Thermal Dispersion Airflow Measurement

Model STx104

Technical Manual

Silver Series Thermal Dispersion Airflow Measurement Technology

Advantage by Ebtron

Silver Series

Installation, Operation and Maintenance Technical Manual

STx104

"Plug & Play" Transmitters

Includes Analog output models: STA104-P, STA104-F & STA104-B
Includes RS-485 output models: STN104-P, STN104-F & STN104-B

Document Name: TM_STx104_R2A

SILVER SERIES
TECHNICAL MANUAL

TM_STx104_R2A

Part Number: 930-0070

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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Insert latest changed pages (in bold text); remove and dispose of superseded pages.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 **18.**

Page No	Revision *	Description of Change	Date
1	**R2A**	**Change revision to R2A**	**12/09/2009**
2	**R2A**	**Updated this page; change revision to R2A**	**12/09/2009**
12	**R2A**	**Added Diagnostic LED Fault Trouble Code reference**	**12/09/2009**
17	**R2A**	**Modified troubleshooting Guide for addition of Diagnostic LED Fault Trouble codes**	**12/09/2009**
1	R1F	Change revision to R1E	8/18/2009
2	R1F	Updated this page; change revision to R1E	8/18/2009
8, 10	R1F	Power fuse 0.5A part number corrected to 800-1110	8/24/2009
10	R1E	Power fuse 0.5A part number corrected to 240-1226	8/18/2009
1	R1D	Change revision to R1D	3/20/2009
2	R1D	Updated this page; change revision to R1D	3/20/2009
4	R1D	Updated List of Tables	3/20/2009
10	R1D	Revised Figure 8, FSR DIP Switch Legend	3/20/2009
11	R1D	Revised to add reference to Table 7	3/20/2009
14	R1D	Added scaling reference to Factory Default Settings paragraph	3/20/2009
15	R1D	Added FSR reference to Table 7	3/20/2009
1	R1C	Added Document Part Number; change revision to R1C	3/2/2009
2	R1C	Updated this page; change revision to R1C	3/2/2009
1, 2	R1B	Update document cover and this page from R1A to R1B	2/18/2009
3 to 5	R1B	Republished as revision R1B	2/18/2009
6	R1B	Added status LED and legend	2/18/2009
7 to 9	R1B	Republished as revision R1B	2/18/2009
10	R1B	Added status LEDs and legends	2/18/2009
11	R1B	Added K factor reference data to Table 3	2/18/2009
12 to 16	R1B	Republished as revision R1B	2/18/2009
17, 18	R1B	Revised troubleshooting tables for status LED nomenclature	2/18/2009
1 through 20	R1A	New Document Review Release	12/17/2008

TM_STx104_R2A

Table of Contents

OVERVIEW 5
SPECIFICATIONS 5
ADVANCED TECHNOLOGY 5
ORDERING GUIDE FOR STx104 TRANSMITTER 6
STx104 TRANSMITTER FEATURES 6
STx104 TRANSMITTER INSTALLATION 7
Mechanical Dimensions 7
Power Transformer Selection 8
Connecting Power to the Transmitter 8
Connecting Sensor Probes to the Transmitter 9
STA104 Analog Transmitter Set Up 10
Analog Output Signal 0-10VDC / 4-20mA Selection 11
Converting Analog Output Signals to Airflow and Temperature 11
Sending a Test Output Signal to the Host Control System 11
STN104 RS-485 Transmitter Set Up 12
STN104 RS-485 Network Connections 12
STN104 Setting Network Options 13
STN104 Setting the Network Protocol 13
STN104 Setting the Transmitter Address 13
STN104 Setting the Transmitter Termination 13
Transmitter Initialization 14
Factory Default Settings for SP1 (-P), SF1 (-F), SB1 (-B), ST1 (-T) and SU1 (-U) Sensor Probes 14
TRANSMITTER CALIBRATION 14
CHANGING FACTORY DEFAULT SETTINGS 14
Converting the Output Signal from fpm to cfm (m/s to L/s for S.I. scaling) 15
FIELD ADJUSTMENT OF FACTORY CALIBRATION 16
Procedure for Field Adjustment 16
MAINTENANCE 16
STANDARD LIMITED PARTS WARRANTY 16
TROUBLESHOOTING GUIDES 17
General Troubleshooting (All STx104 Systems) 17
STA104 - Analog Transmitter Troubleshooting 18
STN104 - RS485 Transmitter Troubleshooting 18

TM_STx104_R2A

List of Figures

Figure 1. STx104 Transmitter 5
Figure 2. STx104 Transmitter Features 6
Figure 3. STx104 Transmitter Ordering Guide 6
Figure 4. STx104 Transmitter Mechanical Detail Drawing 7
Figure 5. STx104 Power Connections 8
Figure 6. Type A, Type B and Type C Transmitters 9
Figure 7. Connector Detail 9
Figure 8. STA104 Analog Circuit Board Detail 10
Figure 9. STN104 RS-485 Transmitter Circuit Board Detail 12

List of Tables

Table 1. STx104 Specifications 5
Table 2. STx104 Connectivity Options 6
Table 3. STA104 Converting Analog to Airflow/Temperature 11
Table 4. STN104 RS-485 BACnet Object List 13
Table 5. STN104 RS-485 Modbus Register Map 13
Table 6. STN104 RS-485 JCI N2® -Bus Point Map 13
Table 7. FSR DIP Switch Settings for Analog output Scaling (with Default Values) 15
Table 8 General Troubleshooting (All STx104 Systems) 17
Table 9. STA104 Analog Transmitter Troubleshooting 18
Table 10. STN104 RS-485 Transmitter Troubleshooting 18

TM_STx104_R2A

OVERVIEW

EBTRON's economical STx104 transmitter (Figure 1) can process up to 4 individual sensing points and is compatible with a number of ***EBTRON*** sensor systems. The transmitter requires 24 VAC and provides the host controls with output signals for airflow and temperature. Each transmitter is fully independent of the sensor probes and does not require field matching to sensor probes. Table 1 details the specifications of the STx104 transmitter.

The STx104 transmitter accepts SP1, SF1, SB1, ST1 or SU1 sensors, and is designed as a competitive upgrade to pitot arrays. Unlike pitot arrays, the STx104 provides *percent of reading* accuracy and can measure accurately from still air. Field configuration is accomplished by setting DIP switches on the main circuit board as shown in Figure 2.

A digital gain adjustment permits a one point field adjustment to factory calibration for installations that require field calibration or adjustment. The STx104 transmitter is available in 3 types depending upon number of sensor probes as shown in the Ordering Guide, Figure 3, and in an analog and RS-485 version (Table 2).

Figure 1. STx104 Transmitter

SPECIFICATIONS

Table 1. STx104 Specifications

Maximum Number of Sensing Points
- 4 (4 airflow + 4 temperature, independently processed)

Sensor System Configurations (max.)
- Type A (probes x sensors/probe): 1x4 (SP1 probes)
- Type B (probes x sensors/probe): 2x2 (SP1, SU1, ST1 probes), 2x1 (SB1 "bleed" sensors)
- Type C (probes x sensors/probe): 4x1 (SF1 fan inlets)

Digital Signal Processing
- Microprocessor: Yes
- Multiplexing: 8 individual channels
- A/D Converter: 12-Bit

"Plug and Play" Sensor Systems
- Probes do not require matching to transmitter

Power Requirements
- Voltage: 24 VAC (22.8 to 26.4VAC), isolation not required
- "Brownout Watchdog" protection reset circuit
- Power: 8 VA max.
- Protection: Over voltage, over current and surge protection

Enclosure
- Aluminum

User Interface
- DIP switches

Display
- Not available

Output to Host Controls
Output/Protocols Supported:
- STA104: Isolated 0-10VDC or 4-20mA (resolution 0.025% F.S.)
- STN104: RS-485, 76.8 kbps max., BACnet®, Modbus, JCI® N2-Bus®

Airflow Output Adjustments:
- Digital gain potentiometer (must be enabled)

System Diagnostics
- Sensor/transmitter diagnostic mode with LED flash notification

Environmental Limits
- Operating Temperature: -20° F to 120° F (-28.8° C to 48.8° C)
- Moisture: 0 to 99% rh, non-condensing (protect from water)

Compatible Sensor Systems
- SP1 probes, SF1 fan inlets, SB1 "bleed" sensors, ST1 small duct probes and SU1 unit ventilator sensors

Listings
- UL® 873 Airflow & Temperature Indicating Devices

Warranty
- 36 months from shipment

TM_STx104_R2A

ADVANCED TECHNOLOGY

- Microprocessor-based electronics with industrial grade integrated circuits.
- "Plug and Play" design sensor probe design.
- Accepts up to 4 individual airflow and temperature sensor pairs.
- DIP Switch user interface for simple field configuration.
- Airflow and temperature outputs.
- Analog output signals and network protocols interface MS/TP BACnet®, MODBUS-RTU, and JCI-N2 Bus®.
- Model STA104 for Analog Output.
- Model STN104 for RS-485 output - **BACNet**® - **MS/TP Master**, **Modbus**®**-RTU or JCI N2-Bus**®.

Network Connectivity Solutions

BACnet®
Modbus
JCI® N2-Bus®

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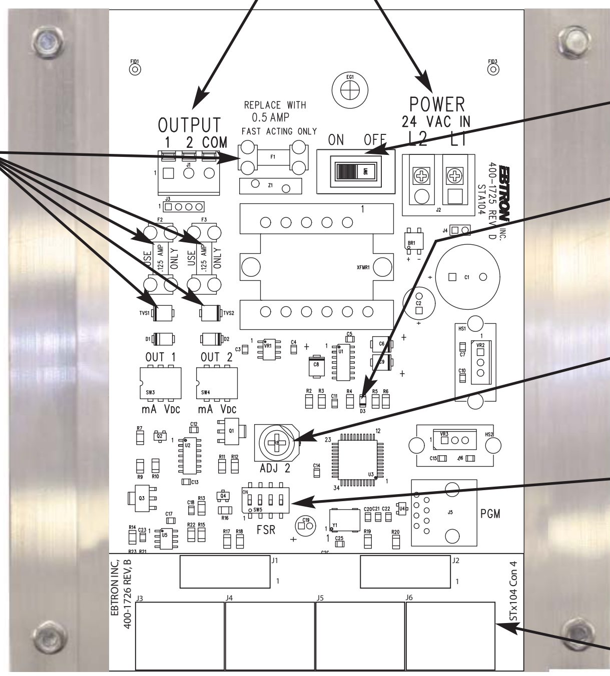
STx104 TRANSMITTER FEATURES



Note: STA104 analog version shown for illustration purposes. Refer to Figures 8 and 9 for specific features of analog and network versions.

Figure 2. STx104 Transmitter Features

ORDERING GUIDE FOR STx104 TRANSMITTER

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Transmitter Type
- Type A 1 Connector
- Type B 2 Connectors
- Type C 4 Connectors

Transmitter Output
- A Analog, 0-10VDC, 4-20mA
- N RS-485, BACnet®, Modbus, JCI® N2-Bus®

Figure 3. STx104 Transmitter Ordering Guide

TM_STx104_R2A

Table 2. STx104 Connectivity Options

Output to Host Controls	Output/Protocols Supported	Airflow	Temperature	Status
Analog x=A	Linear 0-10VDC or 4-20mA	Yes	Yes	Visual Only
RS-485 x=N	BACnet®-MS/TP, BACnet®	Yes	Yes	Yes
	Modbus-RTU			
	JCI® N2-Bus®			

STx104 TRANSMITTER INSTALLATION

The STx104 transmitter is designed for use in an environment between -20° F to 120° F *(-28.8° C to 48.8° C)* where it will not be exposed to rain, snow or condensation.

Mount the transmitter upright in a field accessible location. The enclosure (Figure 4) is designed to accept 3/4 in. *(19.0 mm)* conduit fittings for signal and power wiring at the top left and right sides of the circuit board. Locate the transmitter so that the connecting cables from all of the sensor probes will reach the receptacles on the bottom of the transmitter enclosure.

In locations exposed to direct rain and/or snow, the transmitter must be enclosed in a NEMA4 enclosure.

Leave at least 7" *(177.8 mm)* above, and 3" *(76.2 mm)* to each side and bottom, of unobstructed space around the transmitter to allow for heat dissipation and cover removal.

Locate the transmitter in a location that can be reached by all connecting cables from the sensor probes.

Do not drill into the transmitter enclosure since metal shavings could damage the electronics.

Mechanical Dimensions

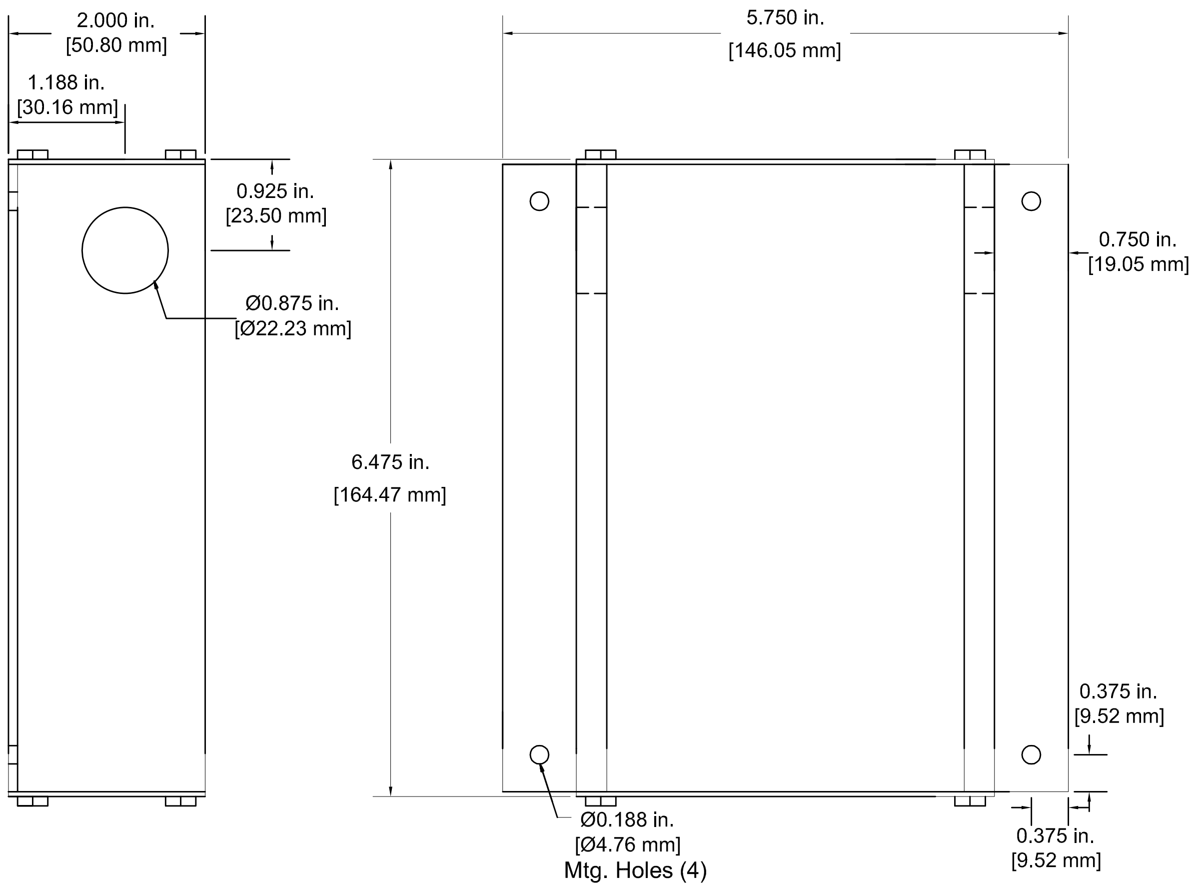

Figure 4. STx104 Transmitter Mechanical Detail Drawing

TM_STx104_R2A

SILVER SERIES *TECHNICAL MANUAL*

Power Transformer Selection

The 24 VAC transformer selected must be capable of supplying 8 VA. The operating supply voltage (transmitter power "ON" with all sensor probes connected) should not be less than 22.8 VAC or greater than 26.4 VAC.

Connecting Power to the Transmitter

Slide the cover plate up and off of the transmitter enclosure, and ensure that the power switch is in the "OFF" position before connecting the 24 VAC power source.

Connect 24 VAC power to the large, two position power input terminals labeled "POWER - L2/L1" on the upper right hand side of the main circuit board as shown in Figure 5. It is not necessary to provide an isolated (secondary not grounded) power source since the output signals are galvanically isolated from the power supply.

Multiple STx104 transmitters wired to a single transformer must be wired "in-phase" (L1 to L1, L2 to L2).

Sensor probes must be connected to the transmitter before turning the power switch to the "ON" position in order to properly "flash" sensor calibration data to the transmitter.

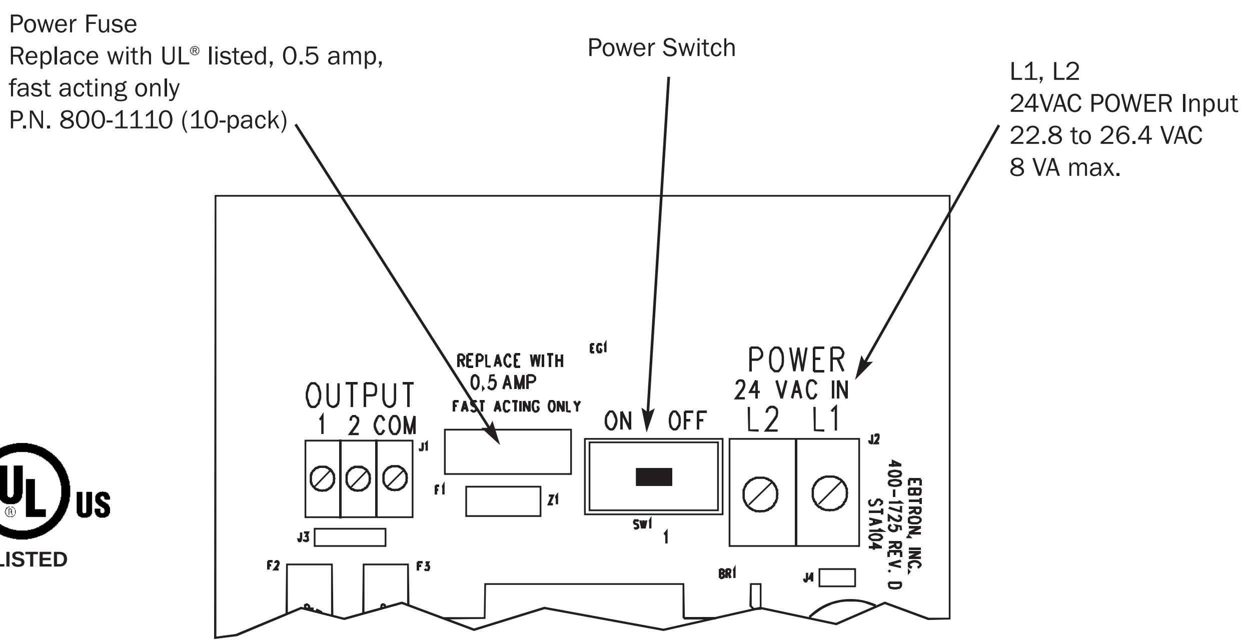

Figure 5. STx104 Power Connections

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Connecting Sensor Probes to the Transmitter

After mounting the sensor probes and transmitter, connect the sensor probe cable plugs to the circular receptacles located at the bottom of the STx104 transmitter enclosure. Probes are *"Plug and Play"* and do not have to be connected to a specific receptacle on the transmitter. Transmitters can accept SP1, SF1, SB1, ST1 or SU1 sensors. Mixing sensor types on a single transmitter is not permitted. Match probes to transmitter by type (A, B or C) as indicated on the tags on the transmitter and sensor probes shown in Figure 6.

⚠ **Provide a "drip loop" at the transmitter if there will be the potential for water runoff or condensation along the sensor probe cable(s).**

⚠ **Sensor probe cable plugs are "keyed" as shown in Figure 7. Line up plug with receptacle and push straight on to receptacle. DO NOT TWIST. Squeeze cable plug "ribs" towards receptacle when removing. Forcing the cable plug in or out of the receptacle will damage the connectors and void warranty.**

TYPE A TRANSMITTER

Accepts 1 probe up to 4 sensors.

TYPE B TRANSMITTER

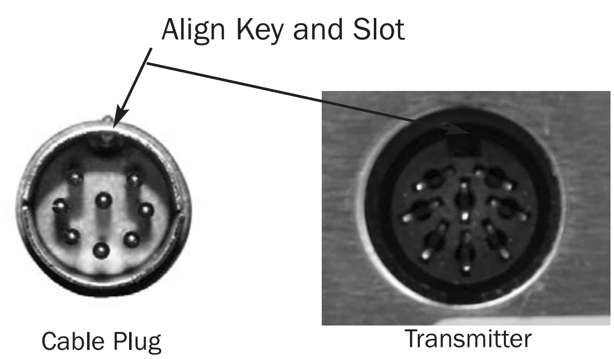
Accepts 2 probes up to 2 sensors each.

TYPE C TRANSMITTER

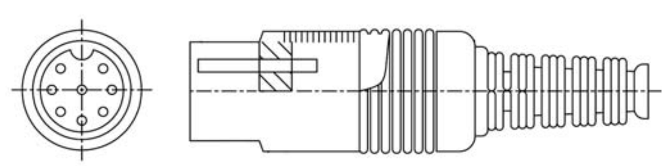
Accepts 4 probes, 1 sensor each.

Figure 6. Type A, Type B and Type C Transmitters

CONNECTING CABLE PROBES TO TRANSMITTER



Type B Shown



Pull to Remove
DO NOT TWIST!

Figure 7. Connector Detail

TM_STx104_R2A

STA104 Analog Transmitter Set Up

The STA104 analog transmitter provides independent 12-bit (4096 discrete states) linear analog outputs for airflow (OUTPUT terminal 1) and temperature (OUTPUT terminal 2), each with overvoltage and overcurrent protection. Each output is field selectable as either 0-10VDC or 4-20mA, and is galvanically isolated from the main power supply to permit simple integration with virtually all building automation systems.

To wire the output signal, slide the cover plate up and off of the enclosure. Ensure that the power switch is in the "OFF" position. Connect signal wires for airflow rate and temperature to the small, three position output terminal labeled "OUTPUT" on the upper left hand side of the main circuit board as indicated in Figure 8. Airflow output is at terminal 1, and temperature output is at terminal 2.

When configured for a 4-20mA output, the STA104 is a "4-wire" device. The host controls must not provide any excitation voltage to the output of the STA104.

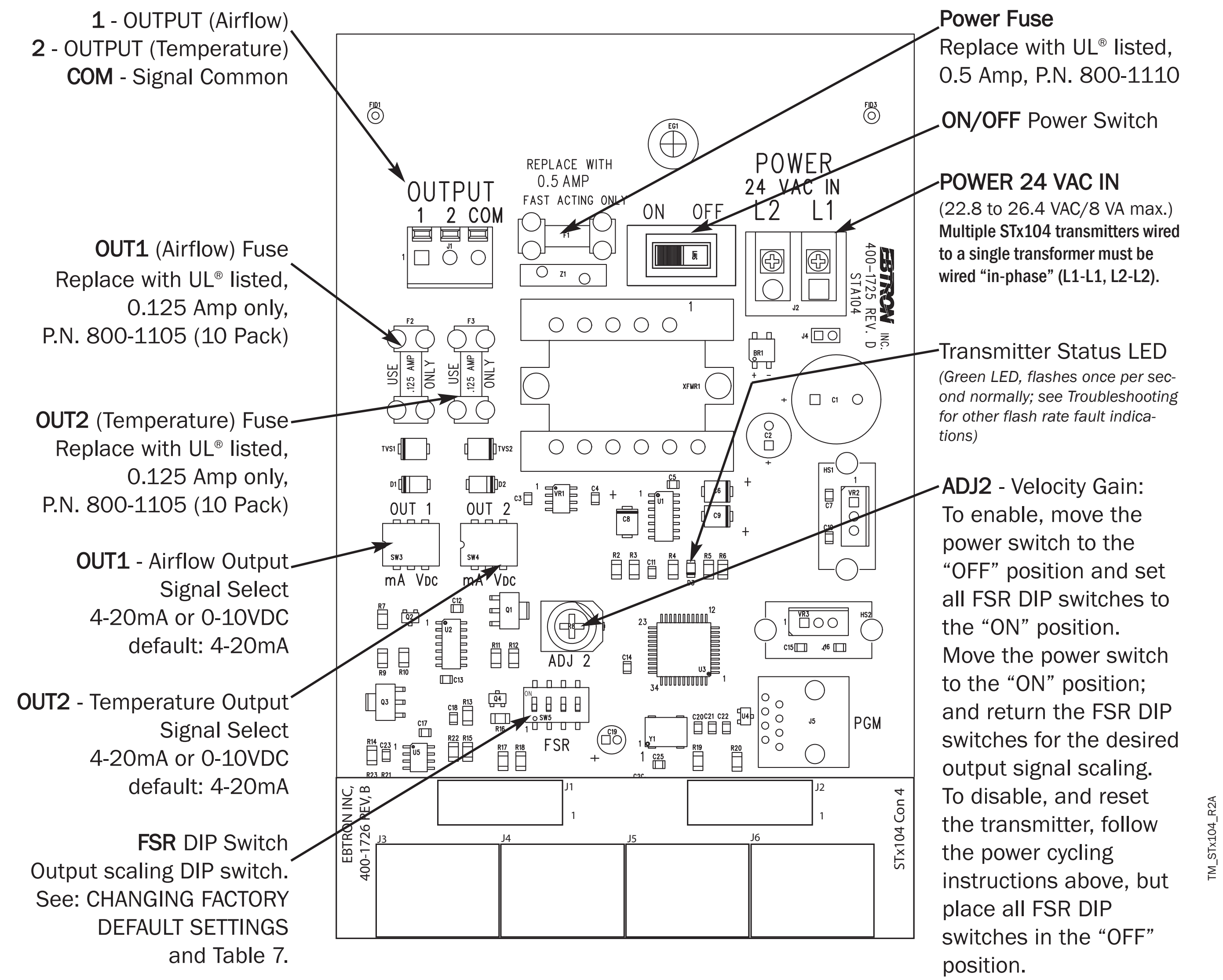


Figure 8. STA104 Analog Circuit Board Detail

Analog Output Signal 0-10VDC / 4-20mA Selection

The transmitter is shipped from the factory with the analog output signals set to the 4-20mA mode. If the 0-10VDC output is desired, set the corresponding output selector (OUT1 for airflow, and/or OUT2 for temperature) to the 0-10VDC position as shown in Figure 8.

Converting Analog Output Signals to Airflow and Temperature

Since the accuracy of the STA104 is "percent of reading" there should be no need to reconfigure the default output scales listed inside of the transmitter cover. However, if desired, factory default settings can be easily reconfigured in the field as described in CHANGING FACTORY DEFAULT SETTINGS and Table 7.

The equivalent volumetric flow full scale reading can easily be determined by multiplying the full scale reading by the free area of the duct in square feet where the airflow measuring station is located (for S.I. measurement units, multiply free area x 1000 when the duct area is calculated in square meters). For -P units, the free area is printed on the hang-tag of each sensor probe. For -F, -B, -T and -U units, the free area should be determined after the units are installed. Table 3 lists specific conversion factors for analog voltage or current options for each sensor type.

Table 3. STA104 Converting Analog to Airflow/Temperature

Converting 0-10VDC to:	Converting 4-20mA to:
Unidirectional Airflow (-P, -F, -T and -U sensors) Airflow (fpm, m/s) = Output Voltage/10 x FS1 Airflow (cfm) = Area (sq ft) x Output Voltage/10 x FS1 Airflow (L/s) = Area (sq m) x 1000 x Output Voltage/10 x FS1	Unidirectional Airflow (-P, -F, -T and -U sensors) Airflow (fpm, m/s) = (Output Current* - 4)/16 x FS1 Airflow (cfm) = Area (sq ft) x (Output Current - 4)/16 x FS1 Airflow (L/s) = Area (sq m) x 1000 x (Output Current - 4)/16 x FS1
Unidirectional Airflow (-B sensors) Airflow (fpm, m/s) = Output Voltage/10 x FS1 Airflow (cfm, L/s) = K x Output Voltage/10 x FS1 *where K is determined by field measurement or from K tables*[1]	Unidirectional Airflow (-B sensors) Airflow (fpm, m/s) = (Output Current - 4)/16 x FS1 Airflow (cfm, L/s) = K x (Output Current - 4)/16 x FS1 *where K is determined by field measurement or from K tables*[1]
Unidirectional Differential Pressure (-B sensors only) Airflow (in.w.g., Pa) = Output Voltage/10 x FS1	Unidirectional Differential Pressure (-B sensors only) Airflow (in.w.g., Pa) = (Output Current - 4)/16 x FS1
Bidirectional Airflow (-B sensors only) Airflow (fpm) = (Output Voltage - 5)/5 x FS1 Airflow (cfm, L/s) = K x (Output Voltage - 5)/5 x FS1 *where K is determined by field measurement or from K tables*[1]	Bidirectional Airflow (-B sensors only) Airflow (fpm) = (Output Current - 12)/8 x FS1 Airflow (cfm, L/s) = K x (Output Current - 12)/8 x FS1 *where K is determined by field measurement or from K tables*[1]
Bidirectional Differential Pressure (-B sensors only) Airflow (in.w.g.) = (Output Voltage - 5)/5 x FS1	Bidirectional Differential Pressure (-B sensors only) Airflow (in.w.g.) = (Output Current - 12)/8 x FS1
Temperature (-P, -F, -B, -T and -U sensors) Temp (°F,°C) = Output Voltage/10 x (FS2 - MS2) + MS2	Temperature (-P, -F, -B, -T and -U sensors) Temp (°F,°C) = (Output Current - 4)/16 x (FS2 - MS2) + MS2 ** Output Current is in mA* *[1] Refer to K factor tables in separate Bleed Sensor Technical Manual, TM_HB1/SB1.*

Sending a Test Output Signal to the Host Control System

Test output signals of 0 and 50% of the full scale output (0 to 10VDC or 4 to 20mA) can be provided by the STA104 transmitter to verify proper conversion of the output signals from the STA104 transmitter at the host control system.

To set a fixed 0 (zero scale) output signal for airflow and temperature (which is 4mA for 4-20mA, and 0VDC for 0-10VDC), set all FSR DIP switches to the "OFF" position during operation.

To set a fixed 50% (half scale) output signal for airflow and temperature (which is 12mA for 4-20mA, and 5 VDC for 0-10VDC), set all FSR DIP switches to the "ON" position during operation.

STN104 RS-485 Transmitter Set Up

The STN104 features a differential bus/line transceiver designed to meet the requirements of the RS-485 standard for multipoint data transmission. Bus contention and wiring fault conditions are over-current and over-voltage protected, including an automatic thermal shutdown of the RS-485 transceiver. The flexibility to integrate with various network protocols and topologies is provided via on-board field-selectable option switches for protocol selection, line termination and address as shown in Figure 9.

To wire the output signal, slide the cover plate up and off of the enclosure. Ensure that the power switch is set to "OFF".

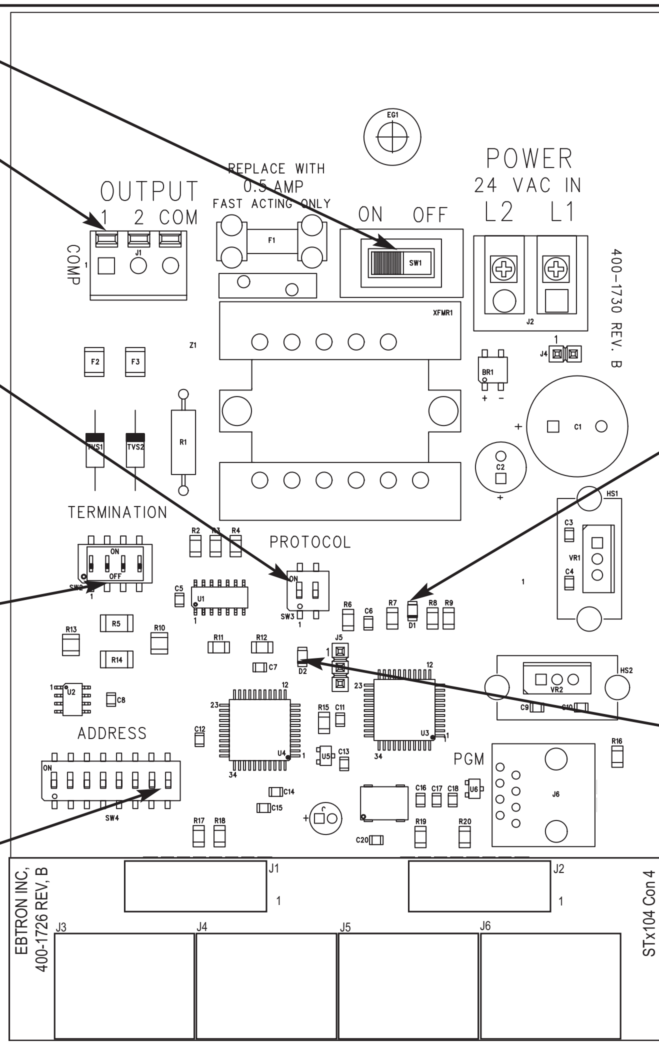
STN104 RS-485 Network Connections

The transmitter provides an output that is isolated from the main power input. Connect the transmitter output to the RS-485 bus in a "daisy-chain" configuration using a shielded, twisted pair communication wire with a signal ground conductor (3 wires and a shield) to OUTPUT terminal block as follows:

OUTPUT TERMINAL	SIGNAL DESCRIPTION
1	NET+
2	NET-
COM	COMMON (Network/Signal GND)

(The shield will typically be grounded at one end of the bus and not connected to the transmitter terminals.)

If the DIP switches are changed after power up, the transmitter must be turned "OFF" and then "ON" in order for the new switch positions to be recognized and stored by the transmitter.



Protocol DIP Switch

Position 1	Position 2	Protocol
off	off	JCI® N2-bus®
off	on	Modbus-RTU
on	off	BACnet® MS/TP Master

Termination DIP Switch

DIP Switch Position 1	2	3	4	Termination
off	off	off	off	No Termination
off	on	on	off	End of Line
on	off	off	on	Fail-safe Bias

Address DIP Switch

DIP Switch Position 1	2	3	4	5	6	7	8	Address
off	off	off	off	off	off	off	off	0
off	off	off	off	off	off	off	on	1
off	off	off	off	off	off	on	off	2
off	off	off	off	off	off	on	on	3
:	:	:	:	:	:	:	:	:
on	on	on	on	on	on	on	on	255

Figure 9. STN104 RS-485 Transmitter Circuit Board Detail

STN104 Setting Network Options

The transmitter must be configured for proper protocol address and termination prior to power up. The transmitter is shipped from the factory with the protocol set to the **BACnet® MS/TP Master**, **address 1** and **no termination.** (DIP switches are located on the circuit card - see Figure 9.)

STN104 Setting the Network Protocol

Transmitter protocol can be changed in the field by setting the "**PROTOCOL**" DIP switch on the main circuit board (Figure 9). Tables 4 through 6 list the specific features of each protocol.

STN104 Setting the Transmitter Address

Each transmitter must be assigned a **unique** address between 1 (default setting) and 255 (127 BACnet®) prior to power up by setting the "**ADDRESS**" DIP switch on the main circuit board (Figure 9). The least significant bit (LSB) is switch position number 8.

STN104 Setting the Transmitter Termination

A termination resistor (typically 120 ohms) should be installed at each end of the bus between the NET+ and NET- (A and B) communication lines. The ***EBTRON*** transmitter provides the ability to select standard (120 ohm) or "fail-safe" termination whenever the device is installed at either end of the bus. When an ***EBTRON*** device is not installed at the end of the bus, the termination for that device should be disabled. The "fail-safe" termination will guarantee that the bus is in a known state during idle-line conditions (when no device is driving the bus). ***EBTRON*** recommends "fail-safe" termination at one end of the bus. Transmitter termination is selected by setting the DIP switch labeled "TERMINATION" (Figure 9) on the circuit card. Termination options are "No Termination", "End of Line" or "Fail-safe Bias" (recommended at one end of the bus).

Table 4. STN104 RS-485 BACnet Object List

BACnet® MS/TP

OBJECTS

Baud Rates: 9.6, 19.2, 38.4, 76.8 Kbps

Type	Description	Default Units
Device	Device Object	
Analog Input	Airflow	FPM
Analog Input	Differential Pressure	in.w.c.
Analog Input	Temperature	°F
Analog Value	Area	sq.ft.
Analog Value	Baud Rate	None
Binary Value	Auto Baud Rate Detection	None

Table 5. STN104 RS-485 Modbus Register Map

Modbus

Modbus RTU

REGISTER MAP

Baud Rate: 9600 bps

	IEEE Floating Point		Binary				
Function	low/high word	high/low word		Length	Units	Point Description	Range/Value
02			10001	1		Status	0:OK, 1:Trbl.
04	30001	30007		2	FPM	Airflow	0 to 15,000
04	30003	30009		2	in.w.c.	Differential Pressure	-2.5 to +2.5
04	30005	30011		2	°F	Temperature	-20 to +160

Table 6. STN104 RS-485 JCI N2® -Bus Point Map

METASYS COMPATIBLE

JCI® N2-Bus®

POINT MAP

Baud Rate: 9600 bps

NPT[1]	NPA[2]	Units	Point Description	Range/Value
AI	1	FPM	Airflow	0 to 15,000
AI	2	in.w.c.	Differential Pressure	-2.5 to +2.5
AI	3	°F	Temperature	-20 to +160
BI	1		Status	0:OK, 1:Trbl.

[1]Network Point Type

[2]Network Point Address

STx104 TRANSMITTER START UP AND OPERATION

To ensure a successful start-up, verify that the sensor probes are installed in accordance with ***EBTRON*** placement guidelines.

Prior to turning the power switch to the "on" position, verify that the physical installation, power connections and model specific signal wiring have been accomplished in accordance with this manual, and that sensor probes are installed in accordance with *EBTRON* Placement Guidelines as indicated in the separate sensor probe technical manual.

Move the power switch to the "ON" position. Whenever the transmitter is powered ON, a complete self-diagnostic routine takes place and requires approximately 10 seconds to complete. Check that the readings at the host control system return an output that matches the output of the STx104.

The STA104 analog transmitter version is designed to operate normally on "POWER-UP". Default output signals for airflow and temperature are set to 4-20mA. No further field configuration is necessary unless 0-10VDC output signals are required. Refer to the **STA104 Analog Transmitter Set Up** section of this manual for additional information.

The STN104 RS485 network transmitter version must be properly configured based upon system network protocol. Review the **STN104 RS-485 Transmitter Set Up** section of this manual for further information on network settings, or contact ***EBTRON*** Customer Service, toll free, at 800-232-8766.

Transmitter Initialization

The STx104 transmitter automatically initializes at power-up and conducts full system diagnostics. Under normal conditions, there is no reason to re-initialize the transmitter. However, if there is a need to re-initalize the transmitter, proceed as follows:

1. On analog STA104 transmitters, set all of the FSR DIP switches to the "OFF" position. On network STA104 transmitters, set all of the ADDRESS DIP switches to the "OFF" position.

2. Turn the power switch "OFF", then "ON" to reset the transmitter.

3. Return the DIP switches to the previous position when complete.

This will force the transmitter to clear and re-read the sensor data, and will also disable the gain adjustment potentiometer, "ADJ 2" on the STA104 if it had been enabled. Refer to Figure 8 to re-enable the velocity gain setting if desired.

Factory Default Settings for SP1 (-P), SF1 (-F), SB1 (-B), ST1 (-T) and SU1 (-U) Sensor Probes

The STx104 transmitter operates "plug and play" with type SP1, SF1, SB1, ST1 and SU1 sensor probes. No user setup is required unless an output (mA/VDC) option change is required. To change the factory default scaling settings, refer to **CHANGING FACTORY DEFAULT SETTINGS** section of this technical manual and Table 7 which shows the FSR DIP switch settings for all compatible sensor probes.

TRANSMITTER CALIBRATION

The STx104 uses high quality industrial grade components and is designed for years of trouble-free operation. Periodic recalibration of the transmitter is neither required or recommended. For installations requiring periodic validation of instrumentation, Transmitter Field Calibration Verifiers are available from ***EBTRON***. Contact ***EBTRON*** for more details.

TM_STx104_R2A

CHANGING FACTORY DEFAULT SETTINGS

The STx104 transmitter is factory tested, set up and ready for operation with appropriate ***EBTRON*** sensor probes. When power is applied and the POWER switch is turned on, the transmitter automatically determines the type of sensors connected and defaults to predetermined factory settings. Factory settings can easily be changed during normal operation in the field by setting the FSR DIP switches on the main circuit board as indicated in Table 7. Power does not have to be cycled "ON" and "OFF" for new settings to take effect.

Table 7. FSR DIP Switch Settings for Analog output Scaling (with Default Values)

FSR				STA104-P and STA104-T		STA104-F		STA104-B		STA104-U	
DIP Switch Position				Output 1	Output 2	Output 1	Output 2	Output 1	Output 2	Output 1	Output 2
1	2	3	4								
off	off	off	off	Output = null	Output = null	Output = null	Output = null	Output = null	Output = null	Output = null	Output = null
off	off	off	on	0-500 FPM	30 to 160 F	0-2,500 FPM	0 to 160 F	+/- 0.05 in.w.g.	-20 to 160 F	0-250 FPM	0 to 160 F
				(0-2.54 m/s)	*(-1.1 to 71.1 C)*	*(0-12.7 m/s)*	*(-17.8 to 71.1 C)*	*(+/- 12.45 Pa)*	*(-28.9 71.1 C)*	*(0-1.27 m/s)*	*(-17.8 to 71.1 C)*
off	off	on	off	0-500 FPM	30 to 80 F	0-2,500 FPM	-20 to 160 F	+/- 0.15 in.w.g.	-20 to 160 F	0-250 FPM	-20 to 160 F
				(0-2.54 m/s)	*(-1.1 to 26.7 C)*	*(0-12.7 m/s)*	*(-28.9 71.1 C)*	*(+/- 37.5 Pa)*	*(-28.9 71.1 C)*	*(0-1.27 m/s)*	*(-28.9 71.1 C)*
off	off	on	on	0-500 FPM	0 to 160 F	0-5,000 FPM	30 to 160 F	+/- 0.25 in.w.g.	-20 to 160 F	0-500 FPM	30 to 160 F
				(0-2.54 m/s)	*(-17.8 to 71.1 C)*	*(0-25.4 m/s)*	*(-1.1 to 71.1 C)*	*(+/- 62.25 Pa)*	*(-28.9 71.1 C)*	*(0-2.54 m/s)*	*(-1.1 to 71.1 C)*
off	on	off	off	0-500 FPM	-20 to 160 F	0-5,000 FPM	30 to 80 F	+/- 0.50 in.w.g.	-20 to 160 F	0-500 FPM	30 to 80 F
				(0-2.54 m/s)	*(-28.9 71.1 C)*	*(0-25.4 m/s)*	*(-1.1 to 26.7 C)*	*(+/- 124.5 Pa)*	*(-28.9 71.1 C)*	*(0-2.54 m/s)*	*(-1.1 to 26.7 C)*
off	on	off	on	0-1,500 FPM	30 to 160 F	0-5,000 FPM	0 to 160 F	0-250 FPM	-20 to 160 F	0-500 FPM	0 to 160 F
				(0-7.62 m/s)	*(-1.1 to 71.1 C)*	*(0-25.4 m/s)*	*(-17.8 to 71.1 C)*	*(0-1.27 m/s)*	*(-28.9 71.1 C)*	*(0-2.54 m/s)*	*(-17.8 to 71.1 C)*
off	on	on	off	0-1,500 FPM	30 to 80 F	0-5,000 FPM	-20 to 160 F	0-500 FPM	-20 to 160 F	0-500 FPM	-20 to 160 F
				(0-7.62 m/s)	*(-1.1 to 26.7 C)*	*(0-25.4 m/s)*	*(-28.9 71.1 C)*	*(0-2.54 m/s)*	*(-28.9 71.1 C)*	*(0-2.54 m/s)*	*(-28.9 71.1 C)*
off	on	on	on	0-1,500 FPM	0 to 160 F	0-7,500 FPM	30 to 160 F	0-1,000 FPM	-20 to 160 F	0-1,000 FPM	30 to 160 F
				(0-7.62 m/s)	*(-17.8 to 71.1 C)*	*(0-38.1 m/s)*	*(-1.1 to 71.1 C)*	*(0-5.08 m/s)*	*(-28.9 71.1 C)*	*(0-5.08 m/s)*	*(-1.1 to 71.1 C)*
on	off	off	off	0-1,500 FPM	-20 to 160 F	0-7,500 FPM	30 to 80 F	0-2,000 FPM	-20 to 160 F	0-1,000 FPM	30 to 80 F
				(0-7.62 m/s)	*(-28.9 71.1 C)*	*(0-38.1 m/s)*	*(-1.1 to 26.7 C)*	*(0-10.16 m/s)*	*(-28.9 71.1 C)*	*(0-5.08 m/s)*	*(-1.1 to 26.7 C)*
on	off	off	on	0-3,000 FPM	30 to 160 F	0-7,500 FPM	0 to 160 F	0-3,000 FPM	-20 to 160 F	0-1,000 FPM	0 to 160 F
				(0-15.24 m/s)	*(-1.1 to 71.1 C)*	*(0-38.1 m/s)*	*(-17.8 to 71.1 C)*	*(0-15.24 m/s)*	*(-28.9 71.1 C)*	*(0-5.08 m/s)*	*(-17.8 to 71.1 C)*
on	off	on	off	0-3,000 FPM	30 to 80 F	0-7,500 FPM	-20 to 160 F	+/- 250 FPM	-20 to 160 F	0-1,000 FPM	-20 to 160 F
				(0-15.24 m/s)	*(-1.1 to 26.7 C)*	*(0-38.1 m/s)*	*(-28.9 71.1 C)*	*(+/- 1.27 m/s)*	*(-28.9 71.1 C)*	*(0-5.08 m/s)*	*(-28.9 71.1 C)*
on	off	on	on	0-3,000 FPM	0 to 160 F	0-10,000 FPM	30 to 160 F	+/- 500 FPM	-20 to 160 F	0-1,500 FPM	30 to 160 F
				(0-15.24 m/s)	*(-17.8 to 71.1 C)*	*(0-50.8 m/s)*	*(-1.1 to 71.1 C)*	*(+/- 2.54 m/s)*	*(-28.9 71.1 C)*	*(0-7.62 m/s)*	*(-1.1 to 71.1 C)*
on	on	off	off	0-3,000 FPM	-20 to 160 F	0-10,000 FPM	30 to 80 F	+/- 1,000 FPM	-20 to 160 F	0-1,500 FPM	30 to 80 F
				(0-15.24 m/s)	*(-28.9 71.1 C)*	*(0-50.8 m/s)*	*(-1.1 to 26.7 C)*	*(0-5.08 m/s)*	*(-28.9 71.1 C)*	*(0-7.62 m/s)*	*(-1.1 to 26.7 C)*
on	on	off	on	0-5,000 FPM	0 to 160 F	0-10,000 FPM	0 to 160 F	+/- 2,000 FPM	-20 to 160 F	0-1,500 FPM	0 to 160 F
				(0-25.4 m/s)	*(-28.9 71.1 C)*	*(0-50.8 m/s)*	*(-28.9 71.1 C)*	*(+/- 10.16 m/s)*	*(-28.9 71.1 C)*	*(0-7.62 m/s)*	*(-28.9 71.1 C)*
on	*on*	*on*	*off*	0-5,000 FPM	-20 to 160 F	0-10,000 FPM	-20 to 160 F	+/- 3,000 FPM	-20 to 160 F	0-1,500 FPM	-20 to 160 F
				(0-25.4 m/s)	*(-28.9 71.1 C)*	*(0-50.8 m/s)*	*(-28.9 71.1 C)*	*(+/- 15.24 m/s)*	*(-28.9 71.1 C)*	*(0-7.62 m/s)*	*(-28.9 71.1 C)*
on	on	on	on	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.	Output = 1/2 F.S.

Underlined items indicate Factory Default Values

Converting the Output Signal from fpm to cfm (m/s to L/s for S.I. scaling)

The equivalent volumetric flow (cfm or L/s) can easily be determined by multiplying the output velocity (fpm or m/s) by the free area in square feet where the sensor probe is located (or free area in square meters x 1000 for m/s output). The total free area is printed on the hang-tag of each -P sensor probe. The free area on -F and -B probes should be determined after they are installed.

TM_STx104_R2A

FIELD ADJUSTMENT OF FACTORY CALIBRATION

The factory calibration should not require adjustment if the sensor probes are installed in accordance with published installation guidelines. However, some installations may not meet placement guidelines, or commissioning requirements may dictate field adjustment. Field adjustment may improve the "installed accuracy" of STx104-F systems when determining volumetric flow rates. Only the Output 1 signal, airflow rate, can be adjusted on STA104 transmitters. To adjust the output signal "gain", the digital gain potentiometer "ADJ 2" must be enabled. If not enabled, changing the position of "ADJ 2" will not affect the output of the transmitter. Network transmitters must be adjusted in the host control system. Ensure that the field reference device and technique used to determine the airflow rate are suitable for such measurement. Select a location that is suitable for the field reference device, recognizing that this may not be the location where the *EBTRON* airflow station is installed. Typically, field measurement accuracy using hand-held equipment will not be better than ±5% of reading and can often exceed ±10%. Therefore, *EBTRON* recommends that users do not adjust the output of the STx104 if the difference between the transmitter and the field measurement is less than 10%.

Procedure for Field Adjustment

Select an airflow rate that represents a valid operating condition for the system. Set fan speed, dampers and VAV boxes to a fixed speed or position when measurements are taken. Complete the following worksheet to determine the gain setting for the host control system.

Determination of a software gain factor for the host control systems

1. __________ Record the transmitter output as indicated by the host control system. Time averaging the data will improve field recalibration.
2. __________ Record the reference reading. Make sure that the unit of measure (fpm, cfm, m/s or L/s) is identical for both the transmitter and the reference. If the unit of measure is velocity (fpm or m/s), make sure that the reference airflow measurement was corrected for the area where the measurement was taken.
3. __________ Calculate the gain factor (m): **m=line 2/line 1.**
4. Scale the airflow reading in the host control system by 'm', calculated in Step 3. Field adjustment is complete.

Visual Setting of gain factor potentiometer, "ADJ 2", on STA104 Analog Output Transmitters.

1. Velocity Gain must first be enabled for settings on potentiometer "ADJ 2" to take effect. Move the power switch to the "OFF" position and set all FSR DIP switches to the 'ON' position. Move the power switch to the "ON" position and return the FSR DIP switches for the output signal scaling desired.
2. Make sure that the unit of measure (fpm, cfm, m/s or L/s) is identical for both the transmitter and the reference. If the unit of measure is velocity (fpm or m/s), make sure that the reference airflow measurement was corrected for the area where the measurement was taken. Turn potentiometer "ADJ 2" until the output of the transmitter is equal to that of the reference. Field adjustment is complete.

MAINTENANCE

When the transmitter and probes are installed in accordance with *EBTRON* guidelines, instrument difficulties are rare. Issues can be easily resolved by viewing the troubleshooting guides (Tables 8 through 10). All devices come with a 3--Year Warranty on Parts and Factory Labor, as well as lifetime, toll-free customer support. Customer support is available Monday through Friday from 8:00 AM to 4:30 PM ET, at 800-2*EBTRON* (800-232-8766). ***EBTRON*** Diagnostic Customer Service forms are available on-line at www.ebtron.com. These forms are designed to assist us in quickly responding to and accurately diagnosing your specific issue and will greatly expedite its resolution. A sketch of the installation location, along with a control sequence of operations is very useful and is recommended to help us diagnose any issue you may encounter. Fax the completed information to 843.756.1838 before you call, and have it available when speaking with our Customer Service representative. Address all correspondence to the *EBTRON* Customer Service Department. Additional information is also available from your local *EBTRON* representative.

TM_STx104_R2A

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.

TROUBLESHOOTING GUIDES

General Troubleshooting (All STx104 Systems) Using the Status LED Fault Codes

The transmitter is equipped with a green Status LED indicator and fault detection circuitry to assist in isolating and correcting faults. In order to view the Status LED (located on the main circuit board -D3 on STA104; -D1 on STN104), remove the transmitter cover by sliding it off the enclosure. Fault trouble codes continuously repeat, beginning with the LED off for 5 seconds, and then flashing a number of times at ½ second intervals. The number of flashes indicates the detected fault condition as shown below. The Action Required column provides the most likely solution to correct the indicated fault condition. If the condition persists, or for further assistance, contact the ***EBTRON*** customer service team at **1-800 2 EBTRON** (*1-800 232-8766*) or visit ***www.ebtron.com***.

Table 8 General Troubleshooting (All STx104 Systems)

Problem	Possible Cause	Remedy
Status LED is not illuminated	Improper supply voltage at the power input terminal block.	Ensure that input voltage is between 22.8 and 26.4 VAC and that it is connected to L1 and L2 of the POWER terminal block.
	Blown fuse.	Check power wiring. Ensure that multiple devices wired on a single transformer are wired "in-phase" (L1 to L1, L2 to L2). Replace fuse with a 0.5 Amp, fast-acting fuse only after the cause of problem has been determined and corrected.
Status LED is illuminated, but is not flashing	The microprocessor is not running.	Deactivate and then reapply power to the transmitter.
Status LED flashing at 1 second intervals	Normal operation. No faults detected.	No action required.
One flash (then 5 second pause)	No sensors have been detected.	Verify that all sensor cables are properly connected to the transmitter, and that they have not been cut or damaged. Remove and then re-apply 24V power to the transmitter.
Two flashes (then 5 second pause)	Sensor Trouble (values out of range). The fault detection system has detected one or more malfunctioning or missing sensors.	Verify that all sensor cables are undamaged and are properly connected to the transmitter and match the number of sensor probes indicated on each probe's hang tag.
	Sensors may have been plugged into different connectors after initialization of the transmitter.	Force the transmitter to clear and re-read the sensor data as follows: Record the positions of all DIP switches. On STA104, set all FSR DIP switches to the "OFF" position. (On STN104, set all ADDRESS DIP switches to the "OFF" position). Cycle 24VAC power to the transmitter OFF and then ON. Return the DIP switches to their previous positions. This action will disable the GAIN adjustment potentiometer on the STA104. If necessary, re-enable this feature as shown in Figure 8 and Table 9.
Three flashes (then 5 second pause)	Too many sensors detected. A probe with 3 or more sensors has been connected to a 'Type B' or 'Type C' transmitter or a probe with 2 or more sensors has been connected to a 'Type C' transmitter.	Verify probe and transmitter application. Type 'A' transmitters are equipped with a single probe connector with up to 4 sensors. Type 'B' transmitters are equipped with two probe connectors for probes with up to 2 sensors each. Type 'C' transmitters are equipped with four probe connectors for probes with a single sensor.
Four flashes (then 5 second pause)	Sensor probe type mismatch detected.	Each transmitter must have all of the same type of sensor probes connected to it (SP1, SF1, ST1, SB1 or SU1 sensor probes). Operation with different sensor types is not permitted.
The transmitter indicates airflow when the HVAC system is not operating.	Transient air flow is being detected.	Sensors are sensitive and can measure very low air velocities. If a reading is indicated, there is actual airflow present at the airflow measuring station location. This may be caused by transient wind or induced flow due to pressure differential between duct openings. Do not attempt to adjust the "gain" as this will result in airflow measurement error. (Gain adjustment feature is available only on the STA104).

STA104 - Analog Transmitter Troubleshooting

Table 9. STA104 Analog Transmitter Troubleshooting

Problem	Possible Cause	Remedy
Output signal is not available at the OUTPUT terminal block of the STA104 transmitter.	Blown output fuse (output 1 and output 2 are fused and protected independently on STA104 transmitters).	Ensure that power has not been inadvertently connected to the output terminal block. Replace fuse with 0.125 Amp, fast acting fuse only.
	Sensor data was not completely read during initial startup.	Force the transmitter to clear and re-read the sensor data as follows: Record the positions of all DIP switches. On STA104, set all FSR DIP switches to the "OFF" position. (On STN104, set all ADDRESS DIP switches to the "OFF" position). Cycle 24VAC power to the transmitter OFF and then ON. Return DIP switches to their previous positions. This action will disable the GAIN adjustment potentiometer on the STA104. If necessary, re-enable this feature as shown below for GAIN potentiometer problem.
The 4-20mA output signal on the STA104 transmitter outputs less than 4mA.	The OUT1 or OUT2 VDC / mA selector (SW3, SW4) was changed after power-up.	Deactivate power to the STA104 transmitter. Select the desired mA or VDC output signal for output 1 (SW3) and/or output 2 (SW4). Reapply power to transmitter.
The 0-10VDC output signal on the STA104 transmitter outputs less than 2VDC.	The OUT1 or OUT2 VDC / mA selector (SW3, SW4) was changed after power-up.	Deactivate power to the STA104 transmitter. Select the desired mA or VDC output signal for output 1 (SW3) and/or output 2 (SW4). Reapply power to transmitter.
The output signal on the STA104 transmitter rapidly fluctuates.	Electrical interference from other devices is inducing noise on the signal wires to the host control system.	Verify that the output signal wiring to the host control system is shielded. Sources of electrical interference vary by location and can usually be resolved by proper grounding techniques. Try individually grounding the following points in the order shown. If that does not resolve the problem begin trying combinations of them. 1. Signal wire shield ground at host control 2. Signal wire shield at the COM on the output terminal block of the STA104 (ONLY if the host control system allows it) 3. Terminal L2 of the POWER terminal block of the STA104 (ONLY if the host control system allows it).
The GAIN potentiometer does not change the output signal.	The GAIN potentiometer is not enabled.	To enable the GAIN potentiometer, remove power from the STA104 transmitter. Move all of the DIP switches to the “ON” position. Reapply power and wait for the green LED to begin flashing. Return the DIP switches to their previous positions. The output signal can now be adjusted with the GAIN potentiometer. To disable the GAIN potentiometer, repeat the steps above, but with the DIP switches in the “OFF” position.
The output signal does not properly relate to the reading in the host control system.	The scaling in the host control system is incorrect.	Compare the current configuration of the STA104 transmitter with that of the host control system (the minimum and full scale settings for each output are determined by the DIP switch settings. Refer to the chart on the inside of the transmitter cover).

STN104 - RS485 Transmitter Troubleshooting

Table 10. STN104 RS-485 Transmitter Troubleshooting

Problem	Possible Cause	Remedy
The host control system is unable to communicate with the STN104 transmitter.	The network signal wiring is not properly connected to the STN104 transmitter or the host controls.	Verify that the network signal wires are connected to the proper terminals on the OUTPUT terminal block of the STN104 transmitter and at the host controls. On the STN104 transmitter OUTPUT terminal block, terminal 1 is for ‘A’, terminal 2 is for ‘B’ and COM for common.
	The network protocol has not been properly set within the STN104.	Set network protocol DIP Switch based on network requirements, and then reset transmitter power. Refer to FIgure 9 of this technical manual for settings.
	The transmitter address has not been properly set on the STN104.	Set Address DIP Switch based on network requirements and reset transmitter power. Refer to Figure 9 of this technical manual for settings. Note that each address must be unique for the network, and that the least significant bit (LSB) on the STN104 is DIP switch position 8.
	The transmitter termination has not been properly set on the STN104.	Set the Termination DIP Switch based on network requirements and reset transmitter power. Refer to Figure 9 of this technical manual for settings.
The host system is able to communicate with the STN104 transmitter but the returned point values are not valid.	Sensor data was not completely read during initial startup.	Force the transmitter to clear and re-read the sensor data as follows: Record the positions of all DIP switches. Set all ADDRESS DIP switches to the "OFF" position. Cycle 24VAC power to the transmitter OFF and then ON. Return the DIP switches to their previous positions.
The status point from the STN104 transmitter indicates a Trouble value.	The sensor detection system has detected one or more malfunctioning or missing sensors.	Verify that all sensor cables are undamaged and are properly connected to the transmitter and match the number of sensor probes indicated on each probe's hang tag.

TM_STx104_R2A

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