Stack Gas Flow Monitor

AIRFLOW METERING SYSTEMS

MODEL # ACCS-IDM70-STD-SYS

TECHNICAL INFORMATION
V1.00

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Instruction Manual

General Information

The Manual

Refer to this manual for proper installation, operation and maintenance of the Accutron Plus Instrument.

Special attention must be paid to warnings and notices highlighted from the rest of the text by grey highlighted sections.

Warning means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.

Note means important information about the actual product or that part of the operating manual.

- These instructions do not claim to cover all details or variations in equipment, or to provide for every possible contingency that may arise during installation, operation, or maintenance.
- For further information or to resolve issues not covered in the manual, consult your Accutron representative.
- The contents of the manual shall not become part of or modify any prior or existing agreement, commitment or relationship. The Sales contact contains the entire obligation of Accutron Instruments. The warranty contained in the contract between the parties is the sole warranty of Accutron Instruments Inc.

IMPORTANT: All specifications are subject to change without notice. Please ensure that any safety-related information is confirmed with a qualified Accutron Instruments representative.

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

This device/system should only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

Information About Your System

When you receive your Accutron airflow unit, be sure to record the product identification information. If you need to contact Customer Service, this information will helpful to your representative.

Model Number (inside panel):	_____
Serial Number (inside panel):	_____
Code version (displayed on startup):	_____

Specifications

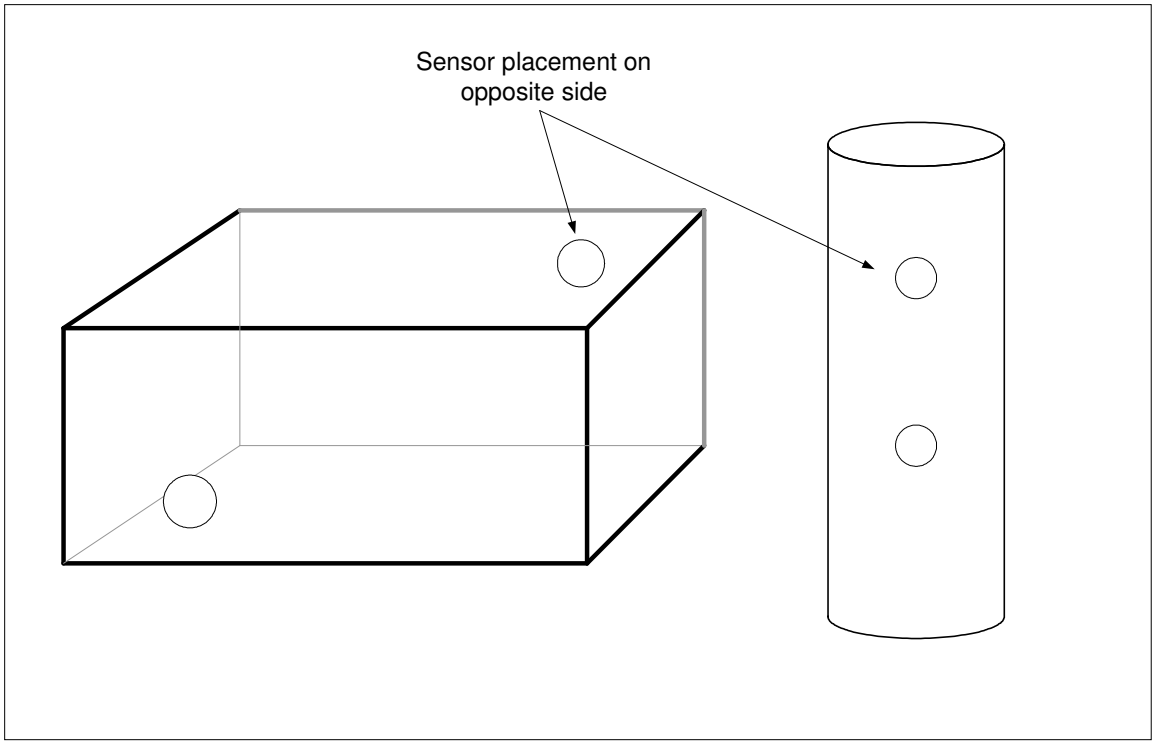
Connections:	Screw terminal Block Type
Display Readout:	8-digit Alphanumeric LED display.
	Each digit is 0.75” (H) X 0.5” (W)
Power Supply:	Switching type with International Approvals (CUL, UL, CE)
Power Consumption:	< 10 watts
Input Power:	120 VAC, 50/60 Hz
	24 VDC (optional)
Display Units:	m/s, cfm, kcfm, m^3/s, fpm
Temperature range:	-40° to +60° Celsius
Accuracy:	2% Full Scale or ± 0.05 m/s (whichever is greater)
Output type:	analog 4-20mA
Output modes:	Normal, Reverse, or Split (used for bi-directional measurements)
Max loop resistance:	750 ohms
Sensor cables:	25 feet standard sensor cables.
Programming:	Handheld terminal used to program and configure the Accutron.

Section 2

Introduction

The Accutron airflow sensors are compact and reliable instruments specially designed for measuring airflows in harsh environments.

In use, the ultrasonic sensor assemblies are installed in the duct diagonally (one further upstream than the other) the “imaginary line” between them intersecting the airflow at a typical angle of between 30 degrees.



Principle of Operation

The Accutron first internally computes the average velocity of the airflow in meters/second, to obtain volumetric flowrates, the area of the duct is entered (during first time set-up), The Accutron then displays airflow volumes in the units selected. Common units used in most applications are kcfm and m^3/s, other units may also be displayed (m/s, fpm).

After installation in the duct, measurements are made (area, baseline distance, Face-to-face distance, etc). Then, using the handheld programmer, these parameters are entered into the unit, along with the selection of Display Units, 4-20 output characteristics, etc. These parameters are retained in non-volatile Flash memory in the Accutron. Whenever the Accutron starts up, this information is automatically reloaded .The handheld programmer is easy to use, and much more convenient than using a laptop computer.

Note One of the important features of the Accutron is the ability to measure bi-directional airflows. A negative sign at the far left hand side of the 8-digit display indicates this. Also, the 4-20 split mode can be used to pass this information to a PLC.

The system can easily measure airflows in excess of 1,000,000 cfm with a precision better than any other conventional methods. In addition, since the system is able to sample across the entire duct (along the imaginary line between the sensors), readings are more representative than “single point” measurements using hot-wire sensors, for example. The Accutron takes into account the fact that there is a “distribution profile” for the air in the ducting, making it superior to other types of measurement methods for fixed installations.

Choosing a Location

The best location to install the instrument is in a straight section of ducting that is at least 8 duct widths in length. In a straight section, the airflow distribution will usually have laminar characteristics and would prove to be a suitable location. Sections close to elbows or curves tend to have turbulent characteristics and should be avoided.

The imaginary line between the Accutron Sensors works likes a "virtual pitot tube" and all flow measurements occur along this line. In practice, best results are realized when this "imaginary line" passes through the center of the duct, slicing through the airflow distribution profile in a representative way.

It is also a good idea to carry out and record a 9-point manual airflow survey to verify the airflow distribution and identify it as a suitable location.

The Accutron relies on the imaginary line between the 2 sensors intersecting the airflow distribution such that:

1. The airflow distribution is well behaved, meaning that the airflow velocity contours should be symmetrically distributed about the center of the duct and that the imaginary line between the two sensors passes through the center as shown in **figure A**.

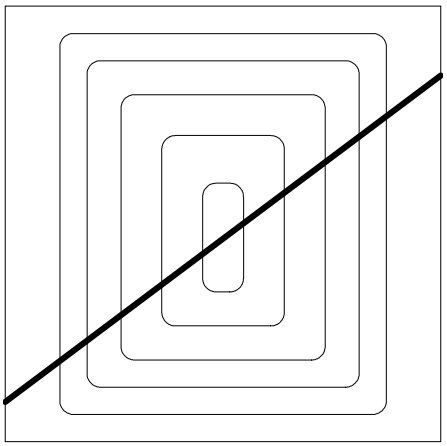


Figure A

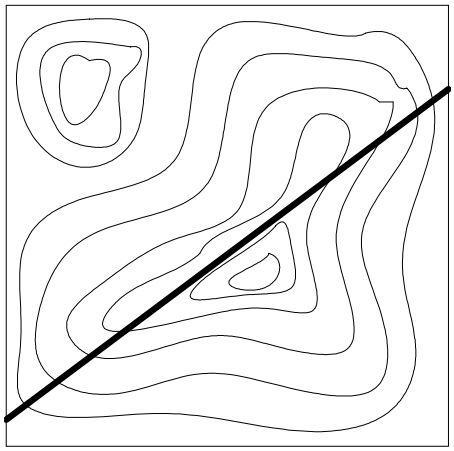


Figure B

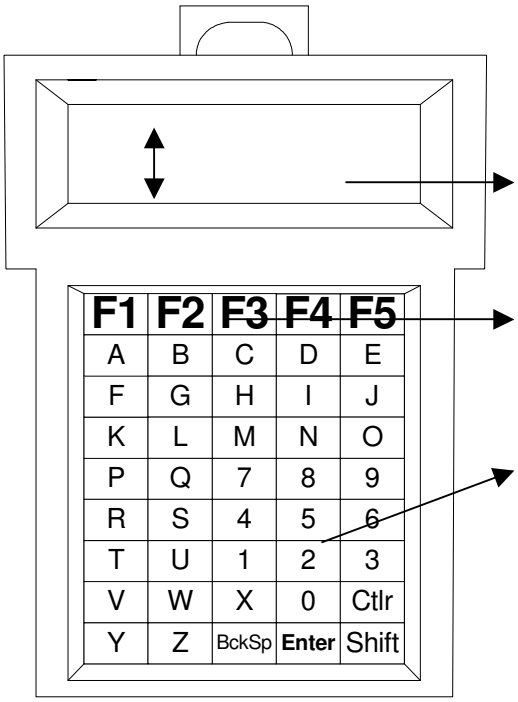
2. In **Figure B**, the flow contours are not symmetrically distributed and there will be a discrepancy between the actual total airflow in the duct and what the instrument reads.

Note: Sometimes there are cases when we need to measure the airflow in a less-ideal location. In this case, we may need to manually adjust the **calibration correction** factor to give accurate flow readings. In this case, the instrument would be calibrated against a handheld anemometer (such as hot-wire) type.

Section 3

Handheld Terminal

The handheld terminal is a universal device, for Accutron products only, that allows the user to configure the unit to the application's parameters. To use this device, insert the connector into the RJ-11 socket, which is located behind the unit's door panel. Make sure the unit is powered and in running.



Hanging Bracket: This is a retractable hanging bracket for optional use.

LCD Display: This is a 4 row, 20-character / line backlit LCD display

Key Pad: Here are the **F key** functions:

[F1] HELP = This key brings you to the Help menu which can be accessed at any time during the configuration.

[F2] FWD = This key takes you to the next parameter in the configuration menu. The **Enter** key has the same function.

[F3] REV = This key brings you back to the previous parameter in the configuration menu.

[F4] N/A = Currently, this key has no function.

[F5] RUN = This key takes you to the **"Run Options"** menu which can be accessed at any time during the configuration except for during the "Transducer Alignment Testing". Once you have selected to return to run mode, the eight-digit display will flash the word "UNPLUG". The device will not run until the handheld controller is unplugged* from the RJ11 socket.

***Note** This is the only way to get the unit back into "Run Mode"

Programming datasheet

Before actually programming the instrument, it is a good idea to work out and write down the parameters first in the following form. The form should also be filed for future reference.

	Configuration	Default	Value entered
	Tag		
	Flow units	A	
	Linear units	A	
	Face to face distance	0.0	
	Baseline distance	0.0	
	Cross section area	1.0	
	Air flow direction	A	
	Zero flow cutoff	0.0	
	Instrument full scale	1000.0	
	4-20mA over range	A	
	Obstruction/fault timeout in minutes	100	
	4-20mA mode	A	
	Moving average	25	
Advanced Menu			
	Calibration correction	1.0	
*	Noise filter	0	
*	Wave detection low threshold	20	
*	Wave detection high threshold	80	
*	Dynamic range limiting factor	5	
*	Hysteresis length	50	

Note A * indicates parameters that should be left at default.

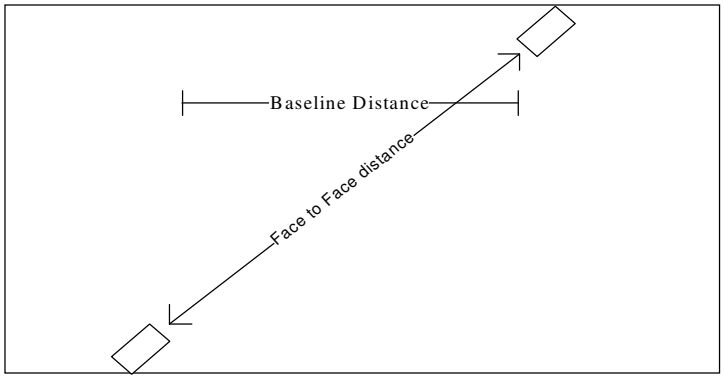
Auto Range Feature

The Accutron airflow monitor is equipped with a unique feature called auto-range. It is a quick and easy way to determine the face-to-face distance between the two sensors without taking the measurement manually. To use this feature, you must follow steps 1-7

1. Make sure that all cables and sensors are installed and connected.
2. Apply power to the display unit.
3. Using the handheld programmer, enter into the "Configuration Menu", scroll through the menu using the "Enter" key. Once you have reached the "Face to Face" parameter, change the value to 0 (**note:** the backspace key will allow you to erase any previous value entered).
4. Restart the system using the F5 key and choosing "Save and exit"
5. Upon reboot, the display will read "Accutron", followed by software version.
6. Next, the display will read "RANGE0-0" while the sensors begin the ranging process.
7. Once the distance has been determined, the display will show airflow readings.
    a. If the sensors do not find the distance after 5 minutes, it is possible to manually enter the distance with the handheld. (See quick start section for instructions)

The face-to-face distance may also be entered manually by measuring the distance and entering the parameter using the hand held programmer.

Note: Once the auto-range is complete the distance between the sensors (Face to Face) will automatically be entered. The baseline distance will also be set to the same value and must be measured manually and entered. The baseline distance will always be less than the face to face distance.



Quick start programming

These step-by-step instructions show you how to quickly program the Accutron airflow unit. For more detailed setup…refer to "Detailed Set-up" section.

1. Plug the handheld in and wait for the display to read "TERMINAL".
2. Press **Enter** to continue, then select your language by pressing **A**, **B**, or **C**
3. Press **A** for the Configuration menu.
4. Press **Enter** on the handheld until the handheld screen shows "Enter flow units"
5. Press **B** for KCFM.
6. On the next screen, select the unit of measurement you will be working with by pressing **A** or **B.**
7. In the "Enter face to face distance", enter the measured distance between both sensors. Press **Enter** to continue.
8. In the "baseline distance" menu, the default value is your face-to-face distance. Change it so that it reflects your calculation. (This value cannot be greater than the face-to-face distance). Press **Enter** to continue.
9. Enter your calculated value for the cross section area and hit **Enter**. Default is 1.
10. Press **Enter** until you see the handheld screen show "Enter 4-20mA mode" and select the parameter you want. By default, the output will be A (4mA = 0 and 20mA = full scale)
11. Press **F5** to view the Options menu and select "Save and Run"
12. The display on the unit will read "UNPLUG"
13. Unplug hand held programmer from the socket and let the Accutron reboot.

Detailed Menu Setup

Plug in the handheld programmer and wait for the main display to read terminal.

Start-up screen

Accutron Plus Serial No: xxxxxxxxx New Press F1 for Help

Press the **[F2]** or **[Enter]** key to continue.

Select Language A English B French C Spanish

Press the letter that corresponds with your preferred language

Select Menu : A Config, B Advanced C Factory Settings D Diagnostics

The Accutron main menu has 4 options. Configuration, Advanced, Factory Settings, and Diagnostics (mainly used for troubleshooting)

Configuration menu

Enter Tag Number :

Enter the Tag Number desired. This option is used to identify individual installations. Example: FIT001

Enter flow units :	
A M/S	B kcfm
C cfm	D M**3/s
E fpm	F usec

Press the letter that corresponds with the desired unit. M/S (meters per second) is the default.

Linear Units : A Meters B Feet	Choose the desired unit of measurement.
Enter face to face distance : 0.0 Feet	This is the distance between the faces of the 2 transducers. By default, the distance is 0.0 Entering a distance of 0.0 will cause the Accutron to begin the auto range mode once the settings have been saved.
Enter baseline distance : 0.0 Feet	This is the straight line distance between the 2 transducers in the direction of the airflow. By default, this value is the same as the face-to-face. *This value cannot be greater than the face-to-face value.
Enter cross section area : 0.0 Cubic Feet	Enter the area of the duct at the location of the sensors
Enter airflow direction sense: A Normal sign B Reverse sign	This setting is set to “Normal sign” by default, If the display shows a negative sign before the reading this setting can be changed to “Reverse sign” for positive reading
Enter zero flow cutoff : 0.0 kcfm	Any reading by the Airflow meter lower than the one selected here, will produce a ‘zero flow’ state. Producing the set analog signal for zero flow.

Enter instrument full scale : 1000 kcfm	This is the full-scale range of the instrument in the units selected. In this case the range is 0 to 1000 kcfm or 0 to 1 million cfm
Enter 4-20mA over range mode: A Saturate / Clipping B Emit 3mA error	Selecting **A** means that if the flow exceeds full-scale, the 4-20mA output will saturate at 20mA. Selecting **B** means that if the flow exceeds full-scale, the instrument will output 3.0 mA indicating an error.
Obstruction/fault timeout in minutes (100 = disabled): 100	This option delays the 4-20 output. If an obstruction is placed between the 2 transducers, you have the option of telling the Accutron if and when to output a 3.5 mA error.
Enter 4-20mA mode : A 4mA 0% 20mA 100% B 4mA 100% 20mA 0% C Split mode 12mA 0%	A (Normal mode) 4mA corresponds to minimum airflow. (20mA max) B (Reverse mode) 4mA corresponds to maximum airflow. (20mA min) C (Split mode) 12mA corresponds to 0 airflow, 4mA to max negative, and 20mA to max.

Enter moving average (0 - 255) : 0

When set to 0, the readings and output values are instantaneous from one measurement to the next. The moving average allows a set of readings to be averaged with previous readings resulting in a smoother output behavior. For example: the default setting of 25 will calculate the average of the previous 25 readings with every new reading acquired by the instrument.

Advanced menu **(only recommended for use with diagnostics equipment)**

Enter calibration correction: 1.0	This feature is a correction factor which multiplies the reading by the entered value. Entering 1.1 would force the readings to be 10% higher, 0.9 would force the readings to be 10% lower.
Enter noise filter level: 0 value (0-4096)	This is a provision for dealing with extreme noise. Normally it is set to 0.
Enter wave detection low threshold: 20 value (0-100)	This option is used to specify the lower wave detection threshold in order to properly detect the ultrasonic signal.
Enter wave detection high threshold: 80 value (0-100)	This option is used to specify the upper wave detection threshold in order to properly detect the ultrasonic signal.
Enter dynamic range limiting factor: 5 value (0-1000)	Places a limit on how much weak signal noise may be expanded (digitally amplified). It prevents over amplification of noise in the absence of a valid signal.
Enter detection hysteresis length: 50 value (0-1000)	This option determines the minimum acceptable length of the waveform. Default is 50 units.

Diagnostics menu

Test quality of transducer alignment A - Yes B - No

Choosing to do an alignment will cause the Accutron display to show a percentage of how well the sensors are aligned. The scale is 0 to 100% where 0 means not aligned. The numbers provide relative indication. Best alignment is when reading is maximum.

Select diagnostic port baud rate:	
A - 9600	B - 38400
C - 57600	D - 115200

Select the baud rate for diagnostic output on the COM port when using PC Diagnostics.

Select diagnostic output:	
A - none	B - flow
C - wave	D - flowsine

This option selects the diagnostic mode. In use, a PC can be used to display the sonic-analog signals showing quality, amplitude, and noise for troubleshooting.

Test current output?		
A - Yes	B - Step	C - No

This option is used to test the 4-20mA outputs. “Yes” will prompt you for a desired output while “Step” will test every output from 0-20mA.

Miscellaneous

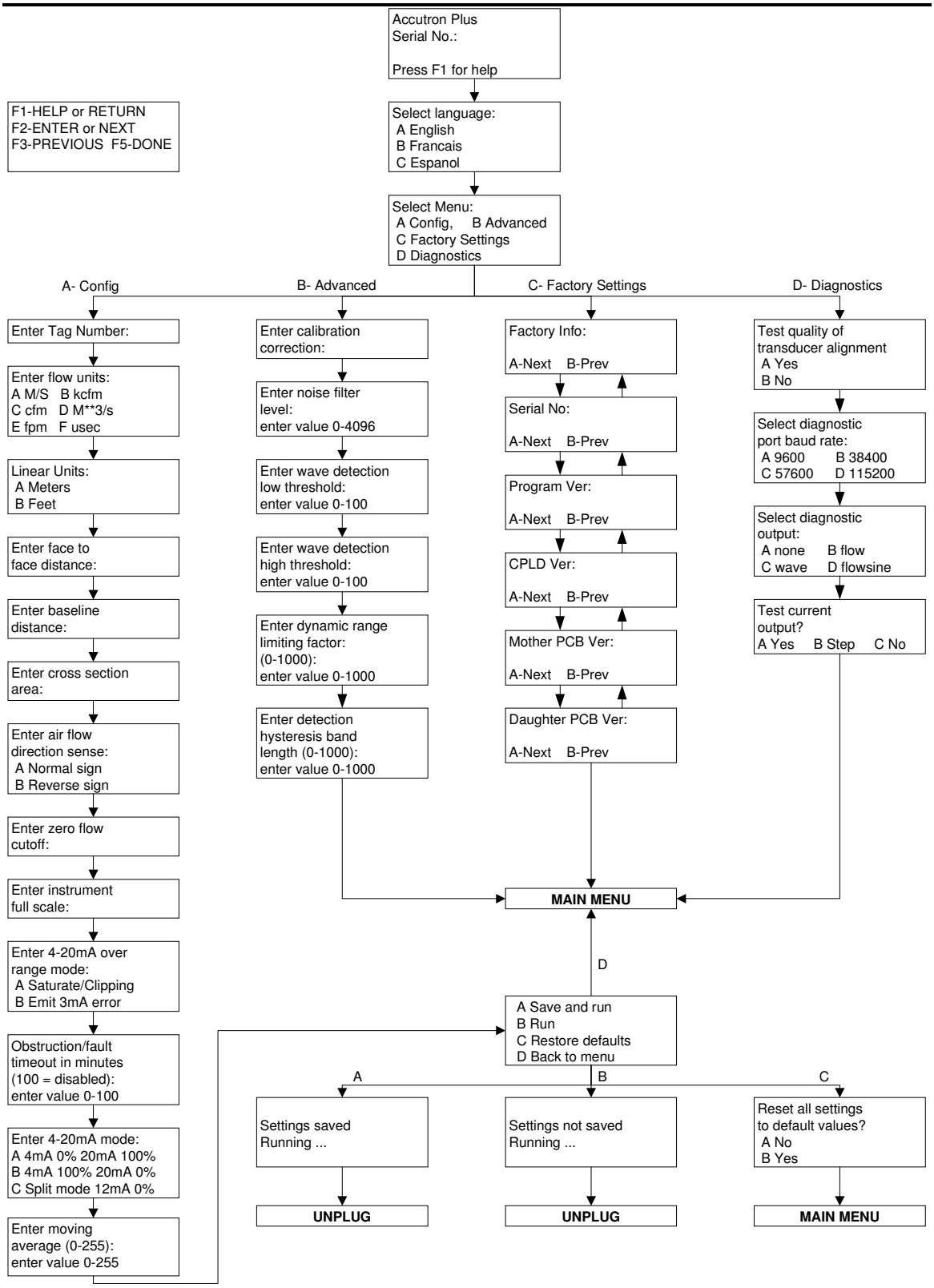
A Save and run B Run C Reset to defaults D Back to menu

To reach this menu, press **F5**. **Important:** This is the only way to get the Accutron back into "Run Mode".

Settings saved Running ...

The settings are now saved and the Accutron is ready to enter its operational mode. The message "UNPLUG" should be blinking on the instrument's LED display. You can now unplug the handheld terminal.

Menu Flow Chart



Section 4

FAQ (Frequently Asked Questions)

A) Why am I not seeing anything on the display?

- Check power connections. When the instrument boots, it should read "ACCUTRON" followed by the code version before entering run mode.
- Ensure that the Accutron was not damaged in any way during shipping. If this is the case, please contact your supplier.

B) The Accutron boots up but I am not getting any readings.

- Make sure all cables are connected.
- Make sure both transducers are aligned, and are alternately snapping (making a slight clicking sound every second).

C) Both my transducers are not snapping, what could be the problem?

Make sure each transducer is attached to the main unit via the cables and tightly connected.

D) Why is the auto range face-to-face value different from what I measured?

This is not a problem. Sometimes the unit may be off by +/- 10cm. This places the incoming waveform close to the center of the acquisition window for digital processing. Differences in this measurement (+/- 10cm or greater) have no effect on accuracy or the reading. If the unit does not function properly, then enter your measurement.

E) What should I set the full-scale setting to?

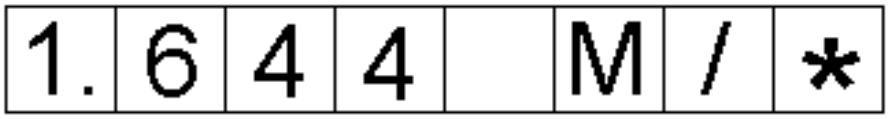
We recommend setting the full-scale to twice the maximum amount of airflow expected

F) Why am I getting readings that differ from what they should be?

- Re-measure the drift cross-sectional area and the baseline distance and verify that it matches with the values inside the Accutron settings.
- Check to see if the sensors are placed on a bend or a corner. (Placing the sensors on a corner can cause inaccuracies with the readings)
- Do a 9-point manual survey and re-measure the total airflow to check if this is so.
- Differences of +/- 10 to 15% are normal.
- The calibration correction, in the **Advanced Menu**, may be used to make any adjustments.

G) What does the star (*) mean at the end of my display?

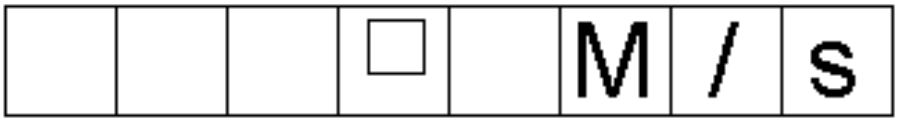
The star indicates that the reading is currently over the full-scale limit. You may want to verify if this is the case. If so, you can adjust the full-scale limit to a higher value.



H) What does the square (donut) mean in the middle of the display?

The donut means that the instrument is rejecting readings acquired because there is a problem (could be an obstruction like a vehicle parked between both sensros).

- Check to see if there is an obstruction between both sensors.
- Make sure both sensors are aligned properly.
- Make sure both transducers are attached to the main unit with cables.
- Check to see if the cables are tightly connected.



I) What is the difference between the 4-20 normal/reverse/split mode?

Normal: Airflow of 0 will output 4mA while airflow reaching instrument full-scale will output 20mA.

Reverse: Airflow of 0 will output 20mA while airflow reaching instrument full scale will output 4mA.

Split: Airflow of 0 will output 12mA (half the distance between 4mA and 20mA). Positive airflow reaching instrument full-scale will output 20mA while the negative value of instrument full-scale will output 4mA.

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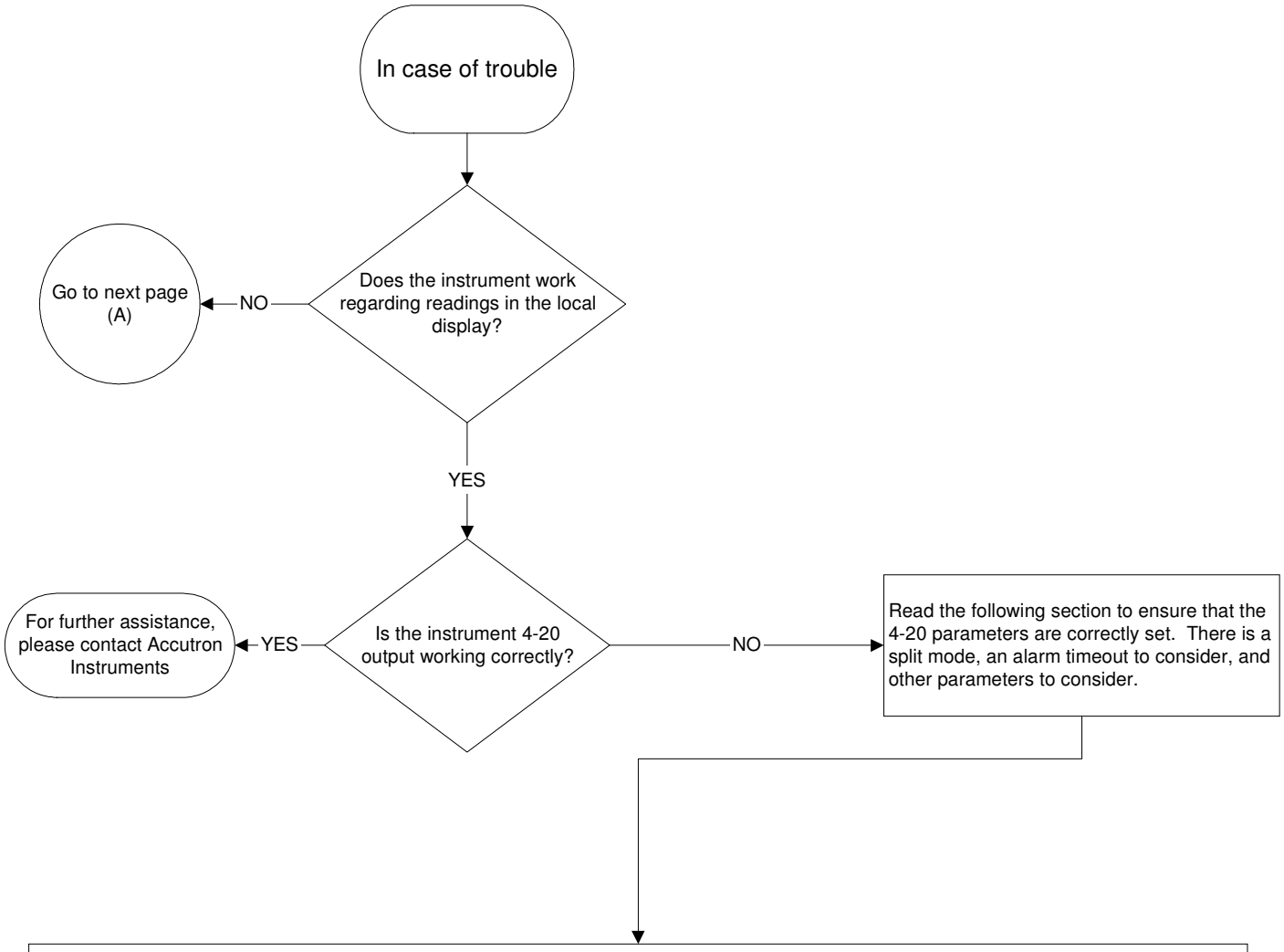
Troubleshooting Flowchart



The 4-20mA instrumentation output transmits the instrument reading on the 4-20mA ouptout. The full scale for the 4-20 is the "instrument fill scale" setting programmed via handheld terminal.

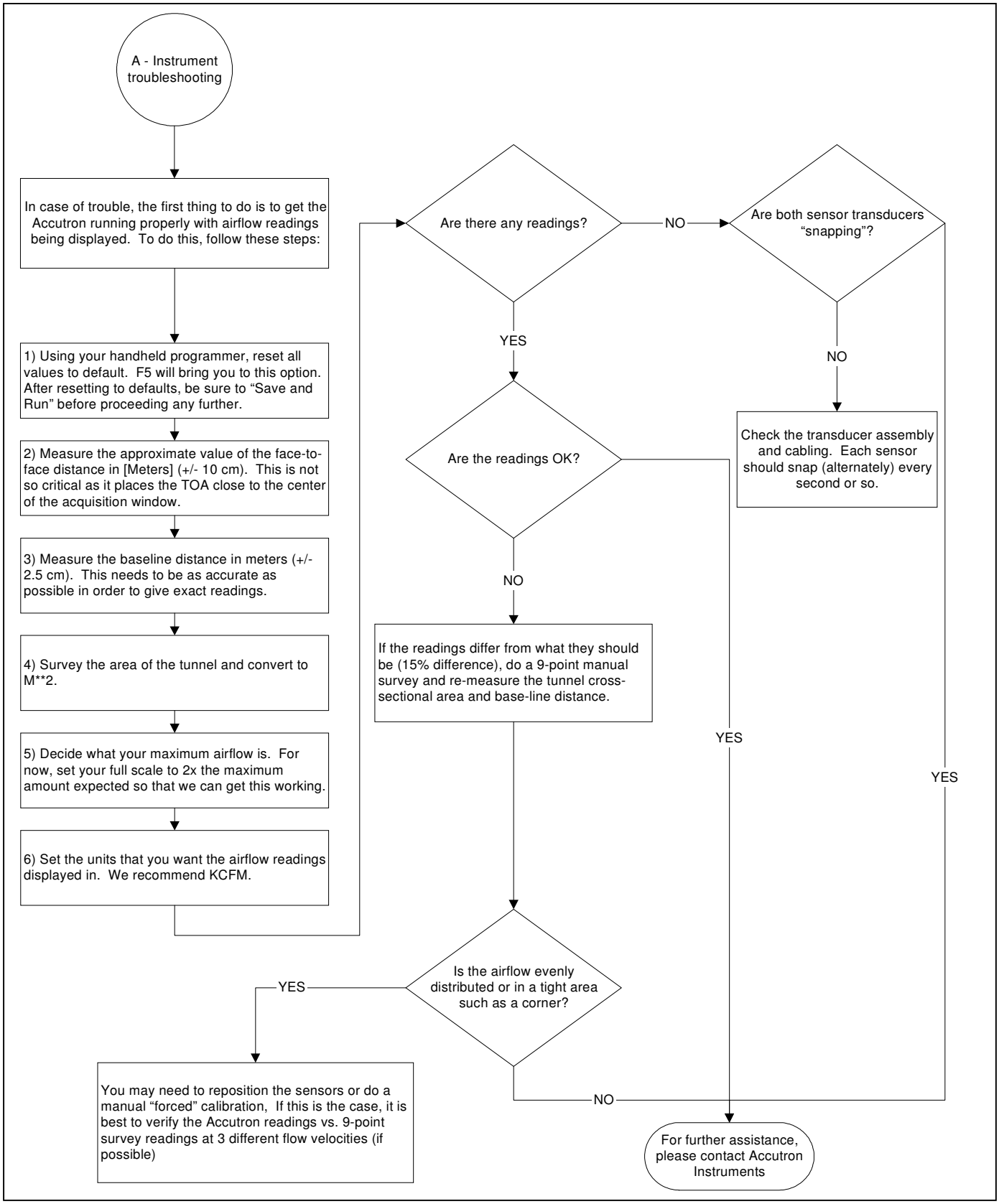
The 4-20 also has the following features:

4-20 alarm timeout: This is used to give an alarm output if the instrument stops giving valid airflow readings. An alarm is indicated by sending a 3.5mA ouptut current (less than 4mA) and care must be taken not to confuse this as a "zero airflow" condition.

Faults can be due to the following:
1) Sensor misalignment (Sensor was bumped or moved)
2) Vehicle or other obstruction in the ultrasonic beam
3) Actual airflow is greater than the full-scale setting
4) Fault with the Accutron (possibly a damaged transducer)

ON/OFF selection via handheld programmer: The 4-20 alarm timeout time is settable in minutes. If a "100 minute timeout" is specified, this feature is "turned off" and the behavior is:

The Accutron transmits whatever reading is on the 4-20. In case of fault, the last reading is transmitted on the 4-20.

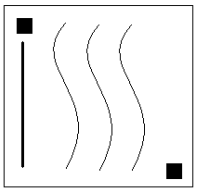

A - Instrument troubleshooting
In case of trouble, the first thing to do is to get the Accutron running properly with airflow readings being displayed. To do this, follow these steps:
1) Using your handheld programmer, reset all values to default. F5 will bring you to this option. After resetting to defaults, be sure to "Save and Run" before proceeding any further.
2) Measure the approximate value of the face-to-face distance in [Meters] (+/- 10 cm). This is not so critical as it places the TOA close to the center of the acquisition window.
3) Measure the baseline distance in meters (+/- 2.5 cm). This needs to be as accurate as possible in order to give exact readings.
4) Survey the area of the tunnel and convert to M**2.
5) Decide what your maximum airflow is. For now, set your full scale to 2x the maximum amount expected so that we can get this working.
6) Set the units that you want the airflow readings displayed in. We recommend KCFM.
Are there any readings?
NO
Are both sensor transducers "snapping"?
YES
NO
Check the transducer assembly and cabling. Each sensor should snap (alternately) every second or so.
Are the readings OK?
YES
NO
If the readings differ from what they should be (15% difference), do a 9-point manual survey and re-measure the tunnel cross-sectional area and base-line distance.
Is the airflow evenly distributed or in a tight area such as a corner?
YES
You may need to reposition the sensors or do a manual "forced" calibration, If this is the case, it is best to verify the Accutron readings vs. 9-point survey readings at 3 different flow velocities (if possible)
NO
For further assistance, please contact Accutron Instruments

Appendix A

Glossary

Autorange: An automatic function that measures the face-to-face distance. This distance should be accurate to ± 6 inches and does not affect the accuracy of the instrument.

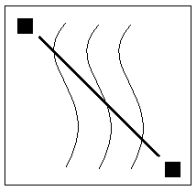
Baseline distance: The distance of the two sensors in the direction of the airflow. (Top view of two sensors)



cfm: Cubic feet per minute.

Dynamic range limiting: In normal operation, analog signals are processed mathematically to produce the "math curve". The math curve represents the envelope of the total received acoustic energy.

Face-to-face distance: The distance between the two sensors facing each other. (Top view of two sensors)



fpm: Feet per minute.

Hysteresis: The lag between making a change, such as increasing power to the transducers, and the response or effect of that change.

kcfm: Cubic feet per minute x 1000.

m/s: Meters per second.

m^3/s: Cubic meters per second.

Snapping:	In operation, the sensor transducers are energized alternately to transmit an ultrasonic pulse. You can hear a "click" when it does this. We refer to this as "snapping"
Transducer:	The sensor that sends and receives ultrasonic signals.
Ultrasonic:	Of or relating to acoustic frequencies above the range audible to the human ear.
Usec:	This is one of the available flow display units, used for laboratory testing only.
Zero flow cutoff:	A feature of the Accutron that forces the instrument to "set to zero" any flow readings that are less than this amount.

Equations

4-20mA Calculations:

Normal: mA = 4 + ((Reading of Instrument / Instrument Full Scale) x 16)

Reverse: mA = 20 - ((Reading of Instrument / Instrument Full Scale) x 16)

Split: mA = 12 + ((Reading of Instrument / Instrument Full Scale) x 8)

Calibration correction: Correction = Expected reading / Displayed reading.

Error percentage:

In the case of perfect airflow distribution between the two sensors, the accuracy of the Accutron is dependent on how accurately the transit times can be measured.

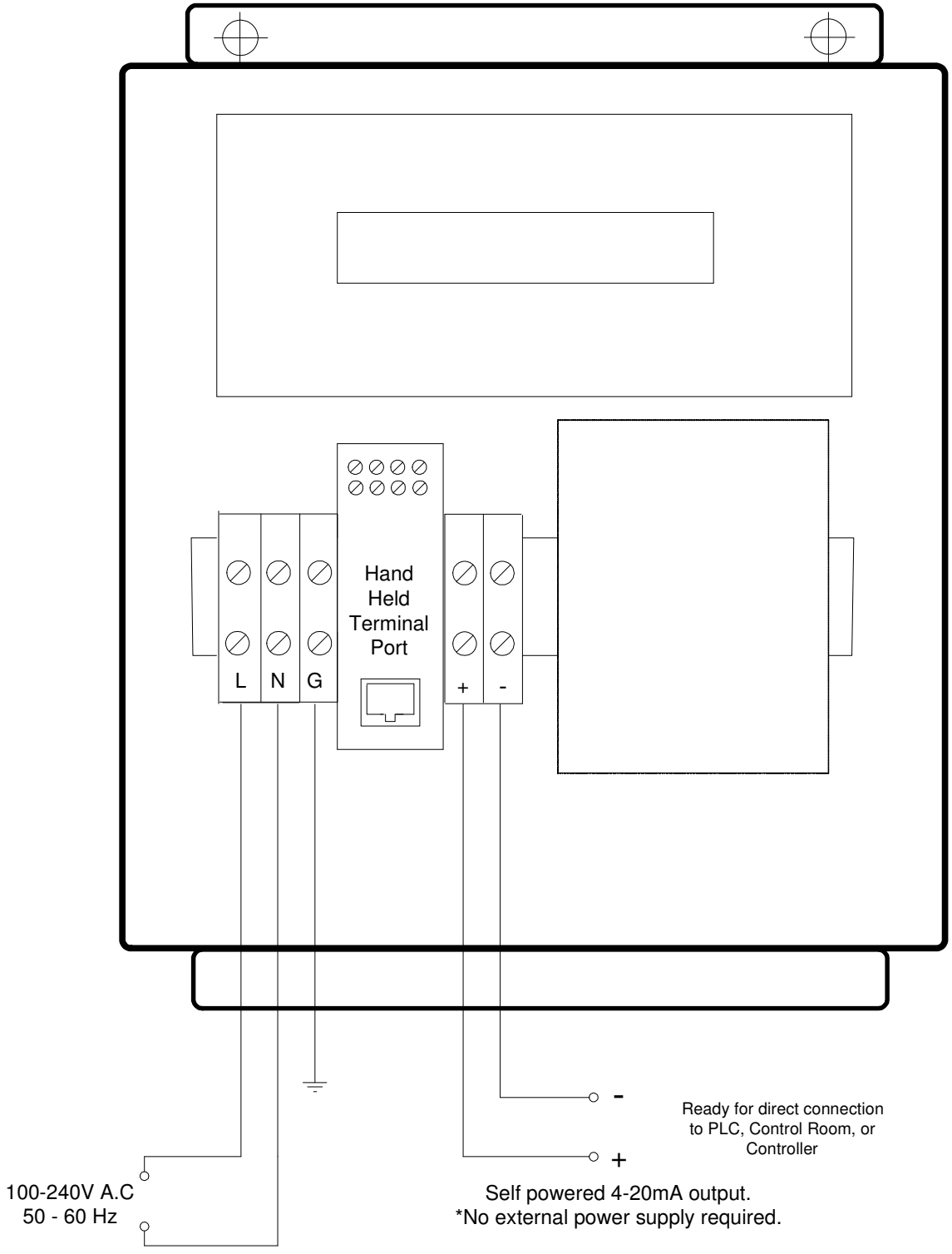
The accuracy of the instrument is 2% of full-scale or the instrument reading ± 0.05 m/s; whichever is greater.

Example: If full scale is 100 kcfm, the error is 2% X 100 kcfm = 2 kcfm.

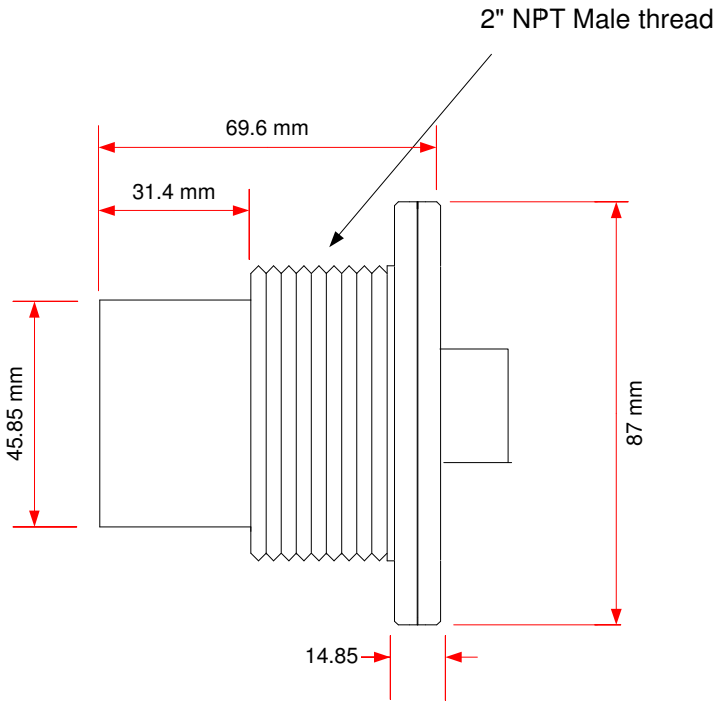
Default Values Chart

Configuration Menu		
	Flow units	A (M/S)
	Linear Units	A (Meters)
	Face to face distance	0.0
	Baseline distance	0.0
	Cross section area	1.0
	Air flow direction	A (Normal sign)
	Zero flow cutoff	0.0
	Instrument full scale	1000.0
	4-20mA over range	A (Saturate/Clipping)
	Obstruction/fault timeout in minutes	100 (disabled)
	4-20mA mode	A (4mA 0% 20mA 100%)
	Moving average	25
Advanced Menu		
	Calibration correction	1.0
	Noise filter	0
	Wave detection low threshold	20
	Wave detection high threshold	80
	Dynamic range limiting factor	5
	Hysteresis length	50
Diagnostics menu		
	Diagnostic port baud output	D (115200)
	Diagnostic output	C (Wave)

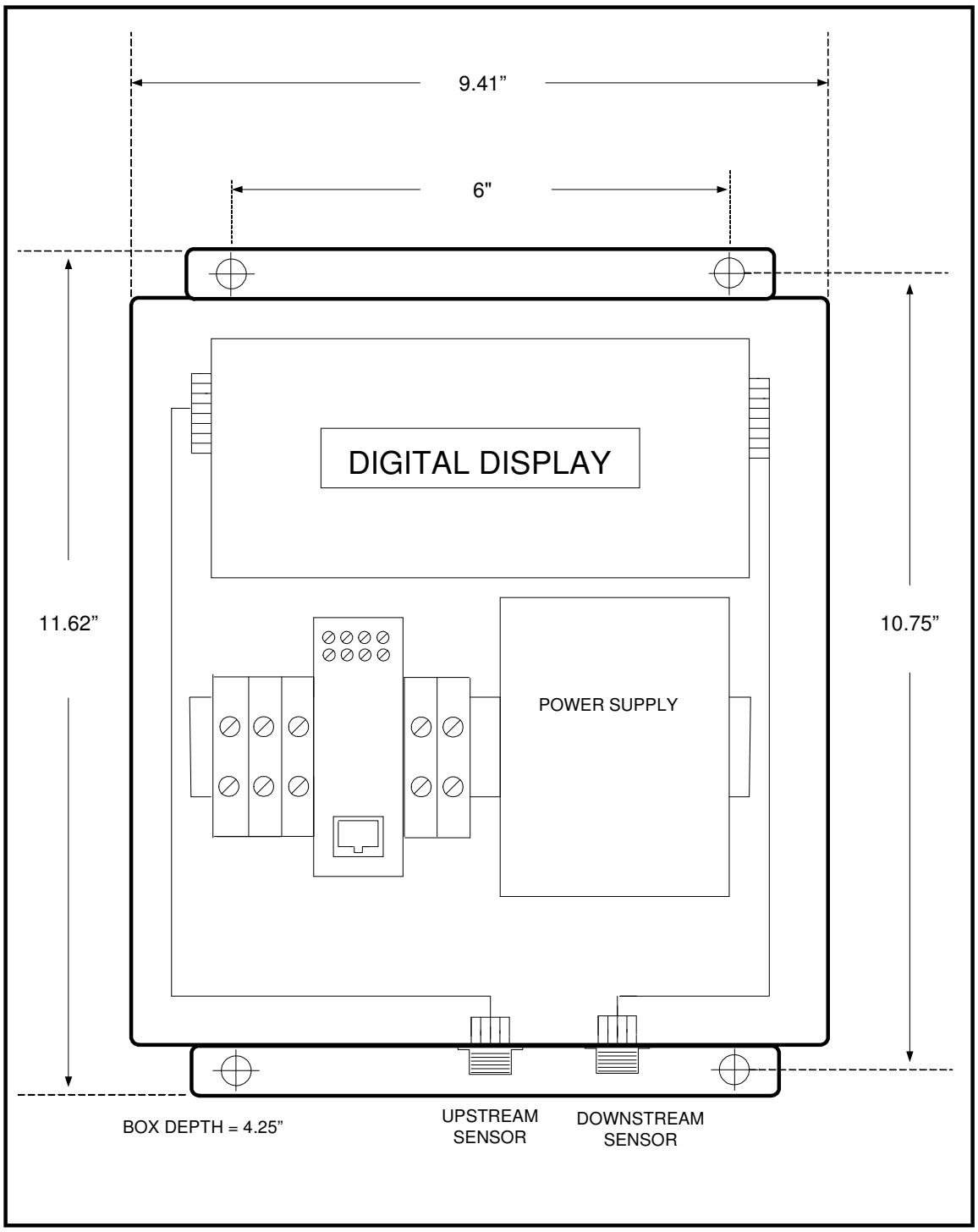
Wiring Diagram



Sensor Dimensions



Enclosure Dimensions



Menu Flow Chart