



Goddard Space Flight Center

GSFC NASA ADVISORY

1. Advisory Number
NA-GSFC-2003-02

2. Subject
Application Note on Grounding the MODE Pin in Actel Field Programmable Gate Arrays.

3. Manufacturer
Actel Corporation
955 E. Arques Ave.
Sunnyvale, CA 94086-4521

4. Manufacturer CAGE Code
0J4Z0

5. Federal Stock Code
N/A

6. Generic Part Number
1020, 1280, 1425, 1460, 14100
A, RT, and RH series.

7. Lot Date Code/Batch Code/Serial
All lot date codes.

8. Controlling Spec/Document Number
Various.

9. References
N/A

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11. Problem Description and Details:

On the GOES SXI project, there was an unterminated MODE pin on one of the Actel RH1280 Field Programmable Gate Arrays (FPGAs). Although there have not been any recorded anomalies on the GOES SXI project, the FPGA long-term reliability may be impacted without the MODE pin grounded due to various possible failure scenarios. In addition, there was a similar previous occurrence on EOS AQUA, where the MODE pin was unterminated which resulted in the replacement of all the Actel FPGAs on the spacecraft.

If your hardware uses Actel FPGAs, please see the continuation section on page 2.
(Continued in section 11 on page 2)

12. Action Taken:

As a preventive measure, this NASA Advisory is being issued to alert all NASA flight projects/programs that all FPGA designers should be aware that grounding the MODE pin on Actel FPGAs is a necessity for ensuring reliable device operation. If a project has boards that have FPGAs with an unterminated MODE pin, the following actions should be implemented:

- 1) Case 1: FPGAs on boards that have been powered up: Replace the FPGA (s), and other components as needed, and rework the board to assure that the FPGA MODE pin is grounded on all Actel FPGAs.
- 2) Case 2: FPGAs on boards that have not been powered up: Rework the board to assure that the FPGA MODE pin is grounded on all Actel FPGAs.

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14. Date Prepared
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16. Released by: (Signature)
Original Signed by
GSFC NASA Advisory Coordinator

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17. Date Released
February 3, 2003

1. Advisory Number
NA-GSFC-2003-02

2. Subject
Application Note on Grounding the MODE Pin in Actel Field Programmable Gate Arrays

11. Problem Description and Details: *(Continued from page 1)*

The recommendation to ground the MODE pin is addressed in the "Termination of the V_{pp} and MODE Pin for RH1020 and RH1280 Devices in a Radiation Environment", which is located at the following Actel web site:
http://www.actel.com/appnotes/RH1020_1280.pdf

This application note is valid for 1020, 1280, 1425, 1460, 14100, A, RT, and RH series devices. The following excerpts of the MODE Pin and Conclusion sections are reproduced by permission of the Actel Corporation.

MODE Pin

The MODE pin is used to control both the state of the device (e.g., normal, programming, debug, outputs disabled, various test modes, etc.) and the operation with regular logic levels. The device can be put into various modes; when the MODE pin is in the logic one state, commands can be shifted into the internal registers via DCLK (Data Clock) and SDI (Serial Data In) and through proper sequencing. When the MODE pin is in the logic zero state, all of the mode registers and control path flip-flops are directly held in the inactive state, guaranteeing that the device is in normal operating mode. Note that there is no guarantee as to the states of these "configuration" registers at power-up.

The effects of a floating MODE pin are difficult to predict because almost anything can happen. For example, one state that the device might go into is to support board level test. In this mode, all of the device outputs are tristated. Other examples of possible modes include programming mode and various device test modes. Incorrect configuration can result in functional failures and or high currents which may either damage or pose a serious reliability hazard to the hardware. The effects for damage to the device and the board must be assessed on a specific basis.

Testing has shown that when the MODE pin was tied high, it was quite easy to "latch-up" the device with heavy ions. The devices repeatedly drew excessive amounts of current. The probability of having a problem with an unterminated MODE pin is quite high.

The recommendation for the MODE pin is to terminate it to GND with a hard jumper in parallel with a 10k ohm resistor. The hard jumper protects against resistor failure. During the prototyping and debug stage the hard jumper can be removed and the Silicon Explorer probing capability capacity can be utilized. The termination of the MODE pin for each Actel device on the flight board should be verified with an ohmmeter. Programming the security/probe fuse does not eliminate the need to terminate the MODE pin.

Conclusion

The above summary and discussion shows the effects of unterminated MODE pin for Actel 1020, 1280, 1425, 1460, 14100, A, RT, and RH series devices relative to spaceflight use. It is trivial to show that the MODE pin must be grounded and this must be done and verified.

Actel will not guarantee the long-term reliability of devices that were not always in a legal operating configuration. No credible analysis has been performed that would guarantee reliable operation of parts that were not always in a legal operating configuration.

12. Action Taken: *See section 12 on page 1.*