

P-TRAK® Ultrafine Particle Counter

Model 8525

TRAKPRO™ Data Analysis Software enclosed

Operation and Service Manual

1980380, Revision K
February 2009



TRUST. SCIENCE. INNOVATION.

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- 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.
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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 TSI at (800) 874-2811 (USA) or (001 651) 490-2811 (International).

Trademarks

P-TRAK[®] and TRAKPRO[™] are trademarks of TSI Incorporated.

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To obtain any of the listed Application Notes, contact TSI at:
U.S. (800) 874-2811/(651) 490-2811, Fax: (651) 490-3824
International (001 651) 490-2811, Fax: (001 651) 490-3824

These Application Notes can also be found under TSI's web site:
<http://www.tsi.com>



Safety Information

When operated according to the manufacturer's instruction, this device is a Class I laser product as defined by U.S. Department of Health and Human Services standards under the Radiation Control for Health and Safety Act of 1968. A certification and identification label like the one shown below is affixed to each instrument.

CLASS 1 LASER PRODUCT
THIS PRODUCT IS IN COMPLETE
COMPLIANCE WITH 21 CFR
1040.10 AND 1040.11

There are no user-serviceable parts inside this instrument. Performing services other than those described in this manual may result in exposure to harmful (invisible) laser radiation. A warning label like the one shown below is affixed to the internal laser device.

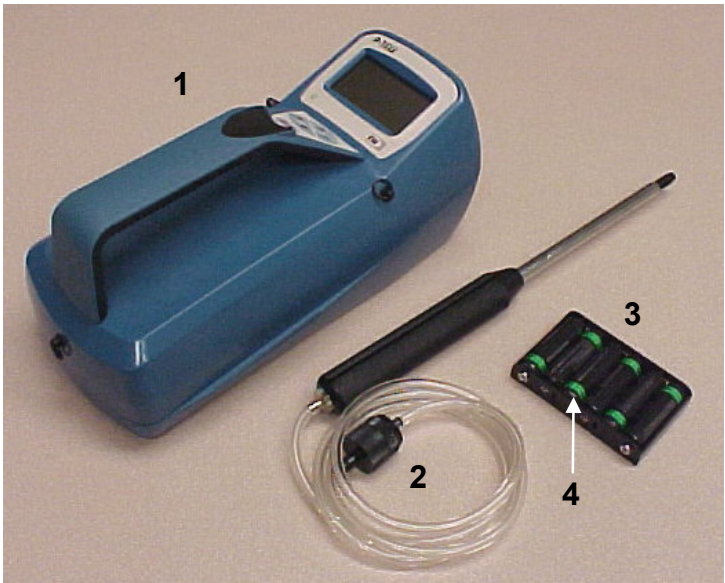
**DANGER: INVISIBLE LASER
RADIATION WHEN OPEN. AVOID
DIRECT EXPOSURE TO BEAM.
WARNING: NO USER SERVICEABLE
PARTS INSIDE. REFER SERVICING
TO QUALIFIED PERSONNEL.**

Chapter 1

Unpacking and Parts Identification

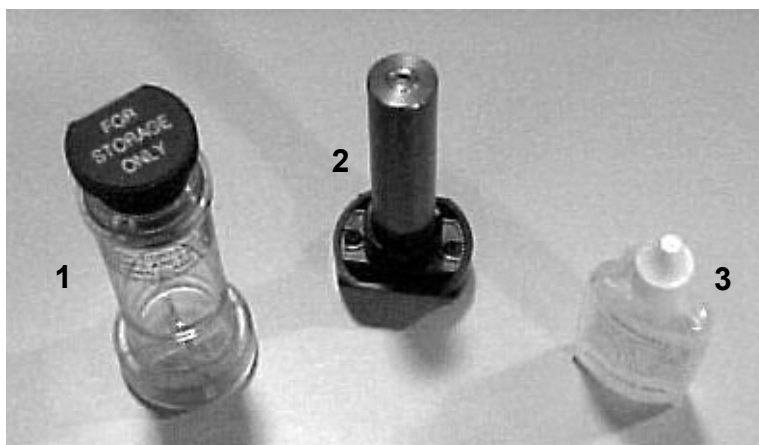
Unpacking the P-TRAK® Ultrafine Particle Counter

Carefully unpack the Model 8525 P-TRAK® Ultrafine Particle Counter from the shipping container. Use the tables and illustrations below to make certain that there are no missing components. Contact TSI immediately if anything is missing or damaged.



**Figure 1-1: Model 8525 P-TRAK® Ultrafine Particle Counter
With Inlet Probe Assembly, Battery Pack, and Batteries**

Quantity	Item Description	Part/Model	Reference
1	P-TRAK® Ultrafine Particle Counter	N/A	1
1	Probe assembly, consisting of telescoping probe, sample tube, and inlet screen assembly	801622 801615 801616	2
1	Battery holder	801623	3
6	Battery, AA, alkaline	N/A	4
1	Carrying case	801613	(not shown)



**Figure 1-2: Alcohol Fill Capsule with Storage Cap,
Alcohol Cartridge, Alcohol Bottles and Shoulder Strap**

Quantity	Item Description	Part/Model	Reference
1	Alcohol fill capsule and storage cap.	1083070	1
1	Alcohol cartridge	801624	2
16	30 ml alcohol bottles (1 shown)	2918011	3



Figure 1-3: Mesh Storage Bag with Spare Wicks, Computer Cable, Zero Filters and DB9/DB25 Adapter

Quantity	Item Description	Part/Model	Reference
1	Mesh bag	N/A	1
2	Spare wick kit	N/A	2
1	Computer cable, RJ45/DB9	800563	3
2	HEPA zero filter, with adapter	801625	4



Figure 1-4: Calibration Certificate, Operation and Service Manual, TRAKPRO™ Software

Quantity	Item Description	Part/Model	Reference
1	Calibration Certificate	N/A	1
1	Operation and Service Manual	1980380	2
1	TRAKPRO™ Software	1090014	3

Optional Accessories

The following table lists optional accessories available for the P-TRAK® Ultrafine Particle Counter.

Quantity	Item Description
1	AC adapter for P-TRAK® particle counter (115V only)
1	Portable printer

Spare/Replacement Parts

The following items may be purchased as spare or replacement parts.

Item Description	Part Number
Alcohol wicks with screens (Pkg. of 10)	8023
Tubing, sample, 4' x 1/8", Tygon	801615
Inlet screen assembly	801616
Alcohol, 16 qty., 30 ml bottles	2918011

Chapter 2

Setting Up

Supplying Power to the P-TRAK® Particle Counter

The Model 8525 P-TRAK® Ultrafine Particle Counter may be powered in one of two ways. The standard configuration instrument is sold with a battery holder containing 6, AA alkaline batteries. An optional AC adapter may also be used to power the instrument when operating in a fixed location.

Installing the Batteries

To install the battery holder, first install the 6 individual AA batteries into the pack, noting the battery polarity as marked on the inside of the battery holder. Remove the battery compartment door by pressing in and pulling out on the two locking tabs. Next, install the battery pack (battery side down) into the battery compartment as shown in Figure 2-1, putting the top of the pack (the side with the two contacts extending from the body of the pack) down first and snapping the rest of the pack in place. Finally, replace the battery compartment door.

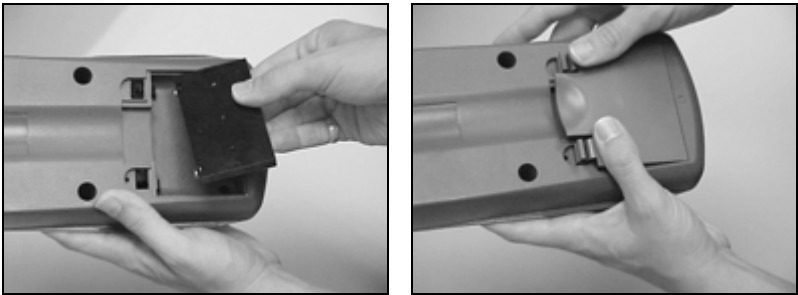



Figure 2-1: Install Battery Pack into Battery Compartment

	CAUTION
	Avoid forcing the battery pack into place. The battery pack fits correctly in only one orientation. When installed properly, the batteries will face <i>down</i> into the compartment.

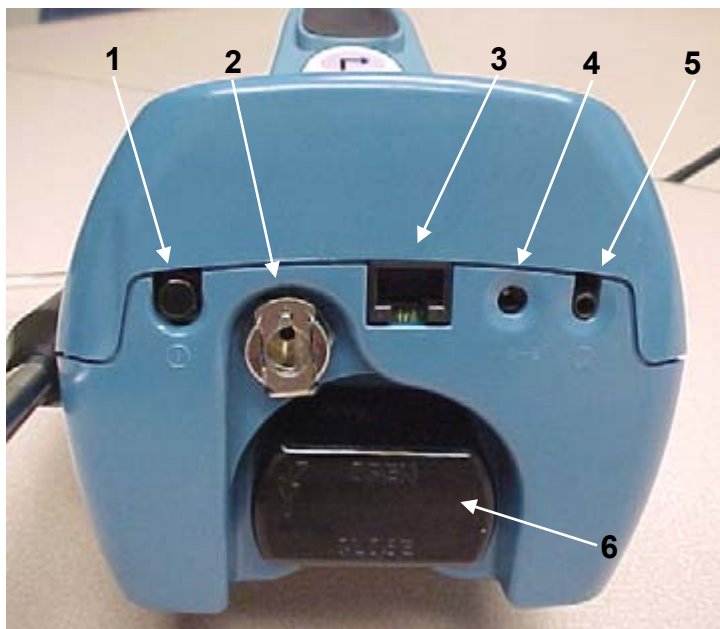


Figure 2-2: The Back of the Instrument

1. On/Off switch	4. AC Adapter socket
2. Inlet quick-connect fitting	5. Headphone jack
3. Communications port	6. Alcohol cartridge

Using the AC Adapter

The AC adapter allows you to power the P-TRAK® particle counter from an AC wall outlet. When using the AC adapter, the batteries (if installed) will be bypassed. The AC adapter will not charge the batteries.

The P-TRAK® particle counter has an internal, non-user accessible battery that is used for battery back-up of logged data when the instrument is turned off. Removing/changing the alkaline batteries or disconnecting the AC adapter will not cause data to be lost. This backup battery will last for years. TSI will install a new battery, if necessary, when the unit is returned to the factory for service.

Charging and Installing the Alcohol Wick

Cautions Before Proceeding



WARNING

Isopropyl Alcohol is hazardous material. Do **not** ingest or allow alcohol to contact your eyes or skin. Refer to the Material Safety Data Sheet (MSDS) located in the box of alcohol for handling precautions and first aid procedures.

Note: *Always recap alcohol containers immediately to prevent absorption of moisture and the escape of fumes.*



Caution

The CO sensor in some models of TSI IAQ monitors may be adversely affected when exposed to isopropyl alcohol vapors released from TSI instruments utilizing condensation particle counting (CPC) technology. For maximum performance, keep CO sensors away from CPC-based instruments utilizing isopropyl alcohol.

The P-TRAK[®] particle counter consumes high-purity isopropyl alcohol at a rate of about 1 ml per hour. The alcohol is used to grow microscopic particles in the air into larger droplets that are easier to detect and count. Refer to the TSI web site, for details on how the P-TRAK[®] particle counter works (www.tsi.com).

The isopropyl alcohol that is required to properly operate the P-TRAK[®] particle counter must be very high purity "reagent grade" alcohol. Isopropyl alcohol that is available from pharmacies, drug stores, or other consumer outlets is low purity and usually contains significant percentages of water and other substances that can damage the P-TRAK[®] particle counter.

Note: *It is essential to use isopropyl alcohol that is 99.5% pure or better. Do **not** use isopropyl alcohol from any source other than TSI or a TSI-approved supplier. Problems caused by the use of unapproved alcohol are **not** covered under warranty.*

Maintaining an adequate alcohol supply inside the P-TRAK[®] particle counter is critical to its operation and requires strict adherence to the directions that follow.

Locating and Identifying Components

To add alcohol to the P-TRAK[®] particle counter you must first identify and locate the alcohol related components and accessories that are included with the instrument (refer to Figure 1-2, for more information). You will need the following items:

- Isopropyl Alcohol
- Alcohol Fill Capsule
- Storage Cap
- Alcohol Cartridge

Isopropyl alcohol is supplied by TSI in 30 ml plastic bottles. The alcohol fill capsule is located in the P-TRAK[®] carrying case. The alcohol cartridge will also be either in the P-TRAK[®] cartridge cavity or in the alcohol fill capsule, whichever one is **not** holding the storage cap. The storage cap should be either sealing the alcohol fill capsule or inserted into the P-TRAK[®] cartridge cavity.

Filling the Alcohol Fill Capsule

1. Turn the P-TRAK[®] particle counter off.
2. Open the alcohol fill capsule by twisting the storage cap (or alcohol cartridge) $\frac{1}{8}$ turn counter-clockwise. Set the storage cap (or alcohol cartridge) down on a clean surface, with the end standing up, as shown in Figure 2-3.



Figure 2-3: Alcohol Cartridge and Storage Cap

3. Open a bottle of alcohol. Invert the bottle and insert the nozzle end into the alcohol fill capsule as far as possible to make certain that you cannot inadvertently spray alcohol anywhere except down into the capsule.

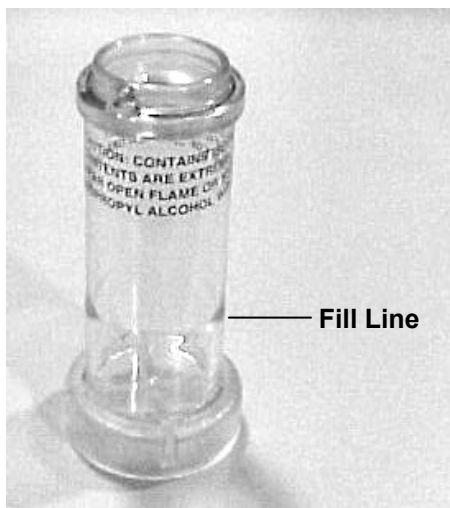


Figure 2-4: Alcohol Fill Capsule

4. Squeeze alcohol into the alcohol fill capsule until the liquid level is even with the scribed fill-line near the base (Figure 2-4). Recap the alcohol bottle.
5. *Make certain the alcohol cartridge is clean!* Insert the alcohol cartridge into the alcohol fill capsule by aligning the groove with the pin and turning $\frac{1}{8}$ turn (clockwise) until it locks into place (Figure 2-5).



Figure 2-5: Insert Alcohol Cartridge into Fill Capsule

6. Set the alcohol fill capsule down and wait a few minutes while the wick inside the cartridge soaks up alcohol.

Installing the Cartridge into the P-TRAK® Particle Counter

1. Remove the alcohol cartridge from the fill capsule and gently shake it to allow excess alcohol to drain back into the capsule. Stop when excess alcohol is no longer dripping. It is not necessary to wait until the outside surface of the alcohol cartridge is dry.
2. Insert the cartridge into the cartridge cavity on the P-TRAK® particle counter. It should slide in easily with little effort. **Do not force it!** Align the tab on the alcohol cartridge with the corresponding tab on the P-TRAK® particle counter, located just above the cartridge cavity.
3. As you approach full insertion, firmly twist the alcohol cartridge clockwise about $\frac{1}{8}$ turn. It should snap into position.



Figure 2-6: Insert Alcohol Cartridge into P-TRAK[®] Particle Counter

Cleaning Up and Final Cautions

1. Recap the alcohol fill capsule using the storage cap.

Note: *Always recap the alcohol fill capsule and other containers immediately to prevent absorption of moisture and the escape of fumes. Dispose of any alcohol that is visibly contaminated.*

2. When the P-TRAK[®] particle counter is stored in the carrying case, you should store the alcohol cartridge in the alcohol fill capsule. The alcohol fill capsule is designed to be a safe transportation and storage container for alcohol. The alcohol cartridge can be left soaking in alcohol indefinitely. Also, install the storage cap into the cartridge cavity to prevent dirt or lint from getting inside the P-TRAK[®] particle counter.
3. **Never** transport or store the P-TRAK[®] particle counter with the alcohol cartridge inside it. Flooding of the optics could occur.
4. **Always** keep the alcohol cartridge clean.
5. **Never** leave the cartridge cavity open longer than necessary. Use the storage cap to cover the cartridge cavity when the P-TRAK[®] particle counter is transported or stored.

6. Keep the storage cap and alcohol cartridge clean. Always set them down with the end standing up. These precautions prevent dirt or debris from entering the instrument and causing operational problems.

Attaching the Inlet Screen Assembly, Sample Tube, and Telescoping Probe to the Instrument

The normal sampling configuration for the P-TRAK[®] Ultrafine Particle Counter consists of the inlet screen assembly, sample tube, and telescoping probe (see Chapter 3, “[Operation](#),” for information on other sampling options).

The inlet screen assembly helps to prevent large particles and fibers from entering the instrument and plugging the internal fittings. *Do **not** operate the P-TRAK[®] particle counter without the inlet screen assembly in place.* To attach the sampling assembly:

1. Make sure the quick-connect fitting is in the “unlocked” position. If the fitting is locked, the sampling tube will not be able to be inserted into the instrument. To unlock the fitting, press up on the tab under the fitting.
2. Insert the inlet screen assembly into the fitting and press it firmly until it snaps into place (see Figure 2-7). It may help to rotate the inlet screen while inserting.
3. Attach one end of the sample tube to the inlet screen assembly barbed fitting.
4. Attach the other end of the sample tube to the barbed fitting on the telescoping probe.



Figure 2-7: Insert Inlet Screen Assembly into Fitting

5. For storage and safe keeping, attach the telescoping probe to *either* side of the instrument. Slide it in lengthwise along the instrument, beginning at the back of the instrument (the alcohol wick end) until it stops (do **not** force it!). See Figure 2-8.



Figure 2-8: Slide Telescoping Probe onto Instrument Case

The P-TRAK[®] particle counter is now ready to operate. Refer to Chapter 3, “[Operation](#),” for information on starting and operating the instrument. The remainder of this chapter contains information on optional setup routines.

Instrument Software and Communications Setup

The P-TRAK[®] particle counter comes with special software called TRAKPRO™ software, which is designed to provide you with maximum flexibility and power when using the P-TRAK[®] particle counter. The following sections describe how to install the software and set up the computer.

Setting up TRAKPRO™ Data Analysis Software

Follow the instructions on the label of TRAKPRO™ Software to install the software on your computer. TRAKPRO™ software contains a very comprehensive Help Function. This utility provides all the necessary information to guide you in all aspects of software operation.

Connecting the P-TRAK[®] Particle Counter to the Computer

Each P-TRAK[®] particle counter comes equipped with an RS-232 cable and a 25-pin to 9-pin serial cable adapter. One end of the cable is a 25-pin D subminiature connector labeled COMPUTER; the other end is an RJ-45 modular connector that connects with the P-TRAK[®] communications port. Serial port connectors always have pins (male) on the computer side.

1. Locate an available RS-232 serial port on your computer: for example, COM1 or COM2.
2. If the port has a 9-pin connector, you do **not** need the adapter. If the port has a 25-pin connector, plug the 9-pin end of the adapter into the RS-232 cable.
3. Connect the RS-232 cable to the available serial port on your computer.
4. Connect the RJ-45 connector to the P-TRAK[®] communications port.

Setting up the Communications Port

To communicate with the P-TRAK[®] particle counter, the software must be configured for the proper COM port. TRAKPRO™ software can be manually set to operate on a specific COM port, or it can automatically find a P-TRAK[®] particle counter that is attached to any COM port. To set up the COM port, do the following:

1. Turn on the P-TRAK[®] particle counter.
2. Start TRAKPRO™ software.

3. Select **I**nstrument Setup, **C**ommunications in TRAKPRO™ software. The following dialog is displayed:

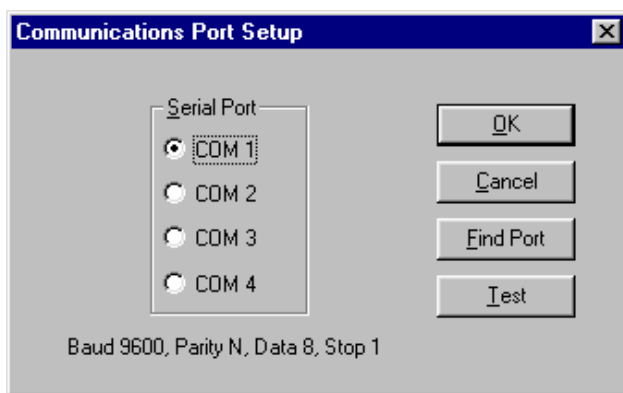


Figure 2-9: Instrument Setup, Communications Dialog Box

4. Select the correct serial port (such as, COM1); then select **T**est. The software will verify that you have set up the communications port correctly and that it is communicating with the P-TRAK® particle counter. The system displays an information message indicating whether it was able to establish communications.
5. As an alternate, you may select **F**ind Port, to have TRAKPRO™ software search the available COM ports, looking for an attached P-TRAK® particle counter.
6. Select **O**K to accept the setup, or **C**ancel to discard the changes.

Connecting the Optional Portable Printer

To connect the portable printer to the P-TRAK® particle counter, do the following:

1. Ensure that the P-TRAK® particle counter and printer are off.
2. Locate the printer interface cable and connect the 9-pin end labeled **PRINTER** to the printer and the other end to the communications port on the P-TRAK® particle counter.
3. Turn on the P-TRAK® particle counter; *then* turn on the printer.

Note: *Always turn on the P-TRAK® particle counter before turning on the printer. If the printer prints question marks (?????), asterisks (*****), or random characters, reset it by turning it off and then on again. If necessary, refer to the Portable Printer Manual.*

Chapter 3

Operation

Overview

The P-TRAK[®] particle counter has three main modes of operation, Survey, Sample, and Data Log.

Survey mode: When the P-TRAK[®] particle counter is first turned on, it will be in Survey mode which is used to display real-time particle concentration readings, in particles per cubic centimeter (pt/cc). The instrument will update the displayed concentration once each second. This is the most common mode of operation and is used to track sources of ultrafine particles.

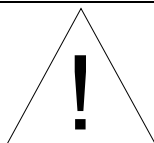
Sample mode: The Sample mode is used to take a 10-second, averaged particle concentration reading. These single data points may be stored in memory and annotated.

Data Log mode: The Data Log mode is used to record particle concentration readings over a period of time, and store these readings in the instrument memory. Data files may be downloaded to a computer for later analysis using TRAKPRO[™] software.

Turning the Instrument On

Press the ON/OFF switch (located at the back of the instrument) and hold for 2 to 3 seconds to turn on the P-TRAK[®] particle counter. The P-TRAK[®] particle counter immediately begins a warm-up, countdown sequence, which takes about 60 seconds. During the warm-up time, the instrument is powering the internal components and coming up to operating temperature. A screen will be displayed identifying the instrument model number and the firmware revision level.

Tilting the Instrument

	<table><tr><th>CAUTION</th></tr><tr><td>To prevent false counts and/or a temporary loss of counting efficiency, the P-TRAK[®] particle counter must be held in a substantially level position during operation. Prolonged operation while tilted can cause alcohol within the instrument to flood the optics. This may result in the need for factory cleaning and servicing.</td></tr></table>	CAUTION	To prevent false counts and/or a temporary loss of counting efficiency, the P-TRAK [®] particle counter must be held in a substantially level position during operation. Prolonged operation while tilted can cause alcohol within the instrument to flood the optics. This may result in the need for factory cleaning and servicing.
CAUTION			
To prevent false counts and/or a temporary loss of counting efficiency, the P-TRAK [®] particle counter must be held in a substantially level position during operation. Prolonged operation while tilted can cause alcohol within the instrument to flood the optics. This may result in the need for factory cleaning and servicing.			

The P-TRAK[®] particle counter contains liquid isopropyl alcohol, which is absorbed into a porous wick. Under most operating conditions, the alcohol remains absorbed in the wick. However, if the instrument is tilted for a period of time, the alcohol will slowly seep out of the wick. This liquid alcohol may be drawn into the optical chamber, causing false particle counts and possibly flooding the optics. This will not permanently damage the instrument, but may result in a temporary loss of performance. To avoid this problem, please observe the following cautions:

- Do **not** tilt the instrument up (into a vertical position) to observe the display. If the instrument is tilted for more than 4 seconds: a tilt error message will be displayed, the beeper will sound, the displayed particle concentration will “blank out” and the pump will be stopped.
- After restoring the instrument to level operation, the tilt error condition will correct itself (the pump will restart and the display will reset).
- If the instrument is tilted during data logging, the instrument may shut down and discontinue logging.
- If the instrument is tilted during the Sample mode, the data point will be discarded.



Daily Zero Check

Before beginning to sample with the P-TRAK[®] particle counter, it is important to verify that the instrument is operating normally. This Daily Zero Check should be performed at least once a day.

1. Turn on the instrument and let it warm up (approximately 60 seconds).
2. Remove the sample tube from the inlet screen assembly (if attached).
3. Attach the supplied zero filter assembly (item #4, Figure 1-3) to the inlet screen assembly.
4. The particle concentration should go to zero in approximately 5 to 10 seconds. Leave the zero filter attached to the instrument for 30 seconds, to make sure the zero reading is stable.

Note: *If the instrument does not go to zero, please refer to Chapter 5, [Troubleshooting](#), for more information.*

The Daily Zero Check cannot be performed when the telescoping sample probe is attached to the instrument. The telescoping joints will cause a small number of particles to be sampled and will invalidate the zero check.

5. Remove the zero filter. Attach the sample tube and telescoping sample probe, as desired. The instrument is now ready for operation.

P-TRAK[®] Particle Counter Keypad

The P-TRAK[®] particle counter is controlled using a simple, 4-way keypad, with Up, Down, Left, and Right keys along with an Enter key. These keys are used to move between menu items, to increase or decrease selected values and to select the desired item/value. When pressing the keys on the front panel, the P-TRAK[®] particle counter beeps to confirm the function. See Figure 3-1.



Figure 3-1: P-TRAK® Particle Counter Keypad and Display

Main Menu

After the instrument has completed its warm-up countdown, the P-TRAK® particle counter will automatically go into the Survey mode and the Main Menu will be displayed.

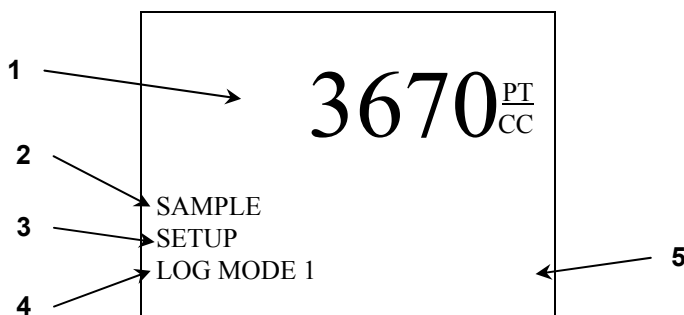


Figure 3-2: Main Menu Screen (sample)

Ref	Description
1	Particle concentration, in units of particles per cubic centimeter.
2	Sample mode. Used for capturing single data points.
3	Setup mode. Used for reviewing logged data, single data points, statistics. Used for changing date/time, log interval, backlight interval, audio function. Used for clearing memory.
4	Log mode (recording data files). Displays current log mode (1, 2, or 3). Used for changing mode and starting data logging.
5	Status area of Main Menu. Used for displaying status and error messages.

Particle Concentration

The P-TRAK[®] particle counter displays the measured particle concentration in units of particles per cubic centimeter (pt/cc). The display updates once per second. The instrument range is from 0 to 500,000 pt/cc.

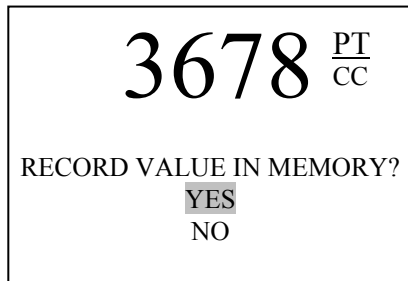
Sample Mode

The SAMPLE mode is the default selection on the Main Menu (the reverse highlight indicates that it is selected). The Sample mode is used to capture a single, 10-second averaged data point.

Instantaneous particle concentrations often fluctuate significantly. When making a measurement, therefore, it is often desirable to dampen out these fluctuations with a short averaging period.

Recording and Saving a Single Data Point

When you press “↵”, with the Sample mode highlighted, the P-TRAK[®] particle counter begins a countdown. During these 10 seconds, it is taking an average reading of the particle concentration. At the end of the averaging period, the following sample screen is displayed:



3678 $\frac{\text{PT}}{\text{CC}}$

RECORD VALUE IN MEMORY?

YES

NO

Figure 3-3: Record Single Data Point

The YES selection is highlighted by default. If you press “↵”, the single data point will be stored in memory. If you scroll down to NO, the data point will be discarded.

Changing the Location Label

Once you choose to save the data point in memory, the P-TRAK[®] particle counter displays the EDIT LOCATION screen. The instrument gives the data point a default name, starting with “LOCATION 01.” The following screen is displayed.

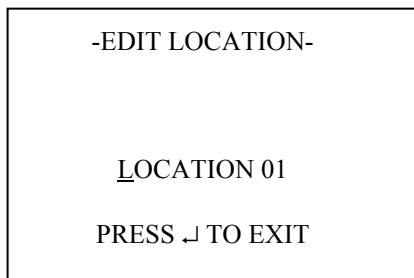


Figure 3-4: Edit Location Label, Single Data Point

If you press “↓”, the instrument will save the data point with the default Location Name (in this case, “Location 01”). If desired, you may change the Location name, up to a maximum of 15 alpha/numeric characters. When done editing, press “↓” to exit and save. The instrument will return to the Survey mode.

Setup Mode

The Setup mode gives you access to a wide range of options for reviewing data, examining statistics and changing operational parameters. When SETUP is selected and “↓” is pressed, the program opens the Setup menu, as shown below:

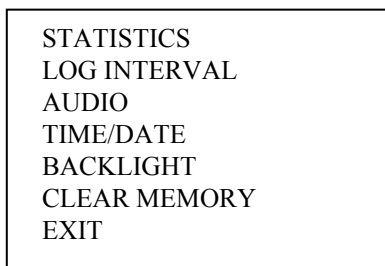


Figure 3-5: Setup Menu

Statistics

The STATISTICS selection gives you access to a sub-menu, which provides a choice of either Logged Test Statistics or Single Point Statistics.

Logged Test Statistics

The Logged Test Statistics screen allows you to review a statistical summary of each data logged test. When the screen is first displayed, it will show the statistics for the most recent test. You may page through and review the statistics for each test in memory. A sample screen is shown below.

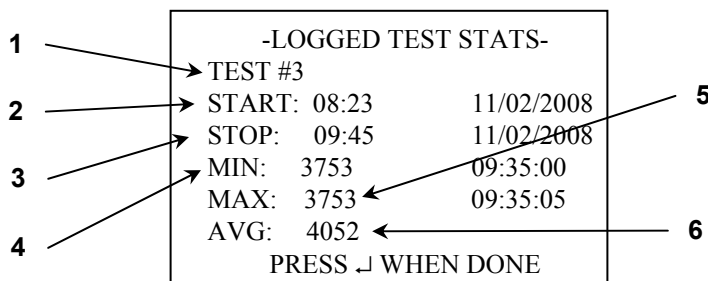


Figure 3-6: Logged Test Statistics

Ref	Description
1	Test number (not user adjustable).
2	Start time and date.
3	Stop time and date.
4	Minimum value during test, along with time at which minimum occurred.
5	Maximum value during test, along with time at which maximum occurred.
6	Average value during logged test, in pt/cc.

Single Point Statistics

The Single Point Statistics screen allows you to review a statistical summary of each recorded single data point. When the screen is first displayed, it will show the information for the most recent single data point. You may page through and review the information for each recorded point. A sample screen is shown below.

-SINGLE POINT STATS-

LOCATION 01
3760 PT/CC
08:22:34 11/02/2008

PRESS ↵ WHEN DONE

Figure 3-7: Single Point Statistics

Log Interval

The Log Interval menu allows you to view the current logging interval used during LOG MODE 1 (see “[Log Mode 2 and 3](#)” section, later in this chapter, for more information about data logging). It also allows you to adjust the log interval to a different value. The menu screen is shown below.

-LOG INTERVAL-

01:00
MIN:SEC

Figure 3-8: Log Interval

The default values for log intervals are set at 1 second, 1 minute, 5 minutes, 15 minutes and 30 minutes. When “↵” is pressed, the program retains the current setting and returns to the Setup menu.

The log interval is both a frequency and an averaging period. For example, when the log interval is set to 5 minutes, readings will be recorded at 5-minute intervals. Each reading will be the average value measured over that 5-minute interval.

The log interval options for LOG MODE 1 may also be programmed using TRAKPRO™ software. Select **Instrument Setup, Parameters**, then **Logging Intervals**, from the TRAKPRO™ software menu. The current settings in the P-TRAK® particle counter will be retrieved and displayed in the dialog box. You may program in new values for each of the five log intervals (within defined limits). Select **Send** to program the P-TRAK® particle counter with the new values.

Note: *This log interval only applies to Log 1 mode, initiated from the instrument keypad. The log interval for Log 2 and Log 3 modes is adjustable only within TRAKPRO™ software.*

Audio

The Audio Output feature on the P-TRAK® particle counter provides an audible feedback which is proportional to the measured particle concentration. When this feature is turned On, you will hear an audio signal which will give you an indication of changing particle concentrations. This feature may be particularly useful when you are attempting to detect highly localized sources of particulate, in a low light condition. A sample screen is shown below.

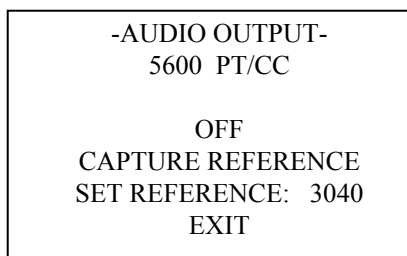


Figure 3-9: Audio Output

The Audio menu allows you to turn the audio output feature OFF/ON and to adjust characteristics of this feature. Note the following characteristics of this function:

- The current, real time particle concentration is displayed at the top of the display.
- The Audio function is turned OFF by default. To turn it ON, use the left/right arrow keys.
- To adjust the reference value to the same as the current ambient concentration, highlight the CAPTURE REFERENCE selection, and press “↵”. You will notice that the real time value and reference value become essentially equal.

- To adjust the reference value manually, move the selection highlight to SET REFERENCE. Then, use the right arrow key to move the highlight to the reference value. Use the up/down arrow to adjust the reference values in increments of 100. When satisfied with the new reference value, use the left arrow key to return to SET REFERENCE.
- When all adjustments are completed, highlight the EXIT selection and press “↵”. This will return you to the SETUP menu.

Time/Date

The P-TRAK[®] particle counter has an internal clock that keeps track of the time of day and the date. The format is HH:MM:SS where HH is the hour in 24-hour format, along with minutes and seconds. It is very important for the P-TRAK[®] particle counter to have the time and date correctly set; otherwise, time and date stamping of recorded data will not be correct.

The time clock is set correctly at the factory (for U.S. Central Standard Time). If it requires adjustment, it may be changed by selecting TIME/DATE from the Setup menu. The following screen is displayed:

-TIME/DATE-
 USE <> FOR POSITION
 USE ^v FOR VALUE

HH:MM:SS 08:25:32

MM/DD/YYYY 11/02/2008

Figure 3-10: Time/Date

When first entering this screen, the first character in the hour (HH) field will have a cursor underneath it. Use the up/down arrows to increment and/or decrement values. Use the left/right arrows to move to the required field. When all adjustments are complete, press the “↵” key to accept the changes and return to the Setup menu.

Programming Time/Date Using TRAKPRO™ Software

The time and date may also be adjusted using TRAKPRO™ software. To program the P-TRAK® particle counter date and time:

1. Make sure the P-TRAK® particle counter is connected to the computer and turned on.
2. In TRAKPRO™ software, select **Parameters**, then **Clock** from the **Instrument Setup** menu. TRAKPRO™ software retrieves the current date and time settings from P-TRAK® particle counter and displays them in the following dialog:

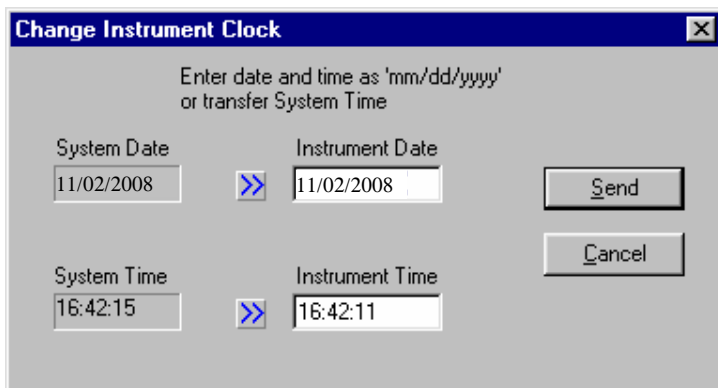


Figure 3-11: Time/Date Programming with TRAKPRO™ Software

3. The system date and time (from the computer) can be transferred to the P-TRAK® particle counter using the “arrows” keys. Alternately, the date and time can be manually entered into the dialog box.
4. Select **Send** to reprogram the P-TRAK® particle counter.

Backlight

The BACKLIGHT option on the Setup menu allows you to adjust how long the display backlight stays on after a key is pressed or an alarm occurs. After the delay, the backlight automatically turns off. To change the backlight delay, use the Up/Down arrows. The options are: No Backlight; 5, 10 and 30 seconds. Press “↵” to select the value and return to the Setup Menu.

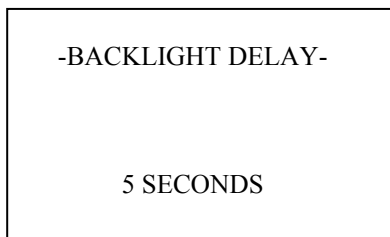


Figure 3-12: Backlight Delay

Note: *Prolonged use of the backlight may severely reduce the overall battery life.*

To edit the backlight delay using TRAKPRO™ software, select **Instrument Setup**, **Parameters**, and **Other**. Follow the onscreen prompts or open the Help Function (F1) for more information.

Clear Memory

The CLEAR MEMORY option on the Setup menu allows you to clear the instrument memory. To preserve data integrity, the P-TRAK® particle counter does not automatically erase the “older” data files. It requires a deliberate step, on your part, to clear the memory.

Note: *Performing this step will erase all logged data files and/or recorded single data points from the instrument memory. There is no reversing this step, once it is performed!*

To clear the memory, select the CLEAR MEMORY option on the Setup menu. After pressing “↵”, the following screen is displayed.

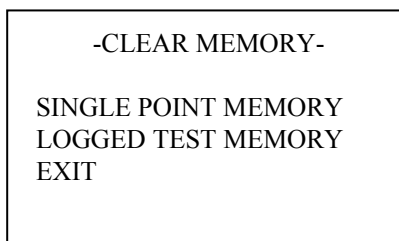


Figure 3-13: Clear Memory Select Screen

The highlighted default selection is Single Point Memory. If you press “↵” at this point, the Single Point Memory will be erased (the Logged Test Memory will be unaffected). Logged Test Memory is cleared in the same manner.

LOG MODE

The third selection on the Main menu allows you to select which data logging mode to use and then to initiate a data logging session. To make changes to the LOG MODE, simply scroll Up/Down to the LOG MODE 1 selection and then adjust the mode using the Left/Right arrows. You may select LOG MODE 1, 2, or 3 (please see the section on “[Log Mode 2 and 3](#),” later in this chapter, for more information about these programmable log modes).

The logging interval for LOG MODE 1 must be adjusted, from the Setup menu, before beginning the logging session. To begin a data logging session, select the LOG MODE and press “↵”. The P-TRAK® particle counter will begin recording logged data into the instrument memory. If LOG MODE 1 was selected, the following screen will be displayed:

4048		$\frac{PT}{CC}$
MIN	4032	08:32:00
MAX	4950	09:27:00
		98 % MEM
LOG MODE 1		↵ TO STOP

Figure 3-14: Log Mode 1

If LOG MODE 2 or 3 was selected, the P-TRAK® particle counter may or may not begin logging immediately, depending upon the setup parameters. See “[Log Mode 2 and 3](#),” in this chapter, for more information.

Log Mode 2 and 3

The P-TRAK® particle counter may be programmed for more sophisticated data logging modes, using TRAKPRO™ software and Log Modes 2 and 3. With Log Modes 2 and 3, you can set the start date, start time, test length, logging interval, number of tests, and the time delay between tests. You program the logging protocols into the P-TRAK® particle counter using the power and simplicity of TRAKPRO™ software. The instrument is then taken to the field, where you simply select Log Mode 2 or Log Mode 3, and begin data logging.

To program a logging protocol for Log Mode 2 or 3:

1. Make sure the P-TRAK[®] particle counter is connected to the computer and turned on.
2. Select **Logging Setup** from the **Instrument Setup** menu. TRAKPRO[™] software retrieves the current settings for Log Modes 2 and 3 from the P-TRAK[®] particle counter and displays them in the following dialog box.

P-Trak Logging Protocols

Serial Number: 8525-11991000
Number Tests Logged: 5
Available Memory %: 100

Start Date (mm/dd/yyyy): 11/02/2008
Start Time (hh:mm): 08:00
Log Interval (mm:ss): 01:00
Test Length (dd:hh:mm): 00:08:00
Number of Tests: 1
Time Between Tests (dd:hh:mm): 00:00:00
Percent Memory Required: 1

Log 2
Channels:
☒ Pt Conc

Log 3
Channels:
☒ Pt Conc

11/03/2008 08:00 05:00 00:08:00 4 00:16:00 1

Send
Cancel

Figure 3-15: P-TRAK[®] Particle Counter Logging Protocols

The following table summarizes the information displayed in the P-TRAK[®] particle counter Logging Protocol dialog box.

Item	Description
Serial Number	Displays the serial number of the P-TRAK [®] particle counter.
Number of tests logged	Displays the number of tests currently logged and stored in the logging instrument.
Available Memory %	Displays the percent of available memory in the P-TRAK [®] particle counter (data logging only; single point memory is not included in this total).
Channels	Displays the channels selected for sampling in LOG 2 and LOG 3 modes (for the P-TRAK [®] particle counter, this is limited to particle concentration).
Start Date	Displays the start date for LOG 2 and LOG 3 modes.
Start Time	Displays the start time for LOG 2 and LOG 3 modes.
Log interval	Displays the log interval for LOG 2 and LOG 3 modes.
Test length	Displays the test length for LOG 2 and LOG 3 modes.
Number of tests	Displays the number of tests for LOG 2 and LOG 3 modes. Selecting more than one test will cause the instrument to cycle through the logging test more than once, separated by the "Time Between Tests."
Time between tests	Displays the time between tests for LOG 2 and LOG 3 modes.
Percent memory required	Displays the percent of logger memory required to perform a LOG 2 or a LOG 3 mode sample. To store the results of a LOG 2 or LOG 3 mode sample, the Available Memory must be equal to or greater than the Percent memory required.

To program the P-TRAK[®] particle counter for Log Mode 2 or 3, do the following:

Item	Description
Channels	Select the channels for which you want to log data. In the case of the P-TRAK [®] particle counter, there is only one channel to select: particle concentration.
Start Date Start Time	Enter the date and time to begin the sample: <ul style="list-style-type: none"> • If you enter a blank for a start date, the sample begins whenever the specified start time occurs. • If you enter a blank for the start time, both start date and start time are ignored, and the sample begins when the operator manually starts the sample.
Log interval	Enter the log interval to use for the test.
Test length	Enter the length for the sample: <ul style="list-style-type: none"> • If you enter a value, the instrument automatically turns off when the last test is complete. • If you enter a blank, the operator must manually stop the sample.
Number of tests	Enter the number of tests to perform.
Time between tests	If you have specified more than one <i>Number of tests</i> , enter the time between tests. If you enter 0 or blank, the next test is started immediately after the last test is complete.

While you are entering values for Log Mode 2 or 3, the *Percent Memory Required* is dynamically updated to show the amount of logger memory required to take the programmed sample. If the protocol you have defined requires more than 100% of memory, you can decrease the amount of memory required by manipulating the following protocol parameters:

- Increase the logging interval.
- Decrease the length for the test.
- Decrease the number of tests.

The settings for each separate Log mode must *not* require more than 100% of the logger memory.

Note: *If the percent memory required is greater than the available memory, TRAKPRO™ software will not allow you to program the Log Mode 2 or 3. It will only accept a protocol which is feasible.*

3. When you have finished defining the parameters for LOG 2 and LOG 3 modes, select **Send**.
4. You can now disconnect the P-TRAK® particle counter and cable from the computer.

Sample Protocol for Log Mode 2 or 3

The following steps describe how to program a sample protocol for Log Mode 2 or 3.

Log Mode 2 sample protocol features:

- The sample protocol for Log Mode 2 is set to take unattended particle concentration readings for one day.
- Logging takes place on 11/02/2008.
- The logging sample begins at 8:00 a.m.
- Logging continues for eight hours.

Log Mode 3 sample protocol features:

- The sample protocol for Log Mode 3 is set up to take unattended particle concentration readings for four days.
- Logging first takes place on 11/03/2008.
- The logging sample begins at 8:00 a.m.
- Logging continues for eight hours.
- The instrument is off for 16 hours, and then repeats an eight hour test for the next three days.

The following graphic gives the appearance of the dialog box displayed in TRAKPRO™ software, with above-described logging parameters.

P-Trak Logging Protocols

Serial Number: 8525-11991000

Number Tests Logged: 5

Available Memory %: 100

Start Date (mm/dd/yyyy): 11/02/2008

Start Time (hh:mm): 08:00

Log Interval (mm:ss): 01:00

Test Length (dd:hh:mm): 00:08:00

Number of Tests: 1

Time Between Tests (dd:hh:mm): 00:00:00

Percent Memory Required: 1

Log 2

Channels: ☒ Pt Conc

Log 3

Channels: ☒ Pt Conc

Start Date (mm/dd/yyyy): 11/03/2008

Start Time (hh:mm): 08:00

Log Interval (mm:ss): 05:00

Test Length (dd:hh:mm): 00:08:00

Number of Tests: 4

Time Between Tests (dd:hh:mm): 00:16:00

Percent Memory Required: 1

Send

Cancel

Figure 3-16: P-TRAK® Particle Counter Logging Example

To program this logging example, do the following:

1. Make sure the P-TRAK® particle counter is connected to the computer and turned on.
2. Select **Logging Setup** from the **Instrument Setup** menu. TRAKPRO™ software retrieves the current settings for Log Modes 2 and 3 from the P-TRAK® particle counter and displays them (as shown in the previous dialog).
3. Enter the following for Log Mode 2 and 3:

Setting	LOG 2	LOG 3
Channels	Particle Conc.	Particle Conc.
Start Date	11/02/2008	11/03/2008
Start Time	08:00	08:00
Log interval	01:00	05:00
Test length	00:08:00	00:08:00
Number of tests	1	4
Time between tests	00:00:00	00:16:00

4. Select **Send**. The logging instrument is programmed for the mode 2 and mode 3 protocols.

5. Note that the LOG 2 test requires 1% of the available memory and LOG 3 requires 1% of the memory. A total of 100% of the memory is available for use.
6. You can now disconnect your P-TRAK[®] particle counter from the computer. Refer to other sections of this Operation and Service Manual for details on making measurements using LOG 2 and LOG 3 modes.

After programming the P-TRAK[®] particle counter with the TRAKPRO[™] Data Analysis Software, take the P-TRAK[®] particle counter to the desired location and turn it on. After warm-up, put it into LOG MODE 2 or LOG MODE 3 (whichever you programmed) using the Left/Right arrow keys. Press the “↵” key to initiate the program.

The following things will happen, depending upon the protocol:

If....	Then....
If you have <i>not set a start time...</i>	...the P-TRAK [®] particle counter will begin logging immediately after the “↵” is pressed. This will happen no matter what is entered for the start date.
If you have set a test start time, but <i>no start date...</i>	...the P-TRAK [®] particle counter will begin at the specified time, regardless of the date.
If you have set a start time and start date which are in the future...	...the P-TRAK [®] pump (and other internal systems) will power down to save battery power, pending the correct starting time and date. The display will return on.
If the test start time is greater than five minutes away...	...the P-TRAK [®] particle counter powers down, as noted above. The green, “power” LED remains lit, to indicate the instrument is turned on. The display shows the current time/date and the start time/date. Several minutes before the start time, the pump (and other internal systems) will turn on, to begin the warm-up period. At the exact start time, the instrument will begin logging data.

If the test start time is less than five minutes away...	...the pump and internal systems do not power down. The current time/date and start time/date are displayed. The instrument begins logging at the correct time.
If the test start date and/or time has passed...	...pressing the “↵” key has no impact. The program will never execute (no data will be logged).
If no test length is set...	...the P-TRAK [®] particle counter samples continuously until the “↵” key is pressed or until the memory is full.
If you press the “↵” key during sampling...	...the program stops data logging.
When a pre-programmed test sequence ends...	...the P-TRAK [®] particle counter automatically returns to the Survey Mode.

Memory Considerations

The P-TRAK[®] particle counter has a great deal of memory and you will not normally have to be concerned with running out. The instrument contains separate memory for the single points and the logged tests (filling up the memory for one type of data will have no affect on the other type).

The P-TRAK[®] particle counter can store approximately 470 single points. It can also store approximately 1000 hours (41 days) of logged tests, when recording at 1 minute logging intervals (the number of hours of logged tests may be more or less, depending upon the logging interval). Those 1000 hours may be separated into as many as 141 tests.

The total test time should be considered when selecting a logging interval. Shorter logging intervals use memory more quickly than longer intervals. The logging interval and the available memory determine the maximum possible duration of a data logging session.

Particle Sampling Configurations

The P-TRAK[®] Ultrafine Particle Counter can be operated in three sampling configurations:

- Sampling through the inlet screen, sample tube, and telescoping probe assembly (standard configuration)
- Sampling through the inlet screen and sample tube
- Sampling through the inlet screen assembly only

Each of these sampling configurations have specific applications, advantages, and disadvantages.

Sampling Through Inlet Screen, Tube, and Probe Assembly

The standard sampling configuration for the P-TRAK[®] particle counter makes use of the inlet screen, sample tube, and telescoping probe. This configuration is the easiest to use and is suitable for a wide range of applications. It has the following features:

Advantages	Disadvantages/Cautions
Allows you to sample a pinpoint source of aerosol.	Small amount of particle loss through sample tube.
Allows you to reach remote locations (ceiling diffusers, etc.).	Slight lag time before response (time it takes for sample to be drawn through probe and tube).
Allows “hands-free” operation (attach probe to instrument case).	

Sampling Through Inlet Screen and Sample Tube

If you desire to pull a sample from a specific location or from a remote location (but do not need the telescoping features of the probe), it may be desirable to remove the probe and use the inlet screen and sample tube only. This configuration has the following features:

Advantages	Disadvantages/Cautions
Allows you to sample particles at a very specific location (pin-point).	Use supplied sample tube only (longer tube may impact sample efficiency).
Allows you to extract a sample from remote location (filter sampling, etc.).	
More efficient sampling (than with telescoping probe attached).	
Slightly faster response to particle concentration changes.	

Sampling Through Inlet Screen Assembly Only

The P-TRAK[®] particle counter must always be operated with the inlet screen assembly in place. This mesh screen prevents large particles and fibers from clogging the sensitive internal components in the instrument. If desired, you may operate the P-TRAK[®] particle counter with *only* the inlet screen and no sampling tubing. This configuration has the following features:

Advantages	Disadvantages/Cautions
Most efficient (least particle loss).	Not able to pinpoint aerosol sources.
Fastest response to particle concentration changes.	
Well suited to area sampling.	

Chapter 4

Maintenance

You can perform routine maintenance on the P-TRAK[®] particle counter using the instructions below. However, you are not able to perform field calibration of the instrument. For this reason, TSI recommends that you return your P-TRAK[®] particle counter to the factory for annual cleaning and calibration. For a reasonable fee, we will quickly clean and calibrate the unit and return it to you in “as new” working condition, along with a Certificate of Calibration. This “annual checkup” helps ensure that the P-TRAK[®] particle counter is always in good operating condition.

Note: *There are no user-serviceable parts inside this instrument. Opening the instrument case may void the warranty. TSI recommends that you return the P-TRAK[®] particle counter to the factory for any required maintenance or service not described in this manual.*

Maintenance Schedule

Your Model 8525 P-TRAK[®] Ultrafine Particle Counter needs very little required maintenance. The few items that are suggested, however, should be done regularly, to ensure reliable operation. Table 4–1 lists the factory recommended maintenance schedule.

Some maintenance items are suggested each time the P-TRAK[®] particle counter is used. Other items are performed based upon usage level, calendar or done as needed.

Table 4–1. Recommended Maintenance Schedule

Item	Frequency
Daily zero check	Daily (or before each use)
Recharge the alcohol wick	Daily (or before each use)
Change the alcohol wick	As needed (see Chapter 5, “Troubleshooting”)
Clean inlet screen assembly	Monthly, or as needed
Return to factory for cleaning and calibration	Annually

Daily Zero Check

The Daily Zero Check ensures that the instrument and alcohol cartridge are properly assembled and free from leaks. Please see the beginning of

Chapter 3, “[Operation](#),” for detailed instructions on performing the Daily Zero Check.

Recharging the Alcohol Wick

The alcohol wick should be recharged with alcohol at least once a day (depending upon usage). Please see Chapter 2, “[Setting Up](#),” for detailed instructions on recharging the alcohol wick.

Alcohol Cartridge

The alcohol cartridge holds a reservoir of isopropyl alcohol. A porous wick inside the cartridge is soaked with alcohol. Because the alcohol cartridge gets inserted into the cartridge cavity of the P-TRAK[®] particle counter, it is critically important to keep it clean. Any dirt or debris that gets into the P-TRAK[®] particle counter may plug the small internal nozzle and prevent operation. Do **not** allow the black part of the alcohol cartridge to make contact with any surface that may be dirty.

Note: *Keep the storage cap and alcohol cartridge clean. Always set them down with the end standing up.*

Changing the Alcohol Wick

The wick and screen inside the alcohol cartridge may be changed in the field. Two spare wicks and screens are included with the P-TRAK[®] particle counter. Normally, the wick will not need to be changed unless one of the following problems develops:

1. Moisture accumulates in the wick and causes the “Low Alcohol” message to come on even when there is an adequate alcohol supply. This may happen when the P-TRAK[®] particle counter is used extensively for long periods of time, especially in high humidity areas.
2. The wick becomes contaminated with dirt, oil, or other foreign substances. This does not normally happen. However, if the instrument is used to sample particles other than those normally found in ambient air (such as, boiler rooms, combustion aerosol) the wick may become contaminated and need replacement.
3. The fine mesh screen inside the Alcohol Cartridge becomes plugged with foreign material.

When moisture accumulation occurs, the alcohol wick can be removed, allowed to dry, and then re-installed into the alcohol cartridge. If the alcohol wick or screen is contaminated, it should be discarded and replaced with a new one (if it is *not* contaminated, it *may* be reused).

Each new wick has a new screen with it. Note that some discoloration is normal and will not influence performance.

Removing the Wick from the Cartridge

To remove the alcohol wick from the cartridge, grasp the cartridge with both hands, with your thumbs near the seam, and firmly apply pressure as if you wanted to break it into two pieces. The cartridge will snap apart exposing the end of the white Alcohol Wick. See Figure 4-1.



Figure 4-1: Snap Apart Cartridge

After separating the two halves, push the alcohol wick and screen out of the wick retainer cap from the opposite end with the wick removal tool (wood dowel) provided with each new alcohol wick. Do **not** use a pencil point because bits of lead could break off. Allow the small, circular, fine-mesh screen to fall out on the table. See Figure 4-2.

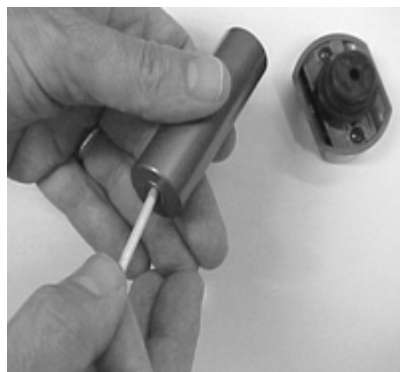


Figure 4-2: Remove Wick and Screen Using Dowel

Hold the screen up to the light and look through it to make sure it is clean. All openings in the mesh should be clear. If any of the openings are blocked, clear them by blowing air through the screen. If the screen cannot be 100% cleaned, replace it with a new one. A new screen is included with each new wick.

Examine the white alcohol wick. Some light brownish-yellow discoloration of the wick is normal. If the wick is severely discolored, discard it. If the wick is in good condition, it should be removed and allowed to air dry in a relatively clean location. A spare wick can be substituted and saturated with alcohol so the instrument can continue to be used.

Re-assembling the Alcohol Cartridge

Before re-installing an alcohol wick, you must make certain that all parts are clean. Small bits of the wick or lint can cause serious problems if they get into the P-TRAK[®] particle counter.

Inspect the inside surfaces of the alcohol cartridge and the wick retainer cap. Blow air into them if necessary to make certain that there are no dust particles present. Blow air onto all surfaces of the Alcohol Wick that will be used to make certain that any loose particles that may have shed from the wick are removed.

Drop a clean screen into the wick retainer cap and make sure it lies flat on the bottom. Examine both ends of the wick. You will notice that one end is smoother than the other. Slide the smooth end of the wick into the wick retainer cap and push firmly until the wick hits bottom. Blow everything off again. See Figure 4-3.

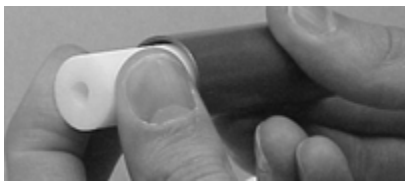
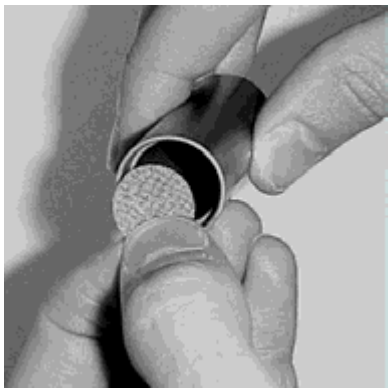


Figure 4-3: Install Screen and Wick into Retainer

Re-assemble the cartridge. Align the two halves of the alcohol cartridge and press firmly until they snap together. The cleaning/replacement procedure is complete.

Cleaning Inlet Screen Assembly

The inlet screen assembly protects the instrument from contamination by coarse particles and/or fibers. When the inlet screen is clean, it has almost no affect upon the instrument particle counting. However, if the screen becomes plugged with lint or fibers, it may cause a reduction in particle counting efficiency.

The screen should be cleaned on a regular basis to prevent the build-up of fibers or contamination. The intervals between cleaning will be determined by the amount of use and the conditions of use. As a general rule-of-thumb, whenever there is any noticeable contamination on the screen, it should be cleaned.

To clean the inlet screen assembly, do the following:

1. Disconnect the inlet screen assembly from the instrument by depressing the quick-connect fitting button and pulling the assembly away from the instrument.
2. Unscrew the two halves of the assembly and remove the inlet screen.
3. Clean off any accumulations with compressed air.
4. Reassemble the inlet screen assembly, taking note of the screen orientation. See Figure 4.4. Screw the two halves securely together (finger-tight only). Failure to properly tighten the inlet fitting halves may result in a particle leak and the inability to “zero check” the instrument.



Figure 4-4: Re-assemble Inlet Screen Assembly

5. Install the inlet screen assembly into the quick-connect fitting and attach the sample tubing.

Chapter 5

Troubleshooting

The table below lists the symptoms, possible causes and recommended solutions for common problems encountered with the P-TRAK[®] particle counter.

Symptom	Possible Cause	Corrective Action
Unable to obtain zero count (using HEPA zero filter)	Optics are flooded with alcohol (caused by multiple or prolonged tilting of instrument).	Let instrument run overnight (using AC adapter) with storage cap installed in P-TRAK [®] particle counter (<i>not</i> alcohol wick). This will dry out the optics and should restore proper operation.
	Inlet screen assembly is loose (not screwed tightly together).	Tighten assembly together (hand-tight only).
	Inlet screen assembly is missing internal screen/washer.	Install screen. Securely tighten.
	Inlet screen assembly has missing or damaged O-ring.	Make sure O-ring is in place on inlet screen assembly tube.
	Attempting to perform zero with telescoping probe attached.	Remove telescoping probe and sample tube. Attach HEPA zero filter directly to inlet screen assembly.
	Alcohol cartridge is loose.	Tightly install the alcohol cartridge into instrument.
	Bad HEPA filter (uncommon).	Try using a different filter. Or try using two filters inline.
	Internal leak inside instrument (very uncommon).	Must be diagnosed and serviced at factory.

Symptom	Possible Cause	Corrective Action
Counts seem too low (below expected values).	<p>Low on alcohol.</p> <p>Particle count in area really <i>is</i> low.</p> <p>Moisture buildup inside alcohol cartridge.</p> <p>Plugged sample tube.</p> <p>Wrong sample tube: too long, wrong material (causing particle loss).</p> <p>Pump problem causing low (or no) flow. Instrument is being operated in wrong environment: too hot, too cold, too humid.</p> <p>Inferior or contaminated alcohol.</p> <p>Unit needs calibration and/or servicing.</p>	<p>Replenish alcohol in wick.</p> <p>N/A</p> <p>Change alcohol wick inside alcohol cartridge.</p> <p>Straighten tube; remove obstruction.</p> <p>Use factory supplied sample tube only!</p> <p>Listen for pump operation. Check pump flow with flowmeter: should be approx. 0.7 L/min. Operate in specified environment only.</p> <p>Change alcohol wick inside alcohol cartridge. Use only approved alcohol.</p> <p>Return to factory for service.</p>
Does not turn on.	<p>Not pressing on/off switch properly.</p> <p>Batteries are dead.</p> <p>AC adapter is not plugged into unit.</p>	<p>Press and hold on/off switch for one second.</p> <p>Replace batteries.</p> <p>Connect AC adapter.</p>
No keypad response.	Keypad defective.	Return to factory for service.
"LO ALC" message	<p>Alcohol wick is depleted.</p> <p>Excess moisture accumulation.</p>	<p>Refill alcohol cartridge.</p> <p>Remove wick, replace with spare wick and allow wick to air dry in a clean location.</p>

Symptom	Possible Cause	Corrective Action
"TILTED" message	Instrument has been tilted during operation.	Hold instrument level during operation! Condition will normally correct itself. Tilt condition may cause data logging or Sample Mode problems.
"PUMP BLOCKED" message	Sample tube inlet is blocked.	Remove obstruction. Press <Enter> to reset.
"LO BATT" message	Low batteries. AC adapter is malfunctioning or not plugged in.	Replace batteries. Connect AC adapter.
"LASER PROBLEM" message	Possible laser failure.	Return to factory for service.

Appendix A

Specifications

Specifications are subject to change without notice.

Concentration Range	0 to 5×10^5 particles/cm ³
Particle Size Range	0.02 to 1 micrometer
Temperature Range Operation Storage	32 to 100°F (0 to 38°C) –40 to 160°F (–40 to 70°C)
Flow Rate Sample Total	Approx. 100 cm ³ /min Approx. 700 cm ³ /min
Memory Single points Data logging	470 points Adjustable interval (up to 1,000 hours of data at 1 minute intervals) Storage of up to 141 separate tests
Power Requirement Battery type Battery life AC adapter	6 AA Alkaline 6 hrs @ 70°F (21°C) 9 V, 1.6 A
Alcohol Requirement Type Hours per charge	100% reagent grade isopropyl 8 hours at 70°F (21°C)
RS232 Output	Baud rate 9600 (8-N-1)
Size	10.75 in. x 5.5 in. x 5.5 in. (27 cm x 14 cm x 14 cm)
Carrying Case Size	21 in. x 14 in. x 8.3 in. (53 cm x 36 cm x 21 cm)
Weight Instrument with batteries Instrument with accessories in case Shipping weight	3.8 lbs (1.7 kg) 16.8 lbs (7.7 kg) 23 lbs (10.5 kg)
Factory Service Interval	One year

Warranty	Two years on workmanship and material
Computer Requirements	PC with Microsoft Windows® 2000 or XP; Windows-compatible printer; 5 MB hard disk space; and available RS-232 serial port (for downloading)

Appendix B

Material Safety Data Sheet: Isopropyl Alcohol

1 - PRODUCT IDENTIFICATION

Product Name.....	Isopropyl Alcohol
Formula	CH ₃ CHOHCH ₃
Formula Wt	60.10
CAS No.	67-63-0
NIOSH/RTECS No.	NT805000
Common Synonyms	2-Propanol; Isopropanol; SEC-Propyl Alcohol; IPA; Dimethylcarbinol
Product Codes	U298, 5082, 9080
Effective	09/03/86 Revision #02

Precautionary Labeling (Baker Saf-T-Data™ System)

Health	1 Slight
Flammability	3 Severe (Flammable)
Reactivity	1 Slight
Contact	1 Slight

Hazard Ratings are 0 to 4 (0 = No Hazard; 4 = Extreme Hazard).

Laboratory Protective Equipment:

Safety glasses; lab coat; vent hood; proper gloves; Class B extinguisher

Precautionary Label Statements:

Warning: Flammable

Causes Irritation.

Harmful if Swallowed or Inhaled.

Keep Away From Heat, Sparks, Flame.

Avoid Contact With Eyes, Skin, Clothing.

Avoid Breathing Vapor. Keep in Tightly Closed Container. Use With Adequate Ventilation.

Wash Thoroughly After Handling.

In Case of Fire, use Alcohol Foam, Dry Chemical, Carbon Dioxide - Water May Be Ineffective.

Flush Spill Area With Water Spray.

SAF-T-DATA™ Storage Color Code: Red (Flammable)

2 - HAZARDOUS COMPONENTS

Component	%	CAS No.
Isopropyl Alcohol	99.5	67-63-0

3 - PHYSICAL DATA

Boiling Point	82°C (180°F)
Vapor Pressure (mm hg)	33
Melting Point	-89°C (-128°F)
Vapor Density (air=1)	2.1
Specific Gravity:	0.79 Evaporation Rate 2.83 (Butyl Acetate=1)
Solubility (H ₂ O)	Complete
Volatiles by Volume	100
Appearance and Odor	Colorless liquid with slight odor of rubbing alcohol.

4 - FIRE AND EXPLOSION HAZARD DATA

Flash Point (closed cup)	12°C (53°F)
NFPA 704M Rating	1-3-0
Flammable Limits, Upper: ...	12.0 %
Lower: ...	2.0 %

Fire Extinguishing Media:

Use alcohol foam, dry chemical or carbon
Dioxide (water may be ineffective)

Special Fire-Fighting Procedures:

Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode.

Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire and Explosion Hazards:

Vapors may flow along surfaces to distant ignition sources and flash back.
Closed containers exposed to heat may explode.
Contact with strong oxidizers may cause fire.

Toxic Gases Produced:

Carbon monoxide, carbon dioxide.

5 - HEALTH HAZARD DATA

Threshold Limit Value (TLV/TWA)	980 mg/m3(400 ppm)
Short-Term Exposure Limit (STEL).....	1225 mg/m3(500 ppm)
Permissible Exposure Limit (PEL)	980 mg/m3 (400 ppm)
Toxicity: LD50 (oral-rat) (mg/kg).....	5045
LD50 (IPR-mouse) (mg/kg)	933
LD50 (SKN-rabbit) (g/kg)...	13
LD50 (IV-mouse) (mg/kg) ..	1863

Carcinogenicity: NTP: no IARC: no Z List: No OSHA Reg: no

Effects of Overexposure:

Inhalation of vapors may cause headache, nausea, vomiting, dizziness, drowsiness, irritation of respiratory tract, and loss of consciousness.

Inhalation of vapors may cause pulmonary edema.

Liquid may be irritating to skin and eyes.

Prolonged skin contact may result in dermatitis.

Eye contact may result in temporary corneal damage.

Ingestion may cause nausea, vomiting, headaches, dizziness, and gastrointestinal irritation.

Ingestion may cause central nervous system depression.

Target Organs:

Eyes, skin, respiratory system.

Medical Conditions Generally Aggravated By Exposure:

None identified.

Routes of Entry:

Inhalation, ingestion, eye contact, skin contact.

Emergency and First Aid Procedures:

Call a physician.

If swallowed, do **not** induce vomiting.

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Flush skin with water.

6 - REACTIVITY DATA

Stability	Stable, hazardous.
Polymerization	Will not occur.
Conditions to Avoid.....	Heat, flame, other sources of ignition.
Incompatibles.....	Strong oxidizing agents, aluminum, nitric acid, sulfuric acid, amines and ammonia, halogen acids and halogen compounds.
Decomposition products	Carbon monoxide, carbon dioxide.

7 - SPILL AND DISPOSAL PROCEDURES

Steps to be Taken in the Event of a Spill or Discharge:

Wear suitable protective clothing. Shut off ignition sources; no flares, smoking, or flames in area. Stop leak if you can do so without risk. Use water spray to reduce vapors. Take up with sand or other non-combustible absorbent material and place into container for later disposal. Flush area with water.

J. T. Baker SOLUSORB[®] solvent adsorbent is recommended for spills of this product.

Disposal Procedure:

Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA hazardous waste number: D001 (ignitable waste)

8 - PROTECTIVE EQUIPMENT

Ventilation:

Use general or local exhaust ventilation to meet TLV requirements.

Respiratory Protection:

Respiratory protection required if airborne concentration exceeds TLV. At concentrations up to 1000 ppm, a chemical cartridge respirator with organic vapor cartridge is recommended. Above this level, a self-contained breathing apparatus is recommended.

Eye/Skin Protection:

Safety goggles, uniform, apron, neoprene gloves are recommended.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATATM Storage Color Code: red (flammable)

Special Precautions:

Bond and ground containers when transferring liquid. Keep container tightly closed. Store in a cool, dry, well-ventilated, flammable liquid storage area.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

Domestic (D.O.T.):

Proper Shipping Name	Isopropanol
Hazard Class	Flammable liquid
UN/NA	UN1219
Labels	Flammable liquid

International (I.M.O.):

Proper Shipping Name	Isopropanol
Hazard Class	3.2
UN/NA	UN1219
Labels	Flammable liquid

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Contact your local TSI Distributor or visit our website **www.tsi.com** for more detailed specifications.