



**Model 430DC/435DC DC-Powered
Air Velocity Transducer
User's Guide**

October 1989

Unit Description Sheet

Complete Model Number: _____

Serial Number: _____

Kurz Order Number: _____

Customer P. O. Number: _____

Gas Calibration: Air
 Other (specify): _____

Calibration Reference Temperature:
 Standard (25° C, 77° F)
 Other (specify): _____

Calibration Reference Pressure:
 Standard (760 mm Hg, 29.92 in Hg)
 Other (specify): _____

Velocity Range: 0-100 SFPM 0-1.5 SMPS
 0-300 SFPM 0-6 SMPS
 0-1,250 SFPM 0-15 SMPS
 0-2,500 SFPM 0-30 SMPS
 0-6,000 SFPM 0-60 SMPS
 0-12,000 SFPM
 Other (specify): _____

Engineering Units: SFPM
 SCFM/ft²
 lbs mass/min/ft²
 SCFM
 lbs/min
 SMPS
 Other (specify): _____

Line or Duct Size (for SCFM and lbs/min only): _____

- Power Supply Input:** Standard (18-24 Vdc)
 Other (specify): _____
- Output Signal:** Standard (linear 0-5 Vdc)
 Isolated 4-20 mA
 Non-Isolated 4-20 mA
 Other (specify): _____
- Probe & Sensor:** Custom Probe Length (specify): _____
 Custom Probe Cable Length (specify): _____
 Teflon-Coated Sensor
 Epoxy-Coated Sensor
 Other: _____

High Temperature Applications:

- HT Rated to 250° C
- Electronics Enclosures:** 437 Board Included in One-Piece Package
 None - Unmounted 437 Circuit Board
 437 Board Mounted in NEMA 1 Enclosure
 437 Board Mounted in Rack-Module, 1.4"
 437 Board Mounted in Rack-Module, 2.8"
 19" Rack Chassis with Guides
 Bench Enclosure for 19" Rack Chassis
- Power Supply:** 191 - 2.4 Amp 115 VAC 50/60 Hz Power Supply
 191 - 4.8 Amp 115 VAC 50/60 Hz Power Supply
 191 - 12 Amp 115 VAC 50/60 Hz Power Supply
 Rack Mounted 191 115 VAC 50/60 Hz Power Supply
 220VAC 50 Hz Operation of 191 Power Supply Above
- Displays:** Multi-Channel LCD Display
- Alarm:** Model 111 Dual Alarm Board
- Totalizers:** Totalizer
 Resettable Totalizer
- Safety Circuit** Sensor Safety Circuit

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The Kurz Model 430DC and Model 435DC DC-Powered Air Velocity Transducers are warranted to be free from defects in material or workmanship for one year from the date of shipment from the factory. Kurz's obligation is limited to repairing, or at its option, replacing products and components that, on verification, prove to be defective. Warranty work will be performed at the factory in Monterey, California. Kurz shall not be liable for installation charges, for expenses of buyer for repairs or replacement, for damages from delay or loss of use, or other indirect or consequential damages of any kind. Kurz extends this warranty only upon proper use and/or installation of the product in the application for which it is intended and does not cover products that have been serviced or modified by any person or entity other than Kurz Instruments Incorporated and its authorized service technicians. This warranty does not cover damaged sensors, units that have been subjected to unusual physical or electrical stress, or upon which the original identifications marks have been removed or altered.

Transportation charges for material shipped to the factory for warranty repair are to be paid for by the shipper. Kurz will return items repaired or replaced under warranty prepaid. No items shall be returned for warranty repair without prior authorization from Kurz. Call Kurz Instruments service department at (408) 646-5911 to obtain a return authorization number.

This warranty contains the entire obligation of Kurz Instruments Incorporated. No other warranties, expressed, implied, or statutory are given.

Special Precautions for Installation with Hazardous Gases

We at Kurz have done everything reasonable to ensure the safety of users of Kurz equipment. Even so, we are aware that special situations can arise that can result in an unsafe condition if hazardous gases are involved.

It is the responsibility of the user to properly install the product and especially to check for leakage in the extended plumbing and to properly seal conduit fittings, etc., according to the relevant codes.

An example is the installation of a Model 555 insertion mass flow meter in which the Model 455 probe is inserted into the ball valve retractor assembly. It is the responsibility of the user to ensure that the assembly does not leak upon initial installation and to perform routine maintenance (such as replacing the seals, etc.) on a regular basis and to verify the safety of the entire installation.

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About This Book

This book contains five sections and an appendix, each of which is briefly described below. The book also contains a Unit Description Sheet and a Quick Set-Up Guide. The book is not designed to be read cover to cover; rather, it is designed to present information to the 430DC and 435DC user in as accessible a manner as possible.

Organization

Unit Description Sheet

This sheet is found in the front of the book, immediately following the title page. It contains important identifying information about your 430DC or 435DC DC-Powered Air Velocity Transducer, including model number, serial number, Kurz order number, and customer purchase order number. It also lists any options you ordered with your transducer. Check the options listed against your original order and against the actual contents of the shipping carton. Report any discrepancies immediately to Kurz Instruments Incorporated at (408) 646-5911.

Quick Set-Up Guide

The Quick Set-Up Guide is a chart summarizing much of the information presented in the rest of the manual. You can use the chart to refresh your memory after you read the relevant sections of the manual. Or, if you feel that you do not need the more detailed information presented in the rest of the manual, you can attempt to install your 430DC or 435DC referring only to the Quick Set-Up chart. Kurz Instruments does **not**, however, recommend the latter approach.

Section 1: Product Overview

This section introduces you to the purpose, principles of operation, and features of the 430DC and 435DC transducers. You can safely skip this section if you are already familiar with that information.

Section 2: Installation

Section 2 explains, in necessarily general terms, how to install your transducer. This section explains how to determine the correct location for installation, as well as how to perform the physical installation in pipes and flat or round ductwork. You should read thoroughly the parts of this section that apply to your installation before you install the 430DC or 435DC. You may also want to read Section 5, "Testing," before you install the transducer.

Section 3: Operation and Maintenance

This section explains how to calculate actual velocities from the standard velocities reported by the 430DC or 435DC, how to recalibrate the unit, and how and when to clean the sensor. Refer to this section as needed.

Section 4: Options

This section lists and explains most of the options available with the transducer. Contact Kurz Instruments for a complete, up-to-date list of available options.

Section 5: Testing

This section explains some of the tests you can perform on the 430DC and 435DC to determine whether or not it is operating properly. Although each transducer is thoroughly tested before it leaves the factory, you may want to run the tests described in Section 5 to make sure that the unit has not been damaged in transit. Whether or not you do so depends largely on your judgment of the complexity of your installation: If installation and possible later removal are relatively easy, it probably makes more sense to go ahead and install the unit without extensive preinstallation testing. If your installation is a difficult one, and removing the unit later for testing would be more time consuming than the testing procedures themselves, you should probably test before you install.

Appendix A: Component Layout and Schematic Drawings

The appendix contains detailed component layout drawings and circuit diagrams of the various components of the 430DC and 435DC. This information is not needed by most users in routine operation of the unit. It is provided as an aid to those users who want to perform more detailed maintenance and testing operations than those described in sections 3 and 5.

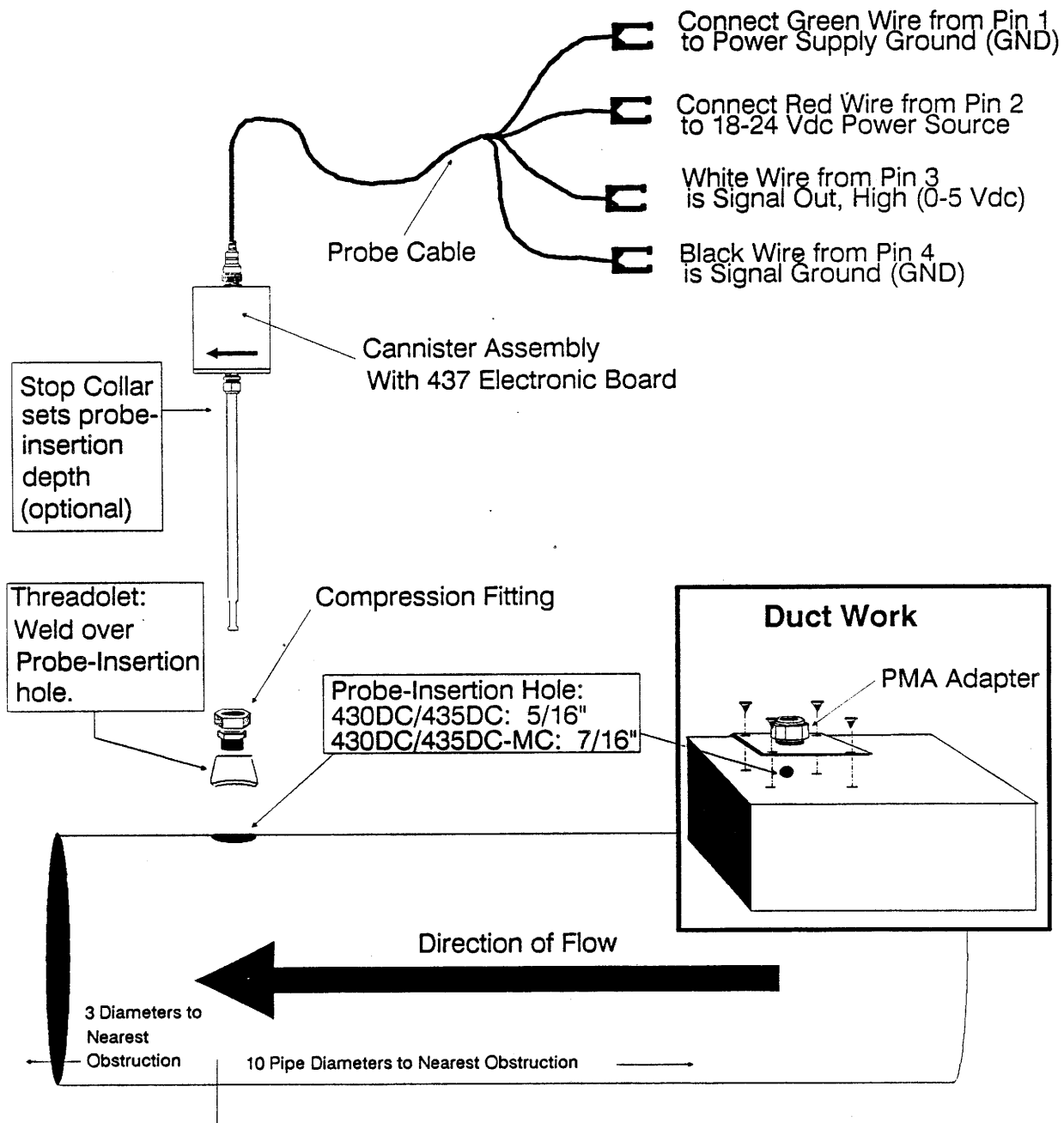
About the Art in This Book

The computer-generated art in the main sections of this book is intended to illustrate particular points under discussion. It includes only as much detail as is relevant to the discussion at hand. No attempt has been made to accurately scale these drawings or to include details not under discussion in the text that precedes and follows each drawing. If you need more detailed and precise visual information, refer to Appendix A, which contains reproductions of actual engineering drawings.

Quick Set-Up Guide

The quick set-up chart below summarizes much of the information presented in this manual. It does not, however, contain all the information you may need for safe and satisfactory installation of your 430DC or 435DC. Kurz Instruments recommends that you read applicable sections of the manual before attempting installation.

Important Note: Do NOT Place Cannister Next to Hot Ducts or Stacks, Ambient Temperature Must Be 50° C or Less.



Section 1: Product Overview

This section contains a general description of the DC-Powered Air Velocity Transducers. It explains how the transducers work and lists their features and specifications.

1.1 Description

The 430DC, 430DC-MC, 435DC, and 435DC-MC DC-Powered Air Velocity Transducers are rugged, very low maintenance instruments ideally suited to monitoring relatively clean air or gas flows in small ducts, pipes, or similar enclosed channels.

The four models are distinguished by the following characteristics:

- 430DC: Outputs a non-linear 0-5 Vdc signal representing flow velocity; uses Duraflo sensor
- 430DC-MC: Outputs a non-linear 0-5 Vdc signal representing flow velocity; uses mini MetalClad sensor
- 435DC: Outputs a linear 0-5 Vdc signal representing flow velocity; uses Duraflo sensor
- 430DC-MC: Outputs a linear 0-5 Vdc signal representing flow velocity; uses mini MetalClad sensor

These models will be referred to generically as the 430DC and 435DC except when specific features of 430DC-MC or 435DC-MC are being discussed.

The 430DC and 435DC can be used stand-alone or integrated into a wide range of OEM instruments and systems. Some of the applications include:

- heating, ventilating, and air conditioning (HVAC) systems
- laminar flow ceilings, bench hoods, and duct monitoring systems in semiconductor manufacturing facilities
- airborne engine test systems (to monitor gas turbine bleed air)
- air control systems in hospitals and other medical facilities

The 430DC and 435DC are best used in commercial applications where the flow to be measured is not heavily laden with particulate contamination and the temperature of the air or gas flow does not exceed 125° C.

The 430DC-MC and 435DC-MC, with the mini Metal Clad sensors, can be used in applications where the air flow does contain particulates. In all other respects excepting the construction of the sensor, the 430DC/435DC and 430DC/435DC-MC are identical. For extremely hot, dirty, or corrosive industrial environments, Kurz recommends the even more robust 455 Industrial Air Velocity Transducer.

The 430DC and 435DC are best suited for monitoring velocity in lines from a minimum of four inches in diameter up to approximately 24 inches in diameter (or in ducts up to 24 inches across in their smaller dimension). With optional custom probe lengths, these transducers can be used in lines up to 48 inches in diameter, although Kurz generally and strongly recommends a multi-point, multi-sensor EVA system for large diameter lines.

The 430DC and 435DC consist of the following basic components:

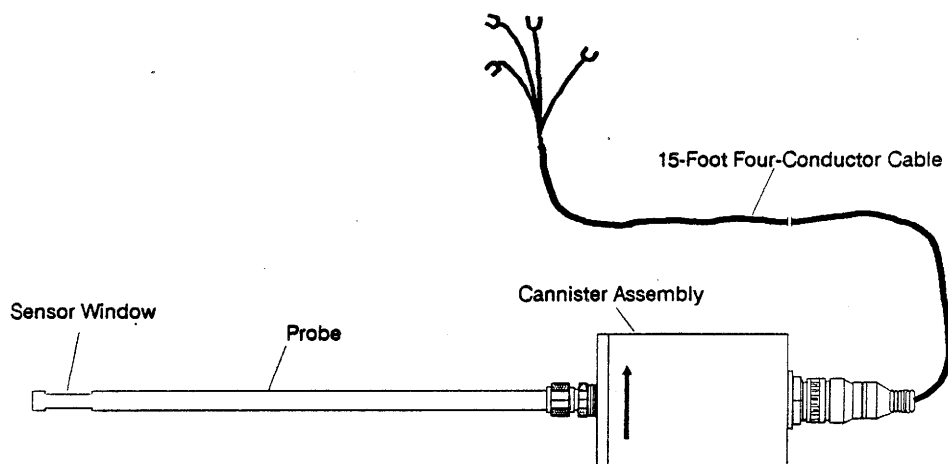
- Duraflo™ (430DC and 435DC) or mini MetalClad™ (430DC-MC and 435DC-MC) sensor mounted in a protective window at one end of the probe support

NOTE: The sensor shipped with your transducer was specifically matched to your unit's electronics during factory calibration. Sensors are **not** interchangeable between different units.

- 12-inch long, 1/4-inch diameter 316 stainless steel probe support (Nonstandard lengths from 3 to 48 inches are optionally available.)
- 437 Electronics Board housed in rugged, weather-resistant enameled aluminum cannister assembly at the end of the probe. (The 437 board can be unmounted, mounted in a NEMA 1 or NEMA 4 enclosure, or mounted in a rack module – refer to Section 4, "Options.")

Figure 1-1 shows the basic components of the 430DC and 435DC.

Figure 1-1. *430DC/435DC Basic Components*

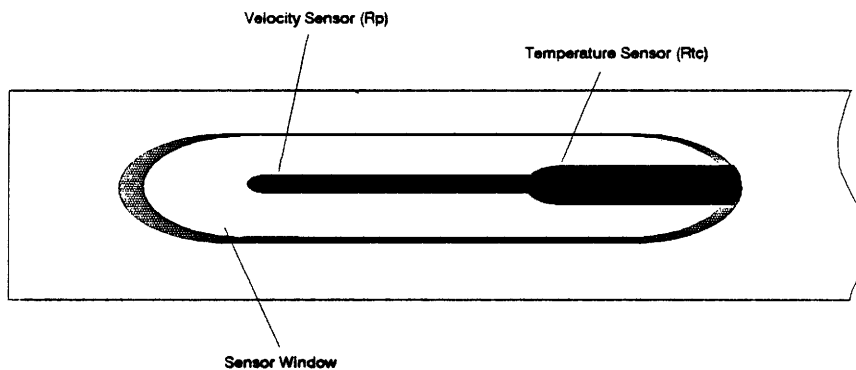


Important Note: The cannister assembly should **NOT** be placed close to a hot duct or stack. Provide enough clearance between the duct or stack and the cannister assembly so that the ambient temperature at the cannister is not above 50° C.

1.2 How the Sensor Works

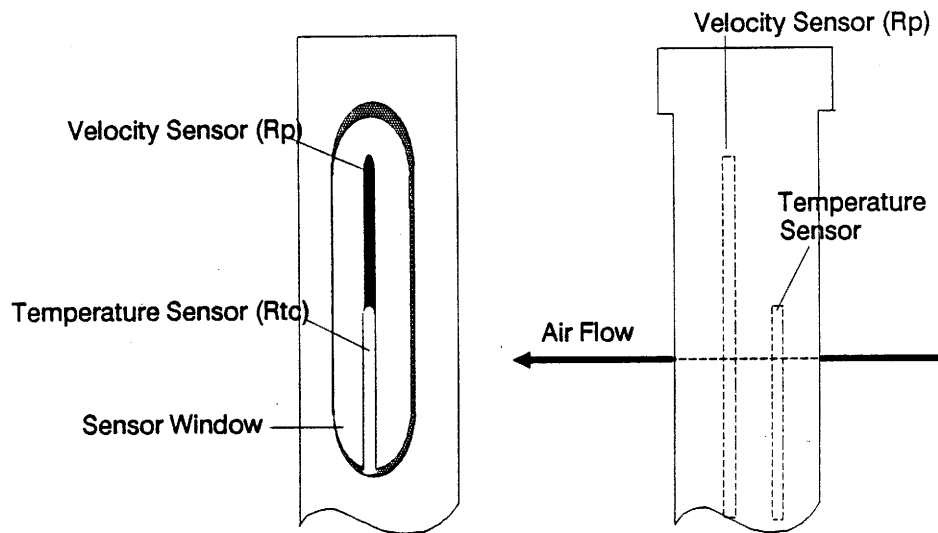
Although different in their construction, the Duraflo sensor of the 430DC and 435DC and the mini MetalClad sensor of the 430DC-MC and 435DC-MC work in the same way. Each of these sensors is in fact two sensors in one: a temperature sensor and a velocity sensor. The Duraflo sensor consists of reference-grade platinum windings wound around a ceramic mandrel and enclosed in a single glass sheath. The temperature sensor (R_{tc}) is located at the base of the sensor. The velocity sensor (R_p) is located at the tip of the sensor. Figure 1-2 shows a close-up view of the Duraflo sensor within its protective sensor window.

Figure 1-2. *Duraflo Sensor*



The mini MetalClad dual-sting sensor in the 430DC-MC and 435DC-MC consists of reference-grade platinum windings wound around two ceramic mandrels enclosed in two stainless steel sheaths. The temperature sensor (R_{tc}) is the shorter of the mini MetalClad's two sensor elements. The velocity sensor (R_p) is the longer of the two elements. Figure 1-3 shows a close-up view of the mini MetalClad sensor within its protective sensor window.

Figure 1-3. *Mini MetalClad Sensor: Two Views*



The temperature sensor senses the ambient temperature of the air flow. The velocity sensor is then heated to approximately 75° to 100° F above the ambient temperature and is maintained at the same level of temperature differential (overheat) above the ambient temperature regardless of changes in ambient temperature or air velocity.

CAUTION: The transducer sensor's standard rating is for nonexplosive gases. An optional safety temperature limiting option is available. Contact Kurz Instruments for more information on using the 430DC or 435DC (and 430DC-MC or 435DC-MC) sensor in explosive gas flows.

Because the temperature sensor compensates for fluctuations in ambient temperature, the amount of electrical power needed to maintain the velocity sensor's overheat is affected only by the flow of air or other gases over the sensor: The greater the velocity of the flow, the greater its cooling effect on the sensor and the greater the electrical power needed to maintain the sensor's overheat. It is this power or current draw that is measured by the 430DC and 435DC.

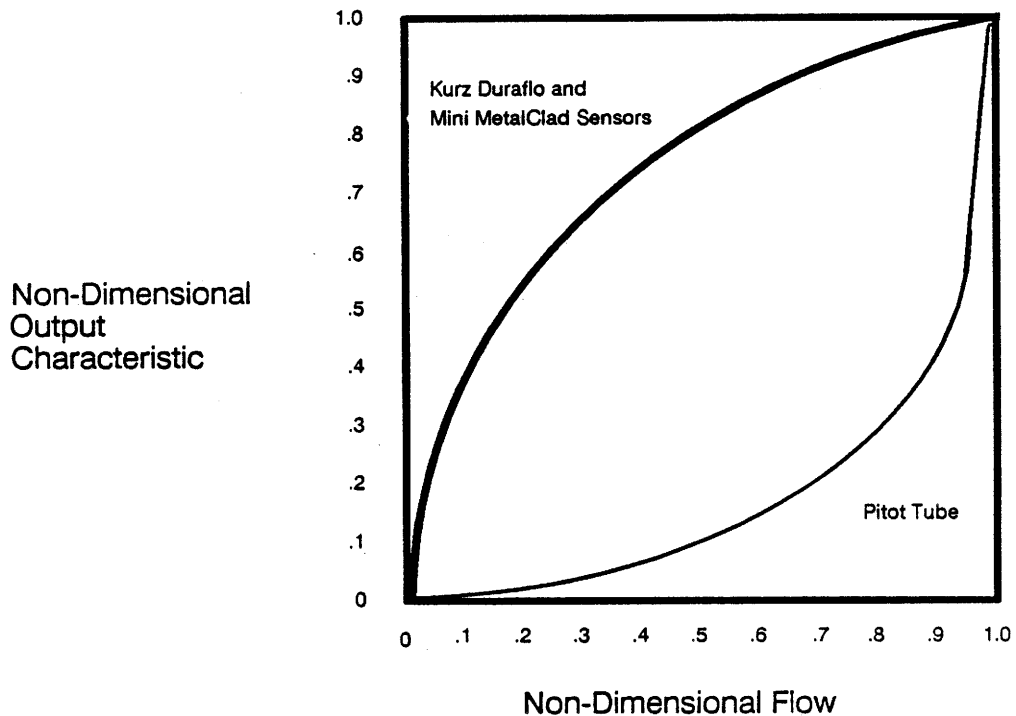
The sensor is directly measuring mass flow (i.e., the number of molecules carrying heat away from the velocity sensor), and is calibrated in **standard** units, which are referenced to a temperature of 25° C and atmospheric pressure of 760 mm Hg. In other words, air at 25° C and 760 mm Hg, flowing at 100 feet per minute (FPM) will produce a reading of 100 **standard** feet per minute (SFPM)¹. A 100 FPM flow at a different temperature or pressure produces a reading in SFPM that accurately compensates for the temperature or pressure differential.

The temperature and velocity sensors form two legs of a balanced Wheatstone bridge. The bridge circuitry itself is contained on the 437 electronics board in the cannister assembly at the end of the probe support. The temperature sensor leg (R_{tc}) is input to the positive side of an operational amplifier as a reference. The bridge is activated through an offset differential of the two legs. The sensor is heated with current through the R_p winding. Resistance increases until it balances with the minus input of the operational amplifier, which drives a power transistor to provide bridge current.

The signal received from the sensor is nonlinear in that the amount of power needed to maintain the velocity sensor's overheat is not directly proportionate to the velocity of the airflow. Instead, the power-consumption curve is fairly steep at low flow rates and relatively flatter at higher rates of flow. Figure 1-4 shows the Duraflo and mini MetalClad sensor's output curve as flow increases. Figure 1-4 also shows the corresponding curve for a pitot-tube type sensor. Note the greatly superior sensitivity of the Duraflo and mini MetalClad sensors at low flow rates.

¹ Standard calibration for these transducers is in SFPM. Other engineering units are also available – refer to Section 4, "Options".

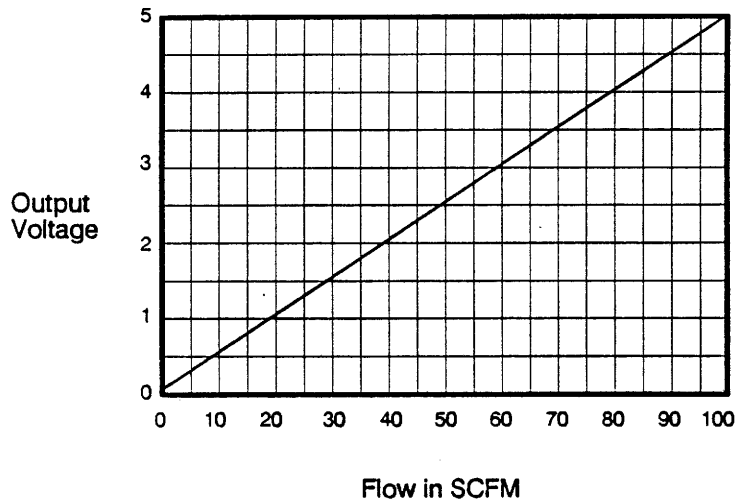
Figure 1-4. *Sensor Output vs Flow*



Zero and span circuitry on the 437 electronics board converts the signal from the sensor to a non-linear 0-5 Vdc signal that has approximately the same curve as shown above. This non-linear 0-5 Vdc signal is output from the 430DC unless the non-isolated 4-20mA option (-I) was ordered. If this option was ordered, the 430DC outputs a non-linear 4-20mA signal.

However, the 437 board in the 435DC and 435DC-MC contains an additional linearizer circuit that converts the nonlinear voltage into a linear voltage that is directly proportionate to flow velocity: 0 Vdc indicates no flow, 5 Vdc indicates maximum measurable flow, and 2.5 Vdc indicates a flow exactly half of the maximum measurable flow, as shown in Figure 1-5.

Figure 1-5. *Linearized 0-5 Vdc Output of the 435DC and 435DC-MC*



The 437 board will convert this linear output voltage to an 4-20 mA output if the 435DC was ordered with the non-isolated option (-I).

1.3 Features and Specifications

Some of the outstanding features of the 430DC and 435DC are summarized below:

Rugged Construction

The Duraflo and mini MetalClad sensor is exceptionally durable in normal use. It is resistant to both dirt and corrosion; unlike pitot-tube and orifice-plate sensors, its performance is not significantly degraded by operation in a dirty atmosphere.

Unsurpassed Accuracy

The Duraflo and MetalClad sensor windings are Resistor Temperature Detector (RTD)-type windings of reference-grade platinum 385.

Automatic Temperature and Pressure Compensation

The 430DC and 435DC directly measure mass velocity. No computations are necessary to compensate for temperature and pressure changes.

Excellent Low-Speed Sensitivity

Unlike pitot-tube and orifice-plate sensors, the 430DC and 435DC can accurately measure flows down to 20 SFPM.

Convenient 0-5 Vdc Output

The 430DC outputs a non-linear 0-5 Vdc signal. The 435DC outputs a linear 0-5 Vdc signal. This output signal is convenient for digital panel meters, voltmeters, chart recorders, and computers. Other outputs are optionally available.

NBS-Traceable Calibration

Every 430DC and 435DC is factory-calibrated in a National Bureau of Standards (NBS) traceable wind tunnel. Packaged with your transducer is a Calibration Certificate showing output voltage vs air velocity. The factory calibration is for air at 25° C and 760 mm Hg. Calibration for other gases, temperatures, and pressures is available at an additional charge.

The specifications of the 430DC and 435DC are given in Table 1-1. All specifications apply to all models except where noted.

Table 1-1. *430DC and 435DC Specifications*

Sensor Construction:	Reference-grade 385 platinum RTD-type windings around a high-purity ceramic core, sheathed in glass (430DC and 435DC) or stainless steel (430DC-MC and 435DC-MC)
Accuracy:	+/- 2% of full scale (non-linear - 430) +/- 3% of full scale (linear - 435)
Repeatability:	+/- 0.25%
Response Time:	1 second
Calibration:	Factory calibrated in NBS-traceable wind tunnel for air at 25° C and 760 mm Hg. Includes Calibration Certificate showing output voltage vs air velocity for 11 data points, including zero flow.
Sensor Operating Temperature Range:	0° C to +125° C standard HT rated sensor optionally available for temperatures from 0° C to +250° C NOTE: The electronic components on the 437 board are rated only to 70° C. Specify a remote-mounted enclosure for the electronics or longer probe if the portion of the probe outside the pipe or duct to be monitored will be exposed to temperatures higher than 50° C. (See Section 2.5.3 for information on high-temperature installations.)

Table 1-1 (continued)

Probe Construction:	430DC/435DC: 316 stainless steel, epoxy, and glass wetted parts 430DC-MC/435DC-MC: 316 stainless steel and epoxy wetted parts
Probe Dimensions:	430DC/435DC: 1/4" outside diameter; 12" length standard; lengths from 3" to 48" optionally available 430DC/435DC-MC: 3/8" outside diameter; 12" length standard; lengths from 3" to 48" optionally available
Electronics Hookup:	A 15-foot four-conductor cable is supplied to connect the transducer to the 18-24 Vdc input and 0-5Vdc output.
Electronics Board Enclosure:	2.75" X 4.75" X 1.13" enameled aluminum cannister. (Refer to Section 4 for information on optional configurations.)
Output:	430DC and 430DC-MC: Non-linear 0-5 Vdc standard 435DC and 435DC-MC: Linear 0-5 Vdc standard Non-isolated 4-20 mA outputs optionally available on the 437 electronics board. Isolated 4-20 mA output available with optional electronics board. See Section 4 for further information. For other nonstandard outputs, consult factory.

End of Section 1

Section 2: Installation

This section explains how to install your Model 430DC or 435DC DC-Powered Air Velocity Transducer. The instructions given in this section are necessarily general in nature; every installation is unique. If you need further assistance with your installation, contact your local Kurz representative, or contact Kurz Instruments, Inc. at (408) 646-5911.

2.1 Checking the Contents of the Shipping Carton

Open the shipping carton and remove the protective foam packaging material that covers the 430DC or 435DC and any options shipped with it. Check to see that the shipping carton contains everything you ordered.

Make sure the NBS traceable calibration certificate is included. Verify that the line size (if applicable) and pipe schedule shown on the calibration certificate are correct.

2.1.1 430DC/435DC Without Options

If you ordered your transducer without any options, the contents of the shipping carton should be as shown in Figure 1-1, "430DC/435DC Basic Components."

If the contents of the shipping carton are correct, proceed with the installation. (If you prefer to test the unit before you install it, refer now to Section 5, "Testing.")

2.1.2 430DC/435DC with Options

Any options you ordered should be specified on the Unit Description Sheet at the front of this manual. Available options are listed, described, and (where applicable) pictured in Section 4, "Options". If the options specified on the Unit Description Sheet do not match the options you ordered or the options actually shipped, contact Kurz immediately.

If you ordered your transducer with the 437 electronics board in a NEMA enclosure, check inside this unit and remove any desiccant or other packaging material you find there.

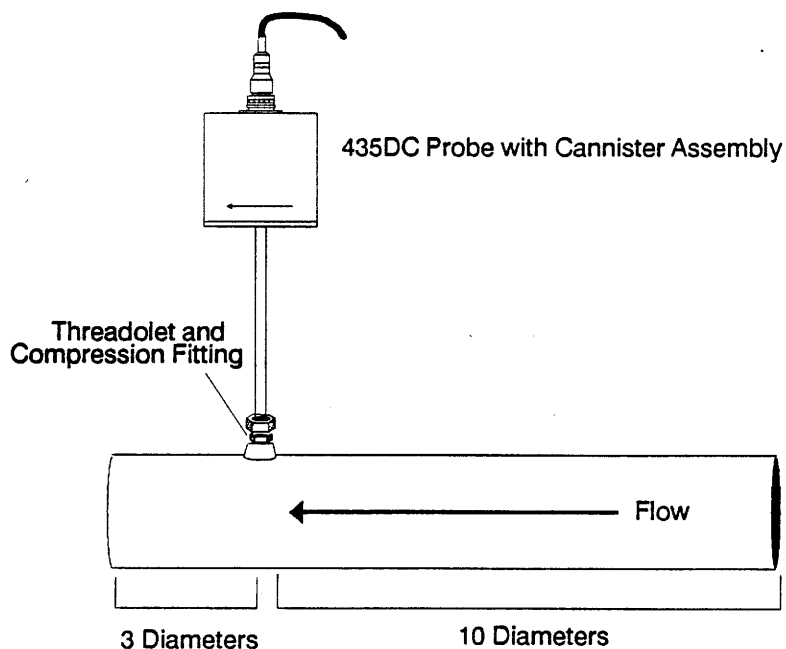
If the contents of the shipping carton are correct, proceed with the installation. (If you prefer to test the unit before you install it, refer now to Section 5, "Testing.")

2.2 Determining Probe Location

If possible, you should locate the probe at least three pipe or duct diameters upstream and ten diameters downstream from the nearest bend, elbow, or other obstruction in the pipe or duct to be monitored. The chosen location should also provide sufficient clearance for inserting and removing the transducer probe; that is, the clearance between the pipe or duct and any obstruction should equal at least the length of the probe, plus the cannister assembly, plus two or three inches for maneuver. Correct probe location is illustrated in Figure 2-1.

Important Note: The cannister assembly should NOT be placed close to a hot duct or stack. Provide enough clearance between the duct or stack and the cannister assembly so that the ambient temperature at the cannister is not above 50° C.

Figure 2-1. *Probe Location*



2.3 Determining Probe Insertion Depth

Because the sensor can, at any one time, measure velocity at only one point within your pipe or ductwork, it is important that the sensor be mounted at a point where velocity closely approximates the average velocity within the pipe or duct. You can approach the problem of determining a point of average velocity in a variety of ways, depending primarily upon the accuracy your application requires.

2.3.1 Center Mounting

Under some circumstances, it may be appropriate to assume that the center point of the pipe or duct represents a point of average velocity. Such circumstances include the following:

- A high degree of accuracy is not critical to your application.
- The pipe or duct to be monitored is so small that it is impractical to mount the sensor anywhere other than at the center of the pipe or duct.
- Flow profile is known to be turbulent and of high velocity; many points of average velocity are likely.
- Flow profile is known to be very uniform.

Even under the circumstances listed above, however, you may want to perform at least a half traverse (described below at 2.3.2) before deciding on center mounting.

2.3.2 Half-Traverse Averaging

You can, with a fair degree of accuracy, determine the average velocity within a pipe or duct, and a specific point at which velocity closely approximates that average, by traversing the sensor once across the center line of the pipe or duct, from the far wall to the center¹. The procedures for performing the traverse and obtaining an average are described below:

- Step 1: Divide a cross section of the pipe or duct into a number of equal, concentric areas (see Figure 2-2). The number of areas you use depends on the the uniformity of flow within the pipe or duct and on the degree of accuracy you require: The more areas you use, the more accurate your computed average will be.
- Step 2: Identify a point to monitor for each area (see Figure 2-2).
- Step 3: Drill a hole in the pipe or duct 1/16"-inch larger in diameter than the probe (5/16" for the 430DC/435DC; 7/16" for the 430DC-MC/435DC-MC).
- Step 4: Insert the probe into the pipe or duct and take a velocity reading at each of the points selected at Step 2².

You can most easily determine the position of the sensor within the pipe or duct by using a pencil or other marker to mark off appropriate measurements on the probe before you insert it.

Be sure the sensor window is aligned with the direction of flow, so that airflow over the sensor is unobstructed..

- Step 5: Compute an arithmetic average of the readings obtained at Step 4.

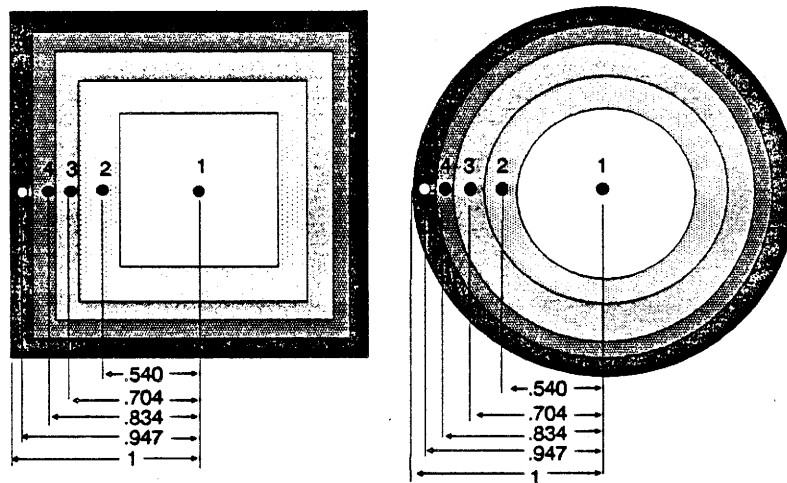
- 1 If the size of the pipe or duct is such that the probe will not reach all the way across it, you can perform the traverse from the center to the near wall. In that case, however, you should omit the reading nearest the wall of the pipe or duct (see Figure 2-1 on page 2-2) because that reading may be influenced by turbulence or leakage caused by the probe-insertion hole.
- 2 The transducer is shipped with a protective rubber cap covering the sensor. You must remove the cap before you can take readings with the instrument.

Step 6: Select the point at which you will permanently mount the sensor. This should be the point whose velocity reading most nearly approximates the average velocity computed at Step 5.

If none of the points monitored yields a reading sufficiently close to the computed average, you may want to repeat the procedure, using a larger number of areas and points. Alternatively, you may want to perform the somewhat more complicated double-traverse averaging described at 2.3.3 below.

Figure 2-2 shows cross sections of square and round ducts, each with five areas and five monitoring points for a half-traverse averaging operation.

Figure 2-2. *Equal-Area Half Traverse*



In Figure 2-2, the unshaded area that contains Point 1 represents one square unit. Each of the shaded areas containing Points 2, 3, 4, and 5 also represents one square unit. The total cross-sectional area of each duct is five square units.

The numbers shown below the ducts give the positions of points 2, 3, 4, and 5 relative to the distance from Point 1 to the wall of the duct. That is, from Point 1 to Point 2 is 54% of the distance from Point 1 to the wall of the duct; from Point 1 to Point 3 is 70.4% of the distance from Point 1 to the wall of the duct; and so on. You can extrapolate from these numbers the actual measurements for any pipe or square duct divided into five equal areas.

Table 2-1 shows an example of averaging readings from a duct like one of those shown in Figure 2-2.

Table 2-1. *Half-Traversal Velocity Averaging Example*

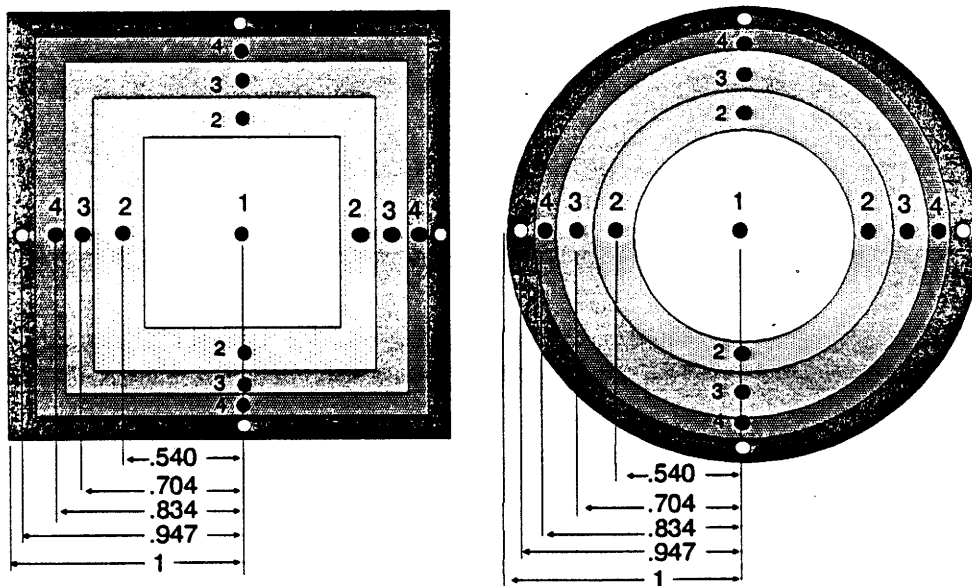
Point	Velocity Reading (SFPM)
1	1000
2	950
3	800
4	700
5	500
Total:	3950
Average:	790

In the example, the average velocity from the five points sampled is 790 SFPM. Point 3, with a measured velocity of 800 SFPM, is closest to the average velocity. You would therefore permanently mount the 435DC with its probe inserted to the correct depth to align the sensor with Point 3.

- Step 5: Compute an arithmetic average of the readings obtained at Step 4. Count the single Point-1 reading four times in determining the average.
- Step 6: Select the point at which you will permanently mount the sensor. This should be the point whose velocity reading most nearly approximates the average velocity computed at Step 5.
- If none of the points monitored yields a reading sufficiently close to the computed average, you may want to repeat the procedure, using a larger number of areas and points.
- Step 7: Be sure you seal the probe-insertion hole that will not be used when you permanently mount the probe.

Figure 2-3 shows cross sections of both square and round ducts, each with five areas and 17 monitoring points for a double-traverse averaging operation.

Figure 2-3. *Equal-Area Double Traverse*



2.3.3 Double-Traverse Averaging

Double-traverse averaging is similar to half-traverse averaging, but requires a second probe-insertion hole and more monitoring points. The procedures for performing the traverse and obtaining an average are described below:

- Step 1: Divide a cross section of the pipe or duct into a number of equal, concentric areas (see Figure 2-3). The number of areas you use depends on the the uniformity of flow within the pipe or duct and on the degree of accuracy you require: The more areas you use, the more accurate your computed average will be.
- Step 2: Identify four points to monitor for each area (see Figure 2-3)³.
- Step 3: Drill a hole in the pipe or duct 1/16"-inch larger in diameter than the probe (5/16" for the 430DC/435DC; 7/16" for the 430DC-MC/435DC-MC).
- Step 4: Insert the probe into the pipe or duct through one of the probe-insertion holes and take a velocity reading at each of the points in line with that hole.⁴ Repeat the process for the other hole.

You can most easily determine the position of the sensor within the pipe or duct by using a pencil or other marker to mark off appropriate measurements on the probe before you insert it.

Be sure the window of the probe's protective shield is aligned with the direction of flow so that airflow over the sensor is unobstructed.

3 Note that the center contains only one monitoring point. The reading from that point must be counted four times in the averaging operation to give each area equal weight.

4 Do not take a reading at the point nearest the probe-insertion hole; such a reading might be influenced by leakage or turbulence caused by the hole. Instead, substitute the reading from the corresponding point nearest the far wall of the duct or pipe. Be sure to remove the protective rubber cap from the 435DC's sensor before you attempt to take readings.

In Figure 2-3, the unshaded area of each duct, which contains Point 1, represents one square unit. Each of the shaded areas containing points 2, 3, 4, and 5 also represents one square unit. The total cross-sectional area of each duct is five square units.

The numbers shown below the ducts give the positions of points 2, 3, 4, and 5 relative to the distance from Point 1 to the wall of the duct. That is, from Point 1 to Point 2 is 54% of the distance from Point 1 to the wall of the duct; from Point 1 to Point 3 is 70.4% of the distance from Point 1 to the wall of the duct; and so on. You can extrapolate from these numbers the actual measurements for any pipe or square duct divided into five equal areas. Table 2-2 shows an example of averaging readings from a duct like one of those shown in Figure 2-3.

Table 2-2. *Double-Traverse Velocity Averaging Example*

From\Points	1	2	3	4	5	Sum	Average
Left	1200	1150	1100	1000	700	5150	1030
Right	1200	1140	1115	1020	700	5175	1035
Top	1200	1200	1175	1100	800	5475	1095
Bottom	1200	1175	1150	1050	800	5375	1075
Sum:	4800	4665	4540	4170	3000	21,175	4235
Average:	1200	1166	1135	1043	750	5294	1059

In the example, the average velocity from the 20 points sampled⁵ is 1059 SFPM. The bottom Point 4, with a measured velocity of 1050 SFPM, is closest to the average velocity. You would therefore permanently mount the 435DC with its probe inserted to the correct depth to align the sensor with the bottom Point 4.

⁵ Point 1 is counted four times.

If you find that the flow profile within the pipe or duct you are monitoring changes, or if you cannot find a single point that closely enough approximates the computed average velocity, you may want to consider moving to a multi-point, multi-sensor velocity averaging array such as the Kurz EVA 4000 or EVA 4100. In all cases, Kurz Instruments recommends a multi-sensor EVA system for monitoring velocity in lines over 48 inches in diameter.

2.4 Mounting the Compression Fitting

The transducer is held in place by means of a compression fitting attached to the outside of the pipe or duct in which the probe is to be mounted. The hardware and procedures necessary to attach the compression fitting vary, depending on whether the installation is for a pipe or for a sheet-metal duct. Installations of both kinds are described below.

2.4.1 Pipe Mounting

All hardware needed to mount the 430DC or 435DC in a pipe is readily available from most hardware supply dealers. You can, however, order the necessary hardware from Kurz Instruments if you want to.

You will need:

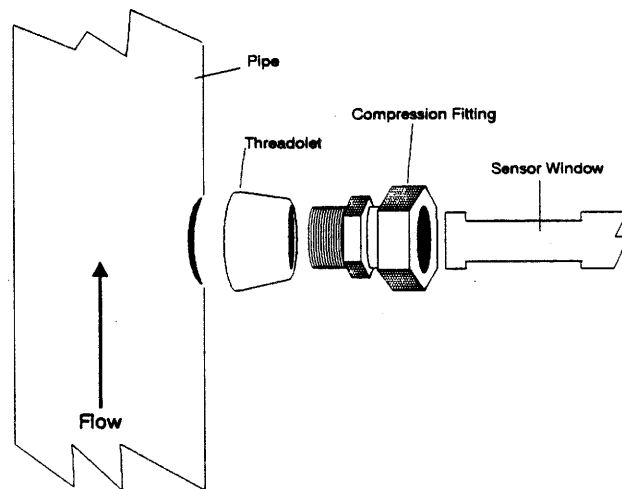
- **Threadolet™ carbon steel coupler⁶**. If you order the Threadolet from Kurz, you must specify the size of NPT (National Pipe Thread) pipe the Threadolet is to be welded to, as well as the wall thickness of that pipe (Schedule 40, 80, etc.). If you are installing a 430DC or 435DC, the Threadolet you use must accept a 1/4"-to-1/4" MNPT (Male National Pipe Thread) tube compression fitting. If you are installing a 430DC-MC or 435DC-MC, the Threadolet you use must accept a 3/8"-to-3/8" MNPT tube compression fitting.
- **Tube compression fitting⁷**. If you are installing a 430DC or 435DC, use a 0.25" AD 0.25" fitting. For a 430DC-MC or 435DC-MC, use a .375" AD .375" fitting.

⁶ Threadolet fittings are also available in aluminum and stainless steel.

⁷ Standard compression fitting is bored-thru 316 stainless steel with teflon ferrules. Optional stainless steel ferrules are available for permanent compression on the probe..

Figure 2-4 shows the hardware needed to mount the transducer in a pipe.

Figure 2-4. *Mounting Hardware, Pipe*



Weld the Threadolet coupler directly over the probe-insertion hole in the pipe in which you are installing the transducer (refer to Section 2.2 for determining the location of the probe-insertion hole). Then thread the tube compression fitting firmly into the coupler.

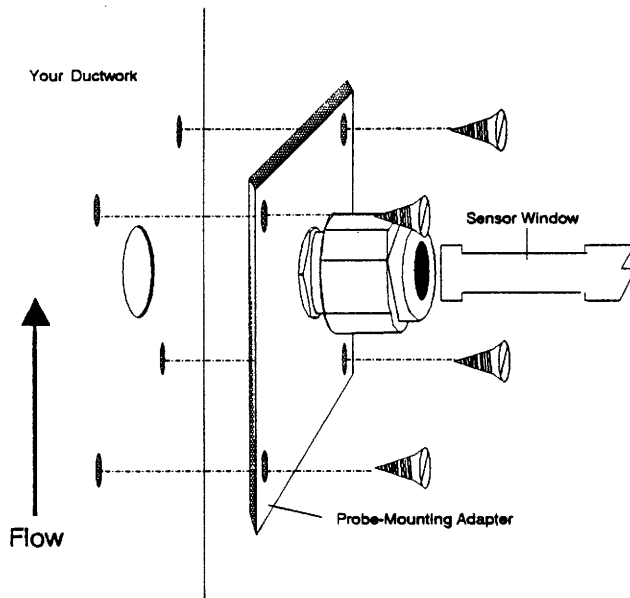
2.4.2 Duct Mounting

To mount the 430DC or 435DC in a duct constructed of thin-wall sheetmetal, order the appropriate mounting adapter from Kurz Instruments.

For installation of a 430DC or 435DC in flat ductwork, order mounting adapter PMA-04. For installation of a 430DC-MC or 435DC-MC in flat ductwork, order mounting adapter PMA-06. The mounting adapter consists of a compression fitting welded to a 3"-by-3" steel plate with four corner mounting holes, as shown in Figure 2-5.

Curved probe mounting adapters (CPMA) are also available for curved ductwork. Specify CPMA-04-*radius* (430DC/435DC) or CPMA-06-*radius* (430DC-MC/435DC-MC) where *radius* is replaced by the actual radius of your ductwork.

Figure 2-5. *PMA Mounting Adapter for Duct Installation*



2.5 Installing the Probe

Once you have mounted the compression fitting to the pipe or duct, installing the probe consists simply of inserting the probe to the predetermined depth (see Section 2.3) and tightening the compression fitting to hold the probe in place.

NOTE: The transducer is shipped with a protective rubber cap covering the sensor. Make sure you remove the cap before you install the probe.

2.5.1 Very Low Velocity Installations

The transducer's sensor is exceptionally accurate at flow rates well below those that can be accurately measured by pitot-tube or orifice-plate type instruments. The 430DC and 435DC can accurately measure flows down to 20 SFPM – the equivalent of less than 1/4 mile per hour.

2.5.2 Sensor Alignment

Make sure the probe is rotated such that the sensor window allows unobstructed flow of air over the sensor.

2.5.3 High-Temperature Installations

The 430DC and 435DC, configured with a longer 24-inch probe, is recommended for pipes and ducts up to 24 inches in diameter. In fact, only 12 inches of probe support is required to position the sensor in the center of a 24-inch diameter pipe. The extra 12 inches of probe support is provided to allow space between the pipe or duct and the cannister assembly on the end of the probe support. We recommend that the cannister not be exposed to ambient temperatures above 50° C. That space helps keep the electronics at or below their rated temperature of 70° C, even when the temperature of the flow inside the pipe or duct is substantially higher than 70° C.

If the extra space provided between the outside of the pipe or duct and the cannister assembly is not sufficient to keep the electronics at or below 70° C, the 437 linearizer board must be mounted in a remote enclosure (see Section 4.7).

2.6 Connecting to an 18-24Vdc Input and 0-5Vdc Output

A 15-foot four-conductor cable is included with all configurations of the 430DC and 435DC. The standard configuration of the transducer includes a cannister assembly at the end of the probe to house the 437 circuit board. One end of the cable terminates in a connector that screws onto the end of the cannister assembly. The other end of the cable provides four wires terminated with spade lugs that can be connected to the power supply and to the output device used to monitor the linearized output from the probe. The pin description of the connector and cable is provided in Table 2-3.

Figure 2-6. Connector Pinout on the Cannister Assembly

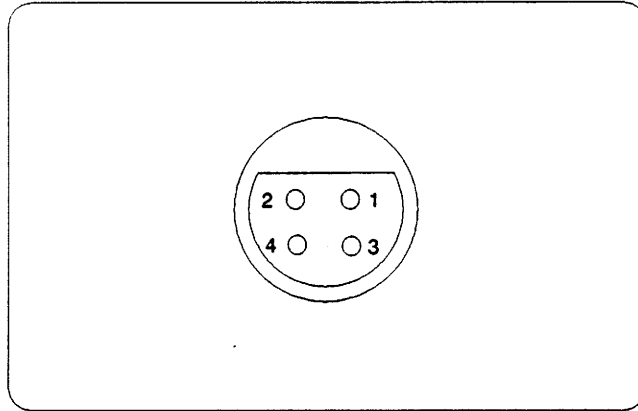


Table 2-3. Pin Description of the Connector on the Cannister Assembly

PIN DESCRIPTION		
Wire Color	Pin No.	Description
Green	1	Power Supply Ground (Gnd)
Red	2	Power In (18-24 Vdc)
White	3	Signal Out, High (5 Vdc or 4-20 mA)
Black	4	Signal Ground (Gnd)

End of Section 2

Section 3: Operation and Maintenance

This section describes the operation and routine maintenance of the Model 430DC and 435DC DC-Powered Air Velocity Transducers.

3.1 Operation

Once you have installed the transducer as described in Section 2, operation is primarily a matter of maintaining the 18-24Vdc power source to the 430DC or 435DC. As long as power is supplied to this unit, the probe is correctly installed in the pipe or duct to be monitored, and all wiring connections are correctly made, the transducer will continue to operate for prolonged periods without intervention.

3.1.1 0-5 Vdc Output

To derive useful data from the operation of the transducer, you can monitor the Signal Out line (0-5 Vdc) connected to Pin 3 of the 4-pin connector at the end of the cannister assembly. When the 15-foot cable supplied with the transducer is attached to the connector on the cannister assembly, the signal is available on the white wire at the end of the cable.

The output from pin 3 of this connector is a non-linear (430DC) or linearized (435DC) 0-5 Vdc signal. Zero Vdc indicates no flow over the sensor; 5 Vdc indicates the maximum measurable flow. The non-linear intermediate voltages output from the 430DC will not be directly proportionate to velocity. These voltages will fall on a curve, closely approximating the curve shown in Figure 1-4 on page 1-7. In comparison, the linear intermediate voltages output from the 435DC do indicate intermediate flows directly proportionate to the voltage of the signal.

You can use the output in a variety of ways:

- Order the transducer with a NEMA enclosure for the 437 electronics board and factory-installed LCD digital panel meter (see Section 4, "Options"). You can then read the output, calibrated in the engineering units of your choice, directly from the NEMA enclosure.
- Order the transducer with the 437 electronics board and LCD display factory-installed in a rack module or order the transducer with a separate rack module for the LCD display.
- Feed the output directly to your own panel meter, voltmeter, chart recorder, or computer. If you choose this option, the transducer and the device receiving its signal should be no more than 50 feet apart.
- Order your 430DC or 435DC with the optional nonisolated 4-20 mA output circuitry installed on the 437 electronics board. If an isolated 4-20 mA output is required, order the Model 132 Isolated 4-20 mA Board with your transducer. See Section 4, "Options" for more information concerning these options. Either of these 4-20 mA options allow for almost unlimited distances between the output signal and a receiving device¹.

3.1.2 Calculating Actual Velocities

For most air-flow monitoring applications, the mass of the flowing gas is the relevant variable. The transducer's sensor was designed with this fact in mind. The sensor accurately registers mass flow at any temperature and pressure. Its output is therefore calibrated in standard units.

Those units are referenced to a standard temperature of 25° C (77° F) and standard atmospheric pressure of 760 mm (29.92 inches) of mercury. A velocity reading obtained for air at a different temperature and/or pressure will not be the actual velocity of that air.

Generally, standard velocity is a much more useful measurement than actual velocity. Sometimes, however, you may want to calculate the **actual** velocity of an airflow whose temperature or pressure differs significantly from the standard temperature and pressure.

¹ The distance is limited only to the extent that the total electrical resistance in the loop must not exceed 800 ohms.

The formula for deriving actual velocity from indicated velocity is given below:

$$V_{act} = V_{ind} \frac{d_s}{d_a}$$

where:

d_s = Standard air density (25° C; 760 mm Hg).

d_a = Actual air density at local temperature and barometric pressure.

V_{act} = Actual air velocity in feet per minute.

V_{ind} = Indicated velocity in standard feet per minute.

Although the intermediate steps are not shown here, by dividing out the known quantities, the formula can be restated as

$$V_{act} = V_{ind} 0.05578 \frac{T_a}{P_a}$$

where

T_a = Actual temperature in degrees Rankine (degrees R = Degrees F + 459.67).

P_a = Actual pressure in inches of mercury.

3.2 Routine Maintenance

The 430DC and 435DC are virtually maintenance free. The only routine maintenance operations required are recalibration and occasional cleaning.

3.2.1 Recalibration

The factory calibration of the 430DC and 435DC remains stable over periods of up to several years. To maintain NBS traceability, however, Kurz Instruments recommends that your transducer be recalibrated annually. You can perform the recalibration yourself or you can return the transducer to Kurz for recalibration. Unless you have an accurate in-house flow-calibration facility, it is probably preferable to return the instrument to Kurz².

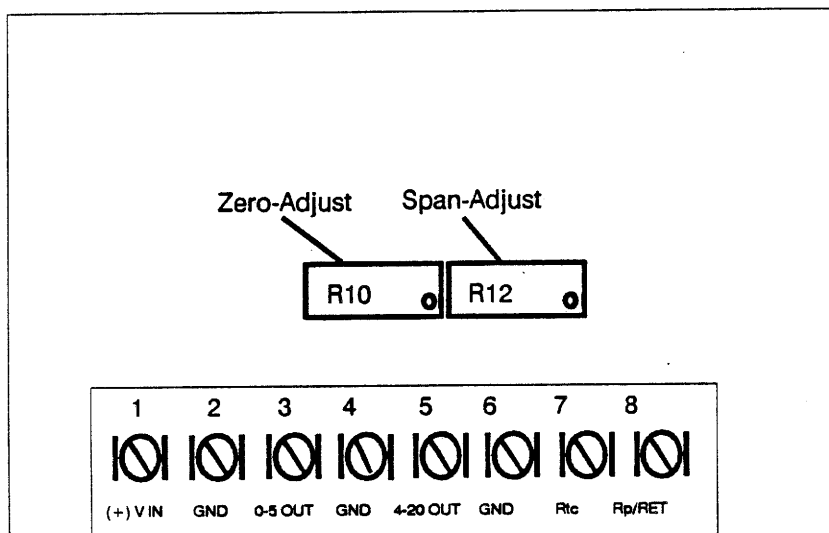
If you do recalibrate the transducer yourself, follow the procedure described below. You will need:

- a digital voltmeter accurate to ± 0.001 Vdc
- a flat-bladed screwdriver with a narrow blade and a long shaft

The velocity calibration procedure consists of inserting the sensor³ in a flow of known velocity and adjusting the zero and span potentiometers (R10 and R12, respectively) on the 437 circuit board. Figure 3-1 shows their locations.

- ² If your transducer requires recalibration while still under warranty, you should return it to Kurz Instruments. Kurz will not perform a free recalibration under warranty if you have already made adjustments to zero or span controls.
- ³ If possible, perform the recalibration with the sensor in an upright position. The factory calibration is performed with the sensor in this position. Any other position may result in a slightly inaccurate zero reading because the heating effect of the velocity sensor changes slightly as its orientation changes.

Figure 3-1. 437 Electronics Board: Zero and Span Potentiometers



Step 1: Set the flow velocity to 0 SFPM.

Step 2: Check the voltage between Terminal Screw 3 (linear output) and Terminal Screw 4 (ground). If necessary, adjust the zero-control potentiometer up or down until you get a reading of zero volts.

NOTE: You should check for zero voltage either immediately after powering the transducer or after first running flow past the sensor and then returning to zero flow. This is necessary because, after several minutes at zero flow in a small air volume, the heat produced by the velocity sensor (R_p) begins to affect the ambient temperature sensor (R_{tc}).

Step 3: Set the flow velocity to the maximum for which your transducer is calibrated⁴.

⁴ Remember, the 430DC and 435DC is calibrated in standard units, not actual units. Therefore, if the airflow you use to perform the recalibration is not at the standard reference temperature of 25° C (77° F) or the standard reference pressure of 760 mm (29.92 in) Hg, you will have to adjust the actual flow rate used in recalibration to equal the desired standard flow rate. To do so, use the formula given at 3.1.2

Step 4: If necessary, adjust the span-control potentiometer up or down until the voltage between terminal screws 3 and 4 is five volts.

If either zero or span cannot be adjusted to its proper value using the zero-control and span-control potentiometers, the zero and span circuit on the 437 board requires factory adjustment – contact Kurz Instruments.

3.2.2 Cleaning the Sensor

The transducer's sensor is far more resistant to particulate contamination than pitot tube or orifice plate sensors. Nevertheless, the 430DC and 435DC perform best when they're kept relatively free of contamination. You should therefore remove the probe and check the sensor at regular intervals, cleaning it if necessary.

The dirtier the flow being measured, the more frequently the sensor should be checked. In relatively clean flows it may be sufficient to check and clean the sensor annually while the probe is removed for recalibration. In very dirty flows a much shorter interval may be appropriate⁵. If you are measuring a dirty flow, you should probably begin by checking the sensor at short intervals. You can then move to longer intervals if the sensor is not becoming heavily loaded between checks.

When the sensor does need to be cleaned, use a fine wire brush, crocus cloth, or fine grit emery cloth to remove built-up contamination from the sensor. Clean the sensor only when power is off.

End of Section 3

⁵ If your application requires the monitoring of very dirty flows, Kurz Instruments recommends that you use the 455 Industrial Air Velocity Transducer rather than the 430DC or 435DC.

Section 4: Options

This section lists and describes some of the more popular options available with the Model 435DC DC-Powered Linear Air Velocity Transducer. The options discussed in this section are

- Specialty Gas Calibrations
- 4-20 mA Output
- Custom Probe Lengths
- HT High Temperature Sensor
- Coated Sensors
- Rack-Module Electronics Packaging
- NEMA Enclosures
- Unmounted 437 Electronics Board
- 110 Vac/50-60 Hz or 220 Vac/50 Hz Power Supply
- LCD Digital Display
- Optional Engineering Units
- Dual Alarm
- Totalizer
- Sensor Safety Circuit

Other custom options may be available. Contact Kurz Instruments if you have special needs not covered by the options described in this section.

4.1 Specialty Gas Calibrations

Standard 430DC and 435DC calibration is for air at 25° C (77° F) and 760 mm (29.92 in) of mercury.

You can order your transducer calibrated for a gas (or gas mixture) other than air. When you order a specialty gas calibration, you specify the reference temperature and pressure as well as gas mixture by weight or volume, in accordance with your application. Calibrations available include those listed below. For information on the availability of calibrations for gases other than those listed, contact Kurz Instruments.

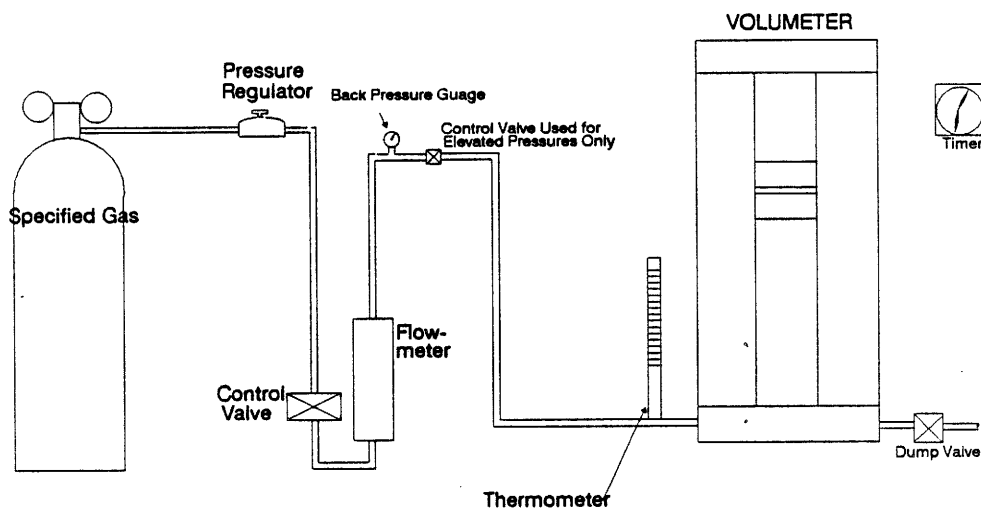
- Flue Mixtures
- Argon (Ar)
- Carbon Dioxide (CO₂)
- Carbon Monoxide (CO)
- Helium (He)
- Hydrogen (H₂)
- Nitrogen (N₂)
- Oxygen (O₂)

Specialty gas calibrations are performed for Kurz Instruments by an independent calibration laboratory. The transducer is calibrated in a flow of the specified gas at eleven data points evenly spaced between zero and maximum rated flow. An NBS-traceable certification is furnished for each instrument so calibrated. The accuracy of specialty gas calibrations is the same as that for air: +/- 2% of full scale for the 430DC, +/- 3% of full scale for the 435DC.

The calibration laboratory uses volume provers and other NBS traceable equipment for flowmeter calibration. A flow of the specified gas is directed into the calibrated prover for a precisely timed period. The volume of gas in the prover is then determined. The provers are calibrated to an accuracy of one part in 2,000, an accuracy of 0.1%.

The calibration procedure is diagramed in general terms in Figure 4-1.

Figure 4-1. *Specialty Gas Calibration*



4.2 4-20 mA Output

Standard 430DC output is a non-linear 0-5 Vdc signal. Standard 435DC output is a linear 0-5 Vdc signal.

Optional 4-20 milliamp (mA) output is available in both non-isolated and isolated versions. 4-20 mA output is appropriate when the distance between the transducer and a device receiving the output signal is such that a significant voltage drop would occur in the standard 0-5 Vdc signal. 4-20 mA output is unaffected by distance, as long as the total resistance in the loop is less than 800 ohms.

4.2.1 Non-Isolated

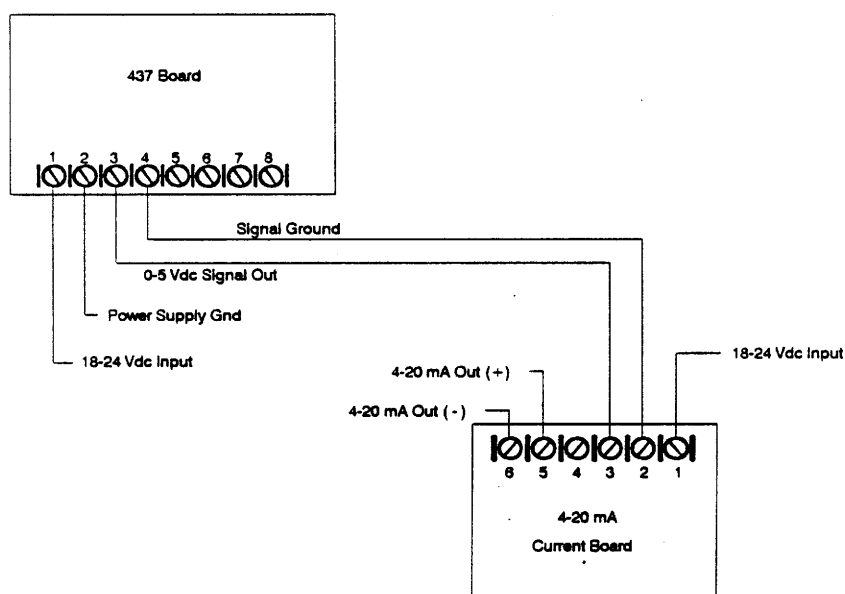
Non-isolated 4-20 mA output is appropriate when there is no need to isolate the electronics of the receiving device from the electronics of the 437 circuit board. When 4-20 mA output is non-isolated, the optional 4-20 mA circuit on the 437 board shares the electrical ground of the entire 430DC or 435DC provided by the ground signal of the power supply.

The circuitry for the non-isolated 4-20 mA circuitry is provided on the 437 board. When the 437 is configured to provide the 4-20 mA output, the 0-5 Vdc output is disabled.

When a non-isolated 4-20 mA output is required in addition to the 0-5 Vdc signal, the optional Model 131 non-isolated 4-20 mA current board can be installed. In this configuration, the 430DC or 435DC should be ordered with the 437 electronics board placed in a NEMA-type enclosure or rack module (-N or -RM configurations).

The 131 board is mounted on standoffs beside the 437 board and connected to the 0-5 Vdc and signal ground lines on the 437 board. An 18-24 Vdc input should be provided on terminal 1 of the 131 board. These connections are shown in Figure 4-2.

Figure 4-2. 4-20 mA Current Board Connections



NOTE: Except for providing a 18-24 Vdc power source to the 4-20 mA boards via terminal 1, Kurz Instruments 4-20 mA output modules are self-powered. Do not supply your own current to the 4-20 mA output loop.

4.2.2 Isolated

Isolated 4-20 mA output is appropriate when it is necessary to isolate the electronics of the receiving device from the electronics of the 437 board. Isolated 4-20 mA output is available using the Model 132 4-20 mA current board. In this configuration, the 430DC or 435DC should be ordered with the 437 electronics board placed in a NEMA-type enclosure or rack module (-N or -RM configurations).

The Model 132 isolated 4-20 mA current board is mounted on standoffs beside the 437 board and connected to the 0-5 Vdc and signal ground lines on the 437 board. An 18-24 Vdc input should be provided on terminal 1 of the 131 board. These connections are shown in Figure 4-2

4.3 Custom Probe Lengths

The standard probe length for the 430DC and 435DC is 12". Other lengths from 3" to 48" are optionally available.

If you believe you require a probe more than 48 inches long, you should consider moving up to a multi-point, multi-sensor velocity averaging array such as the Kurz EVA 4000 or EVA 4100.

4.4 HT High Temperature Sensor

The standard 430DC and 435DC sensor is rated for temperatures from 0° C to +125° C.

The optional HT high temperature sensor is rated from 0° C to +250° C.

4.5 Coated Sensors

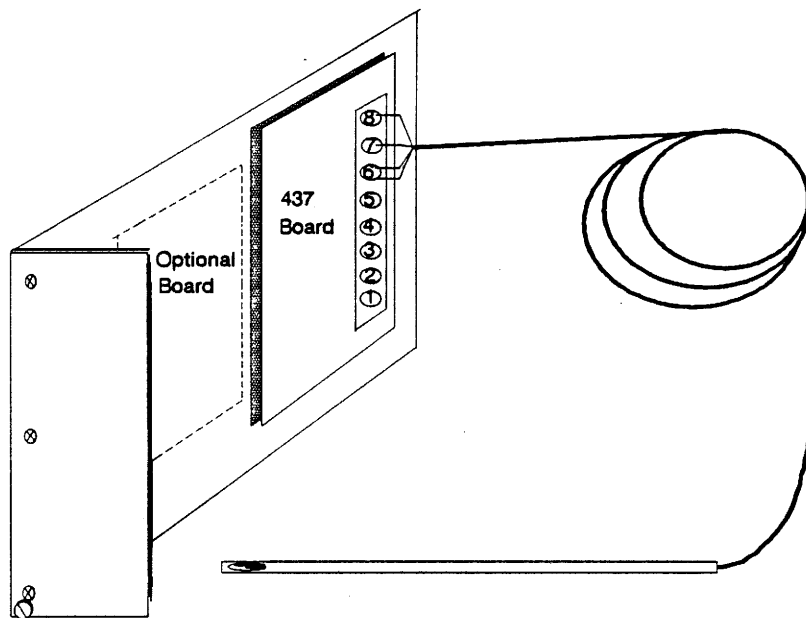
The Duraflo and mini MetalClad sensors can be coated to provide additional resistance to corrosive gases and contaminants. The type of coating that is applied to the sensors will be dependent on the type of gas flow. Epoxy and teflon coatings are two of the most popular options.

The transducer sensors are highly resistant to particulate contamination. For particularly dirty flows containing resinous or sticky materials, however, you may wish to order the special teflon-coated sensor. The teflon-coated sensor generally allows longer intervals between cleanings and is more easily cleaned if it does become heavily loaded with contaminants.

4.6 Rack-Module Electronics Packaging (435DC-RM)

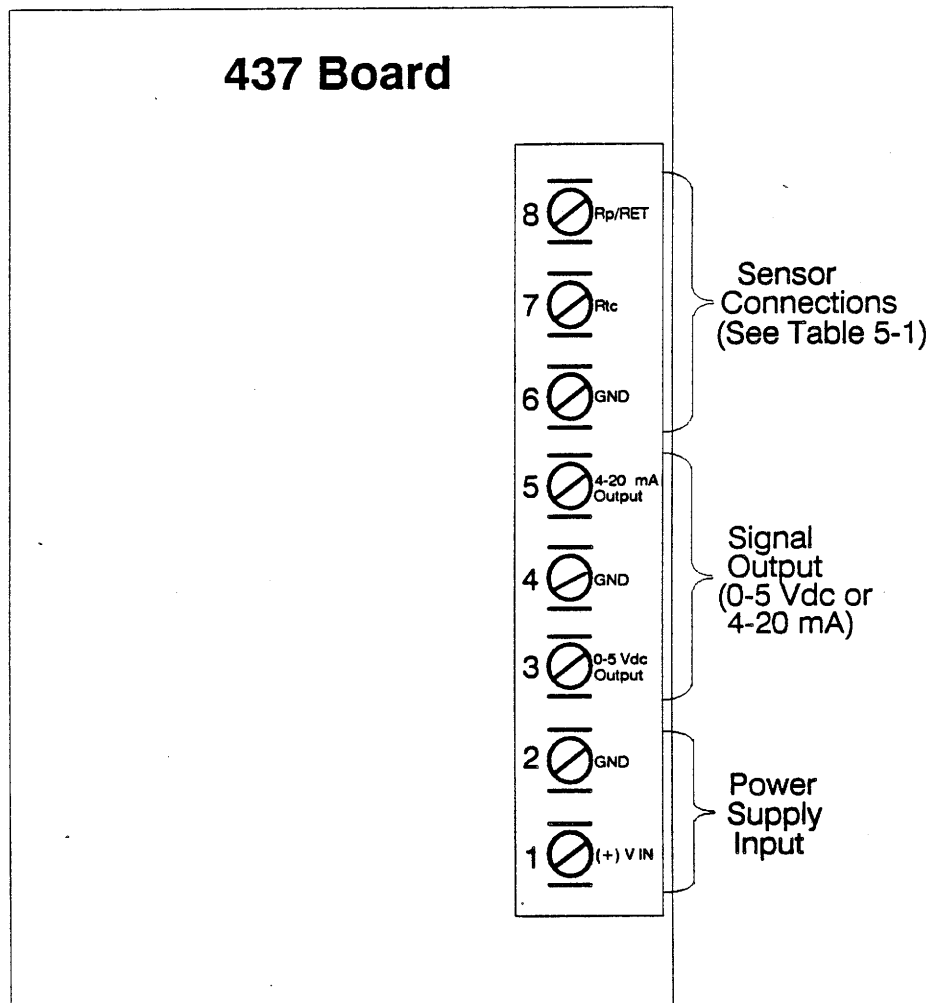
The 437 electronics board is provided in a rack module if you purchased the 430DC-RM or 435DC-RM. The 437 board is mounted on the baseboard of a 1.4"-wide (1/12) rack module, as shown in Figure 4-3. Other optional boards may also be mounted on the baseboard and connected to the 437 board.

Figure 4-3. *430DC/435DC-RM (With 437 Electronics Board Mounted in a Rack Module)*



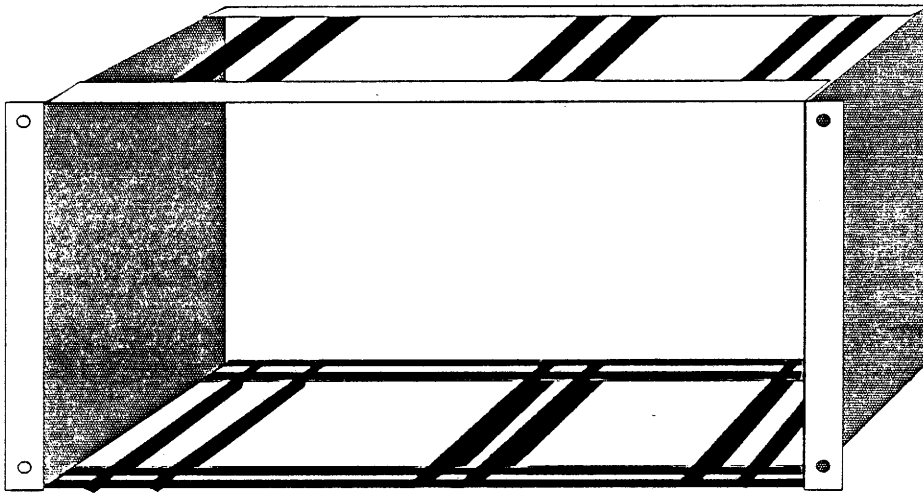
The 15-foot conductor cable connects directly to the 437 board the 430DC-RM or 435DC-RM probe at the back of the rack module. To install the transducer connect the power supply input and ground lines to the terminal screws on the 437 board as shown in Figure 4-4. The 0-5 Vdc output and signal ground lines are also available at the terminal strip.

Figure 4-4. Terminal Strip on the 437 Board



You can mount the 430DC-RM or 435DC-RM in your own standard 19"-wide rack chassis, or you can order the Model 2015 rack chassis, shown in Figure 4-5, from Kurz Instruments. The 2015 rack chassis houses up to twelve 1.4" 430DC/435DC-RM or nine of these rack modules and one 4.2" Multichannel Display (see section 4-11). The 19" rack chassis can be placed in a bench enclosure when the unit requires testing or service.

Figure 4-5. *Model 2015 Rack Chassis*



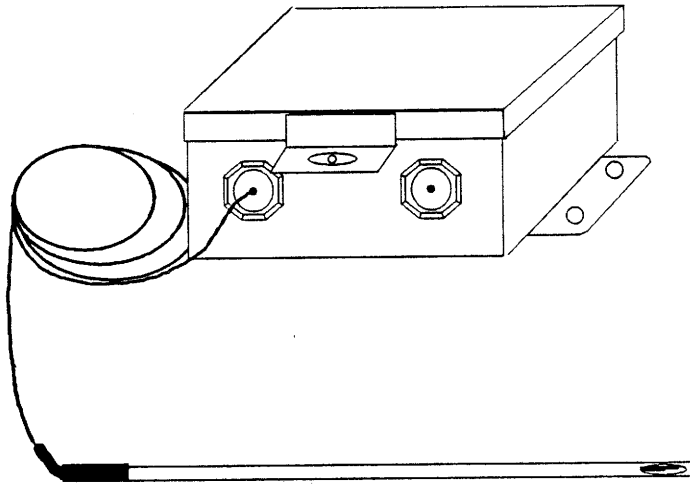
4.7 NEMA Enclosures (430DC/435DC-N1 or 430DC/435DC-N4)

If you ordered the 430DC/435DC-N1, the 437 board is housed in a NEMA 1 painted steel enclosure. NEMA 1 enclosures are intended for indoor use primarily to provide protection against contact with the enclosed equipment and protect the enclosed electronics against a limited amount of falling dirt.

If you ordered the 430DC/435DC-N4, the 437 board is housed in a NEMA 4 painted steel enclosure. The more rugged NEMA 4 enclosures can be used inside or outside and provide protection against wind-blown dust and rain, splashing water, and hose-directed water. NEMA 4 enclosures also remain undamaged by the formation of ice on the enclosure.

The probe cable is interfaced to the 437 board through a connector on the front of the NEMA enclosure as illustrated in Figure 4-6. Another connector is available to provide the required power and ground inputs to the 437 board and to connect the 0-5 Vdc linear output signal and ground to the receiving device. Refer to Figure 4-4, on the previous page, for the location of the terminal connections on the 437 board.

Figure 4-6. Model 430DC/435DC-N1 in a NEMA 1 Enclosure



4.8 Unmounted 437 Electronics Board (430DC/435DC-PC)

If you purchased the 430DC-PC or 435DC-PC, you can mount the 437 electronics board in your own enclosure. The transducer comes with the probe, a 15-foot four-conductor cable, and the 437 electronics board (without enclosure). Figure 4-4, on page 4-7, shows the locations of the terminal screws for connecting the power supply's 18-24 Vdc and ground lines to the 437 board and to connect the 0-5 Vdc output signal and ground to a receiving device.

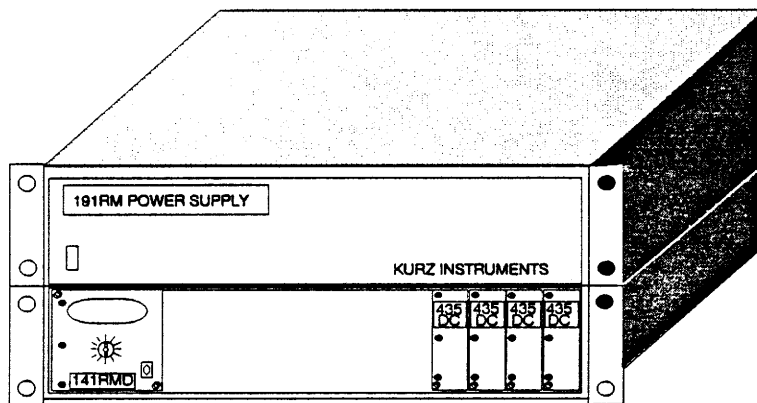
Refer to the 437 PCB assembly drawing included in Appendix A for exact locations of the four mounting holes on the 437 board.

4.9 Power Supplies

A 18-24 Vdc power source and power supply ground must be supplied to the 435DC's 437 electronics board. The 18-24 Vdc and ground can be supplied through the cable attached to the cannister assembly on the transducer, or directly to the 437 board itself when it is installed a rack module (430DC/435DC-RM), NEMA 1 enclosure (430DC/435DC-N1), or custom enclosure (430DC/435DC-PC).

The 191RM-6 (0.6 Amp), 191RM-2.4 (2.4 Amp), 191RM-4.8 (4.8 Amp) and 191RM-12 (12 Amp) rack mount power supplies are available in 115V/50-60 Hz or 220V/50 Hz configurations to provide the 18-24 Vdc input to the transducer. Figure 4-7 shows a possible configuration of a system using multiple 435DC Transducers, a 141RMD Multichannel LCD Display, and a rack mount 191RM power supply.

Figure 4-7. 191RM Power Supply, 141RMD Multichannel LCD Display, and Multiple 435DC-RM Transducers Configured in two 19" Rack Chassis



4.10 141RMD Multichannel LCD Digital Display

The standard 0-5 Vdc output of up to twelve transducers can be connected to the 141RMD Multichannel LCD Display. The 141RMD is a 4.2" rack module that displays the flow rate of the selected transducer (one of twelve) in Standard Feet Per Minute (SFPM) or other optionally selected units.

4.11 Optional Engineering Units

The standard units of measurement displayed on the panel meters of transducers so equipped are Standard Feet Per Minute (SFPM). Readouts in other units of measurement are optionally available. Some of the more common units of measurement available are listed below.

If you prefer a unit not listed, contact Kurz Instruments for more information.

- Standard Cubic Feet per Minute per square foot (SCFM/ft²).
- Pounds Mass per Minute per square foot.
- Standard Cubic Feet per Minute (SCFM). SCFM, unlike SCFM/ft², is a direct measure of the mass of air flowing through your pipe or duct. If you want a readout in SCFM you must supply Kurz with the exact cross-sectional area (in square feet) of your pipe or duct at the point where the transducer will be permanently mounted.
- Pounds per Minute (lbs/min). Again, this is a direct measure of the mass of air flowing through your pipe or duct. If you want a readout in lbs/min you must supply Kurz with the exact cross-sectional area (in square feet) of your pipe or duct at the point where the transducer will be permanently mounted.
- Standard Meters per Second (SMPS)

4.12 Dual Alarm

The Model 111R1 dual alarm board allows you to activate an audible alarm or other device of your choice based on the velocity sensed by the transducer. The board provides two relays, one of which is activated when velocity drops below a specified minimum, and one of which is activated when velocity exceeds a specified maximum. You set both maximum and minimum values by adjusting potentiometers on the 111R1 printed circuit board. You could, for example, specify that the low alarm relay be activated when velocity falls below 10% of full range, and that the high alarm relay be activated when velocity exceeds 90% of full range.

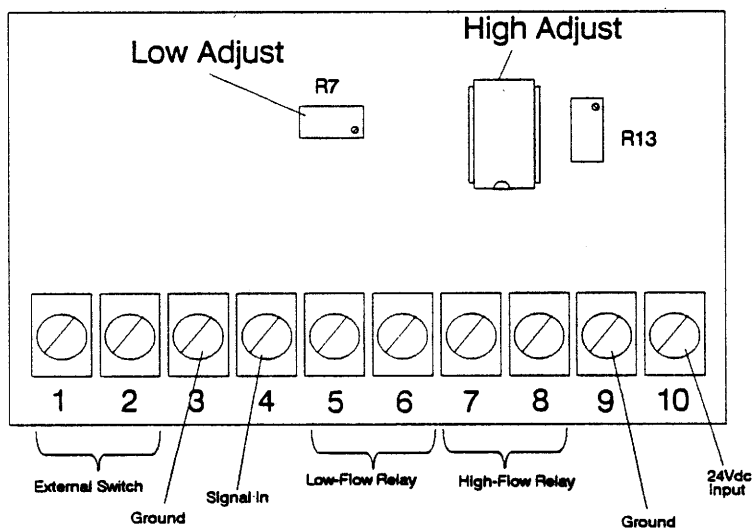
As shipped, the low alarm relay is activated when the velocity falls below 20% of the full range and the high alarm relay is activated when the flow velocity exceeds 80% of the full range.

The low-adjust and high-adjust potentiometers are shown in Figure 4-8, as are the terminal screws used to connect the 111R1 board to other devices.

To set the low alarm value, you must, with the 111R1 board properly connected, run a flow whose velocity represents the desired low alarm limit past the transducer's sensor. You then adjust the low-adjust potentiometer until the low-flow relay closes.

To set the high alarm value, run a flow at the desired high alarm limit past the sensor and adjust the high-adjust potentiometer until the high-flow relay closes.

Figure 4-8. Model 111R1 Dual Alarm Board



4.13 Totalizer

The optional Model 101 Totalizer counts and records the total units of flow that have passed the sensor. The totalizer is available calibrated in any of the engineering units discussed above at 4.11. The totalizer is available in resettable and nonresettable versions.

4.14 Sensor Safety Circuit

The optional sensor safety circuit on the 437 board limits the temperature that the velocity sensor can reach in the unlikely event of a serious failure. The sensor safety circuit employs a ballast-resistor/zener combination to limit the amount of power supplied to the sensor. You must specify the gas in which you intend to use the sensor – the calibration of the safety circuit is gas specific. It is strongly recommended that you select this option if your transducer will be used to monitor the flow of explosive gases.

NOTE: Even with the sensor safety circuit installed, the sensor normally operates at an overheat of approximately 100° F above the ambient temperature of the gas flow it is monitoring. It is the user's responsibility to ensure that the ambient temperature of an explosive gas flow is kept substantially **BELOW** the ignition temperature of the gas. Contact Kurz Instruments if you need further information about using the 430DC or 435DC in explosive gas flows.

End of Section 4

Section 5: Testing

This section describes some of the bench testing procedures you can perform on the Model 430DC and 435DC. You may want to perform these tests before you install the transducer and/or at regular intervals thereafter to verify that the unit is functioning properly.

NOTE: Any warranty service to be performed at the customer's site must be previously approved in writing by Kurz Instruments. Nonwarranty service should be performed only by a certified electrical technician. Refer to Appendix A for component layouts and schematics.

Before you perform the test, check to make sure that the following conditions are met:

- The 437 electronics board is properly wired to a power supply. The 18-24 Vdc input should be wired to terminal screw 1 and power supply ground should be wired to terminal screw 2 (refer to Figure 4-4 on page 4-7). The power supply should be turned on only after all connections have been checked.
- The wires from the sensor are correctly connected to the terminal strip of the 437 (refer to Figure 4-4 on page 4-7 and Table 5-1). The wires from the sensor are normally connected before shipment but should be checked for this test. The colors of the sensor wires vary, depending on the kind of wire or cable used – Refer to Table 5-1. With the standard cable the sensor cable's metal shield serves as a conductor and should be connected to ground.
- No flow is moving past the sensor.

Table 5-1. *Sensor Cable Wire Colors and Terminal Connections*

Signal	Color			Terminal
	Wire	Standard Cable	HT or Tefzel Cable	
R _{tc}	White	Black	White/Blue	7
R _p	Red	Red	White/Orange	8
R _{tc} GND	White	White	White	6
R _p GND	Red	<i>Shield</i>	White/Green	6
Shield	-	-	<i>Shield</i>	*

* Shield is used when the 437 electronics is not in the cannister. The shield is connected to earth ground in the electronics enclosure. The circuit ground used on the 437 board (i.e. R_{tc} GND, R_p GND, and GND) is not connected to any other ground.

5.1 Power-On Voltage Test

The following procedure will verify operation of the major functional circuits on the 437 electronics board used in the 430DC and 435DC. To perform the power-on voltage test, you will need a digital voltage meter accurate to within +/-0.001 Vdc.

The test consists of checking the voltage between DC ground (Terminal Screw 2) and each of the points listed below. The correct voltage for each point is listed below. The points are called out in Figure 5-1 on page 5-4.

Step1: Check the bridge voltage: 3.5 Vdc +/- 2.5%.

Check the voltage between ground (terminal screw 2) and the junction of zener diode D5 and resistor R2. This is the bridge voltage and should read 3.5 Vdc +/- 2.5% (this is the nominal reading; refer to your calibration certificate for the exact rated voltage of your unit).

CAUTION: If the bridge voltage is +5 Vdc or more (with no flow moving past the sensor), and does not start to drop below five volts within five to ten seconds, turn power off **immediately**. Supplying power for more than five to ten seconds under these conditions may result in damage to the probe.

Step 2: Check the + 15 Vdc voltage supply: + 15 Vdc +/- 3%

Check the voltage between ground and right leg of capacitor C3 (or pin 4 of U1, U2, or U3). This is the + 15 Vdc supply voltage and should read + 15 Vdc, +/- 3%. This voltage is used to generate the -9 Vdc supply which is used to generate the -5 Vdc reference voltage. The + 15 Vdc supply is also used in the zero and span circuit, in the linearization circuit (435DC only), and for the voltage to current conversion when the 4-20 mA option is installed.

Step 3: Check the -9 Vdc voltage supply: -9 Vdc +/- 3%

Check the voltage between ground and the left leg of R16 (or pin 11 of U1, U2, or U3). This is the -9 Vdc voltage and should read -9 Vdc +/- 3%. This voltage is used to generate the -5 Vdc reference voltage. It is also used in the zero and span circuit as well as the linearization circuit (435DC only) on the 437.

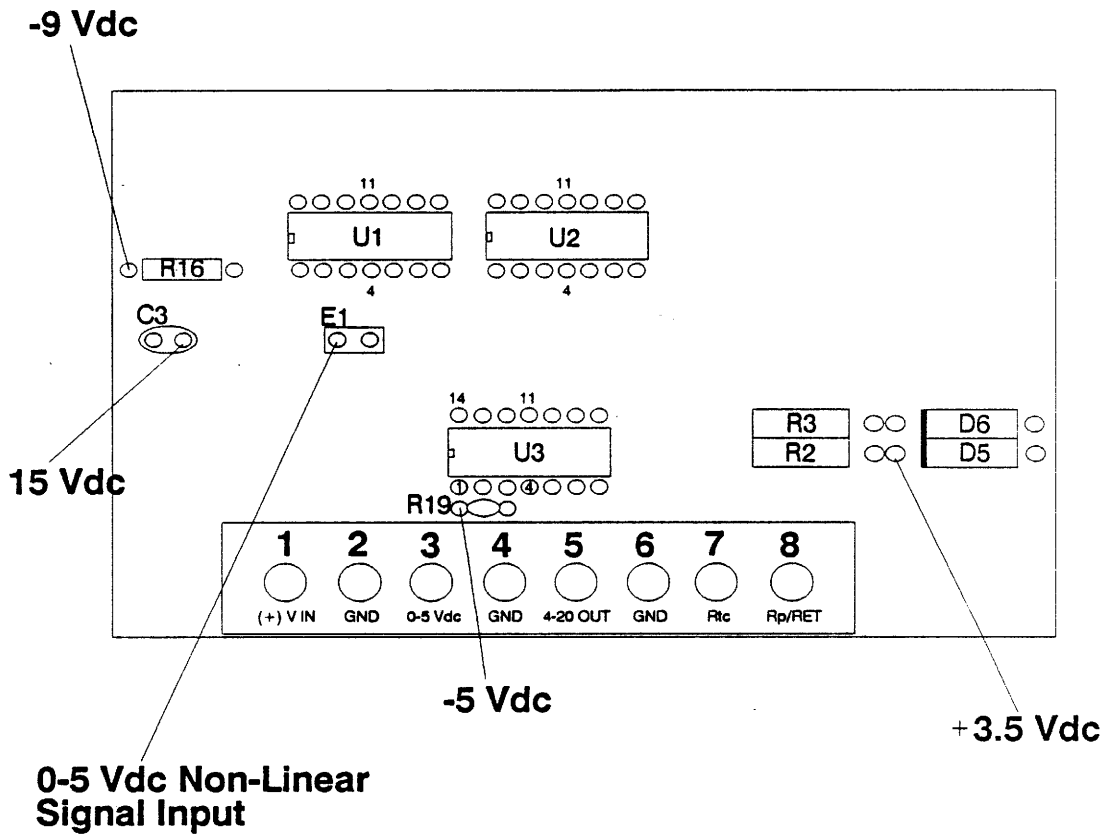
Step 4: Check the -5 Vdc reference voltage supply: -5 Vdc +/- .01%

Check the voltage between ground and the left leg of R19 (or pin 1 of U3). This is the -5 Vdc reference voltage and should read -5 Vdc +/- .01%. This voltage is used in the zero and span circuit as well as the linearization circuit (435DC only) on the 437.

Step 5: Check the non-linear signal: 0-5 Vdc +/- .025 Vdc at zero; +/- .125 at full span.

Check the voltage between ground and either leg of jumper E1 (or pin 14 of U3). This tests the zero and span circuitry (as long as the other voltages are correct). This voltage is then linearized (435DC only) to provide the 0-5 Vdc or 4-20 mA linear output.

Figure 5-1. 437 Electronics Board Test Points



End of Section 5

Appendix A: Component Layout Drawings

This appendix contains components layout drawings for the Model 430DC/435DC transducer and its components. These drawings are included as an aid to those users who want to perform their own testing and servicing as described in the manual.

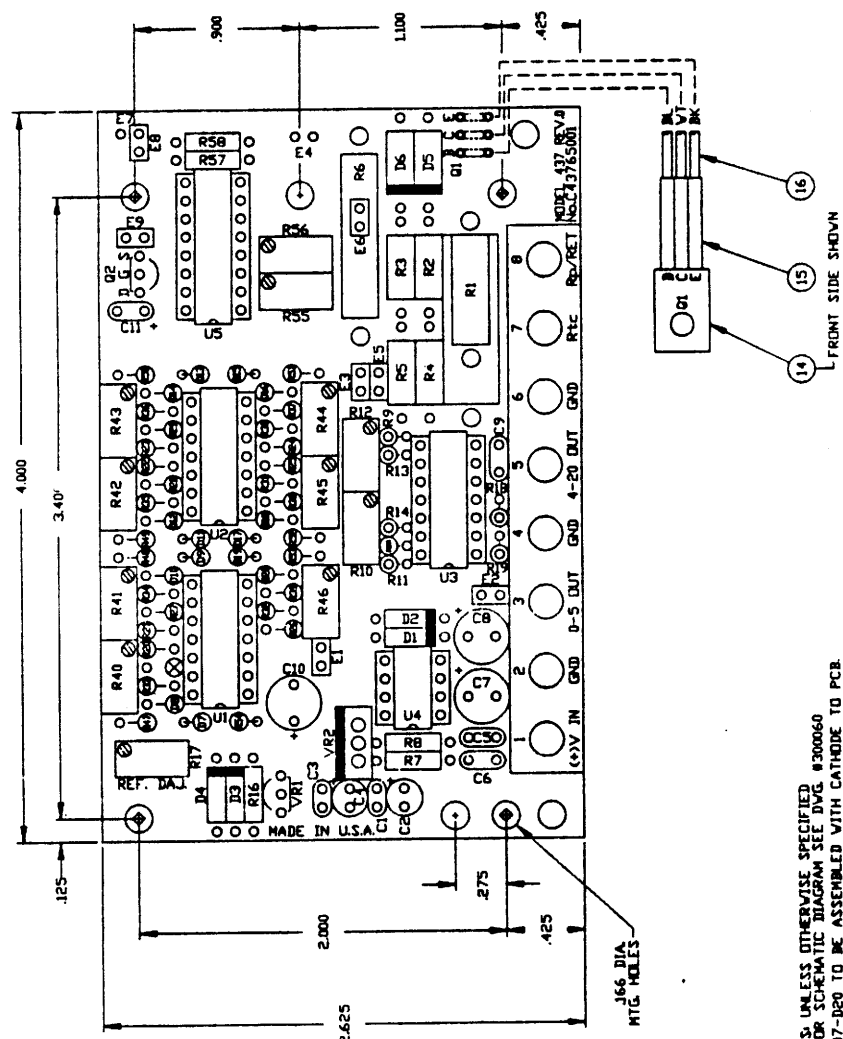
NOTE: If you want to perform your own warranty service, you must first obtain written authorization from Kurz Instruments.

Unauthorized service performed during the warranty period voids your warranty. Please read the warranty statement at the front of this guide before performing any service.

The following drawings are included in this appendix:

Drawing No.	Description
420123, Rev A	Model 437 PCB Component Layout
B50030, Rev B	Model 430/435/560/565 Flow Body Cover Detail
C43070001, Rev A	Model 430/435DC Linear Air Velocity Transducer One Piece Package Assembly
420006, Rev B	Model 132 PCB Component Layout
420099, Rev B	Model 111R1 Dual Alarm Component Layout
420001, Rev B	Model 101 Totalizer Component Layout

JUMPER	DESCRIPTION
E1	CLOSE FOR LINEAR OUTPUT @ TERM. #3 (-02)
E2	CLOSE FOR NON-LIN OUTPUT @ TERM. #3 (-01)
E3	CLOSE FOR VOLTAGE MODE
E4, E5	CLOSE FOR CURRENT MODE. (-RET. IN @ TERM. #8)
E6	CLOSE IF TEMP. LIMITING CIRCUIT (SAFETY) NOT REQ'D
E7, E9	CLOSE FOR 0-20mA NON-ISO OUTPUT @ TERM. #5
E8	CLOSE FOR 4-20mA NON-ISO OUTPUT @ TERM. #5.

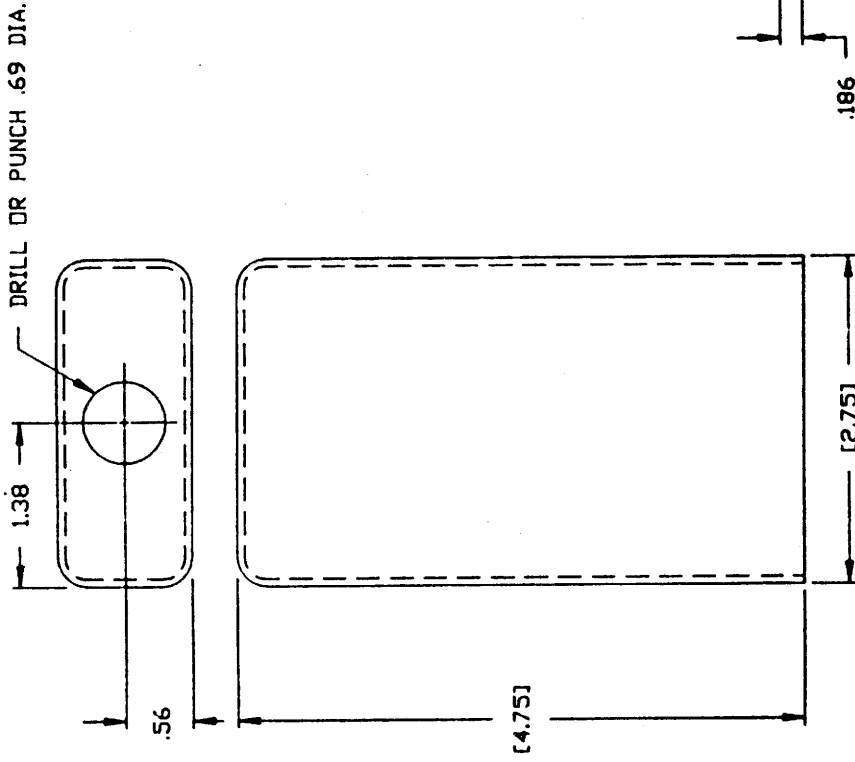


- NOTES: UNLESS OTHERWISE SPECIFIED
 1. FOR SCHEMATIC DIAGRAM SEE DWG. #300060
 2. D7-D20 TO BE ASSEMBLED WITH CATHODE TO PCB.
 3. PLUGS/DIPS TO BE ASSEMBLED WITH 1/8"x1/16" FROM PCB.
 4. HEADS TO BE ASSEMBLED FOR TEMP. LIMITING (SAFETY PURPOSES) ONLY.
 5. CUT OFF LEADS TO 5/16"x1/16" BEFORE SOLDERING TO WIRES.
 6. FOR OEM CUSTOMERS KURZ WILL PROVIDE A HEATSINK ATTACHED TO O1 CUSTOMER TO MOUNT TRANSISTOR AND HEATSINK ONTO CUSTOMER'S SYSTEM.
 7. FOR CURRENT MODE OPTION REMOVE R2-R5, C9, O1 AND USE R1 AS CURRENT SENSE RESISTOR.

PART NO.	DESCRIPTION
-01	NON-LINEAR CIRCUIT
-02	L. LINEAR CIRCUIT

APPROVALS	DATE
DESIGNED BY B. SAXON	9-4-88
CHECKED BY B. SAXON	9-4-88
APPROVED BY J/A	9-4-88
REWORKED BY J/A	9-4-88
MARKED BY J/A	9-4-88

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REVISIONS		DATE	BY	DESCRIPTION
1	REVISED PER ECO # A56547003	6.2.88	SM	
2		6.2.88	SM	
3		6.2.88	SM	
4		6.2.88	SM	

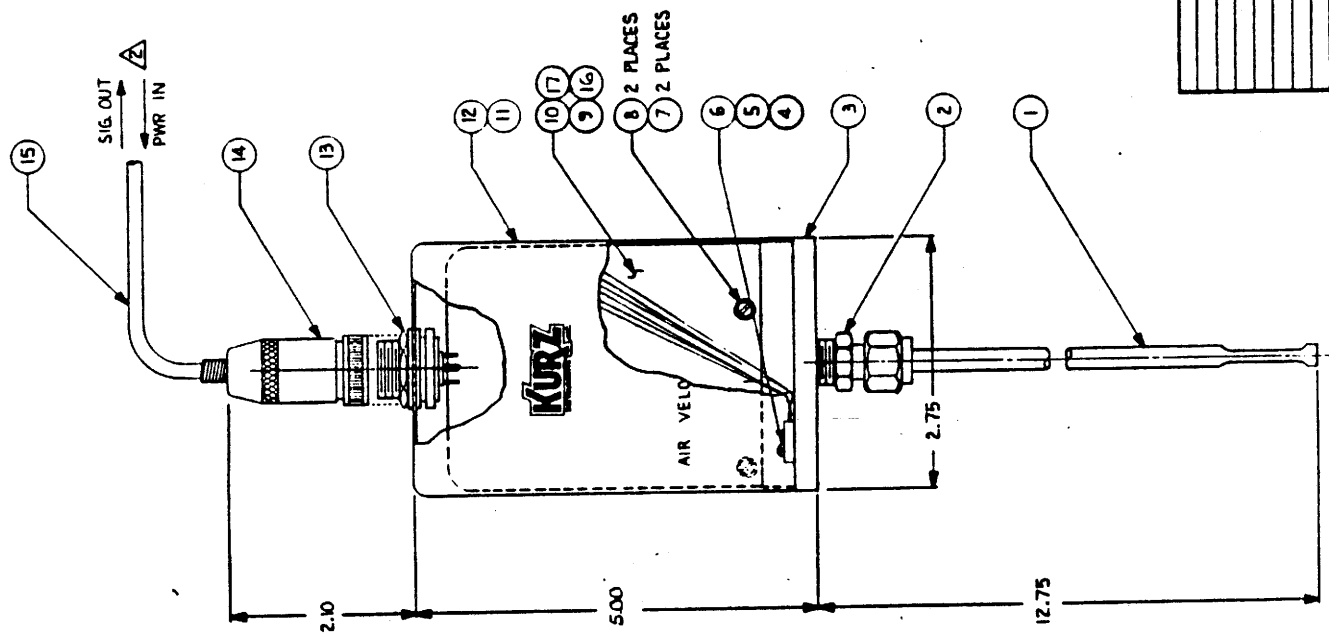
KURZ INSTRUMENTS INC.		TITLE	
MODEL 430/435/560/565		FLOW BODY COVER DETAIL	
DATE	6-2-88	DATE	6-2-88
BY	SM	BY	SM
CHECKED	SM	DATE	6-6-88
DATE	6-2-88	DATE	6-6-88
BY	SM	DATE	6-6-88
BY	SM	DATE	6-6-88
DATE	6-2-88	DATE	6-6-88
BY	SM	DATE	6-6-88
DATE	6-2-88	DATE	6-6-88
BY	SM	DATE	6-6-88

- NOTES:
- MAT'L: MODIFY FROM ZERO MFG. CO. PRODUCT #Z18-44A
 - FINISH: PAINT COLOR OFF-WHITE #27778 (FED-STD 595A) OR EQUIV.

REV	DESCRIPTION	DATE	BY	CHKD	APP'D
A	REVISED PER ECD No. A 56547009	6-10-88	JLD	N/A	6/7/88

WIRE COLOR	PIN	FUNCTION
BLACK	1 & 4	GND
RED	2	+15V
WHITE	3	LIN. OUT
	5	+20mA D.T.

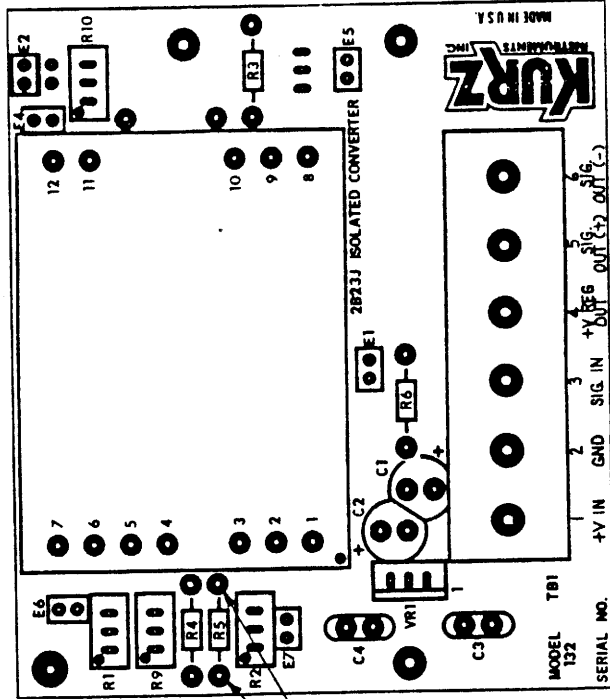
PART NO.	DESCRIPTION
-001	MODEL 430 DC ASSY
-002	MODEL 435 DC ASSY
-003	430 DC WITH +200UT
-004	435 DC WITH +200UT



NOTES: UNLESS OTHERWISE SPECIFIED
 1. WEIGHT APPROXIMATELY 2 LBS.
 2. SEE WIRE CONNECTION TABLE.

APPROVALS		DATE	
By		7-15-87	
By		7-17-87	
By	N/A		
By		7-17-87	
By	N/A		
TITLE		MODEL 430 / 435 DC LINEAR AIR VELOCITY TRANSDUCER ONE PIECE PACKAGE ASSEMBLY	
SCALE	NONE	SHEET	1 OF 1
PART NO.	C43070001	REV.	A

NOTES: UNLESS OTHERWISE SPECIFIED
 1. THIS DRAWING TO BE USED IN CONJUNCTION WITH SCHEMATIC DIAGRAM 300003
 FOR OPTION 4-20 mA IN, 4-20 mA OUT ADD A WIRE JUMPER BETWEEN PADS.
 2. MICRO JUMPER SHALL BE USED AS REQUIRED.



ALL COMPONENTS SHOWN INSTALLED

JUMPER CONFIGURATION	INSTALL
0-5 VDC IN 0-20 mA	E2-E5
0-5 VDC IN 4-20 mA (I/T)	E4-E5
4-20 mA IN 4-20 mA (I/T)	E1-E2-E5-E6

REV	DESCRIPTION	DATE	BY	CHKD	DATE	BY	APPROVED	DATE	BY
A	REVISED DELETED 4-20 mA IN, 0-5 VDC OUT OPTION	2/6/86	J.C.	D.T.	11/23/86				
B	REVISED PER ECO No R13247005	6-17-86	K.D.	K.D.	11/23/86				

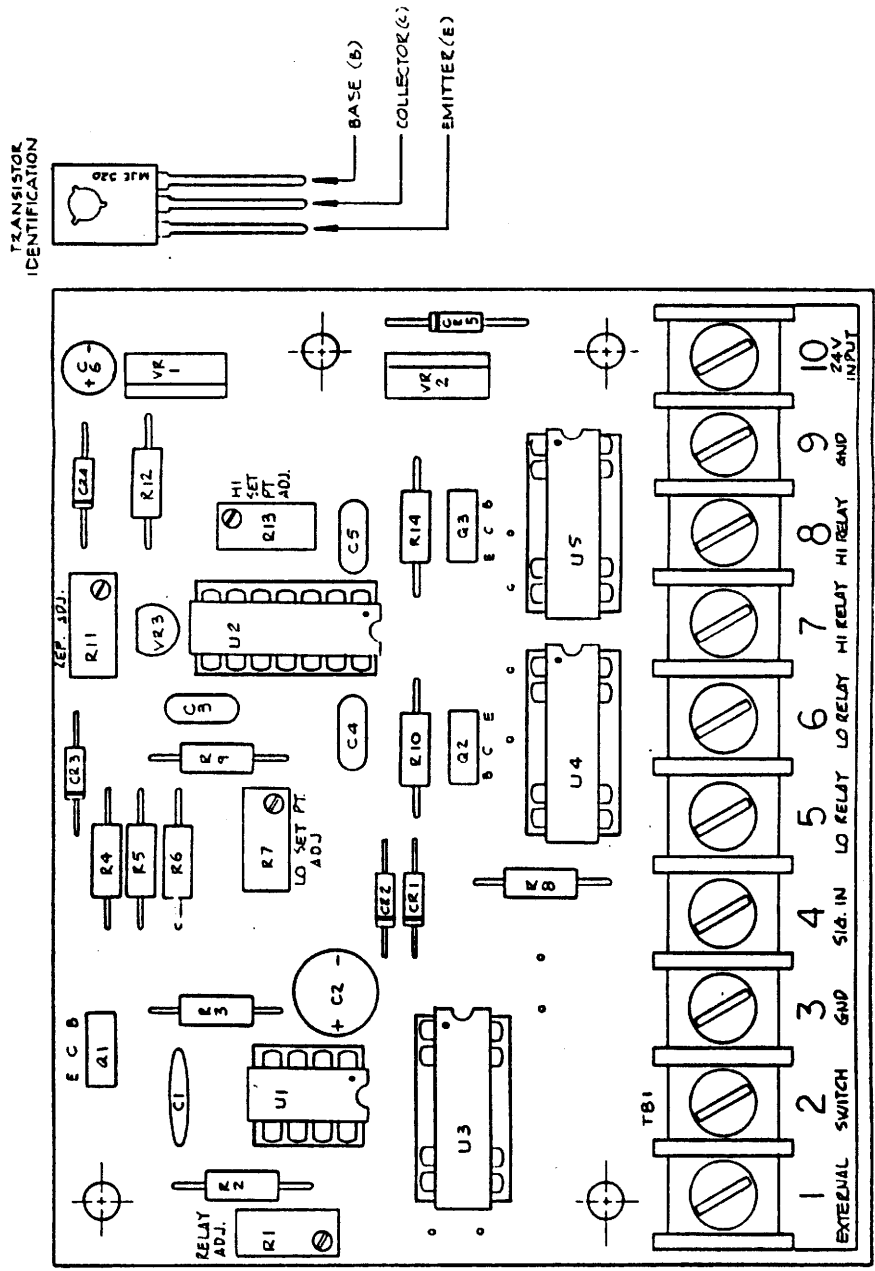
APPROVALS		DATE	
DESIGNED BY	J. AREAGA	DATE	8/13/86
CHECKED BY	D.A.L.	DATE	9-10-86
APPROVED BY	M. P. ...	DATE	9-18-86
DRAWN BY		DATE	

USE THIS INFORMATION TO RECORD DISTRIBUTION AND IN RECORDS	
TELEPHONE NO.	1-708-...
FACSIMILE NO.	1-708-...
ADDRESS	...
CITY	...
STATE	...
COUNTRY	...
DATE OF RELEASE	...

TITLE	MODEL 132 ISOLATED SIGNAL OUTPUT CONVERTER COMPONENT LAYOUT
DATE	8/13/86
SCALE	2:1
REV	B
SHEET	1 OF 1

REVISIONS		
REV.	DESCRIPTION	DATE
A	UPDATED AND NOTES ADDED	7-0-85 AG/DT
B	REVISED PER ECO #14714, A1147002, A1147002, A1147002, A1147002	9-1-88 (S) (S) (S) (S)

PART NO.	DESCRIPTION
-01	DUAL ALARM W/D TIMER (DO NOT STUFF U1, U3, CR1, CR2, C1, C2, Q1, R1, R2, R3)
-02	DUAL ALARM W/ TIMER (STUFF ALL)



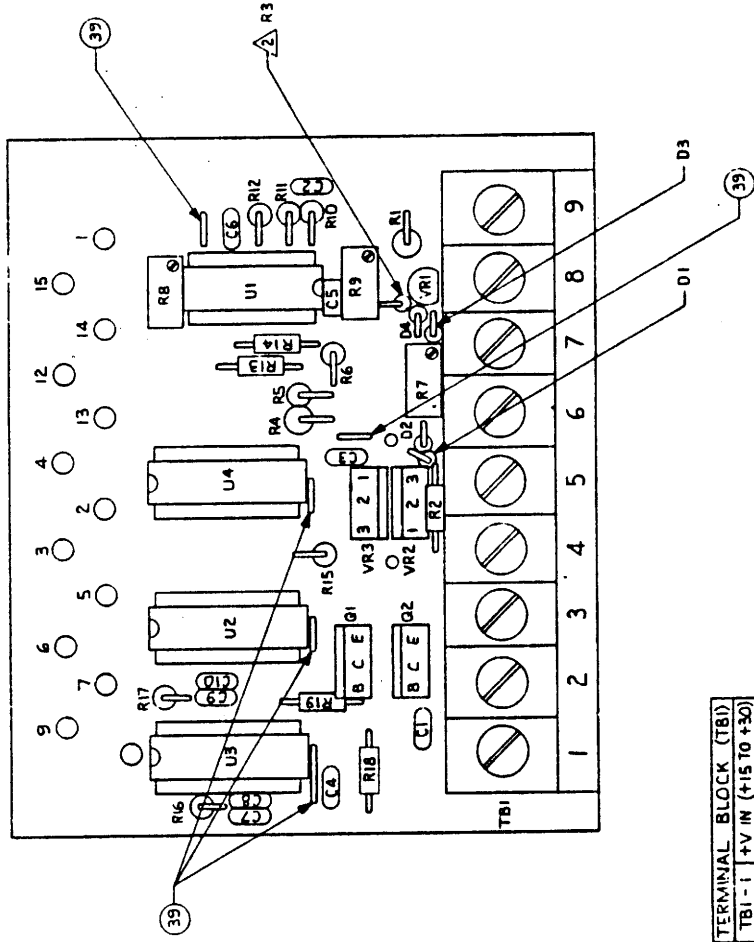
- NOTES:
- THIS DIAG TO BE USED IN CONJUNCTION W/ SCHEMATIC DIAGRAM DWG. # 30002B
 - LAST REF. DEG. USED ARE: T1, VR3, Q3, CR5, C6, Z14, & U5.

SCALE : 2/1
TOLERANCE
XX ± .01
XXX ± .003



DESIGNED BY: L.T.M.	11-2-84	PCB, ASSY, 111R1
CHK'D: J.M.W.	7-15-85	
APP'D: H.C.	7/1/85	
REV B		4-2009q
REV B		SPT 1

- NOTES: UNLESS OTHERWISE SPECIFIED
 1. THIS DRAWING TO BE USED IN CONJUNCTION WITH SCHEMATIC DIAGRAM 3000001
 2. USE R3 ONLY WITH 4-20mA INPUT, KURZ TO ASSEMBLE AS READ.
 3. ALL DIODES TO BE ASSEMBLED WITH THE CATHODE TO THE P.C.B.



TERMINAL BLOCK (TBI)	
TBI-1	+V IN (+15 TO +30)
TBI-2	GND
TBI-3	1st COUNTER
TBI-4	2nd COUNTER
TBI-5	-V IN (-15 OR -18)
TBI-6	+12 OUT
TBI-7	+5 OUT
TBI-8	GND
TBI-9	SIG. IN. 0-5 VDC

REVISIONS			
REV.	DESCRIPTION	DATE	BY
A	REVISED PER ECO A10147001	1-27-73	N/A
B	REVISED PER ECO No 47Z 46	1-29-73	N/A

KURZ INSTRUMENTS INC.	
MODEL 101 TOTALIZER COMPONENT LAYOUT	
DATE: 8-25-86	DATE: 8-26-86
BY: J. CAREAGA	BY: [Signature]
CHECKED BY: [Signature]	DATE: 8-26-86
APPROVED BY: [Signature]	DATE: 8-26-86
SCALE: NONE	SHEET: 1 OF 1