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Title:

Converting an Equinox FS2003 programmer to run FS2000A Programming Projects

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Abstract:

This application note describes how to convert an Equinox FS2003 Programmer so that it will execute Programming Projects which were designed to run on an FS2000A programmer. The document details the differences between the two programmers and describes how projects compiled for an FS2000A will behave when uploaded to an FS2003 programmer.

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Documentation and Technical Support

Further Documentation

For further documentation about the FS2000A or FS2003 programmers, please refer to the following manuals and application notes.

Manuals

- FS2000A – User Manual
- FS2003 – User Manual
- EQTools – Getting Start Guide

Application Notes:

- AN112 - Firmware Update instructions for Equinox ISP Programmers
- AN101 – In-System Programming (ISP) of the Atmel AVR FLASH Microcontroller Family using the SPI Programming Interface

The manuals and application notes detailed above can be downloaded from our website at www.equinox-tech.com.

Technical Support

If you have any questions about the products or information covered in this application note, please email your questions to support@equinox-tech.com.

1.0 Introduction

1.1 Overview

The FS2000A ISP Programmer was released in 2000 and has a large worldwide install base in development, field and production In-System Programming (ISP) applications. The newer FS2003 programmer was released in 2003 as a replacement for the FS2000A. It is a far superior programmer compared to the FS2000A supporting more device algorithms, faster hardware and better ISP connectivity.

The FS2003 programmer cannot use the same 'Programming Projects' as the FS2000A programmer because the internal architecture of the programmer and I/O Driver stages are completely different. To overcome this problem, a special version of firmware has been developed for the FS2003 programmer which allows this programmer to emulate the functionality of the FS2000A programmer.

This application note describes how to convert an Equinox FS2003 Programmer so that it will execute Programming Projects designed for the FS2000A programmer. The newly created programmer is called the **"FS2000B"**.

1.2 Comparison of FS2000A and FS2003 programmers

The table below details the main differences between the FS2000A and FS2003 programmers.

Feature	FS2000A	FS2003	Comment
In Production / availability	No Discontinued	Yes	The FS2000A is no longer available.
RoHS compliant	No	Yes	The FS2003 is a RoHS compliant product.
Programming speed	FS2000A internal electronics run at 1/2 the speed of the FS2003	FS2003 internal electronics run at x2 the speed of the FS2000A	Some algorithms such as high-speed SPI will operate much faster on the FS2003.
On-board FLASH Memory	512 kbytes	4 Mbytes	The FS2003 can store 8 times more project data than the FS2000A.
Programmer I/O pins	3	5	The extra I/O pins allows JTAG programming to be supported.
Individually configurable Programmer I/O pins	No	Yes	Each I/O pin on the FS2003 can be tri-stated individually.

Programmer Status LEDs	None	4 – Target Vcc, PASS, BUSY FAIL	The FS2003 can display the programmer status on 4 LEDs.
Programmer powering	Programmer can only power from a +5.0V Target System	Programmer can power from a Target System running from 3.0 to 5.0V	The FS2003 can be powered from low-voltage Target Systems.
Vpp Generator (+12V)	Not supported	Yes +12V switchable Vpp on RESET pin controllable from the Programming Project.	The Vpp allows the FS2003 to support high-voltage serial programming of Atmel ATtiny AVR microcontrollers.
Target ISP Connectors / Headers	2 x ISP Connectors: <ul style="list-style-type: none"> Equinox 10-way SPI Atmel 10-way SPI 	4 x ISP Connectors: <ul style="list-style-type: none"> Equinox 10-way - SPI / UART Atmel 10-way - SPI Atmel 6-way - SPI Atmel 10-way - JTAG (same as JTAG-ICE connector) 	The FS2003 features the FOUR most popular ISP Header connector configurations. The FS2000A only supports 2 headers and does not support JTAG.
Device support differences	<ul style="list-style-type: none"> Atmel AVR SPI algorithms only AT89Sxxxx SPI algorithms 	<ul style="list-style-type: none"> Atmel AVR SPI algorithms Atmel AVR High-Voltage Serial Programming Atmel AVR JTAG algorithms (upgrade) 24Cxxx I2C Serial Memories (upgrade) AT89Sxxxx SPI algorithms 	The FS2000A cannot support ATmega JTAG, ATtiny High-Voltage Serial Programming, I2C or UART (Boot Loader) algorithms.
Device support updates	Limited New devices are added on an ad-hoc basis if the hardware can support them.	On-going New devices are added on a regular basis.	Select the FS2003 for on-going device support.
Firmware updates	Limited Need to use the Configit utility.	On-going Firmware can be upgraded by uploading a 'Firmware Update Project' using Upload	The FS2003 firmware is updated on a regular basis usually when new algorithms are required.

		Wizard.	
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1.3 Availability of the FS2000A and FS2003 programmers

The FS2000A programmer was discontinued in 2003 when the FS2003 programmer was launched. It is therefore recommended that all customers move to the FS2003 programmer. It is now possible to make an FS2003 programmer emulate the functionality of the FS2000A programmer and run the same Programming Projects which were originally compiled for the FS2000A.

1.4 Introducing the FS2000B (FS2000A look-a-like programmer)

A special version of firmware has been developed for the FS2003 Programmer which will make the programmer emulate the operation of an FS2000A programmer. Once this special firmware has been uploaded to the FS2003, the programmer will become what we now call the **“FS2000B”** programmer. The FS2000B programmer will look like an FS2000A programmer to EQTools and the Upload Wizard utility. It is then possible to run projects designed for the FS2000A programmer on this programmer.

As there are hardware differences between the FS2000A and FS2000B programmer, the conversion of projects between the programmers is not perfect. Please refer to the next sections for details of the differences in operation between the FS2000A and the FS2000B programmers.

1.5 On-board FLASH Memory – Project Storage

The FS2003 features 4 Mbytes of on-board FLASH memory compared to 512 kbytes on the FS2000A programmer. This means that the FS2003 can hold up to 8 times more project data in Standalone Mode. However, When the FS2003 programmer is converted to an FS2000B (emulating an FS2000A), the on-board FLASH memory storage will be limited to 512 kBytes so it is the same as the FS2000A.

Feature	FS2000A	FS2003	FS2000B
On-board FLASH Memory	512 kbytes	4 Mbytes	512 kbytes

1.6 SPI Programming Speeds in ‘Software SPI’ mode

1.6.1 Overview

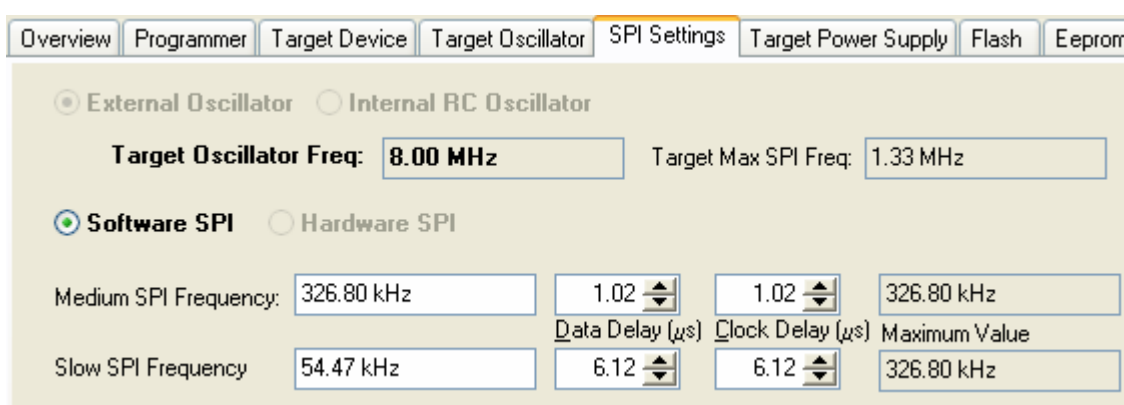
The internal electronics of the FS2003 programmer runs at almost twice the speed of the electronics inside the FS2000A programmer. In **‘Software SPI’** mode (where the programmer is generating the SPI waveforms from software), the FS2003 / FS2000B hardware can generate a higher maximum SPI speed compared to the FS2000A.

Feature	FS2000A	FS2003	FS2000B
Maximum SPI Speed	326 kHz	490 kHz	490 kHz

This means that a Programming Project designed for an FS2000A programmer will produce faster SPI waveforms when uploaded to the FS2000B programmer. This will speed up the programming of the FLASH and EEPROM blocks of most devices which use the 'MEDIUM SPI' setting in EQTools.

1.6.2 Slow SPI speed

The '**Slow SPI**' speed setting in '**Software SPI**' mode is used for all programming operations except for the programming of the FLASH and EEPROM areas of the Target IC. If the Target IC is an Atmel AVR microcontroller which is running from a slow internal oscillator e.g. @ 1 MHz, then it is very important that the '**Slow SPI**' speed is set to a low enough value e.g. 50 – 100 kHz to ensure correct entry in Serial Programming Mode.



The screenshot shows the 'SPI Settings' tab in the EQTools software. It features two radio buttons for 'External Oscillator' (selected) and 'Internal RC Oscillator'. Below these, there are input fields for 'Target Oscillator Freq:' (8.00 MHz) and 'Target Max SPI Freq:' (1.33 MHz). Further down, there are radio buttons for 'Software SPI' (selected) and 'Hardware SPI'. At the bottom, there are two rows of settings: 'Medium SPI Frequency' (326.80 kHz) and 'Slow SPI Frequency' (54.47 kHz). Each row has two spinners for 'Data Delay (µs)' and 'Clock Delay (µs)', both set to 1.02, and a 'Maximum Value' field set to 326.80 kHz.

When the same SPI settings are uploaded to an FS2000B programmer, the FS2000B firmware automatically scales the '**Slow SPI**' settings to adjust for the fact that the programmer is running much faster than the FS2000A. This should mean that a Programming Project designed for the FS2000A programmer should always work OK when loaded into an FS2003 programmer.

1.6.3 Medium SPI speed

The '**Medium SPI**' speed setting in '**Software SPI**' mode is only used for programming the FLASH and EEPROM areas of the Target IC. When a Programming Project designed for an FS2000A programmer is loaded into an FS2000B programmer, the '**Medium SPI**' speed is **NOT** scaled. This means that the resulting SPI frequency when an FS2000A project is uploaded to the FS2000B will be faster.

For example:

If the '**Medium SPI**' speed is set to 326 kHz in the FS2000A project, the resulting SPI frequency when the same project is uploaded to an FS2000B programmer is 490 kHz.

Feature	FS2000A	FS2000B
Medium SPI speed setting	326 kHz	490 kHz

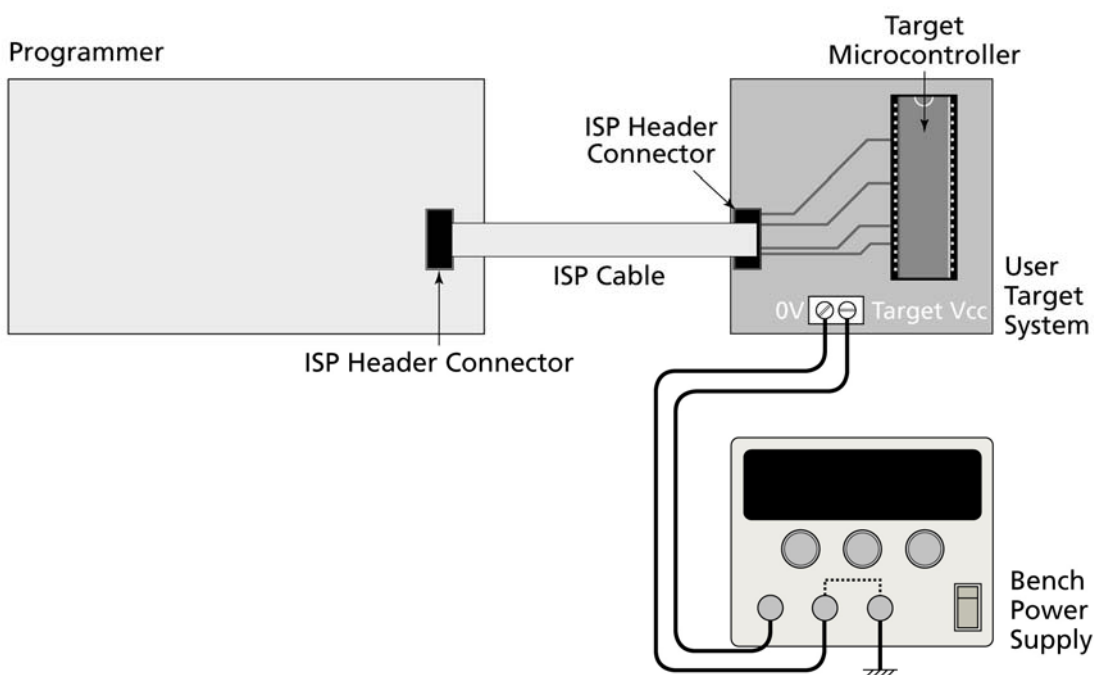
This should result in significantly faster programming speeds for most devices.

Warning!

If the Target Device is an Atmel AVR microcontroller running from its internal RC Oscillator at e.g. 1 MHz then the resulting MEDIUM SPI frequency may be too fast for the Internal Oscillator and the programming operation will fail. If the FS2000B produces a programming error, you will need to decrease the MEDIUM SPI frequency in the original FS2000A project.

1.7 Powering the programmer from the Target System

It is possible to power both the FS2000A and FS2003 programmer from the Target System – see diagram below.



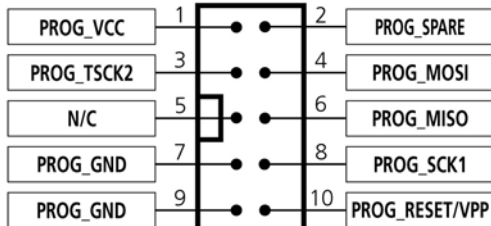
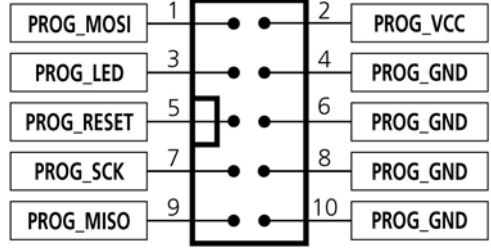
- The FS2003 programmer can be powered from a Target System running from any voltage between 3.0 and 5.0V.
- The FS2000A programmer is only designed to power from a Target System running at 5.0V.

Feature	FS2000A	FS2003	FS2000B
Target System Voltage range	5.0V only	3.0 to 5.0V	3.0 to 5.0V
Target Vcc selection method	Vcc Selection Switch – S1	Vcc Jumper – J9	Vcc Jumper – J9

1.8 ISP Header Connectors

The FS2003 features four ISP Connectors compared to only two on the FS2000A programmer.

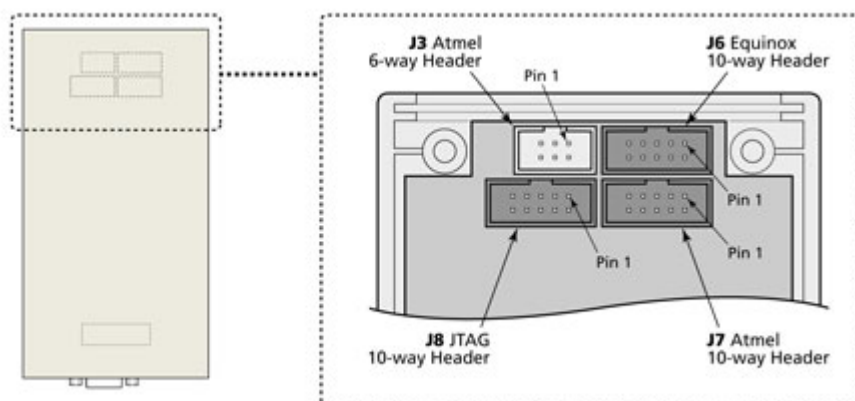
The ISP Connectors which are present on both the FS2000A and FS2003 are the '*Equinox 10-way*' and '*Atmel 10-way*' connectors – see table below.

Feature	FS2000A	FS2003	FS2000B
Equinox 10-way SPI Connector 	Yes "J3"	Yes "J6" +12V Vpp can be applied from the RESET pin	Yes "J6" +12V Vpp can be applied from the RESET pin
Atmel 10-way SPI Connector 	Yes "J4"	Yes "J7"	Yes "J7"

Please note:

The connector label on the PCB is shown as e.g. "J3" in the above table.

The FS2003 ISP Connectors are shown in the diagram below:



2.0 Converting an FS2003 to an FS2000B

2.1 Overview

It is possible to upload a special version of firmware to an FS2003 Programmer which will make the programmer pretend to be an FS2000A programmer. Once this special firmware has been uploaded, the programmer will become an FS2000B programmer. The FS2000B programmer will look like an FS2000A programmer to EQTools and the Upload Wizard utility. It is then possible to run projects designed for the FS2000A programmer on this programmer.

2.2 Uploading the FS2000B firmware to the FS2003 programmer

To change an FS2003 programmer so it will execute projects designed for the FS2000A programmer, it is necessary to upload a special version of firmware to the programmer.

The instructions below describe how to convert an FS2003 programmer to an FS2000B programmer:

1. Download and install EQTools 2.1.0 build 930 or above

- The new FS2000B programmer functionality was introduced in build 930 of EQTools and Upload Wizard.
- Please download **EQTools build 930** or above before following the upgrade instructions below.
- This file can be downloaded from the Equinox website.

2. Locate the file '**FS2003_to_FS2000B_V3-07.ppc**' file

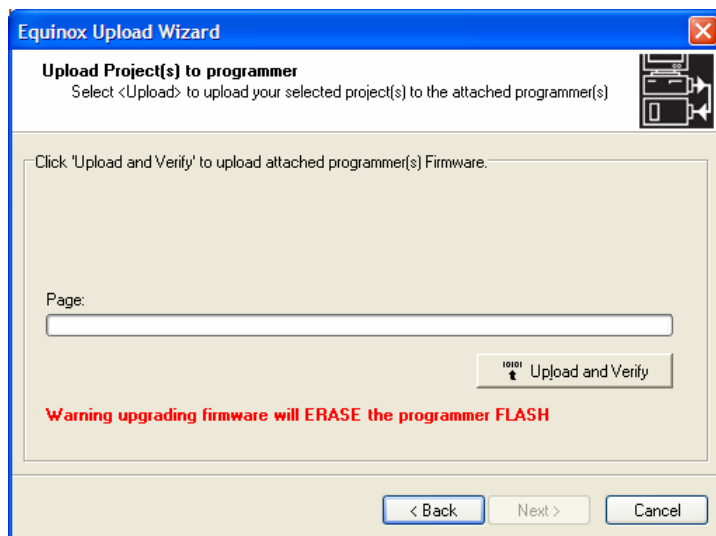
- This file can be downloaded from the Equinox website.
- It is also installed during the installation of EQTools build 930 or above into the **`program files\equinox\firmware\Upload_Wizard_Firmware_Upgrade_from_3-xx`** directory.

3. Connect your FS2003 programmer to a spare COM port on your PC

- See instructions in the programmer User Manual.

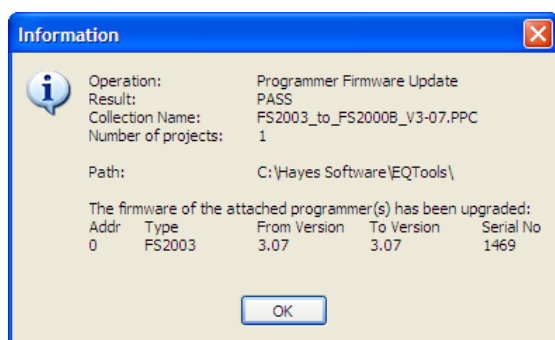
3. Upload the '**FS2003_to_FS2000B_V3-07.ppc**' file to the attached FS2003 programmer

- Launch EQTools
- Click **<OK>** on the '**Welcome Screen**'
- From the left-hand pane, select **<Project Manager><Open Collection>** and then browse to select the '**FS2003_to_FS2000B_V3-07.ppc**' file.
- Click the **<Upload all projects>** button → the Upload Wizard utility will launch



- Click **<Upload and verify>** button → the new firmware is uploaded to the programmer.
- Follow the on-screen instructions to upload the file to the programmer.
- Once the firmware project has been uploaded, a message will appear to say the programmer firmware is being updated.
- Wait for the firmware update to complete

At the end of the process, a message will appear to say the firmware has been updated.



For more detailed instructions of how to update the programmer firmware, please refer to Application Note '**AN112 – Upgrading Programmer Firmware**'.

2.3 Checking that the programmer is now an FS2000B

Once the new firmware has been uploaded to the programmer, the FS2003 should now have become an FS2000B programmer.

1. To check the programmer is now an FS2000B programmer

Power the programmer OFF and then ON again

→ The programmer screen should display the following text:

EQUINOX-TECH UK
FS2000B Ver 3.07

This means the programmer is now running the FS2000B firmware.

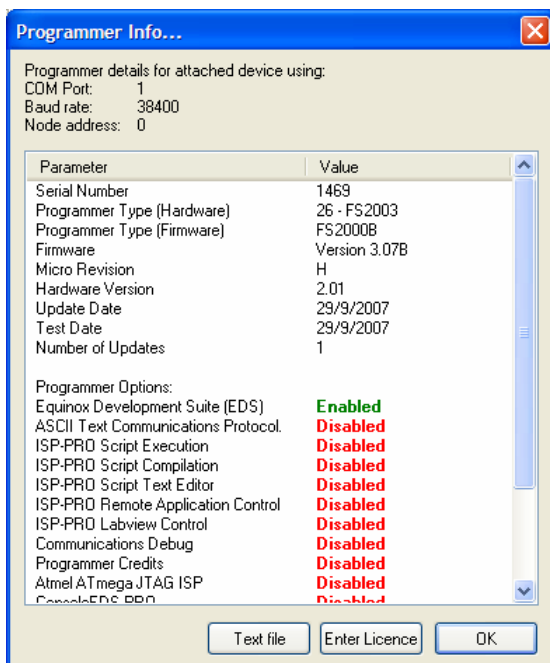
The version of the firmware is 3.07. This version may change in the future if the firmware is updated for any reason.

2. To check the programmer responds to EQTools as an FS2000A programmer

The FS2000B pretends to be an FS2000A programmer making it possible to run Programming Projects on it which were designed for the FS2000A.

To check that the FS2000B programmer is now configured to run FS2000A projects:

- In EQTools, select **<Programmer><Programmer Info>**



If you check the 'Programmer Info' screen, it should now display the following:

- Programmer Type (Hardware): **26 – FS2003**
- Programmer Type (Firmware): **FS2000B**

This means that the physical 'Programmer Hardware' is still an FS2003 but the 'Programmer firmware' is emulating an FS2000B programmer.

2.4 Uploading FS2000A projects to an FS2000B programmer

- Once an FS2003 programmer has been converted to an FS2000B programmer, it will behave in exactly the same way to EQTools as an FS2000A programmer.
- It is now possible to upload any existing Project Collection to the FS2000B programmer which has been designed for the FS2000A programmer.
- No changes to the existing FS2000A projects are required for most applications.
- Upload Wizard will report that the attached programmer is an "FS2000B" programmer but will allow projects compiled for the 'FS2000A' programmer to be uploaded to it.

2.5 Testing FS2000A projects in EDS (Development Mode)

- Once an FS2003 programmer has been converted to an FS2000B programmer, it will behave as if it is an FS2000A programmer in EDS (Development Mode).
- Existing FS2000A Programming Projects can be tested in EDS in exactly the same manner as they could be on an FS2000A programmer.

2.6 Future FS2000B firmware updates

Once the FS2003 programmer has been converted to an FS2000B programmer it will then only accept Programming Projects which have been compiled for the FS2000A programmer. It will no longer accept FS2003 projects.

If the FS2000B firmware is to be upgraded in the future, a special '**FS2000B Firmware Upgrade**' compiled for the FS2000A will be posted on our website.

3.0 Converting an FS2000B to an FS2003

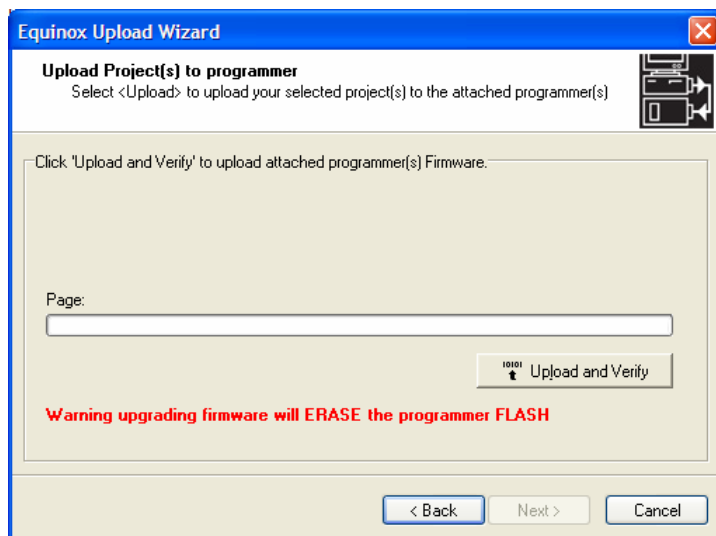
3.1 Overview

Once an FS2003 programmer has been converted to an FS2000B programmer, it will then only execute FS2000A projects. If you wish to execute FS2003 projects, then it is necessary to convert the programmer back to an FS2003 programmer. This can be achieved by uploading the latest '**FS2003 Firmware**' to the programmer. However, as the FS2000B is pretending to be an FS2000A programmer, special FS2000A version of the firmware project is required to fool the **Upload Wizard** utility that the programmer is in fact an FS2000A.

3.2 Uploading the FS2003 firmware to the FS2000B programmer

The instructions below describe how to convert an FS200B programmer back into an FS2003 programmer:

1. Download and install EQTools 2.1.0 build 930 or above
 - The new FS2000B programmer functionality was introduced in build 930 of EQTools and Upload Wizard.
 - Please download **EQTools build 930** or above before following the upgrade instructions below.
 - This file can be downloaded from the Equinox website.
2. Locate the file: '**FS2000B_to_FS2003_3-07.PPC**'
 - This file can be downloaded from the Equinox website.
 - It is also installed during the installation of EQTools into the **program files\equinox\firmware** directory.
3. Connect your FS2003 programmer to a spare COM port on your PC
 - See instructions in the programmer User Manual.
4. Upload the '**FS2000B_to_FS2003_3-07.PPC**' to the attached FS2003 programmer:
 - Launch EQTools
 - Click **<OK>** on the '**Welcome Screen**'
 - From the left-hand pane, select **<Project Manager><Open Collection>** and then browse to and select the '**FS2000B_to_FS2003_3-07.PPC**' file.
 - Click the **<Upload all projects>** button → the Upload Wizard utility will launch



- Click **<Upload and verify>** button → the new firmware is uploaded to the programmer.
- Follow the on-screen instructions to upload the file to the programmer.
- Once the firmware project has been uploaded, a message will appear to say the programmer firmware is being updated.
- Wait for the firmware update to complete
- At the end of the process, a message will appear to say the firmware has been updated.

For more detailed instructions of how to update the programmer firmware, please refer to Application Note '**AN112 – Upgrading Programmer Firmware**'.

3.3 Checking that the programmer is now an FS2003 programmer

Once the new firmware has been uploaded to the programmer, the FS2000B programmer should now have become an FS2003 programmer.

1. To check the programmer is now an FS2003 programmer

Power the programmer OFF and then ON again

→ The programmer screen should display the following text:

EQUINOX-TECH UK
FS2003 Ver 3.07

This means the programmer is now running the FS2003 firmware.

The version of the firmware is 3.07. This version may change in the future if the firmware is updated for any reason.

2. To check the programmer responds to EQTools as an FS2003 programmer

To check that the FS2003 programmer is now configured to run FS2003 projects:

- In EQTools, select **<Programmer><Programmer Info>**
- The programmer will now report it is an '**FS2003**' with firmware '**x.xxf**' where '**f**' indicates the '**FS2003**' programmer type.

4.0 Frequently asked questions (FAQ)

4.1 FAQ Overview

This section details a list of Frequently Asked Questions about the FS2000B programmer. If you do not find the answer to your question in this list, please email your question to support@equinox-tech.com.

4.2 FAQ List

Is the FS2000A programmer still available?

No. There is no further stock of the FS2000A programmer available either at Equinox Technologies or our distributors.

Why was the FS2000A programmer discontinued?

The FS2000A programmer was discontinued back in 2000 – 2001 as it had limited device support and because many of the parts inside it were either non RoHS compliant or could no longer be sourced.

What is the replacement for the FS2000A programmer?

There is no direct replacement with the exact same functionality as the FS2000A programmer. However, we do now offer a special version of firmware for the Equinox FS2003 programmer which will emulate the FS2000A programmer. This new programmer type is called the '**FS2000B**' programmer. It is an FS2003 programmer running special firmware.

Which programmer do I need to order from Equinox or an Equinox distributor?

You would need to order an '**FS2003**' programmer from Equinox or an Equinox distributor. Once you have received the FS2003 programmer, simply follow the instructions in this application note to convert it to be an FS2000B programmer.

How do I change an FS2003 programmer into an FS2000B programmer?

See section 2 of this application note.

Can I change an FS2000B programmer back into an FS2003 programmer?

Yes. This is simply a matter of changing the firmware again. See section 3 of this application note.

Will the FS2000B programmer run FS2000A Programming Projects?

Yes. The specially developed 'FS2000B' firmware should allow you to upload Programming Projects to the FS2000B which were originally compiled for the FS2000A programmer. However, there may be a few compatibility problems because the SPI settings do not transfer between programmers on a 1 for 1 basis.

Do I need to make any changes to my existing FS2000A projects?

In most cases no changes are required.

However, if you do experience any programming issues, try reducing the 'MEDIUM SPI speed' as the FS2000B will actually produce faster SPI frequencies than the FS2000A.