

# OWNER'S MANUAL

## AXD 540 Micromanometer



**ALNOR**<sup>®</sup>

TSI Incorporated

---

---

## LIMITATION OF WARRANTY AND LIABILITY

Seller warrants the goods sold hereunder, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for twenty-four (24) months, or the length of time specified in the operator's manual, from the date of shipment to the customer. This warranty period is inclusive of any statutory warranty. This limited warranty is subject to the following exclusions:

- a. Hot-wire or hot-film sensors used with research anemometers, and certain other components when indicated in specifications, are warranted for 90 days from the date of shipment.
- b. Parts repaired or replaced as a result of repair services are warranted to be free from defects in workmanship and material, under normal use, for 90 days from the date of shipment.
- c. Seller does not provide any warranty on finished goods manufactured by others or on any fuses, batteries or other consumable materials. Only the original manufacturer's warranty applies.
- d. Unless specifically authorized in a separate writing by Seller, Seller makes no warranty with respect to, and shall have no liability in connection with, goods which are incorporated into other products or equipment, or which are modified by any person other than Seller.

The foregoing is IN LIEU OF all other warranties and is subject to the LIMITATIONS stated herein. **NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE.**

TO THE EXTENT PERMITTED BY LAW, THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF SELLER'S LIABILITY FOR ANY AND ALL LOSSES, INJURIES, OR DAMAGES CONCERNING THE GOODS (INCLUDING CLAIMS BASED ON CONTRACT, NEGLIGENCE, TORT, STRICT LIABILITY OR OTHERWISE) SHALL BE THE RETURN OF GOODS TO SELLER AND THE REFUND OF THE PURCHASE PRICE, OR, AT THE OPTION OF SELLER, THE REPAIR OR REPLACEMENT OF THE GOODS. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES. SELLER SHALL NOT BE RESPONSIBLE FOR INSTALLATION, DISMANTLING OR REINSTALLATION COSTS OR CHARGES. No Action, regardless of form, may be brought against Seller more than 12 months after a cause of action has accrued. The goods returned under warranty to Seller's factory shall be at Buyer's risk of loss, and will be returned, if at all, at Seller's risk of loss.

Buyer and all users are deemed to have accepted this LIMITATION OF WARRANTY AND LIABILITY, which contains the complete and exclusive limited warranty of Seller. This LIMITATION OF WARRANTY AND LIABILITY may not be amended, modified or its terms waived, except by writing signed by an Officer of Seller.

### Service Policy

Knowing that inoperative or defective instruments are as detrimental to TSI as they are to our customers, our service policy is designed to give prompt attention to any problems. If any malfunction is discovered, please contact your nearest sales office or representative, or call Customer Service department at (800) 424-7427 (USA) and (1) 651-490-2811 (International).

---

---

## Table of Contents

General Description.....	4
Safety .....	5
Setting-Up.....	6
Detailed Operation.....	9
Maintenance .....	16
Service and Calibration .....	17
Troubleshooting.....	25
DIP Switch Settings.....	27
Specifications .....	29

---

## **SECTION 1**

### **General Description**

The AXD 540 Micromanometer measures pressure, calculates velocity when used with a pitot probe, and calculates averages of pressure or velocity readings. It has an adjustable time constant to make fluctuating measurements easier to read on the display. A printout of readings is available when using the optional MicroPrinter Portable Printer with the AXD 540.

The AXD 540 ships in a soft pouch that holds the meter, batteries, a calibration sheet, and this owner's manual.

The AXD 542 Kit ships in a soft-sided carrying case that holds the AXD 540 meter, an 18-inch pitot probe, static pressure probes, duct plugs, batteries, a calibration sheet, and this owner's manual.

---

## **SECTION 2**

### **Safety**

When using the AXD 540 to check pressure or velocity values, make certain that you can safely raise and hold the instrument while making measurements. Be especially careful when working on a ladder.

Observe all necessary precautions so that the unit does not become caught in moving machinery or touch any exposed electrical wiring.

Use this instrument only for measurements in air.

---

## SECTION 3

### Setting Up

#### **Supplying Power to the AXD 540**

The AXD 540 can be powered in one of two ways: four size AA batteries or the optional AC adapter.

#### **Installing the Batteries**

Insert four AA batteries as indicated by the diagram located on the inside of the battery compartment. The unit is shipped with alkaline batteries. The AXD 540 is designed to operate with either alkaline or NiCd rechargeable batteries. Carbon-zinc batteries are not recommended because of the danger of battery acid leakage. Typical battery life at 20°C is 40 hours for alkaline batteries, or 15 for NiCd batteries.

#### **Using the Optional AC Adapter**

The optional AC adapter allows you to power the AXD 540 from an AC outlet. When using the AC adapter, the batteries (if installed) will be bypassed. The AC adapter is **NOT** a battery charger.

## Selecting the Display Units

The AXD 540 is capable of displaying the measured values in several different measurement units, as shown in the table below.

**Table 3-1: Display Units**

<b>Pressure</b>	<b>Velocity</b>
in. H <sub>2</sub> O mmHg Pa	ft/min m/s

If you wish to change the display units on your AXD 540, see “Section 8, DIP Switch Settings.”

## Changing the Baud Rate

The AXD 540 has a variable baud rate that is used when printing information from the instrument to the portable printer. By increasing the baud rate, the data will be printed faster. The baud rate is displayed during the initial power-up sequence. To change the baud rate, press and hold either arrow key during the power-up sequence while the baud rate is displayed. Release the key when the unit beeps twice. Use the

arrow keys to scroll through the options (1200, 2400, 4800, 9600, 19200) then press the ↵ key to select the value that is on the display.

### **Connecting the Portable Printer**

To connect the optional portable printer to the AXD 540, locate the printer interface cable (supplied with the printer) and connect the 9-pin end labeled “PRINTER” to the printer and the other end to the data port of the AXD 540. If the printer prints question marks (?????), asterisks (\*\*\*\*\*), or random characters, reset it by turning it off and then on again.



---

## **SECTION 4**

### **Detailed Operation**

#### **Keypad Functions**

When pressing the keys on the front panel, the AXD 540 will beep to confirm the function. If you press a key and the AXD 540 does not beep, it does not allow that function during the selected mode. The beep function can be disabled by changing a DIP switch (see Section 8).

#### **ON/OFF Key**

Use the ON/OFF key to turn the AXD 540 on and off. When the instrument is first turned on it goes through a preprogrammed power-up sequence that includes an internal self-check. First, all displayable items will appear on the LCD. If a problem is detected, the display will light 'SErr' for one second and then 'CAL' to indicate that it should be returned for servicing and calibration. After completing the internal self-check, the unit will display the approximate percentage of battery life remaining and baud rate.

The value for the percentage of battery life remaining is accurate for alkaline batteries only.

### **Auto Shut Off**

The AXD 540 is designed to automatically shut off after 10 minutes if no keys have been pressed.

### **$\Delta P$ (Pressure) Key**

Press the  $\Delta P$  key to display pressure measurements (the AXD 540 will automatically start in pressure mode). The pressure will be displayed in inches H<sub>2</sub>O, mm Hg, or Pa depending on the setting of DIP switches #3 and #4 (see Section 8).

To measure pressure, tubing must be connected to the pressure ports on the top of the unit. Connect the other ends of the tubing to the measurement device or pressure source, with the more positive pressure connected to the port marked '+' and the more negative pressure connected to the port marked '-'.

## **Zeroing Pressure**

If the zero reading of pressure has drifted, the pressure function can be easily re-zeroed. To reset the zero, first make sure that both pressure ports are exposed to ambient pressure.

Press and hold the  $\Delta P$  key for at least three seconds. The AXD 540 will beep and the display will show “0 in. H<sub>2</sub>O” or whatever units have been selected. When the pressure key is released, the pressure will be re-zeroed.

## **VEL (Velocity) Key**

Press the VEL key to display velocity. The velocity will be displayed in ft/min or m/s depending on the setting of DIP switch #1 (see Section 8). Velocity is calculated based on the equation  $\text{Velocity} = 4005 \cdot \sqrt{\text{Pressure}}$ .

## **Zeroing Pressure in Velocity Mode**

The pressure transducer can be zeroed while reading velocity. To reset the zero, first make sure that both pressure ports are exposed to ambient pressure.

Press and hold the  $\Delta P$  key for at least three seconds. The AXD 540 will beep and the display will show “0 in. H<sub>2</sub>O” or whatever units have been selected. When the velocity key is released, the pressure will be re-zeroed.

### **TC (Time Constant) Key**

Momentarily press and release the TC key to view the current time-constant setting. To change the time-constant, press the  $\uparrow$  or  $\downarrow$  key to change the value and press  $\leftarrow$  to accept. The available time-constant choices are: 1, 2, 5, 10, 15 and 20 seconds.

The time-constant is an averaging period which can be used to dampen readings in turbulent air flows. The AXD 540 display is updated every second; however, the reading displayed is the average over the last time-constant period. For example, if the current time-constant is set to 10 seconds, the display will update every second, but it will be the average over the last 10 seconds. This is also called a 10-second “moving average.”

## **Arrow Keys ↑↓**

The arrow keys are used to scroll through available choices.

## **↵ Key**

The ↵ key is used to add the currently displayed reading to a stored running average. This reading could be pressure or velocity depending on what is on the display. When the ↵ key is pressed, “SAMPLE” will light up on the display, and a countdown the length of the time constant begins and is displayed on the display. At the end of the countdown, the sample number is displayed for a second, then the value stored, and the instrument returns to measuring mode.

## **AVE Key**

The **AVE** key is used to view the average of samples that have been taken. Press the **AVE** key to display the average of the stored values for the measurement type currently displayed. The message “AVERAGE” will appear along with a number indicating how many values were averaged. The average value is then displayed for one second. To keep displaying the average value, press and hold the **AVE** key. Press the  $\downarrow$  key to return to measuring mode and delete all stored values. You can store additional values after the **AVE** key has been pressed. The next time the **AVE** key is pressed, the additional values are averaged with those already accumulated. When the AXD 540 is turned off, all stored values are cleared.

## **Printer Port**

Data is automatically transmitted to the printer port when the  $\downarrow$  is pressed. If you have the portable printer connected, the readings will be printed.

Press the ↵ key to print the value shown on the display to the printer. To print out the average of the stored pressures and velocities, press the **AVE** key. Press the ↵ key to clear out the storage buffer and to return to the run mode.

---

---

## **SECTION 5**

### **Maintenance**

The AXD 540 requires very little maintenance to keep it performing well.

#### **Cases**

If the instrument case or storage case needs cleaning, wipe it off with a soft cloth. Never submerge the AXD 540 in any liquid.

#### **Storage**

When storing the AXD 540 for more than a month, removing the batteries is recommended to prevent possible damage due to battery leakage.



---

## **SECTION 6**

### **Service and Calibration**

Please return your Product Registration Card immediately. This allows us to send service reminders, special offers, and important information about your product.

Before sending your instrument for calibration or repair, you should call Customer Service. The service department will provide you with the cost of service or calibration, Return Material Authorization (RMA) number, and shipping instructions.

Please have the following information available when you call:

- Owner's name, address, and phone number
- Billing address, if different and applicable
- Instrument name and model
- Serial number
- Date of purchase
- Where purchased

TSI recommends that you keep a “calibration log” and keep all records of service on your instrument.

### **Factory Calibration**

To maintain a high degree of accuracy in your measurements, TSI recommends that you return your instrument to the factory for annual calibration. For a nominal fee, we will calibrate the unit and return it to you with a NIST (US National Institute of Standards and Technology) traceable certificate. This “annual checkup” assures you of consistently accurate readings; it is especially important in applications where strict calibration records must be maintained.

Send the instrument to TSI prepaid. Securely package your instrument in a strong container surrounded by at least 2 inches (5 cm) of suitable shock-absorbing material. Include a purchase order that clearly shows the instrument model number and serial number, a contact name, phone, fax number, and RMA number. Mark the outside of your shipping

container with the RMA number. This will expedite processing of your instrument when we receive it.

### **Field Calibration**

The AXD 540 can be calibrated in the field with a pressure reference at least as accurate as the AXD. When DIP switch 6 is switched to ON the instrument will operate off the field calibration values. Switching it to OFF will reset it to the factory values. The procedure for field calibration is as follows:

1. Prepare the equipment to calibrate the AXD. Connect a squeeze bulb to a piece of tubing, put a T-shaped fitting at the end of the tubing, and connect two more pieces of tubing to the fitting. These pieces of tubing will be connected to the AXD and the other measurement device.
2. With the power OFF, remove the batteries and push DIP switch #6 to ON. To return to factory calibration at any time, turn DIP switch #6 off while the AXD is off. Reinstall the batteries

and the battery cover. Turn the AXD on.

3. Press the VEL and TC keys simultaneously, releasing them when the AXD beeps. 'CAL' should light up on the display for 2 seconds, followed by a zero flashing on the display.
4. Leave both pressure ports open to ambient air. Make sure that there is no significant air flow past the pressure ports.
5. When ready to take the zero reading, press and hold the ↵ key to start a countdown on the display. Release the ↵ key when '0' shows on the display. If the key is released at any other time, the calibration point is not saved and this step must be repeated. If the calibration point was saved successfully, '-3' will show on the display.
6. Connect one end of the tubing to the '-' port of the AXD and the other end to the '-' port of the pressure reference device. Squeeze the bulb to apply a pressure of 3 inches H<sub>2</sub>O (750 Pa) to

the '-' port of the AXD and the other pressure reference device. Testing at the factory indicates that a pressure between 2 and 4 inches H<sub>2</sub>O (500 and 1000 Pa) is acceptable, but 3 inches H<sub>2</sub>O (750 Pa) will give the best accuracy.

7. When ready to take the -3 reading, press and hold the ↵ key to start a countdown on the display. Release the ↵ key when '0' shows on the display. If the key is released at any other time, the calibration point is not saved and the step must be repeated. If the calibration point was saved successfully, '-3.00' will show on the display.
8. Press the up and down arrows to change the display to read the same as the pressure reference device. Press the ↵ key to accept the value on the display. If the calibration point was successful, '7' will show on the display.
9. Connect one end of the tubing to the '+' port of the AXD and the other end to the '+' port of the pressure reference

device. Squeeze the bulb to apply a pressure of 7 inches H<sub>2</sub>O (1750 Pa) to the '+' port of the AXD and the pressure reference device. Testing at the factory indicates that a pressure between 6 and 8 inches H<sub>2</sub>O (1500 and 2000 Pa) is acceptable, but 7 inches H<sub>2</sub>O (1750 Pa) will give the best accuracy.

10. When ready to take the +7 reading, press and hold the ↵ key to start a countdown on the display. Release the ↵ key when '0' shows on the display. If the key is released at any other time, the calibration point is not saved and the step must be repeated. If the calibration point was saved successfully, '7.00' will show on the display.
11. Press the up and down arrows to change the display to read the same as the pressure reference device. Press the ↵ key to accept the value on the display. If the calibration point was successful, '14' will show on the display.

12. Squeeze the bulb to apply a pressure of 14 inches H<sub>2</sub>O (3500 Pa) to the '+' port of the AXD and the pressure reference device. Testing at the factory indicates that a pressure between 13 and 15 inches H<sub>2</sub>O (3250 and 3750 Pa) is acceptable, but 14 inches H<sub>2</sub>O (3500 Pa) will give the best accuracy.
13. When ready to take the +14 reading, press and hold the ↵ key to start a countdown on the display. Release the ↵ key when '0' shows on the display. If the key is released at any other time, the calibration point is not saved and the step must be repeated. If the calibration point was saved successfully, '14.00' will show on the display.
14. Press the up and down arrows to change the display to read the same as the pressure reference device. Press the ↵ key to accept the value on the display. 'CAL' will light up on the display to indicate that the field calibration was finished successfully.

15. Turn off the AXD and then turn it back on to initialize the new calibration data.



---

---

## SECTION 7

### Troubleshooting

Table 7-1 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the AXD 540. If your symptom is not listed, or if none of the corrective actions solve your problem, please contact TSI.

**Table 7-1: Troubleshooting the AXD 540**

<b>Symptom</b>	<b>Possible Causes</b>	<b>Corrective Action</b>
No display	Unit not switched on	Switch on the unit.
	Low or dead batteries	Replace the batteries or plug in the AC adapter.
Display reads "CAL"	The AXD 540 has detected an internal fault	Return to factory for service.
	User calibration DIP switch #6 turned on.	Set DIP switch #6 to off. See Section 8.

<b>Symptom</b>	<b>Possible Causes</b>	<b>Corrective Action</b>
Display reads "LO"	Low battery charge	Replace or recharge batteries.
	Wrong AC adapter	Replace with the correct AC adapter.
	Low AC line voltage	Correct the AC line voltage or use batteries.
	Dirty battery contacts	Clean the battery contacts.
Display says "OVER"	The pressure or velocity is too high	Use an alternate measurement method.

### **WARNING!**

The pressure sensor is protected from damage up to 7 psi (48 kPa or 360 mm Hg). At higher pressures it can burst!

---

## SECTION 8

### DIP Switch Settings

To access the DIP switches, remove the batteries from the battery compartment. On the inside of the battery compartment, there is a window with eight DIP switches. Table 8-1 shows the functions for each switch.

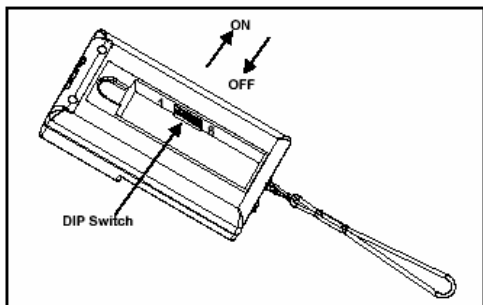
---

#### Caution

---

Make certain that power is turned off before changing DIP switch settings.

---



**Figure 8-1: DIP Switch Location**

**Table 8-1: DIP Switch Settings**

<b>Switch</b>	<b>Function</b>	<b>OFF</b>	<b>ON</b>
1	Velocity	ft/min	m/s
2	Reserved	Reserved	Reserved
3	Pressure	in. H <sub>2</sub> O	Pa and mm Hg
4	Pressure*	Pa	mm Hg
5	Reserved	Reserved	Reserved
6	Calibration	Factory Calibration	User Calibration
7	Beep	Beep Disabled	Beep Enabled
8	Reserved	Reserved	Reserved

The ON position is away from the batteries and OFF is towards the batteries.

\* To display pressure in Pa or mm Hg, DIP switch #3 must be in the ON position.

---

---

## Specifications

*Specifications are subject to change without notice.*

### **PRESSURE**

Range:	-5 to +15 in. H <sub>2</sub> O (-1245 to 3735 Pa, -9.3 to 28 mmHg)
Accuracy:	±1% of reading ± 0.005 in. H <sub>2</sub> O (±1 % of reading ±1 Pa, ±1 % of reading ± .009 mmHg)
Resolution:	0.001 in. H <sub>2</sub> O (1 Pa, .001 mm Hg)

### **VELOCITY**

Range <sup>1</sup> :	250 to 15,500 ft/min (1.27 to 78.7 m/s)
Accuracy <sup>2</sup> :	±1.5% of reading at 2,000 ft/min (±1.5% of reading at 10.16 m/s)

### **UNITS**

Pressure:	in. H <sub>2</sub> O, Pa, mm Hg
Velocity:	ft/min, m/s

### **INSTRUMENT TEMPERATURE RANGE**

Operating range:	32 to 158°F (0 to 70°C )
Storage range:	-40 to 185°F (-40 to 85°C )

### **AVERAGING CAPABILITY**

Range:	Up to 255 values each of pressure and velocity
--------	--

### **TIME CONSTANT**

Values:	1, 5, 10, 15, or 20 seconds
---------	-----------------------------

### **POWER REQUIREMENTS**

Batteries:	Four AA-size alkaline or NiCd rechargeable
------------	--

AC adapter: 7 VDC nominal, 300 mA  
Approx. battery life: 40 hours (alkaline), 15 hours (NiCd)

## **PHYSICAL**

External dimensions: 3.5 in x 6.6 in x 1.6 in  
(89 mm x 168 mm x 41 mm)  
Weight: 0.72 lb (0.33 kg)  
Display: 4-digit LCD, 0.6 in (15 mm) digit  
height

## **PRINTER INTERFACE**

Type: Serial  
Baud rate: 1200, 2400, 4800, 9600, and 19200

- 1 Pressure velocity measurements are not recommended below 1,000 ft/min (5.0 m/s) and are best suited to velocities over 2,000 ft/min (10.0 m/s).
- 2 Accuracy is a function of converting pressure to velocity. Conversion accuracy improves when actual pressure values increase.





---

TSI Incorporated  
Alnor Products  
500 Cardigan Road  
Shoreview, MN 55126 USA  
Toll Free (800) 424-7427  
Telephone (651) 490-2811  
Fax (651) 490-3824  
[www.alnor.com](http://www.alnor.com)  
[customerservice@alnor.com](mailto:customerservice@alnor.com)

July 2003  
Printed in USA  
Part No. 1980473, Rev B  
© Copyright 2003  
TSI Incorporated