KURZ™ INSTRUMENTS, INC.

Model 565DC
DC-Powered Mass Flow Meters
User's Guide

Customer Name: _____

P.O. Number: _____

Date of Order: _____

Complete Model Number: _____

Kurz™ Order Number: _____

Serial Number: _____

Document Number: 360105, Rev. B

2411 GARDEN ROAD • MONTEREY, CA 93940 • TLX 172275 • (800) 424-7356 NATIONWIDE • (408) 646-5911 • FAX (408) 646-8901

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): _____

Maximum Flow: _____

Inlet & Exit Fitting Size: _____

Maximum Pressure Loss (in inches of water) at Full Scale: _____

Engineering Units:
____ SFPM
____ SCFM
____ SCCM
____ SLPM
____ lbs/min
____ Other (specify): _____

Power Supply Input:
____ Standard (18-24 Vdc)
____ Other (specify): _____

Output Signal:

____ Non-linear 0-5 Vdc (standard 560)

____ Linear 0-5 Vdc (standard 565)

____ Non-Linear, Isolated 4-20 mA (560)

____ Linear, Isolated 4-20 mA (565)

____ Non-Linear, Non-Isolated 4-20 mA (560)

____ Linear, Non-Isolated 4-20 mA (565)

____ Other (specify): _____

Probe & Sensor:

____ Teflon-Coated Sensor

____ Epoxy-Coated Sensor

____ Other: _____

High Temperature Applications:

____ HT Rated to 250° C

Electronics Enclosures:

____ 437 Board Included in One-PiecePackage

____ None - Unmounted 437 Circuit Board

____ 437 Board Mounted in NEMA 12 Enclosure

____ 437 Board Mounted in NEMA 4 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:

____ Rack Mount

____ NEMA-enclosed

____ 191-2.4: 2.4 Amp Power Supply

____ 191RM-4.8: 4.8 Amp Power Supply

____ 191RM-12: 12 Amp Power Supply

____ 115 VAC 50/60 Hz Version

____ 220VAC 50 Hz Version

____ Other: _____

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Document Title: *Model 560 and Model 565 DC-Powered Mass Flow Meters User's Guide*

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Warranty Statement

The Kurz Model 560 and 565 DC-Powered Mass Flow Meters 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 relevent 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 rountine maintenance (such as replacing the seals, etc.) on a regular basis and to verify the safety of the entire installation.

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Figures

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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, a Quick Set-Up Guide, and an index. The book is not designed to be read cover to cover; rather, it is designed to present information to the 560 and 565 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 560 or 565 DC-Powered Mass Flow Meter, including model number, serial number, Kurz order number, and customer purchase order number. It also lists any options you ordered with your 560 or 565. 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 560 or 565 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 560 and 565 flow meters. 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 560 or 565. This section explains how to determine the correct location for installation, as well as how to perform the physical installation. You should read thoroughly the parts of this section that apply to your installation before you install the 560 or 565. **You may also want to read Section 5, "Testing," before you install the meter.**

Section 3: Operation and Maintenance

This section explains how to calculate actual velocities from the standard velocities reported by the 560 or 565, 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 560 and 565 flow meters. 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 560 or 565 to determine whether or not it is operating properly. Although the meters are 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

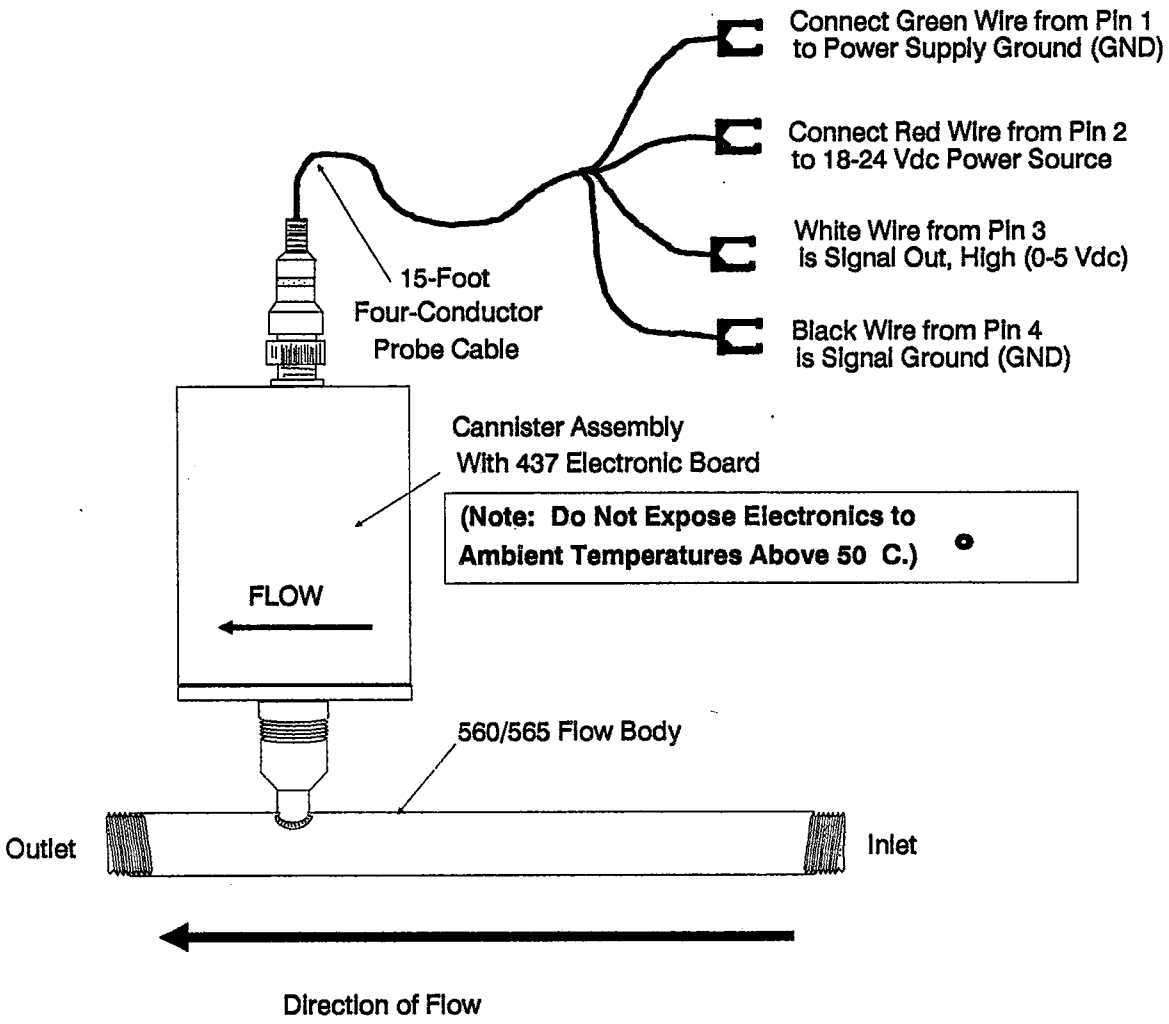
The appendix contains detailed component layout drawings and circuit diagrams of the various components of the 560 and 565. This information is not needed by most users in routine operation of the unit. It is provided as an aid to those users who want to perform more detailed maintenance and testing 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 560 or 565. Kurz Instruments recommends that you read applicable sections of the manual before attempting installation.**



Section 1: Product Overview

This section contains a general description of the Model 560 and Model 565 DC-Powered Mass Flow Meters. It explains how these meters work and lists their features and specifications. All information in this guide applies equally to all 560 and 565 models unless specifically identified as applying to a particular model or models.

1.1 Description

The 560 and 565 DC-Powered Mass Flow Meters are rugged, very low maintenance instruments ideally suited to monitoring relatively clean air or gas flows. The 560 and 565 come with an attached flow body, designed to be installed in gas or air lines. Pressure drops across these mass flow meters are minimal (typically about 2 inches of water, or 1/15th of one psi) due to their energy-efficient design.

The 560 and 565 have all the same features, except for one. The 437 electronics board included with the Model 565 DC-Powered Linear Mass Flow Meter contains the hardware necessary to output a linearized 0-5 Vdc signal representing the measured mass flow. The 437 electronics board included with the Model 560 DC-Powered Mass Flow Meter does not contain the required linearization components and therefore outputs a non-linearized 0-5 Vdc signal.

The 560 and 565 Mass Flow Meters can be used stand-alone or intergrated into a wide range of OEM instruments and systems. Some of the 565 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 560 and 565 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. For extremely hot, dirty, or corrosive industrial environments, Kurz recommends the even more robust 505 Industrial Mass Flow Meter.

The 560 and 565 are available in many sizes to suit a wide range of applications. Table 1-1 lists the various models and summarizes some of their characteristics.

Table 1-1. *560/565 Sizes and Specifications*

Range	Model	MNPT Fittings X Length	Maximum Pressure Drop (In Inches of Water)
0-50 SCCM	560/565-1-00	1/4" x 6"	0.05
0-150 SCCM	560/565-2-00	1/4" x 6"	0.05
0-500 SCCM	560/565-3-00	1/4" x 6"	0.05
0-1500 SCCM	560/565-4-00	1/4" x 6"	0.1
0-5 SLPM	560/565-5-00	1/4" x 6"	0.3
0-15 SLPM	560/565-6-00	1/4" x 6"	0.5
0-1 SCFM	560/565-6-02	1/4" x 6"	2.0
0-50 SLPM	560/565-7-02	3/8" x 6"	2.0
0-3 SCFM	560/565-7-04	3/8" x 7"	5.0
0-5 SCFM	560/565-7-06	3/8" x 7"	10.0
0-3 SCFM	560/565-7A-00	1/2" x 8"	1.0
0-5 SCFM	560/565-7A-02	1/2" x 8"	3.0
0-10 SCFM	560/565-7A-04	1/2" x 8"	11.0
0-5 SCFM	560/565-8-00	3/4" x 10"	0.9
0-10 SCFM	560/565-8-02	3/4" x 10"	3.5
0-15 SCFM	560/565-8-04	3/4" x 10"	8.0
0-25 SCFM	560/565-8-06	3/4" x 10"	9.0
0-15 SCFM	560/565-9-00	1" x 12"	2.2
0-25 SCFM	560/565-9-02	1" x 12"	6.0
0-50 SCFM	560/565-9-04	1" x 12"	12.0

As shown in the Quick Set-up Guide in the front of this manual (page xv), the 560 and 565 consist of the following basic components:

- DuraFlo™ ceramic flow sensor installed within the flow body as shown in Figure 1-1 (Models 560/565-8 and larger flow meters have a window around the sensor that is not shown in Figure 1-1)

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

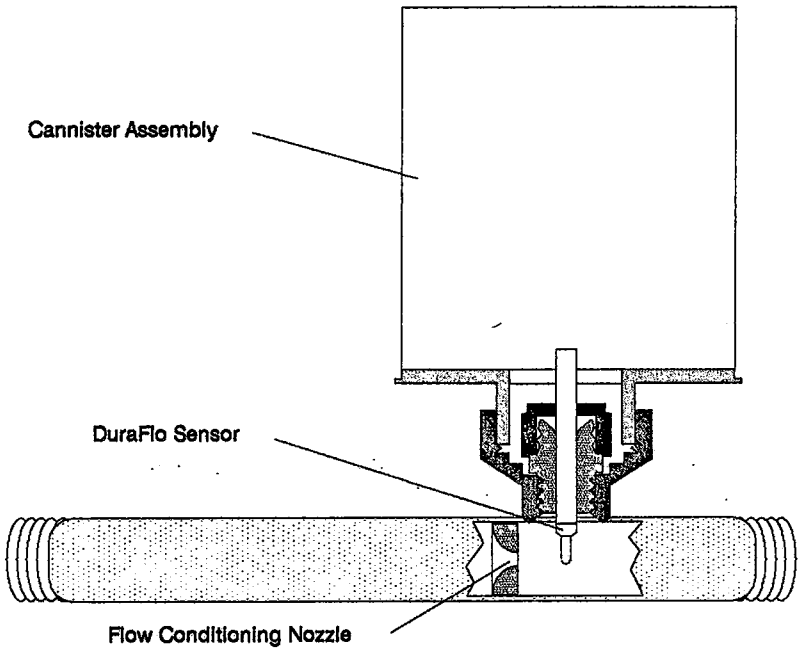
- 316 stainless steel flow body to be installed in the air or gas line

- 437 Electronics Board housed in rugged, weather-resistant enameled aluminum cannister assembly mounted on the flow body (The 437 board can be unmounted, mounted in a NEMA 4 or NEMA 12 enclosure, or mounted in a rack module — refer to Section 4, "Options.")

- 15-foot four-conductor cable for interfacing the flow meter to a power supply and the device used to collect and/or display the output

An illustration of the sensor's placement in the flow body is provided in Figure 1-1.

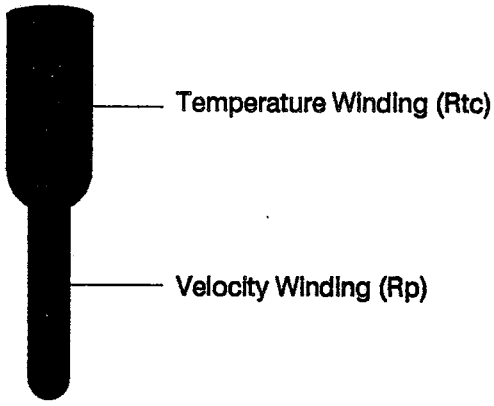
Figure 1-1. *Sensor's Placement in 560/565 Flow Body*



1.2 How the Sensor Works

The DuraFlo sensor used in the 560 and 565 is in fact two sensors in one: a temperature sensor and a velocity sensor. The DuraFlo sensor consist 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.

Figure 1-2. *DuraFlo Sensor*



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 DuraFlo 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 560 or 565 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 draw that is measured by the 560 and 565 flow meters.

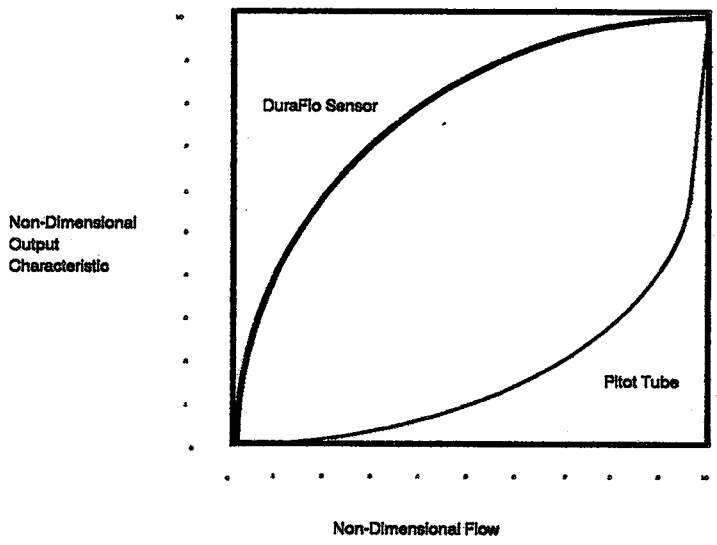
The sensor is directly measuring mass flow (i.e., the number of molecules carrying heat away from the velocity sensor), and is calibrated in **standard** units, which are referenced to a temperature of 25° C and atmospheric pressure of 760 mm Hg. In other words, air at 25° C and 760 mm Hg, flowing at 100 cubic feet per minute (CFM) will produce a reading of 100 **standard** cubic feet per minute (SCFM)[1]. A 100 CFM flow at a different temperature or pressure produces a reading in SCFM 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 mounted on the flow body of the meter. 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 1-3 shows the DuraFlo sensor's output curve as flow increases. Figure 1-3 also shows the corresponding curve for a pitot-tube type sensor. Note the greatly superior sensitivity of the DuraFlo sensor at low flow rates.

1 Standard 560 and 565 calibration is in SCCM, SLPM, or SCFM, depending on the model. Other engineering units are also available – refer to Section 4, "Options".

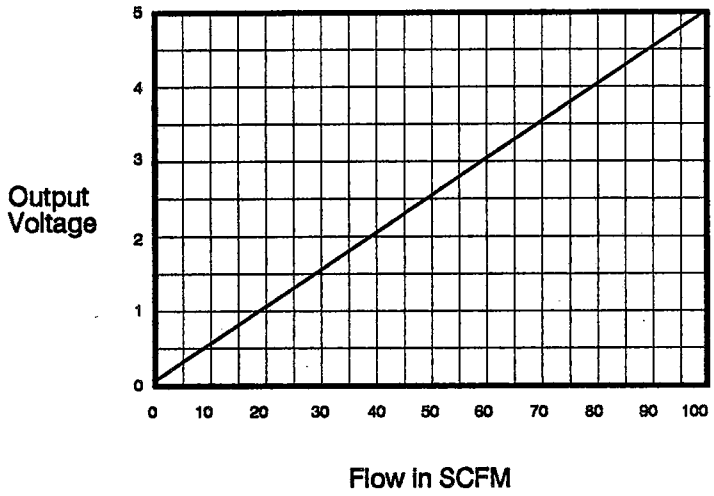
Figure 1-3. *Sensor Output vs Flow*



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 is output from the 560.

However, the 437 board in the Model 565 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 1-4.

Figure 1-4. *Linearized 0-5 Vdc Output of the 565 Models*



Additional circuitry on the 437 board will convert the non-linear (560) or linear (565) output voltage to an 4-20 mA output if the 560 or 565 was ordered with the non-isolated option (-I).

1.3 Features and Specifications

Some of the outstanding features of the 560 and 565 are summarized below:

Rugged Construction

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

Automatic Temperature and Pressure Compensation

The 560 and 565 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 DuraFlo sensor in the 560 and 565 accurately measures very low flow rates.

Convenient Non-Linear or Linear Output

The 560's non-linear and the 565's linear 0-5 Vdc output is convenient for digital panel meters, voltmeters, chart recorders, and computers. Other outputs are optionally available.

NBS-Traceable Calibration

Every 560 and 565 is factory-calibrated in a National Bureau of Standards (NBS) traceable wind tunnel. Packaged with your 560 or 565 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 560 and 565 are given in Table 1-2. All specifications apply to all models except where noted.

Table 1-2. *560 and 565 Specifications*

Sensor Construction:	Reference-grade 385 platinum RTD-type windings around a high-purity ceramic core, sheathed in glass (epoxy, and glass wetted parts)
Accuracy:	± 2% of reading ± .5% of full scale (560 models) ± 3% of reading ± .5% of full scale (565 models)
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

Table 1-2. *560 and 565 Specifications (continued)*

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 437 electronics board is rated only to 125° F. Specify a remote-mounted enclosure for the electronics if the portion of the meter **outside** the flow body will be exposed to temperatures higher than 125° F. (See Section 2.5.3 for information on high-temperature installations.)
Flow Body Construction:	316 stainless steel
Flow Body Dimensions:	Dimensions range from 1/4" by 6" (560/565-1) to 1" by 12" (560/565-9)
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:	Non-linear (560) or linear (565) 0-5 Vdc standard, nonisolated 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 560 or 565 DC-Powered Mass Flow Meter. 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 flow meter 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 and pipe schedule shown on the calibration certificate are correct.

2.1.1 560/565 Without Options

If you ordered your 560 or 565 without any options, the contents of the shipping carton should be as shown in the Quick Set-Up Guide in the front of the manual.

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.")

2.1.2 560/565 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 560 or 565 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 Flow Meter Location

The flow body itself provides the required unobstructed runs upstream and downstream from the sensor. Even so, it is a good idea to install the 560 or 565 near the center of a long, straight pipe section, if possible.

Unless it has been specifically calibrated for another orientation, the flow meter must be installed in a horizontal run, with the cannister extending straight up. You must therefore choose a location where there is sufficient clearance for the cannister, plus two or three inches for maneuver.

Important Note: The electronic components on the 437 board are not warranted to operate above 70° C. Therefore we recommend that you do not place the cannister close to hot ducts or pipes. Provide sufficient clearance between the duct or stack and the cannister assembly so that the ambient temperature around the cannister is less than 50° C.

2.3 Orientation

Note that the flow body is not symmetrical - it has a long end and a short end (relative to the T-connection for the cannister assembly). You must install the 560 or 565 so that flow enters through the long end of the flow body and exits through the short end. This orientation is illustrated in the Quick Set-Up Guide at the front of this manual.

2.4 High-Temperature Installations

If the cannister assembly is exposed to high temperatures above 50° C, the 437 board should be mounted remote to the flow body. For these applications you can select the optional NEMA, rack-mount, or PC-board configurations. Refer to the Section 4, "Options".

2.5 Connecting the Meter to the 18-24Vdc Input and 0-5 Vdc Output

A 15-foot four-conductor cable is included with all configurations of the 560 and 565 flow meters. The standard configuration of these meters includes a cannister assembly mounted perpendicular to the flow body. 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 0-5 Vdc output from the meter. The connector pinout is shown in Figure 2-1. The pin description of the connector and cable is provided in Table 2-1.

Figure 2-1. *Connector Pinout on the 560/565 Cannister Assembly*

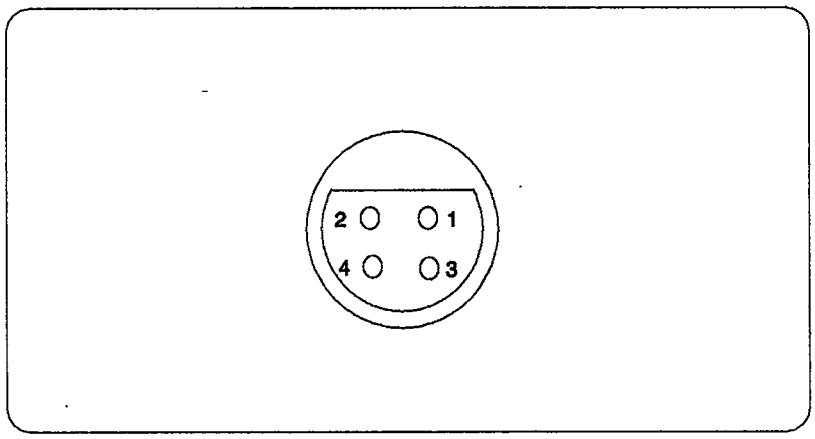


Table 2-1. *Pin Description of the Connector on the 560/565 Cannister Assembly*

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 560 and 565 DC-Powered Mass Flow Meters.

3.1 Operation

Once you have installed the 560 or 565 as described in Section 2, operation is primarily a matter of maintaining the 18-24Vdc power source to the flow meter. As long as power is supplied to this unit, the flow body is correctly installed in the line to be monitored, and all wiring connections are correctly made, the flow meter 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 flow meter, 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 flow meter 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 (560) or linearized (565) 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 560 flow meter will not be directly proportionate to velocity. These voltages will fall on a curve, closely approximating the curve shown in Figure 1-2 on page 1-5. In comparison, the linear intermediate voltages output from the 565 do indicate intermediate flows directly proportionate to the voltage of the signal.