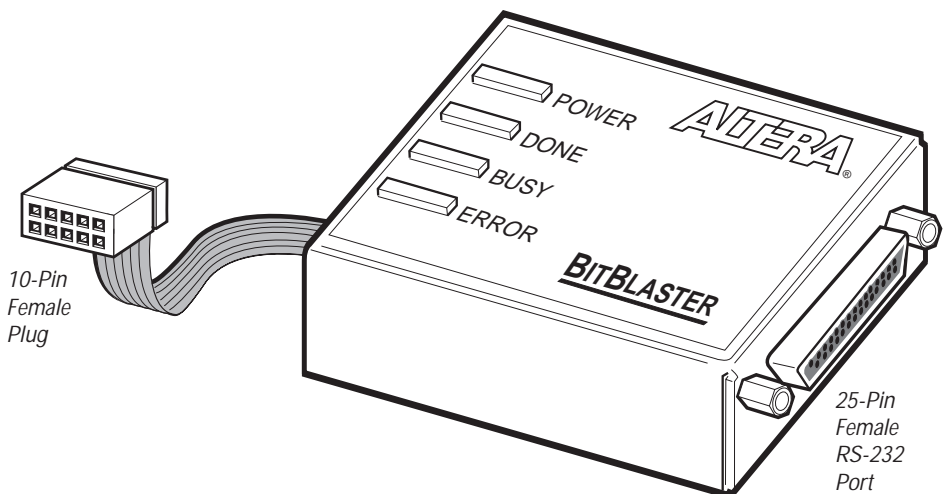# BitBlaster
Serial Download Cable

Features

- Allows PC and UNIX workstation users to perform the following functions:
  - Program MAX® 9000, MAX 7000S, and MAX 7000A devices in-system via a standard RS-232 serial port
  - Configure FLEX® 10K, FLEX 8000, and FLEX 6000 devices in-circuit via a standard RS-232 serial port
- Downloads data from:
  - MAX+PLUS® II development software on PCs and UNIX workstations
  - A system prompt on PCs and UNIX workstations
- Provides two data download modes: passive serial (PS) and JTAG
- Programs/configures a single device or multiple devices in a chain
- Supports data transfer rates from 9,600 to 230,400 baud

Functional Description

The BitBlaster™ serial download cable (ordering code: PL-BITBLASTER) is a hardware interface to a standard RS-232 port (called a "COM port" on PCs and either a "ttya port" or "ttyb port" on UNIX workstations). This cable channels configuration data to FLEX 10K, FLEX 8000, and FLEX 6000 devices, as well as programming data to MAX 9000, MAX 7000S, and MAX 7000A devices. Because design changes are downloaded directly to the device, prototyping is easy, and multiple design iterations can be accomplished in quick succession. See Figure 1.

Figure 1. BitBlaster Serial Download Cable

10-Pin Female Plug

POWER
DONE
BUSY
ERROR

BITBLASTER

25-Pin Female RS-232 Port

Data Download Modes

The BitBlaster cable provides two data download modes:

■ Passive serial (PS) mode—Used for configuring FLEX 10K, FLEX 8000, and FLEX 6000 devices
■ JTAG mode—Industry-standard JTAG boundary-scan test (BST) circuitry (compliant with IEEE Std. 1149.1-1990) implemented for programming or configuring FLEX 10K, MAX 9000, MAX 7000S, and MAX 7000A devices

BitBlaster Connections

Data is downloaded from the computer's RS-232 port through the BitBlaster cable to the circuit board via the connections described in this section.

☞ To configure/program 3.3-V devices (e.g., FLEX 10KA and MAX 7000A devices) using the BitBlaster cable, connect the cable's VCC pin to a 5.0-V power supply and the device to a 3.3-V power supply. FLEX 10KA and MAX 7000A devices have 5.0-V tolerant inputs, so the BitBlaster cable's 5.0-V output will not harm these 3.0-V devices. The pull-up resistors should be connected to the 5.0-V power supply.

BitBlaster Female Port & Plug Connections

The 25-pin female port connects to an RS-232 port with a standard serial cable. See Table 1.

Table 1. BitBlaster 25-Pin Serial Port Pin-Outs

Pin	Signal Name	Description
2	tx	Transmit data
3	rx	Receive data
4	rts	Request to send
5	cts	Clear to send
6	dsr	Data set ready
7	GND	Signal ground
20	dtr	Data terminal ready

The 10-pin female plug connects to a 10-pin male header on the circuit board containing the target device(s). Figure 2 shows the dimensions for the 10-pin female plug.

Figure 2. BitBlaster 10-Pin Female Plug Dimensions

Dimensions are shown in inches. The spacing between pin centers is 0.1 inch.
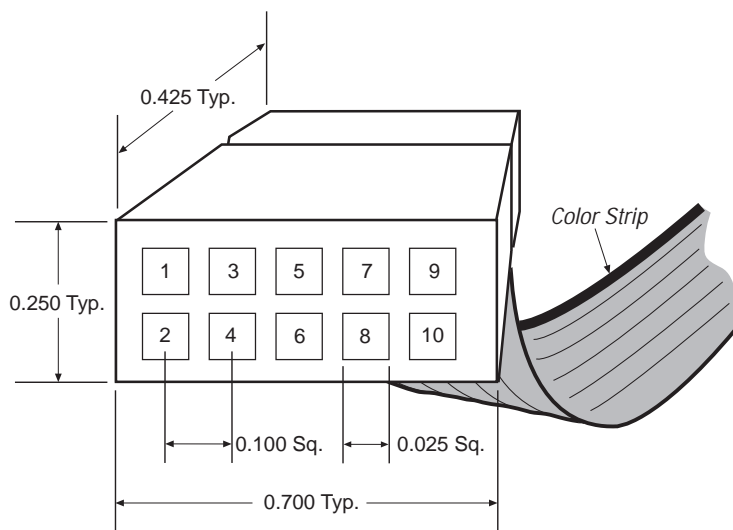
Table 2 identifies the 10-pin female plug's pin names for the corresponding download mode.

Table 2. BitBlaster Female Plug's Pin Names & Download Modes

Pin	JTAG Mode		PS Mode	
	Signal Name	Description	Signal Name	Description
1	TCK	Clock signal	DCLK	Clock signal
2	GND	Ground	GND	Ground
3	TDO	Data from device	CONF_DONE	Configuration done
4	VCC	Power supply	VCC	Power supply
5	TMS	JTAG state machine control	nCONFIG	Configuration control
6	NC	No connect	NC	No connect
7	NC	No connect	nSTATUS	Configuration status
8	NC	No connect	NC	No connect
9	TDI	Data to device	DATA0	Data to device
10	GND	Ground	GND	Ground

Circuit Board Header Connection

The BitBlaster 10-pin female plug connects to a 10-pin male header on the circuit board. The 10-pin male header has two rows of five pins connecting the circuit board to the device's programming or configuration pins. The BitBlaster cable receives power and downloads data via the male header. Figure 3 shows the dimensions of a typical 10-pin male header.

Figure 3. 10-Pin Male Header Dimensions

Dimensions are shown in inches.
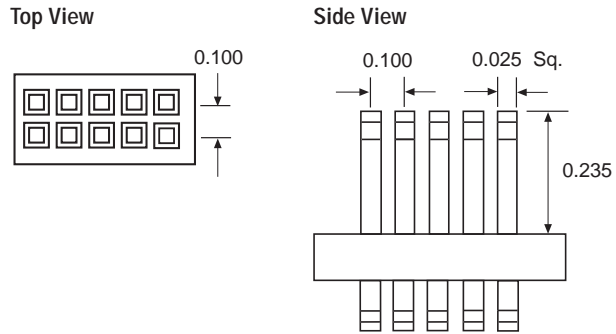
☞ The circuit board must supply V_{CC} and ground to the BitBlaster cable.
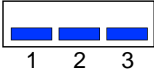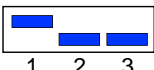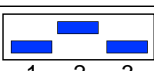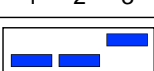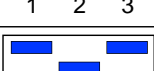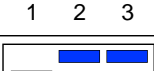
BitBlaster Status Lights

The BitBlaster status lights indicate the state of the device configuration or programming. See Table 3.

Table 3. BitBlaster Status Lights

Status Light	Description
POWER	Indicates a connection to the target system's power supply.
DONE	Indicates that device configuration or programming is complete.
BUSY	Indicates that device configuration or programming is in progress.
ERROR	Indicates error detection during configuration or programming.

Data Transfer Rate Control & Operating Conditions

Three dipswitches on the side panel of the BitBlaster cable control the baud rate of the serial data. Table 4 shows the on/off dipswitch settings, which can be used to specify transfer rates ranging from 9,600 to 230,400 baud. The configuration time for an EPF81188A device, which uses 193,000 bits of configuration data, is also provided for reference.

Table 4. Dipswitch Settings Note (1)		
Baud Rate (BPS)	**Dipswitch Positions**	**EPF81188A Configuration Time (Seconds)**
230,400	1 2 3	1.5
115,200	1 2 3	3.0
76,800	1 2 3	4.5
57,600	1 2 3	5.5
38,400	1 2 3	8.5
19,200	1 2 3	17.0
14,400	1 2 3	22.0
9,600	1 2 3	33.0

Note:
(1)   The supported baud rates vary depending on the computer system. Refer to the computer system's serial port hardware documentation to verify the available baud rates.

Search for "Hardware Setup command" in MAX+PLUS II Help for more information.

Operating Conditions

The following tables summarize the absolute maximum ratings, recommended operating conditions, and DC operating conditions for the BitBlaster cable.

BitBlaster Cable Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply voltage	With respect to ground	−2.0	7.0	V
V_I	DC input voltage	With respect to ground	−2.0	7.0	V

BitBlaster Cable Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply voltage 5.0-V operation		4.75	5.25	V

BitBlaster Cable DC Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{IH}	High-level input voltage		2.0	V_{CC} + 0.3	V
V_{IL}	Low-level input voltage		−0.3	0.8	V
V_{OH}	5.0-V high-level TTL output voltage	I_{OH} = −4 mA, V_{CC} = 4.75 V	2.4		V
V_{OL}	Low-level output voltage	I_{OL} = 4 mA DC		0.45	V
I_{CC}	Operating current			100	mA

Figure 4 shows the typical 5.0-V output drive characteristics of the BitBlaster cable.

Figure 4. BitBlaster Output Drive Characteristics
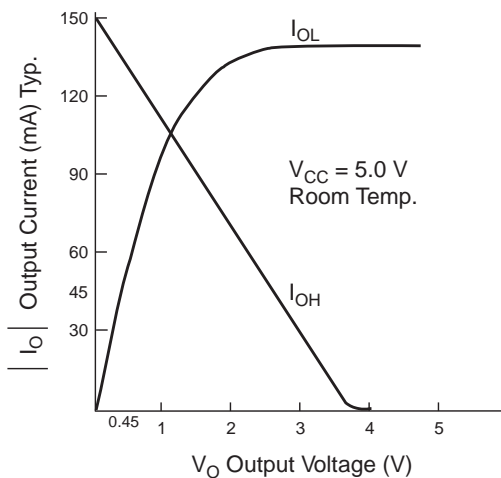
Passive Serial Mode

This section discusses PS configuration for single and multiple FLEX devices. In PS configuration the data is sent to the FLEX device serially by the data source; in this case, the data source is the BitBlaster. The data is synchronized to a clock that is supplied by the data source.

Passive Serial Configuration of a Single FLEX Device

Single FLEX 10K, FLEX 8000, or FLEX 6000 devices can be configured using the PS configuration scheme with one of the following methods:

■ The **Configure** button in the MAX+PLUS II Programmer. Devices are configured with an SRAM Object File (**.sof**), which is automatically generated during project compilation.
■ A command prompt from a PC or UNIX workstation. Devices are configured with a Serial Bitstream File (**.sbf**).

For more information, refer to "Software Instructions" on page 699 of this data sheet.

Figure 5 shows how the BitBlaster cable interfaces to a single FLEX 10K, FLEX 8000, or FLEX 6000 device. (If the DATA0 pin is used in the user mode, it must be isolated during configuration.)

Go to the following sources for additional information:

■ *Application Note 59 (Configuring FLEX 10K Devices)*
■ *Application Note 33 (Configuring FLEX 8000 Devices)*
■ *Application Note 38 (Configuring Multiple FLEX 8000 Devices)*
■ *Application Note 87 (Configuring FLEX 6000 Devices)*
■ Search for *"Configuring a Single Device with the BitBlaster, ByteBlaster, or FLEX Download Cable"* in MAX+PLUS II Help

Figure 5. Single FLEX 10K, FLEX 8000, or FLEX 6000 Device Configuration with the BitBlaster Cable
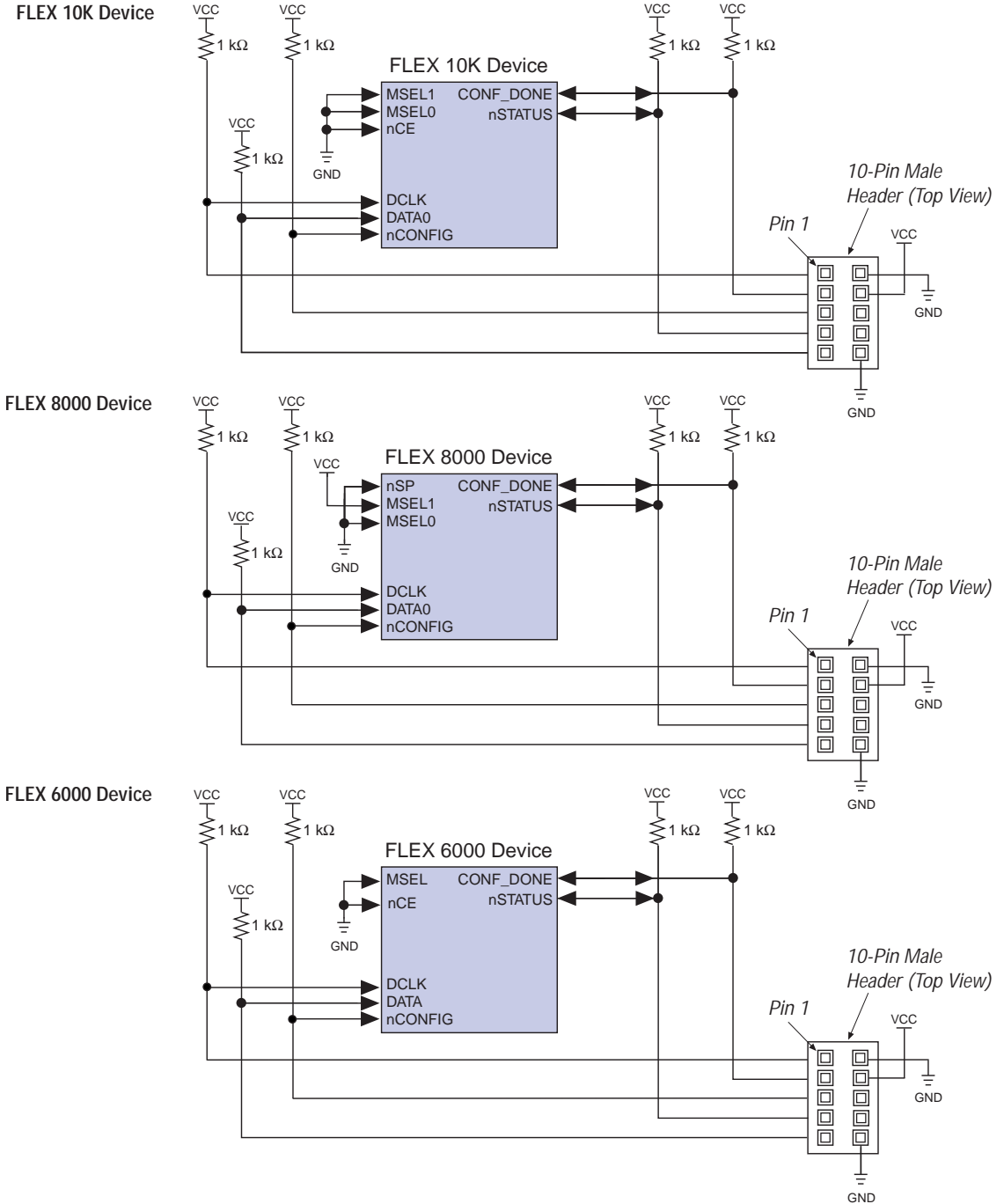
Passive Serial Configuration of Multiple FLEX Devices

Multiple FLEX devices in a FLEX chain (i.e., a series of devices through which configuration data is passed) can be configured with the BitBlaster cable in PS mode either directly from the MAX+PLUS II Programmer or from a PC or UNIX system prompt.

- In the Programmer, specify a sequence of SRAM Object Files (**.sof**) and then choose the **Configure** button.
- From a system prompt, use a Serial Bitstream File (**.sbf**).

Figures 6, 7, and 8 show the BitBlaster interface to FLEX devices using PS configuration. When driving more than four FLEX 10K devices, the DCLK, DATA0, and nCONFIG pins should be buffered with an on-board buffer.

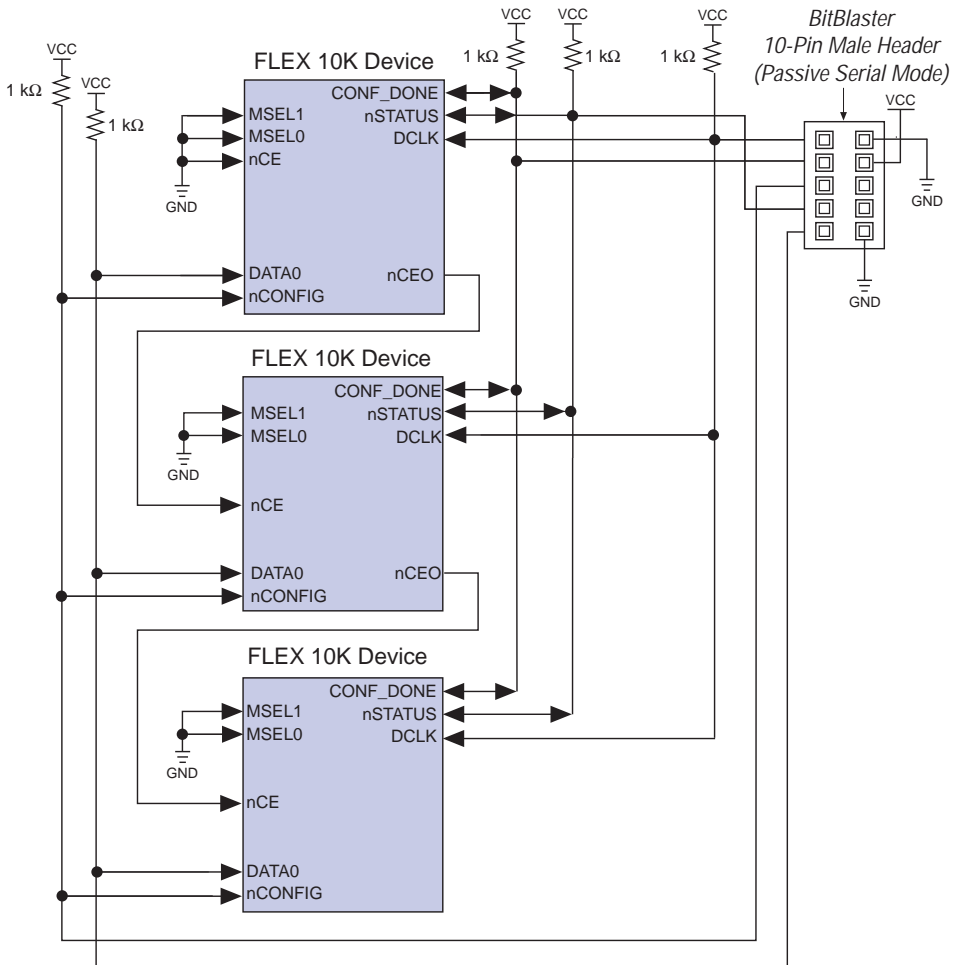*Figure 6. FLEX 10K Multi-Device Configuration with the BitBlaster Cable*

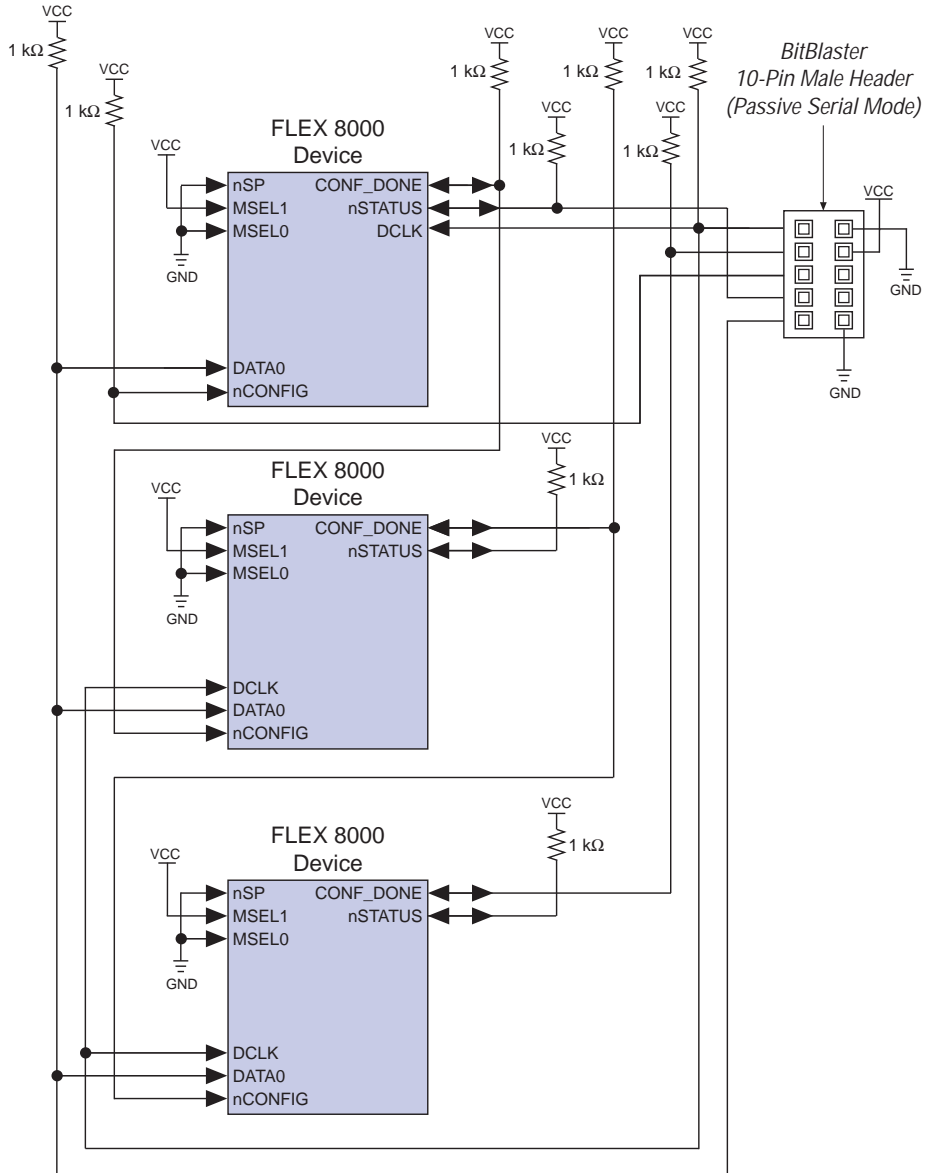*Figure 7. FLEX 8000 Multi-Device Configuration with the BitBlaster Cable*
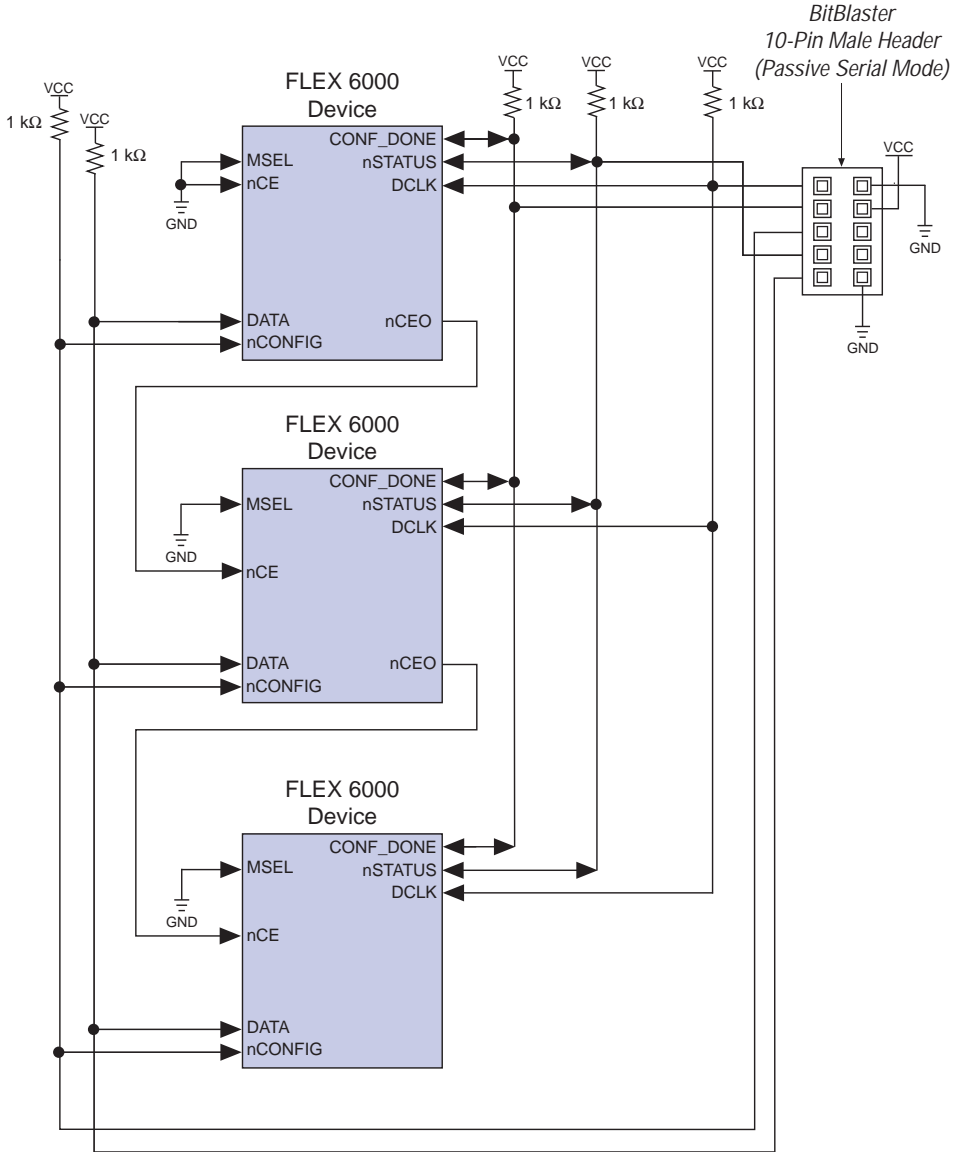
Figure 8. FLEX 6000 Multi-Device Configuration with the BitBlaster Cable

FLEX 10K and FLEX 6000 devices can also be configured in the same configuration chain. The nCEO pin of a FLEX 10K device can be connected to the nCE pin of a FLEX 6000 device and vice versa. The CONF_DONE and nSTATUS pins of all the devices in the configuration chain must be tied together.

Search for "Configuring Multiple FLEX Devices in a FLEX Chain with the BitBlaster, ByteBlaster, or FLEX Download Cable" in MAX+PLUS II Help for more information.

JTAG Mode

In JTAG mode, the BitBlaster cable connects to a device on the circuit board via any standard RS-232 port for in-system programming and in-circuit reconfiguration. This section discusses the following topics:
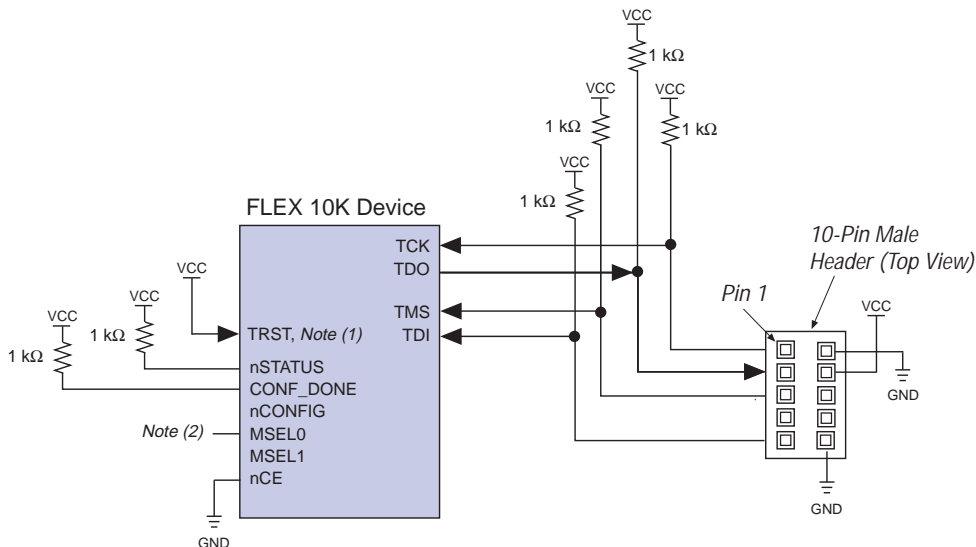
- JTAG configuration of a single FLEX 10K device
- JTAG programming of a single MAX 9000, MAX 7000S, or MAX 7000A device
- JTAG programming and configuration of multiple JTAG-capable devices

JTAG Configuration of a Single FLEX 10K Device

The SRAM Object File (**.sof**), which is created automatically during compilation, can be downloaded directly to a device via the BitBlaster cable. Refer to "Software Instructions" on page 699 for more information. Configuration is performed via the device JTAG pins: TCK, TMS, TDI, and TDO.

Figure 9 shows how the BitBlaster interfaces with a FLEX 10K device. All other I/O pins are tri-stated during this configuration. JTAG configuration should not begin until any other configuration (e.g., via EPC1 Configuration EPROM) has been completed.

Figure 9. JTAG Configuration of a Single FLEX 10K Device

Notes:
(1) FLEX 10K devices in 144-pin TQFP packages do not have a TRST pin. Therefore, the TRST pin can be ignored when using these devices.
(2) nCONFIG, MSEL0, and MSEL1 should be connected to support a FLEX configuration scheme. If only JTAG configuration is used, connect nCONFIG to V_{CC}, and MSEL0, MSEL1, and nCE to ground.
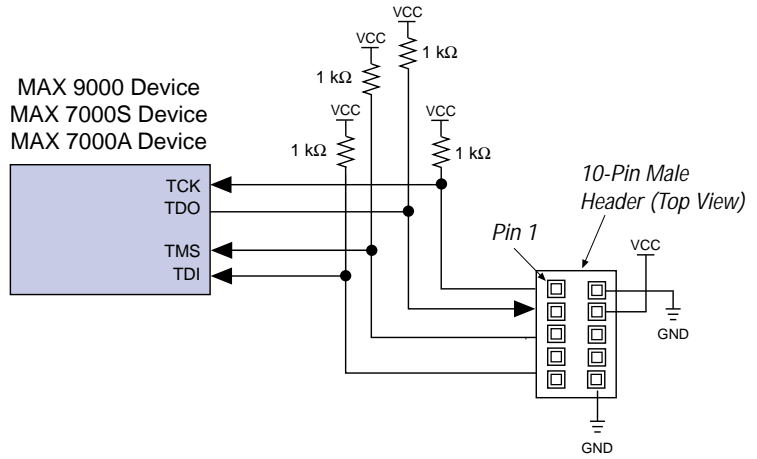
Search for "Configuring a Single Device with the BitBlaster, ByteBlaster, or FLEX Download Cable" in MAX+PLUS II Help for more information.

JTAG Programming of a Single MAX 9000, MAX 7000S, or MAX 7000A Device

A Programmer Object File (**.pof**), which is created automatically during compilation, can be programmed directly into the device via the BitBlaster cable. Refer to "Software Instructions" on page 699 in this data sheet for more information.

Devices are programmed via the device JTAG pins: TCK, TMS, TDI, and TDO. Figure 10 shows how the BitBlaster cable interfaces with a MAX 9000, MAX 7000S, or MAX 7000A device. The I/O pins are tri-stated during in-system programming.

Figure 10. MAX 9000, MAX 7000S & MAX 7000A Device Programming with the BitBlaster


Search for "Programming a Single Device with the BitBlaster or ByteBlaster" in MAX+PLUS II Help for more information.

JTAG Programming & Configuration of Multiple Devices

MAX 9000, MAX 7000S, and MAX 7000A devices can be programmed in-system using a JTAG chain, and FLEX 10K devices can be configured in-circuit using a JTAG chain.

When programming a JTAG chain of devices, one JTAG-compatible header, such as the BitBlaster header, is connected to several devices. The number of devices in the JTAG chain is limited only by the drive capability of the BitBlaster cable. JTAG-chain device programming is ideal when the printed circuit board (PCB) contains multiple devices, or when the PCB will be tested using JTAG BST. When connecting the BitBlaster cable to a chain of more than four devices, Altera recommends buffering the TDI, TMS, and TCK pins with an on-board buffer. See Figure 11.

Figure 11. JTAG-Chain Device Programming & Configuration with the BitBlaster
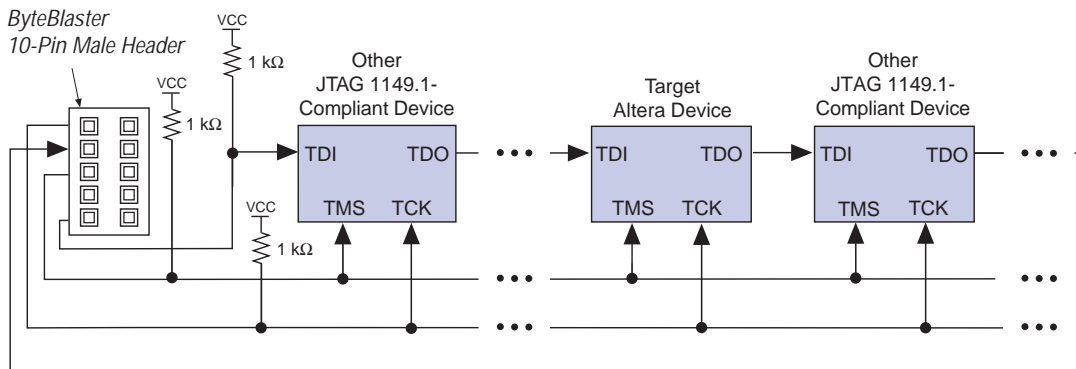
If FLEX 10K devices are part of the JTAG configuration chain, their nCONFIG, MSEL0, MSEL1, CONF_DONE, and nSTATUS pins should be connected as shown in Figure 9; this setup applies only when a JTAG configuration scheme is used, i.e., not when a combination of FLEX and JTAG configuration schemes are used on the same PCB. The CONF_DONE and nSTATUS pins on each device should be pulled up independently.

☞ FLEX 10K devices in 144-pin TQFP packages do not have a TRST pin. Therefore, the TRST pin can be ignored when configuring multiple FLEX 10K 144-pin TQFP devices.

To program a single device in a JTAG chain, the programming software places all other devices in the JTAG chain in BYPASS mode. When in BYPASS mode, devices pass programming data from the TDI pin to the TDO pin through a single bypass register without being affected internally, thereby enabling the programming software to program or verify the target device.

Go to the following sources for additional information:

- *Application Note 39 (JTAG Boundary-Scan Testing in Altera Devices)*
- "Setting Up Multi-Device JTAG Chains" in MAX+PLUS II Help
- "Configuring a Single Device with the BitBlaster or ByteBlaster" in MAX+PLUS II Help
- "Programming a Single Device with the BitBlaster or ByteBlaster" in MAX+PLUS II Help

Software Instructions

The MAX+PLUS II Programmer downloads configuration or programming data. For FLEX 10K, FLEX 8000, and FLEX 6000 devices, configuration data can also be downloaded by copying the SBF to the RS-232 port from the system prompt.

Downloading Configuration or Programming Data from the MAX+PLUS II Programmer

To configure or program one or more devices with the BitBlaster cable and the MAX+PLUS II Programmer, follow these steps:

1. Compile a project. The MAX+PLUS II Compiler automatically generates an SOF for FLEX 10K, FLEX 8000, and FLEX 6000 device configuration, or a POF for MAX 9000, MAX 7000S, or MAX 7000A device programming.

2. Attach the BitBlaster cable to an RS-232 port on a PC or UNIX workstation and plug the 10-pin female header into the system containing the target device. Ensure that the POWER status light is on. The board must supply power to the BitBlaster cable.

3. If necessary, change the BitBlaster cable's baud rate using the dipswitches on its side panel. Dipswitch settings are listed in Table 4 on page 689.

4. Open the MAX+PLUS II Programmer. Choose the **Hardware Setup** command (Options menu) to specify the BitBlaster cable and the appropriate RS-232 port. See "Changing the Hardware Setup" in MAX+PLUS II Help for more information.

☞ When you first open the Programmer, MAX+PLUS II automatically loads the programming file for the current project (either a POF or SOF), or the first programming file for a multi-device project. To specify another programming file, choose **Select Programming File** (File menu) and specify the correct file type. For a FLEX 10K, FLEX 8000, or FLEX 6000 device, select an SOF; for a MAX 9000, MAX 7000S, or MAX 7000A device, select a POF.

5. For JTAG or FLEX-chain programming or configuration, perform the following:

    ✓ To program or configure devices in a JTAG chain (multi- or single-device chain), turn on **Multi-Device JTAG-Chain** (JTAG menu) and choose **Multi-Device JTAG Chain Setup** to set up the multi-device JTAG chain. See "Setting up Multi-Device JTAG Chains" in MAX+PLUS II Help for more information.

    ☞ If the JTAG chain includes either FLEX or MAX devices exclusively, set up and create just one JTAG Chain File (**.jcf**). If the JTAG chain includes a mixture of FLEX and MAX devices, set up and create two separate JCFs.

✓ To configure multiple devices in a FLEX chain, turn on **Multi-Device FLEX Chain** (FLEX menu) and choose **Multi-Device FLEX Chain Setup** to setup the multi-device FLEX chain. See "Setting Up Multi-Device FLEX Chains" in MAX+PLUS II Help for more information.

6. Choose the **Program** or **Configure** button to program or configure the device(s). The BUSY status light on the BitBlaster cable turns on.

The BitBlaster cable downloads the data from the SOFs or POFs into the device(s). When configuration or programming is complete, the BUSY status light turns off, and the DONE status light turns on. After the DONE status light turns on, the BitBlaster can be disconnected.

Downloading Configuration Data from a System Prompt (FLEX Devices Only)

To configure one or more FLEX 10K, FLEX 8000, or FLEX 6000 devices with the BitBlaster cable from a system prompt, follow these steps:

1. Compile the project(s) with the MAX+PLUS II Compiler. The Compiler automatically generates an SOF for device configuration.

2. Open the MAX+PLUS II Programmer or Compiler and choose the **Convert SRAM Object Files** command (File menu).

3. Specify the SOF name by selecting it in the *Files* box or by typing its name in the *File Name* box. Choose **Add** to add the file to the *Selected Files* box.

4. Specify the serial bitstream file format by selecting *.sbf (Sequential)* in the *File Format* drop-down list box. Choose **OK**.

5. Attach the BitBlaster cable to an RS-232 port on your PC or UNIX workstation, and plug the 10-pin female header into the prototype system that contains the target FLEX 10K, FLEX 8000, or FLEX 6000 device(s). Ensure that the POWER status light is on. The board must supply power to the BitBlaster cable.

6. If necessary, change the baud rate of the BitBlaster cable using the dipswitches on its side panel. Dipswitch settings are listed in Table 4 on page 689.

7. Specify an RS-232 port and set its baud rate.

    ✓ On a PC, follow these steps:

a.   For 9,600 baud, type the following command at the system prompt:

```
mode com<serial port number>:9600,N,8,1 ↵
```

b.   For baud rates greater than 9,600, type the following command at the system prompt:

```
slikmode/b<baud rate>/c<serial port number> ↵
```

☞   The **slikmode.exe** utility is available from the Altera FTP site (**ftp.altera.com)** as a self-extracting executable, **bitmode.exe**. For more detailed instructions on using the **slikmode.exe** utility, type slikmode ↵ at the system prompt.

✓ Because commands on UNIX workstations differ depending on the operating system, the following command is provided only as an example. On a UNIX workstation, type the following command from the system prompt:

```
stty <baud rate> </dev/<serial port number> ↵
```

Check the workstation specifications to determine the maximum baud rate allowed by the hardware.

8.   Configure the FLEX 10K, FLEX 8000, or FLEX 6000 device by copying the SBF to the serial port to which the BitBlaster cable is attached.

✓ On a PC, type the following command from the system prompt:

```
copy <filename>.sbf com<serial port number>: ↵
```

✓ Because commands on UNIX workstations differ depending on the operating system, the following command is provided only as an example. On a UNIX workstation, type the following command from the system prompt:

```
cp <filename>.sbf /dev/<serial port number> ↵
```

Conclusion

Downloading configuration and programming data directly to the device via the BitBlaster cable allows designers to verify multiple design iterations in quick succession, thereby speeding the design cycle.