



Silicon Sculptor Quick Reference Card

Introduction

Thank you for purchasing Actel's Silicon Sculptor programming system. This system enables field programming of Actel FPGAs for proof of concept up to the largest production runs. Actel also offers programming services through its factory and distribution partners to meet a variety of custom requirements.



There is little margin for error in today's competitive world, so Actel has assembled the following quick reference guide to help its customers maximize programming yield. Actel's patented antifuse architecture is the most secure programmable logic platform available today. As this innovative technology is One Time Programmable, it is not possible for Actel to screen out 100% of potential programming failures. As a result, a small percentage of each lot is lost in the standard programming process, but there are ways to minimize the fallout.

By following a few easy guidelines, you can prevent unnecessary programming failures and improve overall yields. This document provides guidelines for pre-programming setup, programming both antifuse and Flash FPGAs, how to manage programming failures, a list of common error messages, and troubleshooting tips.

This guide was designed as a reference to keep near your programming station and use as a training guide for programming operators. Details about the Silicon Sculptor and its software may be found in the Silicon Sculptor User's Guide at: <http://www.actel.com>.



Pre-Programming Setup

The following steps are required before programming Actel devices with Silicon Sculptor:

Use Proper Handling and ESD Precautions Actel FPGAs are sensitive electronic devices that are susceptible to damage from ESD and other types of mishandling. You can find specific handling instructions for several packages at: <http://www.actel.com/products/sockets/index.html>.

Use the Latest Version of the Silicon Sculptor Software The programming software is frequently updated in order to accommodate yield enhancements in FPGA manufacturing. These updates ensure maximum programming yield and minimum programming times. Before programming, always check that the version of the Silicon Sculptor software you are using is the most recent: <http://www.actel.com/custsup/updates/silisculpt/>.

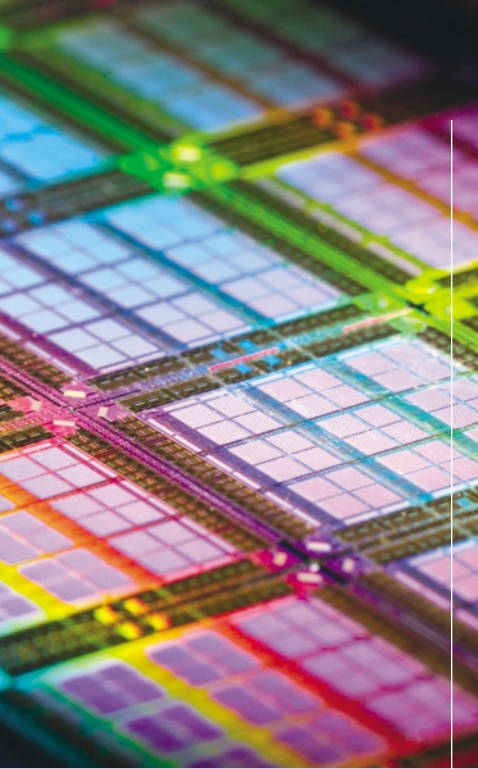
Use the Latest Version of the Designer Software to Generate Your Programming File (Recommended) The files that are used to program (.afm, .fus, .bit, .stp) contain important information about the fuses and switches that will be programmed in the FPGA. Please always zip the programming files to avoid corruption of programming file during file transfer. Find the latest version and corresponding release notes at: <http://www.actel.com/custsup/updates/designer/index.html>.

Use the Most Recent Adapter Module Occasionally, Actel makes modifications to these modules to improve programming yields and programming times. Please visit: <http://www.actel.com/products/tools/silisculpt/modules.html> to identify the latest version of each module before programming.

Perform Routine Hardware Self-Diagnostic The self-diagnostic will verify correct operation of the pin drivers, power supply, CPU, memory, and adapter module. This test should be performed before every programming session. As a minimum, the test must be executed every week.

- To execute the self-diagnostic on DOS versions: From anywhere in the software, type **ALT-D** on your keyboard.
- To execute the self-diagnostic on Windows versions: Click on **Device**, select **Actel Diagnostic**, select the **Test** tab, click **OK**.

Perform Routine Hardware Verification and Calibration The verification and calibration procedure verifies that the test limits used during the self-diagnostic are accurate. Verification and calibration of the Silicon Sculptor is required every 12 months for RadHard and RadTolerant devices, and it is recommended for all other devices. For verification and calibration instructions, please see: <http://www.actel.com/documents/SiliSculptProgCali.pdf>.



Programming Failure Guidelines

Even though it is impossible for Actel to screen out 100% of potential programming failures on antifuse FPGAs, we do screen for low programming yields by programming a sample of devices from every lot that we ship. The size of this sample is selected to give us a high level of confidence that we will satisfy the 95% yield criteria.

As long as all the requirements listed above and on the previous page are satisfied, Actel will replace 100% of field programming rejects. If the programming yield is lower than expected, Actel will perform an investigation to determine if the high failure rate is caused by the system used to program the devices or can be attributed to the devices themselves.

On the other hand, Flash FPGAs are reprogrammable, so Actel tests the programmability for 100% of the devices shipped and expected fallout is zero.

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Programming Antifuse FPGAs

The following steps are required to program Actel Antifuse FPGAs

Perform Blankcheck (Recommended) This test will confirm that the actual device you are about to program matches the device selected and is completely blank. This will help prevent mixing up programming failures with blank devices. We recommend performing this before each programming session.

Program This is the step where the actual programming file is mapped into the device. Don't forget to enable programming the security fuses if desired. If broadcasting, press **Start** to program each site.

Checksum (Recommended) This step will confirm that the FPGA has been programmed correctly.

Save the .txt File (RH/RT Only – Required) During programming of all RadHard and most RadTolerant FPGAs (excluding RTSX and RTSX-S), important programming information is automatically stored in a .txt file located in your programming file directory. Every time you program a new device, this file is overwritten. Therefore, it is mandatory that you save this file under a different name after the programming of every RH or RT FPGA (we recommend using the device serial # in the file name). Programming failures will not be accepted for return if this file is not available for the corresponding failed device. For more information, please see the RH/RT programming guide: <http://www.actel.com/products/devices/radhard/radhardPG.pdf>.

FAQs For Programming Actel Antifuse FPGA

Actel recommends you to check the following FAQs for any concerns or questions you have on programming Antifuse FPGAs: <http://www.actel.com/documents/AFprogrammingFAQ.pdf>



Programming Flash FPGAs

The following steps are required to program Actel Flash FPGAs

Program Programming a Flash device is a one step process whether you are programming using a socket adapter module or using the ISP module with a cable to your board. The **Execute** function will automatically erase the device, program the Flash cells, and verify that it is programmed correctly. We recommend that you confirm the security status is correct before programming.

Below, you will find specific guidelines on what you can do when you encounter programming failures with Actel FPGAs.

Programming Failures Allowance Tables

For volumes greater than 100 units, maximum expected fallout is 5%.

Antifuse FPGAs (non RH/RT)

1. Debug the Error Message

Any Time You Encounter a Failure:

- Record the EXACT error message
- Compare your error message to those listed in the "Common Programming Failure Modes" table, and try to resolve the problem based on the given suggestions.

If failures continue, proceed to the next step.



2. Check the Programming Setup

- Record the version of the Silicon Sculptor software being used, then upgrade to the latest version:
<http://www.actel.com/custsup/updates/silisculpt>
- Perform the self-diagnostic
- Record the exact part number of the adapter module(s) being used, then upgrade to the latest version:
<http://www.actel.com/products/tools/silisculpt/modules.html>

Continue programming and proceed to the next step.



3. Check the Programming Yield

Compare your programming fallout with the "Programming Failure Allowance Table" located to the right. As long as you are within the guidelines, continue programming. Contact your distributor or sales office to return devices, and provide failure rates along with your request.

If the failure rate exceeds expected fallout, proceed to the next step.



4. Record Device Details

Record the following for all failures and programmed devices:

- Date code (4 digit number on top of device)
- Lot code (alphanumeric usually on underside of device)
- Number failed and number passed programming from each lot



5. Contact Actel Support

RadHard and RadTolerant FPGAs

1. Debug the Error Message and Check the Programming Setup

Stop Programming Immediately.

Due to the high cost of RH/RT devices, it is important that you ensure your software and hardware are up to date and are in good working condition. It is also important that you provide detailed information about the failure to Actel. Please see the "RH/RT Programming Guide" on Actel's website for more detailed information about programming RH and RT devices.

- Record the EXACT error message
- Save the .txt file under a different name, so it is not overwritten
- Perform the self-diagnostic
- Record the version of the Silicon Sculptor software being used, then upgrade to the latest version:
<http://www.actel.com/custsup/updates/silisculpt>
- Record the exact part number of the programming module(s) being used, then upgrade to the latest version:
<http://www.actel.com/products/tools/silisculpt/modules.html>

If failures continue, proceed to the next step.



2. Check the Programming Yield

Compare your programming fallout with the "Programming Failure Allowance Table" located to the right. As long as you are within the guidelines, continue programming. Contact your distributor or sales office to return devices, and provide ALL of the above information with your request.

If the failure rate exceeds expected fallout, proceed to the next step.



3. Record Device Details

Record the following for all failures and programmed devices:

- Date code (4 digit number on top of device)
- Lot code (alphanumeric usually on underside of device)
- Serial number (top of device)
- Number failed and number passed programming from each lot



4. Contact Actel Support

Flash FPGAs

1. Debug the Error Message

Even though Actel tests the programmability of every Flash FPGA, there are several external factors that can cause devices to fail, especially when performing In-System Programming, such as noise and out-of-date software and programming hardware. Please review the application notes on Actel's website for details on ISP:
<http://www.actel.com/techdocs/appnotes/products.html>

<http://www.actel.com/techdocs/appnotes/products.html>

For all failures:

- Record the EXACT error message
- Record the operation being executed when error occurs
- Compare your error message to those listed in this table, and try to resolve the problem based on the suggestions given

If failures continue, proceed to the next step.



2. Check the Programming Setup

- Record the version of the Silicon Sculptor software being used, then upgrade to the latest version:
<http://www.actel.com/custsup/updates/silisculpt>
- Perform the self-diagnostic
- Record the exact part number of the programming module(s) being used, then upgrade to the latest version:
<http://www.actel.com/products/tools/silisculpt/modules.html>

If failures continue, proceed to the next step.



4. Record Device Details

Record the following for all failures and programmed devices:

- Date code (4 digit number on top of device)
- Lot code (alphanumeric usually on underside of device)
- Number failed and number passed programming from each lot



5. Contact Actel Support

Contact Actel Support with the Results of the Above Diagnostics Including:

- Specific Error Messages Obtained
- The .log File
- Software Versions Used

- Adapter Module Part Number
- Failure Rates for Each Lot
- The Programming File(s) Being Used

Email: tech@actel.com
Phone: 800.262.1060

Hours: 7:30 AM – 6:00PM (US Pacific Standard Time)
Monday - Friday

Antifuse Devices (except-F devices)

Sample Size	Number Failures Allowed
2 - 9	2
10 - 16	3
17 - 24	4
25 - 33	5
34 - 43	6
44 - 53	7
54 - 64	8
65 - 75	9
76 - 87	10
88 - 99	11

Antifuse Devices (-F devices)

Sample Size	Number Failures Allowed
4 - 8	4
9 - 11	5
12 - 15	6
16 - 18	7
19 - 22	8
23 - 26	9
27 - 30	10
31 - 34	11
35 - 38	12
39 - 43	13
44 - 47	14
48 - 51	15
52 - 56	16
57 - 60	17
61 - 65	18
66 - 70	19
71 - 74	20
75 - 79	21
80 - 84	22
85 - 89	23
90 - 93	24
94 - 99	25

Common Programming Failure Modes

Note (RH/RT only): Before programming any additional RH/RT devices, first complete steps 1 and 2 of the previous page.

Error	Probable Cause	Resolution
Invalid Electronic Signature in Chip (Device ID)	The chip may be damaged.	Try to program another device.
	The chip is not in the proper position in the programmer site.	Reseat the device to ensure that it is oriented correctly in the socket and is making good contact with the socket.
	The socket is dirty and not making a connection.	Clean the socket and make sure that it is making good contact with the device.
Device is Not Blank	The device was previously programmed and cannot be erased.	The Device/Blank command was executed or the "Blank check before programming" option was enabled in the Device/Options dialog box, and the device in the programmer site is determined to have programmed data.
	The wrong algorithm was used.	Make sure that the device and package selected in the software exactly matches the device being programmed.
Incorrect Checksum	Previous programming done on device with different programming file.	Make sure the AFM file used to perform the Actel_Checksum command is the AFM file used to program the device.
	The checksum fuses were not programmed correctly.	The programmer has reported that the checksum antifuses could not be programmed. Record the actual and reported checksum values, and continue following the guidelines for handling programming failures.
Failed to Program Fuse XXX Pulse YYY	There is a problem programming this particular antifuse.	The programmer has reported that this antifuse cannot be programmed. Record the fuse and pulse numbers, and continue following the guidelines for handling programming failures.
	AFM programming file corruption.	It may be due to improper file transfer (always zip the programming file before transferring).
Failed Current Sense	The standby current has increased significantly after programming.	The programmer has reported that the device cannot be reliably programmed. Record the error message, and continue following the guidelines for handling programming failures.
Failed Fuse XXX, Integrity Test YYY	The programmer has reported that this device cannot be correctly programmed.	XXX indicates the fuse number failed. YYY indicates the test number. Record the fuse and integrity test numbers, and continue following the guidelines for handling programming failures.
Excessive Current Detected. The Protection Circuit Has Shut Off the Power	The command was aborted to protect the programmer and the device. The device was taking too much current from the programmer.	Reseat the device to ensure that it is oriented correctly in the socket and is making good contact with the socket.
	The wrong algorithm could be selected and improper voltages were applied to the chip in the programmer site.	Select the correct device and package in the Silicon Sculptor software, and make sure you are using the latest version of the programming software.
	There could be a short in the programming adapter.	Perform the self-diagnostic with the module on the programmer, and try another module if available.
	The device is damaged.	Remove the chip and run the self-diagnostic to make sure all the pin drivers are functioning correctly. If the hardware passes the test, be sure you have the correct algorithm (device entry) selected for your device. If the error still occurs and you are sure the device is inserted correctly, then the problem may be a faulty device.
Error in Programming Algorithm	The software has detected an internal error.	Download the latest Silicon Sculptor software and try again.
There is No Data in the Buffer. You Must Load a File	A command tried to read data from the buffer to program or verify a chip, but nothing has been loaded into the buffer yet or the buffer was recently cleared.	Open the programming file you wish to use in the SiliconSculptor software.
	AFM programming file corruption.	It may be due to improper file transfer (always zip the programming file before transferring)

Common Programming Failure Modes (continued)

Error	Probable Cause	Resolution
There is No Chip in the Programmer Site	A defective chip may cause this error.	Try programming another device.
	The chip may not be inserted correctly.	Reseat the device to ensure that it is oriented correctly in the socket and is making good contact with the socket.
	Programming hardware or module may be faulty.	Remove the device and run the hardware self-diagnostic with and without the adapter module.
Sorry, Algorithm Not Found. Please Call Technical Support	The .EXE file you are executing has been corrupted.	Download the latest version of the programming software. If error persists, Actel will have to examine this on a case by case basis. Please contact Actel technical support.
You Must Properly Install the Correct Socket Module	There is no socket module installed.	Install the correct adapter module.
	The adapter module installed does not support the device you have selected (e.g. you have selected a 100 pin device and you have a 208 pin PQFP socket module attached).	Check the Actel website for the correct part number to use with your device and package. Make sure that you are using the latest revision (i.e. "-1" or "-2" as listed on the website).
	The socket module installed is not supported by the version of the software you are using.	Make sure you are using the latest version of the Silicon Sculptor programming software.
Device Already Secured	The device cannot be legitimately programmed because it has been secured.	The only function that can be performed on a secured device is the checksum command (this does not work for all families). There is nothing else that you can do with a secured device. For Flash FPGAs, you must have the security code to reprogram the device.
Hardware Requires Calibration. Please Call Technical Support	The self-diagnostic (Alt-D) has detected that the hardware is improperly calibrated.	The unit may need to be returned for repair
Self-Diagnostic Failed. This Unit May Need Service. Please Call Technical Support	The self-diagnostic (Alt-D) has detected a hardware problem.	The unit may need to be returned for repair

For all technical inquiries regarding programming, please contact Actel technical support:

Email: tech@actel.com Phone: **800.262.1060** Hours: **7:30AM - 6:00PM** Days: **Monday - Friday**
(US Pacific Standard Time)

For more information about **Actel's Silicon Sculptor Programming System**, please go to <http://www.actel.com/contact/offices/index.html> to locate your local **Actel** sales representative.



www.actel.com

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