TT Series Micromanometer

- Area Setting
- Single Battery
- 0.01 Resolution
- Average Volume
- Pitot Tube Factor
- Stores 2500 Readings
- Air Density Correction

dpm

For Measurement of Air Velocity and Pressure
Positive Negative or Differential

CONTENTS

Limitations of Use 01

Keypad Controls 02

Mode of Operation 03

Display 04

Pressure Connections 05

Volume Flow Rates 05

Velocity Instruments 06

User Menu 07 – 11

Option Menu 12 – 15

Conversion Tables 16

Duct Traverse Points 17

Downloading Data 18

Maintenance & Calibration 18

Specifications 19

LIMITATIONS OF USE

TT Series instruments are intended for measurement of low differential air pressure in and around commercial and industrial air handling systems, and for use with a Pitot Static Tube.

The instruments are not suitable for liquid pressure measurement, and must not be used with corrosive, toxic or otherwise hazardous gases.

The instruments are not classified “Flameproof” or “Intrinsically Safe” and consequently must not be used where an explosion hazard may exist and are not authorised for Life Support applications.

During normal operation small quantities of air (typically less than 0.1ml/min) may pass into or out of the system under test: it is the user’s responsibility to consider the consequences of such leakage before determining the suitability of the instrument for any particular purpose.

The instrument must be turned off before it is stored or transported and if it is to be stored for a long period of time or is to be transported by air, the battery must be removed.

There is a 12-month guarantee on all manufactured parts.
This guarantee does not cover any consumables, and /or wear and tear during normal or abnormal use.

The guarantee becomes null and void if the instruments parts have been tampered with, misused, abused or used outside the parameters set out in the manual.

The manufacturer will determine if the instrument is repairable or requires replacement; charges may apply.

KEYPAD CONTROLS

ENABLE Protects against accidental switching 'on' and 'off' of the instruments power source.

ON Used in conjunction with ENABLE to switch on the instrument.

OFF Used in conjunction with ENABLE to switch off the instrument.

FAST
SLOW Smoothes out the response to applied pressure changes. Time constant:
Fast = 0 sec Slow1 = 5 sec Slow2 = 10 sec Slow3 = 15 sec Slow4 = 20 sec

UNITS Changes the unit of measurement.
The units are arranged in loop formation as follows (model dependent):
Kpa → mmH_2O → inH_2O → mbar → m/sec → ft/min → Kpa

STORE Stores readings manually.

MENU Used to access the Option Menu from operation mode.

↑ and ↓ Operate the backlight.
Select an appropriate function during menu operation.
Set digits and values in menu operation.

ZERO Overrides the time period of the auto zero system.

↵ Backspace.

ENTER Accepts commands during menu operation.
Used in conjunction with ENABLE and ON to access the User Menu.

MODE OF OPERATION

On / Off:

Press and hold ENABLE then press ON or OFF as appropriate.

Auto Zero:

The cycle will begin as soon as the instrument is switched on. This is factory set at a 30 second interval upon switch on and thereafter at 60 second intervals.
To change this timing see User Menu pages 07 and 08.
The instrument contains a miniature solenoid valve, which isolates the pressure sensors during auto zero. The valve emits two clearly audible clicks, which signal the start and end of the auto zero process.

Battery Low:

The battery condition is monitored every time the instrument auto zeroes.
When the 'battery low' warning appears, the battery must be replaced immediately, otherwise the readings obtained will be unreliable.
If at any time the readings seem suspect, check the condition of the battery by zeroing the instrument manually using ZERO.
If in doubt replace the battery. For rechargeable instruments charge the internal battery with the charger supplied.

Units:

The unit of measurement is shown on the right hand side of the display.
Being an auto ranging instrument, the correct resolution and the decimal point will be displayed according to the pressure being applied.

FAST SLOW:

Some pressurised circuits exhibit pressure and velocity fluctuations, which can be disconcerting. If unacceptable fluctuations occur, press FAST SLOW and verify that the slow indication is displayed on the screen.

Store:

Shows the number of readings stored on the instrument.
To store data manually press STORE while in Slow1, Slow2, Slow3 or Slow4 mode; the reading on the display will be logged and the counter will increase by one.
During data logging the counter will increase by one every time the instrument records a value. For information on data logging see Option Menu pages 12 and 14.

Audible Feedback:

While the instrument is on, audible feedback can be heard every time a key is pressed.

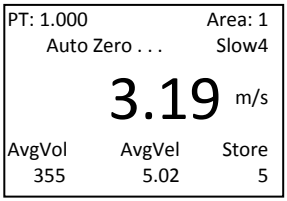
Signal In / Reference:

Pressure ports. The instrument responds to positive, negative and differential pressure.

RS 232 Port:

Is located between the two ports.

DISPLAY



PT: 1.000 — (model dependent) Pitot Tube Factor.

Area: 1 — (model dependent) Area Setting.

Auto Zero . . . — Whenever the auto zero sequence is initiated manually or at preset 'Auto Zero . . .' will be displayed until the cycle is complete. Being an auto ranging instrument, the resolution and decimal points will change according to the pressure being applied.

Slow4 — Mode of the instrument.
Press the FAST SLOW key to change the mode.

3.19 m/s — Unit of measurement.
Press UNITS to toggle between units of measurement.

AvgVol
355 — (model dependent) Average volume of the readings stored in l/s or cfm.
The average volume is a function of velocity multiplied by area, see page 05.

AvgVel
5.02 — (model dependent) Average velocity of the readings stored.

Store
10 — Number of readings stored.
Up to 2500 readings can be stored.

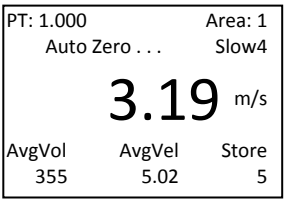
PRESSURE CONNECTIONS

Gauge / Duct Static Measurement:	Connect to Signal In. Leave Reference open to atmosphere. Readings may be positive or negative, depending on whether the system under test is above or below atmosphere pressure.
Orifice Plates:	Connect upstream tapping to Signal In and downstream tapping to Reference. Pressure readings should always be positive.
Flow Grids:	Connect +Ve tapping to Signal In and -Ve tapping to Reference. Pressure readings should always be positive.
Inlet Cones:	Connect tapping to Signal In using 'T' pieces to join the annular tapping together. Leave Reference open to atmosphere making sure that the open port is shielded against significant air movement from the ingoing airstream. Pressure readings should always be negative.
Total Head Probe:	Connect to Signal In. Leave Reference open. Readings should always be positive
dpm Ane™:	Input Pitot tube factor 0.843. Connect clear tubing to Signal In and blue tubing to Reference. Use UNITS to toggle to m/sec or ft/min depending upon model. Readings should always be positive.
dpm-i Pitot Tube:	Input the Pitot Tube factor 0.838. Connect clear tubing to Signal In and black tubing to Reference. Use UNITS to toggle to m/s or ft/min depending upon model. Readings should always be positive.
Ellipsoidal Pitot Tube:	Input the Pitot Tube factor 1.000. Connect clear tubing to Signal In and black tubing to Reference. Use UNITS to toggle to m/s or ft/min depending upon model. Readings should always be positive.

VOLUME FLOW RATES

First Method:

Select the duct shape and input the duct dimensions in mm or ins.
When data is stored in m/sec or ft/min the average velocity is shown, this value is multiplied by the area to give the average volume.



AvgVol 355 (model dependent) Average volume of the readings stored in l/s or cfm.

VELOCITY INSTRUMENTS

dpm Ane™: Input the Pitot Tube factor 0.843.
Connect the clear tubing to Signal In and the blue tubing to Reference.
The ane head should be facing into the air stream in the direction indicated by the arrows. Readings should always be positive.
If negative readings are obtained, the tubing may be blocked, connected the wrong way round, or the measurements may be from an extract grille.

dpm-i Pitot Tube: Input the Pitot Tube factor 0.838.
Connect total pressure tapping to Signal In and static pressure tapping to Reference. The larger hole located at the front of the dpm-i Pitot Tube must face directly into the oncoming air stream.
Readings should always be positive.
If a negative reading is obtained there may be a blockage in one of the pressure tubes or they may be connected the wrong way round.

Ellipsoidal Pitot Tube: Connect total pressure tapping to Signal In and static pressure tapping to Reference. The hole at the tip of the Pitot Static Tube must face directly into the oncoming air stream. Readings should always be positive.
If a negative reading is obtained, there may be a leak or blockage in one of the pressure tubes or they may be connected the wrong way round.
Most Pitot Static Tubes will give satisfactory results, but the NPL modified ellipsoidal pattern is particularly recommended.
The velocity range is calibrated at 'standard air' 1000 mbar / 16°C, for use with Total Head Probes and Pitot Static Tubes having a calibration factor unity. For non-standard air-conditions the barometric pressure and temperature can be set via the User Menu, see pages 07 and 11 or the Option Menu, see pages 12 and 14.

Air Velocity Calculations using S.I Scales:

For non-standard air conditions: $V = 1.291 \times PT \sqrt{\frac{1013.25}{B} \times \frac{T}{293} \times Pv}$

V = Velocity in m/sec

B = Barometric pressure in mbar

T = Absolute temperature in °K (= t in °C + 273 where t = airstream temperature)

Pv = Velocity pressure in Pa

PT = Pitot Tube Factor (for Ellipsoidal type 1.000)

Air Velocity Calculations using Imperial Scales:

For non-standard air conditions: $V = 4006 \times PT \sqrt{\frac{30}{B} \times \frac{T}{528} \times Pv}$

V = Velocity in ft/min

B = Barometric pressure in inHg

T = Absolute temperature in °R (= t in °F + 460 where t = airstream temperature)

Pv = Velocity pressure in wg

PT = Pitot Tube Factor (for Ellipsoidal type 1.000)

USER MENU

The User Menu is used to input user values and change default settings.
To access the User Menu, switch on the instrument while holding down ENTER.

Page 08

Set Clock:	To set the clock to local time and input the date in the chosen format.
Auto Zero Time:	This is factory set at 60 seconds. (for which the instrument specifications are based) Changing the default setting will override this. Inputting 0 seconds will switch off the auto zero function. A manual zeroing facility is available see Keypad Controls page 02.
Note:	(model dependent) When the instrument is in L/sec, m^3/hr or cfm the auto zero time is factory set at 10 seconds. This cannot be changed.
Switch Off Period:	To save battery, providing that no keys are pressed the instrument will switch off after 10 minutes. This can be overridden by changing the default setting.

Page 09

RS232 Period:	To print out raw data as measurements are being made, either to a thermal printer or to a PC via the Hyper terminal.
Note:	**DP Measurement no longer supply thermal printers.**
Back Light Period:	To increase or decrease the backlight time. Use ↑ and ↓ to switch on the back light.

Page 10

Area Settings:	(model dependent) Select the shape of the duct and input the duct dimensions either in mm or ins. Store up to 4 different area settings
Pitot Tube Factor:	(model dependent) Up to three different Pitot Tube Factors can be stored. PT 1: 1.000 PT 2: 1.000 **dpm A: 0.843**
Vol / Hood Select:	(not activated)
Volume Box:	(not activated)
Hood Factor:	(not activated)

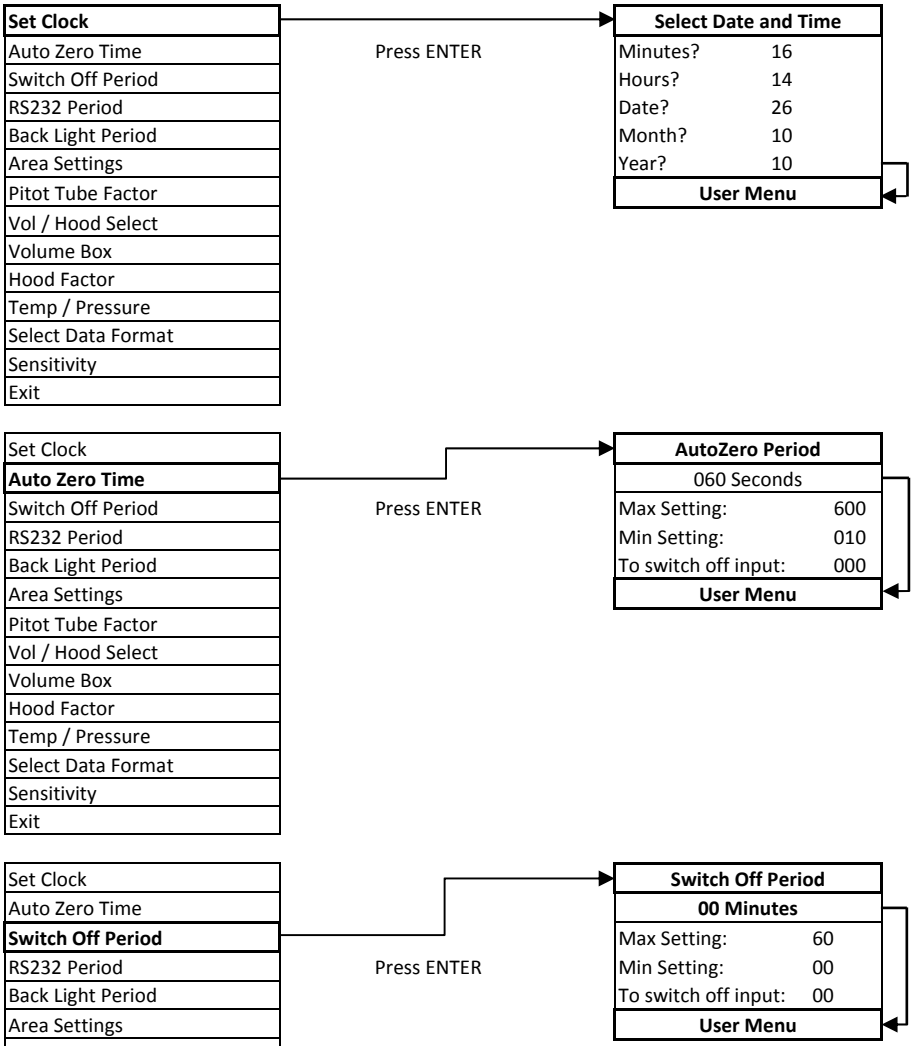
Page 11

Temp / Pressure:	(model dependent) To change the air stream temperature and barometric pressure. Air stream temperature set at 16 °C and Barometric pressure set at 1000 mbar.
Select Date Format:	Set the date format to European or USA, the temperature units to °C or °F and the barometric pressure units to mb or inHg.
Sensitivity:	(model dependent) Select the number of decimal places for Pascals and for velocity readings.

It is not recommended that the settings highlighted in bold are changed as this will give rise to incorrect readings.

USER MENU

Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.



USER MENU

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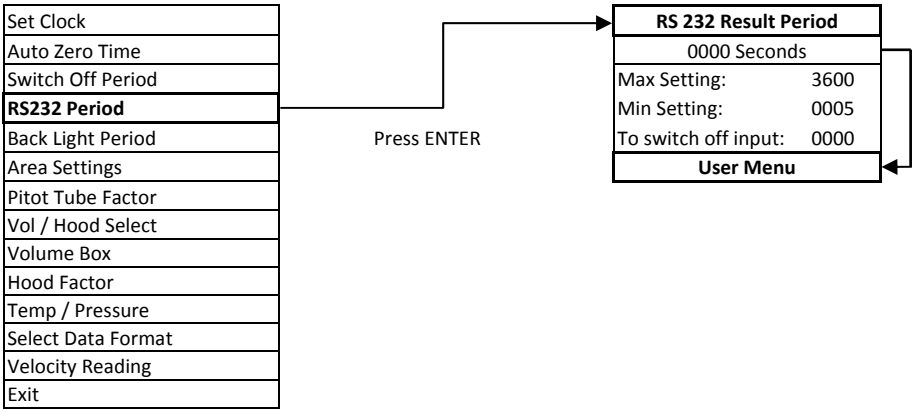
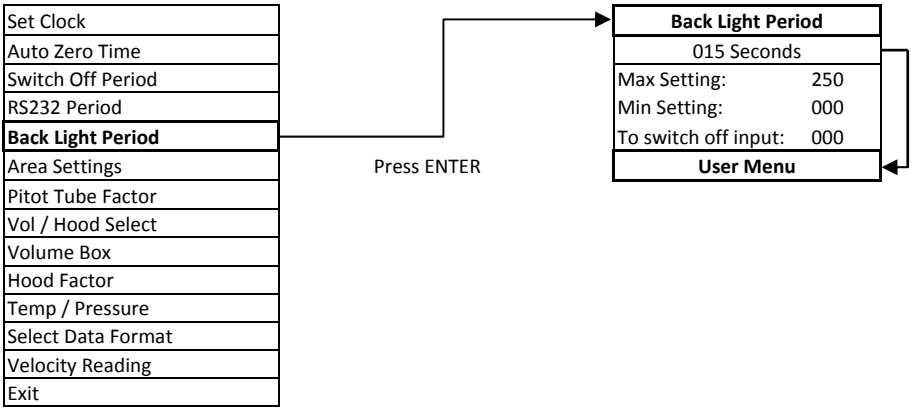
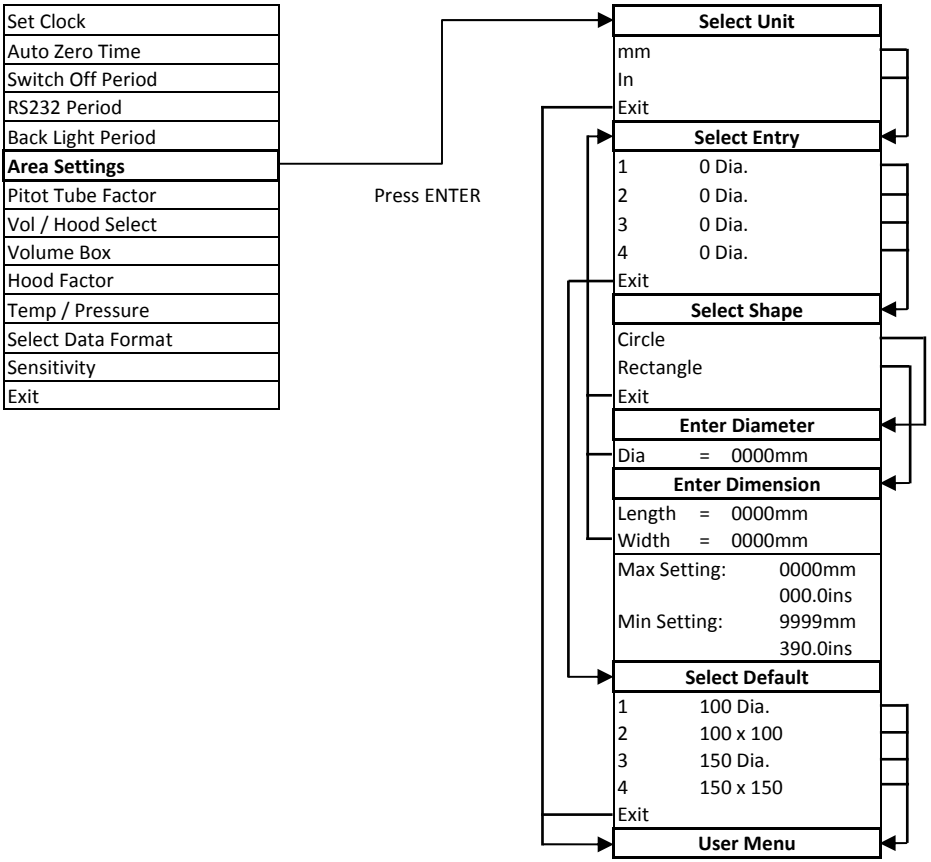
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.

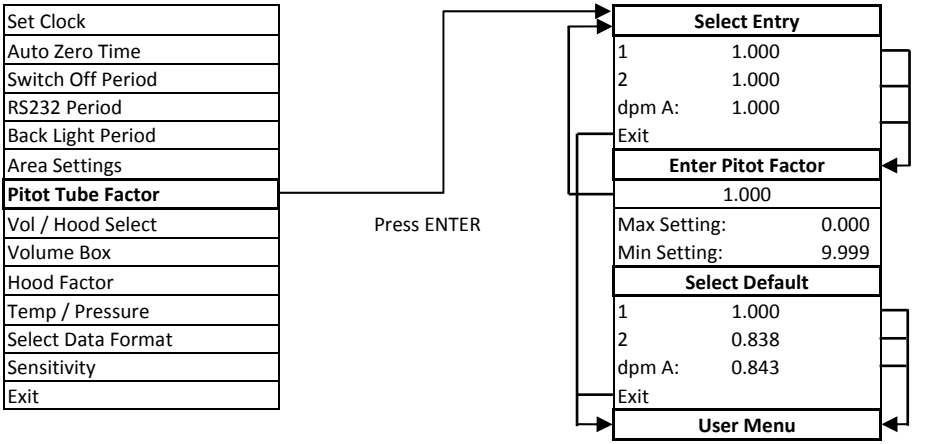




USER MENU

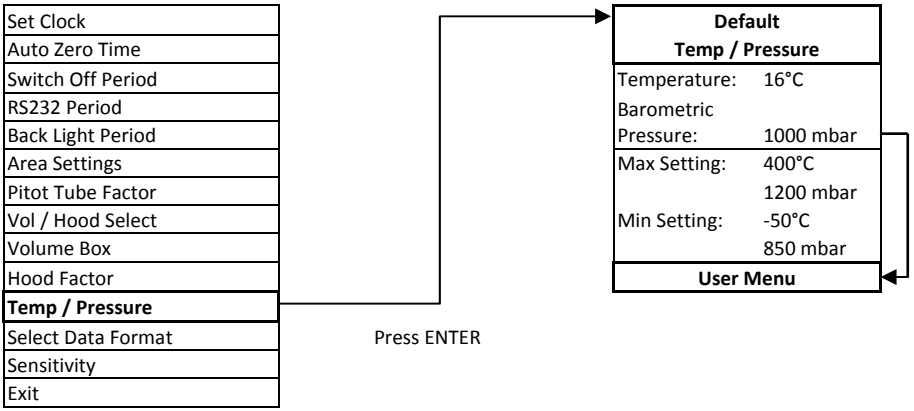
Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.

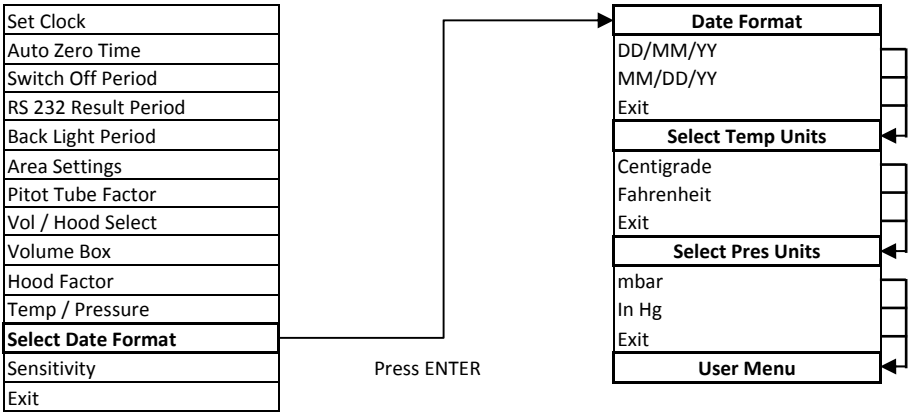


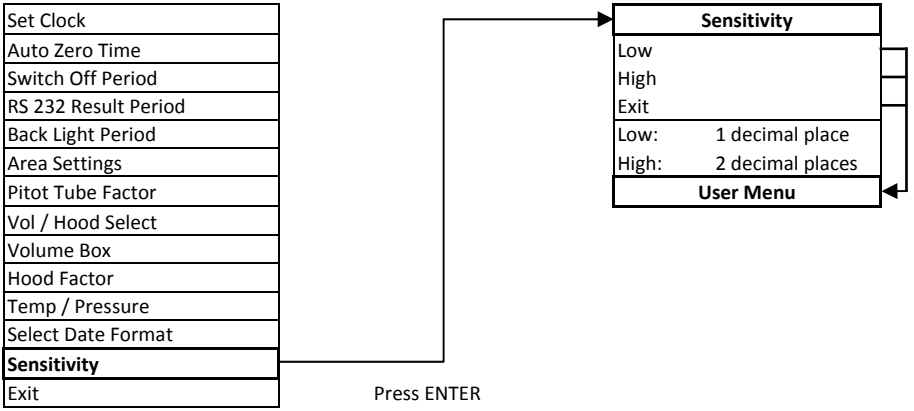


USER MENU

Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.







OPTION MENU

The Option Menu is to temporarily change default settings.
To access the Option Menu, press MENU when the instrument is in operation mode.

Page 12

Review Results:	View stored data in the form of time, measured value and unit of measurement. Providing the stored readings are in the same unit, the average value will be shown at the bottom of the screen as the cursor moves down.

Page 13

Delete Last Result:	Deletes the last stored value.
Clear Memory:	Deletes all stored data.
Set Area:	(model dependent) Select an area setting from a list of 4 defaults.

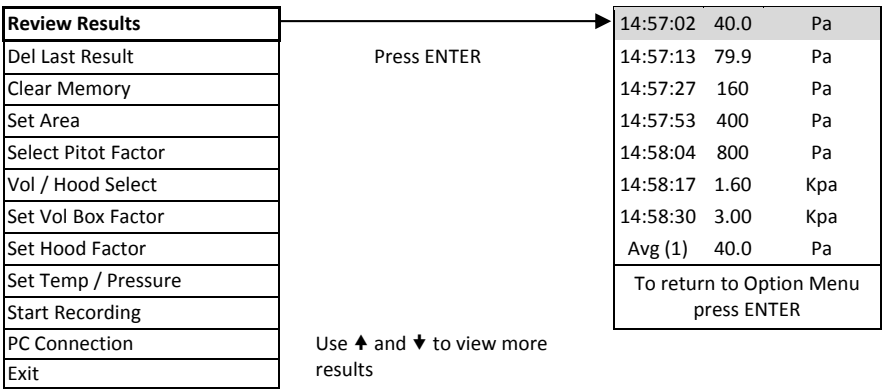
Page 14

Select Pitot Factor:	(model dependent) Select a Pitot Tube Factor from a list of 3 defaults.
Vol / Hood Select:	(not activated)
Set Vol Box Factor:	(not activated)
Hood Factor:	(not activated)
Set Temp. / Pressure:	Change the airstream temperature and barometric pressure.
Start Recording:	This feature is used for data logging. Up to 2500 readings can be stored.

Page 15

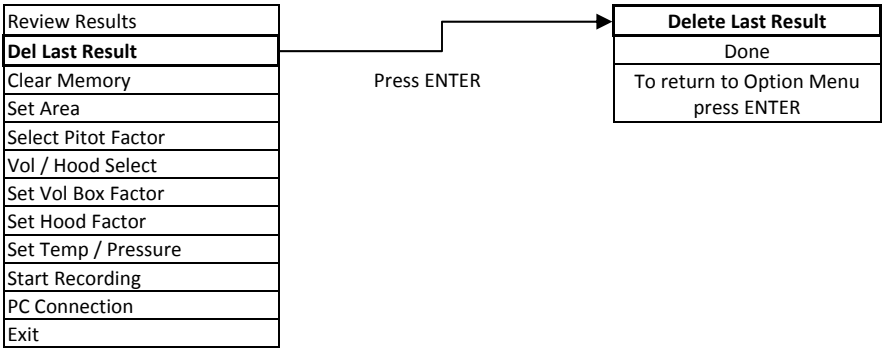
PC Connection:	To download stored data to a PC. See Downloading Data page 18.

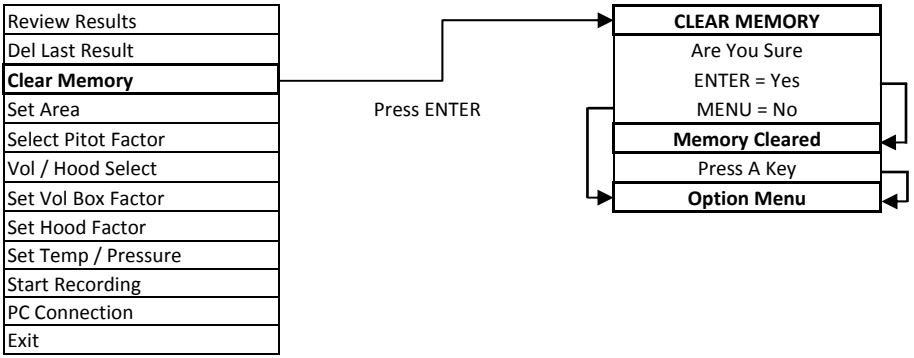
Selecting from a list:	Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value:	Use ↑ and ↓ to set each digit or value then press ENTER.

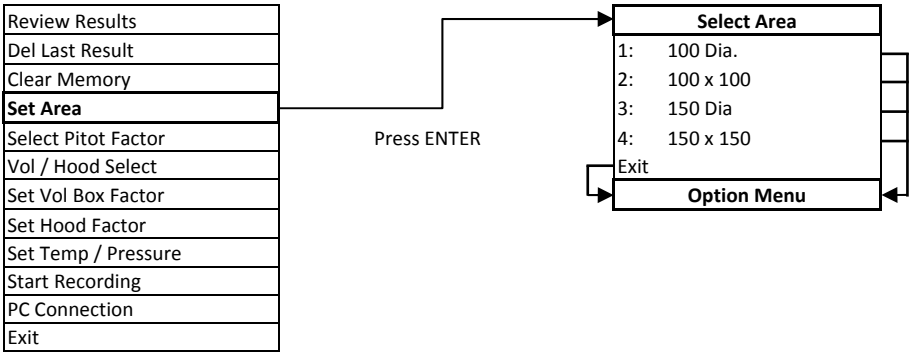


OPTION MENU

Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.

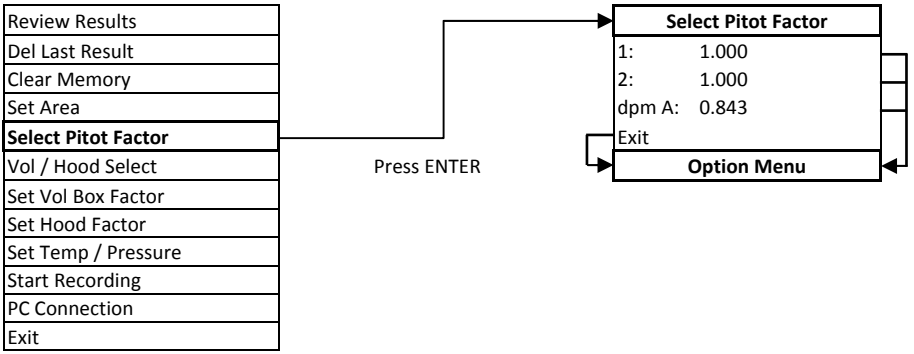


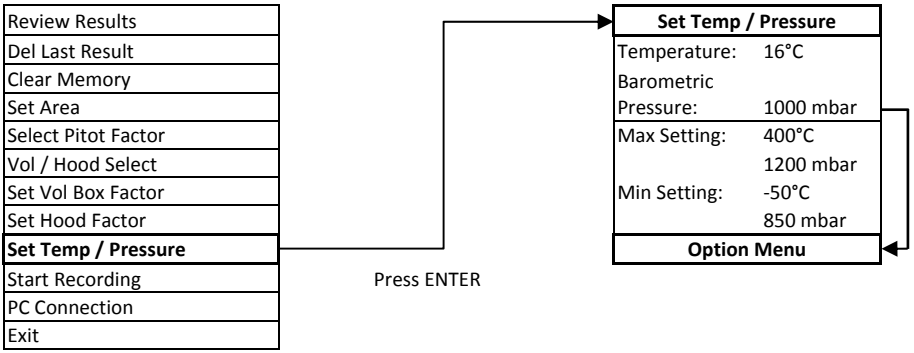




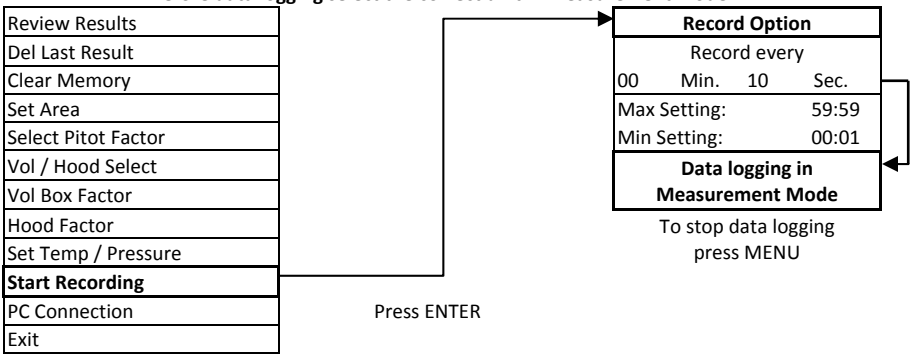
OPTION MENU

Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.





Before data logging select the correct unit in measurement mode.

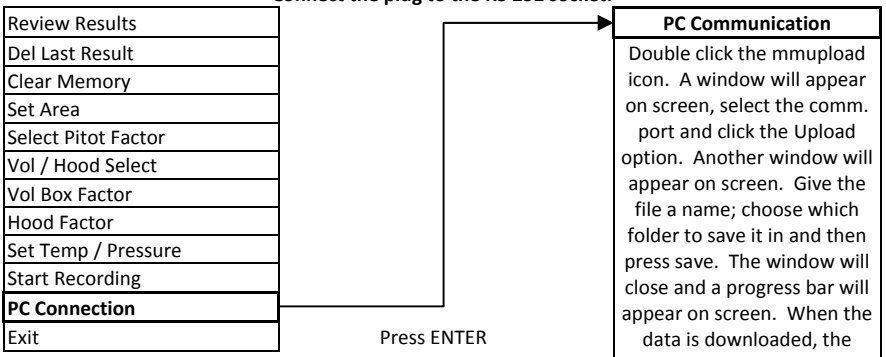


To stop data logging press MENU

OPTION MENU

Selecting from a list: Use ↑ and ↓ to scroll. Press ENTER to select.
Entering a value: Use ↑ and ↓ to set each digit or value then press ENTER.

Software must be installed. Ensure that the cable is connected to the PC via the D-type connector. Connect the plug to the RS 232 socket.



Unplug the connector and press MENU to return to Option Menu

CONVERSION TABLES

Pressure:

	Pa	mbar	mmH_2O	inH_2O	mmHg	inHg	PSI
Pa	1	100.0	9.806	249.1	133.3	3385	6892
mbar	0.010	1	0.098	2.491	1.333	33.85	68.92
mmH_2O	0.102	10.20	1	25.40	13.60	345.42	702.8
inH_2O	0.004	0.402	0.039	1	0.535	13.51	27.67
mmHg	7.501×10^{-3}	0.750	0.074	1.868	1	25.64	51.70
inHg	2.953×10^{-4}	0.029	2.895×10^{-3}	0.074	0.039	1	2.305
PSI	1.451×10^{-4}	0.014	1.423×10^{-3}	0.036	0.019	0.4338	1

Volume:

	m^3/sec	m^3/hr	l/sec	cfm
m^3/sec	1	0.0002	0.001	0.0004
m^3/hr	3600	1	3.6	1.699
l/sec	999.97	0.2777	1	0.4719
cfm	2118.88	0.5885	2.1189	1

Velocity:

	m/sec	ft/min
m/sec	1	0.005
ft/min	196.85	1

Air Velocity Calculations using S.I Scales:

For non-standard air conditions: $V = 1.291 \times PT \sqrt{\frac{1013.25}{B} \times \frac{T}{293} \times Pv}$

V = Velocity in m/sec

PT = Pitot Tube Factor (for Ellipsoidal type 1.000)

B = Barometric pressure in mbar

T = Absolute temperature in °K (= t in °C + 273 where t = airstream temperature)

Pv = Velocity pressure in Pa

Air Velocity Calculations using Imperial Scales:

For non-standard air conditions: $V = 4006 \times PT \sqrt{\frac{30}{B} \times \frac{T}{528} \times Pv}$

V = Velocity in ft/min

PT = Pitot Tube Factor (for Ellipsoidal type 1.000)

B = Barometric pressure in inHg

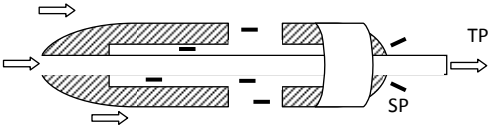
T = Absolute temperature in °R (= t in °F + 460 where t = airstream temperature)

Pv = Velocity pressure in wg

DUCT TRAVERSE POINTS

Principle of Operation:

Pitot Head

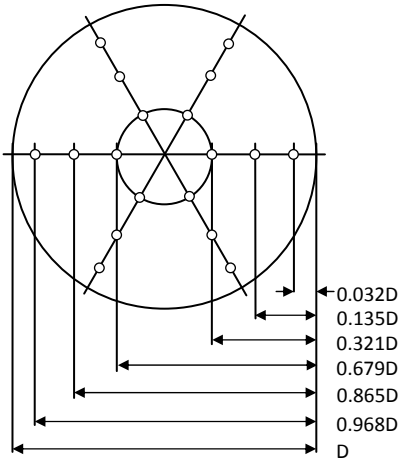


Velocity Pressure* = Total Pressure – Static Pressure

*Calculated by the Micromanometer

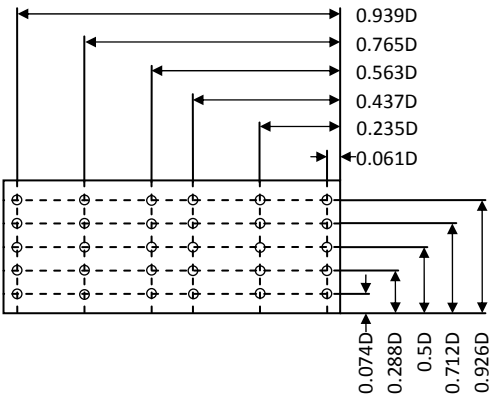
The nose of the Pitot Tube should face directly into the airstream thus the Total Pressure flows down the inner tube which is connected to the Signal In port.
The static holes are positioned around the side of the Pitot Tube and lead into an outer tube. This is connected to the black tubing which in turn is connected to the Reference port.

Log Linear Rule for Traverse Points on 3 Diameters in a Circular Duct:



Ideally traverse points should be at least six duct diameters away from any bend or obstruction in the system.
The Pitot Tube should be inserted at right angles to the walls of the ducts and measurements are taken in the positions shown in the diagrams (left).
The directional pointer can be used to ensure that the Pitot Tube head is parallel to the duct walls.

Alternative Measuring Points and Traverse Lines Relative to Side Lengths for Regular Ducts:



DOWNLOADING DATA

Important: Only use a genuine cable and CD Rom from DP Measurement.
If any other accessories or the incorrect downloading software are used then the guarantee on the instrument and the accessories becomes null and void.
All charges apply.

Download Data: **Software must be installed.**
Ensure that the cable is connected to the PC via the D-type connector.
Connect the plug to the RS 232 socket.
Double click the mmupload icon. A window will appear on screen, select the comm. port and click the Upload option. Another window will appear on screen. Give the file a name; choose which folder to save it in and then press save. The window will close and a progress bar will appear on screen. When the data is downloaded, the message 'Records received successfully' will appear, click OK. Close the downloading software and open the file using Notepad.

MAINTENANCE & CALIBRATION

Maintenance: There are no user serviceable parts in the TT Series Micromanometers.
With the exception of dry cell batteries there are no consumable parts.
If the instrument is damaged or requires servicing, it should be returned to the Buckingham England factory.

Calibration: All TT Series instruments are calibrated against equipment traceable to National Standards. It is good practice to have the instrument calibrated and checked at least once a year. The Buckingham England factory offers a calibration service:

DP Measurement
Unit 11, Top Angel, Buckingham Industrial Park
Buckingham, England. MK18 1TH
Tel / Fax: +44 (0)1280 817122
www.ttseries.com email: dpm@ttseries.com

Manufactured in the United Kingdom.

SPECIFICATIONS

Models:							Range / Resolution in High Sensitivity Setting:			
550	550 S	550 M	550 A	550 B	550 C	550 D	**Pressure:**			
●	●				●	●	Pa	± 0.06 to 99.99	± 100.0 to 999.9	1000 to 5000
●		●			●	●	mmH_2O	± 0.004 to 9.999	± 10.00 to 99.99	± 100.0 to 510.0
●			●		●	●	inH_2O	± 0.000 to 9.999	± 10.00 to 20.00	
●				●	●	●	mbar	± 0.000 to 9.999	± 10.00 to 50.00	
							Velocity:	Ellipsoidal	dpm-i	dpm-Ane™
	●	●		●	●		m/sec	2.00 to 90.0	0.27 to 30.0	0.27 to 25.0
			●			●	ft/min	394 to 17730	53 to 5905	53 to 4921

Accuracy:

Pressure at 20°C, Velocity with Ellipsoidal type at 16°C, 1000 mbar:
Readings < 100 counts ± 2 counts. Readings > 100 counts ± 1% of reading ± 1 count
Velocity with dpm-i type at 16°C, 1000 mbar:
± 3% of reading or ± 0.05 m/sec (10 ft/min) ± 1 count. Whichever is greater.
Velocity with dpm-Ane™ at 16°C, 1000 mbar:
Readings up to 8 m/sec (1575 ft/min) ± 1% of reading ± 0.03 m/sec.
Readings from 8 to 25 m/sec (1575 to 4921 ft/min) ± 1 m/sec (197 ft/min)

General Specifications:

Recommended Operational Limits:	0° to 50°C (32° to 123°F)
Span Stability versus Temperature:	0.1% of range in use per °C (per 2°F)
Zero Drift:	Negligible due to auto zero system. When auto zero set at 60 sec intervals (2 minute warm up).
Zero System Accuracy:	± 0.05 Pascal typical
Orientation Effect:	(any 45° change) 0.1 Pascal typical
Output Socket:	RS 232 (baud rate 9600)
Data Logging:	Up to 2500 any units.
Software:	Download data to PC in very basic form.
Power Source:	Dry cell (MN1604, PP3) or Rechargeable.
System Air Leak:	0.1 ml/minute a 5Kpa (typical)
Safe Line / Differential Pressure:	15KPa
Storage Temperature Limits:	-5° to +50°C
Weight:	555 grammes with battery.
Dimensions:	45 x 92 x 185 mm.
Standard Accessories:	2mm x 6mm tubing adaptors (4) — Instruction manual 3m x 2mm bore flexible tubing (2) — Neck sling Calibration certificate — Soft lined case
Optional Extras:	Basic software to download data to PC — RS 232 lead for PC dpm Ane™ — Rubber holster Pitot Static Tubes

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In the interest of continuous product development and improvement DP Measurement reserve the right to amend specifications and to discontinue models, features and colours of the TT Series Micromanometers at any time without prior notice