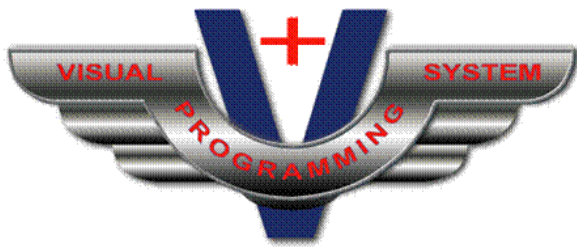


National Instruments MX I/O Driver for V+ User's Manual



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Revision History

Version	Description	Date
1.0	Initial Release	December 30, 2006
1.1	Added a description of the USB-6009 Registry Key and its values.	September 30, 2007
1.2	Added a description for the USB-6009 status indicator.	January 17, 2008



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1 Preface

This document is the SimPhonics' User's Manual for the National Instruments MX I/O Driver for use with our **V+ Development System** or **V+ Run-time System** licenses. **V+** is a completely new way for programming systems to interact with real-world signals in real-time. This I/O driver is an add-on to **V+** which allows the user to install an interface between National Instruments multi-function hardware and a **V+** software application.

1.1 Before Reading This Manual

Please note that this manual is a *living* document and is revised frequently as more enhancements are added to the system. Therefore, ensure you have the latest version of this document. To download the latest version of this document, go to:

<http://www.simphonics.com/supp/downloads/docs/>

You must be familiar with **V+** in order to use this document. Be sure to read the **V+** User's Manual before proceeding. This manual can be downloaded at the same link above.

You should also be familiar with the National Instruments multi-function (MX) line of cards and USB devices. Go to the following to learn more:

<http://www.ni.com>

1.2 Miscellaneous Information

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2 Introduction

The National Instrument MX I/O Driver for **V+** allows access to National Instruments multi-function hardware via **V+** ports.



Currently, this driver supports only one National Instruments MX (multi-function) device: the USB-6009. The USB-6009 features the following capabilities:

- 4 differential or 8 single-ended analog inputs
- 2 analog outputs
- 12 digital inputs/outputs, each independently configurable



3 Installation

The following sections describe how to install National Instruments MX software and various multi-function data acquisition hardware, and how to install the **National Instruments MX I/O Driver for V+**.

Note: At this time, the USB-6009 is the only multi-function hardware that can be accessed from within V+.

3.1 USB-6009

This section describes how to install the National Instruments USB-6009 software and hardware.

3.1.1 Installing the NI-DAQmx Software

Each National Instruments USB-6009 device is delivered with a CD-ROM which contains the NI-DAQmx software drivers needed to use your USB-6009.

To install the National Instruments DAQmx drivers, do the following:

1. Insert the CD-ROM labelled **NI-DAQmx for Windows**, into the CD drive.
2. The CD installation program will start automatically.
3. Click **Install NI-DAQmx / VI Logger**.
4. Click **Next**.
5. Click **Next**.
6. Click **Next**.
7. Select **"I accept the license agreement."**
8. Click **Next**.
9. Click **Next**.
10. Click **Next**.
11. Click **Restart** to reboot the computer.
12. Remove the CD-ROM from the CD drive.
13. After the machine has rebooted, a window may appear requesting you to register your products. Select **Do not register any of my products** and click **Finish**.

3.1.2 Installing the USB-6009 Module

To install a USB-6009 module, do the following:

1. Connect your USB-6009 device to a USB port.
2. When the **New Data Acquisition Device** window appears, click **Cancel**.
3. If the Windows **Found New Hardware Wizard** window appears, click **Next** followed by **Finish**.
4. Double-click the **Measurement and Automation** shortcut on your desktop.
5. Click the **+** next to the **Devices and Interfaces** item to expand it.
6. Click the **+** next to the **NI-DAQmx Devices** item to expand it.
7. Right-click on the **NI USB-6009** device and select **Self Test**.



8. Click **OK** in the Success window.
9. If you wish to run the test panels for this device, right-click on the **NI USB-6009** device and select **Test Panels**. Play around with the test panels to get a better understanding of your USB-6009.
10. Close the Measurement & Automation Explorer window.

3.1.3 Troubleshooting the USB-6009 Module

National Instruments does not provide documentation on the green LED status indicator located next to the USB connector of the module. The table below provides SimPhonics' best understanding of these states and the actions to take.

USB-6009 Status Indicator States		
Indicator State	Description	Action to Take
Off	Not connected, connected improperly, or failed.	Properly connect the module or replace with new module.
Solid On	Connected properly, but not detected by Windows as a device.	See section 3.1.2.
Flashing On/Off	Connected and installed properly.	Ready for use.

3.2 Installing the National Instruments I/O Driver for V+

To install the National Instruments MX I/O Driver for V+, do the following:

1. Insert the CD-ROM labeled **National Instruments MX I/O Driver for V+** into the CD drive.
2. The installation program will begin automatically. (Note: If the installation does not begin automatically, select **Start»Run** and enter `d:\setup`)
3. Click **Next**.
4. Click **Finish**.
5. Remove the CD-ROM from the CD drive.



4 V+ and the USB-6009

The National Instruments **USB-6009** data acquisition module, shown in Figure 1, is a multi-function data acquisition module with USB plug-and-play connectivity. It provides connection to eight analog input (AI) channels, two analog output (AO) channels, 12 digital input/output (DIO) channels



Figure 1. National Instruments USB-6009 Module

The **National Instruments MX I/O Driver for V+** provides the interface software between **V+** and the **USB-6009**. The user is able to configure the **USB-6009** and have those inputs and outputs available as ports in a **V+** design.

4.1 Minimum Requirements

The minimum requirements for installing and using the USB-6009 with **V+** are as follows:

- Windows XP with service pack 2
- USB-6009 module
- NI-DAQmx software, version 8.x or later
- National Instruments I/O Driver for **V+**, version 4.1.0.100 or later
- **V+** Visual Programming Language, version 4.1.0.338 or later



4.2 V+ Configuration

Before using the USB-6009 within **V+**, it must first be configured. To configure this driver, perform the following:

1. Select **Start » Programs » V+ » V+ Run-time System**.
2. Click on the **Configure** menu to open the Platform Configure dialog box (shown in Figure 2).

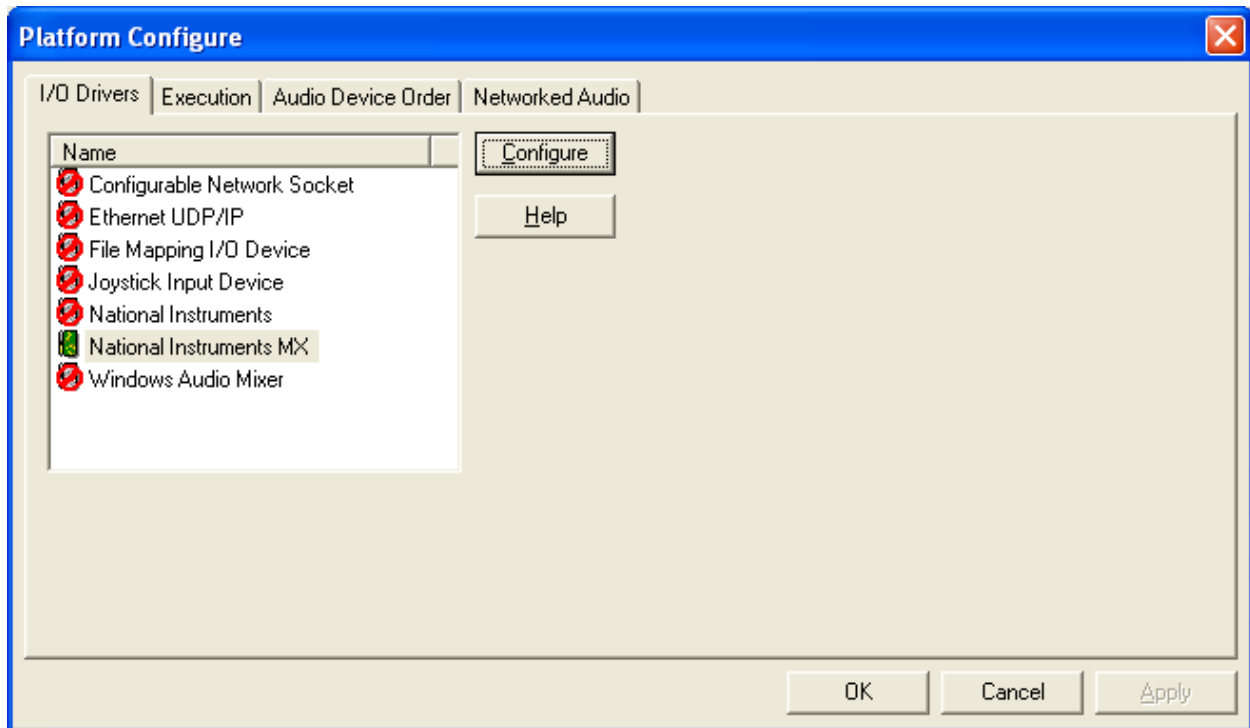


Figure 2. Platform Configure Dialog Box

3. Double-click the National Instruments MX item. The icon to left of the name should change to green indicating the operation was successful. If the icon remains red, the operation failed and the device did not load properly. This more than likely indicates that there was a problem during installation. See section 3 for more information.



4. Click the **Configure** button to open the National Instruments MX Configuration dialog box (see Figure 3).

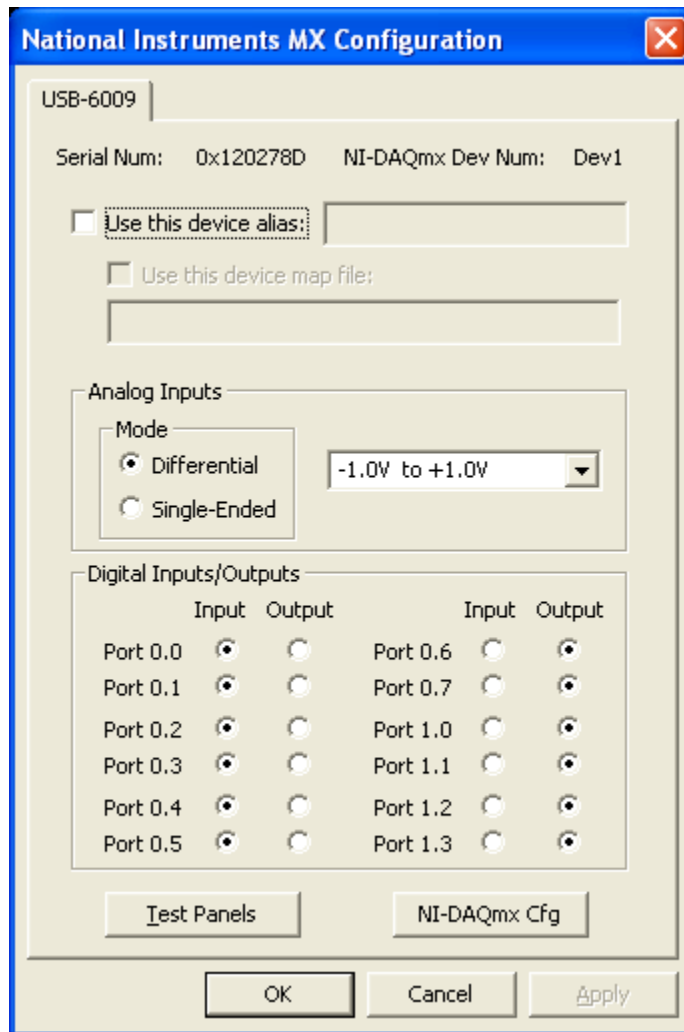


Figure 3. National Instruments MX Configuration Dialog Box

In this figure, there is only one MX hardware device to configure: a USB-6009. If more than one was hooked to the computer, a page tab for each would be shown.

At the top of USB-6009 page, the serial number and device number (as assigned by National Instruments) is shown. The serial number can also be found on the label located on the bottom of the device.



The check box labeled “Use this device alias:” allows you to provide a more descriptive name than what would normally be provided within V+. You must first select the check box before you can enter the name (see Figure 4).

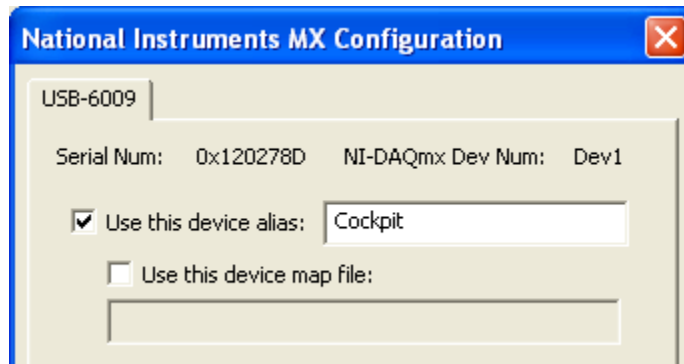


Figure 4. Alias Check Box Enabled

Once the device alias is checked, it then enables another check box for using a device map file. As with the alias check box, you must first select the device map check box before you can enter the device map file name (see Figure 5).

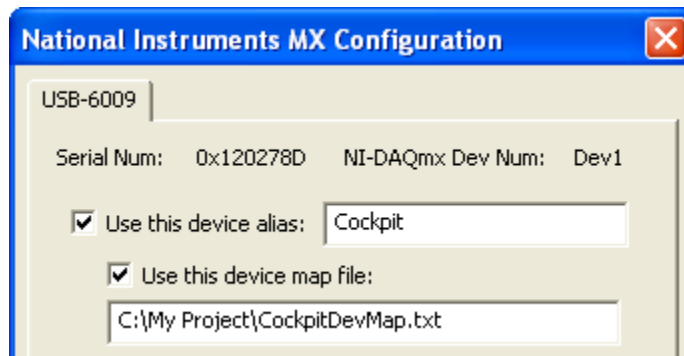


Figure 5. Device Map File Check Box Enabled

For more information regarding the use of a device map file, see section 4.3.

Note: *If a device map file is used, the alias name may not contain any blanks. This is due to the way the alias name is parsed from the device map text file.*



Analog Inputs may be configured to be either differential or single ended by selecting the appropriate radio button. If Differential mode is selected, eight range settings are available in the pull down list to the right (see Figure 6). Only one range setting is available if the Single-Ended mode is selected as shown in Figure 11.

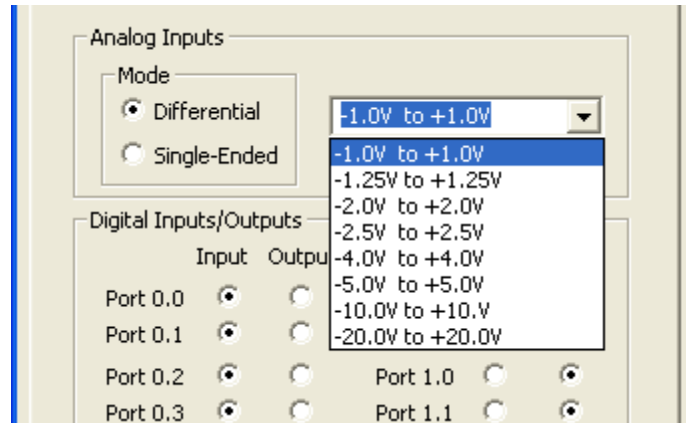


Figure 6. Differential Analog Input Range Settings

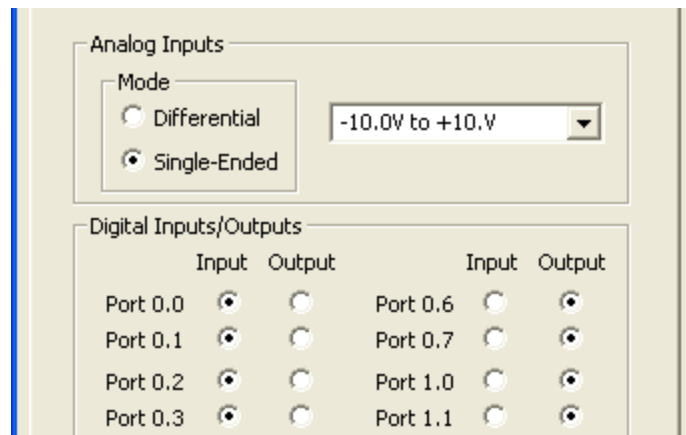


Figure 7. Single-Ended Analog Input Range Setting



Each digital input/output may be individually configured. By default, half of the digital I/O ports are configured as inputs with the other half configured as outputs (see Figure 8). To change these settings, simply select the appropriate radio button(s) to suit your needs.

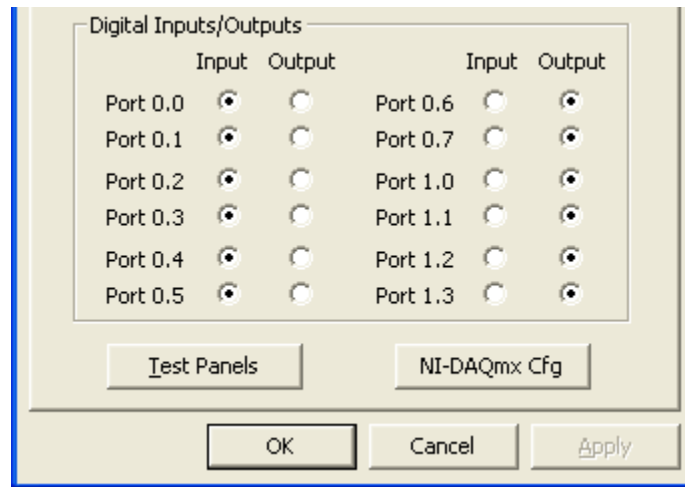


Figure 8. Default Digital Inputs/Outputs

The **Test Panels** button will take you directly to the National Instruments Test Panels application for the USB-6009. The **NI-DAQmx Cfg** button will take you directly to the National Instruments Measurement & Automation Explorer discussed earlier in section 3.1.2.



4.3 Device Map File

The device map provides the capability to specify an alias name, serial number combination in a text file for a given USB-6009 or for multiple USB-6009 modules used in a **V+** application (see Figure 9 and Figure 10 respectively). This can be useful when you have an application that is used on multiple systems which use USB-6009 modules. Since the modules are uniquely identified by serial number, this device map file can be used to override the serial number originally used in the VNE file. The **V+** USB-6009 driver examines the device map file, compares the alias name with what was configured in the VNE file, and determines if a USB-6009 with the serial number provided in the file is attached. If all the checks pass, the application goes along its merry way.

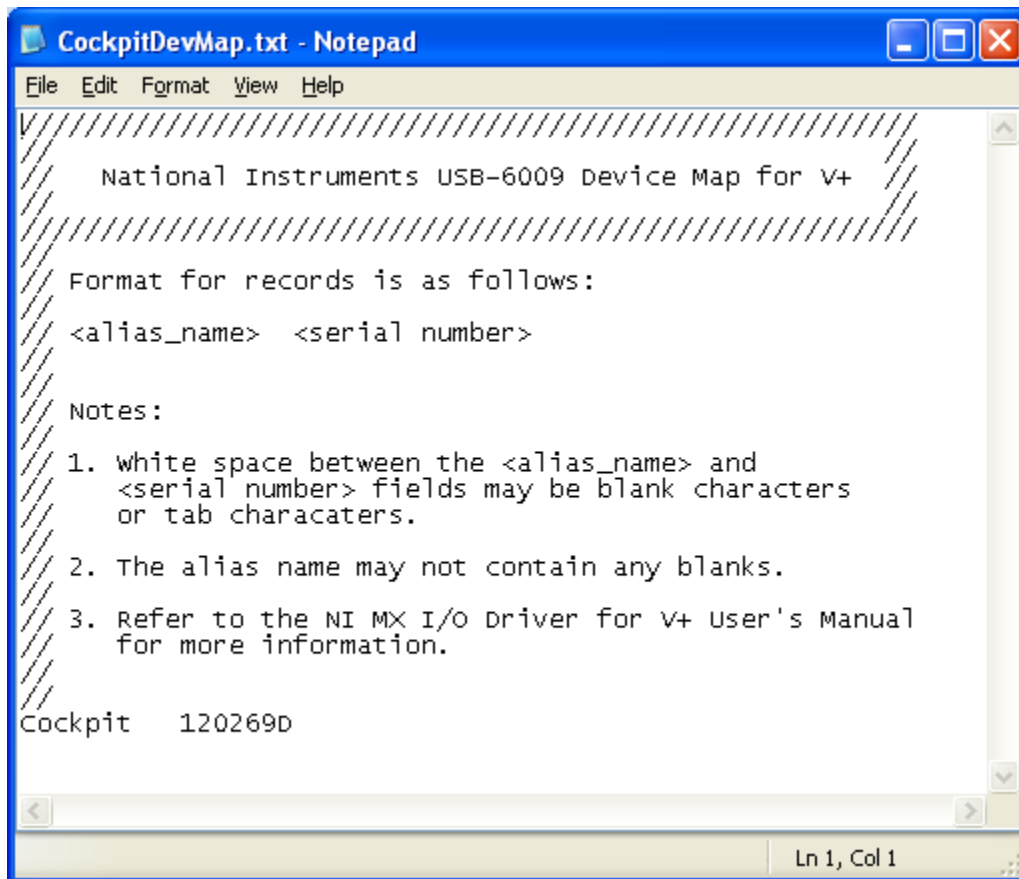


Figure 9. Example Device Map File with One USB-6009 Module



```
IOSDevMap.txt - Notepad
File Edit Format View Help
////////////////////////////////////
National Instruments USB-6009 Device Map for V+
////////////////////////////////////
Format for records is as follows:
<alias_name> <serial number>

Notes:
1. white space between the <alias_name> and
   <serial number> fields may be blank characters
   or tab characaters.
2. The alias name may not contain any blanks.
3. Refer to the NI MX I/O Driver for V+ User's Manual
   for more information.

PrimaryIOS    120278D
SecondaryIOS  12027BF

Ln 1, Col 1
```

Figure 10. Example Device Map File with Two USB-6009 Modules

The format specifications for a device map file are as follows:

1. The file must be an ASCII text file. Using Notepad to create/edit it will do the trick.
2. Any line containing two forward slashes (//) is considered a comment and is ignored.
3. Any blank line is ignored.
4. A line containing an alias name, serial number combination must provide the alias name first and serial number second.
5. The alias name may not contain any blanks.
6. The alias name and serial number must be separated by white space. The white space may be blanks or tabs.



4.4 Port Naming Convention

The I/O pin assignments for the USB-6009 are shown in Figure 11. The V+ port names for the USB-6009 align with these names.

GND	1	17	P0.0
AI 0/AI 0+	2	18	P0.1
AI 4/AI 0-	3	19	P0.2
GND	4	20	P0.3
AI 1/AI 1+	5	21	P0.4
AI 5/AI 1-	6	22	P0.5
GND	7	23	P0.6
AI 2/AI 2+	8	24	P0.7
AI 6/AI 2-	9	25	P1.0
GND	10	26	P1.1
AI 3/AI 3+	11	27	P1.2
AI 7/AI 3-	12	28	P1.3
GND	13	29	PFI 0
AO 0	14	30	+2.5 V
AO 1	15	31	+5 V
GND	16	32	GND

Figure 11. USB-6009 I/O Connector Pin Assignments

A list of the USB-6009 I/O devices is shown in the next two figures. In Figure 12, the Analog Inputs and Analog Outputs are shown. Note that there are only four Analog Input ports listed. This is because the USB-6009 was configured to use the Differential Mode for Analog Inputs. Figure 13 shows the Digital Inputs and Digital Outputs.

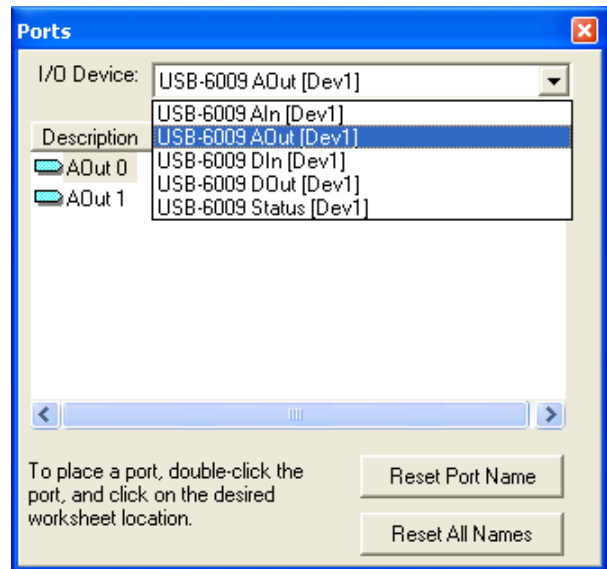
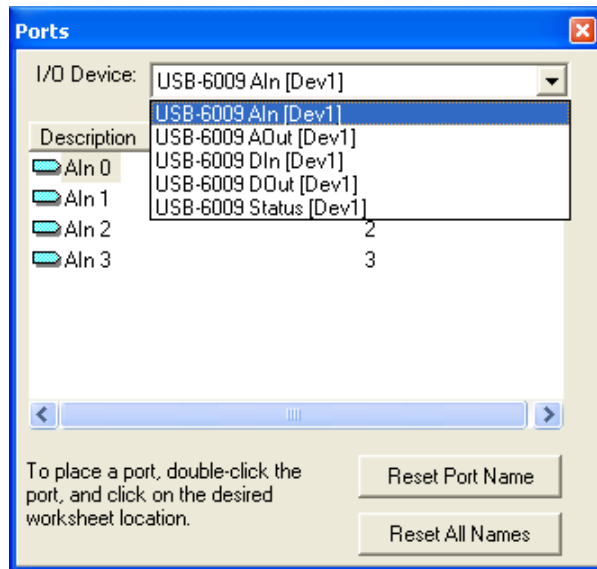


Figure 12. USB-6009 V+ Analog In and Analog Out Devices

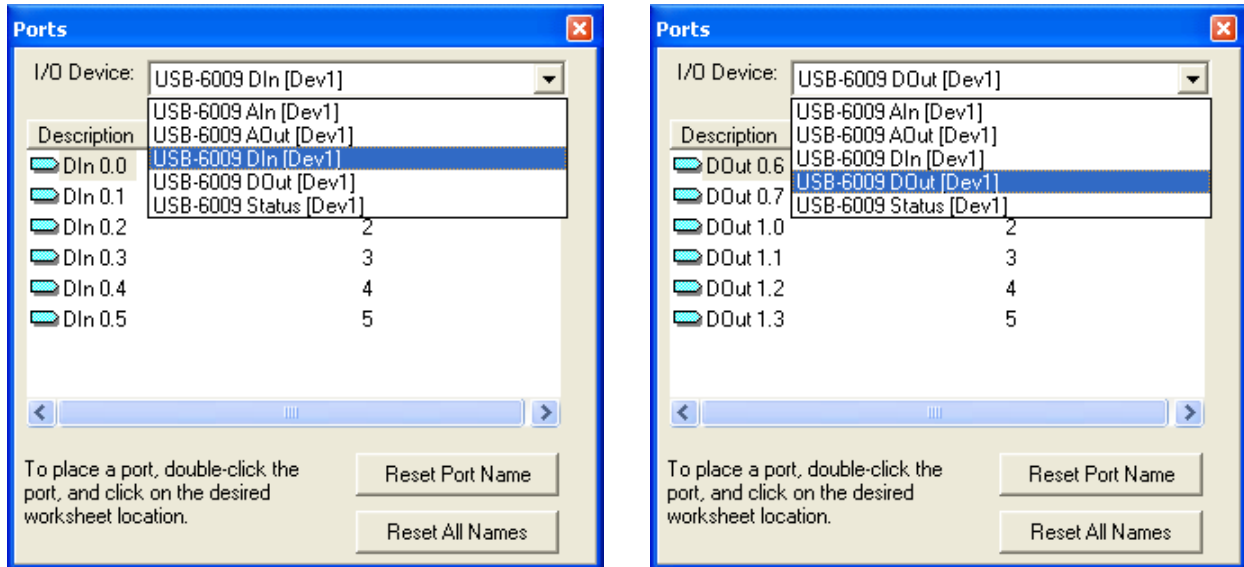


Figure 13. USB-6009 V+ Digital In and Digital Out Devices

The last device in the list of USB-6009 I/O devices is the Status device. This device contains only one port which can be monitored for the status of the USB-6009 module. If the module is operating properly, the port value is 0. If the USB-6009 module fails, or becomes disconnected, the port value will change to -1. It will remain so until the module is either replaced or re-connected.

Note: If you replace a USB-6009 module and you're using a device map file, remember to update the serial number in the device map file.

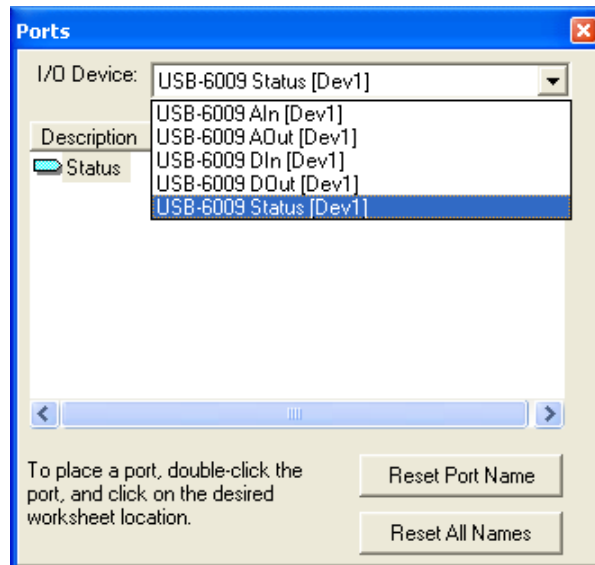


Figure 14. USB-6009 V+ Status Device



4.5 Error Messages

You may encounter error messages due to configuration problems that the **V+** USB-6009 driver cannot resolve. In Figure 15, the VNE file was created with 1 device, but the system senses two USB-6009 modules.

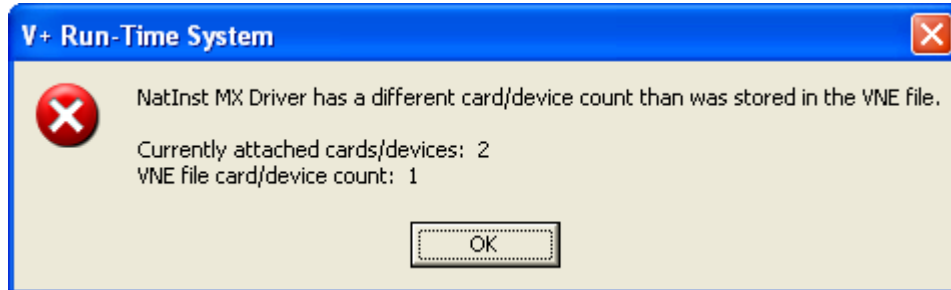


Figure 15. Conflicting USB-6009 Device Count Error

The error shown in Figure 16 is telling us that the serial number provided in the device map file does not match the serial number of the attached USB-6009 module. The **V+** Run Time System will continue with this condition after you press the OK button, however, the device map file should be updated so as to avoid the error message every time **V+** is run.

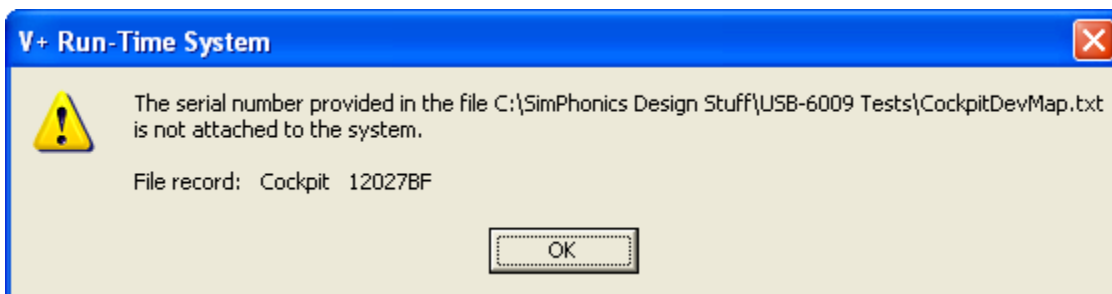


Figure 16. Invalid Serial Number Error



Figure 17 is an error message generated by the National Instruments software. In order to process inputs and outputs, **V+** uses a tasking mechanism provided by the National Instruments DAQmx software. This message occurs after a USB-6009 module has failed or has been disconnected and **V+** has been stopped and started without resolving the problem.

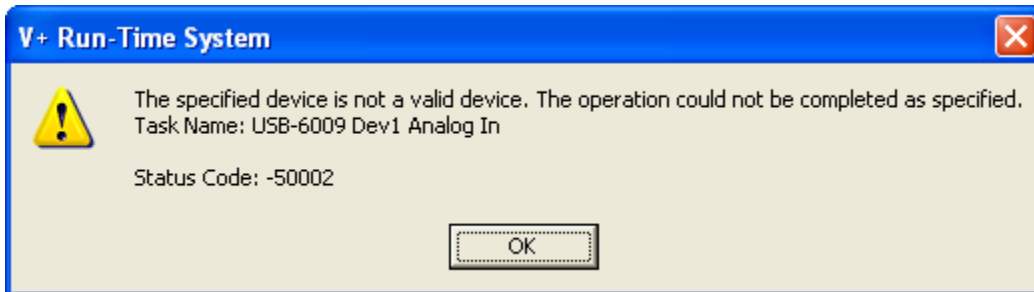


Figure 17. Disconnected or Failed USB-6009 Error

If you provide a device alias name which is not found in the device map file you have specified, an error such as shown in Figure 18 will be generated. Ensure that your device alias name(s) match what is found in your corresponding device map file(s).



Figure 18. Device Alias Not Found in Device Map Error



4.6 Registry Settings

The USB-6009 I/O driver for V+ has two registry settings for adjusting performance:

1. StartupDelay
2. BackgroundAppSleep

These registry settings, shown in Figure 19, are values of a registry key in the **HKEY_LOCAL_MACHINE\SOFTWARE** tree which is named as follows:

SimPhonics\VPlus\Platforms\Native Platform\Drivers\National Instruments MX\USB-6009

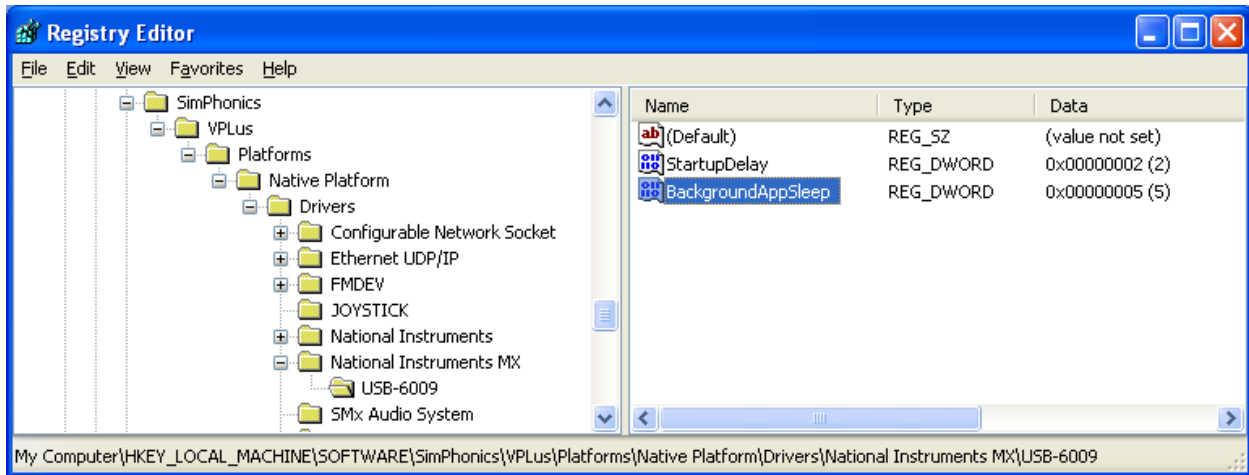


Figure 19. USB-6009 Registry Settings

The USB-6009 registry key and its values are application specific and are not automatically created when the driver is installed. The following sections describe the registry values in more detail.



4.6.1 USB-6009 StartupDelay Registry Value

The USB-6009 I/O driver for **V+** may not initialize properly immediately following a reboot of the computer. A typical scenario is creating a shortcut to your application's VNE file and placing it in the startup folder, allowing your application to start automatically following a reboot or power-up. The initialization problem is due to a National Instruments library call which does not return a complete set of NI devices until a few seconds after reboot has finished. To alleviate this anomaly, the NI MX I/O Driver for **V+** will sleep for a small amount of time before making that National Instruments library call for the list of NI devices. This amount of sleep time is set to a default of 5 seconds, but can be overwritten by a registry value if you so desire. The name of the DWORD value is `StartupDelay` and its units are seconds.

4.6.2 USB-6009 BackgroundAppSleep Registry Value

The USB-6009 I/O driver for **V+** employs a background application to buffer data between the USB-6009 device and a **V+** application. This background application appears on the Windows taskbar as a minimized command window when you start **V+**. It stops and disappears when **V+** is stopped. The `BackgroundAppSleep` DWORD registry value adjusts the amount of time in milliseconds that the background application sleeps between processing intervals. If the registry value is not present or is set to 0, the background application defaults to a sleep interval of 15 milliseconds.