



Getting Started






Reference Sensor Module

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WARNINGS

Although the Reference Sensor Module (RSM) is relatively robust care must still be taken with its handling.

-  Avoid dropping the RSM.
-  Avoid over-pressuring the transducers.
-  There are no user serviceable parts in the RSM. Any significant damage will require the RSM to be returned to TFI for maintenance and recalibration.
-  The warranty will be void if a user dismantles the RSM without specific instructions from TFI.
-  The RSM should be kept 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
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INTRODUCTION

This document outlines the procedure for using a TFI Reference Sensor Module (RSM). All users are encouraged to read this guide in its entirety as it provides all the information necessary to start using your instrumentation.

What is the Reference Sensor Module?

The Reference Sensor Module is a box containing reference sensors: a differential pressure transducer; barometric pressure sensor; and a temperature sensor; and other custom sensors as ordered. The RSM is supplied fully calibrated and ready to use. Figure 1 shows a diagram of the RSM indicating its general features.

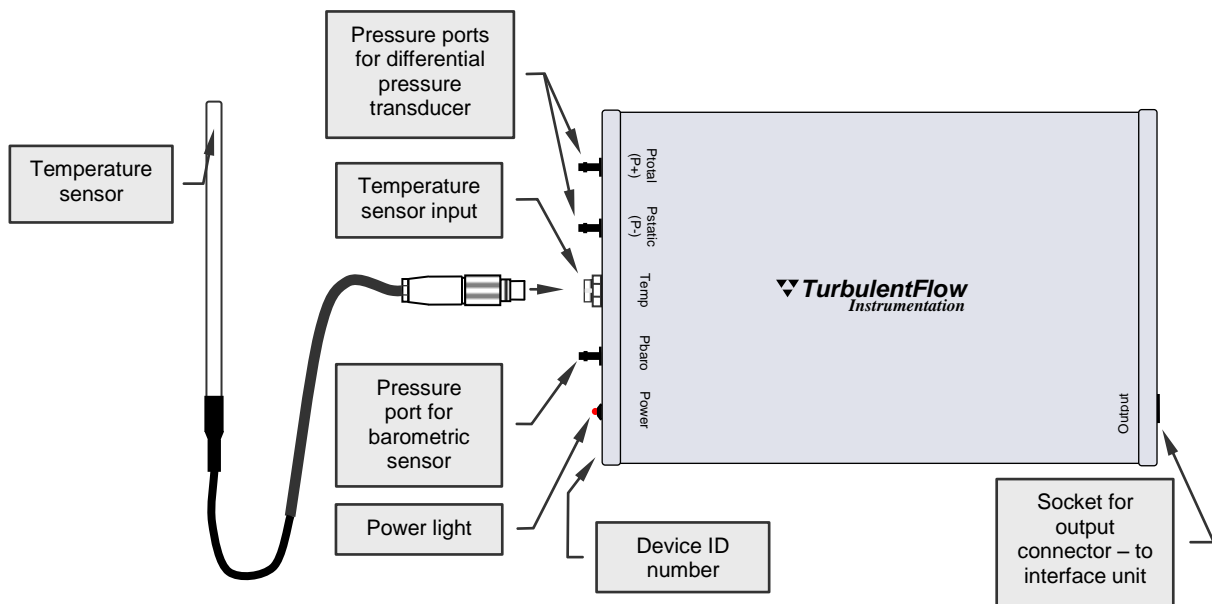


Figure 1: Reference Sensor Module main features

The RSM outputs analogue, raw voltage data that are proportional to the measured pressures and temperature. The voltage data are digitised by a data acquisition device in an interface unit or computer and then processed by the *TFI Device Control* software. Calibration coefficients and other signal processing are used to convert the data to engineering units.

The *Device Control* software is used to operate the RSM and is provided when an RSM is purchased. The software provides access to all functions of the RSM, and can be used to configure measurements, obtain and view data, and save data to disk. The *Device Control* software can also be used with other devices.

Package contents

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

- Reference Sensor Module
- Temperature sensor
- RSM-to-interface unit cable
- Software installation CD – *TFI Device Control*
- This guide and any additional items that were ordered

GETTING STARTED

The following pages introduce the Reference Sensor Module set-up and operation. The hardware and software for the RSM have been designed to be very easy to use and by following the instructions on the following pages you will be able to install, configure and use your RSM very quickly.

Software installation

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

i If using an interface unit with an integrated National Instruments data acquisition card, you should first install the data acquisition drivers from the supplied CD.

i You will require administrator rights to successfully install the *Device Control* software.

To install the *Device Control* software:

- Insert the installation CD (run *Setup.exe* from the CD if installation does not start automatically)
- Follow the on-screen instructions and upon reaching the **Choose Components** screen, refer to Figure 2

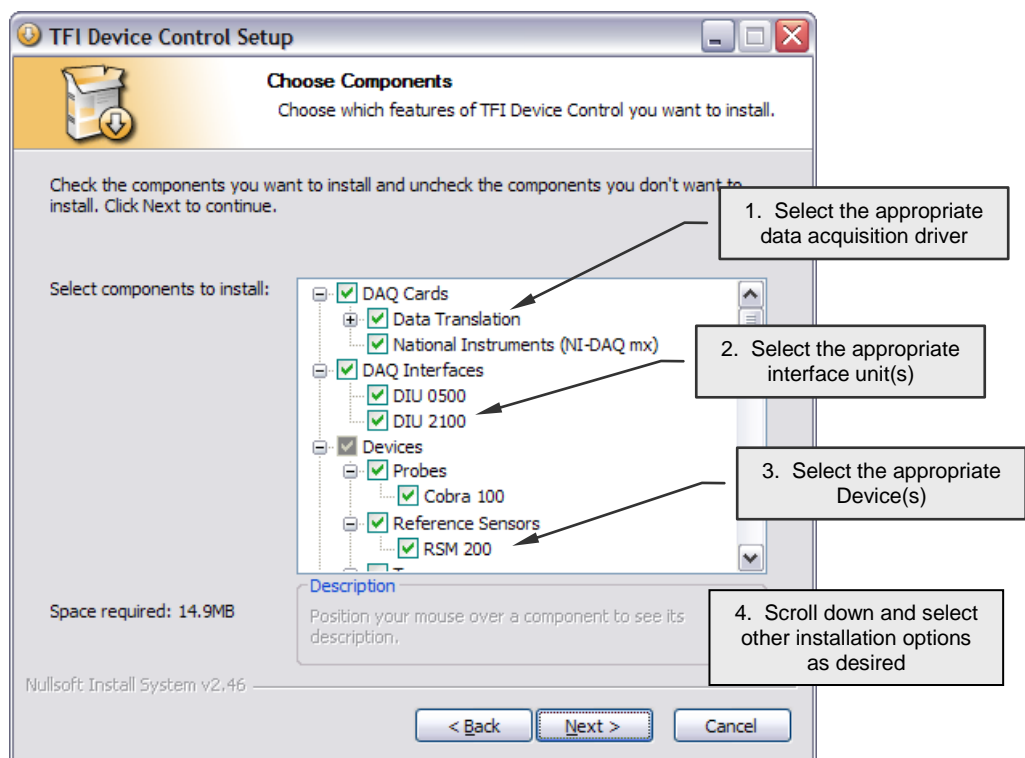


Figure 2: Software installation – Choosing which components are installed

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.

Hardware set up

After unpacking the RSM, you should not have any difficulty connecting it – connectors should only fit in suitable sockets. There are two types of interface unit for using the RSM:

- an Interface Unit with integrated data acquisition;
- an Interface Unit with external data acquisition.

These two types of systems are described in the following sections. Depending on which interface unit you have, refer to Figure 3 or Figure 4 for a diagram of the required connections. To connect the system:

- Connect one end of the RSM cable to the RSM and the other end to the Interface Unit
- Depending on the type of interface unit you have, either connect the Interface Unit via a cable to a data acquisition unit, or use a USB cable to connect it to the computer

- i** Connections can be made in any order, even when the computer is already turned on.
- i** The labels above the sockets on the Interface Unit indicate the channel(s) that those sockets connect to (see the sections below).

Interface Unit with Integrated Data Acquisition (DIU)

This type of interface unit contains an internal data acquisition system and is known as a **Data-acquisition Interface Unit (DIU)**. Analogue signals from the Reference Sensor Module or other devices are converted to digital signals before being sent to a computer via a USB cable. Power is supplied to the **DIU** and RSM via the USB cable (for most units), so it is not necessary to use an external power supply. See Figure 3 for an example of this type of interface unit and the typical connections required for operation.

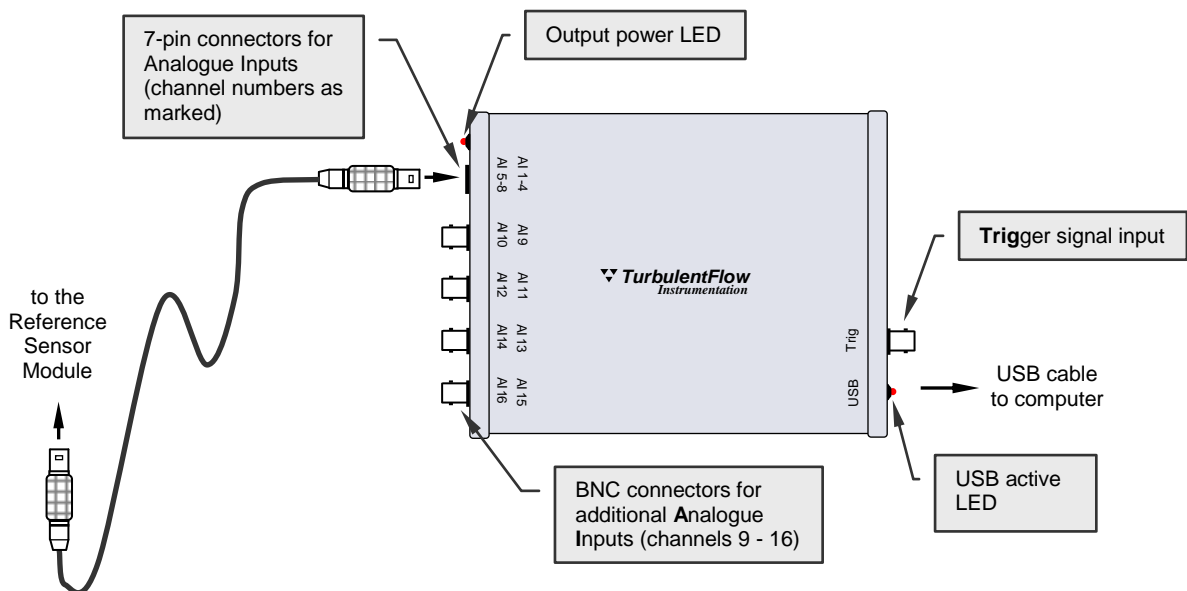


Figure 3: Schematic of an example Data-acquisition Interface Unit with integrated data acquisition.

Interface Unit with External Data Acquisition

This type of Interface Unit (IU) must connect to an external data acquisition system or **DAQ Device**, such as an A/D card in a computer or some other stand-alone data acquisition system. Power is supplied via the cable from the **DAQ Device** or external power supply and the IU passes the analogue data signals from Reference Sensor Modules and other devices to the **DAQ Device**, where they are converted to a digital format. See **Error! Reference source not found.** for an example of this type of interface unit and the typical connections required for operation.

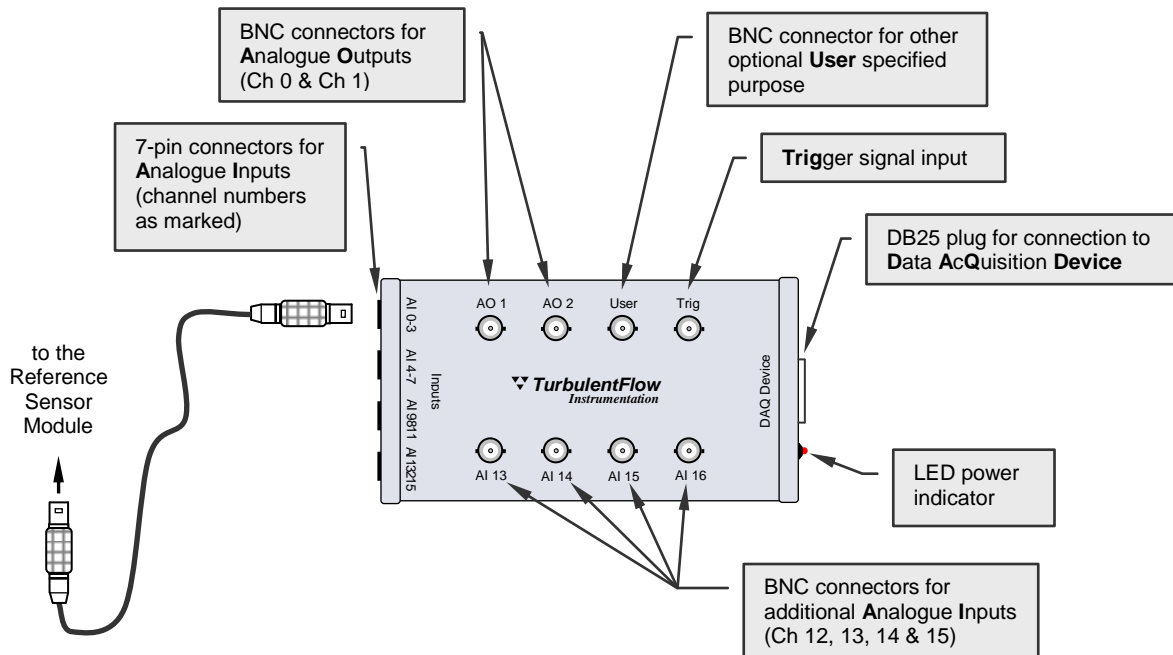


Figure 4: Schematic of an example Interface Unit with external data acquisition.

Interface Unit Common Features

The interface unit configuration will depend on your specified requirements, but interface units have common features (refer to **Error! Reference source not found.** and Figure 3):

- LED power indicator (illuminates when power is connected via the **DAQ Device** or **USB** socket)
- **Analogue Inputs**: one or more 7-pin connectors for multiple RSMs or other devices, depending on customer requirements. Each 7-pin connector is connected to a group of four channels on the data acquisition system, as indicated by the labels, e.g. **AI 1-4** connects to input channels 1, 2, 3 and 4.
- **Additional Analogue Inputs** as per customer requirements: one or more BNC connectors for optional inputs (e.g. for a reference pressure sensor). Each BNC connector is connected to the data acquisition system channel as indicated by its label, e.g. **AI 15** connects to channel 15.

In addition, some Interface Units have extra features:

- **Sync In and Sync Out**: Sockets allowing connection of multiple interface units for synchronised operation. **Sync** cables can be connected between interface units in any order. It is only possible to connect each plug to the corresponding correct socket and auto detection in the software determines the 'master' and 'slave' interface units.
- **Trigger signal input**: user-supplied trigger signal used to start sampling and synchronise measurements with other events. The trigger line is held high (5 V) via a 10 kΩ pull-up resistor

and will activate when pulled low (grounded). This can be accomplished by short circuiting the **Trig** centre pin to the outside of the BNC connector.

- **Analogue Outputs:** one or more BNC connectors for use with A/D cards that support such functions. Each BNC connector is connected to the data acquisition system channel as indicated by its label, e.g. **AO 1** connects to output channel 1.
- **Additional User** input/output: a BNC connector not normally connected but can be used for A/D cards that support other functions – contact TFI for wiring details.

Module Calibration

The RSM is supplied fully calibrated and ready to use. It can be returned to TFI for recalibration if required. For users with suitable, high-precision calibration equipment who would like to perform their own calibration, please contact TFI.

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 RSM (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
- Select **Advanced (DAQ)** from the **Settings** menu, then refer to Figure 5

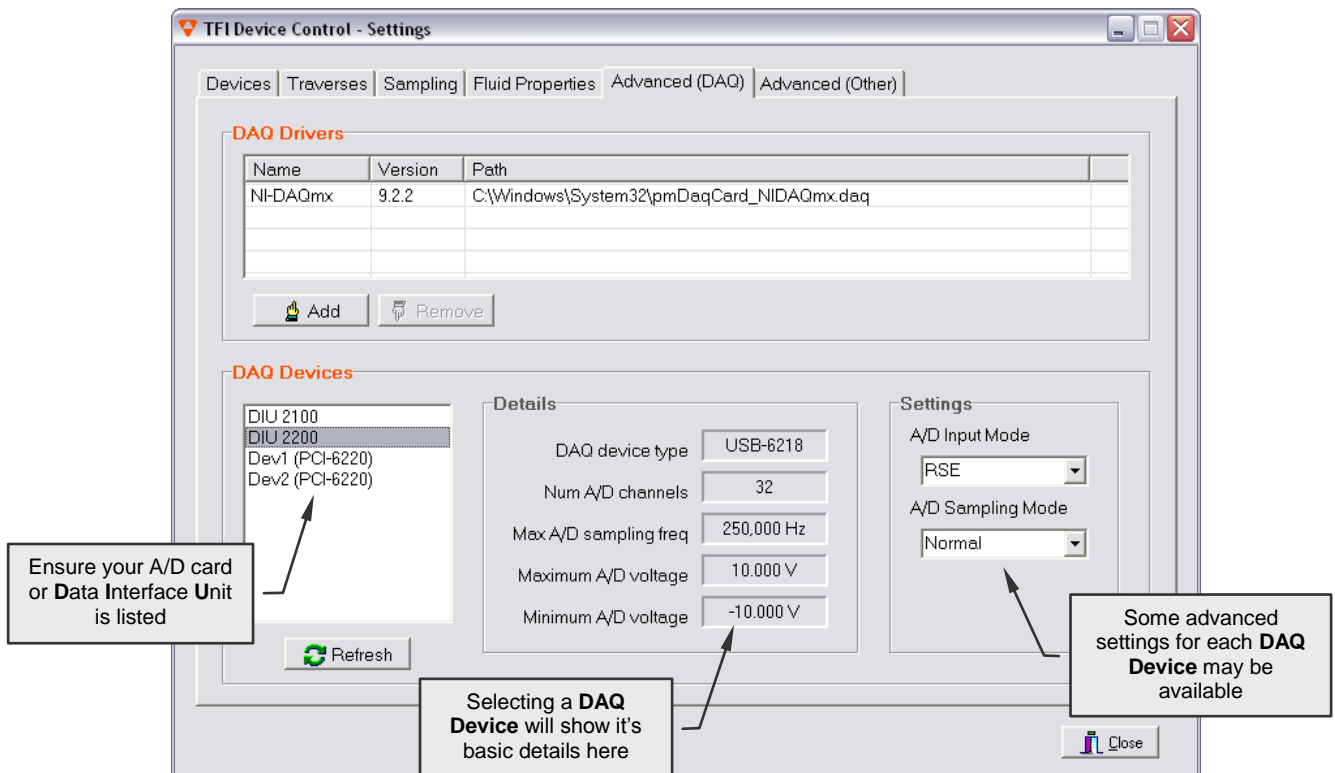


Figure 5: Software configuration – Checking the data acquisition details

- i** The **DAQ Devices** list should contain one item for each data acquisition device installed in, or connected to, your computer.
- i** 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 5 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 6.

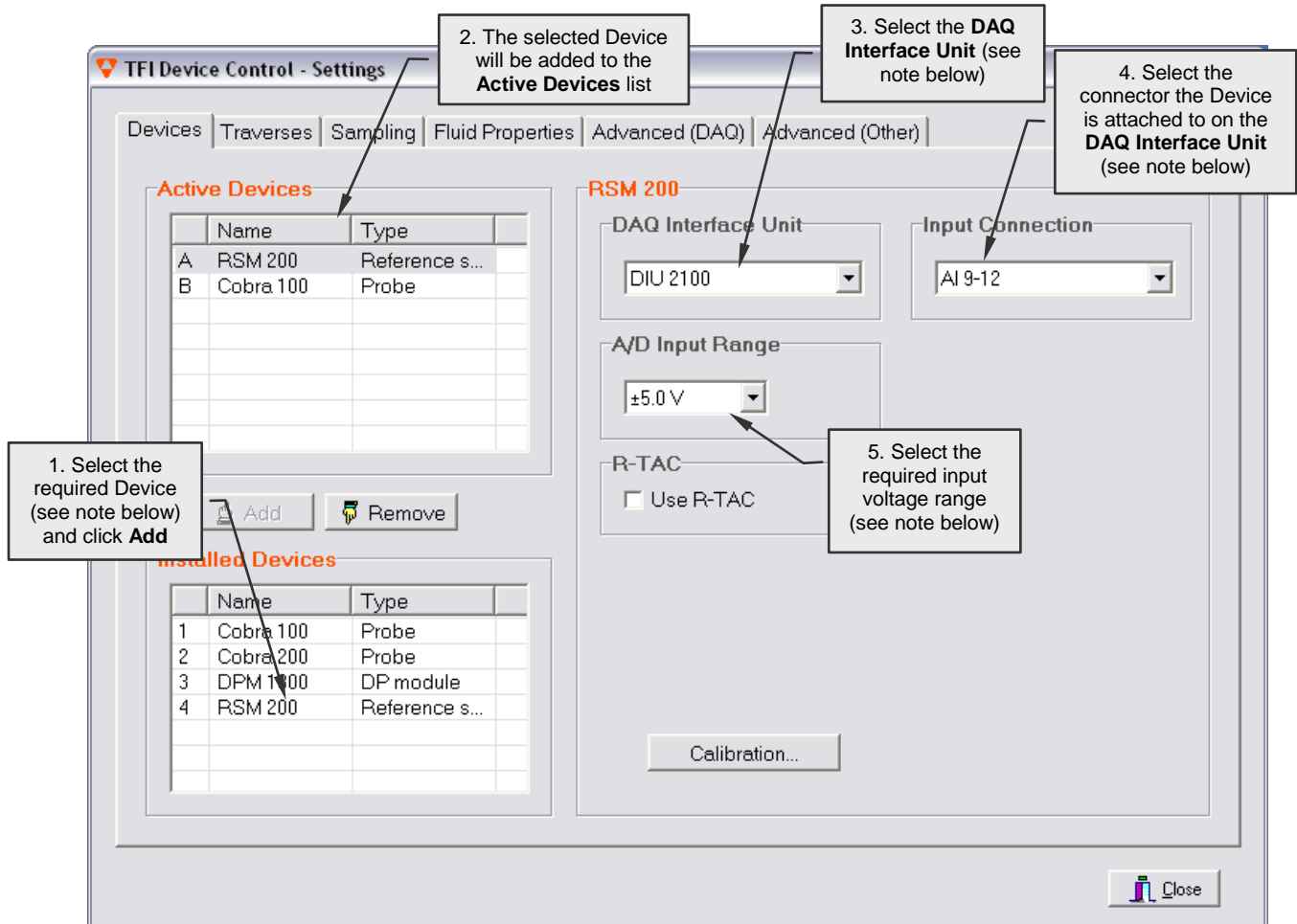


Figure 6: Software configuration – Adding and configuring devices

- Repeat the steps shown in Figure 6 for each additional RSM or other device.
- i** The Device ID number is labelled on the RSM (see Figure 1).
- i** New ‘devices’ can be created if other inputs are required, e.g. to use the TFI software to sample data from other instrumentation. (See the section on Sampling Data from Other Sources for details.)
- i** If your DAQ Interface Unit is not listed, go back and check the **Advanced (DAQ)** tab.
- i** Selecting a connector in the **Input Connection** list will automatically configure the channel list (see the Hardware Set Up section for details about Interface Units and connections).
- i** If not using an Interface Unit, select a **DAQ Device** and manually configure the channel list (see the Hardware section below for channel number details).
- i** For cards that use a common input voltage range for all channels, a note will pop up that the **A/D Input Range** is set on the **Advanced (DAQ)** tab (see Figure 5).

Operation

The sensors in the RSM can be used to determine air density for calculating air speeds. For example, this means that it is not necessary to manually enter temperature and absolute pressure when using a Cobra Probe. Figure 8 shows how to use the temperature and barometric pressure data from an RSM for this purpose.

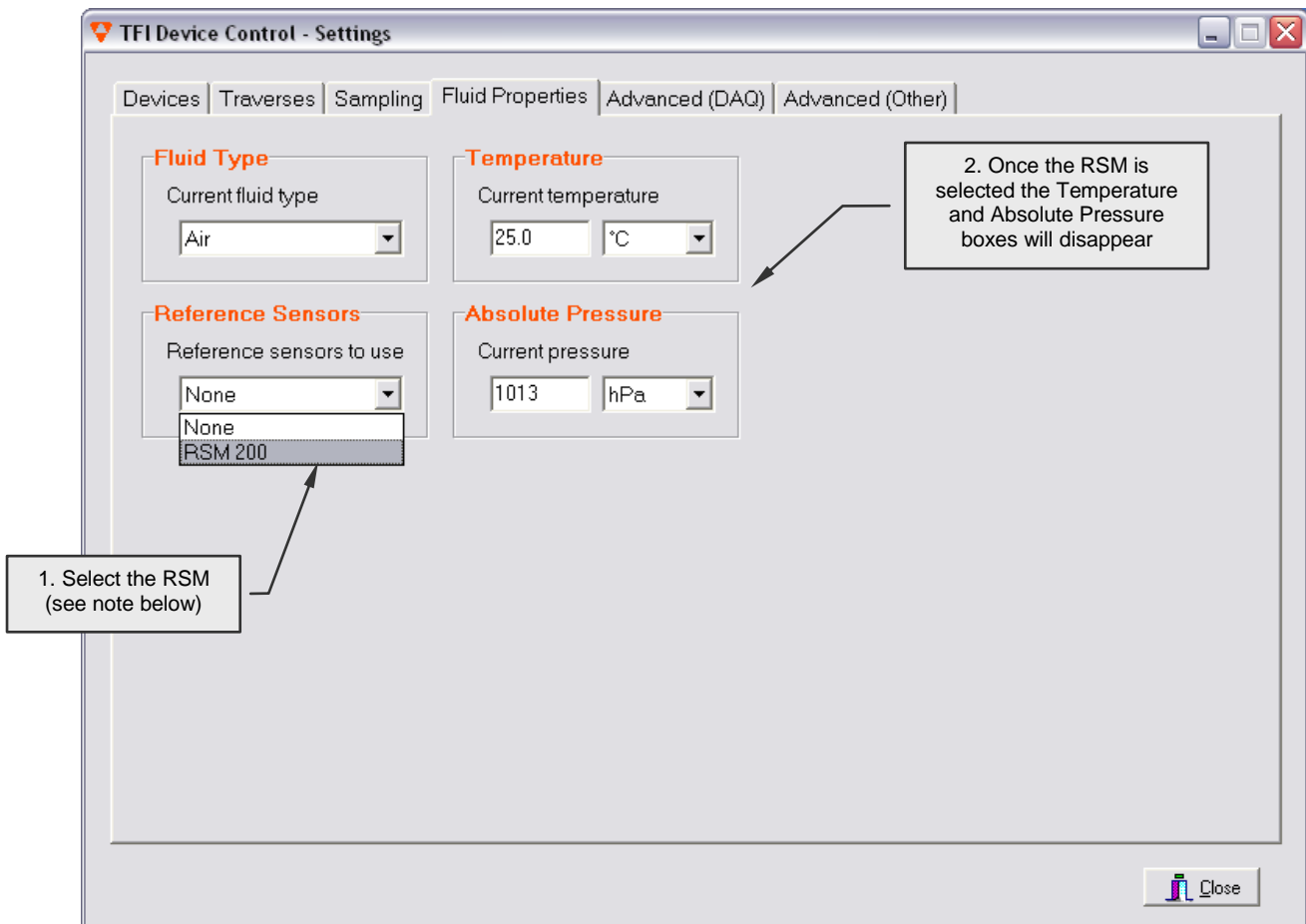


Figure 7: The Fluid Properties tab and how to automatically supply temperature and pressure data

- i** If the RSM is listed on the **Devices** tab as the first device, it will automatically have been selected to provide the temperature and pressure information. If it is not listed as the first device, and you wish it to provide the temperature and pressure information, then select it as indicated above.
- i** When the RSM is selected in the **Reference Sensors** list, it will automatically be set as the first active device on the **Devices** tab.

Figure 8 shows the main screen that appears when the *Device Control* software is run. The steps shown in the figure below indicate how to obtain data from connected Devices.

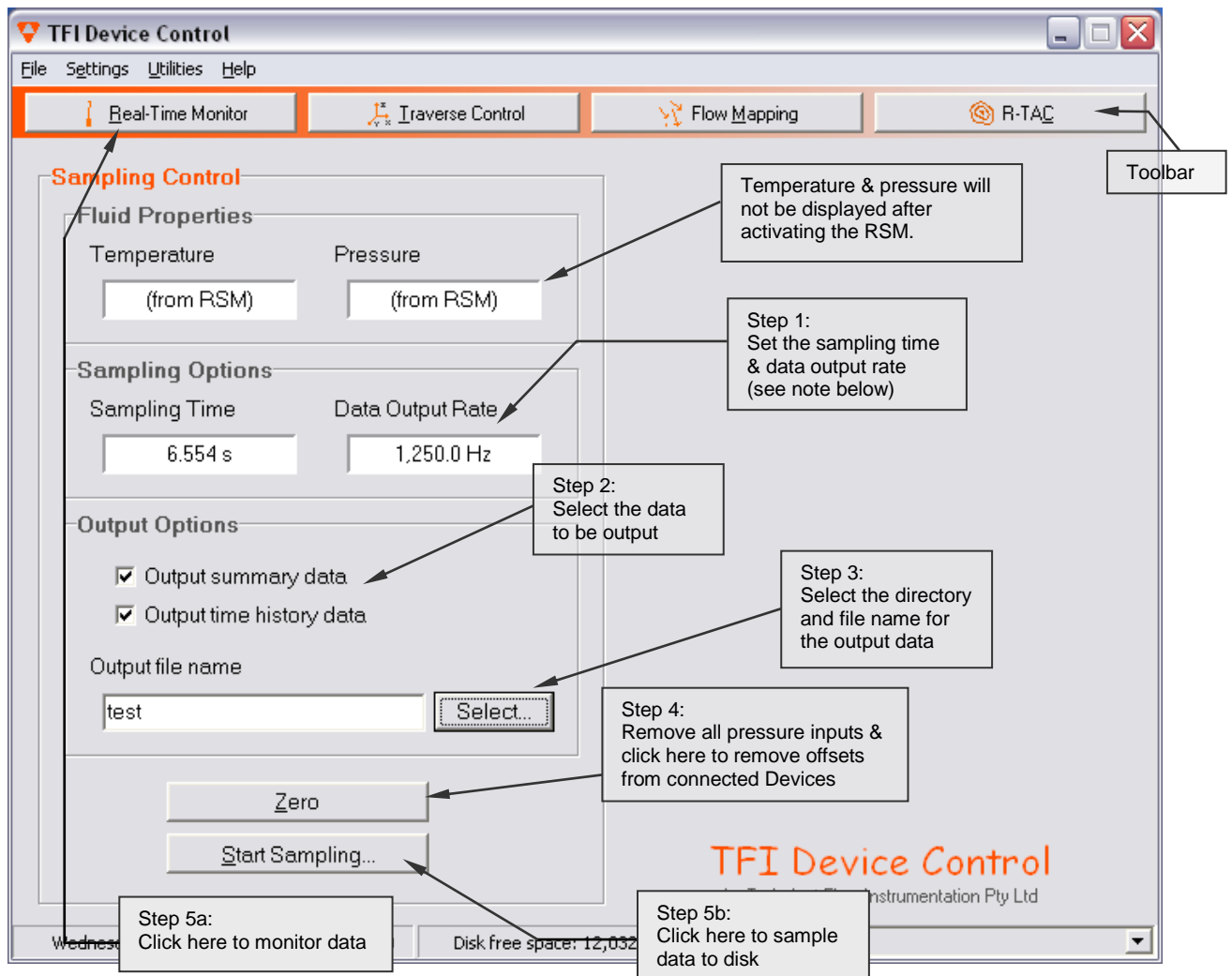


Figure 8: The Main screen of the *TFI Device Control* software & how to obtain data

- i** Go to the **Data Display** form by clicking on **Real-Time Monitor** in order to see the temperature & pressure data (see Figure 9 below)
- 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**.
- i** The RSM differential pressure transducer should be ‘zeroed’ regularly to remove offset voltages. Offsets change with variations in temperature and rotation of the transducers. While zeroing, there should be no pressure inputs to the transducer.

While obtaining data from a device, the **Data Display** form will be shown. A sample screenshot is given in Figure 9. When the RSM is selected from the **Display Data** menu, temperature and pressure data can be selected in the box on the lower right for plotting.

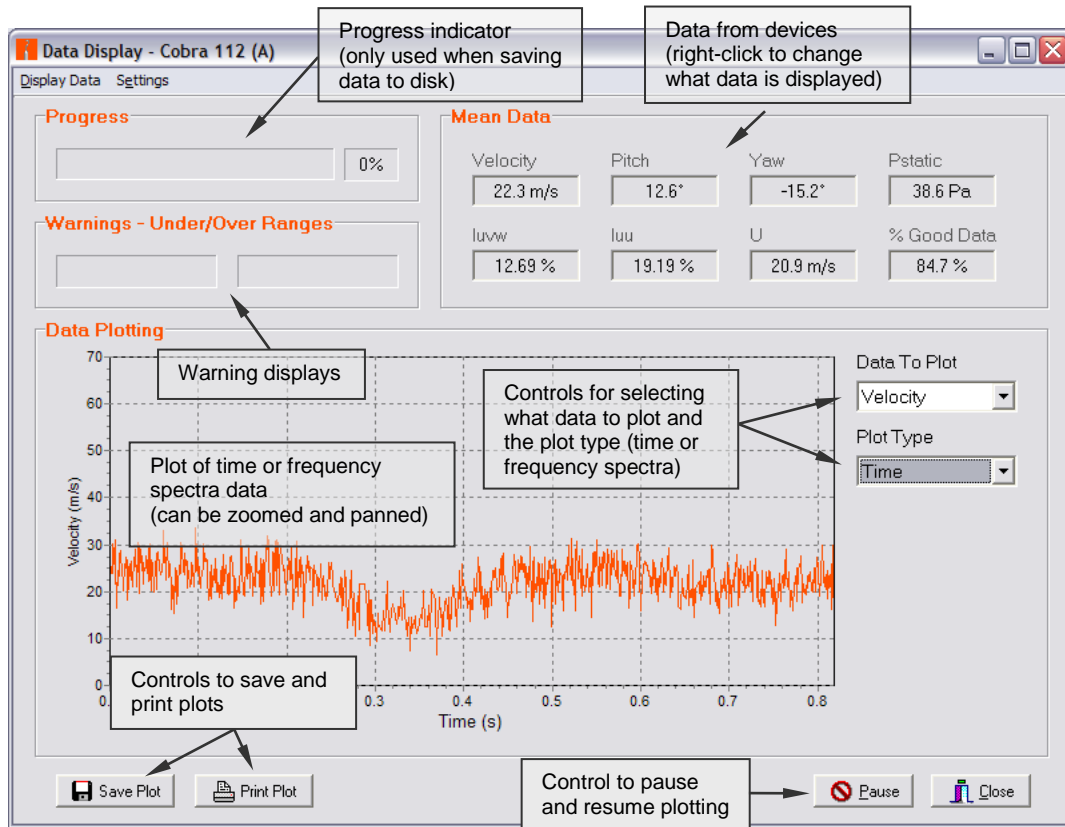


Figure 9: The Data Display screen of the TFI Device Control software

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. The TH files contain data from the connected devices for each measured sample, at the specified **Data Output Rate** (see Step 1, Figure 8). The TH files can be viewed within the Device Control software or directly loaded into MATLAB®. For use with other programs, such as spreadsheet applications, the binary TH files can be converted to plain text files.

Viewing Saved Data

Recorded time-history data can be replayed by selecting **View Time History File** from the **Utilities** menu.

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 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.

Sampling Data from Other Sources

To sample data from other sources, such as 3rd-party instrumentation, a ‘device’ must be created. After creating a device, you can acquire data from it as easily as with the RSM. To create a new device, use the TFI Hardware Manager.

1. Open the TFI Hardware Manager (can be opened from the **Utilities** menu on Main form)
2. On the **Analogue Devices** tab, click **New Device**
3. Enter a name for the device
4. Configure the device as required
 - a. Set the number of channels
 - b. Enter the ‘name’ of the first channel (usually 0 or 1)
 - c. Select if the device requires zeroing (i.e. offset voltage removal)
5. Click **OK** to save the device and close the **Hardware Manager**

You can now select, activate and configure the new device using the same procedure as for the Reference Sensor Module. By default, the volts-to-engineering units ratio is set to 1.0, which is equivalent to saving raw voltage data. The volts-to-engineering units ratio can be changed in the **Calibration** form (select **Devices** from the **Settings** menu and click on **Calibration**).

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 Reference Sensor Module 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.