

Model 8705 DP-CALC™ Micromanometer

Operation and Service Manual

1980381, Revision E
July 2006



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1980381, Revision E
July 2006

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Chapter 1

Unpacking and Parts Identification

Carefully unpack the instrument and accessories from the shipping container. Check the individual parts against the list of components in Table 1-1. If any are missing or damaged, notify TSI or your local distributor immediately.

Table 1-1: List of Components

Qty	Item Description	Part/model
1	Model 8705 DP-CALC	8705
1	Carrying Case	1319114
4	AA Alkaline Batteries	1208013
1	Operation and Service Manual	1980381
2	4 Foot Sections of Rubber Tubing	801039
1	Static Pressure Tip	3002017
1	Computer Interface Cable	8940
1	Data Downloading Software	800832
1	Pitot Tube (optional)	3002018
1	AC Adapter (optional)	
	115V, NEMA-5	2613033
	230 V, European, CEE 7/16	2613078
	230 V, Great Britain	800169
	240 V, Australian	2613105

Parts Identification

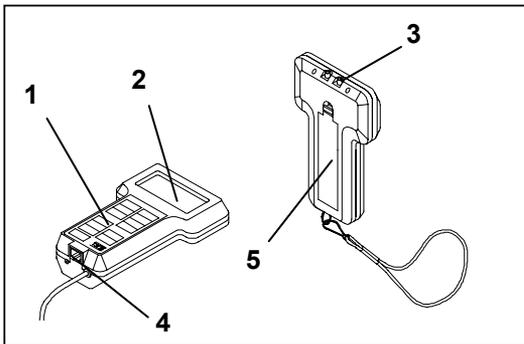


Figure 1-1: DP-CALC

- | | |
|-------------------------------|-------------------------|
| 1. Keypad | 4. RS-232 Printer Port |
| 2. Display | 5. Battery Access Cover |
| 3. Pressure Measurement Ports | |

Chapter 2

Setting-Up

Supplying Power to the DP-CALC

The DP-CALC 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. TSI ships the unit with alkaline batteries. The DP-CALC 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 12 hours for alkaline batteries.

Using the Optional AC Adapter

The optional AC adapter allows you to power the DP-CALC from a wall 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 DP-CALC is capable of displaying the measured values in several different measurement units, as shown in Table 2-1.

Table 2-1: Choices of Measurement Units

Pressure	Velocity	FlowRate
in. H ₂ O	ft/min	ft ³ /min
mm Hg	m/s	m ³ /h
Pa		l/s

If you wish to change the display units on your DP-CALC refer to [Appendix B](#) for DIP Switch Settings.

Setting the Real-Time Clock

The DP-CALC has an internal real-time clock that keeps track of the time of day (the format is HH.MM where HH is the hour in 24-hour format and the MM is minutes) and the date. It is very important for the DP-CALC to have the time and date correctly set, otherwise date and time stamping of recorded data will not be correct.

To set the time and date, press and hold either the ▲ or ▼ key during the power-up sequence while the time is displayed. Release key when the DP-CALC beeps twice. You will have the opportunity to view and/or change the hours, minutes, year, month, and day in sequence. Use the ▲ or ▼ key to change any setting. Press the ENTER key to store each setting and advance to the next one.

Changing the Baud Rate

The DP-CALC has a variable baud rate that is used when downloading or printing data from the instrument. By changing the baud rate to a higher rate, the data will be downloaded faster.

Note: The baud rate must be equal to that of your computer or printer.

The instrument baud rate is displayed during the initial power-up sequence. To change the baud rate, press and hold either ▲ or ▼ key during the power-up sequence while the baud rate is displayed. Release the keys when the DP-CALC beeps twice. Use the ▲ or ▼ key to scroll through the available values of 1200, 2400, 4800, 9600 and 19200. Press ENTER to set the value that is displayed.

Connecting the Optional Portable Printer

To connect the printer to the DP-CALC, locate the Printer Interface Cable (supplied with the optional printer) and connect the 9-pin end labeled “PRINTER” to the printer and the other end to the data port of the DP-CALC. 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*.

Connecting to a Computer

Use the Computer Interface Cable provided with the DP-CALC to connect the instrument to a computer for downloading stored data or for remote polling. A 9-pin to 25-pin adapter may be required if your computer has a 25-pin serial port. For more information on how to download stored data see Chapter 3 for [*Downloading Data to a Computer*](#) section.

Chapter 3

Operation

Overview

The Model 8705 DP-CALC measures differential pressure, calculates velocity, and calculates volumetric flowrate. It has data logging capability, and can store individual readings and calculate statistics.

Keypad Functions

When pressing the keys on the front panel, the DP-CALC will beep to confirm the function. If you press a key and the DP-CALC does not beep, then the DP-CALC does not allow that function during the selected mode.

Common Terms

In this manual there are several terms that are used in different places. The following is a brief explanation of the meanings of terms.

Sample: Consists of all of the measurement parameters stored each time the **SAMPLE** key is pressed, or after each logging interval has passed. The maximum number of samples is 1000.

Test ID: A group of samples. A test ID can contain one sample or up to 1000 samples. The statistics (average, minimum, maximum and count) are calculated for each test ID. The maximum number of test IDs is 500.

Time Constant: The time constant is an averaging period. It is used to dampen the display. If you are experiencing fluctuating flows, a longer time constant will lessen those fluctuations. The display will update every second, but the displayed reading will be the average over the last time constant period. For example, if the time constant is 10 seconds, the display will update every second, but the displayed reading will be the average from the last 10 seconds. This is also referred to as a “moving average.” The time constant is adjusted using the **SAMPLE INTERVAL** key. See the [SAMPLE INTERVAL key](#) section later in this chapter for more detail.

Logging Interval: The logging interval is a frequency period that the instrument will log readings. For example, if the logging interval is set to 30 minutes, readings will be taken and recorded once every 30 minutes.

K Factor: The K factor is a constant that corrects for flow irregularities and is typically close to 1.00. This K factor is defined by the user, by doing a duct traverse to find average velocity. Then a K factor can be figured and assigned for a specific location within the duct. Flowrate is then figured by multiplying velocity times area times the K factor.

Flow Factor: A constant supplied by the manufacturer of duct work, piping, or any other obstruction to airflow. These manufacturers will specify a specific location for a pressure measurement and the flow factor corresponding with the location. Flowrate is figured by multiplying flow factor by the square root of the pressure. Contact TSI for more information about flow factors.

ON/OFF Key

Press the ON/OFF key to turn the DP-CALC on and off. When the instrument is first turned on it goes through a preprogrammed power-up sequence that includes an internal self-check (when all displayable items are shown). Then the DP-CALC displays percentage of battery life, percentage of (“LOG”) memory available, baud rate, time (HH.MM), entered barometric pressure, entered temperature, and then the DP-CALC begins taking pressure readings.

*Note: To skip start-up sequence, press and hold **ENTER** any time after the internal self-check.*

Arrow Keys (▲ ▼)

The two arrow keys are used to scroll through and select values as needed for DP-CALC functions. Pressing either arrow key on the start-up sequence will allow you to change the baud rate, barometric pressure, temperature or time.

ENTER (PRINT) Key

Press the ENTER key to accept a value or condition. In start-up mode, you can also press and hold the ENTER key anytime after the internal self-check to skip the start-up sequence.

Press the ENTER (Print) key momentarily to print information on the optional Portable Printer.

If the optional Portable Printer is connected the following will be printed while pressing the following keys:

- ENTER key: sample value, units
- SAMPLE key: (sample #), sample value, units
- STATISTICS key: AVG (# of samples), average, units

FLOWRATE Key

Press the FLOWRATE key to display volumetric flowrate. The DP-CALC can calculate flowrate in one of two ways. Both methods are available for use any time you are in flowrate mode.

The first method to calculate flowrate is by multiplying velocity times the flow area times a K factor. This K factor is defined by the user, and is usually close to 1.00.

The DP-CALC can also calculate flowrate with manufacturer supplied flow factors. These flow factors are different from K factors in that they are defined by the manufacturer of the airflow product. The specific location where pressure measurements are to be taken is also defined by the manufacturer. In this case, flowrate equals the flow factor times the square root of the pressure.

Flowrate (Calculated Using Velocity, Duct Area and K factor)

Flowrate can be calculated for a round, square or rectangular duct. You must first indicate the shape and size of the duct or other area through which you want to measure flowrate. The DP-CALC displays the volumetric flowrate in ft^3/min , m^3/h or l/s , depending on the setting of DIP switches #1 and #2 (refer to [Appendix B](#)).

Entering Shape, Size, And K Factor

With the DP-CALC in flowrate mode, press and hold the ▲ or ▼ key until the meter beeps. Use the ▲ or ▼ key to toggle between circle, rectangle and pressure symbols. Press the ENTER key to accept a shape and move to selection of the size. See the following section for information on selecting the pressure symbol.

For a circular flow shape, the DP-CALC will ask for the diameter of the circular area. Use the ▲ or ▼ key to select the diameter of the circular area. Press the ENTER key to accept the size.

For a rectangular flow shape, the DP-CALC will ask for two dimensions. Use the ▲ or ▼ key to select the horizontal dimension, then press the ENTER key. Use the ▲ or ▼ key to select the vertical dimension, then press the ENTER key.

Now the display will flash K_f and display a number. To select a stored K-factor, use the ▲ key. Scroll through the five existing K factors, pausing to allow the DP-CALC to display the value of each.

If the K factor needs to be changed, select K-factor #5. Wait a few seconds for the instrument to display the K-factor. Use the ▲ and ▼

keys to adjust the value and press the ENTER key to accept the K-factor and begin measuring flowrate.

Note: Each time you select or change a K factor, the selected or changed K factor will be stored in memory slot #1. The other K factors will shift slots. The previous #1 K factor will become #2, #2 will become #3 and so on. This may result in losing the #5 slot value when a new K-factor value is added.

Flowrate (Calculated Using Pressure and Flow Factor)

This flowrate is calculated by multiplying the square-root of the pressure reading by a manufacturer-supplied flow factor. This flowrate calculation method is applicable for diffusers that contain pressure taps designed for this purpose and for certain flow stations.

Note: When using this option, make sure that the DP-CALC pressure units and the flowrate units provided by the diffuser manufacturer correspond. If they don't match, the calculated flowrate will be incorrect.

Entering Flow Factor

With the DP-CALC in flowrate mode, press and hold the ▲ or ▼ key until the meter beeps. Use the ▲ or ▼ key to scroll through the circle and rectangle, and pressure symbols. Press the ENTER key to accept the pressure symbol and move to the selection of the flow factor value. The flow factor will be stored in the K factor storage slots. However, these two factors are not to be confused with each other. Use the ▲ or ▼ key to choose the flow factor, then press the ENTER key to begin measuring flowrate.

ACTUAL/STANDARD Key

Press to toggle between displaying actual and standard velocity or flowrate. Press and hold to view, enter, or change ambient conditions. When the key is pressed and held, the pressure units will flash and the last barometric pressure entered will be displayed. Use the ▲ or ▼ key to change the barometric pressure and press ENTER to accept it. Then the temperature units will flash and the last temperature entered will be displayed. Use the ▲ or ▼ key to change the temperature and press ENTER to accept it and return to measuring mode. The ranges that can be entered are as follows: Pressure: 15 to 40 in. Hg (381 to 1016 mm Hg), 29.92 in Hg (760 mm Hg) is default; Temperature -80 to 800 °F (-62 to 426 °C), 70 °F (21.1 °C) is default.

When standard velocity or flowrate is being measured, the “STANDARD” symbol will be shown on the display. When actual velocity or flowrate is being measured, no symbol will be shown on the display.

SAMPLE INTERVAL Key

The SAMPLE INTERVAL key is used to set the time constant and logging intervals. Press to display current time constant. Use the ▲ or ▼ key to scroll through the time constant choices, which are 1 s, 2 s, 5 s, 10 s, 15 s, 20 s, and LOG symbol, then press ENTER to accept the choice.

If LOG was chosen, use the ▲ or ▼ keys to scroll through the logging interval choices, which are 2 s, 5 s, 10 s, 15 s, 20 s, 30 s, 1 min, 2 min, 5 min, 10 min, 15 min, 20 min, 30 min, 60 min and OFF. Press ENTER to accept choice and return to measuring mode.

Note: To operate the instrument in discrete data logging (or single point) mode, the logging interval must be set to OFF. To operate the instrument in continuous data logging mode, the logging interval must be set to something other than OFF.

SAMPLE Key

Samples will be stored each time you press the SAMPLE key. Parameters will be stored according to the mode you are in as indicated in Table 3-1.

Table 3-1: Storage

Mode	Parameters Stored in Memory
Pressure	Pressure
Velocity	Velocity and Pressure
Flowrate	Flowrate, Velocity and Pressure

Discrete Data Logging (Single Point Measurements)

Discrete data logging allows you to record single data points. The instrument must first be in discrete data logging mode (default). See [SAMPLE INTERVAL Key](#) section above.

Press the SAMPLE key to take a sample. The sample number and “COUNT” will display briefly. While the sample is being taken, “SAMPLE” will flash on the display. The sampling will last for the length of the set time constant. Then the DP-CALC will display the value that was recorded.

Continuous Data Logging (Multiple Readings Over Time)

Continuous data logging allows you to record samples continuously. To get into data logging mode and to select a logging interval, see [SAMPLE INTERVAL key](#) section above.

Pressing the SAMPLE key once begins the sampling process. The instrument will display “LOG” briefly indicating samples will be recorded, the instrument will display “SAMPLE” briefly along with the log sample value. The instrument continues taking samples until you press the SAMPLE key a second time. One sample is taken every logging interval and each sample is an average over the entire logging interval.

Note: If you attempt to set the logging interval at less than the time constant, the DP-CALC will automatically set the time constant equal to the logging interval.

The display will then scroll through the test ID number, number of samples stored, and sample average for that test ID. To see maximum, minimum, or individual data points, see [STATISTICS \(review data\) key](#) section.

NEXT TEST (clear) Key

Press to advance to the next test ID. If the current test ID does not have anything stored, it will not advance to the next test ID.

The DP-CALC will automatically increment the test ID number under the following conditions:

- turning off the DP-CALC (if there is stored data)
- taking a sample with a different duct size or shape than the last stored sample
- taking a continuous data logging sample
- taking discrete samples after taking a continuous data logging sample

To clear the **last sample**, press and hold the key and the display will begin a countdown from 5 to 0. Release the key at any time during the countdown **before zero** is displayed. The display will flash “SAMPLE CLr.”

To clear **all memory**, keep holding key during the countdown. Release the key **when 0** is displayed. The display will flash “CLr.”

Note: Only the last sample recorded (one sample total) can be cleared without clearing the entire memory. You cannot go back to a previous test ID and clear a single reading. Also, you cannot add data to a previous test ID.

STATISTICS (review data) Key

The STATISTICS key has two purposes. One is to view the statistics for the currently displayed parameter and the other is review data for a particular test ID.

To View Statistics

Press STATISTICS to view statistics for the current mode. The count will be shown first and then the test ID and then the average. Press STATISTICS again (before the average disappears from the display) to proceed to maximum and again to display minimum.

To Review Data

Press and hold the STATISTICS key. The DP-CALC will beep twice, release the key and the test ID number will be displayed. Use the ▲ or ▼ key to select the desired test ID. Press ENTER to accept the test ID number. Use the ▲ or ▼ key to select and view average, maximum, minimum, count, and individual sample numbers with values for the selected test ID. The samples will be displayed in the order that they were taken, from the first sample of that test ID to the last.

To view a different test ID, press STATISTICS again to return to test ID on the display. Use the ▲ or ▼ key to choose a new test ID then press ENTER to accept the choice and continue as above to review the data.

To review data of a different measurement type, press the desired measurement typed button while AVG, MAX, MIN, COUNT or sample ID being displayed. If there is no data for that measurement type, "COUNT" and "----" will be displayed. Press another measurement type key to view more data or press ENTER to return to measuring mode.

Downloading Data to a Computer

"LogDat" is a Windows based program from TSI designed to download the data stored in the memory of the Model 8705 DP-CALC to a computer. This data includes the test ID, measurement, unit of measure, correction factors, actual/standard parameter, flow area, and time constant. This data is date and time stamped. In addition, the statistics for each test ID are provided. The file containing the downloaded data is sorted and tab delimited to allow it to be imported into a spreadsheet for further data manipulation.

To install LogDat™ software, run the SETUP.EXE file on the LogDat distribution disc. Once you open the program, it is self-directing and provides all the necessary instructions for downloading data.

To download data from the DP-CALC, connect the supplied computer interface cable to the DP-CALC and to a computer serial port. Any serial port from COM 1 to COM 4 can be used.

Caution: The data port of the DP-CALC is not intended for connection to a public telecommunications network. Connect the data port only to another RS232 port.

Data Acquisition (Polling)

The DP-CALC is designed to allow the user to perform polling through the use of a computer. To do this, the user's computer must be connected and in terminal mode. The baud rate for the computer and the DP-CALC must be set to the same value. For details on viewing or changing the baud rate, see [Changing the Baud Rate](#) section in Chapter 2. You must then send an upper case V to the instrument.

The user must write their own routine (program) to obtain information at specific intervals from the DP-CALC. The meter will only send information when the SAMPLE or ENTER (print) keys are pressed or after the computer has sent a "V" command to the DP-CALC.

Chapter 4

Maintenance

The DP-CALC requires very little maintenance to keep it performing well.

Recalibration

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

Cases

If the instrument case or storage case needs cleaning, wipe it off with a soft cloth and isopropyl alcohol or a mild detergent. Never immerse the DP-CALC.

Storage

When storing the DP-CALC for more than a month, removing the batteries is recommended. This prevents damage due to battery leakage.

Chapter 5

Troubleshooting

Table 5-1 lists the symptoms, possible causes, and recommended solutions for common problems encountered with the DP-CALC. If your symptom is not listed, or if none of the solutions solves your problem, please contact TSI.

Table 5-1: Troubleshooting the DP-CALC

Symptom	Possible Causes	Corrective Action
No display	Instrument not switched on	Switch on the instrument.
	Low or dead batteries	Replace the batteries or plug in the AC adapter.
	Dirty battery contacts	Clean the battery contacts.
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 reads "CAL"	The DP-CALC has detected an internal fault	Return to factory for service.
Display says "OVER"	The pressure or velocity is too high	Use an alternate measurement method.

Warning! The pressure sensor is protected from damage for up to 7 psi (190 in. H₂O 48 kPa or 360 mm Hg). At higher pressures it can burst!

Appendix A

Specifications

Specifications are subject to change without notice.
Specifications in parentheses () indicate metric equivalents.

PRESSURE:

Range: -5 to +15 in. H₂O (-1245 to 3735 Pa, -9.3 to 28.0 mm Hg)
Accuracy: 1% of reading ± 0.005 in. H₂O (±1 Pa, ±0.01 mm Hg)
Resolution: 0.0005 in. H₂O (0.1 Pa, 0.001 mm Hg)

VELOCITY:

Range¹: 250 to 15,500 ft/min (1.27 to 78.74 m/s)
Accuracy²: 1.5% of reading at 2,000 ft/min (10.00 m/s)

FLOWRATE:

Displayed Range³: to 9,999,000 CFM (9,999,000 l/s, 9,999,000 m³/hr)
K factor Range: 0.01 to 999.9

INSTRUMENT TEMPERATURE RANGE:

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

LOGGING CAPABILITY:

Test ID's Up to 500 test ID's
Samples: Up to 1000 samples
Intervals: 1 sec, 2 sec, 5 sec, 10 sec, 20 sec, 30 sec, 60 sec, 2 min,
5 min, 10 min, 30 min, 60 min.

TIME CONSTANT:

Values: 1, 2, 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: 12 hours (Alkaline), 7 hours (NiCd)

PHYSICAL:

External dimensions: 4.0 in x 6.6 in x 1.5 in (102 mm x 168 mm x 38 mm)
Weight (with batteries): 0.76 lb. (0.35 kg)
Display: 4-digit LCD, 0.6 in (15 mm) digit height

PRINTER INTERFACE:

Type: Serial
Selectable BAUD rates: 1200, 2400, 4800, 9600, 19800

- 1 Pressure velocity measurements are not recommended below 1,000 ft/min (5.00 m/s) and are best suited to velocities over 2,000 ft/min (10.00 m/s). Actual range is a function of pressure, temperature and barometric pressure.
- 2 Accuracy is a function of converting pressure to velocity. Conversion accuracy improves when actual pressure values increase.
- 3 Actual range is a function of maximum velocity, pressure, duct size, K factor, temperature and barometric pressure.

Appendix B

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. The table below shows the functions for each switch.

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

Switch	Function	OFF	ON
1	Imperial or metric	ft/min & ft ³ /min	m/s
2	Flowrate*	l/s	m ³ /h
3	Pressure	in. H ₂ O	Pa and mm Hg
4	Pressure**	Pa	mm Hg
5	Temperature	°F	°C
6	Calibration	Factory Calibration	User Calibration
7	Data Format	Commas; MM.DD.YY	Decimals; DD.MM.YY
8	Not assigned	leave in OFF position	

* To select flowrate to display l/s or m³/hr, DIP switch #1 must be in the ON position.

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

Figure B - 1: DIP Switch Location

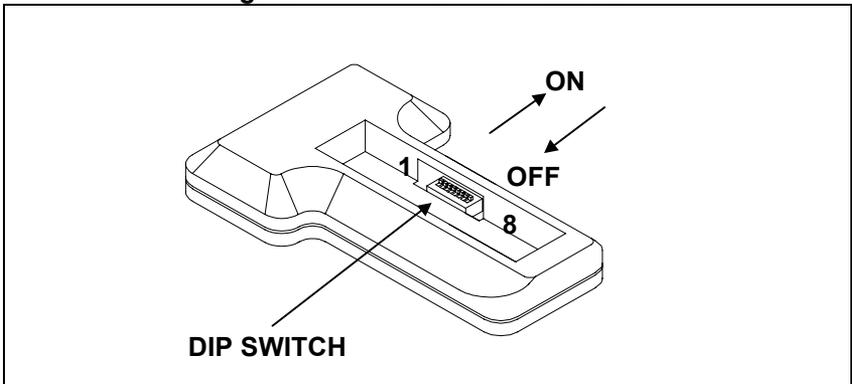


Figure B-1: DIP Switch Location



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