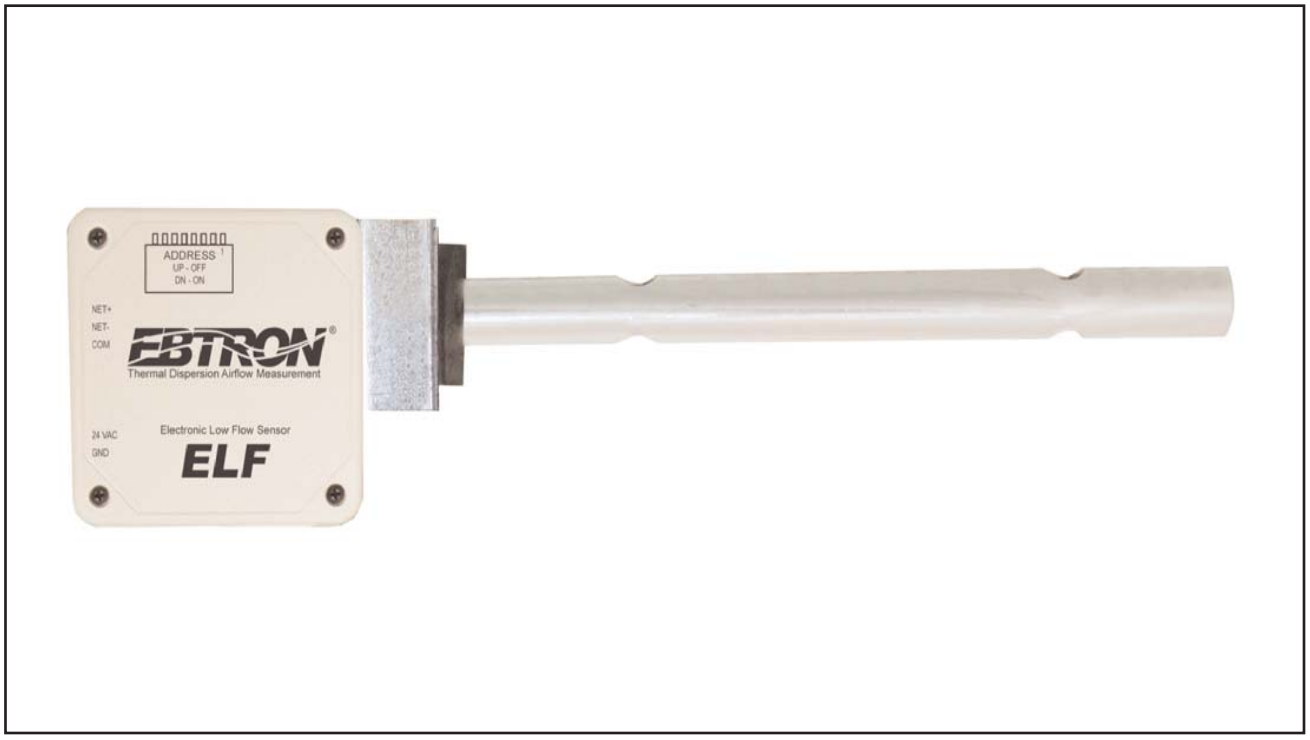
Installation, Operation and Maintenance Technical Manual

ELF RS-485 Network /N Series

Electronic Low Flow Airflow Measurement Station for RS-485 BACnet® and Modbus® RTU Applications

For the following models:
ELF-XXXX/N01:

Document Name: TM_ELF-N_R1C



TM_ELF-N_R1C

Part Number: 930-0180

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LIST OF EFFECTIVE AND CHANGED PAGES

Insert latest changed pages (in bold text); remove and dispose of superseded pages.
Total number of pages in this manual is **16.**

Page No	Revision *	Description of Change	Date
1, 2	**R1D**	**Updated cover/title page to revision R1D**	**12/14/2011**
5	**R1D**	**Clarified placement diagram**	**12/14/2011**
4	R1B	Power Consumption was 5VA, corrected to 8VA:	05/20/2011
1 through 16	R1A	Initial document release	05/03/2011

* R1A indicates an original page without change

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Figure 1. EBTRON ELF Electronic Low Flow Measurement Station

OVERVIEW

The ***EBTRON*** ELF electronic low flow thermal dispersion RS-485 output airflow measurement station features unique sensors designed for precise measurement and control of airflow or temperature in small duct (16 inch max) and VAV box applications. Simple and flexible RS-485 output options permit BACnet® MS/TP or Modbus® RTU interface to virtually all modern building automation systems (BAS).

EBTRON's proprietary flow loss compensation techniques eliminate inaccuracies typically associated with small duct and low airflow measurement. Traditional measurement techniques produce readings that are greater than actual flow due to the inherently large ratio of duct wall surface to duct free area. The ELF uses a single factory calibrated probe equipped with one or two sensor nodes, depending on application.

ELF airflow sensors use "bead-in-glass" and precision thermistors to determine the airflow rate and temperature at each sensing location. The sensor relates the thermal transfer rate of a heated element to airflow rate. As the velocity across the sensor increases, the thermal transfer rate increases. Accuracy is ensured through individual sensor characterization over a range of 0 to 3,000 FPM (0 to 15.24 m/s) in wind tunnels calibrated to volumetric airflow standards. Accuracy is percent of reading (not percent of full scale) throughout the entire calibrated range. Network variables permit measurement of airflow or temperature with adjustable ranges. Configurable network properties permit the ELF to provide output data in velocity (FPM/ m/s) or in equivalent volumetric flow (CFM/Liters per second) units. In addition, a Flow Integration filter feature can be engaged to minimize transient wind effects if required. The integral RS-485 BACnet® MS/TP and Modbus® RTU compatible communications interface includes options for setting address, device instance and baud rate. Each ELF airflow measurement station includes a factory calibrated sensor probe and integral dedicated transmitter and mounting bracket.

TM_ELF-N_R1A

ADVANCED TECHNOLOGY

- ***EBTRON*** Advanced Thermal Dispersion (TD) airflow measurement technology ensures accurate, repeatable airflow/temperature measurement from zero flow (still air).
- Superior performance compared to conventional differential pressure- based pitot technology in challenging small duct and VAV box applications.
- Sensors are factory calibrated from 0-3,000 FPM to volumetric airflow standards.
- Flow Integration filter to minimize the effects of transient wind gusts.
- True volumetric airflow rate using independent sensors.
- Highest quality/stability hermetically sealed **"bead-in-glass"** and precision thermistors.
- Advanced industrial grade components and robust microprocessor based design ensures accuracy, stability and long term reliability.
- Integral RS-485 BACnet® MS/TP and Modbus® RTU interface for interoperability with common BAS devices.
- Integrated mounting bracket simplifies field installation.

SPECIFICATIONS

General

Range: 0 to 3,000 FPM [15.24m/s]
Typical Accuracy: ± 3% of reading from 0 to 3,000 FPM[1]
Repeatability: ±0.25%
Operating Temperature Range (transmitter):
-20°F to 120°F [-28.9°C to 48.9°C]
Operating Temperature Range (sensor probe):
30°F to 160°F [-1.1°C to 71.1°C]
Operating Humidity Range:
0 to 99% (non-condensing)
Power Requirement: 24 VAC (22.8 to 26.4 VAC)
Power Consumption: 8 VA max.

Probe Sizes

Standard Sizes:
4 to 10 inches (101.6 to 254 mm), in 1 inch (25.4 mm) increments; and >10 to 16 inches (>254 to 406.4 mm), in 2 inch (50.8 mm) increments.

Sensor Probes

Sensor housing: Glass-filled polypropylene (Kynar® with 316 SS option)
Sensor potting material: Marine grade, waterproof epoxy
Internal wiring: Kynar® coated copper
Mounting Style: Insertion Mount, with integral mounting bracket

Probe Construction:
0.75 inch (19.05 mm) diameter tubing;
Type 6063 aluminum alloy standard
Type 316 stainless steel optional
Probe Sizes: 4 to 16 in.
Sensing Points per probe:
2 per probe from 5 to 16 inches;
1 per probe on 4 inch probes
Probe Configuration (maximum):
1 Probe x 2 Independent Sensors
Sensor Assembly (each point):
Bead-in-glass and precision thermistor devices bonded in housing with waterproof marine grade epoxy

Output to Host Controls

RS-485 BACnet® MS/TP or Modbus® RTU
Baud rate: Selectable 76,800, 38,400, 19,200, 9,600
Default: RS-485 BACnet® MS/TP 76,800
Default: Modbus® RTU: 19,200

Specification Notes: [1] Accuracy for duct sizes up to 16 inches (406.4 mm). Consult factory for other sizes.

ORDERING GUIDE

E L F - _ _ _ _ / _ _ / _ _

Probe Material Options
Blank (no slash) Aluminum Probe
/ SS Stainless Steel Probe

Features/Options
/ D00 Dual 0-10VDC/2-10VDC Out (Flow + Temp)/0.015% resolution; With Flow Integration
/ D01 Dual 0-5VDC/1-5VDC Out (Flow + Temp)/0.03% resolution; With Flow Integration
/ D02 Dual Staefa SVP Output (Flow + Temp) with Flow Integration
/ D03 Dual 0-10VDC/2-10VDC Out (Flow + Temp)/0.015% resolution; No Flow Integration
/ D04 Dual 0-5VDC/1-5VDC Out (Flow + Temp)/0.03% resolution; No Flow Integration
/ F00 Single 0-10VDC/2-10VDC Out/0.015% resolution; With Flow Integration
/ F01 Single 0-5VDC/1-5VDC Out/0.03% resolution; With Flow Integration
/ F02 Single Staefa SVP Output with Flow Integration
/ F03 Single 0-10VDC/2-10VDC Out/0.015% resolution; No Flow Integration
/ F04 Single 0-5VDC/1-5VDC Out/0.03% resolution; No Flow Integration
/ N01 RS-485 Output

Probe Sizes (inches)
0400 4 inches
0500 5 inches
0600 6 inches
0700 7 inches
0800 8 inches
0900 9 inches
1000 10 inches
1200 12 inches
1400 14 inches
1600 16 inches

Examples:
For a 9 inch duct, single 0-10/2-10VDC Airflow Output and an aluminum probe, specify order code ELF-0900/F00.
For a 9 inch duct, single 0-5/1-5VDC Output and a stainless steel probe, specify order code ELF-0900/F01/SS.
For a 9 inch duct, Staefa SVP single output and an aluminum probe, specify order code ELF-0900/F02.
For a 9 inch duct, RS-485 Output and an aluminum probe, specify order code ELF-0900/N01.
For a 9 inch duct, dual 0-10/2-10VDC analog output with flow integration filter and an aluminum probe, specify order code ELF-0900/D00.

TM_ELF-N_R1B

ELF PLACEMENT

The following paragraphs detail the procedure for determining optimum placement of the ELF in typical installation applications.

CAUTION

Installation of the ELF at the exact location indicated in the Minimum Placement Guidelines below is critical for proper performance of the airflow measurement station.

Minimum Placement Guidelines

The ELF small duct airflow measurement station sensor probes are computer calibrated between 0 and 3,000 FPM (0.25 and 15.24 m/s) in individual wind tunnels to volumetric airflow standards. As a result, performance on smaller ducts is improved by compensating for flow losses near the duct wall. Small ducts have a large duct wall surface to free area ratio that typically results in higher than actual flow measurement when traditional multi-point traverse airflow measurement techniques are used.

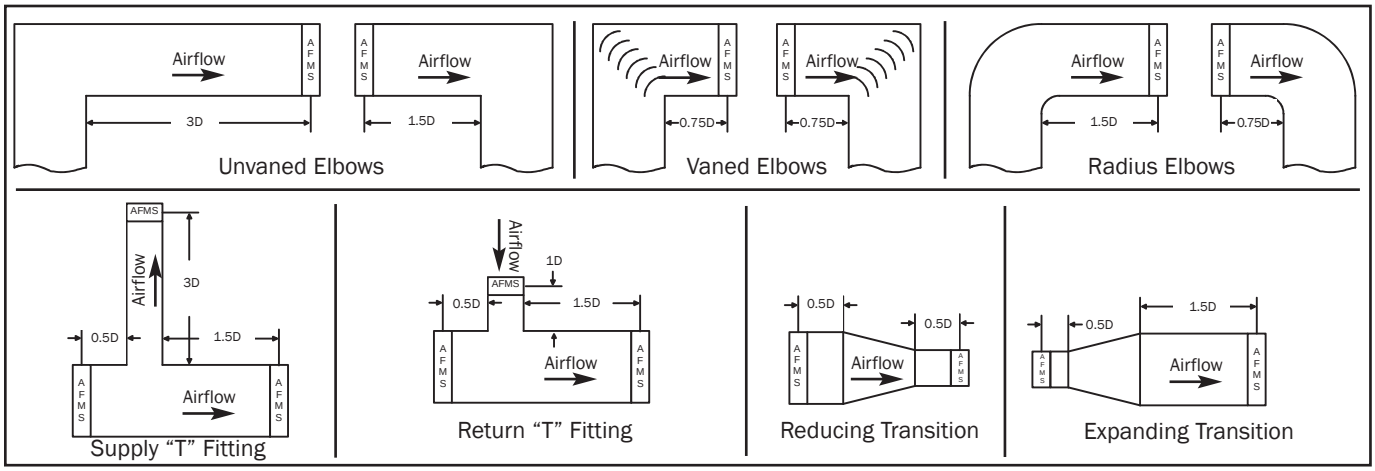
Placement of the ELF is critical for proper operation and accuracy of the airflow measurement station. Figure 2 shows minimum placement requirements for the ELF in typical applications. Placement is indicated in multiples of 'Simple Equivalent Duct Diameter - '*D*', which is determined as follows:

$$'D' = \frac{(\text{duct width} + \text{duct height})}{2}$$

1. Using the illustration in Figure 2 that most closely matches the installation, multiply the the calculated 'D' value above by the value indicated in the application illustration. This is the calculated ELF location.

2. Mark duct location and install the ELF at the calculated location.

MINIMUM PLACEMENT GUIDE



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Minimum placement is indicated in multiples of duct diameter ***'D'***:
See separate diagrams for VAV box applications. Consult ***EBTRON*** for applications not indicated in the diagrams.

Figure 2. ELF Minimum Placement Requirements Guide

ELF INSTALLATION

The ELF is designed for use in smaller ducts (up to 16 inches) and in VAV terminal box applications in an environment between -20°F to 120°F (-28.9° C to 48.9° C) where it will not be exposed to rain or snow. ELF airflow measurement station sensor probes are designed for insertion mounting through one side of the duct or VAV box. Mount the instrument in an accessible location to permit wiring to customer provided BAS control interface, and initial set up of the instrument.

CAUTION

The installed location of the ELF is critical for proper performance. Refer to the previous Minimum Placement Guidelines section of this document to determine the exact location recommended for the ELF.

The installed accuracy of the ELF is ensured in applications where the maximum inside duct dimension is 16 inches or less. Applications in larger duct sizes may degrade accuracy. Consult factory for these applications.

Ensure that adequate clearance exists to permit insertion of the probe, and to allow clearance for the instrument enclosure and access for wiring and setup.

External duct insulation that interferes with mounting should be temporarily removed prior to installation. Mounting requires a 0.875 inches (22.2 mm) hole on the insertion side of the duct.

1. Determine where the ELF airflow measuring station is to be located as indicated on the engineer's plans.
2. Carefully open the ELF package and inspect for damage. If damage is noted, immediately file a claim with carrier.
3. Locate and mark the point on the duct or VAV box where the probe will be inserted, using the previous Minimum Placement Guidelines section of this document. Refer to Figures 3 and 4 for ELF dimensions and probe orientation.
4. Using a 0.875 inches (22.2 mm) hole saw, drill the insertion side hole where marked.
5. Place the probe through the mounting hole, making sure that the gasket is seated firmly against the integral mounting bracket. Ensure that the edge of the ELF mounting bracket is parallel to the edge of the duct or VAV terminal box, and that the airflow arrow printed on it is oriented in the direction of actual airflow. Ensure that the gasket is firmly seated against the bracket, and then fasten the mounting bracket at the four mounting holes using appropriate sheet metal screws.
6. Route the customer provided power and network wiring to the ELF. Refer to the following sections of this document for instrument wiring interconnections,set up and operation.

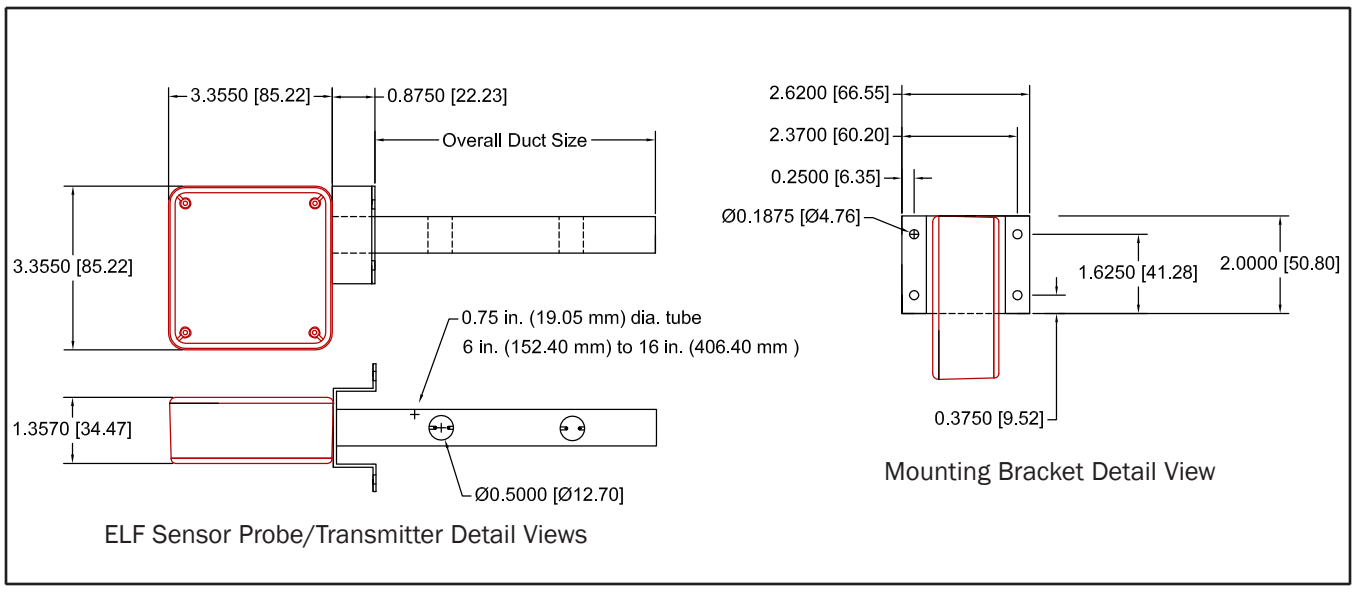
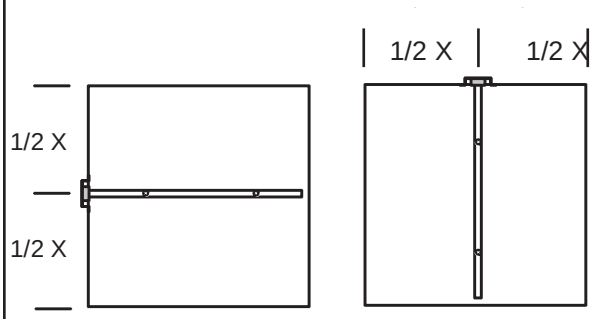


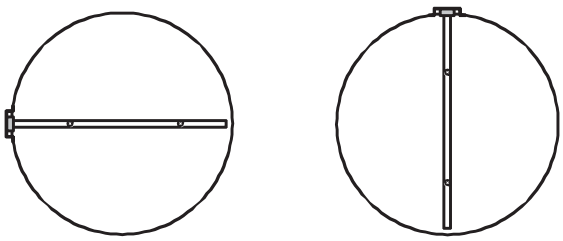
Figure 3. ELF Installation Dimensions

INSTALLING THE ELF IN DUCTED APPLICATIONS

RECTANGULAR DUCT PLACEMENT

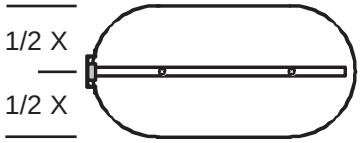


ROUND DUCT PLACEMENT

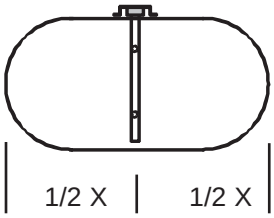


FLAT-OVAL DUCT PLACEMENT

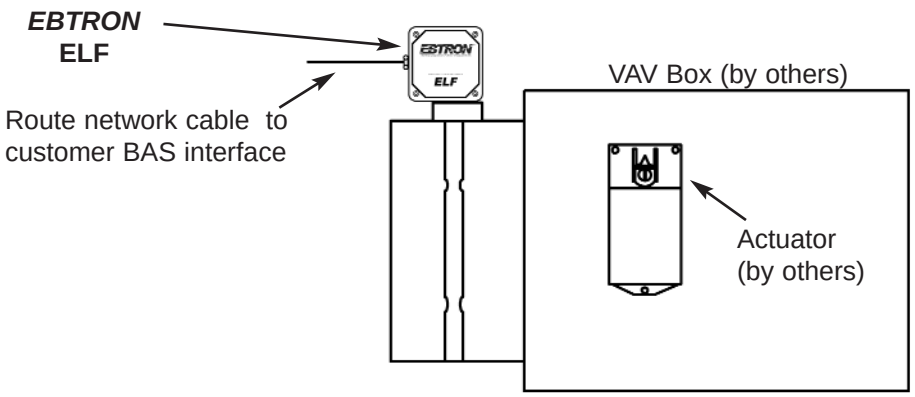
Across major axis



Across minor axis



INSTALLING THE ELF IN VAV BOX APPLICATIONS



Boxes with pneumatic flow rings:
Remove existing flow ring. Locate ELF 3 inches (minimum) upstream of box, OR 3 inches (minimum) upstream of flow ring.

Boxes with no flow rings:
Locate ELF 3 inches (minimum) upstream of box.

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Figure 4. ELF Installation Applications and Orientation

ELF INTERCONNECTIONS

CAUTION

Deactivate 24 VAC power source until all connections to the ELF are complete.

When multiple devices are powered from a common 24VAC power source, ensure that all devices are wired in phase with power to the ELF 24VAC connector at J12 (24VAC to + terminal, and return at GND terminal). Damage will occur to the ELF and/or other devices if this caution is not observed.

To prevent damage to the ELF and/or other connected network devices, observe RS-485 network grounding and ELF 24VAC grounding precautions.

The ELF contains electrostatic discharge (ESD) sensitive components. Observe ESD precautions when handling the instrument to prevent damage. Failure to comply can result in equipment damage.

NOTE

The 24 VAC ground (GND) connection is shared with the RS-485 network GND connection. If an isolated output is desired, a dedicated isolation transformer is required to power the ELF.

All connections to the ELF are accomplished using the two removable push-on screw-terminal block connectors supplied. The two terminal connectors are attached to the ELF circuit board at 24VAC connector J12 and RS-485 connector J2 as shown in the detail of Figure 5, and the wiring diagram of Figure 6. The connectors are keyed to prevent improper connection and feature screw-down clamps to secure each of the wires to be connected to it.

1. Remove the two-terminal connector attached to the ELF at 24VAC connector J12.
2. Connect 24VAC power to the ELF at 24VAC terminal block J12 as shown in the detail of Figures 5 and 6. When powering multiple network devices from a common source, observe 24VAC phasing on all devices (24VAC power to terminal 1(**+**), return at terminal 2(**GND**) - see Caution notes). The GND connection must only be connected to earth ground according to the following guidelines:

   CAUTION

   Damage to network devices may occur if 24VAC GND terminal is connected to earth ground and the RS485 network is not earth grounded.

   a) If the RS485 network connection for the ELF **is ground referenced to earth**, the 24VAC GND terminal **may** also be connected to a wire that is ground referenced to earth.

   b) If the RS485 network connection for the ELF **is not ground referenced to earth**, the 24VAC GND terminal **must not** be connected to a wire ground referenced to earth, as damage to other network devices may occur.
3. Connect RS-485 network connections at RS-485 terminal block J2 as shown in the detail of Figures 5 and 6, observing the precautions in step 2.
4. Proceed to the following ELF INITIAL SET UP section to prepare and set up the the ELF.

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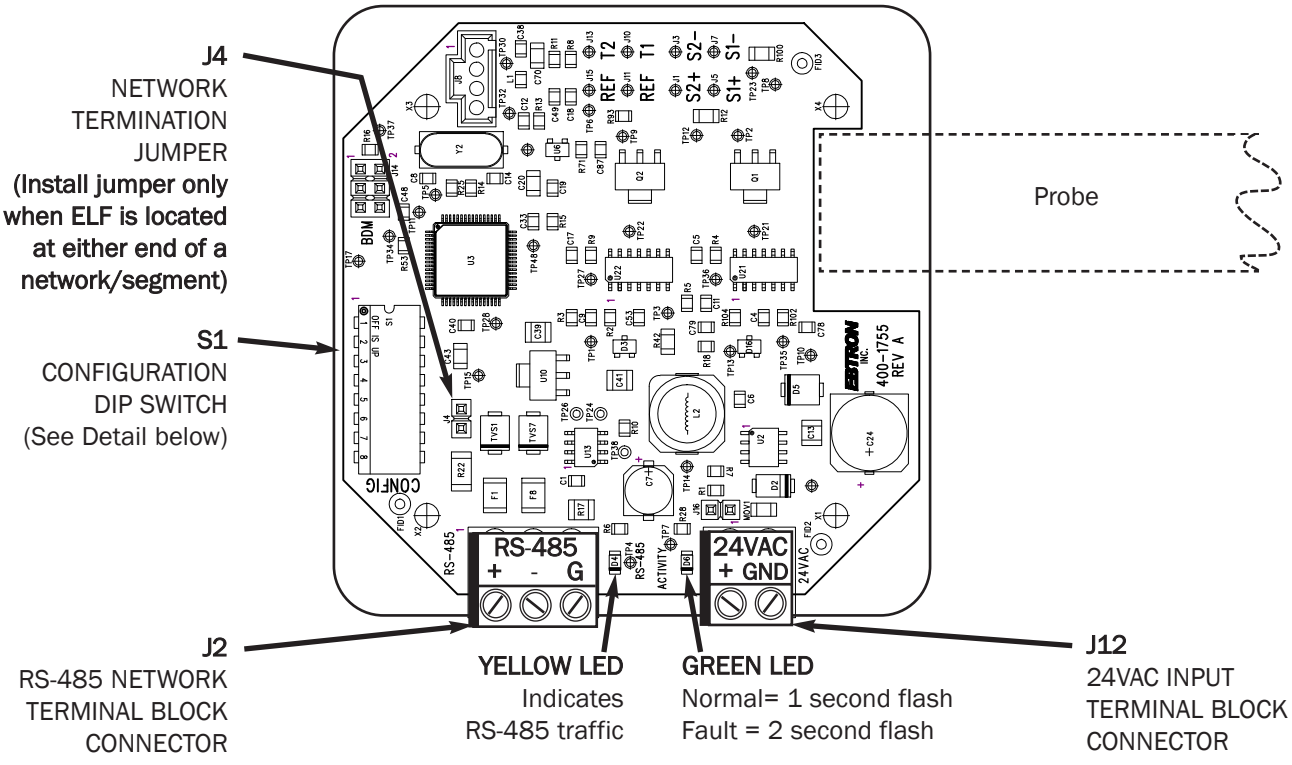
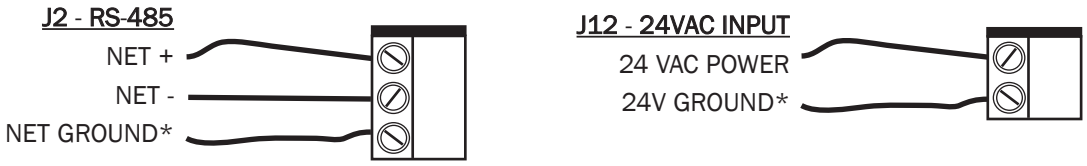


NOTE: J2-GND (Network Ground) and J12-GND (24VAC Ground) are tied together on the ELF!

ELF CIRCUIT BOARD DETAIL

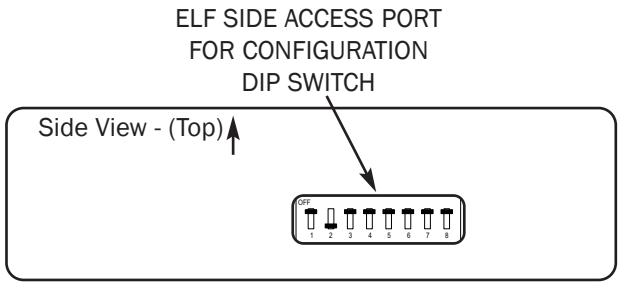


*** CAUTION! - 24VAC POWER AND RS-485 NETWORK GROUNDING PRECAUTIONS**

1. When multiple devices are powered from a common 24VAC power source, ensure that all connected devices are wired in phase with 24VAC power! Damage will occur to the ELF and/or other devices if this caution is not observed.

2. On RS-485 networks that are ground referenced to earth, ELF 24V GND terminal may also be connected to a wire ground referenced to earth. However, on RS-485 networks that are not ground referenced to earth, ELF 24V GND terminal must not be connected to a wire ground referenced to earth. Damage may occur to the ELF or to other network devices if this caution is not observed.

ELF WIRING TERMINAL CONNECTOR DETAIL



ELF CONFIGURATION DIP SWITCH - SIDE ACCESS DETAIL

DIP Switch Number and Position								Network Address
1	2	3	4	5	6	7	8	
off	off	off	off	off	off	off	off	0
on	off	off	off	off	off	off	off	1
off	on	off	off	off	off	off	off	2 (Default
on	on	off	off	off	off	off	off	3
⬇	⬇	⬇	⬇	⬇	⬇	⬇	off	⬇
on	on	on	on	on	on	on	off	127

ELF CONFIGURATION DIP SWITCH
MAC ADDRESS SETTING DETAIL

Figure 5. ELF Circuit Board, Wiring and Configuration Switch Details

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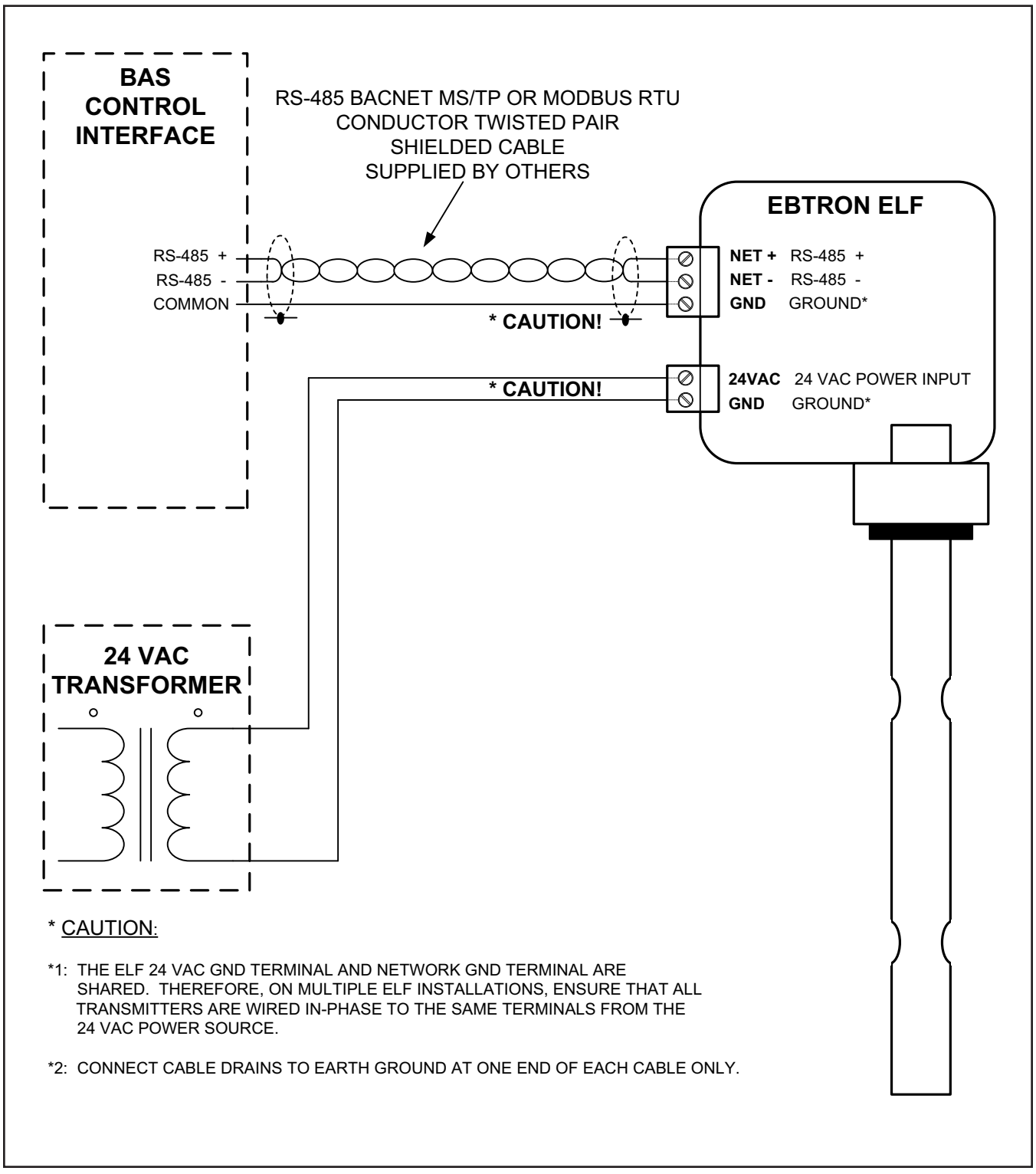

Figure 6. ELF Power and Signal Wiring Interconnections

ELF INITIAL NETWORK SET UP

The ELF is shipped from the factory for BACnet® operation. **For BACnet operation**, perform these INITIAL SET UP tasks and then proceed to the following **ELF BACNET CONFIGURATION** section.

For Modbus® operation, perform these INITIAL SET UP tasks, and then proceed to the **ELF MODBUS® CONFIGURATION s**ection of this document.

S1 - ELF Configuration DIP Switch Settings

CONFIGURATION DIP switch S1 contains eight separate dual-position switches in a dual inline package (DIP) as shown in detail of Figure 5. These switches allow for setting the following ELF network parameters:

- Setting the MAC Address/Slave ID - using Switches 1 through 7
- Setting BACnet® Device Object Instance Number (if the same as the MAC Address) - using Switch 8
- Setting BACnet® Baud Rate - using Switches 1 through 4
- Restoring Defaults - using Switches 1-8
- Enabling Modbus® network operation - using Switches 1 through 4

NOTE:

Prior to initializing the ELF, the MAC address and the baud rate parameters may need to be assigned depending upon your specific network.

Setting the MAC Address

The ELF MAC Address is set at the factory for a value of 2. If it is necessary to change the MAC address, set switches 1 through 7 of CONFIGURATION SWITCH S1 to any address value between 0 and 127 as follows:

1. Deactivate 24VAC power to the ELF.
2. Set S1 switches 1-7 to the desired address as shown in the detail of Figure 5. Record the new MAC address value for future reference.
3. Reapply 24VAC power to the ELF. After a short delay (approximately 20 seconds), the new MAC address is active.

NOTE:

When ELF configuration is complete, confirm that the new MAC address has been set correctly using appropriate BACnet® software.

Setting the Baud Rate

The ELF is shipped from the factory for BACnet® operation with a baud rate of 76,800bps. The baud rate can be changed to 38,400, 19,200 or 9,600bps locally at the ELF by using internal DIP Switch SW1 as follows. Note that for BACnet® operation, changes can also be accomplished remotely over the network using AV2, or through Modbus register 30015 (see Appendices A and B).

1. Record the currently assigned MAC Address (S1 switches 1 through 7 - See Figure 5 detail).
2. Set the desired baud rate using Address Switches 1 through 4 as shown below in Figure 7.
3. Set DIP Switch 8 to the ON position. Allow a short delay (approximately 20 seconds) for the new baud rate to be recognized.
4. Restore DIP Switch 8 to the OFF position.
5. Restore DIP switches 1-7 to the MAC address recorded in step 1.

ADDRESS DIP Switch Number/Position								MS/TP
1	2	3	4	5	6	7	8	Baud Rate
on	off	off	off	X	X	X	X	76,800
off	on	off	off	X	X	X	X	38,400
off	off	on	off	X	X	X	X	19,200
off	off	off	on	X	X	X	X	9,600

Only SW1 Switches 1 through 4 are used to set the Baud Rate - See text for detail.

NOTE:
Baud Rate changes can also be accomplished remotely over the network using AV2 for BACnet® operation, or through Modbus register 30015 (see Appendices A and B).

Figure 7. ELF Baud Rate Selection

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J4 - ELF RS-485 Network Termination Selection

The ELF includes a network termination selector jumper at J4 (shown in Figure 5 detail) for setting network termination of the ELF when it is installed at any point on an RS-485 network. When the ELF is located at either end of an RS-485 network or segment, it is recommended that the jumper be installed across both pins of J4. When the ELF is located at any other point on the RS-485 network, no termination is recommended, and the jumper at J4 should be removed.

Restoring Factory Default Settings

If necessary, the following procedure can be used to restore the factory default settings to the ELF:

1. If the current MAC Address will be reused, record the currently assigned address (S1 switches 1 through 7 - see Figure 5 detail).
2. Deactivate 24VAC power to the ELF.
3. Set all 8 of the DIP switches (1-8) to the ON position.
4. Restore 24VAC power to the ELF. Allow a short delay (approximately 20 seconds) for the factory default settings to be recognized.
5. Deactivate 24VAC power to the ELF.
6. Set all 8 of the DIP switches (1-8) to the OFF position.
7. Restore DIP switches 1-7 to the MAC address recorded in step 1.
8. Restore 24VAC power to the ELF to return it to service with the factory default settings.

ELF BACnet® CONFIGURATION

The following paragraphs detail the final set up instructions for the ELF when using BACnet® device operation. Refer to Appendix A - ELF BACnet® Device Operating Parameters for additional detail.

Changing BACnet® Device Object Instance Number

Matching BACnet Device Object Instance Number to MAC Address

The BACnet® Device Object Instance Number is set at the factory to match the default MAC address of 2. If necessary, the BACnet® Device Object Instance Number can be set to match a different user assigned MAC address, as follows:

1. Set the user assigned MAC address value as previously described in Setting the MAC Address procedure.
2. Deactivate 24VAC power to the ELF.
3. Slide DIP Switch 8 to the ON position.
4. Restore 24VAC power to the ELF. Allow a short delay (approximately 20 seconds) for the new BACnet® Device Object Instance Number to be recognized.
5. Restore DIP Switch 8 to the OFF position.

Setting BACnet Device Object Instance Number to a value different than MAC Address

The BACnet® Device Object Instance Number can be set to a value that does not match the MAC address by using suitable BACnet® software to write to the ELF Device Object Identifier property of the Device Object. Refer to Appendix A for additional detail.

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ELF MODBUS® CONFIGURATION

The ELF is preset at the factory for BACnet® network operation. To set the ELF for Modbus® network operation, perform the following steps. Refer to Appendix B - ELF MODBUS® Device Operating Parameters for available register values and settings.

1. The default network address is set at the factory for a value of 2. Any value between 1 and 127 can be assigned for the ELF using Configuration DIP Switch S1 as outlined in the **Setting the MAC Address** paragraph of this document. If the current network address will be reused, record the current settings of DIP switches 1 through 7.
2. With the ELF powered on, set Configuration DIP switches 1 through 4 to the ON position.
3. Toggle DIP switch 8 to the ON position for 5 seconds, and then back to OFF.
4. Restore DIP switches 1-7 to the network address recorded in step 1.
5. The ELF is now set for Modbus® operation with a baud rate of 19,200bps. If necessary, the baud rate can be changed as outlined previously in the **Setting the Baud Rate** paragraph of this document.
6. Configure the necessary Modbus® register values as outlined in Appendix B.

ELF START-UP

The following procedure is intended for initial start up of the instrument.

1. Confirm that the ELF is installed and wired properly as outlined in the **ELF INSTALLATION** and **ELF INTERCONNECTIONS** sections of this document.
2. Confirm that network termination, address, baud rate and device object instance number (as applicable) have all been properly set as outlined previously in the **ELF BACnet® CONFIGURATION** or **ELF MODBUS® CONFIGURATION** sections of this document.
3. Apply 24VAC power to the ELF. After a brief initialization (approximately 20 seconds) observe that the green Activity LED flashes on for 1 second, then OFF for one second indicating normal operation.
4. Confirm network device settings and operation using Appendices A and B for BACnet® and Modbus® applications respectively.

ELF NORMAL OPERATION

During normal operation of the ELF, no further user activity is required.

The ELF features a green “Activity” LED (Figure 5 detail) that flashes to indicate the operating status of the instrument. Following application of 24VAC power and a brief instrument initialization of approximately 20 seconds, the LED will begin to flash.

During normal ELF operation the Activity LED will continuously flash ON for 1 second, then OFF for 1 second.

During ELF fault conditions, the LED will continuously flash ON for 2 seconds, and then OFF for 2 seconds.

Refer to Appendix A and Appendix B for BACnet® and Modbus® device network values available during operation of the ELF.

Install ELF cover using the four screws provided at each corner of the enclosure (as shown in Figure 3). The ELF is now ready for normal network operation.

ELF MAINTENANCE

In most HVAC environments, periodic maintenance and calibration is not required or recommended*.

*Depending on the application, it may be necessary to periodically inspect and clean sensors using compressed air or a small brush. Factory performance returns immediately after cleaning. Recalibration is NOT required. Periodic inspection of the sensors is always advised, and accessibility must be considered in these applications.

ELF STANDARD LIMITED PARTS WARRANTY

If any ***EBTRON*** product fails within 36 months from shipment, ***EBTRON*** will repair/replace the device free of charge as described in the company's warranty contained in ***EBTRON***'s Terms and Conditions of Sale. Defective equipment shall be shipped back to ***EBTRON***, freight pre-paid, for analysis.

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APPENDIX A -
BACnet® NETWORK DEVICE OPERATING PARAMETERS

BACnet® Standard Object Types Supported

ELF /N Series Standard Object Types Supported				
Object	**Optional Properties Supported**	**Writeable Properties**	**Proprietary Properties**	**Property Range Restrictions** (NOTE 1)
Device	• Description • Location • Max Master • Max Info Frames • Active COV Subscriptions	• Object Name • Description • Location • Object Identifier • APDU Timeout • Max Info Frames • Max Master	None	None
Analog Input 1 – Airflow (NOTE 2)	• Description • Reliability • COV Increment	• Units • Out of Service • COV Increment • Present Value	None	Units: **FPM**, CFM, MPS, LPS
Analog Input 2 – Temperature	• Description • Reliability • COV Increment	• Units • Out of Service • COV Increment • Present Value	None	Units: °C or **°F**
Analog Value 1 – Free Area (NOTE 2)	• Description • Reliability	Present Value	None	>= 0 (NOTE 2)
Analog Value 2 – Baud Rate	• Description • Reliability	Present Value	None	9600, 19200, 38400, **78600**
Binary Value 1 – Flow Integration	• Inactive Text • Active Text	Present Value	None	None

NOTES: 1. Factory default values are shown in **Bold** text.
2. Writing a non-zero value to Analog Input 1 object (AI1) will set the flow output to volumetric flow (CFM/LPS); writing a zero value will set the flow output to standard (FPM/MPS).

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APPENDIX B -
MODBUS® NETWORK DEVICE OPERATING PARAMETERS

ELF Modbus® Register Map

Name	Address	R/W	Length	Type	Description
Airflow	30001	R	2	Float	Avg Airflow (FPM, CFM, MPS, LPS)
Temperature	30003	R	2	Float	Avg Temperature (°F or °C)
Ins 1 Flow	30005	R	2	Float	Flow reading at the first insert
Ins 2 Flow	30007	R	2	Float	Flow reading at the second insert
Ins 1 Temp	30009	R	2	Float	Temperature at first insert
Ins 2 Temp	30011	R	2	Float	Temperature at second insert
Area	30013	R/W	2	Float	Duct area. **Writing a non-zero value** will set the flow output to volumetric flow (CFM/LPS); **Writing a zero value** will set the flow output to standard (FPM/MPS)
Baud	30015	R/W	2	Float	Communication baud rate (76800, 38400, 19200, 9600)
Units	30017	R/W	1	Enum	0 = IP Units, 1 = SI Units
Flow Integration	30018	R/W	1	Enum	0 = standard flow integration, 1 = no flow integration
Invert float	30019	R/W	1	Enum	0 = standard floating point format 1 = inverted floating point
Trouble	30020	R	1	Enum	0 = normal operation 1 = fault detected

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