Programming ProASIC PLUS Devices in a Mixed Chain

Introduction

The ProASIC PLUS family of devices, Actel's second generation Flash FPGA, offers enhanced performance over Actel's ProASIC family of devices. ProASIC PLUS devices combine the advantages of ASICs with the benefits of programmable devices through nonvolatile Flash technology. This combination enables engineers to create high-density systems using existing ASIC or FPGA design flow and tools.

This application note describes the steps to program a ProASIC PLUS device in a mixed chain using a STAPL player or Actel's FlashPro programmer. A mixed chain of devices refers to a chain of devices from various vendors connected together serially through the JTAG port (Figure 1). TD0 of the programming header represents the beginning of the chain. The ProASIC PLUS device supports daisy chain programming through the IEEE 1149.1 (JTAG) port

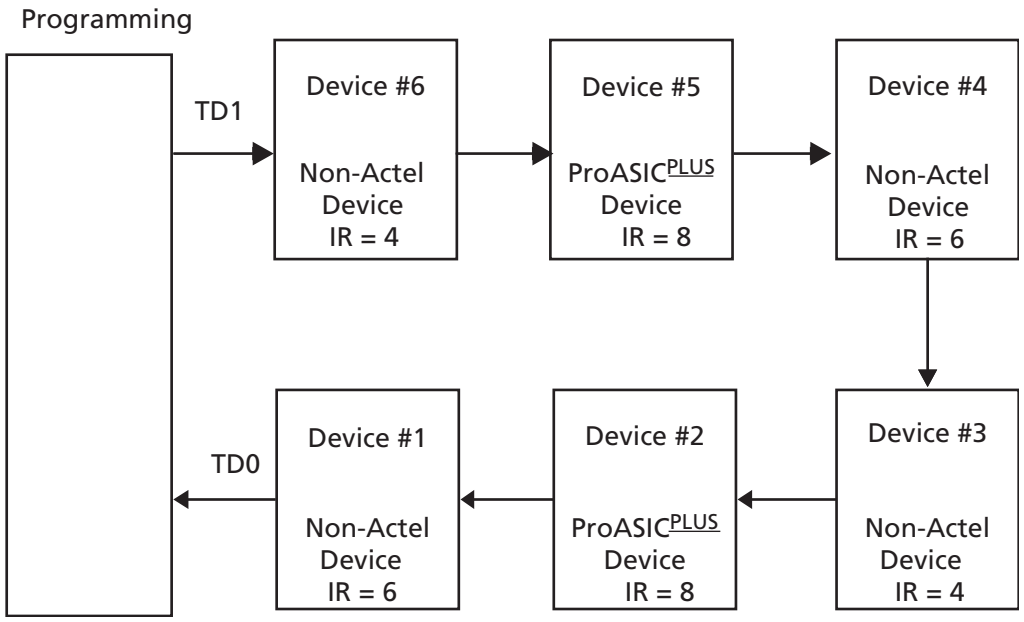

Figure 1 • **Programming a Mixed Chain of Devices**

Overview

To program a device within a chain of devices, first put the other devices in the chain into bypass mode. Once a device is in bypass mode, its data register length becomes one and will not react to any programming instructions given by the programmer. To put a device into bypass mode, the programmer must know its instruction register length.

When using a standard STAPL player, the STAPL file generated from Actel's Designer software, must be edited to include the bypass information. When using Actel's FlashPro programmer, a device data text file in the FlashPro software must be edited to include the bypass information. Table 1 on page 2 shows product support, and Figure 2 on page 2 shows the programming flow for the standard STAPL Player and FlashPro.

All the necessary information for editing the STAPL file or FlashPro data file is located in the BSDL file (Figure 3 on page 3). The instruction length is shown under the INSTRUCTION_LENGTH attribute and the device ID is shown under the IDCODE_REGISTER attribute.

Table 1 • **Product Support Information**

Programming Platform	Daisy Chain Support through Edited STAPL File	Daisy Chain Support through Device.db File
FlashPro	No	Yes
FlashPro Lite	No	Yes
STAPL/JAM Player	Yes	No
Sculptor II (using STAPL)	Yes	No
Sculptor I and II (using Bitstream)	No	No

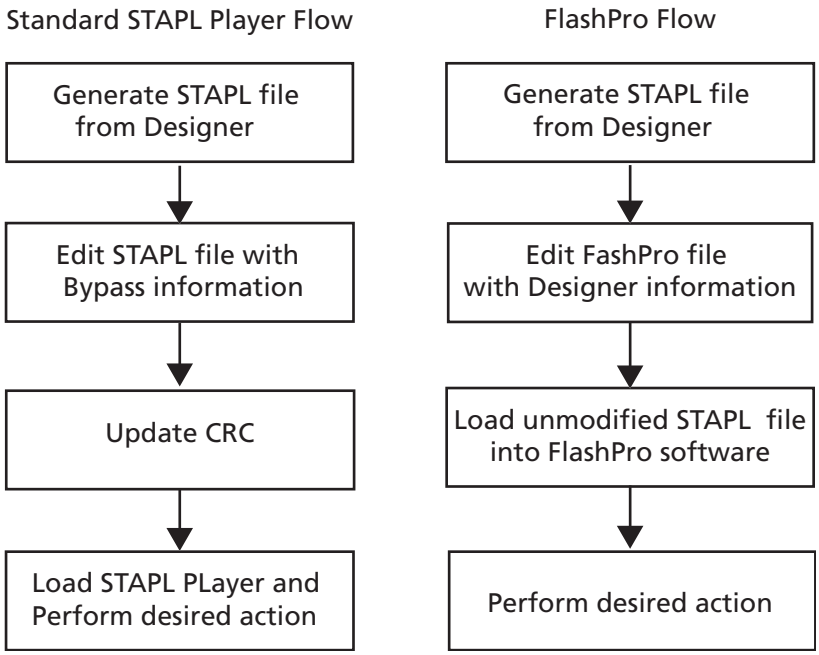

Figure 2 • **STAPL Player and FlashPro Programming Flow**

Editing a STAPL File

In the INITIALIZE procedure, add the following instructions to the STAPL file so it can bypass the other devices in the chain.

PREIR – the sum of the instruction register lengths of all the devices in front of the target device.

POSTIR – the sum of the instruction register lengths of all the devices after the target device.

PREDR – the number of devices in front of the target device.

POSTDR – the number of devices after the target device.

The PREIR and POSTIR instructions give the programmer the information to put all other devices within the chain into bypass mode. The PREDR and POSTDR instructions will give the programmer the proper number of bits to add to the data that is being shifted into the chain. After the devices enter bypass mode, the Data Register becomes one bit wide.

CRC Check

After the STAPL file is edited, the CRC of the file changes. Any STAPL compliant player will reject the edited STAPL file, citing a CRC error. There are two methods to resolve this issue. One method is to set the CRC value of the edited STAPL file to "0000." This action disables the CRC check of the STAPL player (per the STAPL spec). The other method is to load the edited STAPL file into Actel's FlashPro player (v3.1 or newer). The FlashPro player will return a CRC error, but will also recalculate the CRC value and display a new CRC value. Replace the CRC value in the STAPL file with the new recalculated CRC value.

```
attribute INSTRUCTION_LENGTH of A500K050BG272    :   entity is 8;

attribute INSTRUCTION_OPCODE of A500K050BG272   :   entity is
       "BYPASS       (11111111), "    &
       "IDCODE      (00001111),"     &
       "EXTEST       (00000000),"     &
       "SAMPLE      (00000001)";

attribute INSTRUCTION_CAPTURE of A500K050BG272  :  entity is "XXXXXX01" ;


attribute IDCODE_REGISTER of A500K050BG272     :   entity is
       "XXXX00000001101001110001111001111"
```

IR Length

Device ID

Figure 3 • **BSDL File for an Actel ProASIC Device**

STAPL File Example

The following shows a STAPL file example of a mixed chain of devices that are connected together (Figure 1 on page 1) for programming Device #5 (APA device). Table 2 shows the the values for PREIR, POSTIR, PREDR, and ROSTDR using the variable instructions to calculate the values.

The values from Table 2 are then added to the STAPL file (Figure 4). After the STAPL file has been edited with the correct values, load it into the FlashPro software to determine the new CRC value (Figure 5). Then edit the STAPL file with the new CRC value (Figure 7 on page 6).

Table 2 • **STAPL File Example Values**

Variable	Value	Formula
PREIR	24	Σ IR(Dev1, Dev2, Dev3, Dev4)
POSTIR	4	Σ IR(Dev6)
PREDR	4	Total of four devices in front of device 5
POSTDR	1	Single device after device 5

```
PROCEDURE INITIALIZE USES GV, PARAMETERS, GP, POWER_DOWN;
PREIR   24 ;
POSTIR   4 ;
PREDR    4 ;
POSTDR  1;
IF  !USE_RCK THEN FREQUENCY  freq*1000000 ;
WAIT RESET,  5  CYCLES;
IRSCAN  8, $0f;
DRSCAN 32, $000000FF, COMPARE  $014101cf, $0BFFFFFF, PASS;
IF PASS==1  THEN GOTO  idok;
STATUS=6;
CALL POWER_DOWN;
idok:
IRSCAN  8, $09
IRSCAN  8, $0a
IRSCAN  8, $92;
IF USE_RCK THEN DRSCAN  8, B00L (freq-1);
IF !USE_RCK THEN DRSCAN 8, B00L (128+freq-1);
CALL GP;
IRSCAN  8, $d3;
IRSCAN  8, $d8;
IRSCAN  8, $e5;
IRSCAN  8,$c8;
DRSCAN  I, #0, CAPTURE  PS{};
ENDPROC;
```

Note: *The PREIR value is 24; the POSTIR and PREDIR values are four, and the POSTDR value is one.*

Figure 4 • **New Values Added to the STAPL File**

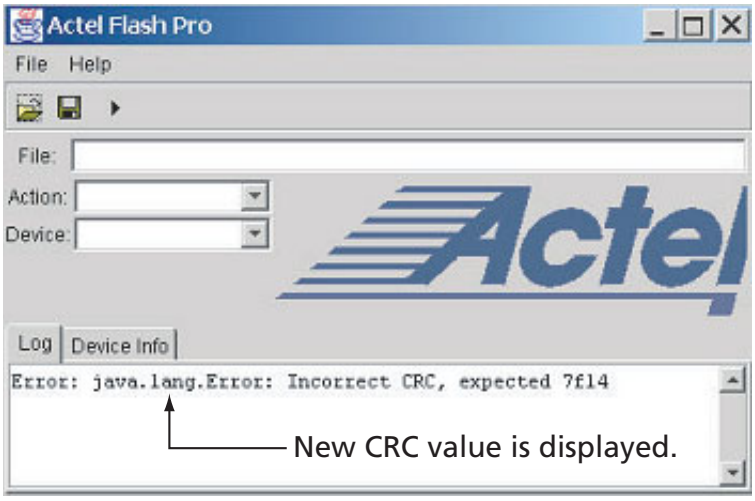

Figure 5 • **CRC Value from the FlashPro Software**

Once the STAPL file is edited, it can be used on most STAPL players except FlashPro.

Using the FlashPro Software

Because of the Analyze Chain feature in the FlashPro software, an edited STAPL file cannot be used with the FlashPro software to program a ProASIC PLUS device within a mixed chain. The FlashPro software has its own database file (Device.db) that contains all the information to bypass a non Actel device. Any new non Actel device that a user requires support for must have the necessary information entered into this Device.db file.

The Device.db file contains the following information for each device: device ID, device name, and instruction register length (Figure 8 on page 9).

```
PROCEDURE POWER_DOWN USES GV;
IRSCAN 8 $0b
WAIT 5 USEC;
STATE RESET;
EXIT STATUS;
ENDPROC;


CRC 7f14;
```

Change CRC to a new value (last line of the STAPL file).

Figure 6 • **Edited STAPL File with New CRC Value**

```
<BANK  NUMBER = "1">
            <ENTRY  ID="47"  COMPANY= "ACTEL ">
                  <DEVICE  PART= "20BD"  NAME = "SX32P"  IR = "5"  />

                  <DEVICE  PART= "22BD"  NAME = "SX32P"  IR = "5"  />
                  <DEVICE  PART= "40B2"  NAME = "SX72A"  IR = "5"  />
                  <DEVICE  PART= "40B4"  NAME = "SX08A"  IR = "5"  />
                  <DEVICE  PART= "40B8"  NAME = "SX16A"  IR = "5"  />
                  <DEVICE  PART= "40BD"  NAME = "SX32A"  IR = "5"  />

      </ENTRY>
      <ENTRY  ID = "73"  COMPANY= "Xilinx"   />
            <ENTRY  ID= "110"  COMPANY= "ALTERA"  />

</BANK>

<BANK  NUMBER = "2">
            <ENTRY  ID = "103"  COMPANY= "ACTEL"  >
                  <DEVICE  PART = "01A7"  NAME = "A500K050"  IR = "8"  />
            <DEVICE PART = "02CA"  NAME= "A500K130"  IR= "8"  />


            <DEVICE PART = "034C"  NAME= "A500K180"  IR= "8"  />
            <DEVICE PART = "03CF"  NAME= "A500K270"  IR= "8"  />
            <DEVICE PART = "0C10"  NAME= "A61PA750"  IR= "8"  />
            <DEVICE PART = "19C4"  NAME= "APA075"  IR= "8"  />
            <DEVICE PART = "1A46"  NAME= "APA150"  IR= "8"  />
            <DEVICE PART = "1A08"  NAME= "APA300"  IR= "8"  />
            <DEVICE PART = "1B08"  NAME= "APA450"  IR= "8"  />
            <DEVICE PART = "138C"  NAME= "APA600"  IR= "8"  />
            <DEVICE PART = "1410"  NAME= "APA750"  IR= "8"  />
            <DEVICE PART = "1594"  NAME= "APA1000"  IR= "8"  />
             </ENTRY>
</BANK>

<BANK NUMBER ="3">
</BANK>
```

Figure 7 • **Device.db. File Example**

Device.db File Description

The Device.db file includes the device ID, device name, and the instruction register length.

Device ID

A device ID is 32 bits wide and divided into four sections:

LSB (Bit 0) – The first bit in the Device ID is always a one.

Manufacturing ID (Bits 1-7) – The manufacturing ID is assigned by the JEDEC office. Within the device.db file, the manufacturing ID is referred to as the Entry ID and it is represented in decimal form.

Bank Value (Bits 8-11) – The bank value allows multiple vendors to have the same value assigned to the manufacturing ID. Bits 0000 represent bank one.

Part Number (Bits 12-27) – The part number is assigned by the manufacturer. The part number is represented in Hex.

Version Number (Bits 28-31) – The version number is assigned by the manufacturer

A complete listing of all bank value and manufacturing IDs can be found at:

http://www.jedec.org/download/search/jep106L.pdf

Device Name

The device name is the name that will appear after the FlashPro completes the Analyze Chain function.

Instruction Register Length

The instruction register length is the length of the instruction register for a particular device.

When the FlashPro programmer performs the analyze chain function, it will compare the device IDs read back from the chain to those stored in the device.db file to obtain the device's instruction register length.

FlashPro Software Example

Below is a FlashPro software example using the chain in Figure 1 on page 1 with more information assigned to each device:

Device #6 is a Cisco device with the following:

- ID code: 0000,0010001010110001,0011,0001010,1
- Bank number: 3
- Part number: 22B1
- Entry ID (manufacturing ID): 10
- Device Name: Router_IC
- Device #4 is a TI device with the following information:
- ID code of: 0000,0011001010110101,0000,0010111,1
- Bank number: 1
- Part number: 32B5
- Entry ID (manufacturing ID): 23
- Device Name: DSP_IC
- Device #3 is an Atmel device with the following information:
- ID code of: 0000,1010011010101101,0000,0011111,1
- Bank number: 1
- Part number: A6AD
- Entry ID (manufacturing ID): 31
- Device Name: EPROM

Device #1 is a Xilinx device with the following information:

- ID code of: 0000,0110010010100101,0000,10010001,1
- Bank number: 1
- Part number: 64A5
- Entry ID (manufacturing ID): 73
- Device Name: Spartan

A description of the ID code is represented in the "Device ID" on page 7 section, and the ID code of Device #6 is shown in Table 3.

Table 3 • **ID Code Description**

Bit(s)	Description
0000	Version number
0010001010110001	Part number
0011	Bank value
0001010	Manufacturing ID
1	Always one

The Bank number, part number, and Entry ID are calculated using the descriptions from Table 2 on page 3.

Then, open the device.db file using any text editor. Enter the information of the four non Actel devices into the file (Figure 8 on page 9).

```
<BANK  NUMBER = "1">
        <ENTRY  ID="47"  COMPANY= "ACTEL ">
              <DEVICE  PART= "20BD"  NAME = "SX32P"  IR = "5"  />

              <DEVICE  PART= "22BD"  NAME = "SX32P"  IR = "5"  />
              <DEVICE  PART= "40B2"  NAME = "SX72A"  IR = "5"  />
              <DEVICE  PART= "40B4"  NAME = "SX08A"  IR = "5"  />
              <DEVICE  PART= "40B8"  NAME = "SX16A"  IR = "5"  />
              <DEVICE  PART= "40BD"  NAME = "SX32A"  IR = "5"  />

          </ENTRY>
      <ENTRY  ID = "73"  COMPANY= "Xilinx"   />
Device # 1 ──▶ <DEVICE  PART = "65A5" NAME = Spartan"  ir= "6"  />

        </ENTRY>
        <ENTRY  ID = "110"  COMPANY= "ALTERA"   />
        <ENTRY  ID= "23"  COMPANY= "TI"  />
Device # 4 ──▶  <DEVICE  PART= "32B5"  NAME ="DSP_IC"  IR=" 6 "  />
        </ENTRY>
        <ENTRY  ID= "31"  COMPANY "ATMEL"  />
Device # 3 ──▶  <DEVICE  PART= "A6AD"  NAME ="EPROM"  IR ="4"  />
        </ENTRY


</BANK>

 <BANK  NUMBER = "2">
        <ENTRY  ID = "103"  COMPANY= "ACTEL"  >
              <DEVICE  PART = "01A7"  NAME = "A500K050"  IR = "8"  />
        <DEVICE PART = "02CA"  NAME= "A500K130"  IR= "8"  />

        <DEVICE PART = "034C"  NAME= "A500K180"  IR= "8"  />
        <DEVICE PART = "03CF"  NAME= "A500K270"  IR= "8"  />
        <DEVICE PART = "0C10"  NAME= "A61PA750"  IR= "8"  />
        <DEVICE PART = "19C4"  NAME= "APA075"  IR= "8"  />
        <DEVICE PART = "1A46"  NAME= "APA150"  IR= "8"  />
        <DEVICE PART = "1A08"  NAME= "APA300"  IR= "8"  />
        <DEVICE PART = "1B08"  NAME= "APA450"  IR= "8"  />
        <DEVICE PART = "138C"  NAME= "APA600"  IR= "8"  />
        <DEVICE PART = "1410"  NAME= "APA750"  IR= "8"  />
        <DEVICE PART = "1594"  NAME= "APA1000"  IR= "8"  />
    </ENTRY>

</BANK>

<BANK NUMBER ="3">

Device # 6 ──▶ <ENTRY  ID= "10"  COMPANY= Cisco"  >
              <DEVICE  PART= "22b1"  NAME= "ROUTER_IC"  IR="4"  />
          </ENTRY>

</BANK>

<BANK  NUMBER = "4>
</BANK>
```

Figure 8 • **Programming Mixed Chain Device Example**

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