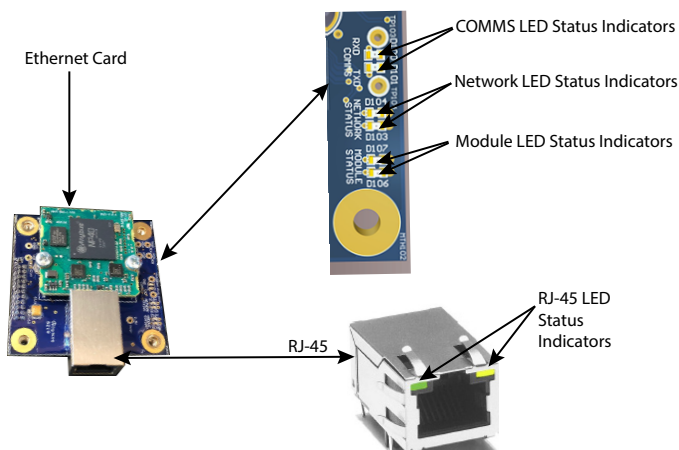The card has an RJ-45 connector.

Figure 1: Ethernet port on the TFX-5000

Removing the Cover from the Communication Board

1. Turn off the power.
2. Open the enclosure.
3. Remove (2) M3 pan head Phillips screws that secure the cover over the communication board.
4. Remove the cover.
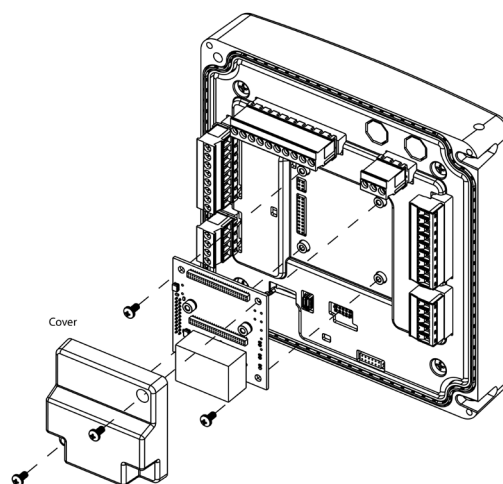

Figure 2: Removing the communication board cover

BACNET/IP SETUP

If the *BACnet/IP* menu is not available, check *Main Menu > System Setup > Options > Card Type*. The *Card Type* should be set to **Autodetect** or **BACnet/IP**.

BACNET OBJECTS

Flow Meter Objects

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)
Readings			
Flow Rate on Screen	Flow rate displayed on home screen. Unit is based on selection for home screen.	R	AV600
Velocity on Screen	Fluid velocity displayed on home screen. Unit is based on selection for home screen.	R	AV601
Delta Time Filtered (ns)	Time of flight difference between upstream and downstream used to calculated the flow rate. Units are nanoseconds.	R	AV602
Flow Rate (gal/min)	Flow rate in gallons/minute	R	AV800
Velocity (ft/sec)	Fluid velocity in feet/second	R	AV801
Flow Rate (l/min)	Flow rate in liters/minute	R	AV1000
Velocity (m/sec)	Fluid velocity in meters/second	R	AV1001
Flow Total Decimal Places	Data type=Real	R	AV1304
Totals			
Flow Totalizer, Net	Total volume as forward flow minus reverse flow. A negative total results when reverse flow is greater than forward flow. Unit is based on selection for home screen.	R	AV1100
Flow Totalizer, Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV1101
Flow Totalizer, Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV1102
Flow Totalizer, Gross	Total volume of forward and reverse flow. Unit is based on selection for home screen.	R	AV1103
Flow Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1104
Flow Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1105
Flow Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1106
Flow Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1107
Flow Totalizer (gal), Net	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV1150
Flow Totalizer (gal), Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV1151
Flow Totalizer (gal), Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV1152
Flow Totalizer (gal), Gross	Total volume of forward and reverse flow.	R	AV1153
Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1154
Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1155
Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1156
Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1157
Flow Totalizer (liters), Net	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV1200
Flow Totalizer (liters), Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV1201
Flow Totalizer (liters), Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV1202
Flow Totalizer (liters), Gross	Total volume of forward and reverse flow.	R	AV1203
Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1204
Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1205
Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1206
Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1207
Setup			
Low Flow Cutoff	Setting to display flow rate as zero & stop totalizing when flow rate goes below this value.	R	AV1400
Low Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes below this value and trigger a low signal error message.	R	AV1401
High Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes above this value and trigger an oversaturate error message.	R	AV1402

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)
Diagnostics			
Signal Strength	Indicates the strength of the ultrasonic signal.	R	AV1500

Descriptive Name	Description	Network Access	Multistate Value
Units			
Flow Rate Units	Flow rate units on home screen as defined in parameter settings.	R	1300 (25 states)
Velocity Units	Velocity units on home screen as defined in parameter settings.	R	1302 (12 states)
Flow Total Units	Total volume units on home screen as defined in parameter settings.	R	1303 (7 states)

Energy Meter Objects

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)
Readings			
Flow Rate on Screen	Flow rate displayed on home screen. Unit is based on selection for home screen.	R	AV600
Velocity on Screen	Fluid velocity displayed on home screen. Unit is based on selection for home screen.	R	AV601
Delta Time Filtered (ns)	Time of flight difference between upstream and downstream used to calculated the flow rate. Units are nanoseconds.	R	AV602
Energy/BTU Rate	Energy rate displayed on home screen. Unit is based on selection for home screen.	R	AV604
Temperature #1	Temperature #1 displayed on home screen. Unit is based on selection for home screen.	R	AV605
Temperature #2	Temperature #2 displayed on home screen. Unit is based on selection for home screen.	R	AV606
Delta Temperature	Delta temperature displayed on home screen. Order of operation and unit is based on selection for home screen.	R	AV607
Flow Rate (gal/min)	Flow rate in gallons/minute	R	AV800
Velocity (ft/sec)	Fluid velocity in feet/second	R	AV801
Energy Rate (kBTU)	Energy rate in kBTU	R	AV802
Flow Rate (l/min)	Flow rate in liters/minute	R	AV1000
Velocity (m/sec)	Fluid velocity in meters/second	R	AV1001
Energy Rate (kWH)	Energy rate in kWH	R	AV1002
Flow Total Decimal Places	The number of decimal places to display	R	AV1304
Energy Total Decimal Places	The number of decimal places to display	R	AV1309
Totals			
Flow Totalizer, Net	Total volume as forward flow minus reverse flow. A negative total results when reverse flow is greater than forward flow. Unit is based on selection for home screen.	R	AV1100
Flow Totalizer, Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV1101
Flow Totalizer, Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total. Unit is based on selection for home screen.	R	AV1102
Flow Totalizer, Gross	Total volume of forward and reverse flow. Unit is based on selection for home screen.	R	AV1103
Flow Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1104
Flow Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1105
Flow Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1106
Flow Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1107
Energy/BTU Total, Net	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate. Unit is based on selection for home screen.	R	AV1108
Energy/BTU Total, Positive	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total. Unit is based on selection for home screen.	R	AV1109
Energy/BTU Total, Negative	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total. Unit is based on selection for home screen.	R	AV1110
Energy/BTU Total, Gross	Total energy of forward and negative energy rate (all energy to heat and cool). Unit is based on selection for home screen.	R	AV1111
Energy/BTU Totalizer Overflow Counter, Net	Number of times the net energy total overruns.	R	AV1112
Energy/BTU Totalizer Overflow Counter, Positive	Number of times the positive energy total overruns.	R	AV1113
Energy/BTU Totalizer Overflow Counter, Negative	Number of times the negative energy total overruns.	R	AV1114
Energy/BTU Totalizer Overflow Counter, Gross	Number of times the gross energy total overruns.	R	AV1115
Flow Totalizer (gal), Net	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV1150
Flow Totalizer (gal), Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV1151
Flow Totalizer (gal), Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV1152
Flow Totalizer (gal), Gross	Total volume of forward and reverse flow.	R	AV1153
Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1154
Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1155

Descriptive Name	Description	Network Access	Analog Value (Single Precision 32-bit floating point)
Totals (continued)			
Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1156
Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1157
Energy/BTU Total (kBTU), Net	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate.	R	AV1158
Energy/BTU Total (kBTU), Positive	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total.	R	AV1159
Energy/BTU Total (kBTU), Negative	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total.	R	AV1160
Energy/BTU Total (kBTU), Gross	Total energy of forward and negative energy rate (all energy to heat and cool).	R	AV1161
kBTU Totalizer Overflow Counter, Net	Number of times the net energy total overruns.	R	AV1162
kBTU Totalizer Overflow Counter, Positive	Number of times the positive energy total overruns.	R	AV1163
kBTU Totalizer Overflow Counter, Negative	Number of times the negative energy total overruns.	R	AV1164
kBTU Totalizer Overflow Counter, Gross	Number of times the gross energy total overruns.	R	AV1165
Flow Totalizer (liters), Net	Total volume as forward flow minus reverse flow. A negative total results when reserse flow is greater than forward flow.	R	AV1200
Flow Totalizer (liters), Positive	Total volume of flow in forward direction. Reverse flow is not accounted for in the total.	R	AV1201
Flow Totalizer (liters), Negative	Total volume of flow in reverse direction. Forward flow is not accounted for in the total.	R	AV1202
Flow Totalizer (liters), Gross	Total volume of forward and reverse flow.	R	AV1203
Totalizer Overflow Counter, Net	Number of times the net flow total overruns.	R	AV1204
Totalizer Overflow Counter, Positive	Number of times the positive flow total overruns.	R	AV1205
Totalizer Overflow Counter, Negative	Number of times the negative flow total overruns.	R	AV1206
Totalizer Overflow Counter, Gross	Number of times the gross flow total overruns.	R	AV1207
Energy Total (kWh), Net	Total energy as positive energy rate minus negative energy rate. A negative total results when reverse flow is greater than positive energy rate.	R	AV1208
Energy Total (kWh), Positive	Total energy of flow in forward direction, such as heating. Negative energy rate is not accounted for in the total.	R	AV1209
Energy Total (kWh), Negative	Total energy of flow in reverse direction, such as cooling. Positive energy rate is not accounted for in the total.	R	AV1210
Energy Total (kWh), Gross	Total energy of forward and negative energy rate (all energy to heat and cool).	R	AV1211
kWh Totalizer Overflow Counter, Net	Number of times the net energy total overruns.	R	AV1212
kWh Totalizer Overflow Counter, Positive	Number of times the positive energy total overruns.	R	AV1213
kWh Totalizer Overflow Counter, Negative	Number of times the negative energy total overruns.	R	AV1214
kWh Totalizer Overflow Counter, Gross	Number of times the gross energy total overruns.	R	AV1215
Setup			
Low Flow Cutoff	Setting to display flow rate as zero & stop totalizing when flow rate goes below this value.	R	AV1400
Low Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes below this value and trigger a low signal error message.	R	AV1401
High Signal Cutoff	Setting to display flow rate as zero & stop totalizing when signal strength goes above this value and trigger an oversaturate error message.	R	AV1402
Diagnostics			
Signal Quality	Indicates the strength of the ultrasonic signal.	R	AV1500

Descriptive Name	Description	Network Access	* Multistate Value
Units			
Flow Rate Units	Flow rate units on home screen as defined in parameter settings.	R	1300 (25 states)
Velocity Units	Velocity units on home screen as defined in parameter settings.	R	1302 (12 states)
Flow Total Units	Total volume units on home screen as defined in parameter settings.	R	1303 (7 states)
Energy Rate Units	Energy rate units on home screen as defined in parameter settings.	R	1306 (12 states)
Temperature Units	Temperature units on home screen as defined in parameter settings.	R	1308 (3 states)
Energy Total Units	Energy total units on home screen as defined in parameter settings	R	1309 (12 states)

* The BACnet Multistate Values may support more states than are available on the TFX-5000 meter. Only the states available on the TFX-5000 are shown below.

Units of Measure Enumerations

Parameter	Enumeration
Flow Rate Units	1. Liters per second
	2. Liters per minute
	3. Liters per hour
	4. Cubic meters per second
	5. Cubic meters per minute
	6. Cubic meters per hour
	7. Cubic feet per second
	8. Cubic feet per minute
	9. Cubic feet per hour
	10. Gallons per second
	11. Gallons per minute
	12. Gallons per hour
	13. Mega gallons per day
	14. Imperial gallons per second
	15. Imperial gallons per minute
	16. Imperial gallons per hour
	19. Oil Barrels per minute
	20. Mega Imperial gallons per day
	21. Oil Barrels per day
	22. Acre feet per day
	23. Fluid barrels per day
	24. Imperial barrels per day
	25. Custom flow rate
Velocity Units	1. Meters per second
	10. Feet per second
Flow Total Units	1. Liters
	2. Hectoliters
	3. Cubic meters
	4. Cubic feet
	5. Gallons
	6. Mega gallons
	7. Imperial gallons
	10. Acre Feet
	11. Oil Barrels (BBL)
	12. Imperial MegaGallons (MIGAL)
	13. Liquid Barrels (FBBL)
	17. Custom

Parameter	Enumeration
Energy Rate Units	1. Custom
	2. Watts
	3. Kilowatts
	4. Mega Watts
	5. British thermal units per hour
	6. Thousand British thermal units per hour
	7. Million British thermal units per hour
	8. KiloJoule per hour
	9. Mega Joule per hour
	10. Kilocalorie per hour
	11. Megacalorie per hour
	12. Ton of refrigeration
Temperature Units	1. Degrees Celsius
	2. Degrees Fahrenheit
	3. Degrees Kelvin
Energy Total Units	1. Custom
	2. Watt-Hour
	3. KiloWatt-Hour
	4. MegaWatt-Hour
	5. BTU
	6. kBTU
	7. MMBTU
	8. KiloJoule
	9. MegaJoule
	10. KiloCalorie
	11. MegaCalorie
	12. Ton-Hours

TROUBLESHOOTING

TFX-5000 Message

Code	Description	Recommended Action
S64 MODULE FAILED	Unable to initialize module.	Reseat module and reboot trnasmitter. If error repeats, replace module.
S65 MODULE MISMATCH	Module installed does not match settings.	Replace module with correct module. Check card type settings.

LED Indicators

RJ-45 (J100)

	LED Color	Description
RJ-45 LED Status Indicators	Yellow	Link/Act for Network
	Green	10 Mbit Link/Act

PCB LED Status Indicators (Remove Cover For Viewing)

	LED Color	Signal Name	Description
COMMS (UART) Status Indicators (D100=Yellow, D101=Green)	Yellow	RXD	UART, from Brick to DSP
	Green	TXD	UART, from DSP to Brick

	LED State	Description
Network Status Indicators (D103=Green, D104=Red)	Off	No power or no IP address.
	Green	Online, one or more connections established.
	Green, flashing	Online, no connections established.
	Red	Duplicate IP address, Fatal error.
	Red, flashing	A timeout has occurred. Cycle power to return status to its normal state (flashing green).
Module Status Indicators (D106=Green, D107=Red)	Off	No power.
	Green	Controlled by a scanner in Run State.
	Green, flashing	Not configured, or scanner in Idle state.
	Red	Major fault (for example, Exception state or Fatal error).
	Red, flashing	Recoverable fault(s). Module is configured, but stored parameters differ from currently used parameters.

Symptoms	Possible Causes	Recommended Action
Intermittent communication	Cable is not properly shielded.	Communication cables must have shielding to protect the quality of the communication signals from electromagnetic interference (EMI). Check that the cable has a shield. Typically, one end of the shield drain is connected to a clean ground to dissipate EMI and prevent ground loops. However, depending on the ground quality, cable length and type of interference, other methods can be employed.
	Cable routed near power cables such a variable frequency drives.	Cables carrying high currents cause a high degree of electromagnetic interference that can interfere with the quality of the communication signals. Route signal cables away from power cable.

CONFORMANCE STATEMENT

ANNEX A - PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (NORMATIVE)
(This annex is part of this Standard and is required for its use.)

BACnet Protocol Implementation Conformance Statement

Date: 3/6/20
Vendor Name: Badger Meter, Inc.
Product Name: TFX-5000 Ultrasonic Clamp-on Flow Meter
Product Model Number: TFX-5000
Application Software Version: N/A **Firmware Revision:** 2.02.480 **BACnet Protocol Revision:** 12

Product Description:
Clamp-on ultrasonic flow meter designed for measuring water.

BACnet Standardized Device Profile (Annex L):

☐ **BACnet Operator Workstation (B-OWS)**

☐ **BACnet Advanced Operator Workstation (B-AWS)**

☐ **BACnet Operator Display (B-OD)**

☐ **BACnet Building Controller (B-BC)**

☐ **BACnet Advanced Application Controller (B-AAC)**

☑ **BACnet Application Specific Controller (B-ASC)**

☐ **BACnet Smart Sensor (B-SS)**

☐ **BACnet Smart Actuator (B-SA)**

List all BACnet Interoperability Building Blocks Supported (Annex K):
  • Data Sharing-ReadProperty-B (DS-RP-B)
  • Data Sharing-WriteProperty-B (DS-WP-B)
  • Data Sharing - ReadProperty Multiple - B (DS-RPM-B)
  • Data Sharing - WriteProperty Multiple - B (DS-WPM-B)
  • Device Management-Dynamic Device Binding-B (DM-DDB-B)
  • Device Management-Dynamic Object Binding-B (DM-DOB-B)
  • Device Management-DeviceCommunicationControl-B (DM-DCC-B)

Segmentation Capability:

☐ Able to transmit segmented messages   Window Size _____
☐ Able to receive segmented messages   Window Size _____

Standard Object Types Supported:
  • 1 Device Object
  • 6 Notification Class Objects
  • 73 Analog Value Objects
  • 6 Multistate Value Objects

ANNEX A - PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (NORMATIVE)

Data Link Layer Options:

■ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) _____
☐ MS/TP master (Clause 9), baud rate(s):_____
☐ MS/TP slave (Clause 9), baud rate(s): <u>9600, 19200, 38400, 57600, 76800, 115,200</u>
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):_____
☐ Point-To-Point, modem, (Clause 10), baud rate(s): _____
☐ LonTalk, (Clause 11), medium: _____
☐ BACnet/ZigBee (ANNEX O)
☐ Other: _____

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes   ■ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)

    Does the BBMD support registrations by Foreign Devices?   ☐ Yes ■ No
    Does the BBMD support network address translation?   ☐ Yes ■ No

Network Security Options:

■ Non-secure Device - is capable of operating without BACnet Network Security
☐ Secure Device - is capable of using BACnet Network Security (NS-SD BIBB)
    ☐ Multiple Application-Specific Keys:
    ☐ Supports encryption (NS-ED BIBB)
    ☐ Key Server (NS-KS BIBB)

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ISO 10646 (UTF-8/ ANSI X3.4) ☐ IBM™/Microsoft™ DBCS   ☐ ISO 8859-1
☐ ISO 10646 (UCS-2)   ☐ ISO 10646 (UCS-4)   ☐ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

Not supported.

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