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Programming CPLDs Via the 'LVT8986 LASP

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ABSTRACT

This application report summarizes key information required for understanding the 'LVT8986 linking addressable scan ports (LASPs) multidrop addressable IEEE Std 1149.1 (JTAG) test access port (TAP) transceiver. This report includes information about the 'LVT8986 secondary TAPs, bypass and linking shadow protocol, scan-path description languages, serial vector format files, and an example of how to program a PLD via an 'LVT8986.

It is expected that the reader is already familiar with JTAG testing, so there is little review of any of the aspects of this device that are defined by the standard. The intent is that, after reading this and either being familiar with the LASP and JTAG or becoming so, the reader should be able to understand what necessary adaptations to a JTAG test would need to be made to include the 'LVT8986.

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1 Introduction

The 'LVT8986 linking addressable scan port (LASP) has three addressable IEEE Std 1149.1 (JTAG) secondary test access ports (STAPs) that can be connected dynamically into a single primary scan chain. Each LASP can be cascaded with another LASP, allowing up to 8 LASPs or 24 STAPs to be connected and active on a single address. The 'LVT8996 addressable scan port (ASP) device only has a single IEEE Std 1149.1 port and cannot cascade (link), so, for every address one can only turn the ASP with that address on or off. However, with the LASP, for every address, each of the 24 possible STAPs can be uniquely configured. This is because each LASP in a chain is given a unique position from 0–7. Controlling the LASP is similar to the ASP and can be used compatibly on the same backplane. See Figure 1 and Figure 2 for diagrams of the ASP and LASP, respectively.

ASP
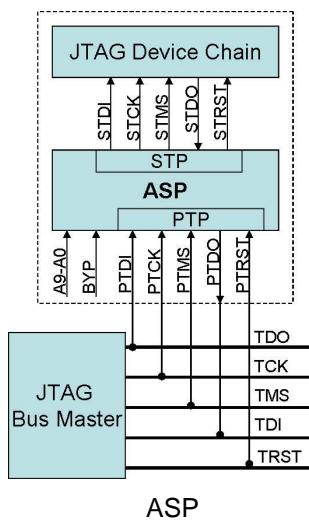
Figure 1. ASP
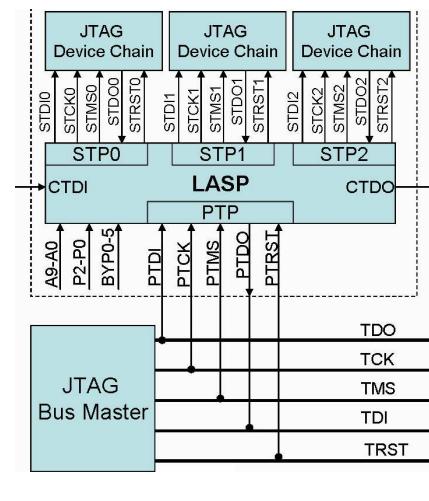
LASP

Figure 2. LASP

The most powerful use of the LASP is in system-level JTAG testing. At the system level, the LASP configurability allows boards to be removed from the system without breaking the scan chain and, in the interest of speed, a dynamic set of boards can be selected for testing instead of having to run data through the entire JTAG system.

The LASP can also improve testing on a single board, which would have had one long JTAG scan chain. For example, the board could be designed with the chain divided into three (for a single LASP) smaller chains. The division in the three chains can be based on scan speed, to group fast or slow testing devices together or to isolate programmable devices to improve the JTAG test, service, and programming speed.

2 Secondary Test Access Port (STAP) Configuration

For each LASP, whether cascaded or not, the secondary scan paths (SSPs) or STAPs can be configured on or off, independent of other STAP or LASP configurations. The LASP offers two methods of configuring the connections, bypass mode and linking shadow protocol. Both allow the LASP to be integrated into a system that also contains an ASP. This section is only a brief introduction to these methods, and additional information on this subject can be found in two other documents, *Cascading Multiple-Linking Addressable-Scan-Port Devices* (2002), and *Evolution of the IEEE Std 1149.1 Addressable Shadow Protocol Devices* (2003).

2.1 Bypass Mode

Bypass mode uses six bypass ($\overline{BYP_5}$–$\overline{BYP_0}$) pins to connect the primary TAP to configured secondary TAPs (see Figure 3). This protocol connects the secondary scan paths without the use of linking shadow protocol, and the LASP does not respond to linking shadow protocol while in this mode. Entry into the bypass mode is a low active control on the $\overline{BYP_5}$ pin.
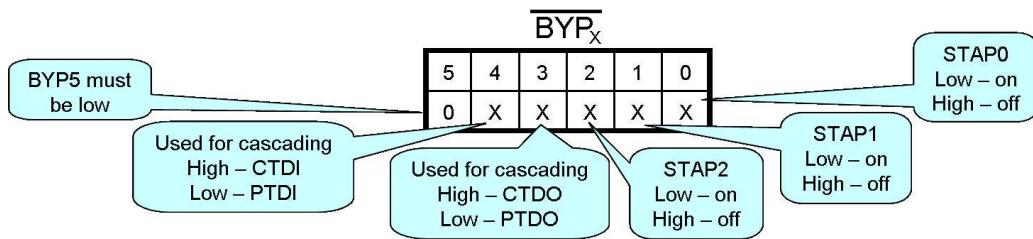
Figure 3. $\overline{BYP_5}$ –$\overline{BYP_0}$ Connect Primary TAP to Configured Secondary TAPs

Pins $\overline{BYP_2}$–$\overline{BYP_0}$ correspond to the STAP2–STAP0 connections. Pins $\overline{BYP_4}$–$\overline{BYP_3}$ are used to control the path of the TDO line for cascaded LASPs. Each LASP has a primary TDI and TDO (PTDI and PTDO) and a cascade TDI and TDO (CTDI and CTDO). Bypass pins 3 and 4 indicate to the LASP from which TDI and to which TDO the signal should travel.

Figure 4 shows configurations for a single LASP (no cascade) based on example $\overline{BYP_5}$–$\overline{BYP_0}$ pin configurations.
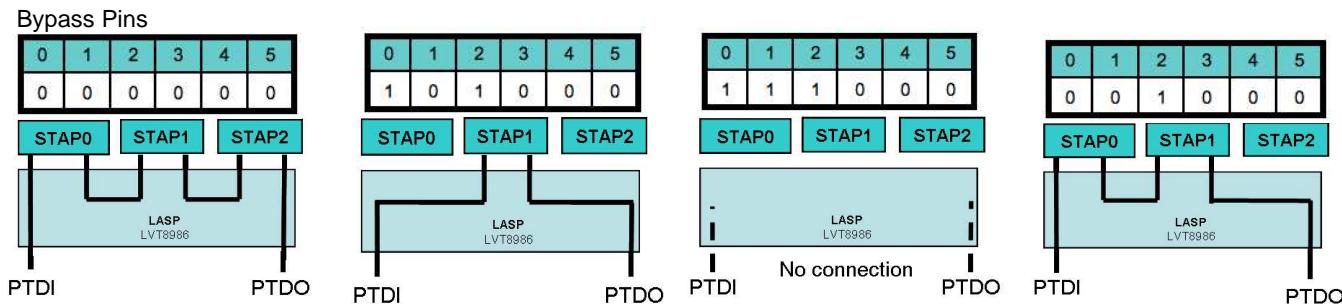
Figure 4. Single LASP Bypass Pin Configuration Examples, Position 000

To cascade the LASPs using bypass, careful attention must be paid to the BYP3 and BYP4 bits, to correctly select between the cascade and primary input/output. The CTDI and CTDO lines on each LASP also must be connected in order for cascading to be possible (see Figure 5). Position and address bits do not affect the bypass mode. The bypass mode does not give notification of a failed or correct configuration.
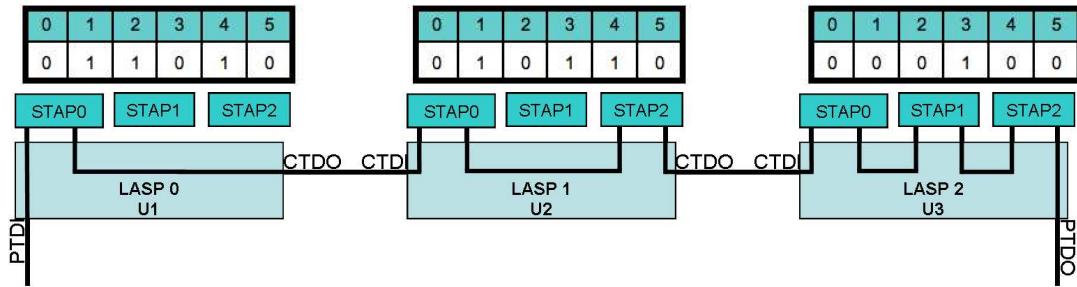
Figure 5. CTDI and CTDO Lines on Each LASP

2.2 Linking Shadow Protocol

Linking shadow protocol is a serial bit-pair stream sent to the entire JTAG scan path (see Figure 6). Keying off the bit-pair scheme, each LASP listens for its address and position information to determine its status (see Figure 7). For each LASP that recognizes its address and then its position, it configures its STAPs based on the configuration information that immediately follows the position information (see Figure 8).
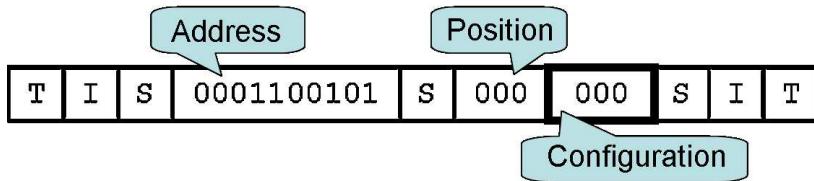
A   Single LASP address 0001100101, position 000, all STAPs set to active.

Figure 6. Linking Shadow Protocol

I	S	D(1)	D(0)
HH	LL	LH	HL

A   D(0) and D(1) refer to the 0s and 1s in the address, position, and configuration.

Figure 7. Bit-Pair Signaling Scheme
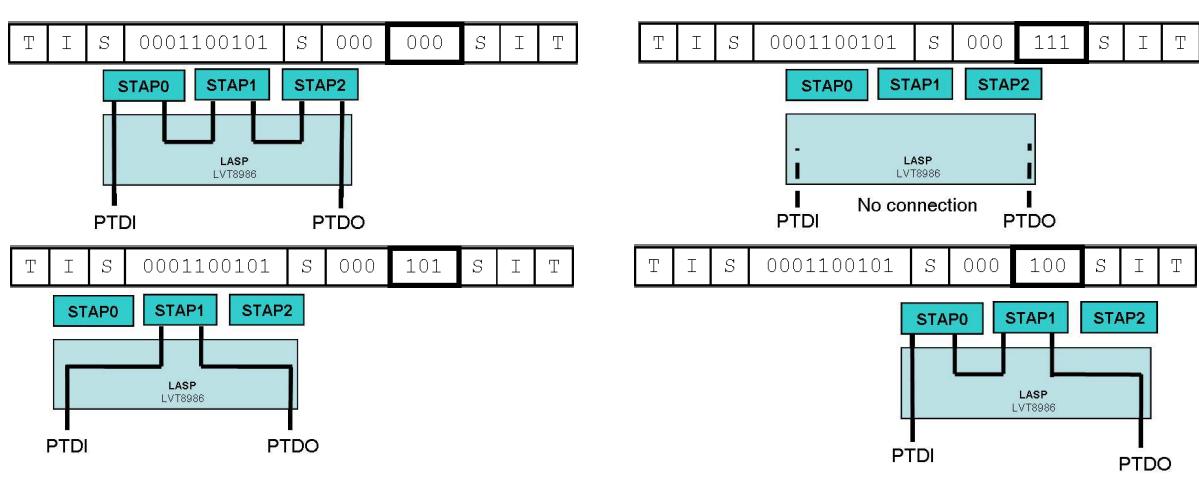
Figure 8. Linking Shadow Protocol Connection and No Connection

2.3 Cascading LASPs

Cascading LASPs using linking shadow protocol use a single bit-pair signaling scheme (see Figure 7) but, in addition to the single-position configuration command (see Figure 6), up to eight-position configuration commands can be included (see Figure 9 and Figure 10).
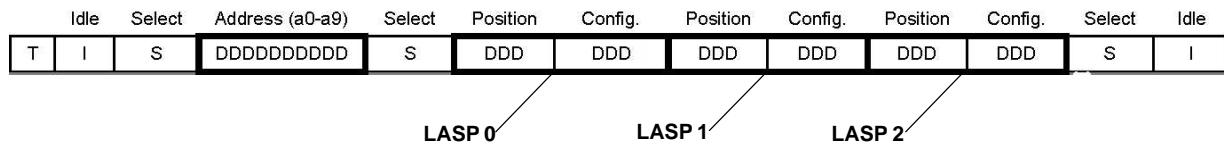
Figure 9. Cascading LASPs – A
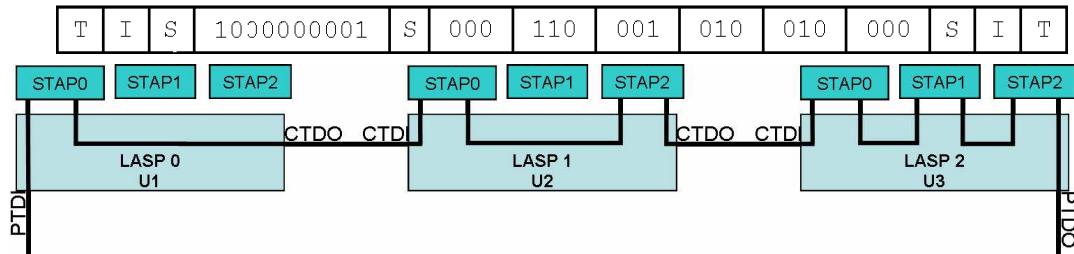
Figure 10. Cascading LASPs – B

3   Pad Bits

3.1   Design Necessity

In order to allow the LASP to have the added improvement of cascading, additional registers were placed along the scan chain. These pad bits exist on the TDI–TDO line and must be accounted for in any JTAG test vectors,. Between one and four extra bits must be added at certain places in the vector in order for the test to properly fill the registers of the JTAG devices. These pad bits act as 1-bit registers between each of the STAPs, P/CTDI, and P/CTDO connections.

3.2   Testing Limitations

IEEE Std 1149.1 bus masters that control the test clock (TCK) can either use a gated or free-running clock. The gated mode halts the clock when pause is needed, and the free-running mode places the applicable scan chains in a stable state while the clock continues to run. If a pause is needed while scanning data in or out, as in the Shift-DR and Shift-IR states, the scan chains are put into Pause-DR and Pause-IR, respectively. While the LASP can successfully accept linking shadow protocols in the Pause-DR and Pause-IR states, JTAG tests cannot be successfully performed through a LASP if, while shifting data in or out, scan chains are placed in these states while using a free-running test clock.

As long as the clock continues to cycle, the data in the pad bits will continue to be updated. If the scan chain the LASP is connected to is in one of the pause states, the chain's boundary cells will not shift, but test values are overwritten in the pad bits.

While it may not be possible to use the LASP compatibly with a free-running test clock, by using a gated clock, these difficulties can be easily avoided.

3.3 Location

The position and number of pad bits for every configuration of the LASPs are shown in Table 1.

Table 1. Bit Location

CASCADE POSITION	STAP0	STAP1	STAP2	SCAN-PATH CONFIGURATION	NO. PAD BITS
Single device	Inactive	Inactive	Inactive	None	0
Single device	Active	Inactive	Inactive	PTDI-(1)-STAP0-(1)-PTDO	2
Single device	Inactive	Active	Inactive	PTDI-(1)-STAP1-(1)-PTDO	2
Single device	Active	Active	Inactive	PTDI-(1)-STAP0-(1)-STAP1-(1)-PTDO	3
Single device	Inactive	Inactive	Active	PTDI-(1)-STAP2-(1)-PTDO	2
Single device	Active	Inactive	Active	PTDI-(1)-STAP0-(1)-STAP2-(1)-PTDO	3
Single device	Inactive	Active	Active	PTDI-(1)-STAP1-(1)-STAP2-(1)-PTDO	3
Single device	Active	Active	Active	PTDI-(1)-STAP0-(1)-STAP1-(1)-STAP2-(1)-PTDO	4
First device	Inactive	Inactive	Inactive	None	0
First device	Active	Inactive	Inactive	PTDI-(1)-STAP0-(1)-CTDO	2
First device	Inactive	Active	Inactive	PTDI-(1)-STAP1-(1)-CTDO	2
First device	Active	Active	Inactive	PTDI-(1)-STAP0-(1)-STAP1-(1)-CTDO	3
First device	Inactive	Inactive	Active	PTDI-(1)-STAP2-(1)-CTDO	2
First device	Active	Inactive	Active	PTDI-(1)-STAP0-(1)-STAP2-(1)-CTDO	3
First device	Inactive	Active	Active	PTDI-(1)-STAP1-(1)-STAP2-(1)-CTDO	3
First device	Active	Active	Active	PTDI-(1)-STAP0-(1)-STAP1-(1)-STAP2-(1)-CTDO	4
Last device	Inactive	Inactive	Inactive	None	0
Last device	Active	Inactive	Inactive	CTDI-(1)-STAP0-(1)-PTDO	2
Last device	Inactive	Active	Inactive	CTDI-(1)-STAP1-(1)-PTDO	2
Last device	Active	Active	Inactive	CTDI-(1)-STAP0-(1)-STAP1-(1)-PTDO	3
Last device	Inactive	Inactive	Active	CTDI-(1)-STAP2-(1)-PTDO	2
Last device	Active	Inactive	Active	CTDI-(1)-STAP0-(1)-STAP2-(1)-PTDO	3
Last device	Inactive	Active	Active	CTDI-(1)-STAP1-(1)-STAP2-(1)-PTDO	3
Last device	Active	Active	Active	CTDI-(1)-STAP0-(1)-STAP1-(1)-STAP2-(1)-PTDO	4
Middle device	Inactive	Inactive	Inactive	None	0
Middle device	Active	Inactive	Inactive	CTDI-(1)-STAP0-(1)-CTDO	2
Middle device	Inactive	Active	Inactive	CTDI-(1)-STAP1-(1)-CTDO	2
Middle device	Active	Active	Inactive	CTDI-(1)-STAP0-(1)-STAP1-(1)-CTDO	3
Middle device	Inactive	Inactive	Active	CTDI-(1)-STAP2-(1)-CTDO	2
Middle device	Active	Inactive	Active	CTDI-(1)-STAP0-(1)-STAP2-(1)-CTDO	3
Middle device	Inactive	Active	Active	CTDI-(1)-STAP1-(1)-STAP2-(1)-CTDO	3
Middle device	Active	Active	Active	CTDI-(1)-STAP0-(1)-STAP1-(1)-STAP2-(1)-CTDO	4

3.4 Impact on Scan Chain

Because these pad bits are designed on the scan-chain path from P/CTDI to P/CTDO, they must be accounted for in the test patterns run on systems, including an 'LVT8986. Figure 11 shows example configurations for a set of three cascaded 'LVT8986s. The "PB" in Figure 11 indicate a pad bit that needs to be accommodated for along the scan chain.
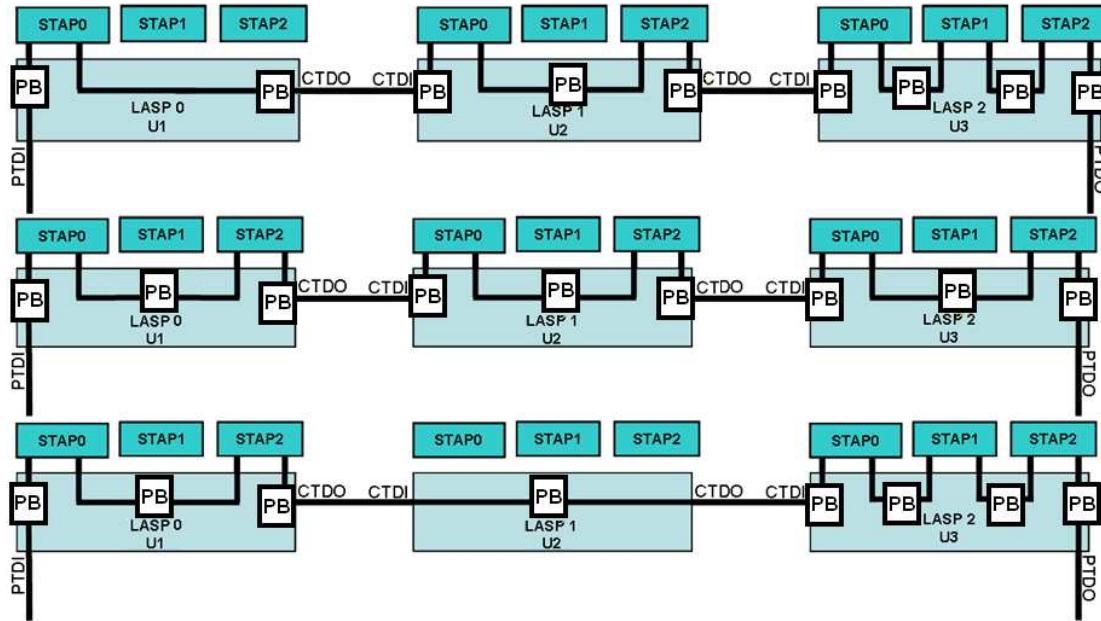
Figure 11. Three Cascaded 'LVT8986 Examples

4 Scan Description Languages

4.1 Introduction

Boundary scan description language (BSDL) and hierarchical scan description language (HSDL) were developed to aid in automated testing for JTAG systems. BSDL describes the implementation of IEEE Std 1149.1 (JTAG) on a device and is described in IEEE Std 1149.1b, while HSDL is not included as a standard. HSDL was developed originally by TI and is now supported by ASSET InterTech™. Both languages are based on the same subset of VHSIC hardware description language (VHDL) and are in a human-readable format that can be opened in almost any text editor.

4.2 Boundary Scan Description Language (BSDL) (.bsm, .bsl, .bsdl)

BSDL is a subset of VHDL, which describes how an IEEE Std 1149.1 device operates. The BSDL of a part describes the instruction codes, register sizes, and optional registers and instructions, among other things. BSDL was approved in 1994 in IEEE Std 1149.1b. BSDL is a human-readable standard, which is a major enabler of the development of automatic testing processes for IEEE Std 1149.1.

4.2.1 BSDL Syntax

4.2.1.1 Elements of BSDL

A BSDL description of a device consists of the following elements:
- Entity descriptions
- Generic parameter
- Logical port description
- Use statements
- Pin mapping(s)
- Scan-port identification
- Instruction-register description
- Register access description
- Boundary-register description

4.2.2 BSDL Example

Either // or ! comments out the remainder of a line. Comments are in *italics* in this example for clarity.

```
-- Entity name is the device name
entity your_device is
-- Generic Parameter for package name
generic (PHYSICAL_PIN_MAP : string := "your_device_package");
-- Port Description
port (
    TCK     : in bit;
    TMS     : in bit;
    TDI     : in bit;
    TDO     : out bit;
    GND     : linkage bit;
    VDD     : linkage bit;
    BS      : inout bit
    );
-- Using standard statement
use STD_1149_1_2001.all;
-- Conformance statement
attribute COMPONENT_CONFORMANCE of your_device : entity is
    "STD_1149_1_2001";
-- Pin map for the "your_device_package" package
attribute PIN_MAP of your_device : entity is PHYSICAL_PIN_MAP;
constant your_device_package : PIN_MAP_STRING:=
    " TCK : 1," &
    " TMS : 2," &
    " TDI : 3," &
    " TDO : 4," &
    " GND : 5," &
    " VDD : 6," &
    " BS  : 7" ;
-- TAP attributes
attribute TAP_SCAN_CLOCK of TCK    : signal is (50.0e6, BOTH);
attribute TAP_SCAN_IN    of TDI    : signal is true;
attribute TAP_SCAN_MODE  of TMS    : signal is true;
attribute TAP_SCAN_OUT   of TDO    : signal is true;
attribute INSTRUCTION_LENGTH of your_device: entity is 3;
attribute INSTRUCTION_OPCODE of your_device: entity is
-- BYPASS gets all unused codes (000,101,111)
    "EXTEST        (001)," &
    "SAMPLE        (010)," &
    "PRELOAD       (011)," &
    "HIGHZ         (100)," &
    "CLAMP         (110)" ;
attribute INSTRUCTION_CAPTURE of your_device: entity is "101";
-- Optional Register Description -- none-- Register Access Description
attribute REGISTER_ACCESS of your_device: entity is
    "BOUNDARY  (EXTEST, SAMPLE, PRELOAD)," &
    "BYPASS (BYPASS, CLAMP, HIGHZ)" ;
-- Boundary-Scan Register Description
attribute BOUNDARY_LENGTH   of your_device : entity is 3;
attribute BOUNDARY_REGISTER of your_device : entity is
    "2 (BC_4,    *,     INTERNAL,    X)," &
    "1 (BC_1,    *,     CONTROL,    1)," &
    "0 (BC_8,    BS,    BIDIR,    X, 1, 1, Z)" ;
end your_device;
```

4.3   Hierarchical Scan Description Language (HSDL) (.hsm)

HSDL is the system-level complement to BSDL and is based on the same subset of VHDL statements. With HSDL, the description of JTAG systems picks up where BSDL ends, and describes device interconnections and gives system-level descriptions of IEEE Std 1149.1-compliant devices.

Entities in HSDL, unlike in BSDL, are used to describe not just devices but modules, as well. A module is any level of architecture including, but not limited to, boards, multichip modules, backplanes, subsystems, and systems. HSDL specifically improves three areas not well covered by BSDL descriptions alone.

- Describes test bus interconnections of IEEE Std 1149.1 at board or module level
- Describes boards with dynamic and reconfigurable architectures
- Reduces risk during interactive design debug and verification

Using BSDL and HSDL together can create a full description of the unit under test.

4.3.1   HSDL Syntax

4.3.1.1   Elements of HSDL

A HSDL description of a system consists of the following elements:
- Entity descriptions
- Generic parameter
- Logical port description
- Use statements
- [Optional module descriptions]
- [Optional port description(s)]
- Pin mapping(s)
- Scan port identification
- [Optional member description(s)]
- [Optional bus description(s)]
- Path description
- [Optional member connections]
- [Optional constraint description(s)]
- [Optional design warning]

4.3.2 HSDL Example

Either // or ! comments out the remainder of a line. Comments are in *italics* in this example for clarity.

```
entity LASP_Demo is
    generic (PHYSICAL_PIN_MAP : string := "UNDEFINED");
    port (PTDI : in  bit;
          PTDO : out bit;
          PTMS : in  bit;
          PTCK : in  bit);
    use STD_1149_1_1990.all;
    use HSDL_module.all;
    attribute PIN_MAP of LASP_Demo : entity is PHYSICAL_PIN_MAP;
    constant PCB : PIN_MAP_STRING :=
            "PTDI:1, " &
            "PTDO:2, " &
            "PTMS:3, " &
            "PTCK:4";
    attribute TAP_SCAN_IN    of PTDI : signal is TRUE;
    attribute TAP_SCAN_OUT   of PTDO : signal is TRUE;
    attribute TAP_SCAN_MODE  of PTMS : signal is TRUE;
    attribute TAP_SCAN_CLOCK of PTCK : signal is (1.0e6, both);
    attribute MEMBERS of LASP_Demo : entity is
-- !!change "your_U0" to name your device
            "your_U0 (your_device, your_device_package)," &
-- !!change "your_U1" to name your device
            "your_U1 (your_device, your_device_package)," &
-- !!change "your_U2" to name your device
            "your_U2 (your_device, your_device_package)," &
-- retiming bits
            "LASP0_dly_stdo0 (amoeba, membrane)," &
            "LASP0_dly_stdo1 (amoeba, membrane)," &
            "LASP0_dly_stdo2 (amoeba, membrane)," &
            "LASP0_dly_ptdo  (amoeba, membrane)," ;
    constant TAP : EXTERNAL_PATH := "PTDI, PTDO, PTCK, PTMS";
    constant short : STATIC_PATH := "";
-- !! change "your_U0" to list all of your devices on LASP0 STAP0
    constant your_path0 : STATIC_PATH := "your_U0";
-- !! change "your_U1" to list all of your devices on LASP0 STAP1
    constant your_path1 : STATIC_PATH := "your_U1";
-- !! change "your_U2" to list all of your devices on LASP0 STAP2
    constant your_path2 : STATIC_PATH := "your_U2";
    constant subpath0 : STATIC_PATH := "LASP0_dly_stdo0, your_path0";
    constant subpath1 : STATIC_PATH := "LASP0_dly_stdo1, your_path1";
    constant subpath2 : STATIC_PATH := "LASP0_dly_stdo2, your_path2";
    constant subpath3 : STATIC_PATH := "LASP1_dly_stdo0, your_path3";
    constant LASP0_ssp0 : DYNAMIC_PATH :=
      "0 (short:LASP0_ssp0, subpath0:1), " &
      "1 (short:1, subpath0:LASP0_ssp0)";
    constant LASP0_ssp1 : DYNAMIC_PATH :=
      "0 (short:LASP0_ssp1, subpath1:1), " &
      "1 (short:1, subpath1:LASP0_ssp1)";
    constant LASP0_ssp2 : DYNAMIC_PATH :=
      "0 (short:LASP0_ssp2, subpath2:1), " &
      "1 (short:1, subpath2:LASP0_ssp2)";
    constant LASP0_all : STATIC_PATH := "LASP0_ssp0, LASP0_ssp1, LASP0_ssp2, LASP0_dly_ptdo";
    constant LASP0 : DYNAMIC_PATH :=
      "0 (short:LASP0, LASP0_all:1), " &
      "1 (short:1, LASP0_all:LASP0)";
    constant primary : STATIC_PATH :=
      "TAP, LASP0, ";
end LASP_Demo;
```

5 Serial Vector File (SVF) (.svf)

An SVF file is an ASCII human-readable file format used for exchanging descriptions of high-level JTAG bus operations. These operations, in general, consist of scan operations and movements between the different stable states of the IEEE Std 1149.1 state diagram, but do not go into a description of the state at every test clock. SVF promotes the reuse of serial vectors throughout the life cycle of a product.

5.1 SVF Syntax

The ASCII SVF file consists of a set of case-insensitive SVF statements, with a maximum number of characters per line of 256, although commands may span multiple lines (see Table 2). Each statement consists of a command, associated parameters, and a terminating semicolon. A pair of slashes '//' or an exclamation point '!' comment out the remainder of that line. Scan data always is enclosed in parentheses and expressed in hexadecimal.

The most significant bit zeroes in the scan data hex string are ignored when considering the length of the string. This length cannot be longer than the specified bit length. The least significant bit (right-most bit) is the first bit scanned in (for TDI and SMASK) and the first bit scanned out (for TDO and MASK data). This bit ordering is consistent with IEEE Std 1149.1.

Table 2. SVF Commands

COMMAND	ABBREVIATION	FUNCTION
ENDDR		Specifies default end state for DR scan operations
ENDIR		Specifies default end state for IR Scan operations
FREQUENCY		Specifies maximum test clock frequency
HDR	Header Data Register	Specifies a header pattern to prefix to subsequent DR scan operations
HIR	Header Instruction Register	Specifies a header pattern to prefix to subsequent IR scan operations
PIO	Parallel Input/Output	Specifies a parallel test program
PIOMAP	Parallel Input/Output Map Scan Data Register	Maps PIO column position to a logical pin
RUNTEST		Forces the JTAG bus to a run state for a specified number of cycles or time period
SDR		Performs a JTAG standard DR scan
SIR	Scan Instruction Register	Performs a JTAG standard IR scan
STATE		Forces JTAG bus into a specified stable state
TDR	Trailer Data Register	Specifies a trailer pattern to postfix to subsequent DR scans
TIR	Trailer Instruction Register	Specifies a trailer pattern to postfix to subsequent IR scans
TRST	Test Reset	Controls optional TRST line

Scan operations can be defined as the execution of a SIR or SDR command and any associated header and trailer commands. Some of the optional command parameters, such as MASK and SMASK, are remembered separately for each of the scan operation commands (SIR, SDR, HIR, HDR, TIR, and TDR). This means that the sticky command parameter stays in operation until it is either changed or becomes invalidated, usually by scan-length conflicts. This memory is done to reduce the SVF file size.

The format for real numbers is similar to that of decimal literals in VHDL, without the underlines.

digit [. digits] [E [+/–] digits]

Here, brackets indicate optional parts of the syntax. The digits are one or more decimal digits 0–9. The range and precision of real numbers are dependent on implementation.

Some SVF commands reference IEEE Std 1149.1 TAP states. Table 3 equates the names for the states used by the standard to the names used for each state in SVF.

Table 3. SVF State Names

IEEE Std 1149.1 TAP STATE NAME	SVF TAP STATE NAME
Test-Logic-Reset	RESET
Run-Test/Idle	IDLE
Select-DR-Scan	DRSELECT
Capture-DR	DRCAPTURE
Shift-DR	DRSHIFT
Exit1-DR	DREXIT1
Pause-DR	DRPAUSE
Exit2-DR	DREXIT2
Update-DR	DRUPDATE
Select-IR-Scan	IRSELECT
Capture-IR	IRCAPTURE
Shift-IR	IRSHIFT
Exit1-IR	IREXIT1
Pause-IR	IRPAUSE
Exit2-IR	IREXIT2
Update-IR	IRUPDATE

5.2 SVF Example

The following SVF code is a part of a file that was created to program the Xilinx™ 9572XL VQ64 CPLD. This example SVF file was created using the free Xilinx iMPACT™ software tool , which is part of ISE WebPACK™ version 7.1.02i. Information on how to download or buy a CD of the most current version of this software can be found at www.xilinx.com.

Either // or ! comments out the remainder of a line. Comments are in *italics* in this example for clarity.

```
// Created using Xilinx iMPACT Software [ISE WebPACK - 7.1.02i]
TRST OFF;
ENDIR IDLE;
ENDDR IDLE;
STATE RESET IDLE;
FREQUENCY 1E6 HZ;
TIR 0 ;
HIR 0 ;
TDR 0 ;
HDR 0 ;
TIR 0 ;
HIR 0 ;
HDR 0 ;
```

```
    TDR 0 ;
//Loading device with 'idcode' instruction.
    SIR 8 TDI (fe) SMASK (ff) ;
    SDR 32 TDI (00000000) SMASK (ffffffff) TDO (f9604093) MASK (0fffffff) ;
//Check for Read/Write Protect.
    SIR 8 TDI (ff) TDO (01) MASK (e3) ;
// Validating chain...
    TIR 0 ;
    HIR 0 ;
    TDR 0 ;
    HDR 0 ;
    SIR 16 TDI (ffaa) SMASK (ffff) TDO (aa01) MASK (ffe3) ;
    TIR 0 ;
    HIR 0 ;
    TDR 0 ;
    HDR 0 ;
    TIR 0 ;
    HIR 0 ;
    TDR 0 ;
    HDR 0 ;
// Loading devices with 'ispen' or 'bypass' instruction.
    SIR 8 TDI (e8) SMASK (ff) ;
    SDR 6 TDI (05) SMASK (3f) ;
// Loading devices with 'fbulk' instruction.
    SIR 8 TDI (ed) ;
    SDR 18 TDI (03ffff) SMASK (03ffff) ;
    RUNTEST 200000 TCK;
    SDR 18 TDI (03fffd) TDO (000001) MASK (000003) ;
// Loading devices with 'conld' or 'bypass' instruction.
    SIR 8 TDI (f0) ;
    RUNTEST 100 TCK;
// Loading devices with 'ispen' or 'bypass' instruction.
    SIR 8 TDI (e8) ;
    SDR 6 TDI (05) SMASK (3f) ;
// Loading device with 'fpgm' instruction.
    SIR 8 TDI (ea) ;
    SDR 50 TDI (00000000000001) SMASK (03ffffffffffff) ;
    SDR 50 TDI (00000400000001) ;
    SDR 50 TDI (00000800000001) ;
    SDR 50 TDI (00000c00000001) ;
    SDR 50 TDI (00001000000001) ;
    SDR 50 TDI (00002000000001) ;
    SDR 50 TDI (00002400000001) ;
    SDR 50 TDI (00002800000001) ;
    SDR 50 TDI (00002c00000001) ;
    SDR 50 TDI (00003000000001) ;
    SDR 50 TDI (00004000000001) ;
    SDR 50 TDI (00004400000001) ;
    SDR 50 TDI (00004800000001) ;
    SDR 50 TDI (00004c00000001) ;
    SDR 50 TDI (00005000000003) ;
    RUNTEST 20000 TCK;
    SDR 50 TDI (00008000000000) TDO (00000000000001) MASK (00000000000003) ;
    SDR 50 TDI (00008000000001) ;
    SDR 50 TDI (00008400000001) ;
    SDR 50 TDI (00008800000001) ;
    SDR 50 TDI (00008c00000001) ;
    SDR 50 TDI (00009000000001) ;
    SDR 50 TDI (0000a000000001) ;
    SDR 50 TDI (0000a400000001) ;
    SDR 50 TDI (0000a800000001) ;
    SDR 50 TDI (0000ac00000001) ;
    SDR 50 TDI (0000b000000001) ;
    SDR 50 TDI (0000c000000001) ;
    SDR 50 TDI (0000c400000001) ;
    SDR 50 TDI (0000c800000001) ;
```

```
SDR 50 TDI (0000cc00000001) ;
SDR 50 TDI (0000d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00010000000000) TDO (00000000000001) MASK (00000000000003) ;
```

6   Case Example – Programming PLD Via 'LVT8986

This example shows all the necessary steps to program the Xilinx 9572XL found on a CPLD demo board via an 'LVT8986 on the LASP demo board, using ASSET InterTech JTAG software solution ScanWorks® 3.5 SP03.

For more information on the LASP demo board, see *[Placeholder for LASP Demo Board User's Guide]*

For more information on ScanWorks, see www.asset-intertech.com.

For more information on the CPLD demo board, see
http://www.memec.co.jp/html/xilinx/eboard/image/ds-kit-95xl.pdf

6.1   Theory

This example shows programming a CPLD via a STAP on an 'LVT8986. For this example, the LASP demo board is used. Because one CPLD is used, only one LASP of the three on the LASP demo board is used. No cascading is addressed in this section, but the two pad bits required for a single STAP on the LASP are addressed using ScanWorks. Even though this example makes use of ScanWorks, the pad bits can be addressed using other JTAG software, or the user could create some kind of script to edit an existing SVF file or possible other format to insert the additional bits needed for the successful use of the 'LVT8986.

6.2   Setup

This example (see Figure 12) uses many different types of hardware and software including:
- Software
  - ScanWorks 3.5 SP03
    - Software solution for JTAG testing
  - Xilinx ISE WebPACK version 7.1.02i
    - Create the SVF files for programming the CPLD
- Hardware
  - ASSET InterTech PCI-100 controller pod
    - Connect computer to LASP demo board
  - Insight™ 9500XL CPLD board
    - Xilinx 9572XL CPLD to program
  - LASP demo board
    - 3 LASPs for a total of 9 STAPs
  - 3.3-V power supply
    - Power for LASP demo board
  - Various ribbon cables and jumper pins to connect the LASP demo board to the CPLD board

6.3 *Necessary Files*

There are three file types that program the CPLD via an 'LVT8986 on the LASP demo board.

*   HSDL description of the LASP demo board

    The best way to define a design using the 'LVT8986 in ScanWorks is to use an HSDL description of the board. In this case, the LASP demo board was used, and an example HSDL for this board can be found in the section *HSDL Example*. The only change necessary is to replace the "your_device" and "your_device_package" with an actual entity and package name of the CPLD for all the "your_Us" that will be connected to a LASP STAP that is targeted for programming. To test out all of the STAPs on each of the three LASPs, replace all the occurrences of "your_device" and "your_device_package" with "xc9572XL" and "vq64", respectively.

    This HSDL defines a CPLD connected to every STAP, but normally there are a number of devices or defined boards connected to each STAP. Since only one CPLD is used in this case, it is not possible to cascade the LASPs but, with additional CPLDs, only minor modifications are needed to turn on additional STAPs. See Appendix A for the HSDL description of the LASP demo board with the Xilinx CPLD included.

*   BSDL description of the Xilinx CPLD

    The xc9572XL vq64 BSDL file can be found at www.xilinx.com. The most current version at the time of this writing can be found in Appendix B. No modifications were necessary to this file for this project.

*   SVF files to program CPLD
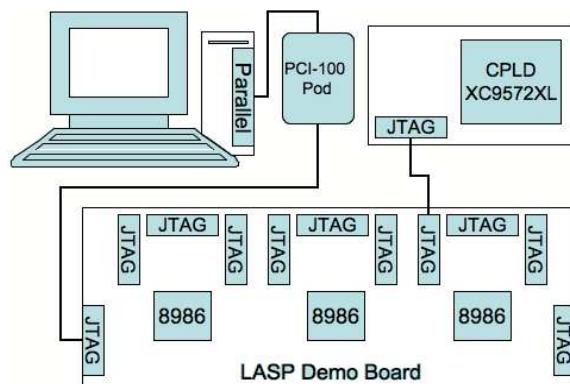
Figure 12. Programming a CPLD Via STAP on an 'LVT8986

To verify that the CPLD can be programmed from each STAP on the demo board, there are two SVF files that cause different patterns to be displayed on the CPLD demo board LEDs. Both of these SVF files can be found in Appendix C.

6.4   Example

6.4.1   Interface

ScanWorks uses a three-column interface, with the left column for the design hierarchy, the middle column for a list of possible actions to create, and the right column for a list of user-created and named actions. Actions in ScanWorks are tests that can have specified pre- and post-condition files and attached test data, as applicable. The pre- and post-condition files use ScanWorks macro language to support a number of user-specified custom applications, including support for the ASP and LASP.

6.4.2   Design Description

To define a design that includes the 'LVT8986, use the "define a scan path manually" option, after a design is created. This is where the HSDL file comes in. Include the HSDL file, as well as any BSDL files necessary for the design. Make sure that the BSDL file is higher in the list than the HSDL file.

6.4.3   Macro Language

ScanWorks macro language can be used in stand-alone macro actions or in precondition files for other actions. For every action performed on a system using the 'LVT8986 a precondition file must be used to set up the scan chain, whether using linking shadow or bypass mode. Only the precondition file for the linking shadow protocol actually activates the LASPs. Figure 13 and Figure 14 show two example precondition files; the first is for linking shadow protocol and the second is for a system using bypass mode.

Both examples activate a single STAP on one LASP. The LASP is named LASP0 in the HSDL file and the STAP is named LASP0_ssp0. This normally translates to STAP0 on LASP0 (position 000). The linking shadow example uses binary for the address and position configuration, which is indicated by the 'B' following the bits. These address and position configurations also can be defined using hex, where an 'H' following the value indicates base 16. Leading zeroes in a hex value are ignored so, in this case, the address is '201'H and position configuration is '30'H.

```
ENTITY LASP_Demo
Process
IS
--Address width is set at 10 bits
sc_asp_address_width( 10 );
--Command Width is set at 6 bits
  sc_lasp_command_width( 6 );


--LASP Linking Shadow Protocol Information to be Sent
  sc_lasp_address( '1000000001'B, '110000'B, SC_TEST_RESET );
--Activate LASP0
setActivePath (LASP0, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP0_ssp0, 1);
  setActivePath (LASP0_ssp1, 0);
  setActivePath (LASP0_ssp2, 0);
END Process;
```

| Con2 | Con1 | Con0 | Pos2 | Pos1 | Pos0 |
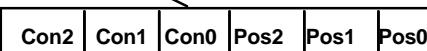
Figure 13. Linking Shadow Protocol Macro
ScanWorks Version 3.5 SP03

```
ENTITY LASP_Demo
Process
IS
--Activate LASP0
setActivePath (LASP0, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP0_ssp0, 1);
  setActivePath (LASP0_ssp1, 0);
  setActivePath (LASP0_ssp2, 0);
END Process;
```

Figure 14. Bypass-Mode Macro (ScanWorks Version 3.5 SP03)

Figure 15 and Figure 16 show examples of linking shadow and bypass modes for multiple LASPS. Both are for an active STAP0 (_ssp0) on LASP0 and LASP1, as named in the HSDL. For the linking shadow macro, two changes are made to prepare for cascaded LASPs. Both the command width and sc_lasp_address position configuration must be changed to reflect the requested configuration and position of the additional LASPs. Again, the bypass macro does not interact with the LASP, but just indicates to the ScanWorks program which STAPs to consider connected and active. No error is given if the macro does not match the board configuration.

```
ENTITY LASP_Demo
Process
IS
--Address width is set at 10 bits
sc_asp_address_width( 10 );
--Command Width is set at 6 bits
  sc_lasp_command_width( 12 );

--LASP Linking Shadow Protocol Information to be Sent
  sc_lasp_address( '1000000001'B, '110000110001'B, SC_TEST_RESET );
--Activate LASP0
setActivePath (LASP0, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP0_ssp0, 1);
  setActivePath (LASP0_ssp1, 0);
setActivePath (LASP0_ssp2, 0);
--Activate LASP1
setActivePath (LASP1, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP1_ssp0, 1);
  setActivePath (LASP1_ssp1, 0);
  setActivePath (LASP1_ssp2, 0);
END Process;
```

**Figure 15. Linking Shadow Protocol Macro, Multiple LASPs
(ScanWorks Version 3.5 SP03)**

```
ENTITY LASP_Demo
Process
IS
--Activate LASP0
setActivePath (LASP0, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP0_ssp0, 1);
  setActivePath (LASP0_ssp1, 0);
  setActivePath (LASP0_ssp2, 0);
--Activate LASP1
setActivePath (LASP1, 1);
--Activate Secondary Scan Path 0
  setActivePath (LASP1_ssp0, 1);
  setActivePath (LASP1_ssp1, 0);
  setActivePath (LASP1_ssp2, 0);
END Process;
```

Figure 16. Bypass-Mode Macro, Multiple LASPs (ScanWorks Version 3.5 SP03)

6.4.4 Verifying Scan Chain

After assembling the system including the LASP demo board, CPLD demo board, and the computer, the scan path needs to be verified to ensure that the system is assembled as expected in the software. ScanWorks uses a scan path verify (SPV) action to do this. The SPV action does a number of low-risk tests to interrogate the board, in order to reduce the risk to the system. A number of tests can be run to verify the correct connection of components, including (but not limited to):

- Read the start-up IDCODE
- Place the device in bypass
- Read the IDCODE
- Read the USERCODE
- Check the boundary length

For these tests to pass, the pad bit must be accounted for and, in ScanWorks, the macro language must be used to specify a precondition file. In this case, the precondition file looks very similar to the macros in Section 6.4.3. Only minor alterations would need to be made, depending on which LASP and STAP are active.

6.4.5 Programming

Six actions are required to repeat this example:

- SPV – ignoring the USERCODE
- SVF Pattern1 – SVF created by iMPACT Software first erases then programs the CPLD
- SPV – Checks the USERCODE set by Pattern1 to verify programming
- SVF Pattern2 – SVF created by iMPACT Software first erases then programs the CPLD
- SPV– Checks the USERCODE set by Pattern2 to verify reprogramming
- Reset – Resets the LASP demo board for the next test

Each of these actions requires a matching precondition file to target the connected STAP. Make sure that the correct device is targeted for each action.

6.4.6 Common Mistakes

There are several common mistakes made when using ScanWorks with a LASP design. Steps to avoid four of the most common errors are:

- Check all power and data connections
- Ensure that the macro activates the correct STAP
- Ensure the linking shadow protocol command in the macro matches the active path command
- Target the correct entity

Appendix A

HSDL description of LASP demo board including the Xilinx CPLD

```
entity LASP_Demo is
   generic (PHYSICAL_PIN_MAP : string := "UNDEFINED");
   port (PTDI : in  bit;
         PTDO : out bit;
         PTMS : in  bit;
         PTCK : in  bit);
   use STD_1149_1_1990.all;
   use HSDL_module.all;
   attribute PIN_MAP of LASP_Demo : entity is PHYSICAL_PIN_MAP;
   constant PCB : PIN_MAP_STRING :=
           "PTDI:1, " &
           "PTDO:2, " &
           "PTMS:3, " &
           "PTCK:4";
   attribute TAP_SCAN_IN    of PTDI : signal is TRUE;
   attribute TAP_SCAN_OUT   of PTDO : signal is TRUE;
   attribute TAP_SCAN_MODE  of PTMS : signal is TRUE;
   attribute TAP_SCAN_CLOCK of PTCK : signal is (1.0e6, both);
   attribute MEMBERS of LASP_Demo : entity is
           "your_U0 (xc9572xl_vq64, vq64)," &
           "your_U1 (xc9572xl_vq64, vq64)," &
           "your_U2 (xc9572xl_vq64, vq64)," &
           "your_U3 (xc9572xl_vq64, vq64)," &
           "your_U4 (xc9572xl_vq64, vq64)," &
           "your_U5 (xc9572xl_vq64, vq64)," &
           "your_U6 (xc9572xl_vq64, vq64)," &
           "your_U7 (xc9572xl_vq64, vq64)," &
           "your_U8 (xc9572xl_vq64, vq64)," &
           "LASP0_dly_stdo0 (amoeba, membrane)," &
           "LASP0_dly_stdo1 (amoeba, membrane)," &
           "LASP0_dly_stdo2 (amoeba, membrane)," &
           "LASP0_dly_ptdo  (amoeba, membrane)," &
           "LASP1_dly_stdo0 (amoeba, membrane)," &
           "LASP1_dly_stdo1 (amoeba, membrane)," &
           "LASP1_dly_stdo2 (amoeba, membrane)," &
           "LASP1_dly_ptdo  (amoeba, membrane)," &
           "LASP2_dly_stdo0 (amoeba, membrane)," &
           "LASP2_dly_stdo1 (amoeba, membrane)," &
           "LASP2_dly_stdo2 (amoeba, membrane)," &
           "LASP2_dly_ptdo  (amoeba, membrane)";
   constant TAP : EXTERNAL_PATH := "PTDI, PTDO, PTCK, PTMS";
   constant short : STATIC_PATH := "";

   constant your_path0 : STATIC_PATH := "your_U0";
   constant your_path1 : STATIC_PATH := "your_U1";
   constant your_path2 : STATIC_PATH := "your_U2";
   constant your_path3 : STATIC_PATH := "your_U3";
   constant your_path4 : STATIC_PATH := "your_U4";
   constant your_path5 : STATIC_PATH := "your_U5";
   constant your_path6 : STATIC_PATH := "your_U6";
   constant your_path7 : STATIC_PATH := "your_U7";
   constant your_path8 : STATIC_PATH := "your_U8";
   constant subpath0 : STATIC_PATH := "LASP0_dly_stdo0, your_path0";
   constant subpath1 : STATIC_PATH := "LASP0_dly_stdo1, your_path1";
   constant subpath2 : STATIC_PATH := "LASP0_dly_stdo2, your_path2";
   constant subpath3 : STATIC_PATH := "LASP1_dly_stdo0, your_path3";
   constant subpath4 : STATIC_PATH := "LASP1_dly_stdo1, your_path4";
   constant subpath5 : STATIC_PATH := "LASP1_dly_stdo2, your_path5";
   constant subpath6 : STATIC_PATH := "LASP2_dly_stdo0, your_path6";
   constant subpath7 : STATIC_PATH := "LASP2_dly_stdo1, your_path7";
```

```
constant subpath8 : STATIC_PATH := "LASP2_dly_stdo2, your_path8";
constant LASP0_ssp0 : DYNAMIC_PATH :=
  "0 (short:LASP0_ssp0, subpath0:1), " &
  "1 (short:1, subpath0:LASP0_ssp0)";
constant LASP0_ssp1 : DYNAMIC_PATH :=
  "0 (short:LASP0_ssp1, subpath1:1), " &
  "1 (short:1, subpath1:LASP0_ssp1)";
constant LASP0_ssp2 : DYNAMIC_PATH :=
  "0 (short:LASP0_ssp2, subpath2:1), " &
  "1 (short:1, subpath2:LASP0_ssp2)";
constant LASP1_ssp0 : DYNAMIC_PATH :=
  "0 (short:LASP1_ssp0, subpath3:1), " &
  "1 (short:1, subpath3:LASP1_ssp0)";
constant LASP1_ssp1 : DYNAMIC_PATH :=
  "0 (short:LASP1_ssp1, subpath4:1), " &
  "1 (short:1, subpath4:LASP1_ssp1)";
constant LASP1_ssp2 : DYNAMIC_PATH :=
  "0 (short:LASP1_ssp2, subpath5:1), " &
  "1 (short:1, subpath5:LASP1_ssp2)";
constant LASP2_ssp0 : DYNAMIC_PATH :=
  "0 (short:LASP2_ssp0, subpath6:1), " &
  "1 (short:1, subpath6:LASP2_ssp0)";
constant LASP2_ssp1 : DYNAMIC_PATH :=
  "0 (short:LASP2_ssp1, subpath7:1), " &
  "1 (short:1, subpath7:LASP2_ssp1)";
constant LASP2_ssp2 : DYNAMIC_PATH :=
  "0 (short:LASP2_ssp2, subpath8:1), " &
  "1 (short:1, subpath8:LASP2_ssp2)";
constant LASP0_all : STATIC_PATH := "LASP0_ssp0, LASP0_ssp1, LASP0_ssp2, LASP0_dly_ptdo";
constant LASP1_all : STATIC_PATH := "LASP1_ssp0, LASP1_ssp1, LASP1_ssp2, LASP1_dly_ptdo";
constant LASP2_all : STATIC_PATH := "LASP2_ssp0, LASP2_ssp1, LASP2_ssp2, LASP2_dly_ptdo";
constant LASP0 : DYNAMIC_PATH :=
  "0 (short:LASP0, LASP0_all:1), " &
  "1 (short:1, LASP0_all:LASP0)";
constant LASP1 : DYNAMIC_PATH :=
  "0 (short:LASP1, LASP1_all:1), " &
  "1 (short:1, LASP1_all:LASP1)";
constant LASP2 : DYNAMIC_PATH :=
  "0 (short:LASP2, LASP2_all:1), " &
  "1 (short:1, LASP2_all:LASP2)";
constant primary : STATIC_PATH :=
  "TAP, LASP0, LASP1, LASP2";
end LASP_Demo;
```

Appendix B

BSDL file for xc9572XL vq64 package

```
-- -- BSDL File created/edited by XILINX bsdl.pl script -- --Package: vq64 --RCS:$Header:
/tools/xicad/bsdl/master/xc9kxl/RCS/xc9572xl_vq64.bsd,v 1.2 2002/01/29 18:40:24 terry Exp $
--BSDE:$Revision: 1.2 $ --BSDE: Xilinx xc9572xl_vq64 macrocell FastFlash ISP CPLD -- --For
technical support, contact Xilinx as follows: -- North America 1-800-255-7778
hotline@xilinx.com -- United Kingdom +44 870 7350 610 eurosupport@xilinx.com -- France (33) 1
3463 0100 eurosupport@xilinx.com -- Germany (49) 89 991 54930 eurosupport@xilinx.com -- Japan
(81) 3-3297-9163 jhotline@xilinx.com -- entity xc9572xl_vq64 is
generic (PHYSICAL_PIN_MAP : string := "vq64" );
port (
    PB00_01: inout bit;
    PB00_02: inout bit;
    PB00_03: inout bit;
    PB00_04: inout bit;
    PB00_05: inout bit;
    PB00_07: inout bit;
    PB00_08: inout bit;
    PB00_09: inout bit;
    PB00_10: inout bit;
    PB00_11: inout bit;
    PB00_13: inout bit;
    PB00_14: inout bit;
    PB00_16: inout bit;
    PB01_01: inout bit;
    PB01_02: inout bit;
    PB01_03: inout bit;
    PB01_04: inout bit;
    PB01_05: inout bit;
    PB01_07: inout bit;
    PB01_08: inout bit;
    PB01_09: inout bit;
    PB01_10: inout bit;
    PB01_11: inout bit;
    PB01_13: inout bit;
    PB01_14: inout bit;
    PB01_16: inout bit;
    PB02_01: inout bit;
    PB02_02: inout bit;
    PB02_03: inout bit;
    PB02_04: inout bit;
    PB02_05: inout bit;
    PB02_07: inout bit;
    PB02_08: inout bit;
    PB02_09: inout bit;
    PB02_10: inout bit;
    PB02_11: inout bit;
    PB02_13: inout bit;
    PB02_14: inout bit;
    PB02_15: inout bit;
    PB02_16: inout bit;
    PB03_01: inout bit;
    PB03_02: inout bit;
    PB03_03: inout bit;
    PB03_04: inout bit;
    PB03_05: inout bit;
    PB03_07: inout bit;
    PB03_09: inout bit;
    PB03_10: inout bit;
    PB03_11: inout bit;
    PB03_13: inout bit;
```

```
        PB03_14: inout bit;
        PB03_16: inout bit;
        TCK: in bit;
        TDI: in bit;
        TDO: out bit;
        TMS: in bit;
        Vccint_1: linkage bit;
        VccInt_Vpp: linkage bit;
        Vccio_1: linkage bit;
        Vccio_2: linkage bit;
        Vssint_2: linkage bit;
        Vssint_3: linkage bit;
        Vssio_1: linkage bit;
        Vssio_2: linkage bit );
use STD_1149_1_1994.all;
attribute COMPONENT_CONFORMANCE of xc9572xl_vq64 : entity is "STD_1149_1_1993";
attribute PIN_MAP of xc9572xl_vq64 : entity is PHYSICAL_PIN_MAP;
constant vq64: PIN_MAP_STRING:=
        "PB00_01:8," &
        "PB00_02:12," &
        "PB00_03:13," &
        "PB00_04:9," &
        "PB00_05:10," &
        "PB00_07:11," &
        "PB00_08:15," &
        "PB00_09:18," &
        "PB00_10:16," &
        "PB00_11:23," &
        "PB00_13:17," &
        "PB00_14:19," &
        "PB00_16:20," &
        "PB01_01:60," &
        "PB01_02:58," &
        "PB01_03:59," &
        "PB01_04:61," &
        "PB01_05:62," &
        "PB01_07:63," &
        "PB01_08:64," &
        "PB01_09:1," &
        "PB01_10:2," &
        "PB01_11:4," &
        "PB01_13:5," &
        "PB01_14:6," &
        "PB01_16:7," &
        "PB02_01:22," &
        "PB02_02:31," &
        "PB02_03:32," &
        "PB02_04:24," &
        "PB02_05:34," &
        "PB02_07:25," &
        "PB02_08:27," &
        "PB02_09:39," &
        "PB02_10:33," &
        "PB02_11:40," &
        "PB02_13:35," &
        "PB02_14:36," &
        "PB02_15:42," &
        "PB02_16:38," &
        "PB03_01:43," &
        "PB03_02:46," &
        "PB03_03:47," &
        "PB03_04:44," &
        "PB03_05:49," &
        "PB03_07:45," &
        "PB03_09:51," &
        "PB03_10:48," &
```

```
      "PB03_11:52," &
      "PB03_13:50," &
      "PB03_14:56," &
      "PB03_16:57," &
      "TCK:30," &
      "TDI:28," &
      "TDO:53," &
      "TMS:29," &
      "Vccint_1:37," &
      "VccInt_Vpp:3," &
      "Vccio_1:26," &
      "Vccio_2:55," &
      "Vssint_2:14," &
      "Vssint_3:41," &
      "Vssio_1:21," &
      "Vssio_2:54";
   attribute TAP_SCAN_IN    of TDI : signal is true;
   attribute TAP_SCAN_OUT   of TDO : signal is true;
   attribute TAP_SCAN_MODE  of TMS : signal is true;
   attribute TAP_SCAN_CLOCK of TCK : signal is (1.00e+07, BOTH);
   attribute INSTRUCTION_LENGTH of xc9572xl_vq64 : entity is 8;
   attribute INSTRUCTION_OPCODE of xc9572xl_vq64 : entity is
      "BYPASS ( 11111111)," &
      "CLAMP ( 11111010)," &
      "ISPEX ( 11110000)," &
      "EXTEST ( 00000000),"&
      "FBLANK ( 11100101),"&
      "FBULK ( 11101101),"&
      "FERASE ( 11101100),"&
      "FPGM ( 11101010)," &
      "FPGMI ( 11101011)," &
      "FVFY ( 11101110)," &
      "FVFYI ( 11101111)," &
      "HIGHZ ( 11111100),"&
      "IDCODE ( 11111110),"&
      "INTEST ( 00000010),"&
      "ISPEN ( 11101000)," &
      "ISPENC ( 11101001)," &
      "SAMPLE ( 00000001)," &
      "USERCODE ( 11111101)";
   attribute INSTRUCTION_CAPTURE of xc9572xl_vq64: entity is "000XXX01";
   attribute IDCODE_REGISTER of xc9572xl_vq64: entity is
         "XXXX" &                   -- version
         "1001011000000100" &      -- part number
         "00001001001" &           -- manufacturer's id
         "1";                       -- required by standard


   attribute USERCODE_REGISTER of xc9572xl_vq64: entity is
         "XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX";
   attribute REGISTER_ACCESS of xc9572xl_vq64 : entity is
         "BYPASS ( ISPEX, HIGHZ, CLAMP )," &
         "ISCENABLE[6] ( ISPEN, ISPENC )," &
         "ISDATA[34] (  FPGMI, FVFYI ),"&
         "ISADDRESS[18] ( FERASE, FBULK, FBLANK ),"&
         "ISCONFIGURATION[50] (  FPGM, FVFY )";
   attribute BOUNDARY_LENGTH of xc9572xl_vq64 : entity is 216;
   attribute BOUNDARY_REGISTER of xc9572xl_vq64 : entity is
     "   215 (BC_1, *, internal, X)," &
     "   214 (BC_1, *, internal, X)," &
     "   213 (BC_1, *, internal, X)," &
     "   212 (BC_1, PB00_01, input, X), "  &
     "   211 (BC_1, PB00_01, output3, X, 210, 0, Z)," &
     "   210 (BC_1, *, controlr, 0)," &
     "   209 (BC_1, PB00_02, input, X), "  &
     "   208 (BC_1, PB00_02, output3, X, 207, 0, Z)," &
```

```
"   207 (BC_1, *, controlr, 0)," &
"   206 (BC_1, PB00_03, input, X), "  &
"   205 (BC_1, PB00_03, output3, X, 204, 0, Z)," &
"   204 (BC_1, *, controlr, 0)," &
"   203 (BC_1, PB00_04, input, X), "  &
"   202 (BC_1, PB00_04, output3, X, 201, 0, Z)," &
"   201 (BC_1, *, controlr, 0)," &
"   200 (BC_1, PB00_05, input, X), "  &
"   199 (BC_1, PB00_05, output3, X, 198, 0, Z)," &
"   198 (BC_1, *, controlr, 0)," &
"   197 (BC_1, *, internal, X)," &
"   196 (BC_1, *, internal, X)," &
"   195 (BC_1, *, internal, X)," &
"   194 (BC_1, PB00_07, input, X), "  &
"   193 (BC_1, PB00_07, output3, X, 192, 0, Z)," &
"   192 (BC_1, *, controlr, 0)," &
"   191 (BC_1, PB00_08, input, X), "  &
"   190 (BC_1, PB00_08, output3, X, 189, 0, Z)," &
"   189 (BC_1, *, controlr, 0)," &
"   188 (BC_1, PB00_09, input, X), "  &
"   187 (BC_1, PB00_09, output3, X, 186, 0, Z)," &
"   186 (BC_1, *, controlr, 0)," &
"   185 (BC_1, PB00_10, input, X), "  &
"   184 (BC_1, PB00_10, output3, X, 183, 0, Z)," &
"   183 (BC_1, *, controlr, 0)," &
"   182 (BC_1, PB00_11, input, X), "  &
"   181 (BC_1, PB00_11, output3, X, 180, 0, Z)," &
"   180 (BC_1, *, controlr, 0)," &
"   179 (BC_1, *, internal, X)," &
"   178 (BC_1, *, internal, X)," &
"   177 (BC_1, *, internal, X)," &
"   176 (BC_1, PB00_13, input, X), "  &
"   175 (BC_1, PB00_13, output3, X, 174, 0, Z)," &
"   174 (BC_1, *, controlr, 0)," &
"   173 (BC_1, PB00_14, input, X), "  &
"   172 (BC_1, PB00_14, output3, X, 171, 0, Z)," &
"   171 (BC_1, *, controlr, 0)," &
"   170 (BC_1, *, internal, X)," &
"   169 (BC_1, *, internal, X)," &
"   168 (BC_1, *, internal, X)," &
"   167 (BC_1, PB00_16, input, X), "  &
"   166 (BC_1, PB00_16, output3, X, 165, 0, Z)," &
"   165 (BC_1, *, controlr, 0)," &
"   164 (BC_1, *, internal, X)," &
"   163 (BC_1, *, internal, X)," &
"   162 (BC_1, *, internal, X)," &
"   161 (BC_1, *, internal, X)," &
"   160 (BC_1, *, internal, X)," &
"   159 (BC_1, *, internal, X)," &
"   158 (BC_1, PB01_01, input, X), "  &
"   157 (BC_1, PB01_01, output3, X, 156, 0, Z)," &
"   156 (BC_1, *, controlr, 0)," &
"   155 (BC_1, PB01_02, input, X), "  &
"   154 (BC_1, PB01_02, output3, X, 153, 0, Z)," &
"   153 (BC_1, *, controlr, 0)," &
"   152 (BC_1, PB01_03, input, X), "  &
"   151 (BC_1, PB01_03, output3, X, 150, 0, Z)," &
"   150 (BC_1, *, controlr, 0)," &
"   149 (BC_1, PB01_04, input, X), "  &
"   148 (BC_1, PB01_04, output3, X, 147, 0, Z)," &
"   147 (BC_1, *, controlr, 0)," &
"   146 (BC_1, PB01_05, input, X), "  &
"   145 (BC_1, PB01_05, output3, X, 144, 0, Z)," &
"   144 (BC_1, *, controlr, 0)," &
"   143 (BC_1, *, internal, X)," &
"   142 (BC_1, *, internal, X)," &
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"   141 (BC_1, *, internal, X)," &
"   140 (BC_1, PB01_07, input, X), "  &
"   139 (BC_1, PB01_07, output3, X, 138, 0, Z)," &
"   138 (BC_1, *, controlr, 0)," &
"   137 (BC_1, PB01_08, input, X), "  &
"   136 (BC_1, PB01_08, output3, X, 135, 0, Z)," &
"   135 (BC_1, *, controlr, 0)," &
"   134 (BC_1, PB01_09, input, X), "  &
"   133 (BC_1, PB01_09, output3, X, 132, 0, Z)," &
"   132 (BC_1, *, controlr, 0)," &
"   131 (BC_1, PB01_10, input, X), "  &
"   130 (BC_1, PB01_10, output3, X, 129, 0, Z)," &
"   129 (BC_1, *, controlr, 0)," &
"   128 (BC_1, PB01_11, input, X), "  &
"   127 (BC_1, PB01_11, output3, X, 126, 0, Z)," &
"   126 (BC_1, *, controlr, 0)," &
"   125 (BC_1, *, internal, X)," &
"   124 (BC_1, *, internal, X)," &
"   123 (BC_1, *, internal, X)," &
"   122 (BC_1, PB01_13, input, X), "  &
"   121 (BC_1, PB01_13, output3, X, 120, 0, Z)," &
"   120 (BC_1, *, controlr, 0)," &
"   119 (BC_1, PB01_14, input, X), "  &
"   118 (BC_1, PB01_14, output3, X, 117, 0, Z)," &
"   117 (BC_1, *, controlr, 0)," &
"   116 (BC_1, *, internal, X)," &
"   115 (BC_1, *, internal, X)," &
"   114 (BC_1, *, internal, X)," &
"   113 (BC_1, PB01_16, input, X), "  &
"   112 (BC_1, PB01_16, output3, X, 111, 0, Z)," &
"   111 (BC_1, *, controlr, 0)," &
"   110 (BC_1, *, internal, X)," &
"   109 (BC_1, *, internal, X)," &
"   108 (BC_1, *, internal, X)," &
"   107 (BC_1, *, internal, X)," &
"   106 (BC_1, *, internal, X)," &
"   105 (BC_1, *, internal, X)," &
"   104 (BC_1, PB02_01, input, X), "  &
"   103 (BC_1, PB02_01, output3, X, 102, 0, Z)," &
"   102 (BC_1, *, controlr, 0)," &
"   101 (BC_1, PB02_02, input, X), "  &
"   100 (BC_1, PB02_02, output3, X, 99, 0, Z)," &
"   99 (BC_1, *, controlr, 0)," &
"   98 (BC_1, PB02_03, input, X), "  &
"   97 (BC_1, PB02_03, output3, X, 96, 0, Z)," &
"   96 (BC_1, *, controlr, 0)," &
"   95 (BC_1, PB02_04, input, X), "  &
"   94 (BC_1, PB02_04, output3, X, 93, 0, Z)," &
"   93 (BC_1, *, controlr, 0)," &
"   92 (BC_1, PB02_05, input, X), "  &
"   91 (BC_1, PB02_05, output3, X, 90, 0, Z)," &
"   90 (BC_1, *, controlr, 0)," &
"   89 (BC_1, *, internal, X)," &
"   88 (BC_1, *, internal, X)," &
"   87 (BC_1, *, internal, X)," &
"   86 (BC_1, PB02_07, input, X), "  &
"   85 (BC_1, PB02_07, output3, X, 84, 0, Z)," &
"   84 (BC_1, *, controlr, 0)," &
"   83 (BC_1, PB02_08, input, X), "  &
"   82 (BC_1, PB02_08, output3, X, 81, 0, Z)," &
"   81 (BC_1, *, controlr, 0)," &
"   80 (BC_1, PB02_09, input, X), "  &
"   79 (BC_1, PB02_09, output3, X, 78, 0, Z)," &
"   78 (BC_1, *, controlr, 0)," &
"   77 (BC_1, PB02_10, input, X), "  &
"   76 (BC_1, PB02_10, output3, X, 75, 0, Z)," &
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"   75 (BC_1, *, controlr, 0)," &
"   74 (BC_1, PB02_11, input, X), " &
"   73 (BC_1, PB02_11, output3, X, 72, 0, Z)," &
"   72 (BC_1, *, controlr, 0)," &
"   71 (BC_1, *, internal, X)," &
"   70 (BC_1, *, internal, X)," &
"   69 (BC_1, *, internal, X)," &
"   68 (BC_1, PB02_13, input, X), " &
"   67 (BC_1, PB02_13, output3, X, 66, 0, Z)," &
"   66 (BC_1, *, controlr, 0)," &
"   65 (BC_1, PB02_14, input, X), " &
"   64 (BC_1, PB02_14, output3, X, 63, 0, Z)," &
"   63 (BC_1, *, controlr, 0)," &
"   62 (BC_1, PB02_15, input, X), " &
"   61 (BC_1, PB02_15, output3, X, 60, 0, Z)," &
"   60 (BC_1, *, controlr, 0)," &
"   59 (BC_1, PB02_16, input, X), " &
"   58 (BC_1, PB02_16, output3, X, 57, 0, Z)," &
"   57 (BC_1, *, controlr, 0)," &
"   56 (BC_1, *, internal, X)," &
"   55 (BC_1, *, internal, X)," &
"   54 (BC_1, *, internal, X)," &
"   53 (BC_1, *, internal, X)," &
"   52 (BC_1, *, internal, X)," &
"   51 (BC_1, *, internal, X)," &
"   50 (BC_1, PB03_01, input, X), " &
"   49 (BC_1, PB03_01, output3, X, 48, 0, Z)," &
"   48 (BC_1, *, controlr, 0)," &
"   47 (BC_1, PB03_02, input, X), " &
"   46 (BC_1, PB03_02, output3, X, 45, 0, Z)," &
"   45 (BC_1, *, controlr, 0)," &
"   44 (BC_1, PB03_03, input, X), " &
"   43 (BC_1, PB03_03, output3, X, 42, 0, Z)," &
"   42 (BC_1, *, controlr, 0)," &
"   41 (BC_1, PB03_04, input, X), " &
"   40 (BC_1, PB03_04, output3, X, 39, 0, Z)," &
"   39 (BC_1, *, controlr, 0)," &
"   38 (BC_1, PB03_05, input, X), " &
"   37 (BC_1, PB03_05, output3, X, 36, 0, Z)," &
"   36 (BC_1, *, controlr, 0)," &
"   35 (BC_1, *, internal, X)," &
"   34 (BC_1, *, internal, X)," &
"   33 (BC_1, *, internal, X)," &
"   32 (BC_1, PB03_07, input, X), " &
"   31 (BC_1, PB03_07, output3, X, 30, 0, Z)," &
"   30 (BC_1, *, controlr, 0)," &
"   29 (BC_1, *, internal, X)," &
"   28 (BC_1, *, internal, X)," &
"   27 (BC_1, *, internal, X)," &
"   26 (BC_1, PB03_09, input, X), " &
"   25 (BC_1, PB03_09, output3, X, 24, 0, Z)," &
"   24 (BC_1, *, controlr, 0)," &
"   23 (BC_1, PB03_10, input, X), " &
"   22 (BC_1, PB03_10, output3, X, 21, 0, Z)," &
"   21 (BC_1, *, controlr, 0)," &
"   20 (BC_1, PB03_11, input, X), " &
"   19 (BC_1, PB03_11, output3, X, 18, 0, Z)," &
"   18 (BC_1, *, controlr, 0)," &
"   17 (BC_1, *, internal, X)," &
"   16 (BC_1, *, internal, X)," &
"   15 (BC_1, *, internal, X)," &
"   14 (BC_1, PB03_13, input, X), " &
"   13 (BC_1, PB03_13, output3, X, 12, 0, Z)," &
"   12 (BC_1, *, controlr, 0)," &
"   11 (BC_1, PB03_14, input, X), " &
"   10 (BC_1, PB03_14, output3, X, 9, 0, Z)," &
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    "    9 (BC_1, *, controlr, 0)," &
    "    8 (BC_1, *, internal, X)," &
    "    7 (BC_1, *, internal, X)," &
    "    6 (BC_1, *, internal, X)," &
    "    5 (BC_1, PB03_16, input, X), "  &
    "    4 (BC_1, PB03_16, output3, X, 3, 0, Z)," &
    "    3 (BC_1, *, controlr, 0)," &
    "    2 (BC_1, *, internal, X)," &
    "    1 (BC_1, *, internal, X)," &
    "    0 (BC_1, *, internal, X)";
end xc9572xl_vq64;
```

Appendix C

SVF program 1 "zoom.svf"

```
// Created using Xilinx iMPACT Software [ISE WebPACK - 7.1.02i]
TRST OFF;
ENDIR IDLE;
ENDDR IDLE;
STATE RESET IDLE;
FREQUENCY 1E6 HZ;
TIR 0 ;
HIR 0 ;
TDR 0 ;
HDR 0 ;
TIR 0 ;
HIR 0 ;
HDR 0 ;
TDR 0 ;
//Loading device with 'idcode' instruction.
SIR 8 TDI (fe) SMASK (ff) ;
SDR 32 TDI (00000000) SMASK (ffffffff) TDO (f9604093) MASK (0fffffff) ;
//Check for Read/Write Protect.
SIR 8 TDI (ff) TDO (01) MASK (e3) ;
// Validating chain...
TIR 0 ;
HIR 0 ;
TDR 0 ;
HDR 0 ;
SIR 16 TDI (ffaa) SMASK (ffff) TDO (aa01) MASK (ffe3) ;
TIR 0 ;
HIR 0 ;
TDR 0 ;
HDR 0 ;
TIR 0 ;
HIR 0 ;
TDR 0 ;
HDR 0 ;
// Loading devices with 'ispen' or 'bypass'  instruction.
SIR 8 TDI (e8) SMASK (ff) ;
SDR 6 TDI (05) SMASK (3f) ;
// Loading devices with 'fbulk' instruction.
SIR 8 TDI (ed) ;
SDR 18 TDI (03ffff) SMASK (03ffff) ;
RUNTEST 200000 TCK;
SDR 18 TDI (03fffd) TDO (000001) MASK (000003) ;
// Loading devices with 'conld' or 'bypass' instruction.
SIR 8 TDI (f0) ;
RUNTEST 100 TCK;
// Loading devices with 'ispen' or 'bypass'  instruction.
SIR 8 TDI (e8) ;
SDR 6 TDI (05) SMASK (3f) ;
// Loading device with 'fpgm' instruction.
SIR 8 TDI (ea) ;
SDR 50 TDI (00000000000001) SMASK (03ffffffffffff) ;
SDR 50 TDI (00000400000001) ;
SDR 50 TDI (00000800000001) ;
SDR 50 TDI (00000c00000001) ;
SDR 50 TDI (00001000000001) ;
SDR 50 TDI (00002000000001) ;
SDR 50 TDI (00002400000001) ;
SDR 50 TDI (00002800000001) ;
SDR 50 TDI (00002c00000001) ;
SDR 50 TDI (00003000000001) ;
SDR 50 TDI (00004000000001) ;
```

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        SDR 50 TDI (00004400000001) ;
        SDR 50 TDI (00004800000001) ;
        SDR 50 TDI (00004c00000001) ;
        SDR 50 TDI (00005000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (00008000000000) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (00008000000001) ;
        SDR 50 TDI (00008400000001) ;
        SDR 50 TDI (00008800000001) ;
        SDR 50 TDI (00008c00000001) ;
        SDR 50 TDI (00009000000001) ;
        SDR 50 TDI (0000a000000001) ;
        SDR 50 TDI (0000a400000001) ;
        SDR 50 TDI (0000a800000001) ;
        SDR 50 TDI (0000ac00000001) ;
        SDR 50 TDI (0000b000000001) ;
        SDR 50 TDI (0000c000000001) ;
        SDR 50 TDI (0000c400000001) ;
        SDR 50 TDI (0000c800000001) ;
        SDR 50 TDI (0000cc00000001) ;
        SDR 50 TDI (0000d000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (00010000000000) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (00010000000001) ;
        SDR 50 TDI (00010400000101) ;
        SDR 50 TDI (00010800000001) ;
        SDR 50 TDI (00010c00000001) ;
        SDR 50 TDI (00011000000001) ;
        SDR 50 TDI (00012000000001) ;
        SDR 50 TDI (00012400000001) ;
        SDR 50 TDI (00012800000001) ;
        SDR 50 TDI (00012c00000001) ;
        SDR 50 TDI (00013000000001) ;
        SDR 50 TDI (00014000000001) ;
        SDR 50 TDI (00014400000001) ;
        SDR 50 TDI (00014800000001) ;
        SDR 50 TDI (00014c00000001) ;
        SDR 50 TDI (00015000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (00018000c400e0) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (00018000c400e1) ;
        SDR 50 TDI (00018400000001) ;
        SDR 50 TDI (00018800000001) ;
        SDR 50 TDI (00018c00000001) ;
        SDR 50 TDI (00019000000001) ;
        SDR 50 TDI (0001a000000071) ;
        SDR 50 TDI (0001a400000001) ;
        SDR 50 TDI (0001a800000001) ;
        SDR 50 TDI (0001ac00000001) ;
        SDR 50 TDI (0001b000000001) ;
        SDR 50 TDI (0001c0008000e1) ;
        SDR 50 TDI (0001c400000001) ;
        SDR 50 TDI (0001c800000001) ;
        SDR 50 TDI (0001cc00000001) ;
        SDR 50 TDI (0001d000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (00020000000000) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (00020000000001) ;
        SDR 50 TDI (00020400000001) ;
        SDR 50 TDI (00020800000001) ;
        SDR 50 TDI (00020c00000001) ;
        SDR 50 TDI (00021000000001) ;
        SDR 50 TDI (00022000000001) ;
        SDR 50 TDI (00022400000001) ;
        SDR 50 TDI (00022800000001) ;
        SDR 50 TDI (00022c00000001) ;
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SDR 50 TDI (00023000000001) ;
SDR 50 TDI (00024000000001) ;
SDR 50 TDI (00024400000001) ;
SDR 50 TDI (00024800000001) ;
SDR 50 TDI (00024c00000001) ;
SDR 50 TDI (00025000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00028000c400e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00028000c400e1) ;
SDR 50 TDI (00028400000001) ;
SDR 50 TDI (00028800000001) ;
SDR 50 TDI (00028c00000001) ;
SDR 50 TDI (00029000000001) ;
SDR 50 TDI (0002a000040071) ;
SDR 50 TDI (0002a400000001) ;
SDR 50 TDI (0002a800000001) ;
SDR 50 TDI (0002ac00000001) ;
SDR 50 TDI (0002b000000001) ;
SDR 50 TDI (0002c0008000e1) ;
SDR 50 TDI (0002c400000001) ;
SDR 50 TDI (0002c800000001) ;
SDR 50 TDI (0002cc00000001) ;
SDR 50 TDI (0002d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00030000000100) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00030000000101) ;
SDR 50 TDI (00030400080301) ;
SDR 50 TDI (00030800080201) ;
SDR 50 TDI (00030c00000201) ;
SDR 50 TDI (00031000000101) ;
SDR 50 TDI (00032000000201) ;
SDR 50 TDI (00032400000301) ;
SDR 50 TDI (00032800000301) ;
SDR 50 TDI (00032c00000001) ;
SDR 50 TDI (00033000000001) ;
SDR 50 TDI (00034000000001) ;
SDR 50 TDI (00034400000001) ;
SDR 50 TDI (00034800000001) ;
SDR 50 TDI (00034c00000001) ;
SDR 50 TDI (00035000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00038000000100) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00038000000101) ;
SDR 50 TDI (00038400000201) ;
SDR 50 TDI (00038800000301) ;
SDR 50 TDI (00038c00000301) ;
SDR 50 TDI (00039000000101) ;
SDR 50 TDI (0003a000000201) ;
SDR 50 TDI (0003a400000301) ;
SDR 50 TDI (0003a800000101) ;
SDR 50 TDI (0003ac00000001) ;
SDR 50 TDI (0003b000000001) ;
SDR 50 TDI (0003c000200001) ;
SDR 50 TDI (0003c400000001) ;
SDR 50 TDI (0003c800000001) ;
SDR 50 TDI (0003cc00000001) ;
SDR 50 TDI (0003d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00040000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00040000000001) ;
SDR 50 TDI (00040400000001) ;
SDR 50 TDI (00040800000001) ;
SDR 50 TDI (00040c00000001) ;
SDR 50 TDI (00041000000001) ;
SDR 50 TDI (00042000000001) ;
SDR 50 TDI (00042400000001) ;
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SDR 50 TDI (00042800000001) ;
SDR 50 TDI (00042c00000001) ;
SDR 50 TDI (00043000000001) ;
SDR 50 TDI (00044000000001) ;
SDR 50 TDI (00044400000001) ;
SDR 50 TDI (00044800000001) ;
SDR 50 TDI (00044c00000001) ;
SDR 50 TDI (00045000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00048000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00048000000001) ;
SDR 50 TDI (00048400000001) ;
SDR 50 TDI (00048800000001) ;
SDR 50 TDI (00048c00000001) ;
SDR 50 TDI (00049000000001) ;
SDR 50 TDI (0004a000000001) ;
SDR 50 TDI (0004a400000001) ;
SDR 50 TDI (0004a800000001) ;
SDR 50 TDI (0004ac00000001) ;
SDR 50 TDI (0004b000000001) ;
SDR 50 TDI (0004c000000001) ;
SDR 50 TDI (0004c400000001) ;
SDR 50 TDI (0004c800000001) ;
SDR 50 TDI (0004cc00000001) ;
SDR 50 TDI (0004d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00050000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00050000000001) ;
SDR 50 TDI (00050400000001) ;
SDR 50 TDI (00050800000001) ;
SDR 50 TDI (00050c00000001) ;
SDR 50 TDI (00051000000001) ;
SDR 50 TDI (00052000200001) ;
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SDR 50 TDI (00052800000001) ;
SDR 50 TDI (00052c00000001) ;
SDR 50 TDI (00053000000001) ;
SDR 50 TDI (00054000000001) ;
SDR 50 TDI (00054400080001) ;
SDR 50 TDI (00054800080001) ;
SDR 50 TDI (00054c00000001) ;
SDR 50 TDI (00055000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00058000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00058000000001) ;
SDR 50 TDI (00058400000001) ;
SDR 50 TDI (00058800000001) ;
SDR 50 TDI (00058c00000001) ;
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SDR 50 TDI (0005b000000001) ;
SDR 50 TDI (0005c000000001) ;
SDR 50 TDI (0005c400000001) ;
SDR 50 TDI (0005c800000001) ;
SDR 50 TDI (0005cc00000001) ;
SDR 50 TDI (0005d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00060003000200) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00060003000201) ;
SDR 50 TDI (00060403000201) ;
SDR 50 TDI (00060803000201) ;
SDR 50 TDI (00060c03000201) ;
SDR 50 TDI (00061003000201) ;
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SDR 50 TDI (00062003000201) ;
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SDR 50 TDI (00062c03000301) ;
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SDR 50 TDI (00064400000001) ;
SDR 50 TDI (00064800000001) ;
SDR 50 TDI (00064c00000001) ;
SDR 50 TDI (00065000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00068000d400e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00068000d400e1) ;
SDR 50 TDI (00068400000001) ;
SDR 50 TDI (00068800000001) ;
SDR 50 TDI (00068c00000001) ;
SDR 50 TDI (00069000000001) ;
SDR 50 TDI (0006a0001c0071) ;
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SDR 50 TDI (0006ac00000001) ;
SDR 50 TDI (0006b000000001) ;
SDR 50 TDI (0006c0009400e1) ;
SDR 50 TDI (0006c400000001) ;
SDR 50 TDI (0006c800000001) ;
SDR 50 TDI (0006cc00000001) ;
SDR 50 TDI (0006d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (000700002000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00070002000001) ;
SDR 50 TDI (00070402000001) ;
SDR 50 TDI (00070802000001) ;
SDR 50 TDI (00070c01000001) ;
SDR 50 TDI (00071002000001) ;
SDR 50 TDI (00072003000001) ;
SDR 50 TDI (00072400000001) ;
SDR 50 TDI (00072802000001) ;
SDR 50 TDI (00072c00000001) ;
SDR 50 TDI (00073000000001) ;
SDR 50 TDI (00074000000001) ;
SDR 50 TDI (00074400000001) ;
SDR 50 TDI (00074800000001) ;
SDR 50 TDI (00074c00000001) ;
SDR 50 TDI (00075000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00078000d400e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00078000d400e1) ;
SDR 50 TDI (00078400000001) ;
SDR 50 TDI (00078800000001) ;
SDR 50 TDI (00078c00000001) ;
SDR 50 TDI (00079000000001) ;
SDR 50 TDI (0007a0000c0071) ;
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SDR 50 TDI (0007a800000001) ;
SDR 50 TDI (0007ac00000001) ;
SDR 50 TDI (0007b000000001) ;
SDR 50 TDI (0007c0008400e1) ;
SDR 50 TDI (0007c400000001) ;
SDR 50 TDI (0007c800000001) ;
SDR 50 TDI (0007cc00000001) ;
SDR 50 TDI (0007d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00080000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00080000000001) ;
SDR 50 TDI (00080402000001) ;
SDR 50 TDI (00080800000001) ;
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SDR 50 TDI (00080c01000001) ;
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SDR 50 TDI (00082003000001) ;
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SDR 50 TDI (00082802000001) ;
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SDR 50 TDI (00084000000001) ;
SDR 50 TDI (00084400000001) ;
SDR 50 TDI (00084800000001) ;
SDR 50 TDI (00084c00000001) ;
SDR 50 TDI (00085000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00088000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00088000000001) ;
SDR 50 TDI (00088400000001) ;
SDR 50 TDI (00088800000001) ;
SDR 50 TDI (00088c00000001) ;
SDR 50 TDI (00089000000001) ;
SDR 50 TDI (0008a000000001) ;
SDR 50 TDI (0008a400000001) ;
SDR 50 TDI (0008a800000001) ;
SDR 50 TDI (0008ac00000001) ;
SDR 50 TDI (0008b000000001) ;
SDR 50 TDI (0008c000000001) ;
SDR 50 TDI (0008c400000001) ;
SDR 50 TDI (0008c800000001) ;
SDR 50 TDI (0008cc00000001) ;
SDR 50 TDI (0008d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00090000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00094400000001) ;
SDR 50 TDI (00094800000001) ;
SDR 50 TDI (00094c00000001) ;
SDR 50 TDI (00095000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00098000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00098000000001) ;
SDR 50 TDI (00098400280001) ;
SDR 50 TDI (00098800000001) ;
SDR 50 TDI (00098c00000001) ;
SDR 50 TDI (00099000000001) ;
SDR 50 TDI (0009a000000011) ;
SDR 50 TDI (0009a400e00001) ;
SDR 50 TDI (0009a800000001) ;
SDR 50 TDI (0009ac00000001) ;
SDR 50 TDI (0009b000000001) ;
SDR 50 TDI (0009c000000081) ;
SDR 50 TDI (0009c400480001) ;
SDR 50 TDI (0009c800000001) ;
SDR 50 TDI (0009cc00000001) ;
SDR 50 TDI (0009d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (000a0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (000a0000000001) ;
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      SDR 50 TDI (000a0400000001) ;
      SDR 50 TDI (000a0800000001) ;
      SDR 50 TDI (000a0c00000001) ;
      SDR 50 TDI (000a1000000001) ;
      SDR 50 TDI (000a2000000001) ;
      SDR 50 TDI (000a2400000001) ;
      SDR 50 TDI (000a2800000001) ;
      SDR 50 TDI (000a2c00000001) ;
      SDR 50 TDI (000a3000000001) ;
      SDR 50 TDI (000a4000000001) ;
      SDR 50 TDI (000a4400000001) ;
      SDR 50 TDI (000a4800000001) ;
      SDR 50 TDI (000a4c00000001) ;
      SDR 50 TDI (000a5000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (000a8000000020) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (000a8000000021) ;
      SDR 50 TDI (000a8400000001) ;
      SDR 50 TDI (000a8800000001) ;
      SDR 50 TDI (000a8c00000001) ;
      SDR 50 TDI (000a9000000001) ;
      SDR 50 TDI (000aa000000011) ;
      SDR 50 TDI (000aa400000001) ;
      SDR 50 TDI (000aa800000001) ;
      SDR 50 TDI (000aac00000001) ;
      SDR 50 TDI (000ab000000001) ;
      SDR 50 TDI (000ac000000081) ;
      SDR 50 TDI (000ac400000001) ;
      SDR 50 TDI (000ac800000001) ;
      SDR 50 TDI (000acc00000001) ;
      SDR 50 TDI (000ad000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (000b0000000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (000b0000000001) ;
      SDR 50 TDI (000b0402000001) ;
      SDR 50 TDI (000b0800000001) ;
      SDR 50 TDI (000b0c01000001) ;
      SDR 50 TDI (000b1002000001) ;
      SDR 50 TDI (000b2003000001) ;
      SDR 50 TDI (000b2400000001) ;
      SDR 50 TDI (000b2802000201) ;
      SDR 50 TDI (000b2c00000001) ;
      SDR 50 TDI (000b3000000001) ;
      SDR 50 TDI (000b4000000001) ;
      SDR 50 TDI (000b4400000001) ;
      SDR 50 TDI (000b4800000001) ;
      SDR 50 TDI (000b4c00000001) ;
      SDR 50 TDI (000b5000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (000b8000000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (000b8000000001) ;
      SDR 50 TDI (000b8400000001) ;
      SDR 50 TDI (000b8800000001) ;
      SDR 50 TDI (000b8c00000001) ;
      SDR 50 TDI (000b9000000001) ;
      SDR 50 TDI (000ba000000001) ;
      SDR 50 TDI (000ba400000001) ;
      SDR 50 TDI (000ba800000001) ;
      SDR 50 TDI (000bac00000001) ;
      SDR 50 TDI (000bb000000001) ;
      SDR 50 TDI (000bc000000001) ;
      SDR 50 TDI (000bc400000001) ;
      SDR 50 TDI (000bc800000001) ;
      SDR 50 TDI (000bcc00000001) ;
      SDR 50 TDI (000bd000000003) ;
      RUNTEST 20000 TCK;
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        SDR 50 TDI (000c0000000000) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (000c0000000001) ;
        SDR 50 TDI (000c0400000001) ;
        SDR 50 TDI (000c0800000001) ;
        SDR 50 TDI (000c0c00000001) ;
        SDR 50 TDI (000c1000000001) ;
        SDR 50 TDI (000c2000000001) ;
        SDR 50 TDI (000c2400000001) ;
        SDR 50 TDI (000c2800000001) ;
        SDR 50 TDI (000c2c00000001) ;
        SDR 50 TDI (000c3000000001) ;
        SDR 50 TDI (000c4000000001) ;
        SDR 50 TDI (000c4400000001) ;
        SDR 50 TDI (000c4800000001) ;
        SDR 50 TDI (000c4c00000001) ;
        SDR 50 TDI (000c5000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (000c8000000000) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (000c8000000001) ;
        SDR 50 TDI (000c8400000001) ;
        SDR 50 TDI (000c8800000001) ;
        SDR 50 TDI (000c8c00000001) ;
        SDR 50 TDI (000c9000000001) ;
        SDR 50 TDI (000ca000000001) ;
        SDR 50 TDI (000ca400000001) ;
        SDR 50 TDI (000ca800000001) ;
        SDR 50 TDI (000cac00000001) ;
        SDR 50 TDI (000cb000000001) ;
        SDR 50 TDI (000cc000000001) ;
        SDR 50 TDI (000cc400000001) ;
        SDR 50 TDI (000cc800000001) ;
        SDR 50 TDI (000ccc00000001) ;
        SDR 50 TDI (000cd000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (000d0003000200) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (000d0003000201) ;
        SDR 50 TDI (000d0403000201) ;
        SDR 50 TDI (000d0803000201) ;
        SDR 50 TDI (000d0c03000201) ;
        SDR 50 TDI (000d1003000201) ;
        SDR 50 TDI (000d2003000201) ;
        SDR 50 TDI (000d2403400301) ;
        SDR 50 TDI (000d2803400301) ;
        SDR 50 TDI (000d2c03000301) ;
        SDR 50 TDI (000d3000000001) ;
        SDR 50 TDI (000d4000080001) ;
        SDR 50 TDI (000d4400000001) ;
        SDR 50 TDI (000d4800000001) ;
        SDR 50 TDI (000d4c00000001) ;
        SDR 50 TDI (000d5000000003) ;
        RUNTEST 20000 TCK;
        SDR 50 TDI (000d8000000060) TDO (00000000000001) MASK (00000000000003) ;
        SDR 50 TDI (000d8000000061) ;
        SDR 50 TDI (000d8400000001) ;
        SDR 50 TDI (000d8800000001) ;
        SDR 50 TDI (000d8c00000001) ;
        SDR 50 TDI (000d9000000001) ;
        SDR 50 TDI (000da000000031) ;
        SDR 50 TDI (000da400000001) ;
        SDR 50 TDI (000da800000001) ;
        SDR 50 TDI (000dac00000001) ;
        SDR 50 TDI (000db000000001) ;
        SDR 50 TDI (000dc0000000a1) ;
        SDR 50 TDI (000dc400000001) ;
        SDR 50 TDI (000dc800000001) ;
        SDR 50 TDI (000dcc00000001) ;
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RUNTEST 20000 TCK;
SDR 50 TDI (000e0000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (000e0400000001) ;
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SDR 50 TDI (000e3000000001) ;
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SDR 50 TDI (000e4400000001) ;
SDR 50 TDI (000e4800000001) ;
SDR 50 TDI (000e4c00000001) ;
SDR 50 TDI (000e5000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (000eac00000001) ;
SDR 50 TDI (000eb000000001) ;
SDR 50 TDI (000ec0000000a1) ;
SDR 50 TDI (000ec400000001) ;
SDR 50 TDI (000ec800000001) ;
SDR 50 TDI (000ecc00000001) ;
SDR 50 TDI (000ed000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (000f0002000001) ;
SDR 50 TDI (000f0402000001) ;
SDR 50 TDI (000f0802000001) ;
SDR 50 TDI (000f0c01000001) ;
SDR 50 TDI (000f1002000001) ;
SDR 50 TDI (000f2003000001) ;
SDR 50 TDI (000f2400000001) ;
SDR 50 TDI (000f2802000001) ;
SDR 50 TDI (000f2c00000001) ;
SDR 50 TDI (000f3000000001) ;
SDR 50 TDI (000f4000000001) ;
SDR 50 TDI (000f4400000001) ;
SDR 50 TDI (000f4800000001) ;
SDR 50 TDI (000f4c00000001) ;
SDR 50 TDI (000f5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (000f80004000e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (000f80004000e1) ;
SDR 50 TDI (000f8400000001) ;
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SDR 50 TDI (000fa800000001) ;
SDR 50 TDI (000fac00000001) ;
SDR 50 TDI (000fb000000001) ;
SDR 50 TDI (000fc0000000e1) ;
SDR 50 TDI (000fc400000001) ;
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SDR 50 TDI (00104000400001) ;
SDR 50 TDI (00104400000001) ;
SDR 50 TDI (00104800000001) ;
SDR 50 TDI (00104c00000001) ;
SDR 50 TDI (00105000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (0010c400000001) ;
SDR 50 TDI (0010c800000001) ;
SDR 50 TDI (0010cc00000001) ;
SDR 50 TDI (0010d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00114400000001) ;
SDR 50 TDI (00114800000001) ;
SDR 50 TDI (00114c00000001) ;
SDR 50 TDI (00115000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00118000c000e0) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00119000000001) ;
SDR 50 TDI (0011a000000071) ;
SDR 50 TDI (0011a400000001) ;
SDR 50 TDI (0011a800000001) ;
SDR 50 TDI (0011ac00000001) ;
SDR 50 TDI (0011b000000001) ;
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SDR 50 TDI (0011c0000000e1) ;
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SDR 50 TDI (0011c800000001) ;
SDR 50 TDI (0011cc00000001) ;
SDR 50 TDI (0011d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00120400000001) ;
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SDR 50 TDI (00121000000001) ;
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SDR 50 TDI (00122400000001) ;
SDR 50 TDI (00122800000001) ;
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SDR 50 TDI (00123000000001) ;
SDR 50 TDI (00124000000001) ;
SDR 50 TDI (00124400000001) ;
SDR 50 TDI (00124800000001) ;
SDR 50 TDI (00124c00000001) ;
SDR 50 TDI (00125000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00128000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00128000000001) ;
SDR 50 TDI (00128400000001) ;
SDR 50 TDI (00128800000001) ;
SDR 50 TDI (00128c00000001) ;
SDR 50 TDI (00129000000001) ;
SDR 50 TDI (0012a000000001) ;
SDR 50 TDI (0012a400000001) ;
SDR 50 TDI (0012a800000001) ;
SDR 50 TDI (0012ac00000001) ;
SDR 50 TDI (0012b000000001) ;
SDR 50 TDI (0012c000000001) ;
SDR 50 TDI (0012c400000001) ;
SDR 50 TDI (0012c800000001) ;
SDR 50 TDI (0012cc00000001) ;
SDR 50 TDI (0012d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00132c00000001) ;
SDR 50 TDI (00133000000001) ;
SDR 50 TDI (00134000000001) ;
SDR 50 TDI (00134400000001) ;
SDR 50 TDI (00134800000001) ;
SDR 50 TDI (00134c00000001) ;
SDR 50 TDI (00135000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00138001000200) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00138001000201) ;
SDR 50 TDI (00138401000201) ;
SDR 50 TDI (00138801000201) ;
SDR 50 TDI (00138c02000201) ;
SDR 50 TDI (00139001000201) ;
SDR 50 TDI (0013a000000201) ;
SDR 50 TDI (0013a403000301) ;
SDR 50 TDI (0013a801000301) ;
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SDR 50 TDI (0013c4000000001) ;
SDR 50 TDI (0013c8000000001) ;
SDR 50 TDI (0013cc000000001) ;
SDR 50 TDI (0013d0000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (0014100000000001) ;
SDR 50 TDI (0014200000000001) ;
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SDR 50 TDI (0014280000000001) ;
SDR 50 TDI (00142c0000000001) ;
SDR 50 TDI (0014300000000001) ;
SDR 50 TDI (0014400000000001) ;
SDR 50 TDI (0014440000000001) ;
SDR 50 TDI (0014480000000001) ;
SDR 50 TDI (00144c0000000001) ;
SDR 50 TDI (0014500000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (0014800000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (0014800000000001) ;
SDR 50 TDI (0014840000000001) ;
SDR 50 TDI (0014880000000001) ;
SDR 50 TDI (00148c0000000001) ;
SDR 50 TDI (0014900000000001) ;
SDR 50 TDI (0014a00000000001) ;
SDR 50 TDI (0014a40000000001) ;
SDR 50 TDI (0014a80000000001) ;
SDR 50 TDI (0014ac0000000001) ;
SDR 50 TDI (0014b00000000001) ;
SDR 50 TDI (0014c00000000001) ;
SDR 50 TDI (0014c40000000001) ;
SDR 50 TDI (0014c80000000001) ;
SDR 50 TDI (0014cc0000000001) ;
SDR 50 TDI (0014d00000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (0015040000000001) ;
SDR 50 TDI (0015080000000001) ;
SDR 50 TDI (00150c0000000001) ;
SDR 50 TDI (0015100000000001) ;
SDR 50 TDI (0015200000000001) ;
SDR 50 TDI (0015240000000001) ;
SDR 50 TDI (0015280000000001) ;
SDR 50 TDI (00152c0000000001) ;
SDR 50 TDI (0015300000000001) ;
SDR 50 TDI (0015400000000001) ;
SDR 50 TDI (0015440000000001) ;
SDR 50 TDI (0015480000000001) ;
SDR 50 TDI (00154c0000000001) ;
SDR 50 TDI (0015500000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (0015800000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (0015800000000001) ;
SDR 50 TDI (0015840000000001) ;
SDR 50 TDI (0015880000000001) ;
SDR 50 TDI (00158c0000000001) ;
SDR 50 TDI (0015900000000001) ;
SDR 50 TDI (0015a00000000001) ;
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      SDR 50 TDI (0015a400000001) ;
      SDR 50 TDI (0015a800000001) ;
      SDR 50 TDI (0015ac00000001) ;
      SDR 50 TDI (0015b000000001) ;
      SDR 50 TDI (0015c000000001) ;
      SDR 50 TDI (0015c400000001) ;
      SDR 50 TDI (0015c800000001) ;
      SDR 50 TDI (0015cc00000001) ;
      SDR 50 TDI (0015d000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (00160002000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (00160002000001) ;
      SDR 50 TDI (00160402000001) ;
      SDR 50 TDI (00160802000001) ;
      SDR 50 TDI (00160c01000001) ;
      SDR 50 TDI (00161002000001) ;
      SDR 50 TDI (00162003000001) ;
      SDR 50 TDI (00162400000001) ;
      SDR 50 TDI (00162802000001) ;
      SDR 50 TDI (00162c00000001) ;
      SDR 50 TDI (00163000000001) ;
      SDR 50 TDI (00164000000001) ;
      SDR 50 TDI (00164400000001) ;
      SDR 50 TDI (00164800000001) ;
      SDR 50 TDI (00164c00000001) ;
      SDR 50 TDI (00165000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (00168003000200) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (00168003000201) ;
      SDR 50 TDI (00168403000201) ;
      SDR 50 TDI (00168803000201) ;
      SDR 50 TDI (00168c03000201) ;
      SDR 50 TDI (00169003000201) ;
      SDR 50 TDI (0016a003000201) ;
      SDR 50 TDI (0016a403000301) ;
      SDR 50 TDI (0016a803000101) ;
      SDR 50 TDI (0016ac03000301) ;
      SDR 50 TDI (0016b000000001) ;
      SDR 50 TDI (0016c000000001) ;
      SDR 50 TDI (0016c400000001) ;
      SDR 50 TDI (0016c800000001) ;
      SDR 50 TDI (0016cc00000001) ;
      SDR 50 TDI (0016d000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (00170002000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (00170002000001) ;
      SDR 50 TDI (00170402280001) ;
      SDR 50 TDI (00170802080001) ;
      SDR 50 TDI (00170c01000001) ;
      SDR 50 TDI (00171002000001) ;
      SDR 50 TDI (00172003000001) ;
      SDR 50 TDI (00172400e00001) ;
      SDR 50 TDI (00172802e00001) ;
      SDR 50 TDI (00172c00000001) ;
      SDR 50 TDI (00173000000001) ;
      SDR 50 TDI (00174000000001) ;
      SDR 50 TDI (00174400680001) ;
      SDR 50 TDI (00174800480001) ;
      SDR 50 TDI (00174c00000001) ;
      SDR 50 TDI (00175000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (00178000280000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (00178000280001) ;
      SDR 50 TDI (00178402000001) ;
      SDR 50 TDI (00178800000001) ;
      SDR 50 TDI (00178c01000001) ;
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SDR 50 TDI (00179002000001) ;
SDR 50 TDI (0017a003e00001) ;
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SDR 50 TDI (0017a802000001) ;
SDR 50 TDI (0017ac00000001) ;
SDR 50 TDI (0017b000000001) ;
SDR 50 TDI (0017c000680001) ;
SDR 50 TDI (0017c400000001) ;
SDR 50 TDI (0017c800000001) ;
SDR 50 TDI (0017cc00000001) ;
SDR 50 TDI (0017d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00180000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00180000000001) ;
SDR 50 TDI (00180400000001) ;
SDR 50 TDI (00180800000001) ;
SDR 50 TDI (00180c00000001) ;
SDR 50 TDI (00181000000001) ;
SDR 50 TDI (00182000000001) ;
SDR 50 TDI (00182400000001) ;
SDR 50 TDI (00182800000001) ;
SDR 50 TDI (00182c00000001) ;
SDR 50 TDI (00183000000001) ;
SDR 50 TDI (00184000000001) ;
SDR 50 TDI (00184400000001) ;
SDR 50 TDI (00184800000001) ;
SDR 50 TDI (00184c00000001) ;
SDR 50 TDI (00185000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00188000c400e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00188000c400e1) ;
SDR 50 TDI (00188400000001) ;
SDR 50 TDI (00188800000001) ;
SDR 50 TDI (00188c00000001) ;
SDR 50 TDI (00189000000001) ;
SDR 50 TDI (0018a000040071) ;
SDR 50 TDI (0018a400000001) ;
SDR 50 TDI (0018a800000001) ;
SDR 50 TDI (0018ac00000001) ;
SDR 50 TDI (0018b000000001) ;
SDR 50 TDI (0018c0008400e1) ;
SDR 50 TDI (0018c400000001) ;
SDR 50 TDI (0018c800000001) ;
SDR 50 TDI (0018cc00000001) ;
SDR 50 TDI (0018d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00190000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00190000000001) ;
SDR 50 TDI (00190400000001) ;
SDR 50 TDI (00190800000001) ;
SDR 50 TDI (00190c00000001) ;
SDR 50 TDI (00191000000001) ;
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SDR 50 TDI (00192800000001) ;
SDR 50 TDI (00192c00000001) ;
SDR 50 TDI (00193000000001) ;
SDR 50 TDI (00194000000001) ;
SDR 50 TDI (00194400000001) ;
SDR 50 TDI (00194800000001) ;
SDR 50 TDI (00194c00000001) ;
SDR 50 TDI (00195000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00198003000300) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00198003000301) ;
SDR 50 TDI (00198400000001) ;
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SDR 50 TDI (00198800000001) ;
SDR 50 TDI (00198c00000001) ;
SDR 50 TDI (00199003000301) ;
SDR 50 TDI (0019a000000001) ;
SDR 50 TDI (0019a400000001) ;
SDR 50 TDI (0019a800000001) ;
SDR 50 TDI (0019ac00000001) ;
SDR 50 TDI (0019b000000001) ;
SDR 50 TDI (0019c000000001) ;
SDR 50 TDI (0019c400000001) ;
SDR 50 TDI (0019c800000001) ;
SDR 50 TDI (0019cc00000001) ;
SDR 50 TDI (0019d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001a0001000100) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001a0001000101) ;
SDR 50 TDI (001a0400000001) ;
SDR 50 TDI (001a0800000001) ;
SDR 50 TDI (001a0c00000001) ;
SDR 50 TDI (001a1001000101) ;
SDR 50 TDI (001a2000000001) ;
SDR 50 TDI (001a2400000001) ;
SDR 50 TDI (001a2800000001) ;
SDR 50 TDI (001a2c00000001) ;
SDR 50 TDI (001a3000000001) ;
SDR 50 TDI (001a4000000001) ;
SDR 50 TDI (001a4400000001) ;
SDR 50 TDI (001a4800000001) ;
SDR 50 TDI (001a4c00000001) ;
SDR 50 TDI (001a5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001a8001200020) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001a8001200021) ;
SDR 50 TDI (001a8400000001) ;
SDR 50 TDI (001a8800080001) ;
SDR 50 TDI (001a8c00000001) ;
SDR 50 TDI (001a9001000001) ;
SDR 50 TDI (001aa000000031) ;
SDR 50 TDI (001aa400000001) ;
SDR 50 TDI (001aa800e00001) ;
SDR 50 TDI (001aac00000001) ;
SDR 50 TDI (001ab000000001) ;
SDR 50 TDI (001ac0000000a1) ;
SDR 50 TDI (001ac400200001) ;
SDR 50 TDI (001ac800480001) ;
SDR 50 TDI (001acc00000001) ;
SDR 50 TDI (001ad000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001b0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001b0000000001) ;
SDR 50 TDI (001b0400000001) ;
SDR 50 TDI (001b0800000001) ;
SDR 50 TDI (001b0c00000001) ;
SDR 50 TDI (001b1000000001) ;
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SDR 50 TDI (001b2400000001) ;
SDR 50 TDI (001b2800000001) ;
SDR 50 TDI (001b2c00000001) ;
SDR 50 TDI (001b3000000001) ;
SDR 50 TDI (001b4000000001) ;
SDR 50 TDI (001b4400000001) ;
SDR 50 TDI (001b4800000001) ;
SDR 50 TDI (001b4c00000001) ;
SDR 50 TDI (001b5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001b8001000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (001b8001000001) ;
SDR 50 TDI (001b8400000001) ;
SDR 50 TDI (001b8800000001) ;
SDR 50 TDI (001b8c00000001) ;
SDR 50 TDI (001b9003000201) ;
SDR 50 TDI (001ba000000001) ;
SDR 50 TDI (001ba400000001) ;
SDR 50 TDI (001ba800000001) ;
SDR 50 TDI (001bac00000001) ;
SDR 50 TDI (001bb000000001) ;
SDR 50 TDI (001bc000000001) ;
SDR 50 TDI (001bc400000001) ;
SDR 50 TDI (001bc800000001) ;
SDR 50 TDI (001bcc00000001) ;
SDR 50 TDI (001bd000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001c0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001c0000000001) ;
SDR 50 TDI (001c0400000001) ;
SDR 50 TDI (001c0800000001) ;
SDR 50 TDI (001c0c00000001) ;
SDR 50 TDI (001c1001000101) ;
SDR 50 TDI (001c2000000001) ;
SDR 50 TDI (001c2400000001) ;
SDR 50 TDI (001c2800000001) ;
SDR 50 TDI (001c2c00000001) ;
SDR 50 TDI (001c3000000001) ;
SDR 50 TDI (001c4000000001) ;
SDR 50 TDI (001c4400000001) ;
SDR 50 TDI (001c4800000001) ;
SDR 50 TDI (001c4c00000001) ;
SDR 50 TDI (001c5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001c8001d401e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001c8001d401e1) ;
SDR 50 TDI (001c8400000001) ;
SDR 50 TDI (001c8800000001) ;
SDR 50 TDI (001c8c00000001) ;
SDR 50 TDI (001c9001000101) ;
SDR 50 TDI (001ca0001c0071) ;
SDR 50 TDI (001ca400000001) ;
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SDR 50 TDI (001cac00000001) ;
SDR 50 TDI (001cb000000001) ;
SDR 50 TDI (001cc0008400e1) ;
SDR 50 TDI (001cc400000001) ;
SDR 50 TDI (001cc800000001) ;
SDR 50 TDI (001ccc00000001) ;
SDR 50 TDI (001cd000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001d0002000200) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001d0002000201) ;
SDR 50 TDI (001d0400000001) ;
SDR 50 TDI (001d0800000001) ;
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SDR 50 TDI (001d1002000201) ;
SDR 50 TDI (001d2000000001) ;
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SDR 50 TDI (001d4000000001) ;
SDR 50 TDI (001d4400000001) ;
SDR 50 TDI (001d4800000001) ;
SDR 50 TDI (001d4c00000001) ;
SDR 50 TDI (001d5000000003) ;
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RUNTEST 20000 TCK;
SDR 50 TDI (001d8001000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001d8001000001) ;
SDR 50 TDI (001d8400000001) ;
SDR 50 TDI (001d8800000001) ;
SDR 50 TDI (001d8c00000001) ;
SDR 50 TDI (001d9001000301) ;
SDR 50 TDI (001da000000001) ;
SDR 50 TDI (001da400000001) ;
SDR 50 TDI (001da800000001) ;
SDR 50 TDI (001dac00000001) ;
SDR 50 TDI (001db000000001) ;
SDR 50 TDI (001dc000000001) ;
SDR 50 TDI (001dc400000001) ;
SDR 50 TDI (001dc800000001) ;
SDR 50 TDI (001dcc00000001) ;
SDR 50 TDI (001dd000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001e0002000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001e0002000001) ;
SDR 50 TDI (001e0400000001) ;
SDR 50 TDI (001e0800000001) ;
SDR 50 TDI (001e0c00000001) ;
SDR 50 TDI (001e1002000101) ;
SDR 50 TDI (001e2000000001) ;
SDR 50 TDI (001e2400000001) ;
SDR 50 TDI (001e2800000001) ;
SDR 50 TDI (001e2c00000001) ;
SDR 50 TDI (001e3000000001) ;
SDR 50 TDI (001e4000000001) ;
SDR 50 TDI (001e4400000001) ;
SDR 50 TDI (001e4800000001) ;
SDR 50 TDI (001e4c00000001) ;
SDR 50 TDI (001e5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001e8000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001e8000000001) ;
SDR 50 TDI (001e8400000001) ;
SDR 50 TDI (001e8800000001) ;
SDR 50 TDI (001e8c00000001) ;
SDR 50 TDI (001e9000000001) ;
SDR 50 TDI (001ea000000001) ;
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SDR 50 TDI (001eac00000001) ;
SDR 50 TDI (001eb000000001) ;
SDR 50 TDI (001ec000000001) ;
SDR 50 TDI (001ec400000001) ;
SDR 50 TDI (001ec800000001) ;
SDR 50 TDI (001ecc00000001) ;
SDR 50 TDI (001ed000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (001f0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (001f0000000001) ;
SDR 50 TDI (001f0400000001) ;
SDR 50 TDI (001f0800000001) ;
SDR 50 TDI (001f0c00000001) ;
SDR 50 TDI (001f1000000001) ;
SDR 50 TDI (001f2000000001) ;
SDR 50 TDI (001f2400000001) ;
SDR 50 TDI (001f2800000001) ;
SDR 50 TDI (001f2c00000001) ;
SDR 50 TDI (001f3000000001) ;
SDR 50 TDI (001f4000000001) ;
SDR 50 TDI (001f4400000001) ;
SDR 50 TDI (001f4800000001) ;
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SDR 50 TDI (001f4c00000001) ;
SDR 50 TDI (001f5000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (001fc400000001) ;
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SDR 50 TDI (001fcc00000001) ;
SDR 50 TDI (001fd000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00204400000001) ;
SDR 50 TDI (00204800000001) ;
SDR 50 TDI (00204c00000001) ;
SDR 50 TDI (00205000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00208001d403f0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00208001d403f1) ;
SDR 50 TDI (00208400000001) ;
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SDR 50 TDI (00208c00000001) ;
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SDR 50 TDI (0020c0009400f1) ;
SDR 50 TDI (0020c400000001) ;
SDR 50 TDI (0020c800000001) ;
SDR 50 TDI (0020cc00000001) ;
SDR 50 TDI (0020d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00210001000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00214000000001) ;
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SDR 50 TDI (00214800000001) ;
SDR 50 TDI (00214c00000001) ;
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SDR 50 TDI (00218001000101) ;
SDR 50 TDI (00218400000001) ;
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SDR 50 TDI (0021c400000001) ;
SDR 50 TDI (0021c800000001) ;
SDR 50 TDI (0021cc00000001) ;
SDR 50 TDI (0021d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00220000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00224400000001) ;
SDR 50 TDI (00224800000001) ;
SDR 50 TDI (00224c00000001) ;
SDR 50 TDI (00225000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00228800000001) ;
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SDR 50 TDI (0022a400000001) ;
SDR 50 TDI (0022a800000001) ;
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SDR 50 TDI (0022c000000001) ;
SDR 50 TDI (0022c400000001) ;
SDR 50 TDI (0022c800000001) ;
SDR 50 TDI (0022cc00000001) ;
SDR 50 TDI (0022d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00230800000001) ;
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SDR 50 TDI (00231000000001) ;
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SDR 50 TDI (00232400000001) ;
SDR 50 TDI (00232800000001) ;
SDR 50 TDI (00232c00000001) ;
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SDR 50 TDI (00233000000001) ;
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SDR 50 TDI (00234400000001) ;
SDR 50 TDI (00234800000001) ;
SDR 50 TDI (00234c00000001) ;
SDR 50 TDI (00235000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00238000c000e0) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00238000c000e1) ;
SDR 50 TDI (00238400000001) ;
SDR 50 TDI (00238800000001) ;
SDR 50 TDI (00238c00000001) ;
SDR 50 TDI (00239000000001) ;
SDR 50 TDI (0023a000000071) ;
SDR 50 TDI (0023a400000001) ;
SDR 50 TDI (0023a800000001) ;
SDR 50 TDI (0023ac00000001) ;
SDR 50 TDI (0023b000000001) ;
SDR 50 TDI (0023c0008000e1) ;
SDR 50 TDI (0023c400000001) ;
SDR 50 TDI (0023c800000001) ;
SDR 50 TDI (0023cc00000001) ;
SDR 50 TDI (0023d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00240000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00240800000001) ;
SDR 50 TDI (00240c00000001) ;
SDR 50 TDI (00241000000201) ;
SDR 50 TDI (00242000000001) ;
SDR 50 TDI (00242400000001) ;
SDR 50 TDI (00242800000001) ;
SDR 50 TDI (00242c00000001) ;
SDR 50 TDI (00243000000001) ;
SDR 50 TDI (00244000000001) ;
SDR 50 TDI (00244400000001) ;
SDR 50 TDI (00244800000001) ;
SDR 50 TDI (00244c00000001) ;
SDR 50 TDI (00245000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00248000000060) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00248000000061) ;
SDR 50 TDI (00248400000001) ;
SDR 50 TDI (00248800000001) ;
SDR 50 TDI (00248c00000001) ;
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SDR 50 TDI (0024ac00000001) ;
SDR 50 TDI (0024b000000001) ;
SDR 50 TDI (0024c0000000e1) ;
SDR 50 TDI (0024c400000001) ;
SDR 50 TDI (0024c800000001) ;
SDR 50 TDI (0024cc00000001) ;
SDR 50 TDI (0024d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00250003080100) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00250003080101) ;
SDR 50 TDI (00250400000001) ;
SDR 50 TDI (00250800000001) ;
SDR 50 TDI (00250c00000001) ;
SDR 50 TDI (00251003000301) ;
TEXR 50 TDI (00252000000001) ;
SDR 50 TDI (00252400200001) ;
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SDR 50 TDI (00252800200001) ;
SDR 50 TDI (00252c00000001) ;
SDR 50 TDI (00253000000001) ;
SDR 50 TDI (00254000000001) ;
SDR 50 TDI (00254400000001) ;
SDR 50 TDI (00254800000001) ;
SDR 50 TDI (00254c00000001) ;
SDR 50 TDI (00255000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00258000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00258000000001) ;
SDR 50 TDI (00258400000001) ;
SDR 50 TDI (00258800000001) ;
SDR 50 TDI (00258c00000001) ;
SDR 50 TDI (00259000000001) ;
SDR 50 TDI (0025a000000001) ;
SDR 50 TDI (0025a400000001) ;
SDR 50 TDI (0025a800000001) ;
SDR 50 TDI (0025ac00000001) ;
SDR 50 TDI (0025b000000001) ;
SDR 50 TDI (0025c000000001) ;
SDR 50 TDI (0025c400000001) ;
SDR 50 TDI (0025c800000001) ;
SDR 50 TDI (0025cc00000001) ;
SDR 50 TDI (0025d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00260003000200) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00260003000201) ;
SDR 50 TDI (00260400000001) ;
SDR 50 TDI (00260800000001) ;
SDR 50 TDI (00260c00000001) ;
SDR 50 TDI (00261003000301) ;
SDR 50 TDI (00262000000001) ;
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SDR 50 TDI (00262800000001) ;
SDR 50 TDI (00262c00000001) ;
SDR 50 TDI (00263000000001) ;
SDR 50 TDI (00264000000001) ;
SDR 50 TDI (00264400000001) ;
SDR 50 TDI (00264800000001) ;
SDR 50 TDI (00264c00000001) ;
SDR 50 TDI (00265000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00268000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00268000000001) ;
SDR 50 TDI (00268400000001) ;
SDR 50 TDI (00268800000001) ;
SDR 50 TDI (00268c00000001) ;
SDR 50 TDI (00269000000001) ;
SDR 50 TDI (0026a000000001) ;
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SDR 50 TDI (0026ac00000001) ;
SDR 50 TDI (0026b000000001) ;
SDR 50 TDI (0026c000000001) ;
SDR 50 TDI (0026c400000001) ;
SDR 50 TDI (0026c800000001) ;
SDR 50 TDI (0026cc00000001) ;
SDR 50 TDI (0026d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00270001000100) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00270001000101) ;
SDR 50 TDI (00270400000001) ;
SDR 50 TDI (00270800000001) ;
SDR 50 TDI (00270c00000001) ;
SDR 50 TDI (00271000000001) ;
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SDR 50 TDI (00272000000001) ;
SDR 50 TDI (00272501010101) ;
SDR 50 TDI (00272800000001) ;
SDR 50 TDI (00272c00000001) ;
SDR 50 TDI (00273000000001) ;
SDR 50 TDI (00274000000001) ;
SDR 50 TDI (00274400000001) ;
SDR 50 TDI (00274800000001) ;
SDR 50 TDI (00274c00000001) ;
SDR 50 TDI (00275000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00278000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00278000000001) ;
SDR 50 TDI (00278400000001) ;
SDR 50 TDI (00278800000001) ;
SDR 50 TDI (00278c00000001) ;
SDR 50 TDI (00279000000001) ;
SDR 50 TDI (0027a000000001) ;
SDR 50 TDI (0027a400000001) ;
SDR 50 TDI (0027a800000001) ;
SDR 50 TDI (0027ac00000001) ;
SDR 50 TDI (0027b000000001) ;
SDR 50 TDI (0027c000000001) ;
SDR 50 TDI (0027c400000001) ;
SDR 50 TDI (0027c800000001) ;
SDR 50 TDI (0027cc00000001) ;
SDR 50 TDI (0027d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00280000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00280000000001) ;
SDR 50 TDI (00280400000001) ;
SDR 50 TDI (00280800000001) ;
SDR 50 TDI (00280c00000001) ;
SDR 50 TDI (00281000000001) ;
SDR 50 TDI (00282000000001) ;
SDR 50 TDI (00282400000001) ;
SDR 50 TDI (00282800000001) ;
SDR 50 TDI (00282c00000001) ;
SDR 50 TDI (00283000000001) ;
SDR 50 TDI (00284000000001) ;
SDR 50 TDI (00284400000001) ;
SDR 50 TDI (00284800000001) ;
SDR 50 TDI (00284c00000001) ;
SDR 50 TDI (00285000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00288000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00288000000001) ;
SDR 50 TDI (00288400000001) ;
SDR 50 TDI (00288800000001) ;
SDR 50 TDI (00288c00000001) ;
SDR 50 TDI (00289000000001) ;
SDR 50 TDI (0028a000000001) ;
SDR 50 TDI (0028a400000001) ;
SDR 50 TDI (0028a800000001) ;
SDR 50 TDI (0028ac00000001) ;
SDR 50 TDI (0028b000000001) ;
SDR 50 TDI (0028c000000001) ;
SDR 50 TDI (0028c400000001) ;
SDR 50 TDI (0028c800000001) ;
SDR 50 TDI (0028cc00000001) ;
SDR 50 TDI (0028d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00290000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00290000000001) ;
SDR 50 TDI (00290400000001) ;
SDR 50 TDI (00290800000001) ;
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      SDR 50 TDI (00290c00000001) ;
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      SDR 50 TDI (00292000000001) ;
      SDR 50 TDI (00292400000001) ;
      SDR 50 TDI (00292800000001) ;
      SDR 50 TDI (00292c00000001) ;
      SDR 50 TDI (00293000000001) ;
      SDR 50 TDI (00294000000001) ;
      SDR 50 TDI (00294400000001) ;
      SDR 50 TDI (00294800000001) ;
      SDR 50 TDI (00294c00000001) ;
      SDR 50 TDI (00295000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (00298000d400f0) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (00298000d400f1) ;
      SDR 50 TDI (00298400000001) ;
      SDR 50 TDI (00298800000001) ;
      SDR 50 TDI (00298c00000001) ;
      SDR 50 TDI (00299000000001) ;
      SDR 50 TDI (0029a0001c0071) ;
      SDR 50 TDI (0029a400000001) ;
      SDR 50 TDI (0029a800000001) ;
      SDR 50 TDI (0029ac00000001) ;
      SDR 50 TDI (0029b000000001) ;
      SDR 50 TDI (0029c0009400e1) ;
      SDR 50 TDI (0029c400000001) ;
      SDR 50 TDI (0029c800000001) ;
      SDR 50 TDI (0029cc00000001) ;
      SDR 50 TDI (0029d000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (002a0000000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (002a0000000001) ;
      SDR 50 TDI (002a0400000001) ;
      SDR 50 TDI (002a0800000001) ;
      SDR 50 TDI (002a0c00000001) ;
      SDR 50 TDI (002a1000000001) ;
      SDR 50 TDI (002a2000000001) ;
      SDR 50 TDI (002a2400000001) ;
      SDR 50 TDI (002a2800000001) ;
      SDR 50 TDI (002a2c00000001) ;
      SDR 50 TDI (002a3000000001) ;
      SDR 50 TDI (002a4000000001) ;
      SDR 50 TDI (002a4400000001) ;
      SDR 50 TDI (002a4800000001) ;
      SDR 50 TDI (002a4c00000001) ;
      SDR 50 TDI (002a5000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (002a80000000e0) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (002a80000000e1) ;
      SDR 50 TDI (002a8400000001) ;
      SDR 50 TDI (002a8800000001) ;
      SDR 50 TDI (002a8c00000001) ;
      SDR 50 TDI (002a9000000001) ;
      SDR 50 TDI (002aa000000071) ;
      SDR 50 TDI (002aa400000001) ;
      SDR 50 TDI (002aa800000001) ;
      SDR 50 TDI (002aac00000001) ;
      SDR 50 TDI (002ab000000001) ;
      SDR 50 TDI (002ac0000000e1) ;
      SDR 50 TDI (002ac400000001) ;
      SDR 50 TDI (002ac800000001) ;
      SDR 50 TDI (002acc00000001) ;
      SDR 50 TDI (002ad000000003) ;
      RUNTEST 20000 TCK;
      SDR 50 TDI (002b0000000000) TDO (00000000000001) MASK (00000000000003) ;
      SDR 50 TDI (002b0000000001) ;
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SDR 50 TDI (002b0400000001) ;
SDR 50 TDI (002b0800000001) ;
SDR 50 TDI (002b0c00000001) ;
SDR 50 TDI (002b1000000001) ;
SDR 50 TDI (002b2000000001) ;
SDR 50 TDI (002b2400000001) ;
SDR 50 TDI (002b2800000001) ;
SDR 50 TDI (002b2c00000001) ;
SDR 50 TDI (002b3000000001) ;
SDR 50 TDI (002b4000000001) ;
SDR 50 TDI (002b4400000001) ;
SDR 50 TDI (002b4800000001) ;
SDR 50 TDI (002b4c00000001) ;
SDR 50 TDI (002b5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (002b8000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (002b8000000001) ;
SDR 50 TDI (002b8400000001) ;
SDR 50 TDI (002b8800000001) ;
SDR 50 TDI (002b8c00000001) ;
SDR 50 TDI (002b9000000001) ;
SDR 50 TDI (002ba000000001) ;
SDR 50 TDI (002ba400000001) ;
SDR 50 TDI (002ba800000001) ;
SDR 50 TDI (002bac00000001) ;
SDR 50 TDI (002bb000000001) ;
SDR 50 TDI (002bc000000001) ;
SDR 50 TDI (002bc400000001) ;
SDR 50 TDI (002bc800000001) ;
SDR 50 TDI (002bcc00000001) ;
SDR 50 TDI (002bd000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (002c0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (002c0000000001) ;
SDR 50 TDI (002c0400000001) ;
SDR 50 TDI (002c0800000001) ;
SDR 50 TDI (002c0c00000001) ;
SDR 50 TDI (002c1000000001) ;
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SDR 50 TDI (002c2800000001) ;
SDR 50 TDI (002c2c00000001) ;
SDR 50 TDI (002c3000000001) ;
SDR 50 TDI (002c4000000001) ;
SDR 50 TDI (002c4400000001) ;
SDR 50 TDI (002c4800000001) ;
SDR 50 TDI (002c4c00000001) ;
SDR 50 TDI (002c5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (002c8000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (002c8000000001) ;
SDR 50 TDI (002c8400000001) ;
SDR 50 TDI (002c8800000001) ;
SDR 50 TDI (002c8c00000001) ;
SDR 50 TDI (002c9000000001) ;
SDR 50 TDI (002ca000000001) ;
SDR 50 TDI (002ca400000001) ;
SDR 50 TDI (002ca800000001) ;
SDR 50 TDI (002cac00000001) ;
SDR 50 TDI (002cb000000001) ;
SDR 50 TDI (002cc000000001) ;
SDR 50 TDI (002cc400000001) ;
SDR 50 TDI (002cc800000001) ;
SDR 50 TDI (002ccc00000001) ;
SDR 50 TDI (002cd000000003) ;
RUNTEST 20000 TCK;
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    SDR 50 TDI (002d0000000000) TDO (00000000000001) MASK (00000000000003) ;
    SDR 50 TDI (002d0000000001) ;
    SDR 50 TDI (002d0400000001) ;
    SDR 50 TDI (002d0800000001) ;
    SDR 50 TDI (002d0c00000001) ;
    SDR 50 TDI (002d1000000001) ;
    SDR 50 TDI (002d2000000001) ;
    SDR 50 TDI (002d2400000001) ;
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    SDR 50 TDI (002d2c00000001) ;
    SDR 50 TDI (002d3000000001) ;
    SDR 50 TDI (002d4000000001) ;
    SDR 50 TDI (002d4400000001) ;
    SDR 50 TDI (002d4800000001) ;
    SDR 50 TDI (002d4c00000001) ;
    SDR 50 TDI (002d5000000003) ;
    RUNTEST 20000 TCK;
    SDR 50 TDI (002d8000000000) TDO (00000000000001) MASK (00000000000003) ;
    SDR 50 TDI (002d8000000001) ;
    SDR 50 TDI (002d8400000001) ;
    SDR 50 TDI (002d8800000001) ;
    SDR 50 TDI (002d8c00000001) ;
    SDR 50 TDI (002d9000000001) ;
    SDR 50 TDI (002da000000001) ;
    SDR 50 TDI (002da400000001) ;
    SDR 50 TDI (002da800000001) ;
    SDR 50 TDI (002dac00000001) ;
    SDR 50 TDI (002db000000001) ;
    SDR 50 TDI (002dc000000001) ;
    SDR 50 TDI (002dc400000001) ;
    SDR 50 TDI (002dc800000001) ;
    SDR 50 TDI (002dcc00000001) ;
    SDR 50 TDI (002dd000000003) ;
    RUNTEST 20000 TCK;
    SDR 50 TDI (002e0000000000) TDO (00000000000001) MASK (00000000000003) ;
    SDR 50 TDI (002e0000000001) ;
    SDR 50 TDI (002e0400000001) ;
    SDR 50 TDI (002e0800000001) ;
    SDR 50 TDI (002e0c00000001) ;
    SDR 50 TDI (002e1000000001) ;
    SDR 50 TDI (002e2000000001) ;
    SDR 50 TDI (002e2400000001) ;
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    SDR 50 TDI (002e2c00000001) ;
    SDR 50 TDI (002e3000000001) ;
    SDR 50 TDI (002e4000000001) ;
    SDR 50 TDI (002e4400000001) ;
    SDR 50 TDI (002e4800000001) ;
    SDR 50 TDI (002e4c00000001) ;
    SDR 50 TDI (002e5000000003) ;
    RUNTEST 20000 TCK;
    SDR 50 TDI (002e8000000000) TDO (00000000000001) MASK (00000000000003) ;
    SDR 50 TDI (002e8000000001) ;
    SDR 50 TDI (002e8400000001) ;
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    SDR 50 TDI (002e9000000001) ;
    SDR 50 TDI (002ea000000001) ;
    SDR 50 TDI (002ea400000001) ;
    SDR 50 TDI (002ea800000001) ;
    SDR 50 TDI (002eac00000001) ;
    SDR 50 TDI (002eb000000001) ;
    SDR 50 TDI (002ec000000001) ;
    SDR 50 TDI (002ec400000001) ;
    SDR 50 TDI (002ec800000001) ;
    SDR 50 TDI (002ecc00000001) ;
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SDR 50 TDI (002ed000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (002f0000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (002f0000000001) ;
SDR 50 TDI (002f0400000001) ;
SDR 50 TDI (002f0800000001) ;
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SDR 50 TDI (002f2400000001) ;
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SDR 50 TDI (002f2c00000001) ;
SDR 50 TDI (002f3000000001) ;
SDR 50 TDI (002f4000000001) ;
SDR 50 TDI (002f4400000001) ;
SDR 50 TDI (002f4800000001) ;
SDR 50 TDI (002f4c00000001) ;
SDR 50 TDI (002f5000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (002f8000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (002f8400000001) ;
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SDR 50 TDI (002fb000000001) ;
SDR 50 TDI (002fc000000001) ;
SDR 50 TDI (002fc400000001) ;
SDR 50 TDI (002fc800000001) ;
SDR 50 TDI (002fcc00000001) ;
SDR 50 TDI (002fd000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00304000000001) ;
SDR 50 TDI (00304400000001) ;
SDR 50 TDI (00304800000001) ;
SDR 50 TDI (00304c00000001) ;
SDR 50 TDI (00305000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00308800000001) ;
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SDR 50 TDI (0030a800000001) ;
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TEXR 50 TDI (0030c000000001) ;
SDR 50 TDI (0030c400000001) ;
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SDR 50 TDI (0030d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00312c00000001) ;
SDR 50 TDI (00313000000001) ;
SDR 50 TDI (00314000000001) ;
SDR 50 TDI (00314400000001) ;
SDR 50 TDI (00314800000001) ;
SDR 50 TDI (00314c00000001) ;
SDR 50 TDI (00315000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00318000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00318800000001) ;
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SDR 50 TDI (0031a000000001) ;
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SDR 50 TDI (0031a800000001) ;
SDR 50 TDI (0031ac00000001) ;
SDR 50 TDI (0031b000000001) ;
SDR 50 TDI (0031c000000081) ;
SDR 50 TDI (0031c400000001) ;
SDR 50 TDI (0031c800000001) ;
SDR 50 TDI (0031cc00000001) ;
SDR 50 TDI (0031d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00322c00000001) ;
SDR 50 TDI (00323000000001) ;
SDR 50 TDI (00324000000001) ;
SDR 50 TDI (00324400000001) ;
SDR 50 TDI (00324800000001) ;
SDR 50 TDI (00324c00000001) ;
SDR 50 TDI (00325000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00328000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00328000000001) ;
SDR 50 TDI (00328400000001) ;
SDR 50 TDI (00328800000001) ;
SDR 50 TDI (00328c00000001) ;
SDR 50 TDI (00329000000001) ;
SDR 50 TDI (0032a000000001) ;
SDR 50 TDI (0032a400000001) ;
SDR 50 TDI (0032a800000001) ;
SDR 50 TDI (0032ac00000001) ;
SDR 50 TDI (0032b000000001) ;
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SDR 50 TDI (0032c000000001) ;
SDR 50 TDI (0032c400000001) ;
SDR 50 TDI (0032c800000001) ;
SDR 50 TDI (0032cc00000001) ;
SDR 50 TDI (0032d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00330c00000001) ;
SDR 50 TDI (00331000000001) ;
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SDR 50 TDI (00332400000001) ;
SDR 50 TDI (00332800000001) ;
SDR 50 TDI (00332c00000001) ;
SDR 50 TDI (00333000000001) ;
SDR 50 TDI (00334000000001) ;
SDR 50 TDI (00334400400001) ;
SDR 50 TDI (00334800400001) ;
SDR 50 TDI (00334c00000001) ;
SDR 50 TDI (00335000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00338800000001) ;
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SDR 50 TDI (0033a800000001) ;
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SDR 50 TDI (0033c000000081) ;
SDR 50 TDI (0033c400000001) ;
SDR 50 TDI (0033c800000001) ;
SDR 50 TDI (0033cc00000001) ;
SDR 50 TDI (0033d000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00342c00000001) ;
SDR 50 TDI (00343000000001) ;
SDR 50 TDI (00344000000001) ;
SDR 50 TDI (00344400000001) ;
SDR 50 TDI (00344800000001) ;
SDR 50 TDI (00344c00000001) ;
SDR 50 TDI (00345000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00348000000000) TDO (00000000000001) MASK (00000000000003) ;
SDR 50 TDI (00348000000001) ;
SDR 50 TDI (00348400000001) ;
SDR 50 TDI (00348800000001) ;
SDR 50 TDI (00348c00000001) ;
SDR 50 TDI (00349000000001) ;
SDR 50 TDI (0034a000000001) ;
SDR 50 TDI (0034a400000001) ;
SDR 50 TDI (0034a800000001) ;
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SDR 50 TDI (0034ac00000001) ;
SDR 50 TDI (0034b000000001) ;
SDR 50 TDI (0034c000000001) ;
SDR 50 TDI (0034c400000001) ;
SDR 50 TDI (0034c800000001) ;
SDR 50 TDI (0034cc00000001) ;
SDR 50 TDI (0034d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (00350000000000) TDO (00000000000001) MASK (00000000000003) ;
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SDR 50 TDI (00350c00000001) ;
SDR 50 TDI (00351000000001) ;
SDR 50 TDI (00352000000001) ;
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SDR 50 TDI (00352800000001) ;
SDR 50 TDI (00352c00000001) ;
SDR 50 TDI (00353000000001) ;
SDR 50 TDI (00354000000001) ;
SDR 50 TDI (00354400000001) ;
SDR 50 TDI (00354800000001) ;
SDR 50 TDI (00354c00000001) ;
SDR 50 TDI (00355000000003) ;
RUNTEST 20000 TCK;
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SDR 50 TDI (00358000c400e1) ;
SDR 50 TDI (00358400000001) ;
SDR 50 TDI (00358800000001) ;
SDR 50 TDI (00358c00000001) ;
SDR 50 TDI (00359000000001) ;
SDR 50 TDI (0035a0000c0071) ;
SDR 50 TDI (0035a400000001) ;
SDR 50 TDI (0035a800000001) ;
SDR 50 TDI (0035ac00000001) ;
SDR 50 TDI (0035b000000001) ;
SDR 50 TDI (0035c0008400e1) ;
SDR 50 TDI (0035c400000001) ;
SDR 50 TDI (0035c800000001) ;
SDR 50 TDI (0035cc00000001) ;
SDR 50 TDI (0035d000000003) ;
RUNTEST 20000 TCK;
SDR 50 TDI (0035d000000000) TDO (00000000000001) MASK (00000000000003) ;
// Loading devices with 'conld' or 'bypass' instruction.
SIR 8 TDI (f0) ;
RUNTEST 100 TCK;
TIR 0 ;
HIR 0 ;
HDR 0 ;
TDR 0 ;
//Loading device with 'bypass' instruction.
SIR 8 TDI (ff) ;
TIR 0 ;
HIR 0 ;
HDR 0 ;
TDR 0 ;
// Loading devices with 'conld' or 'bypass' instruction.
SIR 8 TDI (f0) ;
RUNTEST 100 TCK;
TIR 0 ;
HIR 0 ;
HDR 0 ;
TDR 0 ;
TIR 0 ;
HIR 0 ;
TDR 0 ;
```

```
HDR 0 ;
SIR 8 TDI (ff) ;
SDR 1 TDI (00) SMASK (01) ;
```

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