MODEL LF-SERIES
FLOW STATION

	CAUTIONS
⚠️	• Ensure that adequate installation / service clearance exists at the installation site to permit installation of the probe into the duct / plenum, and that the cable length for the probe(s) is sufficient to reach the planned transmitter installation. Refer to the mechanical details of Figure 2. • Location of the probe(s) is critical for proper performance of the air flow station. Probes must be installed in accordance with the engineer's plans and TSI Minimum Placement Guidelines (Figure 3) for the specified location. • On applications where multiple probes are to be installed at a single measurement location, install probes in accordance with Figure 4. For vertical mounting, install with cables exiting on the higher side to prevent any potential moisture from accumulating on the heated sensors. • Insulation that may interfere with mounting should be temporarily removed prior to installation and replaced afterwards.

	WARNING
⚡	The Model LF-Series Flow Station must be wired to 24 VAC only. Wiring the unit to 110 VAC will cause serious damage to the unit and void the warranty.

Figure 1. LF-Series Thermal Flow Station

Overview of Installation

Figure 2 provides probe installation details. Probes 18 in. (457.2 mm) and longer include a terminal stud (and for rectangular ducts, a terminal bracket plate) for additional support at the far end of the probe. On these longer probes, a terminal stud mounting hole is required on the other side of the duct (opposite the insertion side). Shorter probes (under 18 in. / 457.2 mm) do not require a terminal bracket or end stud hole, and are fabricated 0.25 in. (6.3 mm) less than the overall duct size.

Marking and Preparation

1. Each probe package is factory labeled for the specific location and duct size for which it is designed. Orders for locations requiring multiple probes at a specific location are typically banded and packaged together. Determine the specific duct location for the probe(s) as indicated on the engineer's plans showing where the air flow measuring station is to be located. Refer to Figure 4 for probe spacing and orientation.

2. Carefully open the probe packaging and inspect for damage. Proceed to the specific additional installation instructions for rectangular ducts (step 3) or for round ducts (step 6).
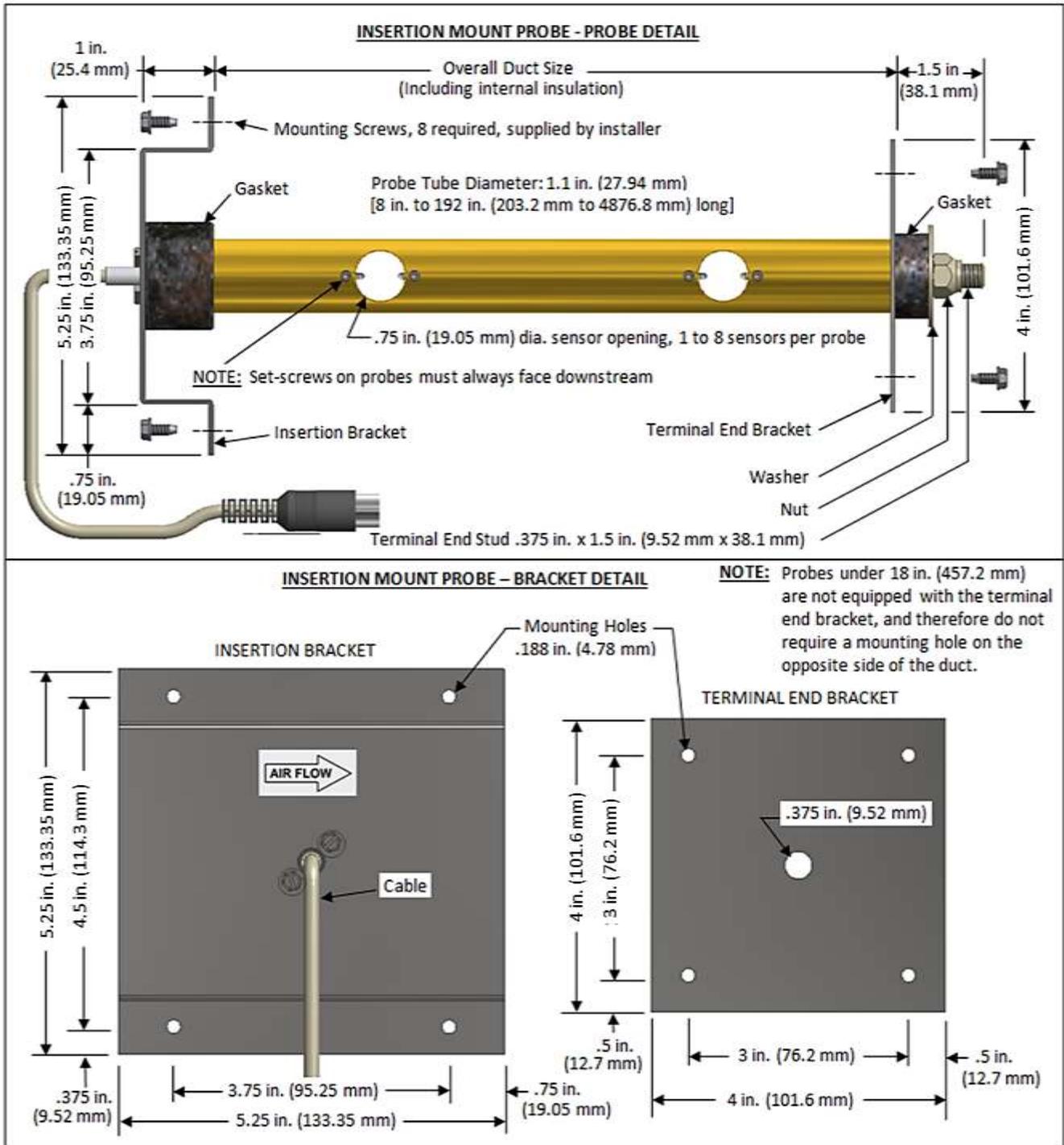

Figure 2. Probe Mechanical Detail

For Rectangular Ducts

3. The first dimension of the probe size indicates the length of the probe. The second dimension indicates the specific duct insertion side dimension "X." Refer to Figure 3 and verify that the probe is the correct size for the application duct size. Mark a point at the center of the insertion side of the duct at "X." Draw a line on the insertion side of the duct at this point that is perpendicular to the edge of the duct. This line will be used to locate the position of the hole(s) to be drilled for probe insertion. The number of probes for the specific measurement site determines the probe installation location and orientation.

4. Using the applicable Rectangular Probe Spacing/Configuration detail of Figure 4 locate and mark the location(s) on the insertion side of the duct [where the probe(s) will be inserted] at the line drawn in step 3.

5. Prepare a 1.25 in. (31.75 mm) insertion hole on the side of the duct where each probe will be inserted and complete the appropriate step 5a or 5b for the corresponding probe terminal end.

    a. **For probes 18 in. (457.2 mm) and greater**, a terminal end bracket and terminal stud is provided on the non-cable probe end opposite the insertion side bracket. Mark the location for the probe terminal stud hole to be prepared on the duct wall that is opposite the insertion side hole.

        1) Using the terminal end bracket as a guide and while keeping the top of the bracket parallel to the edge of the duct, mark the locations of the four terminal end bracket mounting holes.

        2) Prepare the 1.25 in. (31.75 mm) hole for the probe end bracket at the duct location marked in 5a.

    or

    b. **For probes under 18 in. (457.2 mm)**, no terminal end bracket or stud is supplied, therefore no additional marking or drilling is required on the opposite side of the duct.

For Round Ducts

6. Mark and draw a line around the circumference of the duct at the probe(s) insertion point(s). The number of probes for the specific measurement site determines the probe installation locations and orientation as shown in Figure 4. Applications with multiple probes must be staggered 1.5 to 2 in. (38.1 to 50.8 mm) from each other as shown in Round Duct Probe Spacing detail of Figure 4 to prevent probes from intersecting at the center of the duct.

7. Using the applicable Round Duct Probe Spacing detail of Figure 4, locate and mark the probe insertion location(s) on the circumference line drawn in step 6 where each of the probe(s) will be inserted.

8. Prepare a 1.25 in. (31.75 mm) insertion hole on the insertion side of the duct where each probe will be inserted.

    a. For probes equal to and greater than 18 in. (457.2 mm), a terminal stud is included at the probe end opposite the insertion side bracket. For these probes, mark and prepare a 0.5 in. (12.7 mm) terminal stud mounting hole for the terminal stud on the opposite side of the duct for each probe.

    b. For probes under 18 in. (457.2 mm), no terminal stud is supplied.

9. Proceed to Final Probe Assembly.

LF-Series Flow Station Placement

The following paragraphs detail the procedure for determining optimum placement of the LF-Series Flow Station in typical installation applications.

⚠	**CAUTION**
	Installation of the LF-Series Flow Station with straight duct lengths equal to or greater than indicated in the Minimum Placement Guidelines below is critical for proper performance of the air flow measurement station.

Minimum Placement Guidelines

Placement of the LF-Series Flow Station is critical for proper operation and accuracy of the air flow measurement station. Figure 3 shows minimum placement requirements for the LF-Series Flow Station in typical applications. Probe placement is expressed in multiples of Simple Equivalent Duct Diameter – "*D*," which is determined as follows:

D = (duct width + duct height) / 2

1. Using the illustration in Figure 3 that most closely matches the installation, multiply the calculated "D" value from above by the value indicated in the application illustration.

2. Mark the duct location and install the LF-Series Flow Station at the calculated location.
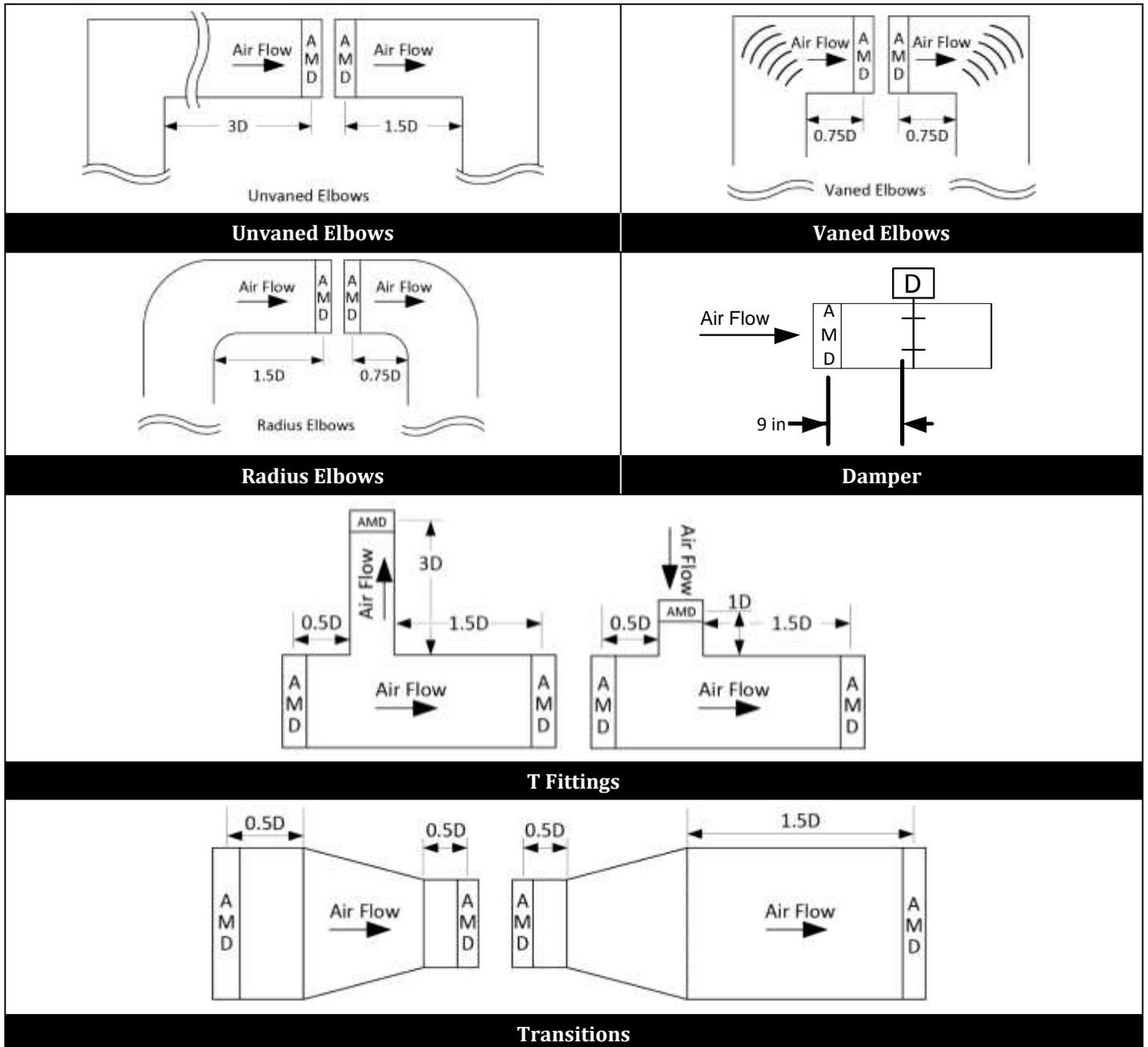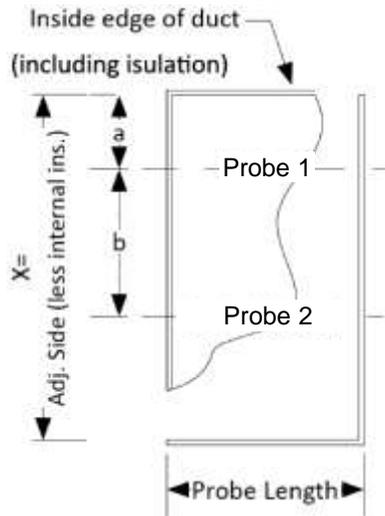

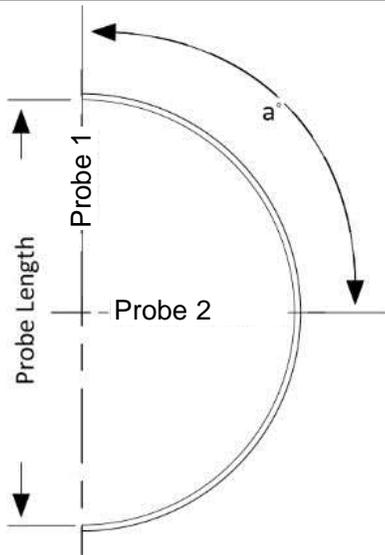**Figure 3. LF-Series Flow Station Minimum Placement Requirements Guide**

Rectangular Duct Placement

# of Probes	a	b
1	$^1/_2$ X	N/A
2	$^1/_4$ X	$^1/_2$ X

a. Distance from duct wall to Probe 1
b. Distance between Probes

Round Placement

# of Probes	a
1	NA
2	90°

a. Angle between Probes

CAUTION
Multiple probes must be staggered 1.5 to 2 in. (38.1 to 50.8 mm) from each other to prevent probes from intersecting at the center of the duct.

Figure 4. LF-Series Installation Flow Station Applications and Orientation

Final Probe Assembly

1. Carefully insert each probe assembly through the insertion side mounting hole, making sure that the larger insertion side gasket is firmly seated against the insertion side bracket. On probes with terminal studs, ensure that the terminal stud passes through the hole prepared on the opposite side of the duct. Fasten the insertion side mounting plate to the duct at four (4) places with appropriate sheet metal screws, making sure that the printed air flow arrow on the plate and probes is in the actual direction of duct air flow and that the plate is parallel to the edge of the duct. On probes under 18 in. (457.2 mm) without terminal studs, proceed to below.

> ### NOTE
> If the air flow direction labels are not visible on the probe or bracket, orient the probe so that the set screws (two per sensor) face the **DOWNSTREAM** side of the probe. (Set screws are only on the downstream side).

2. For rectangular duct applications with probes of 18 in. (457.2 mm) or greater, place the terminal end bracket plate onto the terminal stud that is protruding through the opposite side of the duct. (For round duct applications with probes 18 in./457.2 mm and greater, a terminal end bracket is not required.) Pass the bracket over the end stud and locate it using the marks prepared earlier in . Fasten the terminal end bracket plate to the duct at the four (4) marked locations using appropriate fasteners.

3. Place the smaller foam shock absorber/gasket over the terminal mounting stud then place the large flat washer against the shock absorber/gasket. Tighten the lock nut onto the terminal mounting bolt until snug. A tight fit is not required, can limit probe movement and result in air leakage when the duct is pressurized.

4. Connect all sensor probes to the transmitter. This completes probe installation. Complete the installation, wiring and set up of the associated transmitter as detailed in the separate Transmitter Installation Guide and Installation, Operation and Maintenance Technical Manual (each provided under separate cover).

Transmitter Installation

Mount the transmitter upright in a field accessible location with sufficient service clearance to permit cover removal. The enclosure (Figure 5) is designed to accept signal and power wiring at the bottom-right of the enclosure. Ensure that the planned location of the transmitter will allow each sensor probe cable to reach the receptacle at the bottom-left of the transmitter enclosure.
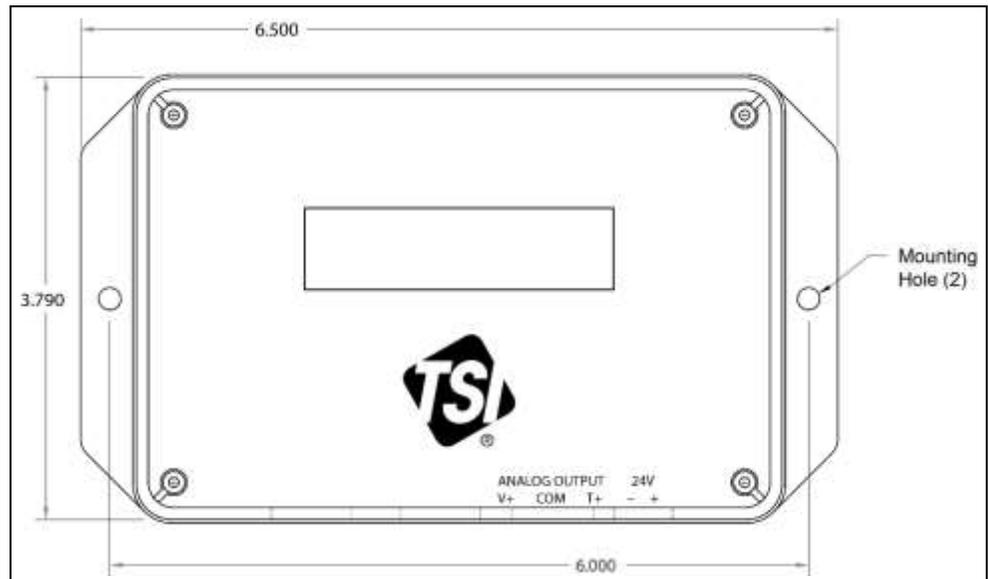

Figure 5. Transmitter Dimensions

1. Using the engineer's plans, locate where the transmitter will be installed.

2. Refer to Figure 5 and mark the two mounting holes located on each of the side flanges of the transmitter.

3. Drill two holes suitable for the hardware that will be used to secure the transmitter.

4. Secure the transmitter in two places using suitable hardware.

5. Connect wiring to transmitter as outlined in the following procedure.

⚠	**CAUTIONS**
	• Provide sufficient clearance around the transmitter to permit cover removal and allow for heat dissipation.
	• Locate the transmitter in a location that can be reached by the connecting cable from the sensor probe.
	• **DO NOT** drill into the transmitter enclosure since doing so may damage the electronics.
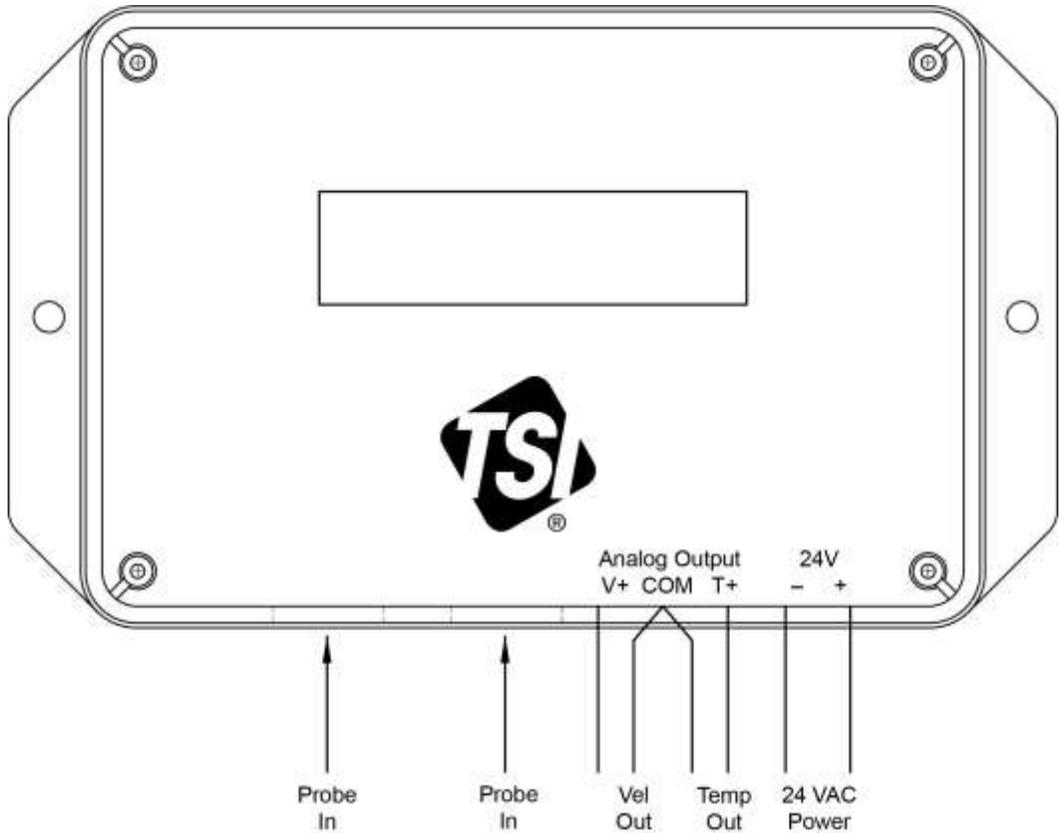
Figure 6. Wiring Diagram

Transmitter Wiring

Transmitter wiring consists of connecting the probes, analog output signal and 24 VAC input power to the LF-Series Thermal Flow Station. Refer to Figure 6 and Figure 7 and for additional detail. Following installation, the air flow measurement station is ready for operation. Custom setup options (other than the default values) can be entered in the Transmitter Setup procedure detailed later in this document.

Sensor Probe Connection

With 24 VAC power off, connect each sensor probe plug to the transmitter by pushing it into the keyed circular receptacle located at the bottom of the transmitter enclosure.
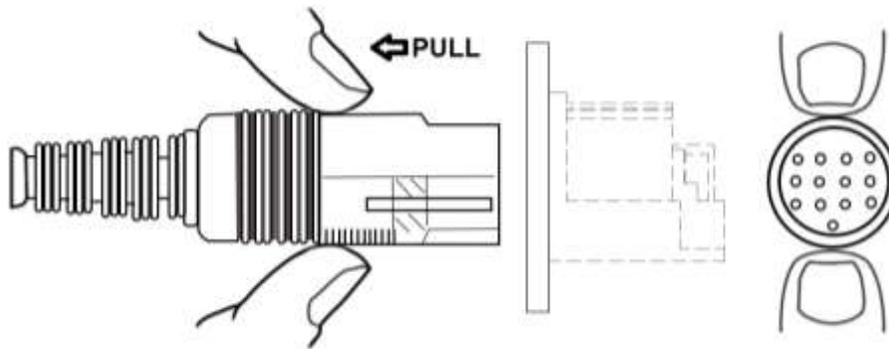

Figure 7. Sensor Probe Connector Detail

CAUTION
Twisting connector while connecting may damage the connector, voiding the warranty.

Power Requirements

LF-Series Thermal Flow Station require 24-VAC power, 9 VA. Ensure the power is between 22.8 and 26.4 VAC when the transmitter is ON.

Signal and Power Connections

CAUTIONS
• To prevent damage to the LF-Series Thermal Flow Station, deactivate 24 VAC power source until all connections to the instrument are complete.
• LF-Series Thermal Flow Stations are not electrically isolated. **DO NOT** share power with other devices. Observe polarity if sharing power among multiple LF-Series Thermal Flow Stations.
• LF-Series Thermal Flow Stations are not electrically isolated. If an isolated analog output is desired, use a dedicated isolation transformer to provide power.

1. Connect Velocity Output signal wire to V+ and COM terminals.

2. Connect Temperature Output signal wire, if desired, to TEMP+ and COM terminals.

3. Connect 24 VAC power to terminals 24 V terminals.

Field Configuration

LF-Series Thermal Flow Stations are shipped pre-configured for typically encountered applications. To adjust these settings, remove the cover from the transmitter to access the push buttons. Press the ↓ and ↑ push buttons simultaneously to enter the menu system.

- **ENTER** push button selects a menu, menu item, or saves a new menu setting.
- **ESC** push button escapes out of the menu, menu item or menu item setting without saving.
- ↓ push button scrolls to the next menu, menu item or setting.
- ↑ push button scrolls to the previous menu, menu item or setting.

Settings Menu

Submenu	Menu Item	Description	Range (Default Value)
Global	**SYS**	Sets units of measure.	IP, SI (IP)
General	**AIRFLOW**	Use the **AIRFLOW** item to select from Standard (STD) or Actual (ACT) air flow. If set to Actual air flow, the LF series flow station will adjust its measurements based on the actual air temperature and field-configured altitude. TSI recommends setting air flow to **ACTUAL**.	STD, ACT (STD)
General	**ALT**	The **ALT** item sets the Altitude of the LF-series thermal flow station. The **ALT** item is only used when **AIRFLOW** is set to **ACT**. When viewing the item, it will display "ALT=*current altitude*. To adjust the Altitude: • Press the **Enter** key to access the item, • use the ↑ and ↓ buttons to set the Altitude, • press the **Enter** button to save, or • press the **ESC** to exit without saving.	-200 to 20,000 ft. / -50 to 6,000 m (0)
General	**TEMPMETH**	The **TEMPMETH** sets the temperature averaging method for LF series flow stations with more than one (1) sensor. **WGT** — Uses a weighted average using the velocity of the air stream. **AVG** — Uses a simple average of the different temperatures.	WGT, AVG (WGT)
General	**EXT CAB**	The **EXT CAB** sets the length of the probe extension cables, if used. Probe extension cables are not normally supplied. Contact TSI if the 10-foot cable supplied with the LF series flow stations is not sufficient.	0 to 40 ft. / 0 to 12.2 m (0 ft.)
Analog Output	**AO1 ASGN**	The **AO1 ASGN** is set to **FLOW**.	N/A
Analog Output	**AO1 TYPE**	The **AO1 TYPE** is set to **VDC**, indicating a voltage output signal.	VDC (VDC)

Submenu	Menu Item	Description	Range (Default Value)
Analog Output	**AO1 RNGE**	The **AO1 RNGE** item sets the output range of the AO1 voltage output.	0–10, 0–5, 1–5, 2–10 (0–10)
Analog Output	**AO1 FS**	The **AO1 FS** item sets the maximum range of the analog output. For example, if **AO1 RNGE** s set to 0–10 and the AO1 FS is set to 3000 then a 10 VDC output signal means an air velocity of 3000 fpm.	100 to 15,000 fpm / 0.5 to 75 m/s (3000 fpm)
Analog Output	**AO2 TYPE**	The **AO2 TYPE** is set to VDC, indicating a voltage output signal.	VDC (VDC)
Analog Output	**AO2 RNGE**	The **AO2 RNGE** item sets the output range of the AO2 voltage output.	0–10, 0–5, 1–5, 2–10 (0-10)
Analog Output	**AO2 UM**	The **AO2 UM** is set to F, indicating temperature is output in degrees F.	F (F)
Analog Output	**AO2 MS**	The **AO2 MS** item sets the minimum output value of the air temperature measurement.	-50 to 160 (50)
Analog Output	**AO2 FS**	The **AO2 FS** item sets the maximum output value of the air temperature measurement.	-50 to 160 (160)

Tools Menu

Menu Item	Description		Range (Default Value)
TEST OUT	The **TEST OUT** item allows you to manually adjust the analog output to verify the connected controller is seeing the signal.		
LOCK TOOL	**LOCK TOOL** enables passcode protection to prevent unauthorized changes to field configuration.		Refer to Lock Tool section
RESET	The **RESET** item returns field configuration parameters to factory default:		
	RESET ALL	Resets all field configuration.	
	RESET SENS	Removes sensor data. Use **RESET SENS** to prevent trouble codes if a probe is disconnected. After **RESET SENS** is selected, the LF Flow Station will immediately detect all connected probes.	
	RESET ADJ	Resets all field calibration adjustments.	
	RESE TRBL SET	Resets Trouble Codes.	

Diagnostics Menu

Menu Item	Description
TRBL Codes	Refer to TRBL CODES section for Trouble Codes.
TRBL HISTORY	Refer to TRBL CODES section for Trouble Code History.

Menu Item	Description
SERIAL NUMBERS	Shows serial numbers for: BRD2: transmitter C1: Connector / Probe #1 C2: Connector / Probe #2 **NOTE**: Serial Number is displayed as "NC" if a probe is Not Connected.
SENS VELOCITY	The **SENS VELOCITY** item displays the velocity measured by each sensor. Use the ↓ and ↑ arrows to select the sensor.
SENS TEMP	The **SENS TEMP** item displays the temperature measured by each sensor. Use the ↓ and ↑ arrows to select the sensor.
SENS VOLTS	The **SENS VOLTS** item displays the raw voltage of the Heated (velocity) and Temperature sensors. A raw voltage reading less than 2 V or greater than 10 V may indicate a sensor failure.

Trouble Codes

The LF-Series Flow Stations can detect instrument faults. Entering the **TRBL CODES** item displays error codes currently in effect, while the **TRBL HISTORY** shows error codes that previously occurred. Error codes are:

Code	Text	Details
1	**NO PROBES**	No probes connected.
2	**WRONG SENS**	Two (2) different probe types connected.
3	**INS COUNT**	Too many inserts in connected probes.
7	**P1 MISSING**	Probe #1 disconnected. (The system remembers connected probes through power cycles.)
8	**P2 MISSING**	Probe #2 disconnected. (The system remembers connected probes through power cycles.)
9	**P1 DATA**	Probe memory chip has bad data or cannot be read.
10	**P2 DATA**	Probe memory chip has bad data or cannot be read.
11	**SENSOR 1**	Sensor #1 is damaged or faulty.
12	**SENSOR 2**	Sensor #2 is damaged or faulty.
13	**SENSOR 3**	Sensor #3 is damaged or #faulty.
14	**SENSOR 4**	Sensor #4 is damaged or #faulty.
15	**SENSOR 5**	Sensor #5 is damaged or #faulty.
16	**SENSOR 6**	Sensor #6 is damaged or #faulty.
17	**SENSOR 7**	Sensor #7 is damaged or #faulty.
18	**SENSOR 8**	Sensor #8 is damaged or #faulty.
19	**OW1 FAIL**	Probe #1 memory chip unreadable.
20	**OW2 FAIL**	Probe #2 memory chip unreadable.
21	**BAD DATA**	Invalid flow value.
25	**LOW TEMP**	Temperature value is below spec. The system will continue running.

Lock Tool

After entering the **LOCK TOOL** item, the LF Series Flow Station will ask **LOCK**? Select **Yes** to proceed to enable passcode. Passcode is the last four (4) digits of the product serial number. Selecting **No** will exit the item, returning to the **LOCK TOOL** item.

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 advised, and accessibility must be considered in these applications.