

Installation Guide

EF-N1000 Series
BACnet/Modbus Network Output
Electronic Low Flow (ELF)
Airflow/Temperature Measurement Station

Document: IG_EF-N1000-T_R1A



IG_EF-N1000-T_R1A

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Insert latest changed pages (in bold text); remove and dispose of superseded pages.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 **8**.

Page No	Revision *	Description of Change	Date
1 through 12	R1A	Initial document release.	1/25/2016

* R1A indicates an original page without change

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1. INTRODUCTION AND SCOPE

This Quick Installation Guide provides basic installation information for the instrument installer. Information includes physical instrument installation, power and output cable connections as well as initial setup of the instrument. The self contained electronic low flow instrument in this document is referred to as the ELF. Model EF-N1000 provides a non-isolated RS-485 BACnet MS/TP or Modbus RTU output related to airflow (or equivalent velocity pressure) and temperature.

Models covered in this document are as follows:

EF-N1110	RS-485 BACnet Modbus Output (4" Single Sensor Probe)
EF-N1111	RS-485 BACnet Modbus Output (>4" Dual Sensor Probe)

For complete and detailed specifications, operating instructions and technical information, refer to the separate Installation, Operation and Maintenance Technical Manual **TM_EF-x1000** under separate cover.

2. EF-N1000 INSTALLATION

The ELF instruments are designed for use in small ducts 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. The ELF airflow measurement station sensor probes are designed for insertion mounting through one side of the duct or VAV box sidewall. Mount the instrument in an accessible location to permit set up. Locate the instrument so that the customer provided power and network cables will reach the instrument.



CAUTION

The installed location of the ELF is critical for proper performance. Refer to the Minimum Placement Guidelines in Technical Manual **TM_EF-x1000** to determine the exact location recommended for the instrument.

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 around the duct to permit insertion of the probe, and to allow clearance for the instrument enclosure.

Insulation that interferes with probe 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 or VAV terminal box.

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 Minimum Placement Guidelines section of Technical Manual **TM_EF-x1000**. Figures 1 and 2 show ELF installation detail, probe orientation and dimensions.
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. Refer to the following sections of this document for instrument wiring, set up and operation.

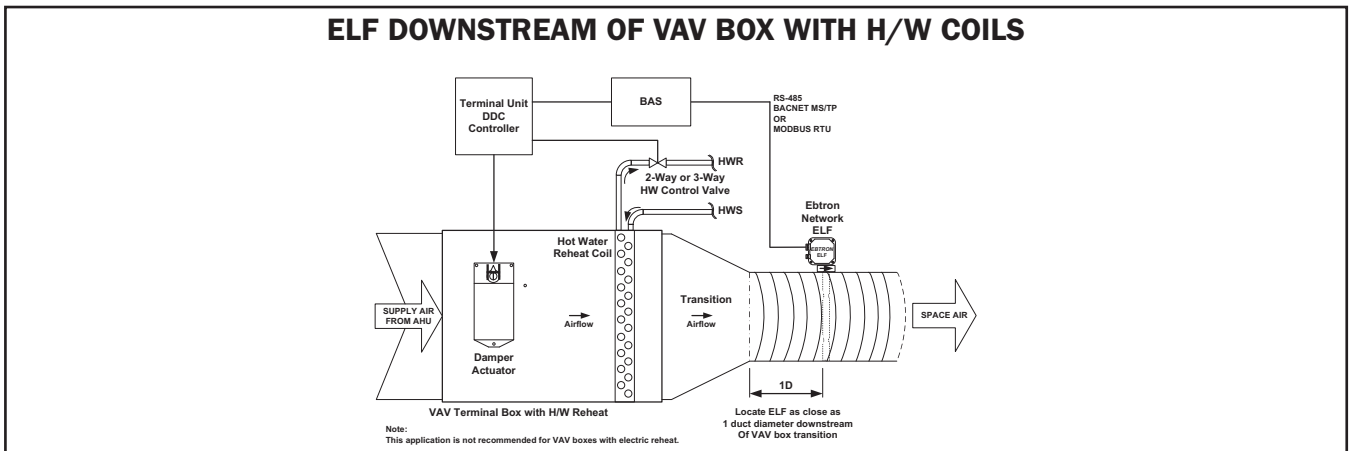
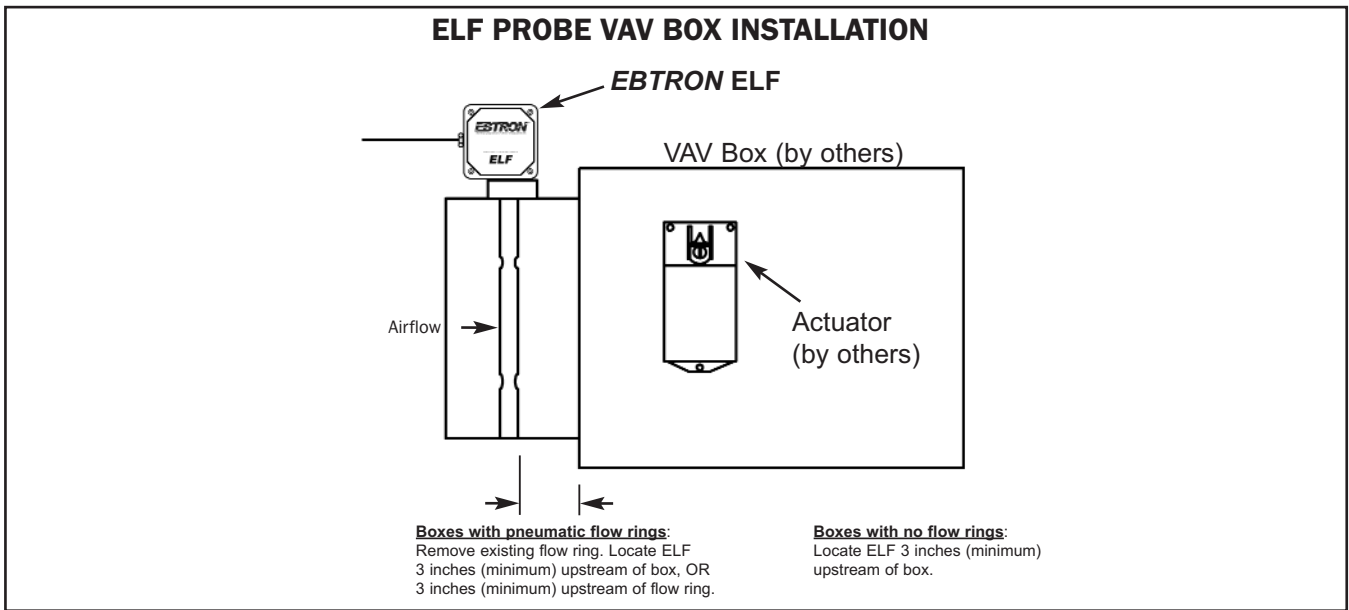
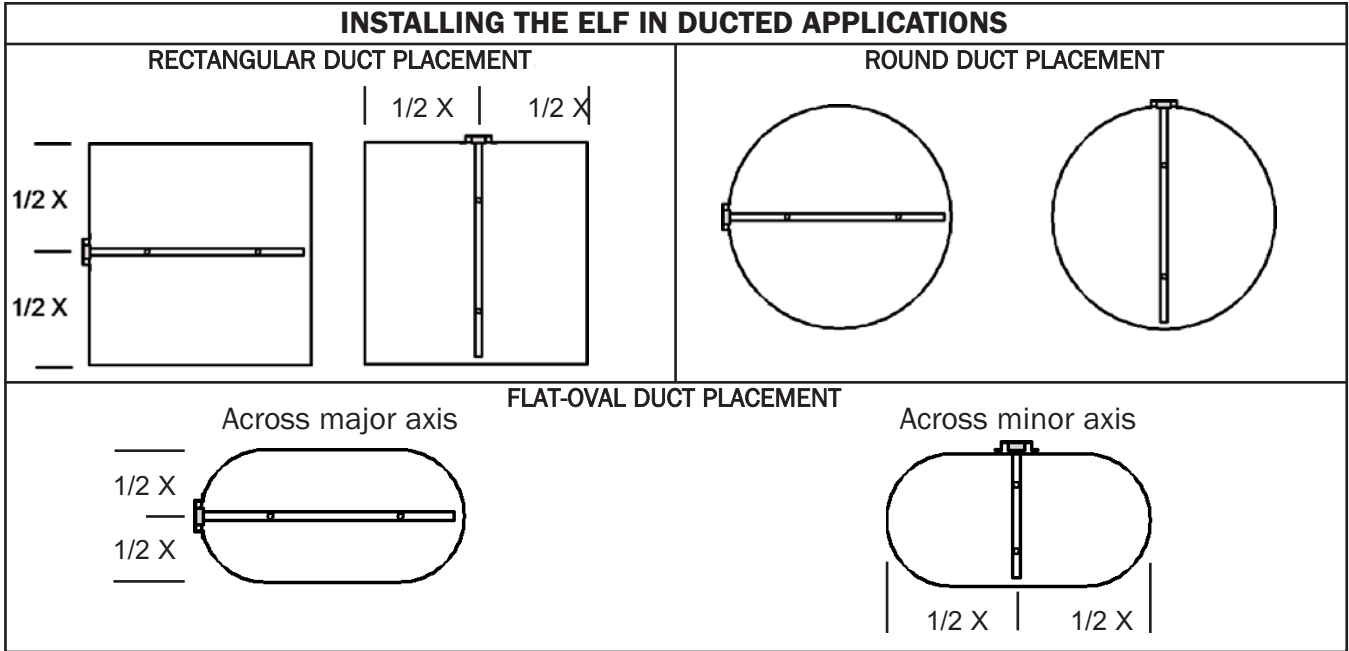


Figure 1. ELF Installation Applications and Orientation

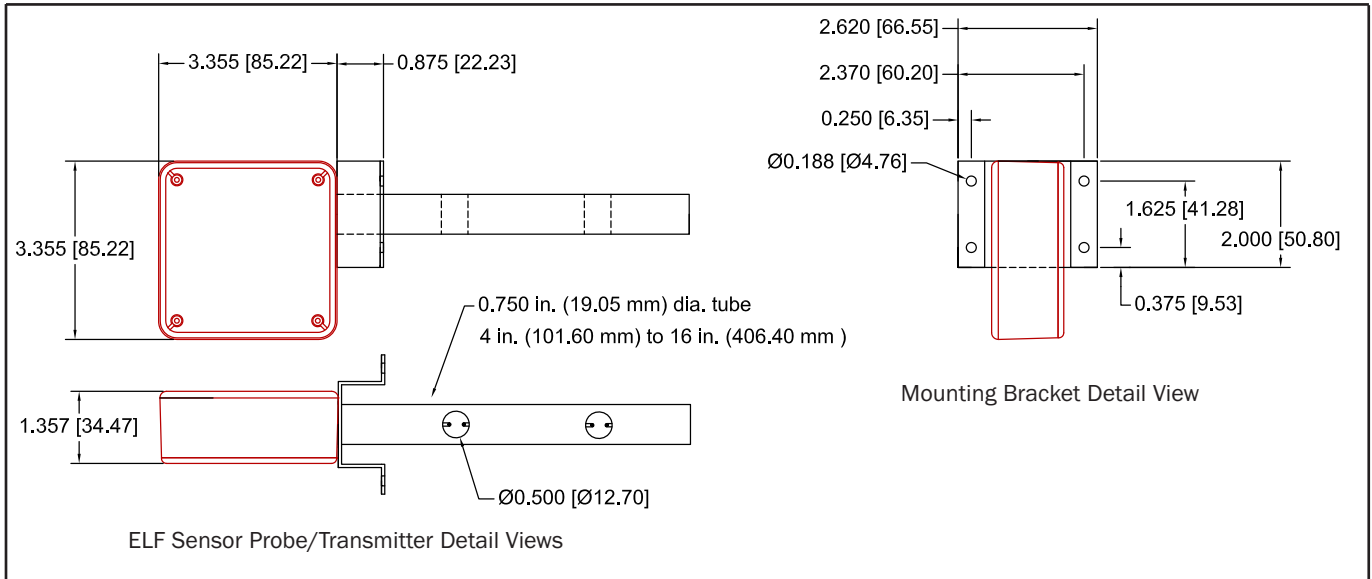


Figure 2. ELF Installation Dimensions

3. ELF PREPARATION FOR USE

ELF model EF-N1000 provides a non isolated RS-485 BACnet MS/TP or Modbus RTU output for airflow (or equivalent velocity pressure) and temperature measurement.

Preparation for use consists of connecting 24VAC input power, connecting RS-485 network signal wires from the ELF to the BAS interface, and if required, setting network options through CONFIG switch S1.

4. ELF INTERCONNECTIONS

The ELF is equipped with removable push-on screw-terminal block connectors for power and network output connections with customer equipment. Connect 24 VAC power and RS-485 network cables as outlined in the following paragraphs. Refer to Figures 3 to 5.

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.

4.1 ELF 24 VAC Power Connections

The ELF requires a power source capable of providing 22.8 to 26.4 VAC at 5 VA.

NOTE

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

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 3 and 4. 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 3 and 4, observing the precautions in step 2. The connection to the network must be made in a "daisy chain" configuration. "T" connections and stubs are NOT permitted.
 4. Set network configuration via S1 - ELF Configuration DIP Switch as detailed in the following paragraph.

4.2 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 3. 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.

4.3 Setting the MAC Address

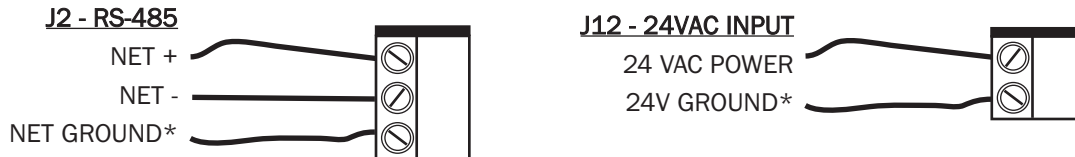
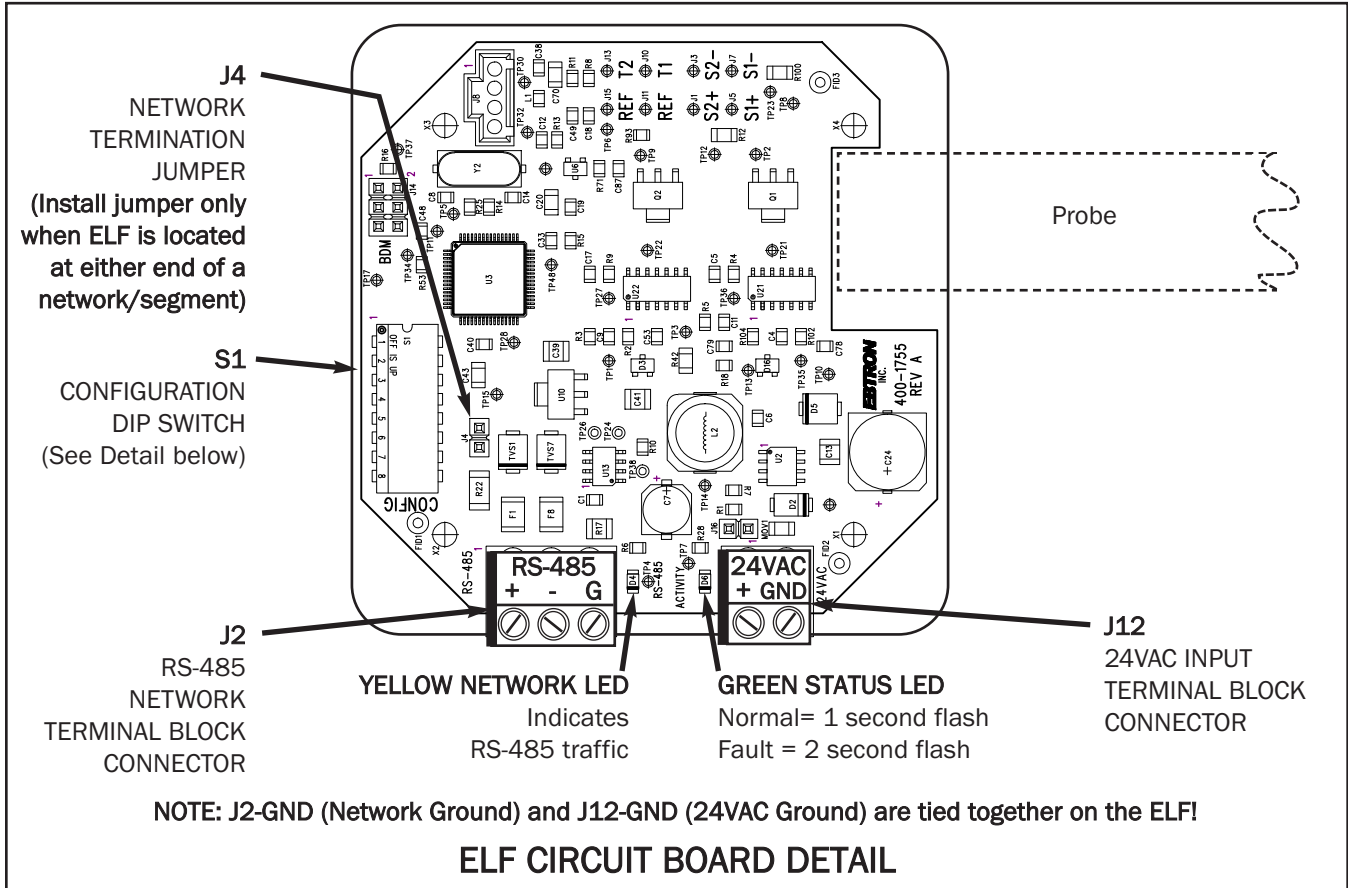
The ELF MAC Address is set at the factory for a value of 2. If it is necessary to change the MAC address, set switches 1 through 7 of CONFIGURATION SWITCH S1 to any address value between 0 and 127 as follows:

1. Deactivate 24VAC power to the ELF.
2. Set S1 switches 1-7 to the desired address as shown in the detail of Figure 3. 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:

The default Object Instance is 2.

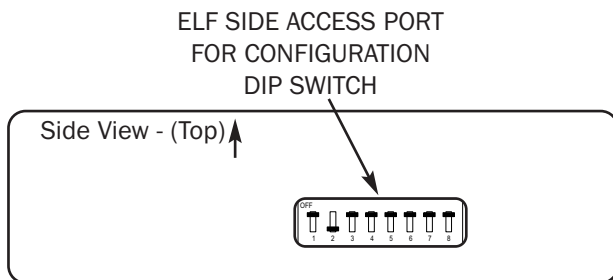
When ELF configuration is complete, confirm that the new MAC address has been set correctly using appropriate BACnet software.



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

- 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.
- 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 3. ELF Circuit Board, Wiring and Configuration Switch Details

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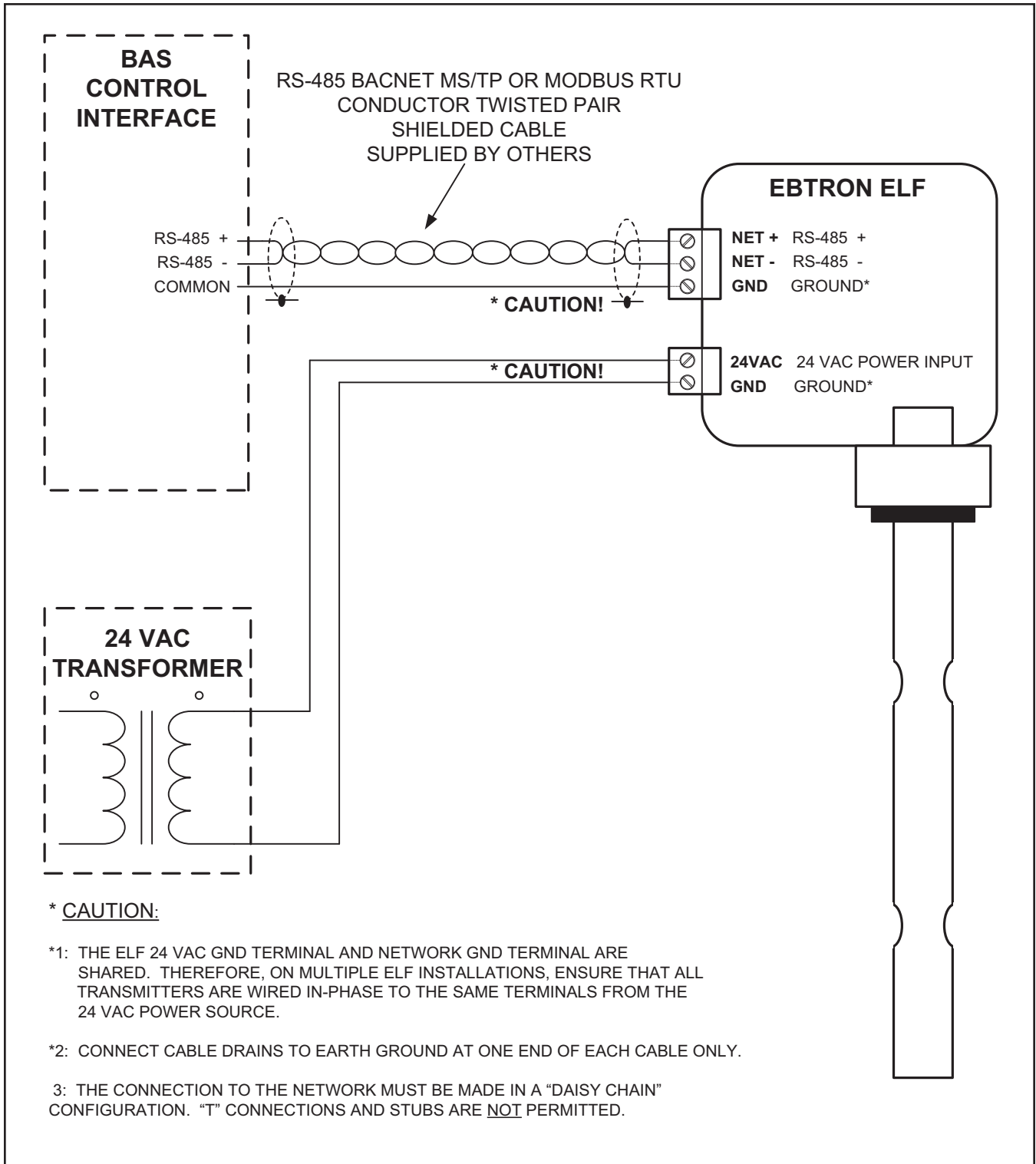


Figure 4. ELF Power and Signal Wiring Interconnections

4.4 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 3 detail).
2. Set the desired baud rate using Address Switches 1 through 4 as shown below in Figure 5.

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

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).

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

Figure 5. ELF Baud Rate Selection

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.

4.5 J4 - ELF RS-485 Network Termination Selection

The ELF includes a network termination selector jumper at J4 (shown in Figure 3 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.

4.6 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 3 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.

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5. ELF BACnet CONFIGURATION

The following paragraphs detail the final set up instructions for the ELF when using BACnet device operation. The ELF-N1000 is shipped from the factory for BACnet operation. Default communication is set for 8 Data Bits, 1 Stop Bit and No Parity.

For Modbus operation, proceed to **ELF MODBUS CONFIGURATION** section 6 of this document.

Refer to Appendix A - ELF BACnet Object properties for additional detail.

5.1 Changing BACnet Device Object Instance Number

5.1.1 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.

5.1.2 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.

6. ELF MODBUS CONFIGURATION

The ELF is preset at the factory for BACnet network operation. Default communication is set for 8 Data Bits, 1 Stop Bit and No Parity. To set the ELF for Modbus network operation, perform the following steps. Refer to Appendix B - ELF MODBUS Register Map 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.

7. ELF INITIAL START UP / NORMAL OPERATION

The following procedure is intended for initial start up of the instrument. Following the initial set up, no further user activity is required during normal operation.

1. Remove the cover to the electronics enclosure by removing the four screws on the cover.
2. Make sure that the 24VAC circuit breaker used to power the ELF is turned OFF until all wiring is complete!
3. Confirm 24VAC connections to the ELF power connector J12.
4. Confirm that the ELF's common 24VAC ground and network ground connection are permitted.
5. Note that the ground of the BAS must be at the same voltage reference as the ground of the ELF and the power source.
6. Confirm the settings of CONFIG switches SW1 to SW7 as outlined in paragraphs 4.1 through 4.3 of this document.
7. Activate the 24VAC power source to power on the ELF.
8. Following a brief instrument initialization, the green Activity LED will continuously flash ON for 1 second, then OFF for 1 second. This indicates normal operation. In the event of a sensor fault, the LED will produce longer continuous flashes ON for 2 seconds, and OFF for 2 seconds.
9. Confirm that the yellow RS-485 Network LED is blinking indicating traffic between the ELF and the BAS network. Also, verify instrument airflow (or equivalent velocity pressure) and temperature at the BAS control interface.
10. Replace the ELF electronics enclosure cover and secure with the four screws removed in step 1.

8. FOR ADDITIONAL INFORMATION

Refer to the separate Installation, Operation and Maintenance Technical Manual **TM_EF-x1000-D** for additional information, or contact your local **EBTRON** representative or our Technical Support Team at 800.2**EBTRON** (1.800.232.8766).

APPENDIX A - ELF BACnet Object Properties

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

APPENDIX B - 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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