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User Manual

NANOFLASH REPROGRAMMING SOFTWARE FOR NANOSCAN NPC-D SERIES CONTROLLERS

Software tool to reprogram Queensgate nanopositioning controllers

Document No: PS-000494-UM Rev 1.0

Safety Precautions

WARNINGS

HAZARDOUS VOLTAGES

The Product generates high voltages and relies on the provision of a protective earth (ground) conductor to prevent user accessible components developing a hazardous potential in the event of an insulation failure. This protective earth is provided by the external power supply and only an approved power supply should be used with the product. Additional protection is provided by special NanoMechanism interface connectors and cable assembles. To maintain the integrity of the operator safety systems only approved NanoMechanisms and cables should be used with the product. The product should not be used if there are any signs of damage or if the equipment is believed to be faulty. It should be returned to the manufacturer for investigation and repair.

DO NOT remove the equipment's protect covers. There are no user serviceable parts within the equipment and removal of the cover will expose the user to potential high voltage hazards and will invalidate the Warranty.

Do read the manual before using the controller to understand how to correctly and safely operate the product. Incorrect use of the equipment may lead to personal injury or damage to property. Always turn the equipment off and remove the mains plug when not in use. Always use the equipment as specified in this manual.

CAUTIONS

ELECTROSTATIC SENSITIVE DEVICES (ESD)

The unit contains components that are susceptible to damage through electrostatic discharge at the NanoMechanism and interface connectors. Removal of protective connector covers and connection of cables should be performed in a static safe environment using approved static safety handling procedures.

ENVIRONMENT

The unit is designed for use in-doors in a dry environmentally controlled manufacturing facility, office or laboratory. The temperature and relative humidity should be kept within those specified in Table 2.1. Significant dust or acoustic/mechanical vibration may cause faulty operation or damage to components so should be avoided. Maintain adequate cooling of the controller by not restricting the air flow to and from the fan cooling vents. For prolonged periods of operation it is advisable to keep the environmental humidity to a minimum.

DIRECTIVE AND STANDARDS APPLIED:

CE

2004/108/EC	EMC Directive BS EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use EMC requirements — Part 1: General requirements FCC part 15, subpart B
2006/95/EC	Low Voltage Directive BS EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
2003/108/EC	WEEE Directive

Table of Contents

Related documents

Document Ref	Title	Usage
EN-002246-MS	NPC-D-5200 NanoMechanism Controller - User Manual	User manual for the 5000 series controller
EN-014635-UM	NanoScan NPC-D-6xx0 NanoMechanism Controller - User Manual	User manual for the 6000 series controller
PS-00006-UM	Nanobench 6000 User Manual	Details the usage of Nanobench 6000 application to calibrate stages and configure controller

Revision history

Revision	Changes
1.0	First version.

1 Overview

The NanoScan NPC-D series digital controllers provide closed-loop positioning control for one or more Queensgate NanoMechanisms. Since these are digital controllers, positioning control is implemented by controller firmware.

Upgrades may be required to the controller's firmware, whether to fix reported issues with the firmware or to make new features available. The NanoFlash software tool allows the controller's firmware to be reprogrammed without requiring special connectors or requiring the case to be opened.

The firmware reprogramming process is designed to be robust to issues such as power loss or disconnection during reprogramming. Whilst these errors may leave the controller in an unprogrammed state, it is always possible to resume programming, and the controller cannot be damaged by interruptions during programming.

The NanoFlash software tool requires Windows 7, 8 or 10.

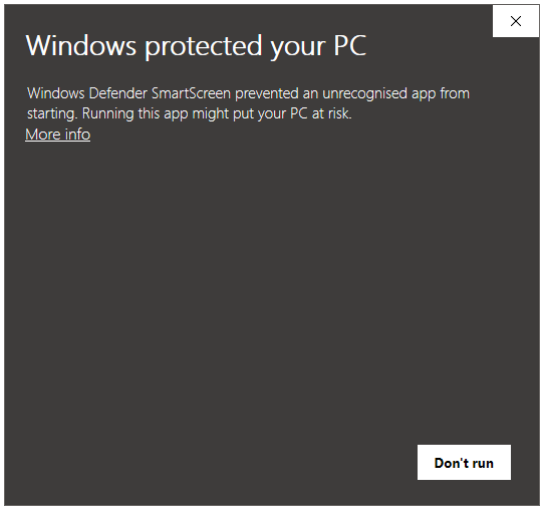
Reprogramming from a PC running Linux is not currently supported. If your organisation has a requirement for this, please contact your Queensgate representative.

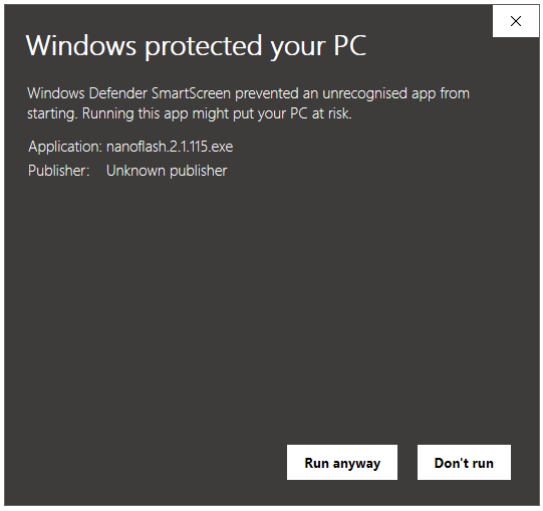
2 Installation and uninstallation

2.1 Installing NanoFlash

The NanoFlash application is supplied as a standard Windows installer, named “nanoflash.1.2.3.exe”, where “1.2.3” will be the current version number. Run this installer.

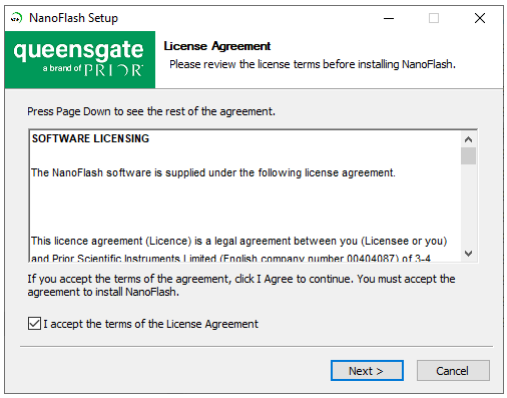
Windows Defender will typically warn you before allowing installation. Select “More info” and click on “Run anyway”



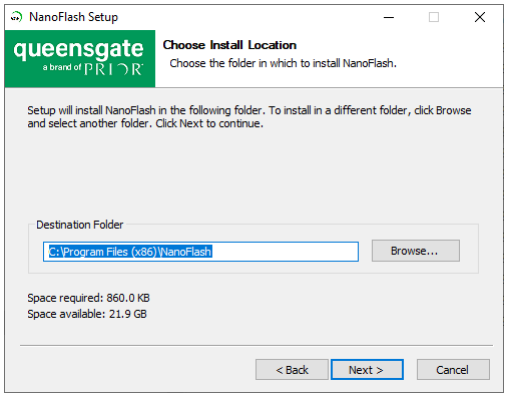


If you do not have admininstrator rights on your PC, you will then be requested for an administrator to enter their username and password. Corporate users may require authorisation from their IT department to install the software, if their IT policy does not allow users to install software themselves.

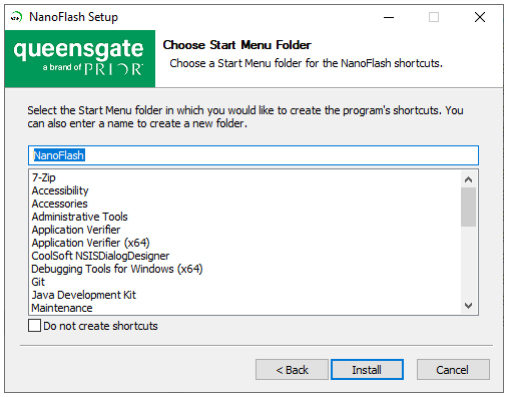
The user must then accept the license agreement.



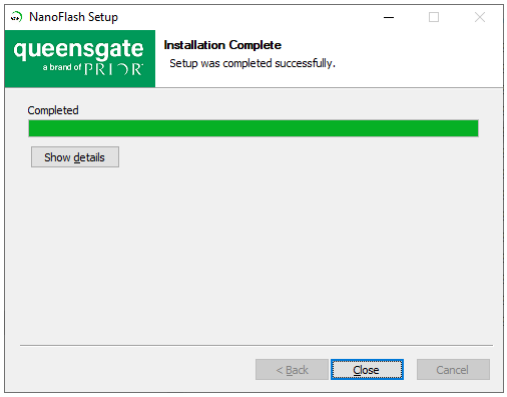
The location to install NanoFlash will be presented, and may be changed if desired.



By default, a shortcut is created on the Start Menu. This may be changed if desired.



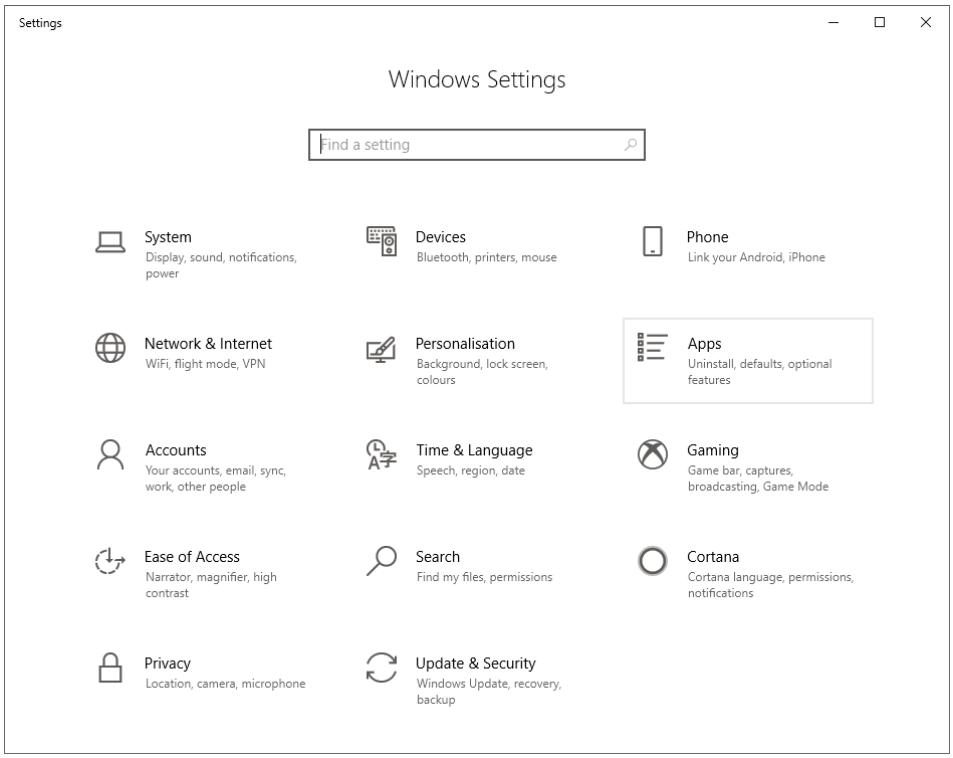
The NanoFlash software will then be installed.



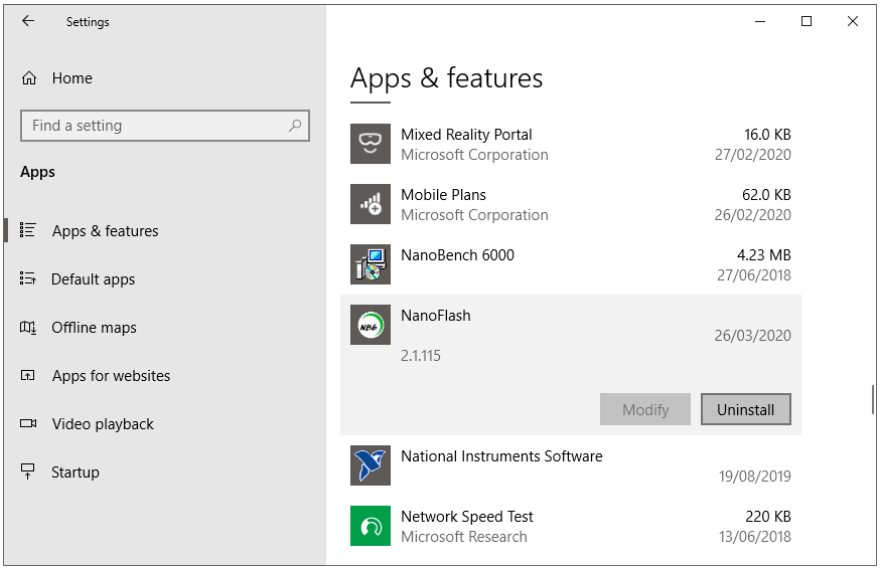
If a Start Menu shortcut was created (by default), the user may select this to run the application. If the user opted not to create a Start Menu shortcut, they may browse to the directory where they chose to install NanoFlash, and run the application “nanoflash.exe”.

2.2 Uninstalling NanoFlash

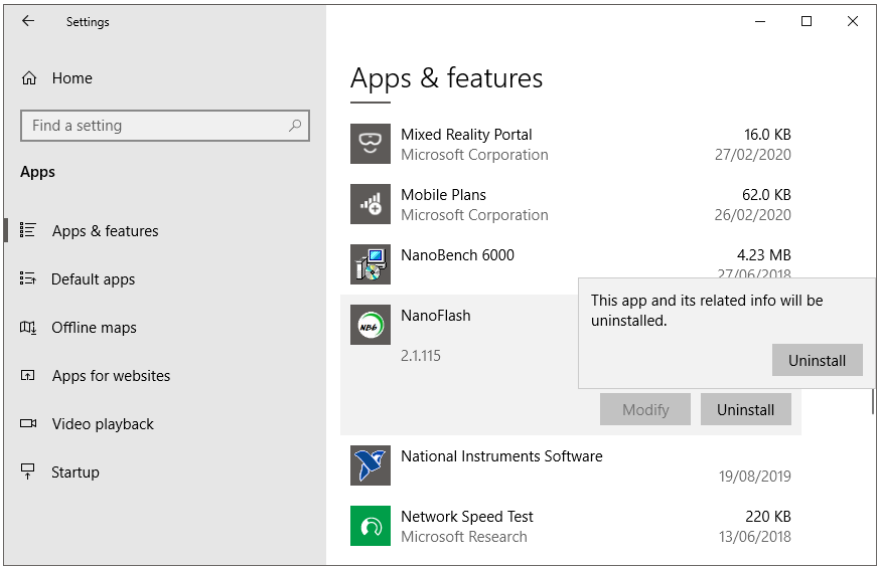
To uninstall the software, go to Settings and select “Apps”.



In the list of installed applications, scroll down to find “NanoFlash”. Click on this, and then click “Uninstall”.

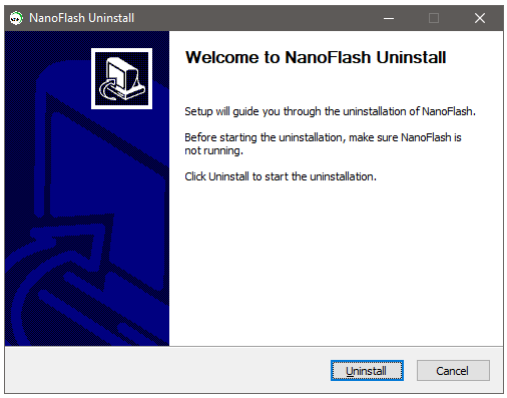


On the popup which appears, click “Uninstall” to continue with uninstallation, or click anywhere else to stop.

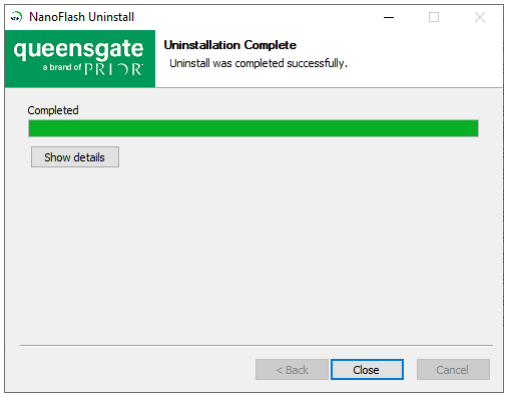


If you do not have administrator rights on your PC, you will be requested for an administrator to enter their username and password.

The installer will finally ask you to confirm that you wish to uninstall NanoFlash.



NanoFlash will then be uninstalled from your PC.



3 Host PC connection to controller

3.1 Requirements for connecting host PC to controller

Reprogramming is carried out over Ethernet between a host PC and the controller.

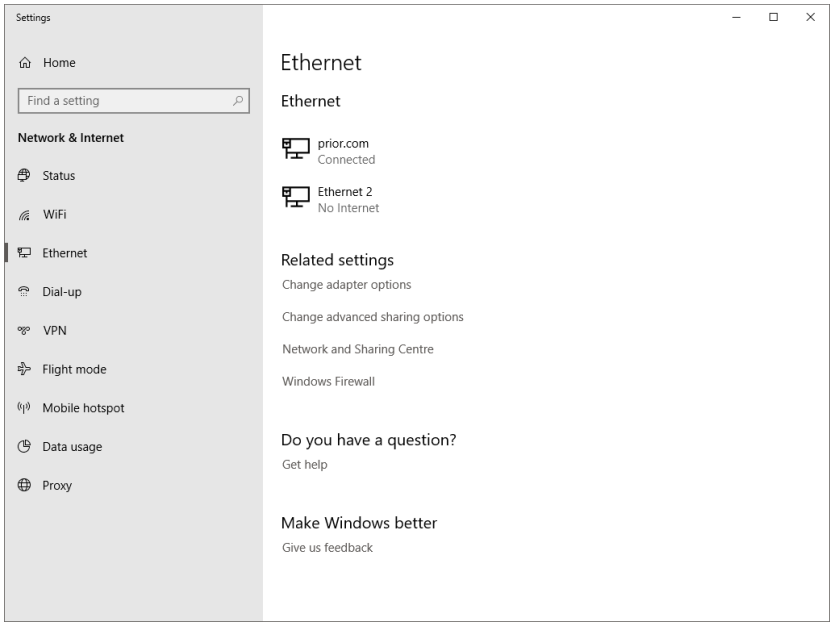
It is recommended that an Ethernet cable be directly connected between the host PC carrying out reprogramming and the controller. Whilst it is possible for reprogramming to be carried out over a network, this introduces the risk that another user may inadvertently attempt programming on the same controller at the same time, or that a different controller may inadvertently be reprogrammed. A direct Ethernet connection ensures that this cannot happen.

Reprogramming also requires that the host PC's Ethernet adapter is assigned a static IP address (see sections 3.2 and 4.1). It may be difficult on some corporate networks to enable this, which again may be a reason to use a direct Ethernet connection.

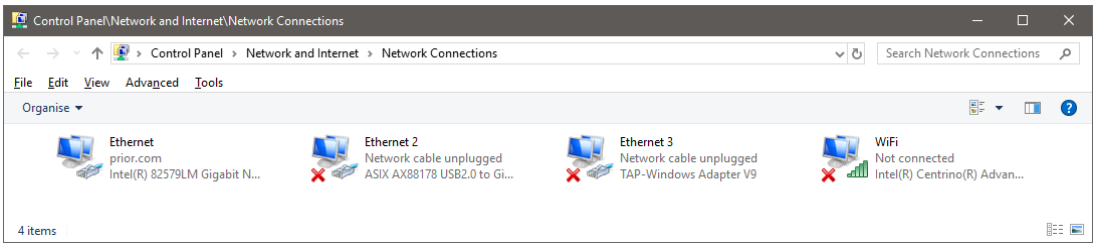
Many PCs only have a single Ethernet connection, which is often required for connection to a network. In this case it may be advisable to buy a USB to Ethernet adapter device. These are relatively inexpensive, and will allow the host PC to maintain its connection to the network whilst programming the controller. This can be useful if firmware files are stored on a network drive.

3.2 Setting the static IP address for an Ethernet adapter

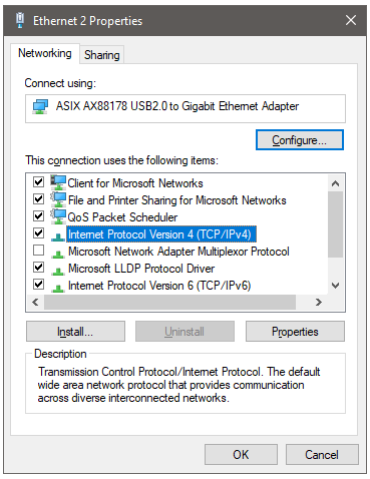
In Windows, open the Control Panel and navigate to "Network Connections". In Windows 10, this may be reached by going to the "Ethernet" settings and selecting "Change adapter options". Other versions of Windows may reach this in different ways.



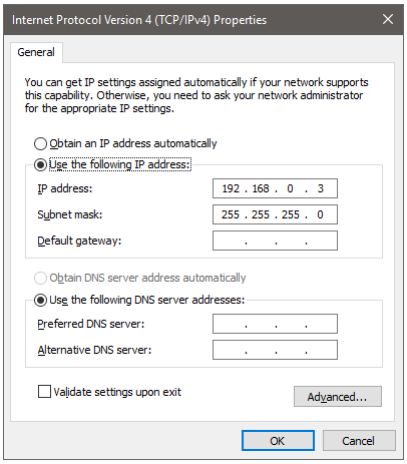
This brings up a list of network connections available.



Right-click on the relevant Ethernet connection and select “Properties” from the pop-up menu.



Select “Internet Protocol Version 4 (TCP/IPv4” as shown. Ensure this has a tick next to it, and tick the checkbox if not. Once this is enabled, hit the button marked “Properties”.



In the TCP/IPv4 settings, select “Use the following IP address” and enter the static IP address and subnet mask to be used for this Ethernet connection. Queensgate use

- IP address: 192.168.0.3
- Subnet mask: 255.255.255.0

as the default settings for direct connection between a host PC and controller. If this clashes with IP addresses used by your company’s corporate network, or if you are connecting to the controller over the network, you may need to choose different settings which ensure your host PC will not cause conflicts on the network, and in some cases to ensure your host PC is not

blocked by a network firewall. In both these cases, consult your IT department for assistance. Generally this will require you to be allocated a static IP address which will be logged by your IT department.

Note that some corporate users may find these settings have been locked due to your company's IT policy and can only be accessed by an administrator. Again, it will be necessary to consult your IT department for assistance.

3.3 Windows Firewall settings

The majority of Windows PCs run Windows Firewall. The installer automatically configures the Firewall to allow NanoFlash to access the controller.

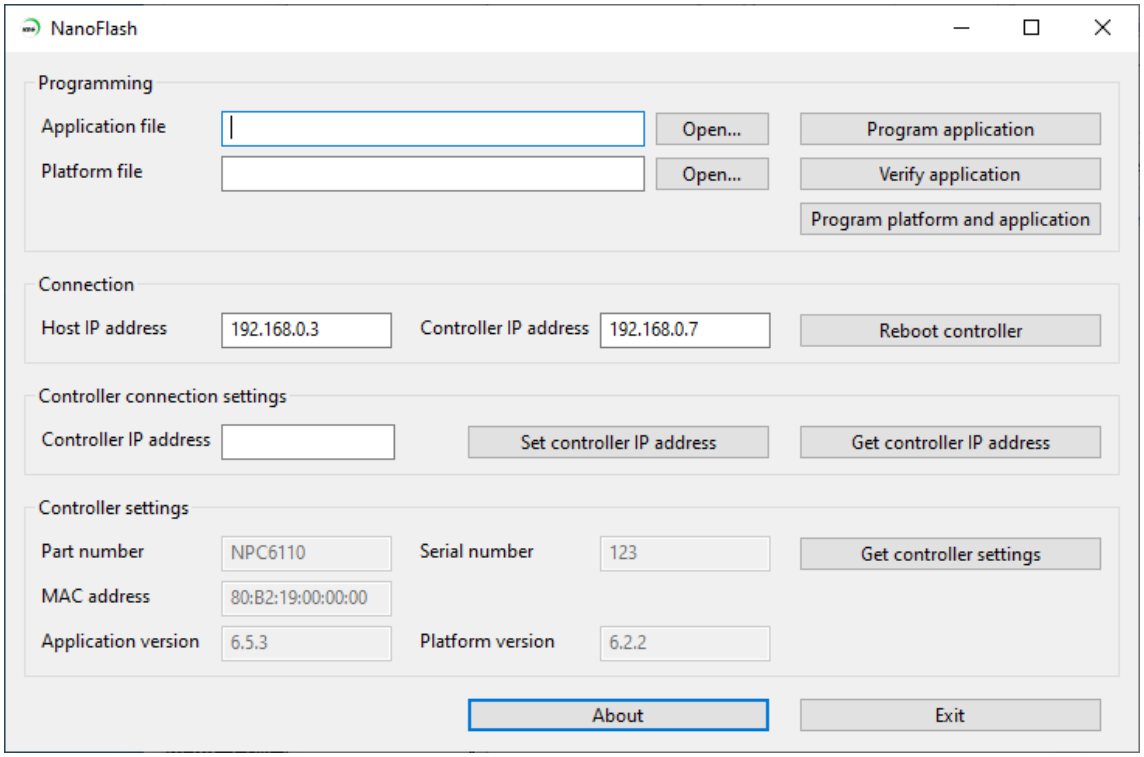
Other security software providers such as Norton or McAffee may provide the firewall software instead. Consult your manual, and your company's IT department if necessary. It will be necessary to give permissions to the applications "nanoflash.exe", "nanoflash_cmd.exe" and "nfs.exe" (an internal process used by NanoFlash) to access both public and private networks.

Some corporate users may find these settings have been locked due to your company's IT policy and can only be accessed by an administrator. In this case, it will be necessary to consult your IT department for assistance. The IT department should install NanoFlash with the appropriate permissions.

If connecting over a network, it is also possible that a company's firewall may block the connections. In either case, it will be necessary to consult your IT department for assistance, requesting that ports be unblocked for Telnet, TFTP and NFS connections (the methods used for reflashing).

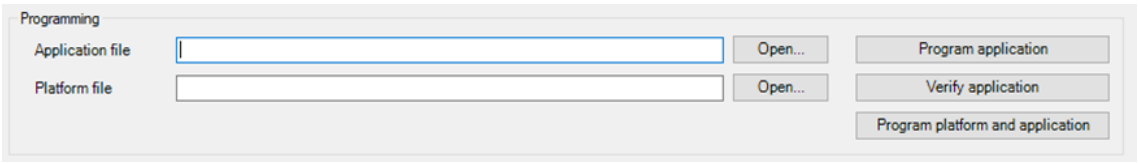
4 NanoFlash user interface

NanoFlash is designed to provide a relatively intuitive user interface for reprogramming. This manual will address each section of the user interface in turn.



4.1 Programming

This section handles reprogramming of the controller with new firmware.



There are two parts to the controller firmware. The “platform” is the operating system which handles file storage, external comms links such as USB and Ethernet, memory management, and other similar functions. Since these rarely change, the platform will rarely be updated. The “application” runs the control loop and all features of the controller, and this will be updated regularly as new features are released.

Support for new features may on occasion require changes to both the platform and application. In this case, the user must ensure that both the platform and application are updated together. The release note for each version of the application specifies which platform version is required to run that application version. Using an incorrect application or platform version will not damage the controller, but the controller may be unable to drive stages or may be left with key features unavailable until the correct firmware is programmed.

- **Application file:** This selects the new application firmware to be used by the controller. This file is named following the pattern “npc6000_application_1.2.3.tgz”, where

"npc6000" reflects that this is the application for a 6000-series controller and "1.2.3" is the application release version number.

- **Platform file:** This selects the new platform firmware to be used by the controller. This file is named following the pattern "npc6000_platform_1.2.3.tgz", where "npc6000" reflects that this is the platform for a 6000-series controller and "1.2.3" is the platform release version number.
- **Program application:** Reprograms the controller with the specified application. The new application does not run until after the controller has been rebooted.
- **Verify application:** Verifies whether the specified application matches that currently programmed into the controller.
- **Program platform and application**: Reprograms the controller with the specified platform and application. The new application does not run until after the controller has been rebooted.

NanoFlash verifies that the application and platform files have the correct structure as expected. It is not possible to accidentally program the platform with an application file, or vice versa, nor for any other arbitrary file to accidentally be programmed instead. NanoFlash alerts the user in this case and will not carry out programming.

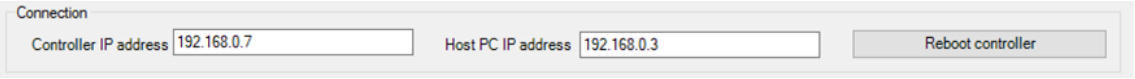
Reprogramming the application does not affect current running of the controller. The controller will continue running with the existing application until it is rebooted, when the new application will be used.

As part of reprogramming the platform, NanoFlash will cause the controller to reboot several times. Reprogramming the platform takes several minutes to complete, and the controller is unable to drive stages whilst platform programming is in progress.

Note that reprogramming the platform requires full erasure of the entire controller storage. Reprogramming the platform therefore also requires an application to be provided. It is not possible to reprogram the platform without also reprogramming the application (even if the application specified is the same version as the controller previously used).

4.2 Connection

The settings in this section specify the controller which will be communicated with, and the Ethernet connection which will be used.



- **Host PC IP address:** This must be set to the static IP address set up for the Ethernet connection in section 3.2.
- **Controller IP address:** This is the static IP address for the controller. All controllers are assigned the static IP address 192.168.0.7 by default during manufacture. This may be changed from within NanoFlash (see section 4.3).

Both these IP addresses must be set correctly in order for any other operations to take place. If the application cannot locate those IP addresses, it will alert the user that they have been entered incorrectly (or, in the case of the controller, may not be turned on).

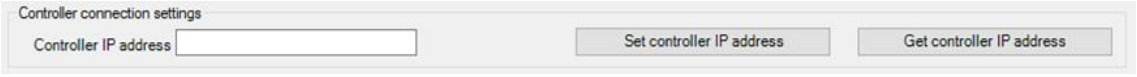
If connecting over a network, or if connecting on a network where this IP address is already in use, the issues described in section 3.2. for assigning a static IP address to the host PC will also apply to the controller's IP address. In this case, consult your IT department for assistance.

- **Reboot controller:** This allows the controller to be rebooted without cycling power. When it restarts, the controller will use the new firmware and/or settings as entered here.

Note that the ability to reboot the controller remotely can be useful for installations where the controller is mounted in an inaccessible location.

4.3 Controller connection settings

This section allows the controller's static IP address to be changed.



- **Controller IP address:** Controller's static IP address, as read from the controller, or entered by the user to be sent to the controller.
- **Set controller IP address:** Set the controller's static IP address to the value entered. This will not take effect until the controller is rebooted or power-cycled. After rebooting, the "Controller IP address" field in the "Connection" section (see section 4.1) must be set to the new controller IP address, otherwise the application will not be able to communicate with the controller.
- **Get controller IP address:** Read back the currently-set controller IP address from the controller. Note that the controller IP address currently *in use* must already be known, otherwise this operation will not be possible. This is primarily used if confirmation is required that the controller IP address set by "Set controller IP address" has taken effect.

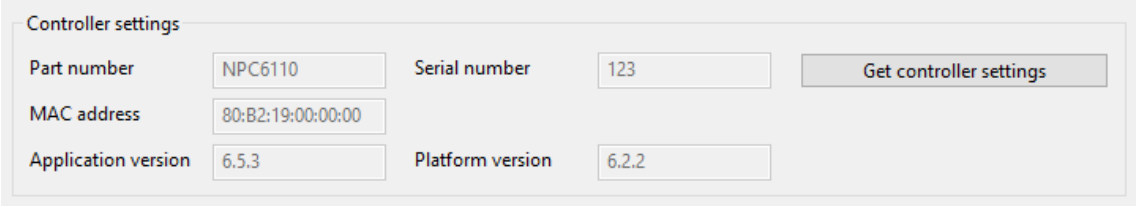
NOTE: If the static IP address is changed for a controller, it is *strongly* recommended that the controller is labelled with the new IP address for future reference, and that the IP address is additionally recorded in a configuration document. Without knowing the static IP address of the controller, it will not be possible to reflash it in future.

In the unfortunate event that the static IP address for a controller is changed and then forgotten, tools such as "nmap" or "Zenmap" may be used to scan the entire IP address range for the address used by the controller. This is frequently prohibited on corporate PCs for security reasons, so it may require the assistance of your IT department. This is outside the scope of NanoFlash.

Alternatively the controller may be returned for service. This will be at customer cost and is not covered under warranty.

4.4 Controller settings

This section allows controller details to be read back. If the user's system contains multiple controllers, this will typically be used to ensure the correct controller is being updated.



- **Part number:** The controller part number, for example “NPC6330”. Note that this is entered in a slightly abbreviated form, instead of the full form “NPC-D-6330”.
- **Serial number:** The controller’s serial number, as printed on the underside of the case.
- **MAC address:** The MAC address for the controller’s Ethernet connection. As for all MAC addresses, this is a globally unique value.
- **Application version:** The release version number for the application firmware.
- **Platform version:** The release version number for the platform firmware.
- **Get controller settings**: Reads back the above settings from the controller.

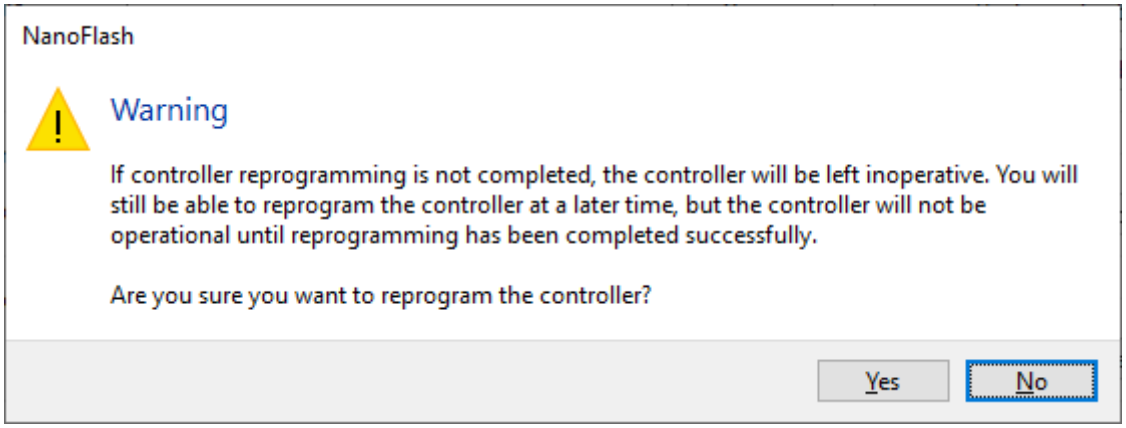
4.5 Cancelling the current operation

Whilst NanoFlash is carrying out an operation, a dialog box shows the current progress. This also includes a “**Cancel**” button which may be used to cancel this operation.

Note that cancelling application or platform programming may leave the controller with no application or platform present. The controller will be unable to drive connected stages until this has been recovered.

4.6 Recovering from a fault during programming

Programming the controller application and/or platform requires the user to acknowledge the following.



If programming of the application and/or controller is not completed, whether due to this being cancelled or due to loss of power or connection, the controller will not be useable until programming has been carried out again and is successful.

4.6.1 Recovering from a fault during application programming

If the controller or host PC lose power, the Ethernet connection is broken or the “**Cancel**” button is pressed during application programming, then the controller will be left without an application.

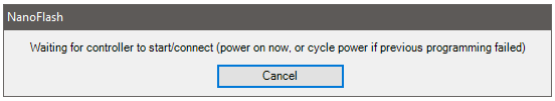
If the controller is rebooted or power-cycled in this state, the power light on the front panel will remain red and the controller will not drive connected stages.

Recovering from this state simply requires that "**Program application**" is selected again, with an appropriate application file specified, and with the controller powered on. The application will be programmed as normal, and will be executed when the controller is rebooted.

4.6.2 Recovering from a fault during platform programming

If the controller or host PC lose power, the Ethernet connection is broken or the "**Cancel**" button is pressed during platform programming, the controller will be left without a platform or application. If the controller is rebooted or power-cycled in this state, the power light on the front panel will remain red and the controller will not drive connected stages.

Recovering from this state simply requires that "**Program platform and application**" is selected again, with an appropriate platform and application file specified. The controller must be initially powered off before "**Program platform and application**" is selected. After a short time, the following dialog will be displayed.



At this point, power on the controller. If the controller was inadvertently left powered on, power it off and back on again at this point. After approximately 30-40s, the dialog should report further progress through the programming sequence as normal.

5 NanoFlash command line interface

NanoFlash includes a command-line equivalent to allow key operations to be run from external programs or via batch files. This is provided by the application “nanoflash_cmd.exe” which is installed to the same directory as the main NanoFlash application.

```
NANOFLASH - Queensgate digital controller firmware reprogramming tool
Version 2.1.115

nanoflash_cmd -h
nanoflash_cmd -a applicationfile
         -c controlleripaddress -i hostipaddress
nanoflash_cmd -a applicationfile -v
         -c controlleripaddress -i hostipaddress
nanoflash_cmd -a applicationfile -p platformfile
         -c controlleripaddress -i hostipaddress

  -h          Print this help text
  -a VALUE    Application file
  -p VALUE    Platform file
  -v          Verify application only (do not program)
  -c VALUE    Controller IP address
  -i VALUE    Host PC IP address
```

The command line interface does not provide some features which are available from the main NanoFlash user interface, such as reading back controller settings or modifying the controller’s static IP address. These are not considered core features which would typically be required from a command line interface.

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Prior Scientific Ltd
3-4 Fielding Industrial Estate
Wilbraham Road • Fulbourn
Cambridge • CB21 5ET • UK
t: +44 (0)1223 881711
e: uksales@prior.com
www.prior-scientific.co.uk

Prior Scientific Inc
80 Reservoir Park Drive
Rockland • MA. 02370
U.S.A.
t: +1 781-878-8442
e: info@prior.com
www.prior-us.com

Prior Scientific GmbH
Wildenbruchstr. 15
D-07745
Jena • Germany
t: +49 (0) 3641 675 650
e: jena@prior.com
www.prior-instruments.de

Prior Scientific KK
Kayabacho 3rd Nagaoka Bldg 10F
2-7-10 • Nihonbashi Kayabacho
Chuo-Ku • Tokyo • 103-0025 • Japan
t: +81-3-5652-8831
e: info-japan@prior.com
www.priorjp.co.jp