







TABLE OF CONTENTS

WARNINGS.....	2
TFI CONTACT DETAILS	2
INTRODUCTION.....	3
What is the DPMS?	3
Package contents	4
System requirements	4
GETTING STARTED	6
Software installation.....	6
Software configuration	6
Hardware set up	9
Power Lights	10
Reference Port.....	10
Advanced software configuration – Tube response.....	11
Calculating Tubing Frequency Response.....	11
R-TAC configuration	14
Mode	14
R-TAC main form	15
Configuration Settings	16
Operation.....	18
Sampling and Data Rates.....	19
DPMS Calibration	20
Data Output Files.....	20
Data Replay	20
Creating Movie Files	21
Exporting Data - MATLAB®	21
Exporting Data – Other Programs	21
FURTHER INFORMATION.....	22
Help Hints	22
Context Sensitive Help.....	22

WARNINGS

Although the Dynamic Pressure Measurement System (DPMS) is relatively robust, care must still be taken with its handling.

-  Avoid dropping the Dynamic Pressure (DP) modules.
-  Avoid over-pressuring the transducers.
-  The warranty will be void if a user dismantles any part of the DPMS without specific instructions from TFI. Any significant damage will require the DPMS to be returned to TFI for maintenance.
-  The DPMS should be stored in a secure location when not in use.

TFI CONTACT DETAILS

Turbulent Flow Instrumentation – Victoria, Australia

- Main website: www.turbulentflow.com.au
- Support website: support.turbulentflow.com.au
- Email support: support@turbulentflow.com.au
- Phone support: (61 2) 6020 9250

INTRODUCTION

This document outlines the basic procedure for using the TFI Dynamic Pressure Measurement System (DPMS). However, users are referred to the on-line *User's Guide* for complete details of the DPMS and its operation. The *User's Guide* can be run from:

- the software installation CD
- the *TFI Device Control* software **Help** menu
- the Windows **Start** menu (under 'Program Files\TFI')

What is the DPMS?

The DPMS is a multi-channel pressure measurement system that provides both time-averaged (static) and time-varying (dynamic) pressure measurements in real-time.

The number of channels available in DPMS units varies from 32 to 1024, depending on the user requirements. The system is capable of a linear frequency-response from 0 Hz to several kHz and is available in various full-scale ranges. The measurement modules, or Dynamic Pressure (DP) modules, are supplied fully calibrated and ready to use. Figure 1 shows a diagram of a DP module and a complete DPMS. Figure 2 shows how a module may be removed from the DPMS rack.

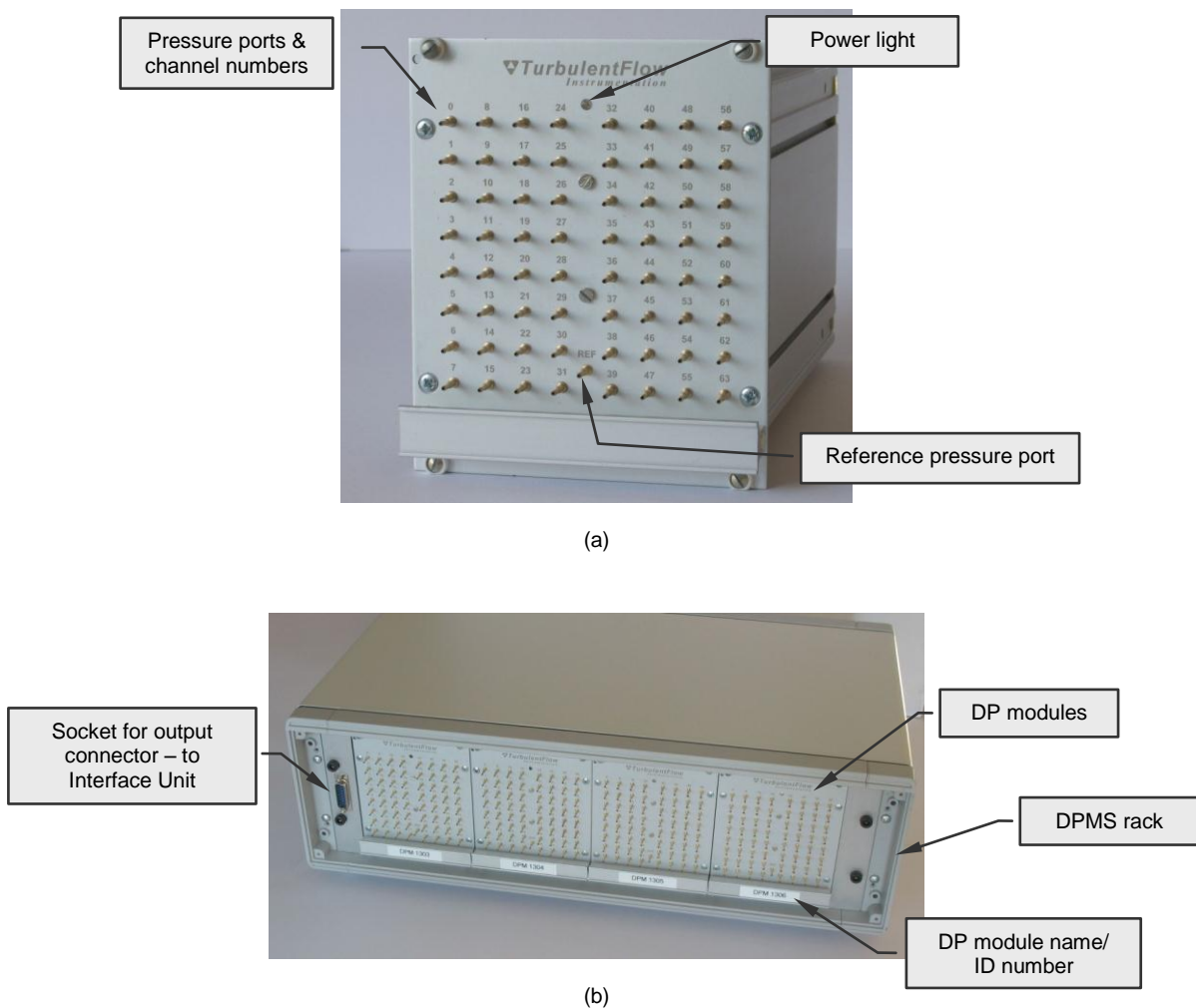


Figure 1: The main features of a DPMS: (a) a DP module; (b) a complete DPMS.

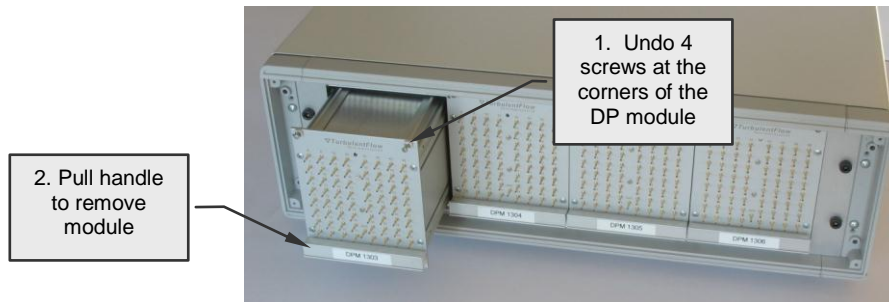


Figure 2: A DPMS rack showing a module being removed

Included with the DPMS are the *TFI Device Control* software and the *Real-Time Animated Contouring (R-TAC)* software, for operating the DPMS and viewing measurements respectively.

The *Device Control* software provides access to all functions of the DPMS, and can be used to configure measurements, obtain and view data, save data to disk, and interface with the *R-TAC* software. *R-TAC* overlays dynamic pressure contours, in real-time, on an imported image of the measurement situation. This allows the user to see the fluctuating pressure contours directly on the object where measurements are taken.

Package contents

Your DPMS should have been supplied with the following items. If any items appear to be missing or damaged, contact TFI as soon as possible.

- Dynamic Pressure (DP) modules
- Rack case for modules
- Cables
- Data acquisition Interface Unit
- Software installation CD – *TFI Device Control* + *R-TAC* software
- This guide & additional items that were ordered

System requirements

The requirements for running the *Device Control* software are listed below. These requirements allow real-time viewing of data from the DPMS, and are the minimum required to run the software efficiently. The use of a slower processor may prevent real-time display capability, while the use of a faster computer may be required if there are a large number of channels.

Table 1: Minimum required computer system for running the *Device Control* software


Operating system	Microsoft® Windows 2000 or XP
Processor	Pentium 1 GHz or equivalent
RAM	128 Mb
Display	1024x768, 65536 colours (16-bit)
Storage (program)	15 MB
Storage (data) [#]	Approx. 120 kB/channel/minute (if saving all data)
A/D card	See below (normally supplied)

[#] This only applies if saving all time-varying data. Summary files of each run are less than 2 kB in size

The *Device Control* software currently supports the following analogue-to-digital (A/D) cards for operating the DPMS:

- National Instruments E-series or M-series cards (for desktop and laptop computers)
- Data Translations cards

TFI can also customise the software to support other suitable A/D cards or data acquisition systems – contact us for further information.

 Please follow the A/D card manufacturers' instructions for installation of the A/D card before attempting to install and run the *Device Control* software.

GETTING STARTED

Complete instructions for installing and using the DPMS are provided in the on-line *User's Guide*. The following pages only introduce the DPMS set-up and operation.

Software installation

Before installing the software, *TFI Device Control with R-TAC*, ensure that your data acquisition drivers are installed and operating correctly.

i You will need administrator rights to successfully install the *Device Control with R-TAC* software.

To install the *Device Control with R-TAC* software:

- Insert the installation CD (run *Startup.exe* on the CD if installation does not start automatically).
- Follow the on-screen instructions and upon reaching the **Choose Components** screen, refer to Figure 3.

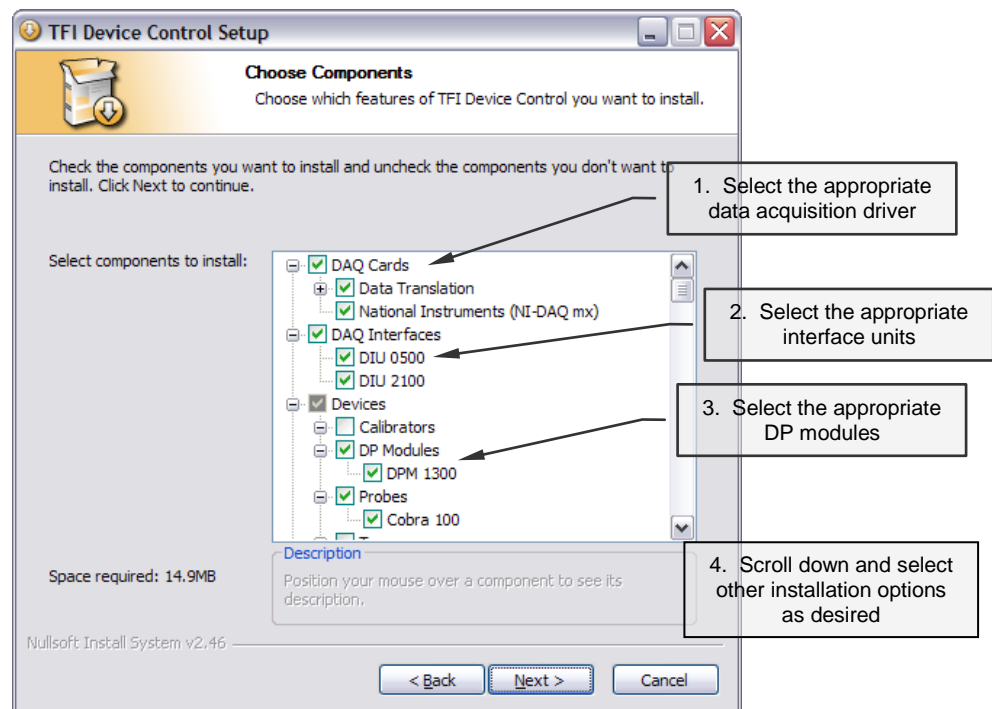


Figure 3: Software installation – Choosing which components are installed

i All the devices that you have purchased should already be selected, but please ensure that the correct DAQ driver for the card that you are currently using is chosen.

After installation is complete, you can run the software – you should not need to restart your computer.

Software configuration

Some basic settings need to be configured when the software is first run, or when the set-up is changed, in order to correctly use your instrumentation.

Prior to configuring your DPMS (or any other device), ensure the data acquisition details are correct.

When the *Device Control* software is run you can access information about the data acquisition devices

available for use on the **Advanced (DAQ)** tab. Check this first to ensure that your data acquisition devices have been identified.

- Run the *Device Control* software – ignore any warning messages
- Select **Advanced (DAQ)** from the **Settings** menu, then refer to Figure 4 below

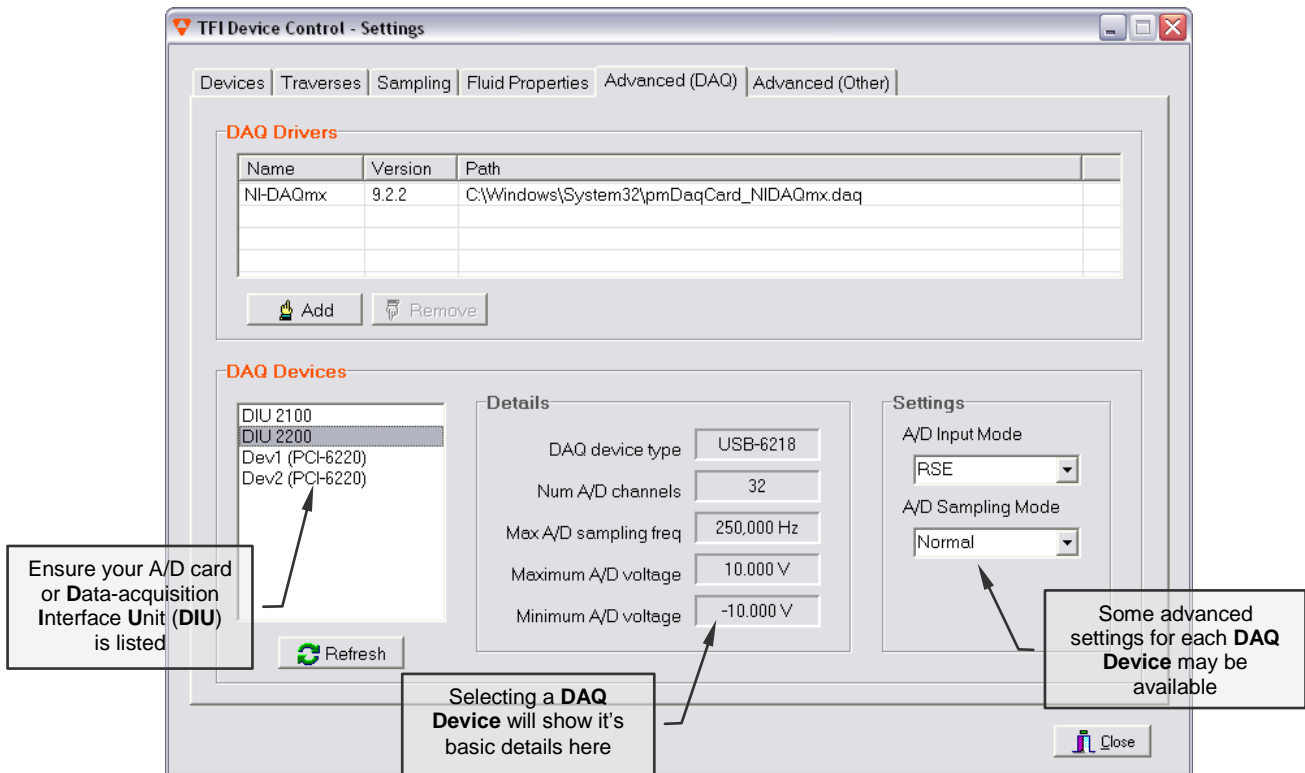


Figure 4: Software configuration – Checking/Selecting the Interface Unit

- ❗ In most cases, there will only be one Interface Unit listed
- ❗ When the Interface Unit is set to **None**, it is possible to set the data acquisition channels for all devices manually. However, this is not normally done when using a DPMS and you should select the appropriate interface unit.
- ❗ For DAQ devices that use a common input voltage range for all channels (e.g. some Data Translations A/D cards) it will also be necessary to choose the appropriate input voltage range on the **Advanced (DAQ)** tab (this is not shown above in Figure 4 but will appear if such a DAQ device is selected).

- To choose and configure the devices that you wish to use, select the **Devices** tab (or choose **Devices** from the **Settings** menu) and refer to Figure 5.

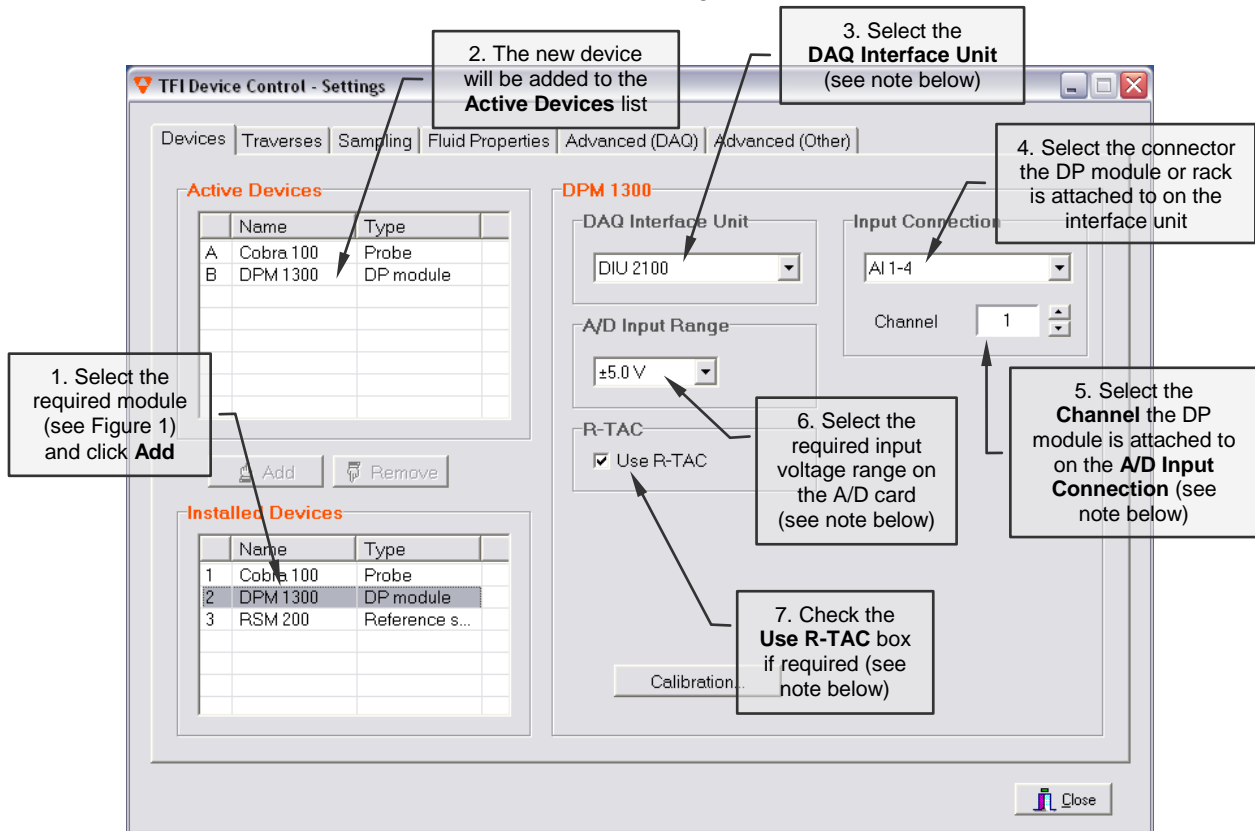


Figure 5: Software configuration – Adding and configuring devices

- Repeat the steps shown in Figure 5 for each additional DP module or other device.
- i** If your DAQ Interface Unit is not listed, go back and check the **Advanced (DAQ)** tab.
 - i** When using a DPMS you should select the appropriate interface unit. Some custom units may allow the channels to be set up manually; however, this is not normally required.
 - i** Select the connector the DP Module is attached to from the **Input Connection** list (this will automatically configure the channel list – see the Hardware Set Up section for details about Interface Units and connections)
 - i** When using a rack to hold the modules, **Channel** corresponds to the particular slot in the rack that a DP Module is placed in. The first slot in the rack will be the first channel used by the connector, the second slot will be the second channel, etc. For example, for connector **AI 1-4** the first slot will be Channel 1, the second slot will be Channel 2. For connector **AI 5-8**, the first slot will be Channel 5.
- If a module is connected directly to connector **AI 1-4**, the **Channel** setting should be 1.
- i** For cards that use a common input voltage range for all channels, the **A/D Input Range** is set on the **Advanced (DAQ)** tab (see Figure 4).
 - i** To use the *R-TAC* software, the **Use R-TAC** box must be checked for each DP Module for which R-TAC data is required. This must be done for at least one module before *R-TAC* will run.

Hardware set up

After unpacking the DPMS, you should not have any difficulty connecting it – connectors should only fit in suitable sockets. Refer to Figure 6 and Figure 7 for diagrams of the required connections.

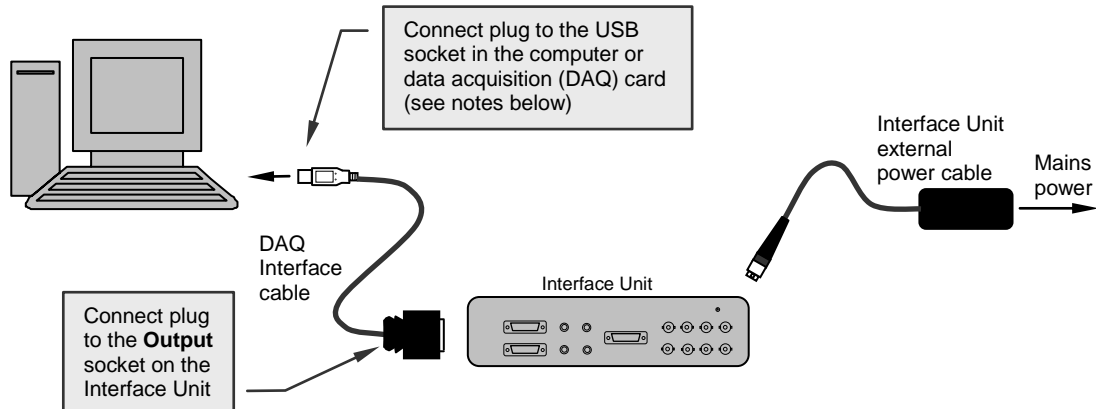


Figure 6: Schematic of the DPMS connections between the computer and Interface Unit

- i** Connections can be made in any order, even when the computer is already turned on.
- i** If the Interface Unit contains an internal A/D card (**Data-acquisition Interface Unit** or **DIU**), it will have a USB connector which plugs into a USB socket on your computer. A USB 2.0 (high-speed USB) port should be used.

If the A/D card is installed in your computer, the DAQ Interface cable will plug into the socket provided on the A/D card.

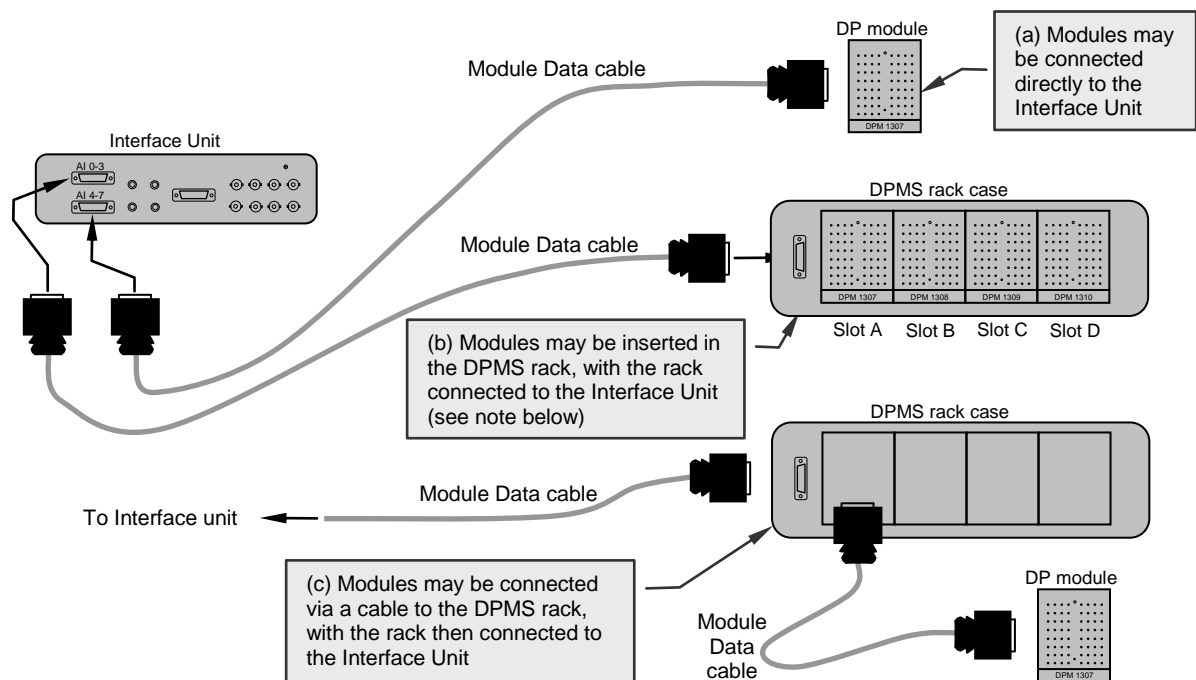


Figure 7: Schematic of the different configurations possible between the Interface Unit and the DP modules

- i** All Module Data cables have common wiring and are interchangeable.
- i** Modules can be connected to the Interface Unit in three different ways:
 - (a) directly to the Interface Unit
 - (b) inserted in the rack case, which is then connected to the Interface Unit
 - (c) connected via a cable to the rack case, which is then connected to the Interface Unit
- i** Module Data cables may also be connected together to extend the cable length.
- i** The labels above the sockets on the Interface Unit indicate the DAQ card channels that those sockets connect to (**AI** stands for **Analogue Input**).
- i** If a module is connected directly to the Interface Unit, it is always connected to the first channel listed on the socket, e.g. if a module is directly connected to **AI 1-4** on the Interface Unit, it is on channel 1. This information is required for step 5 in Figure 5 of the Software Configuration.
- i** When a rack is connected to the Interface Unit, e.g. to socket **AI 5-8**, slot A corresponds to the first channel (e.g. channel 5), slot B corresponds to the second channel (e.g. channel 6), slot C corresponds to the third channel (e.g. channel 7) etc. This information is required for step 5 in Figure 5 of the Software Configuration.

Power Lights

The DP module power lights indicate when power is connected to the modules.

Reference Port

The reference pressure port (see Figure 1) provides the common reference pressure for the transducers. Therefore, pressures measured by the DPMS are relative to the pressure applied at the reference port.

Advanced software configuration – Tube response

Advanced software settings need to be configured for each new measurement situation. The reasons and procedure for doing this are detailed below.

The DPMS measures dynamic pressure by sensing the pressure fluctuations at the end of the pressure tubes that connect the measurement points to the DP modules. Amplitude and phase distortions are introduced into the pressure fluctuations as they propagate along the tubing from the measurement point to the pressure transducer.

The default *Device Control* software configuration assumes a linear tubing response, which is appropriate for time-averaged (static) measurements. However, to take accurate time-varying (dynamic) measurements it is necessary to provide the frequency response function (transfer function) of the tubing being used. Figure 8 shows how effectively a fluctuating pressure signal can be recreated by applying the appropriate tube response function (the corrected pressure is within 2% of the actual pressure, compared to 30% amplitude error and a large phase error for the uncorrected pressure). If an accurate frequency response function is not used, the resulting frequency content of time-varying pressure fluctuations will be incorrect.

A tubing frequency response function can be either theoretical or experimental. A theoretical function can be generated by the *TFI Device Control* software's *Frequency Response Calculator*. Please contact TFI about using experimentally acquired frequency response functions.

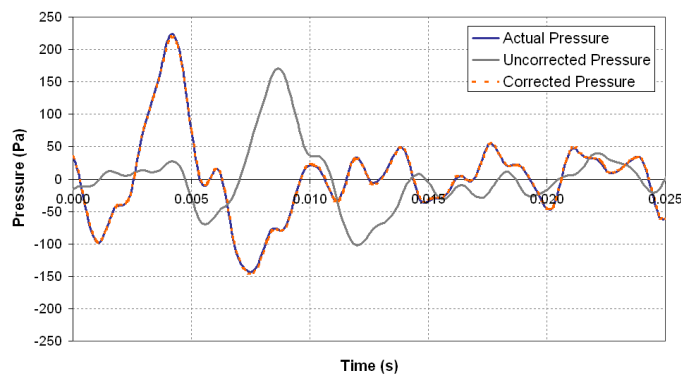


Figure 8: Sample data showing uncorrected and corrected pressure measurements. Data were obtained using 1200 mm of 1.2 mm ID tubing at a sample rate of 5 kHz.

Calculating Tubing Frequency Response

Amplitude and phase distortions in the pressure fluctuations depend on both the length and internal diameter of the pressure tubing, and can be corrected for by linearising the measured signal (i.e. returning it to its original undistorted state). The *Frequency Response Calculator* supplied with the *TFI Device Control* software can be used to generate theoretical frequency response functions for this purpose.

The following procedure is greatly simplified by using identical tubing configurations (i.e. number of segments per tubing line, segment diameters and lengths) for every channel of a DPM.

With the *Device Control* software running:

- Select **Devices** from the **Settings** menu, select the DP module for which the transfer functions will be specified, then click on **Calibration ...**
- Select the **Transfer Function** tab
- Within the **Transfer Function File** area, select **Create**


The next part of the procedure depends on whether identical sizes and lengths of tubing are being used for all the channels/pressure ports.


If identical diameter and length tubes are used for all channels, known as a Common Tubing Configuration, then


- 1 In **Tube Properties** select the **Number of Tubes** that make up an individual tubing line (one or more segments, the internal tubing in the DP module, are already specified and 'greyed out')
- 2 Detail the tubing inner **Diameter** and **Length** of every segment of tubing from the DP module to the measurement point (see information notes below)
- 3 In **Response Properties**, set **Max Frequency** to at least half the data acquisition rate (it does not matter if this value is set to a higher value) (see information notes below)
- 4 In **Fluid Properties** set the **Temperature** and barometric **Pressure** at which the theoretical response function is to be calculated (see information notes below)
- 5 Select **Save Current Response** from the **File** menu, enter a file name and select **Save**
- 6 Once finished select **Exit** from the **File** menu
- 7 Confirm use of the new theoretical response by selecting **Yes**

If there are any variations in either the diameter or length of tubes used for different channels, known as a Varied Tubing Configuration, then


- 1 Complete steps 1-4 for channel 1 as for a Common Tubing Configuration – this is Response 1
- 2 Select **Add** from the **Response** menu at the top of the page
- 3 Complete steps 1-4 for channel 2 – this will be Response 2
- 4 Repeat this process for every other channel in the DPM, in the channel order
 - If a particular channel has identical tubing to an earlier channel, select the earlier channel tab, and select **Copy** from the **Response** menu
 - Unwanted responses can be deleted by selecting the response and choosing **Remove** from the **Response** menu
- 5 When all channel responses are complete, select **Save All Responses** from the **File** menu, enter a file name and select **Save**
- 6 Once finished select **Exit** from the **File** menu
- 7 Confirm use of the new theoretical response by selecting **Yes** when prompted

 The units used for the various parameters on the Calculator page can be changed by going to the **Units** menu at the top of the page

 The tube dimensions (length and internal diameter) must be specified accurately in order for the calculated frequency response function to give accurate results

 The order that the tubing segments are listed in must start at the transducer end and proceed, in order, to the measurement point – this should include any connectors and restrictors


 The data acquisition rate is set on the **Advanced** page of the *Device Control Settings Form*

 Temperature and barometric pressure have minimal effect on the frequency response and can therefore be set to nominal values – small changes (e.g. $\pm 10^{\circ}$ C) do not require the frequency response to be recalculated

 Select the **Plot** or **Plot All** buttons at the bottom of the Calculator page to view the theoretical response functions

The above procedure needs to be repeated for every DP module in the DPMS.

- **Close** the **Transfer Function** tab
- On the **DP Devices** tab select the next device to be configured
- Repeat the above procedure

 If a module uses identical tubing configurations for its channels as that of an existing module, the same transfer function file can be used for both modules. Use **Select** in the **Transfer Function** tab of a particular module to select a previously defined transfer function file and use it for this module.

R-TAC configuration

The *Real-Time Animated Contouring (R-TAC)* software provides contour generation and plotting of the pressure signals. The user may import a chosen background image (photo or drawing) and specify the location of the pressure measurement points (taps) on the image, including zones for contour generation, so that the fluctuating pressures can be visualised in the actual measurement situation. This can be viewed while measurements are being taken or can be played back later for further analysis.

Figure 9 shows the *R-TAC* main form. The *R-TAC* software can be accessed from a button at the top of the main form of the *Device Control* software (shown in Figure 11 on page 18), or by clicking on the **Start Sampling** button on the same form.

i As noted on page 6, the **Use R-TAC** box must be checked on the **DP Devices** tab in the **Settings** menu for each DP module from which *R-TAC* data is required. This must be done for at least one module before the *R-TAC* software will run.

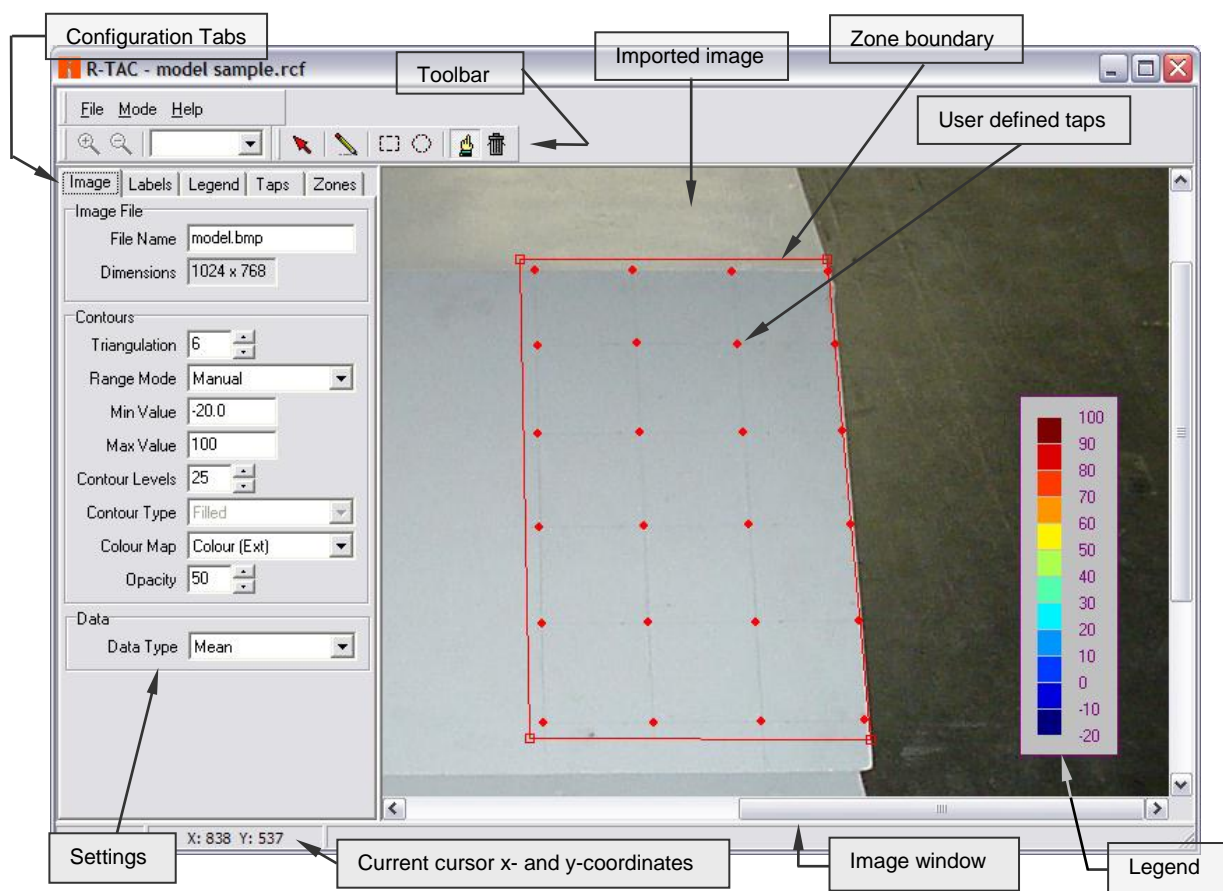


Figure 9: The main screen of the *R-TAC* software

Mode


The *R-TAC* software operates in two possible modes: configuration; or operation. *R-TAC* must be put in configuration mode in order to configure it for operation (e.g. import an image, and define or change zones or taps). Upon running *R-TAC* for the first time for a given measurement situation, configuration must occur before data will be displayed in the Operate mode.

To put *R-TAC* into configuration mode:

- Select the **R-TAC** button from the *Device Control* software main form

- Select **Config** from the **Mode** menu on the *R-TAC* main form

The operational mode is automatically activated by selecting the **Start Sampling** or **Real-Time Monitor** buttons on the *Device Control* software main form (see Figure 11). In operational mode, *R-TAC* plots the measured pressure contours on an imported image according to the configuration settings entered by the user.







 If configuration settings have not been entered (e.g. an image has not been loaded, or pressure taps and zones are not defined) the *R-TAC* software will not display anything.

R-TAC main form

As shown in Figure 9, the *R-TAC* main form consists of a menu bar, tool bar, five configuration tabs and an image window.


Menu bar. The menu bar controls the loading and saving of configuration files, print options, operation or configuration mode and the help facility. These functions are straightforward and will not be discussed any further here, other than to say that the ability to save particular configurations at any stage, and load them for later use or further development, greatly reduces the configuration time required for new measurement situations.


Toolbar. The toolbar, immediately below the menu bar, contains the tools for configuring the taps and zones on the imported image. Placing the cursor over a tool button will bring up the tool-tip describing the tool function. Clicking on any of the tool buttons activates the selected tool.

	Select	When the cursor is placed over an existing tap (or zone vertex) in the image window, the corresponding Configuration Tab and tap number are displayed on the left of the <i>R-TAC</i> main form
	Add Tap	Clicking anywhere within the image window will place a tap at that point
	Create Zone (Rectangular)	Clicking and dragging creates a rectangular zone, clicking again sets the zone size
	Create Zone (Polygon)	Each click of the cursor within the image window sets a vertex of the polygon. To complete the polygon, on the last vertex, double-click the cursor instead of a single-click.
	Move	Place the cursor over a tap or zone vertex, click and drag to move it to a new location, and complete the move with a single click once the point is in the desired position
	Delete	Move the cursor over a tap or zone vertex that is to be deleted (the cursor will change to a pointer when over a valid point) and click once. You will be asked to confirm whether you wish to delete the point.

All the tools are simple to operate and it is suggested that the user experiment with using them to quickly gain an appreciation of how they work.

Image window. Below the toolbar on the right-hand side of the *R-TAC* main form is the image window. This is where imported images, zones, pressure taps, and contoured data are displayed. In configuration mode, the image window is also where the pressure taps and zone boundaries can be defined, moved or deleted using either the tools on the toolbar or from within the configuration tabs.

 The image window units are pixels; all coordinates for taps, zone boundaries and the cursor position are given in pixels of the imported image, with (0,0) being the top left-hand corner of the image.

 When the cursor is positioned over the image window, the current cursor x- and y-coordinates (in units of pixels) are displayed at the bottom-left of the main form.

Configuration tabs. Below the toolbar on the left-hand side of the main form are the configuration tabs. In the configuration tabs all the settings for the definition of zones and taps, and the processing and display of pressure data and contours, are controlled. The contour colouring, transparency, legend settings, text fonts and other settings can also all be adjusted. Most settings are self-explanatory, however, a few need further explanation and are detailed in the next section.

Configuration Settings

The first step when configuring *R-TAC* is to load an image, as other functions will not operate until this is done. Once an image is loaded, zone and tap definition can be configured in any order.

The loading of an image is performed in the **Image** configuration tab, zones and taps are defined in the **Zones** and **Taps** tabs respectively, and other settings related to legends and labels are controlled in the **Legend** and **Labels** tabs.




 Especially when configuring large numbers of taps or zones, it is recommended that the configuration be saved at regular intervals (remember to use **Save As** when creating a new set-up, or you will write over a previous configuration).

Image tab. The image tab is used to configure the image and contour appearance. Images can be imported by clicking in the **Image File, File Name** box and browsing to select a JPG or BMP image of choice. Once imported, the image file size in pixels is displayed below the filename. The following points are worth noting about the functions in the **Image** tab:

- Images can only be imported when *R-TAC* is in configuration mode
- **Contours** and **Data** settings can be changed in either configuration or operational modes
- The triangulation or grid multiplier setting increases the smoothness of contour levels between taps by using spline interpolation to increase the effective number of tap points; the higher the triangulation setting, the smoother the contours.
- Increasing the number of contour levels produces a smoother contour map, while reducing the number of contour levels produces more distinction between different contour bands and has an averaging effect within the bands.
- Reducing the opacity makes the contours more transparent and allows the background image to show through the contour map.
- The **Data Type** setting allows the user to select which type of data will be used to generate contours: mean, minimum, maximum or RMS pressure data.

 Changing the **Contours** and **Data** settings in operational mode, while measuring or replaying real pressure data, is a good way to instantaneously see the effect of different settings and become familiar with them.

 With uneven grids of pressure taps, especially where the grid is elongated in one direction, high triangulation settings may give unsatisfactory results. When this happens it is recommended that the triangulation be reduced, until a more reasonable contour map is achieved.

Labels & Legend tabs. Both labels and the legend can be displayed in either configuration or operational mode. It is recommended that users experiment with the different settings in these tabs in order to become familiar with their functions.

Taps tab. The **Taps** tab is where the pressure tap locations are defined. This can only be done when *R-TAC* is in configuration mode. Use the tools on the toolbar (see page 15) to initially place pressure taps on the imported image. As each tap is added, it is listed in the **Tap** tab on the left of the screen.

- Taps are automatically added in channel order, however, the user can change the channel number assigned to a tap, or assign an equation involving a number of channels, by directly editing the Equation column
- Channel numbers correspond to the DP module channel numbers and are designated by 'chXX', where 'XX' is the channel number
- Users can designate their own label for each tap, by directly editing the Label column
- Fine tuning of tap position can be done by directly editing the X and Y coordinates in the list, and then pressing the **Update** button at the bottom of the tab to see the effect of the changes
- Right-clicking on a particular tap in the list brings up a context menu that allows the user to insert a new tap above the current tap in the list, delete the current tap, or clear all taps in the list
- The settings at the top of the **Taps** tab allow the user to choose whether the taps are visible over the imported image, and change their size and colour

i The equation feature supports most basic mathematic operations including: +, -, /, *, (), sqr, sqrt, abs, max, min, trunc, ceil, floor, as well as trigonometric, logarithmic and exponential functions.

i Settings controlling Label appearance are in the **Labels** configuration tab

Zones tab. The **Zones** tab is where the zones, over which contours are required to be generated, are defined. This can only be done when *R-TAC* is in configuration mode. An imported image may have pressure taps on several different areas or faces and it is not required that contours be interpolated between taps in these different areas. Therefore, each contour generation area is defined by its own zone. *R-TAC* is able to support a large number of separate zones. Use the tools on the toolbar (see page 15) to initially define zones on the imported image.

- Each zone must contain at least 3 pressure taps in order for contours to be generated, however, contour quality increases with increasing tap numbers and regularity of tap positions in a zone
- The contour region is defined by the outermost tap positions within a particular zone

- If a zone only has taps in a straight line, contouring will not occur because triangulation cannot be performed. In this situation, placing an extra or 'dummy' tap next to the existing tap on the image, and assigning it to the same channel as the tap it is next to, will allow triangulation to occur over a narrow strip formed by the two rows of taps.

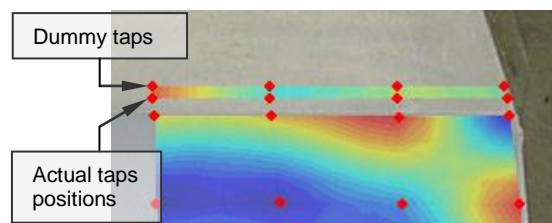


Figure 10: Application of dummy taps to visualise pressures from a linear tap configuration

- Fine tuning of zone vertices can be done by directly editing the X and Y coordinates in the list, and then pressing the **Update** button at the bottom of the tab to see the effect of the changes

- The settings at the top of the **Zones** tab allow the user to choose whether the zone boundaries are visible in configuration mode, as well as change their colour

i In order for the data from particular taps to be contoured, they must be included within a zone boundary

Operation

The basic operation of the DPMS is outlined in Figure 11, which shows the main screen that appears when the *Device Control* software is run – refer to the on-line *User's Guide* for complete details.

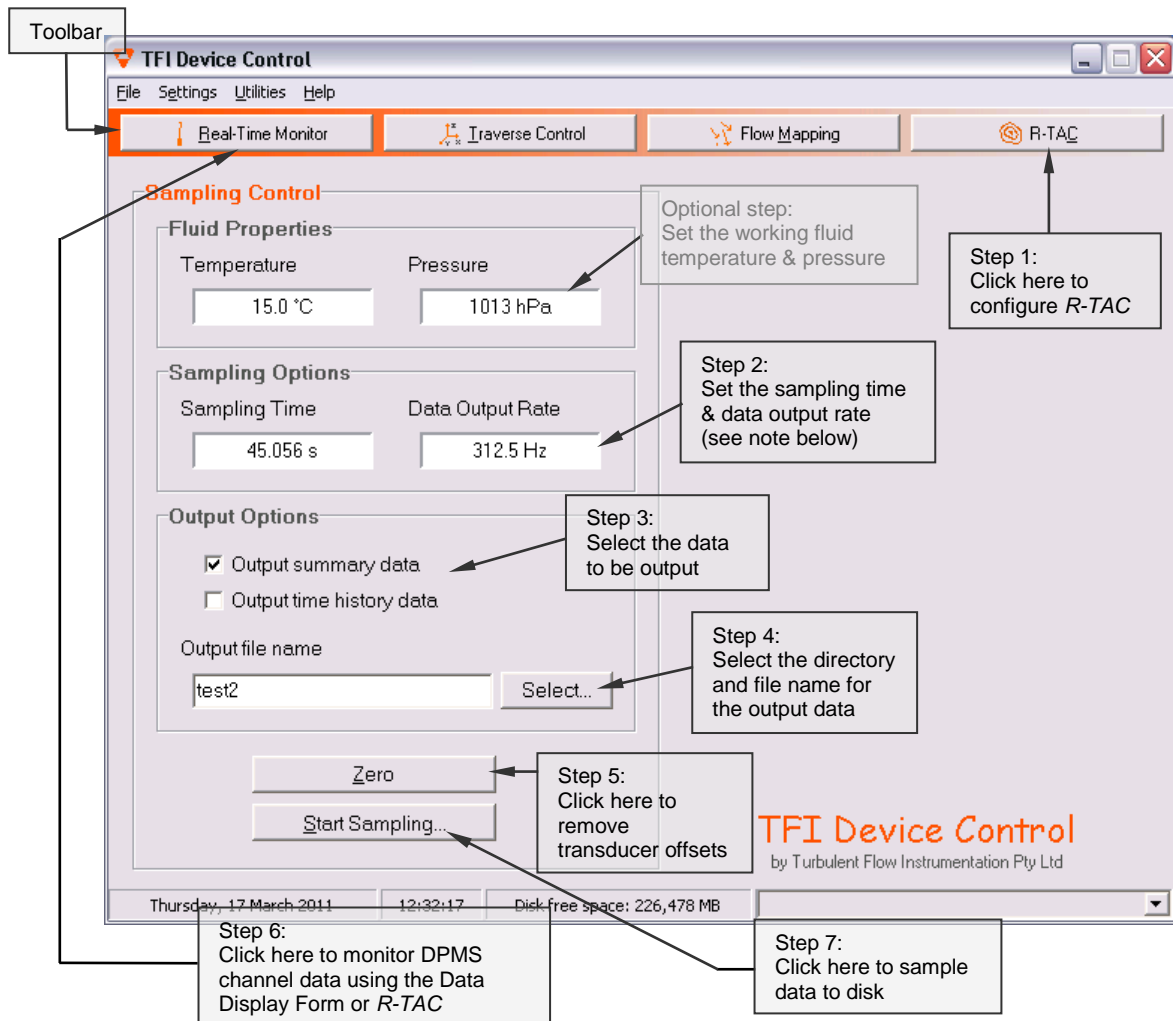


Figure 11: The Main screen of the *TFI Device Control* software & how to obtain data

- i** The Data Output Rate is that required for the data that is written to a file or displayed on the screen and is different to the Acquisition Scan Rate (see the Sampling Rate section below).
- i** The DPMS should be ‘zeroed’ regularly to remove offset voltages from the pressure transducers. Offsets change with variations in temperature and movement of the transducers. While zeroing, the flow should be stopped, or the pressure measurement points completely shielded from the flow.

While obtaining data via sampling or the **Real-Time Monitor**, the *R-TAC* main form will be shown. However, it is also possible to view the pressure signals from individual channels using the **Data Display Form**, Figure 12. During sampling or monitoring, this can be found behind the *R-TAC* main form by minimising the *R-TAC* form or using Alt-Tab to select the **Data Display Form**. The main features of the **Data Display Form** are shown below. The user can choose which type of data to display (mean, minimum, maximum and rms) in the **Mean Data** boxes at the top of the form, by going to the **Display Data** menu. Either time history data or frequency spectra can be displayed in the plot window.

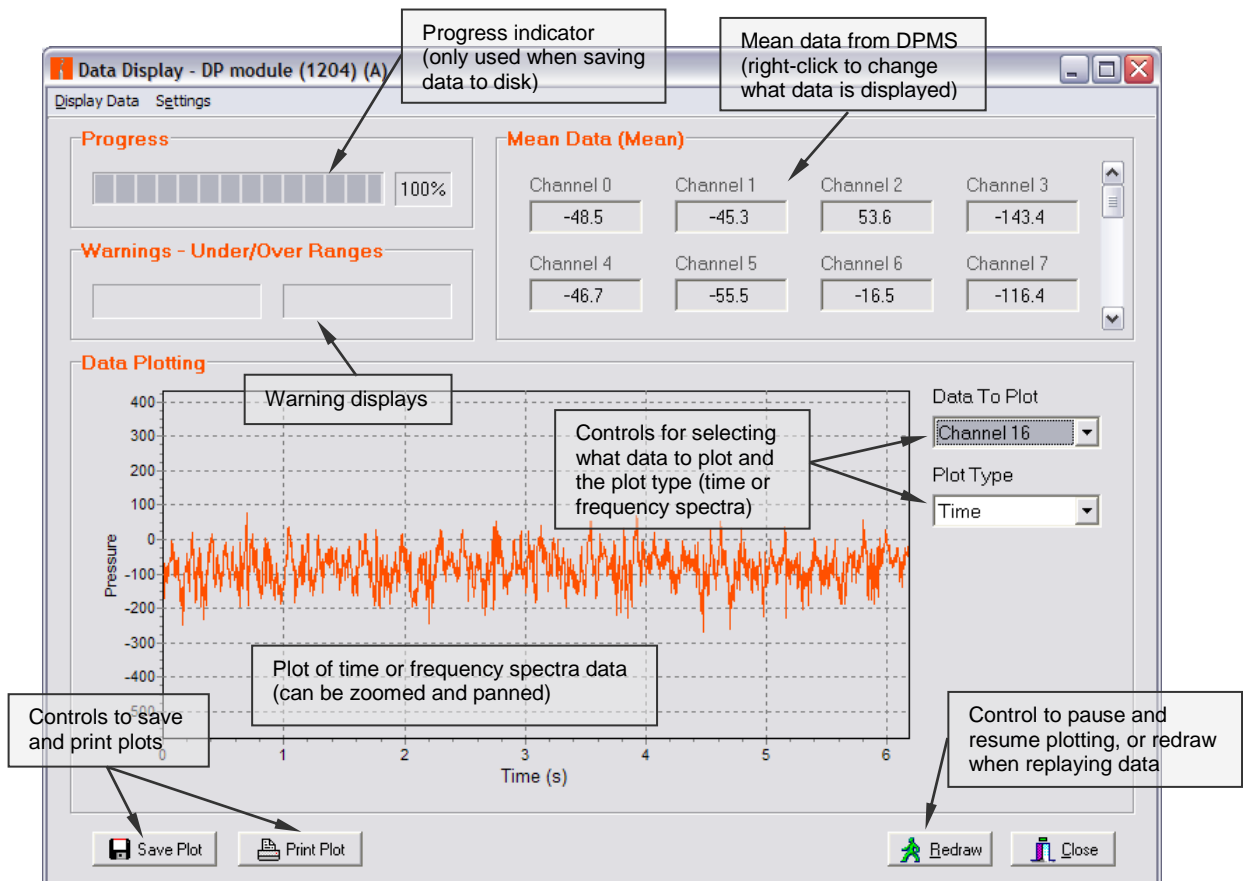


Figure 12: The Data Display screen of the *TFI Device Control* software

i After using the DPMS for a short time, you should refer to the on-line *User's Guide* to gain a better understanding of the DPMS' operation and characteristics.

Sampling and Data Rates

Two terms are used to configure the sampling and data rates: Acquisition Scan Rate and Data Output Rate. The Acquisition Scan Rate is the frequency that the analogue data are sampled at, and is the sampling rate *per channel*. It must be set high enough to avoid aliasing; typically at least 2 kHz/channel is required for a DP Module. The Acquisition Scan Rate multiplied by the number of channels being sampled must also be lower than the A/D card maximum sampling rate. Ideally, in order to maximise accuracy, the Acquisition Scan Rate should be below 80% of the A/D card maximum sampling rate divided by the number of channels being sampled.

$$2\text{kHz} \leq \text{Acquisition Scan Rate} \leq 0.80 \times \frac{\text{A/D card maximum sampling rate}}{\text{number of sampled channels}}$$

The Acquisition Scan Rate setting is found by selecting **Advanced** from the **Settings** menu and clicking on **Show Advanced Settings**.

The Data Output Rate is the frequency at which data are output to screen and file. This rate must be equal to or less than the Acquisition Scan Rate. The Data Output Rate is achieved by decimating (low-pass filtering and down sampling) data from the Acquisition Scan Rate down to the required Data Output Rate. This allows data to be sampled at a sufficiently high frequency to prevent aliasing while outputting data at a lower rate if only low frequency components are required. A higher Acquisition Scan Rate also helps to reduce measurement noise.

The Data Output Rate setting is found by selecting **Sampling** from the **Settings** menu.

DPMS Calibration

The DPMS is supplied fully calibrated and ready to use. However, the user may wish to occasionally perform a ‘static’ calibration of the transducers – see the *User’s Guide* for details.




Data Output Files

There are two common data output files: plain text summary files and binary time-history (TH) files. The summary files contain an overall summary of the measured data for each channel. The TH files contain time-varying pressure data for each channel at the specified data output rate.

Data Replay

Previously saved data can be replayed at a later date for viewing.

- On the *Device Control* software main form, select **View Time History File ...** from the **Utilities** menu – this opens the **Time-History-File Replay Control** form
- Under **Options**, if the data being replayed was measured using multiple DP modules, select **Check for Multiple Devices**
- If the data is to be viewed as a time-history pressure signal, do not select **Use R-TAC**
- If the data is to be viewed as animated contours, select **Use R-TAC**, then
 - Select **Config R-TAC**
 - Load the configuration file that was originally used with the data to be replayed (or configure *R-TAC* as detailed on pages 14-18)
 - Close the *R-TAC* main form
- On the **Time-History-File Replay Control** form, click on **Select File**, browse to find the required data file, and select **Open**
- Finally, select **Play**. The **Data Display** form, and the *R-TAC* form if required, will open and proceed to play the data

-  The **Pause** button on the **Time-History-File Replay Control** can be used to pause the playback at any time
-  The **Time-History-File Replay Control** can be moved around the screen during playback, in order to better see the *R-TAC* or **Data Display** forms. Alternatively, selecting the **Hide** button will minimise the **Time-History-File Replay Control**. (Use **Alt-Tab** to re-maximise it)
-  During playback of animated contours, the **Data Display** form can be viewed at any time by minimising the *R-TAC* form or using **Alt-Tab** to select the **Data Display** form

- Selecting **Show Entire File** on the **Time-History-File Replay Control** will display the entire file in the **Data Display** form

Creating Movie Files

Previously measured data can also be used to create a movie file of the animated contouring for reports and presentations.

- On the *Device Control* software main form, select **R-TAC to AVI Conversion...** from the **Utilities** menu – this opens the **R-TAC to AVI** main form
- Under **R-TAC Configuration**, select **Config R-TAC** and load the configuration file that was originally used with the data that is to be converted to a movie file (or configure *R-TAC* as detailed on pages 14-18). Once configuration is complete, close the *R-TAC* form.
- In **R-TAC Data File**, if the data being converted was measured using multiple DP modules, select **Check for Multiple Devices**. Then choose the data file for conversion by clicking on **Select**, browsing to the file and selecting it.
- In **AVI Output File**, click on **Select** and set the file name to be used for the created movie file
- Under **AVI Options**, choose the compression type and movie quality level. The default data output rate is displayed in the bottom box. If a lower output data rate is desired (gives a smaller file size), select **Limit Data Rate** and enter the required **Data Rate Limit**.
- Finally, under **Conversion** select **Make AVI**

Exporting Data - MATLAB®

Functions for loading time-history data into MATLAB® are installed by default with the *Device Control* software. To use the supplied functions the directory containing the m-files must be added to the MATLAB® path. By default the m-files are located in

C:\Program Files\Common Files\TFI\Matlab m-files

To load a TH file, enter the following command in MATLAB®:

```
[x, s] = ReadTHFile;
```

MATLAB® is not case sensitive for commands and either 'readthfile' or 'readTHfile' will work.

Data from each channel will be loaded into a column of **x**, while details including data rate, channel names and units will be loaded into **s** (note that **s** is an optional output argument). There are several options for using the ReadTHFile function; for more details enter

```
help ReadTHFile
```

Exporting Data – Other Programs


For other programs, the binary time-history (TH) data files can be converted to plain text files by using the **Time History File Conversion** utility under the **Utilities** menu. Many applications such as spreadsheets can then load this data. The file format used by the binary TH files is available for users who wish to write code for importing data directly into other programs.

FURTHER INFORMATION

The hardware and software described here have been designed to be as easy as possible to use. All details required for general operation are described in this guide. However, if you have specific questions or require further information on the set-up and operation of the DPMS and *Device Control* software, send an email to support@turbulentflow.com.au.

Help Hints

Placing the mouse cursor over a control in the *Device Control* software will display a brief hint describing its function.

 To enable the Help Hints function, ensure that **Show Help Hints** is selected in the **Help** menu.

Context Sensitive Help

Help about specific controls in the software can be accessed by selecting a control in the software and pressing the **F1** key.