
**Particle Analysis and Display
System (PADS):
National Instruments'
Analog-to-Digital
(NI_A2D) Module
Operator Manual**

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PADS 2.5.6, NI_A2D Module 2.5



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1.0 Introduction

The Particle Analysis and Display System (PADS) is a software package that interfaces with instruments produced by Droplet Measurement Technologies (DMT) and other leading instruments used in the atmospheric sciences. This manual describes the PADS module for National Instruments' Analog-to-Digital hardware (NI_A2D).

For an explanation of the basic PADS setup and instructions on how to acquire data using PADS, consult the *PADS Operator Manual*. Definitions and calculations used in the NI_A2D module are also described in the *PADS Operator Manual*.

2.0 Configuration

The section below describes the requirements for making your NI device interface with PADS. The next sections describe how to configure your NI_A2D and the NI_A2D display in PADS.

Requirements

The NI_A2D will work with most National Instruments data acquisition devices, including E-Series plug-in boards, M-Series plug-in boards, and USB devices such as USB 6008. However, PADS does not support older NI devices with traditional NI-DAQ software drivers. Devices must use NI-DAQmx drivers. Each NI device requires its own PADS tab.

Configuring the NI_A2D

Before configuring your NI_A2D device in PADS, you may want to test that the device is working properly by itself. You can find many useful diagnostics for testing your device in the National Instruments' Measurement and Automation Explorer (MAX). To get to the Explorer, select `Start > Programs > National Instruments > Measurement & Automation`. See National Instruments' documentation for instructions on using MAX.

To configure the NI device from within PADS, follow the steps below.

1. Click on the “NI_A2D” tab.
2. From the **Configure** menu, select **Configure Instrument**. You will see the following window.

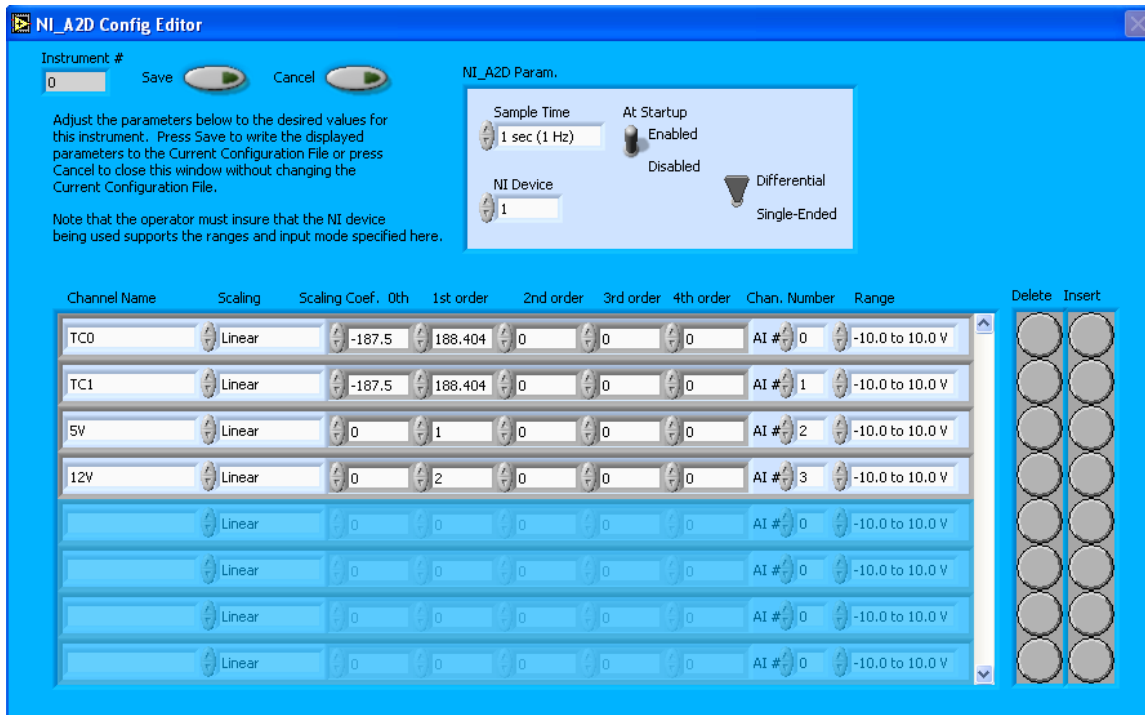


Figure 1: NI_A2D Configuration Editor Window

3. Now you can configure the instrument parameters to your desired specifications. You will find a list of the parameters you may want to reconfigure below. If at any time you would like to revert to the previously saved values for the NI_A2D parameters, press **Cancel** to exit the window without saving changes.
4. When you are done configuring the NI_A2D parameters, press **Save** at the top of the Config editor window. (If you would instead like to revert to the previously saved values, click **Cancel**.) Then press the green **Reset Program** button for the new configuration to take effect. Note that pressing the **Reset Program** button will clear any data currently being displayed.

NI_A2D Configuration Editor Parameters

The NI_A2D configuration editor screen allows you to specify the parameters listed below.

Sample Time: This parameter shows the time interval you'd like between samples. You can have the probe sample at intervals of .1, .2, .5, 1, 2, 5, or 10 seconds (10, 5, 2, 1, 0.5 or 0.1 Hz).

At Startup Enabled / Disabled: If you want the NI_A2D to acquire data when PADS begins sampling, make sure this parameter is in the “Enabled” mode. In some cases, such as if the NI_A2D is inoperative, you may want to use this control to disable the probe. Disabling the NI_A2D allows data to transmit from other instruments without interference.

NI Device: This field indicates the National Instruments device number. If you have multiple NI devices, this number helps PADS distinguish inputs from the different devices. You must have a separate PADS tab for each NI Device.

If you do not know the NI device number, you can find it by going to Start > Programs > National Instruments > Measurement & Automation. This will bring up the screen shown in Figure 2. In the left window, “Configuration,” go to My System > Devices and Interfaces > NI-DAQmx Devices. (If you cannot see these headings, click on the “+” signs to expand subheadings as necessary.) Your device and the device number should be listed under NI-DAQmx Devices. In Figure 2, for instance, the NI device is a USB-6008 and the device number is 1.

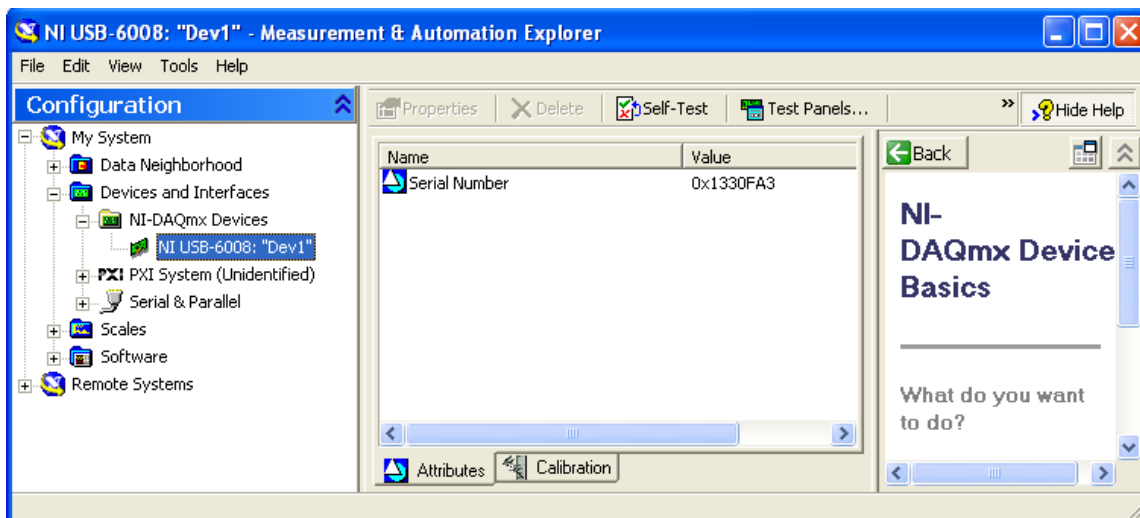


Figure 2: National Instruments' Measurement and Automation Explorer

NI-DAQmx is the software driver that the device uses. Note that PADS can only support NI_A2D devices that use NI-DAQmx drivers. Devices that are listed under “Traditional NI-DAQ” are not supported.

Differential / Single-Ended Switch: This control tells PADS whether the NI-DAQ device will be used in single-ended mode or differential mode. PADS expects all output channels to be in the same category; you cannot have some channels with a single-ended setup and others with a differential setup. A differential wiring scheme will yield only half the number of input channels of a single-ended setup, but readings may be more accurate. For more information, consult the NI device’s hardware manual.

Channels Table

The bottom half of the NI_A2D Config Editor screen lists the configurable channel information, as shown in Figures 1 and 3. You can use the channels table to add and delete channels from the instrument. Every channel listed in the Config Editor screen will be listed in the instrument’s output file.

The raw values returned by the instrument’s channels can be turned into other, more meaningful units (e.g., mBar or °C) by using a conversion equation. You can specify this equation in the channels table.

The channels table allows you to set the following parameters:

Channel Name: The first column in the table specifies the channel’s name.

Scaling: The second column in the table indicates the type of equation that PADS should use—linear, polynomial, or none. (Do not use the “CAS Temp.” option, which is reserved for internal use.) “Linear” indicates a linear equation, while “4th Order Poly” indicates a higher order polynomial equation with up to five terms. “None” means the digital value (between 0 and 4095) will be returned without any scaling.

Scaling Coefficients: The columns marked 0th through 4th Order in the channels table indicate the coefficients to be used in the conversion equation. Figure 3 shows the setup for a hypothetical channel with a linear conversion equation, as follows:¹

$$TC0 = -187.5 + 188.404 x$$

¹ This channel is for a temperature (°C) reading. However, it is quite unusual to be able to scale a temperature sensor’s reading linearly, as in this example. In this case extra hardware was added to the original temperature sensor in order to make the output linear.

where x is the digitized analog value returned by the A/D converter.

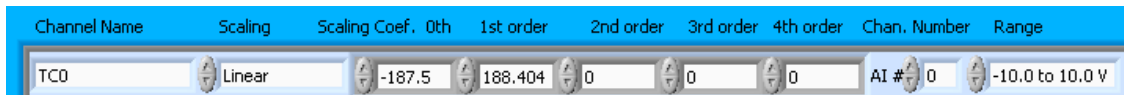


Figure 3: Example Channel Specifications in the NI_A2D Config Editor Window

The number of coefficients that PADS uses depends on the equation type. “None” does not use any coefficients. “Linear” uses the coefficients listed in the columns marked **0th** and **1st order**. “4th Order Poly” can use any of the coefficients listed in the columns marked **0th** - **4th order**.

In cases where there are non-zero numbers in cells that are not used in the function, PADS ignores these numbers. For instance, if you specify “Linear” as your function and have .32 in the **4th order** column, the program will just ignore this value.

Chan. Number: This field indicates the input channel on the NI-A2D device. The number on the hardware must correspond to the number specified in PADS. For more information on which channels correspond to which connection pins, consult the NI device’s hardware manual.

Range: This field indicates the minimum and maximum voltage inputs for the NI_A2D device. These values will depend on the sensor that is feeding the device data. For the range parameter in PADS, you want to select the values that most closely match the voltage range of the sensor. Choosing a significantly larger range will lower the data resolution. You also want to make sure the range listed in the **Range** field completely encompasses the actual spectrum of data, however, since otherwise data can be lost. (Note that NI device’s range should also encompass that of the sensor, or otherwise the device itself may lose data before it ever gets relayed to PADS.)

After making changes in the instrument configuration window, you will need to press the **Save** button and then click the green **Reset Program** to activate these changes. Clicking **Reset Program** will clear any data PADS is currently displaying.

Configuring the NI_A2D Display

To configure the NI_A2D display, go to the **Configure** menu from the NI_A2D tab and select **Configure Display**. This will bring up the following window.

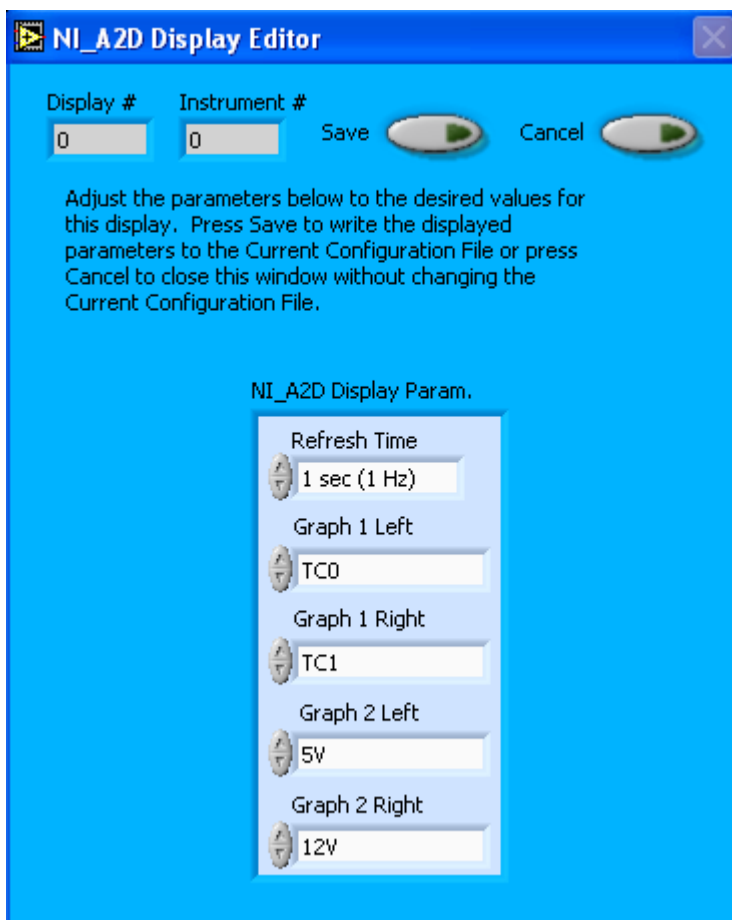


Figure 4: NI_A2D Display Editor Window

Display # or **Instrument #** cannot be modified. Changing the **Refresh Time** allows you to set the time intervals for data display during acquisition mode; you can choose any time that is equal to or greater than the sample time. (Choosing a time less than the sample time is not useful, since the same data will be displayed multiple times.) The four graph fields at the bottom of the NI_A2D Display Parameter box allow you to configure the channels on the NI_A2D's two graphs. You can click on the arrow buttons to scroll between available options for the channels. You can also click on the white fields to bring up a list of all the available options, from which you can then choose the channel you want.

When you are done, click on **Save** to update the configurations or **Cancel** to revert to the previous configurations. After you reset PADS, you will be able to see any changes on the NI_A2D tab. Note that clicking **Reset Program** will clear out any data currently being displayed.

Configuring channels in the Configuration Display Editor will change the display upon start-up. Once PADS has started, you can select any channels to be displayed from the NI-A2D window itself.

3.0 The NI_A2D Window

For explanations of the Enable button and the Fault/No Fault button, see the “Instrument Tabs” section of the *PADS Operator Manual*.

The NI-A2D window consists of two graphs that display two channels each. These channels are always graphed with respect to time, as in shown in Figure 5. PADS displays the channels listed in the graph’s left-hand fields in white. The y-axis legends for these channels are listed on the far left side of the graphs. It displays right-hand fields in red, and it lists these legends on the far right of the graphs.

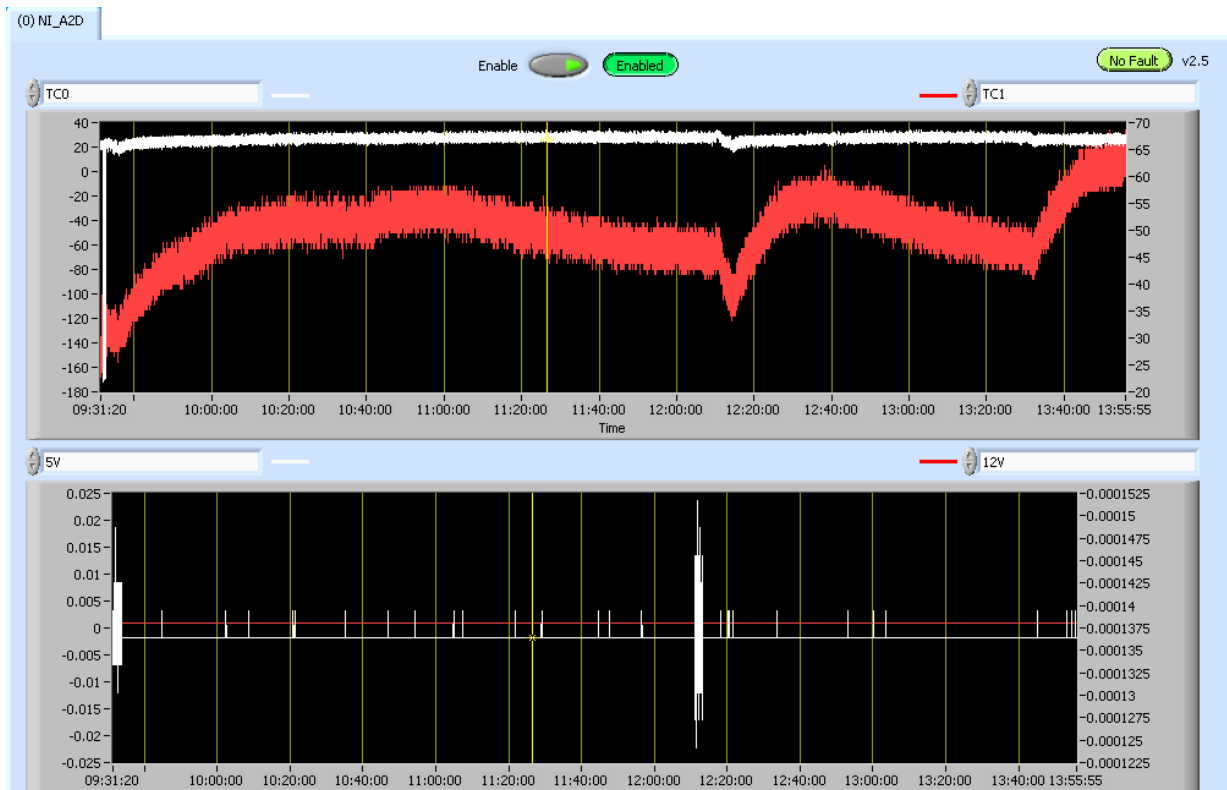


Figure 5: NI_A2D Window

To change the channels plotted in the charts, you have two options:

- 1.) To change the charts for the current session only, use the controls in the upper corners of the charts to select the channel you desire. You can either click on the text control to the right, which brings up a selectable list of channels, or you can use the button on the left to scroll between channels.
- 2.) To change the channels shown in the chart's display when PADS starts, go to the **Configure** menu, select **Configure Display**, and choose the desired channels. Then press the **Reset Changes** button to apply this configuration.

When you view charts in playback mode, the currently selected moment in time is indicated by a yellow cursor, as shown above. The y-axis value for this time is indicated by cross (+) on this cursor. Y-axis values marked with the cursor are always for channels displayed in white. Note that when you display a large range of time-series data, the chart display does not have sufficient resolution to display each individual time point. To increase resolution, zoom in on the data by changing the time interval to a smaller range.

On all the charts with x and y axes, you can change the scale by typing a different number into the starting and ending values on each axis. For instance, if you want to change the time period in one of the graphs above to end at 10:30:00, you simply select the field that currently says 13:55:55 and type in 10:30:00. In acquisition mode, you must disable autoscaling (see below) before you modify fields in this way.

Many charts also show you options for scaling and copying the data when you right-click on the graph. These options are as follows:

Autoscale This autoscales the relevant axis. Note that on charts that have autoscale buttons, like the large histogram chart on some instrument tabs, the buttons override the Autoscale options in the drop-down menu. To see autoscaling options in the drop-down menu, position the cursor over the relevant axis before right-clicking. Note that you may not always be able to autoscale the x-axis.

Copy Data This copies the chart to the clipboard using a screen capture.

Export Simplified Image This copies a simplified image of the data to the clipboard or an output file. You can choose the format you desire—bitmap (.bmp), encapsulated postscript (.eps), or enhanced metafile (.emf). Note that when you select the .eps option, you must copy the data to a file. Unless you specify otherwise, output files will be saved in the time-and-date-specific output file directory for the current session.

Clear Graph This lets you clear the graph of the currently displayed data points.

Appendix A: NI_A2D Channels

NI_A2D has two default channels, *Time* and *Status*. *Time* is generated by the PADS computer clock and is the time when the program receives the NI_A2D data. *Status* stores statistical data the NI_A2D has gathered on the communication between PADS and the NI device. The output file may contain a third channel, *GPS Time*, if the system also has a GPS. This channel may be measured by an instrument other than the NI_A2D.

The output file will list any channels that you have specified in the NI_A2D Config Editor's screen. For these configurable channels and the default channels listed above, the output file will contain data values for each sampling instance. You can also plot each of these channels with respect to time on the NI_A2D window.

For definitions of the default channels, see *Appendix A* in the *PADS Operator Manual*.