# libjtaghal

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# Contents

# Chapter 1

# jtaghal

JTAG Hardware Abstraction Library

Provides an object-oriented interface to JTAG-accessible devices, JTAG adapters, and so on. Intended to be easily extensible so that applications can add support for custom in-system debug features on FPGAs, etc.

This repo contains the library only, and no client application code or standalone build system.

Most users should probably use azonenberg/jtaghal-cmake and not this repo.

# Chapter 2

# Module Index

## 2.1 Modules

Here is a list of all modules:

# Chapter 3

# Hierarchical Index

## 3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

# Chapter 4

# Class Index

## 4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

# Chapter 5

# File Index

## 5.1 File List

Here is a list of all documented files with brief descriptions:

# Chapter 6

# Module Documentation

## 6.1 JTAG interface layer

### Classes

- class DigilentJtagInterface

  *A JTAG adapter exposed through the Digilent Adept SDK.*
- class FTDIJtagInterface

  *A JTAG adapter using the FTDI chipset, accessed through libftd2xx (proprietary driver from FTDI)*
- class JtagInterface

  *Abstract representation of a JTAG adapter.*
- class NetworkedJtagInterface

  *Thin wrapper around TCP sockets for talking to a jtagd instance.*
- class PipeJtagInterface

  *Thin wrapper around pipes for talking to an openfpga JtagPipeBridge.*

### 6.1.1 Detailed Description

The JTAG interface layer exposes many different JTAG hardware devices as a simple C++ API.

## 6.2 Stuff not in another group yet

### Classes

- class ARM7TDMISProcessor

  *An ARM7TDMI-S CPU core supporting the ARMv4 architecture, as seen over JTAG (no CoreSight support)*
- class ARMAPBDevice

  *A device attached to an ARM APB bus (may be a debug core or something else)*
- class ARMCoreSightDevice

  *Base class for ARM CoreSight components (other than CPU cores) on a debug APB bus.*
- class ARMCortexA57

  *An ARM Cortex-A57 CPU core, as seen over a CoreSight APB bus.*
- class ARMCortexA9

  *An ARM Cortex-A9 CPU core, as seen over a CoreSight APB bus.*
- class ARMCortexM4

  *An ARM Cortex-M4 CPU core, as seen over a CoreSight APB bus.*
- class ARMDebugAccessPort

  *Base class for all access ports within an ARMDebugPort.*
- class ARMDebugMemAccessPort

  *A bridge from an ARMDebugPort to an ARM memory bus.*
- class ARMDebugPort

  *Base class for ARM debug ports (JTAG-DP, SWJ-DP, etc)*
- class ARMDevice

  *Abstract base class for all ARM Ltd JTAG devices (ADIv5 DAP or legacy CPUs with their own JTAG TAPs)*
- class ARMFlashPatchBreakpoint

  *Cortex-M Flash Patch/Breakpoint Unit (see ARMv7-M architecture ref C1.11)*
- class ARMJtagDebugPort

  *An ARM JTAG-DP (contains one or more APs and a DP)*
- class ARMv7MProcessor

  *An ARMv7 Cortex-M CPU core, as seen over a CoreSight APB bus.*
- class ARMv7Processor

  *An ARMv7 Cortex-A CPU core, as seen over a CoreSight APB bus.*
- class ARMv8Processor

  *An ARMv8 Cortex-A CPU core, as seen over a CoreSight APB bus.*
- class AttachedMemoryDevice

  *Base classes for devices which can connect to external memory devices.*
- class ByteArrayFirmwareImage

  *Generic base class for all firmware images consisting of an array of bytes.*
- class CPLD

  *Generic base class for all complex programmable logic devices.*
- class CPLDBitstream

  *Abstract base class for CPLD configuration bitstreams.*
- class DebuggableDevice

  *Generic base class for all debuggable devices (CPU cores etc)*
- class DebuggerInterface

  *Generic base class for all debugger interfaces (may connect to multiple DebuggableDevice's in a SoC)*
- class FirmwareImage

  *Generic base class for all firmware images for any kind of programmable device.*
- class FPGA

  *Generic base class for all field-programmable gate array devices.*

- class FPGABitstream

  *Abstract base class for FPGA configuration bitstreams.*
- class FreescaleDevice

  *Abstract base class for all Freescale devices (typically MCUs or parts thereof)*
- class FreescaleIMXDevice

  *A Freescale i.mx applications processor.*
- class FreescaleIMXSmartDMA

  *The SDMA in a Freescale i.mx SoC (Chapter 55 of i.mx6 reference manual)*
- class FreescaleMicrocontroller

  *Generic base class for all Freescale MCUs.*
- class JtagDevice

  *A single TAP in the JTAG chain. May not correspond 1:1 with physical silicon dies.*
- class JtagDummy

  *An unknown device (IDCODE not recognized, or no IDCODE present) on a JTAG chain.*
- class JtagException

  *Base class for all exceptions thrown by libjtaghal.*
- class JtagFPGA

  *Abstract base class for all JTAG-programmed FPGAs.*
- class LockableDevice

  *Generic base class for all devices which have some kind of read/write protection.*
- class MicrochipDevice

  *Abstract base class for all Microchip devices (typically MCUs)*
- class MicrochipMicrocontroller

  *Generic base class for all Microchip MCUs.*
- union MicrochipPIC32DeviceStatusRegister

  *Status register for a Microchip PIC32 device.*
- union EjtagImplementationCodeRegister

  *MIPS EJTAG implementation register.*
- class MicrochipPIC32Device

  *A Microchip PIC32 microcontroller (MX, MZ, MM, etc)*
- class Microcontroller

  *Generic base class for all microcontrollers.*
- class ProgrammableDevice

  *Generic base class for all programmable devices (PLD, MCU, flash, etc)*
- class ProgrammableLogicDevice

  *Generic base class for all programmable logic devices (FPGA and CPLD)*
- class RawBinaryFirmwareImage

  *Raw binary firmware image loaded from a file.*
- class SerialNumberedDevice

  *Abstract base class for all devices that have a unique die serial number.*
- class STM32Device

  *A STM32 microcontroller.*
- class STMicroDevice

  *Abstract base class for all STMicro devices.*
- class STMicroMicrocontroller

  *Generic base class for all STMicro MCUs.*
- class Xilinx3DFPGABitstream

  *A bitstream for Xilinx 3D FPGAs (multiple dies on a passive interposer, each with their own bitstream)*
- union Xilinx7SeriesDeviceConfigurationFrame

  *7-series configuration frame (see UG470 page 87)*
- union Xilinx7SeriesDeviceStatusRegister

*7-series status register (see UG470 table 5-28)*

- class Xilinx7SeriesDevice

  *A Xilinx 7-series FPGA device.*
- union XilinxCoolRunnerIIDeviceStatusRegister

  *Status register for a Xilinx CoolRunner-II device.*
- class XilinxCoolRunnerIIDevice

  *A Xilinx CoolRunner-II device.*
- class XilinxCPLD

  *Generic base class for all Xilinx CPLD devices.*
- class XilinxCPLDBitstream

  *A bitstream for Xilinx CPLDs.*
- class XilinxDevice

  *Abstract base class for all Xilinx devices (FPGA, CPLD, flash, etc)*
- class XilinxFPGA

  *Abstract base class for all Xilinx FPGAs.*
- class XilinxFPGABitstream

  *A bitstream for Xilinx FPGAs.*
- union XilinxSpartan3ADeviceConfigurationFrame

  *Spartan-3A configuration frame header (see UG332 page 323)*
- union XilinxSpartan3ADeviceStatusRegister

  *Spartan-3A status register (see UG332 table 17-13, pages 327-328)*
- class XilinxSpartan3ADevice

  *A Xilinx Spartan-3A FPGA device.*
- union XilinxSpartan6DeviceConfigurationFrame

  *Spartan-6 configuration frame (see UG380 page 91)*
- union XilinxSpartan6DeviceStatusRegister

  *Spartan-6 status register (see UG380 table 5-35)*
- class XilinxSpartan6Device

  *A Xilinx Spartan-6 FPGA device.*
- union XilinxUltrascaleDeviceConfigurationFrame

  *UltraScale configuration frame (see UG570 page 158)*
- union XilinxUltrascaleDeviceStatusRegister

  *UltraScale status register (see UG570 table 9-25)*
- class XilinxUltrascaleDevice

  *A Xilinx Ultrascale or Ultrascale+ FPGA device.*

## Functions

- bool PeekBit (const unsigned char ∗data, int nbit)

  *Extracts a bit from a bit string.*
- void PokeBit (unsigned char ∗data, int nbit, bool val)

  *Writes a bit to a bit string.*
- unsigned char FlipByte (unsigned char c)

  *Flips the bits in a byte.*
- void FlipByteArray (unsigned char ∗data, int len)

  *Reverses an array of bytes in place without changing bit ordering.*
- void FlipBitArray (unsigned char ∗data, int len)

  *Reverses the bit ordering in an array of bytes, but does not change byte ordering.*
- void MirrorBitArray (unsigned char ∗data, int bitlen)

  *Reverses the bit ordering in an array of bits (need not be integer byte size)*

- void FlipEndianArray (unsigned char *data, int len)

  *Swaps endianness in an array of 16-bit values.*
- void FlipEndian32Array (unsigned char *data, int len)

  *Swaps endianness in an array of 32-bit values.*
- void FlipBitAndEndianArray (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 16-bit endianness.*
- void FlipBitAndEndian32Array (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 32-bit endianness.*
- double GetTime ()

  *Returns a timestamp suitable for performance measurement.*
- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))

### Variables

- class ARMDebugAccessPort **__attribute__**
- ARMDebugMemAccessPort **__attribute__**
- ARMDebugPort **__attribute__**
- ARMJtagDebugPort **__attribute__**
- ARMv7Processor **__attribute__**
- Xilinx7SeriesDevice **__attribute__**
- XilinxCoolRunnerIIDevice **__attribute__**
- XilinxSpartan3ADevice **__attribute__**
- XilinxSpartan6Device **__attribute__**
- XilinxUltrascaleDevice **__attribute__**

## 6.2.1 Detailed Description

## 6.2.2 Function Documentation

### 6.2.2.1 FlipBitAndEndian32Array()

```
void FlipBitAndEndian32Array (
            unsigned char * data,
            int len )
```

Reverses the bit ordering in an array of bytes, as well as 32-bit endianness.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer |

#### 6.2.2.2 FlipBitAndEndianArray()

```
void FlipBitAndEndianArray (
            unsigned char * data,
            int len )
```

Reverses the bit ordering in an array of bytes, as well as 16-bit endianness.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer |

#### 6.2.2.3 FlipBitArray()

```
void FlipBitArray (
            unsigned char * data,
            int len )
```

Reverses the bit ordering in an array of bytes, but does not change byte ordering.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer |

#### 6.2.2.4 FlipByte()

```
unsigned char FlipByte (
            unsigned char c )
```

Flips the bits in a byte.

**Parameters**

| | |
|---|---|
| *c* | Input byte |

**Returns**

Output byte

#### 6.2.2.5 FlipByteArray()

```
void FlipByteArray (
            unsigned char * data,
            int len )
```

Reverses an array of bytes in place without changing bit ordering.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer |

#### 6.2.2.6 FlipEndian32Array()

```
void FlipEndian32Array (
            unsigned char * data,
            int len )
```

Swaps endianness in an array of 32-bit values.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer (must be a multiple of 4) |

#### 6.2.2.7 FlipEndianArray()

```
void FlipEndianArray (
            unsigned char * data,
            int len )
```

Swaps endianness in an array of 16-bit values.

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *len* | Length, in bytes, of the buffer (must be even) |

#### 6.2.2.8 GetTime()

```
double GetTime ( )
```

Returns a timestamp suitable for performance measurement.

The base unit is seconds.

**Returns**

The timestamp.

#### 6.2.2.9 MirrorBitArray()

```
void MirrorBitArray (
            unsigned char * data,
            int bitlen )
```

Reverses the bit ordering in an array of bits (need not be integer byte size)

**Parameters**

| | |
|---|---|
| *data* | The buffer to manipulate |
| *bitlen* | Length, in bits, of the buffer |

#### 6.2.2.10 PeekBit()

```
bool PeekBit (
            const unsigned char * data,
            int nbit )
```

Extracts a bit from a bit string.

(data[0] & 1) is considered to be the LSB.

**Parameters**

| | |
|---|---|
| *data* | The bit string |
| *nbit* | Index (zero based) of the bit to extract |

**Returns**

Value of the bit

#### 6.2.2.11 PokeBit()

```
void PokeBit (
            unsigned char * data,
```

```
int nbit,
bool val )
```

Writes a bit to a bit string.

(data[0] & 1) is considered to be the LSB.

**Parameters**

| | |
|---|---|
| *data* | The bit string |
| *nbit* | Index (zero based) of the bit to write |
| *val* | The value to write at that bit |

# Chapter 7

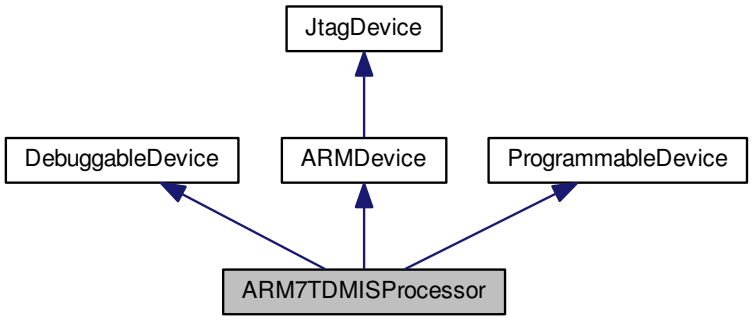
# Class Documentation

## 7.1 ARM7TDMISProcessor Class Reference

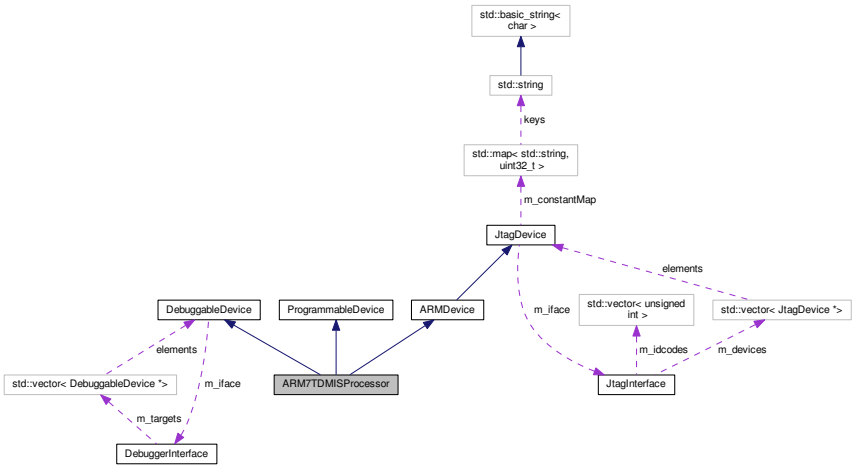
An ARM7TDMI-S CPU core supporting the ARMv4 architecture, as seen over JTAG (no CoreSight support)

`#include <ARM7TDMISProcessor.h>`

Inheritance diagram for ARM7TDMISProcessor:



Collaboration diagram for ARM7TDMISProcessor:




## Public Types

- enum **JTAG_INSTRUCTIONS** {
  **SCAN_N** = 0x2, **RESTART** = 0x4, **INTEST** = 0xc, **IDCODE** = 0xe,
  **BYPASS** = 0xf }

## Public Member Functions

- **ARM7TDMISProcessor** (unsigned int partnum, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- virtual void DebugHalt ()

  *Halts the CPU and enters debug state.*
- virtual void **DebugResume** ()
- virtual void **PrintRegisters** ()
- virtual uint32_t ReadMemory (uint32_t addr)

  *Checks if the CPU is halted due to a fatal error.*
- virtual void **WriteMemory** (uint32_t addr, uint32_t value)

### Public Attributes

- unsigned int **m_rev**
- unsigned int **m_selectedChain**

### Protected Types

- enum **IceRegisters** {
  **DEBUG_CTRL** = 0x00, **DEBUG_STAT** = 0x01, **DCC_CTRL** = 0x04, **DCC_DATA** = 0x05,
  **WATCH0_ADDR** = 0x08, **WATCH0_AMASK** = 0x09, **WATCH0_DATA** = 0x0a, **WATCH0_DMASK** = 0x0b,
  **WATCH0_CTRL** = 0x0c, **WATCH0_CMASK** = 0x0d, **WATCH1_ADDR** = 0x10, **WATCH1_AMASK** = 0x11,
  **WATCH1_DATA** = 0x12, **WATCH1_DMASK** = 0x13, **WATCH1_CTRL** = 0x14, **WATCH1_CMASK** = 0x15 }

### Protected Member Functions

- void **SelectScanChain** (uint8_t n)
- void **SelectDebugChain** ()
- void **SelectIceRTChain** ()
- void **WriteIceRegister** (uint8_t reg, uint32_t value)
- uint32_t **ReadIceRegister** (uint8_t reg)

### Additional Inherited Members

## 7.1.1 Detailed Description

An ARM7TDMI-S CPU core supporting the ARMv4 architecture, as seen over JTAG (no CoreSight support)

## 7.1.2 Member Function Documentation

#### 7.1.2.1 Erase()

```
void ARM7TDMISProcessor::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.1.2.2 IsProgrammed()

```
bool ARM7TDMISProcessor::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.1.2.3 LoadFirmwareImage()

```
FirmwareImage * ARM7TDMISProcessor::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.1.2.4 PostInitProbes()

```
void ARM7TDMISProcessor::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.1.2.5 Program()

```
void ARM7TDMISProcessor::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

The documentation for this class was generated from the following files:

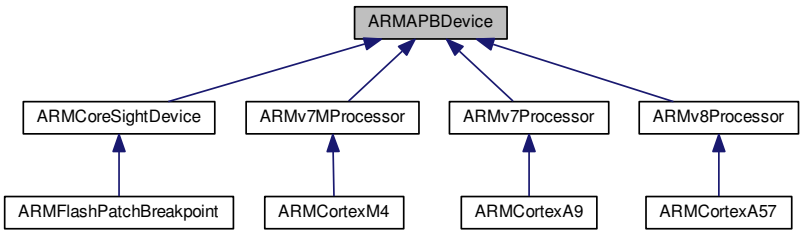
- ARM7TDMISProcessor.h
- ARM7TDMISProcessor.cpp

## 7.2 ARMAPBDevice Class Reference

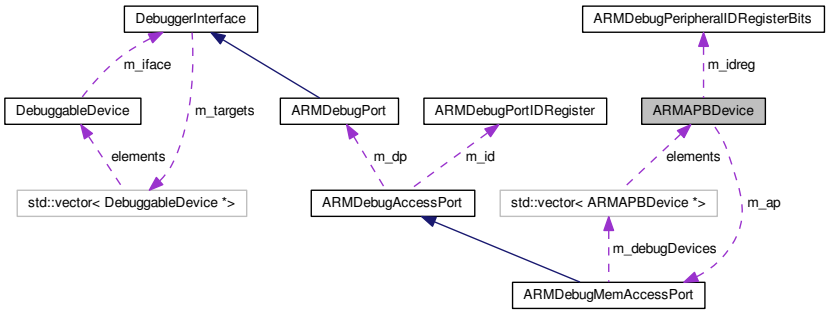
A device attached to an ARM APB bus (may be a debug core or something else)

```
#include <ARMAPBDevice.h>
```

Inheritance diagram for ARMAPBDevice:



Collaboration diagram for ARMAPBDevice:




## Public Member Functions

- **ARMAPBDevice** (ARMDebugMemAccessPort *ap, uint32_t address, ARMDebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()=0
- virtual void **PrintInfo** ()=0

## Protected Member Functions

- uint32_t ReadRegisterByOffset (uint32_t offset)

  *reads a register given the offset from our base address*
- uint32_t ReadRegisterByIndex (uint32_t index)

  *reads a register given the index into a 32-bit register space*
- void WriteRegisterByIndex (uint32_t index, uint32_t value)

  *writes a register given the index into a 32-bit register space*
- void WriteRegisterByOffset (uint32_t offset, uint32_t value)

  *writes a register given the offset from our base address*

## Protected Attributes

- ARMDebugMemAccessPort * m_ap

  *The Mem-AP.*
- ARMDebugPeripheralIDRegisterBits m_idreg

  *The peripheral ID register.*
- uint32_t m_address

  *Base address of the device.*

### 7.2.1 Detailed Description

A device attached to an ARM APB bus (may be a debug core or something else)

The documentation for this class was generated from the following files:

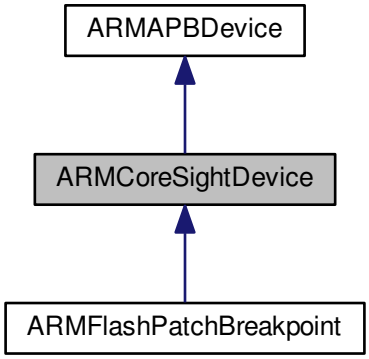
- ARMAPBDevice.h
- ARMAPBDevice.cpp

## 7.3 ARMCoreSightDevice Class Reference

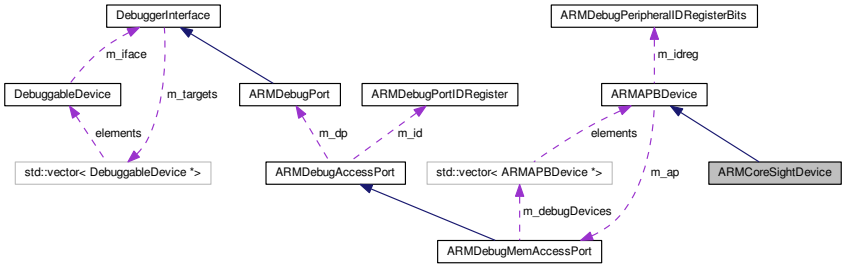
Base class for ARM CoreSight components (other than CPU cores) on a debug APB bus.

`#include <ARMCoreSightDevice.h>`

Inheritance diagram for ARMCoreSightDevice:




Collaboration diagram for ARMCoreSightDevice:




### Public Member Functions

- **ARMCoreSightDevice** (ARMDebugMemAccessPort *ap, uint32_t address, ARMDebugPeripheralID↩ RegisterBits idreg)
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()

### Additional Inherited Members

#### 7.3.1 Detailed Description

Base class for ARM CoreSight components (other than CPU cores) on a debug APB bus.

The documentation for this class was generated from the following files:

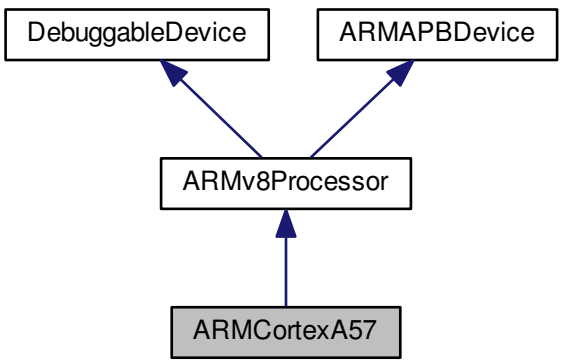
- ARMCoreSightDevice.h
- ARMCoreSightDevice.cpp

## 7.4 ARMCortexA57 Class Reference

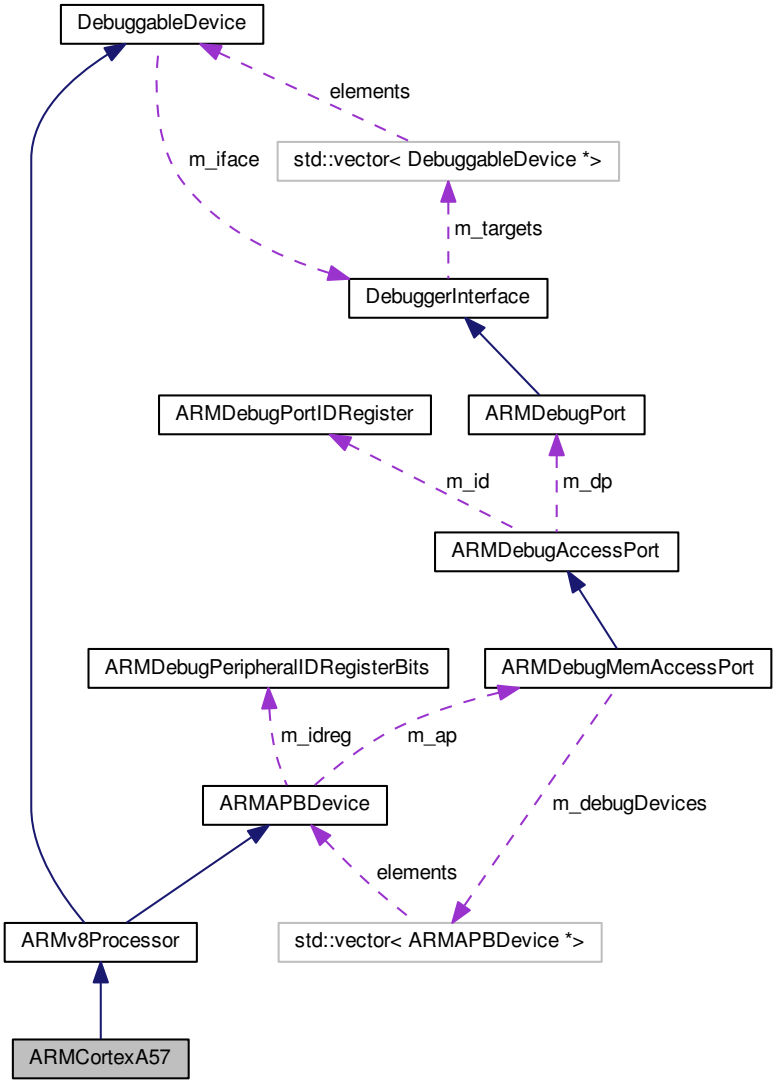
An ARM Cortex-A57 CPU core, as seen over a CoreSight APB bus.

`#include <ARMCortexA57.h>`

Inheritance diagram for ARMCortexA57:



Collaboration diagram for ARMCortexA57:




## Public Member Functions

- **ARMCortexA57** (DebuggerInterface *iface, ARMDebugMemAccessPort *ap, uint32_t address, ARM↩ DebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()

## Additional Inherited Members

### 7.4.1 Detailed Description

An ARM Cortex-A57 CPU core, as seen over a CoreSight APB bus.

The documentation for this class was generated from the following files:

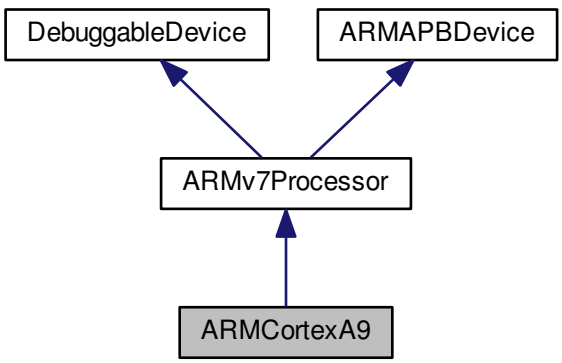
- ARMCortexA57.h
- ARMCortexA57.cpp

## 7.5 ARMCortexA9 Class Reference

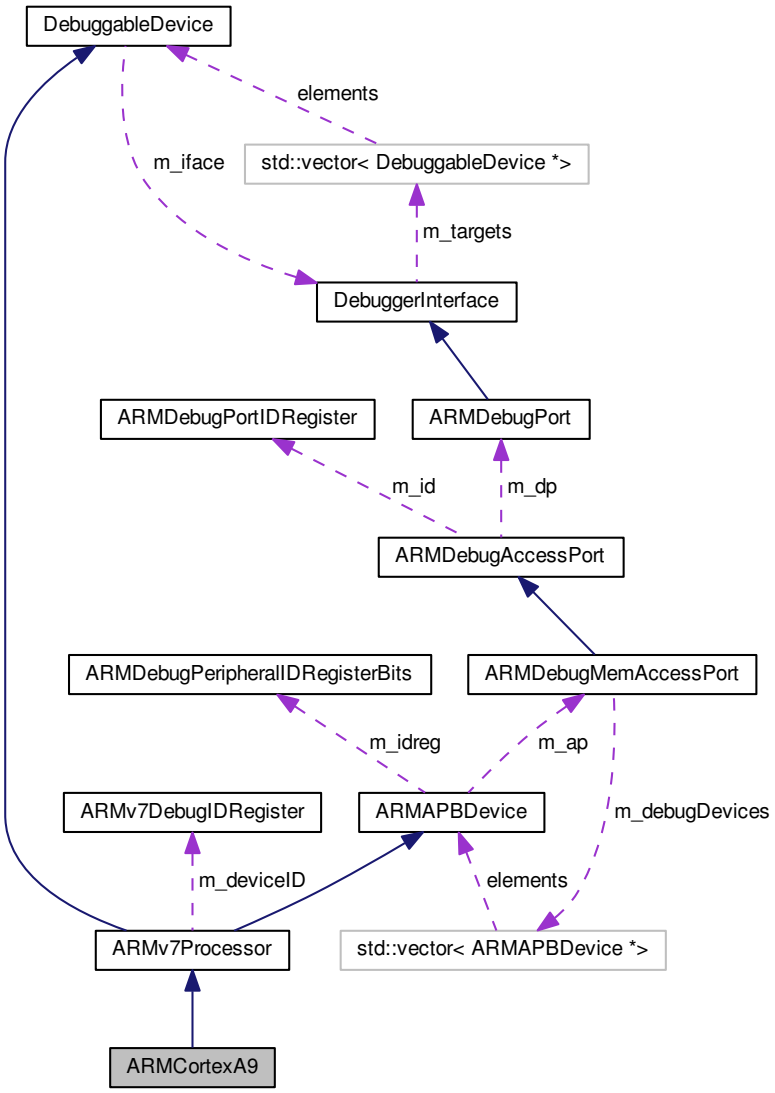
An ARM Cortex-A9 CPU core, as seen over a CoreSight APB bus.

```
#include <ARMCortexA9.h>
```

Inheritance diagram for ARMCortexA9:



Collaboration diagram for ARMCortexA9:




## Public Member Functions

- **ARMCortexA9** (DebuggerInterface ∗iface, ARMDebugMemAccessPort ∗ap, uint32_t address, ARMDebug↩ PeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()
- uint32_t SampleProgramCounter ()

  *Sample program counter (for sample-based profiling)*

## Additional Inherited Members

### 7.5.1 Detailed Description

An ARM Cortex-A9 CPU core, as seen over a CoreSight APB bus.

The documentation for this class was generated from the following files:

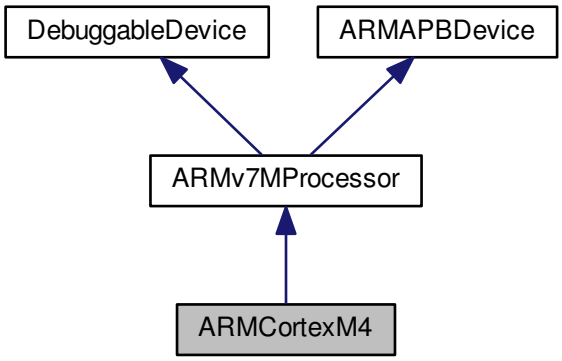
- ARMCortexA9.h
- ARMCortexA9.cpp

## 7.6 ARMCortexM4 Class Reference

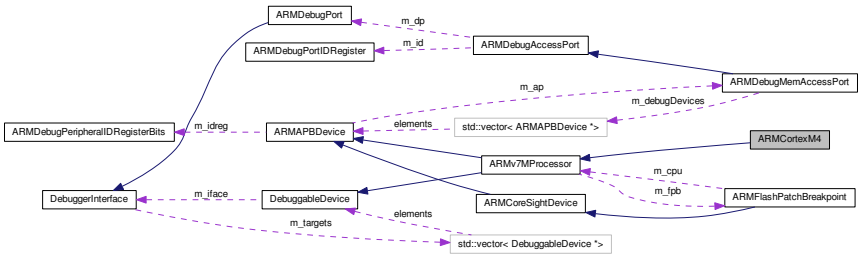
An ARM Cortex-M4 CPU core, as seen over a CoreSight APB bus.

```
#include <ARMCortexM4.h>
```

Inheritance diagram for ARMCortexM4:




Collaboration diagram for ARMCortexM4:



### Public Member Functions

- **ARMCortexM4** (DebuggerInterface *iface, ARMDebugMemAccessPort *ap, uint32_t address, ARMDebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()

### Additional Inherited Members

#### 7.6.1 Detailed Description

An ARM Cortex-M4 CPU core, as seen over a CoreSight APB bus.

The documentation for this class was generated from the following files:

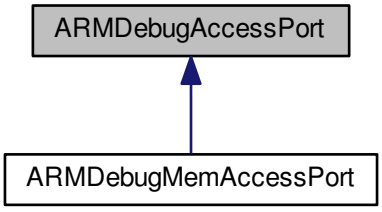
- ARMCortexM4.h
- ARMCortexM4.cpp

## 7.7 ARMDebugAccessPort Class Reference

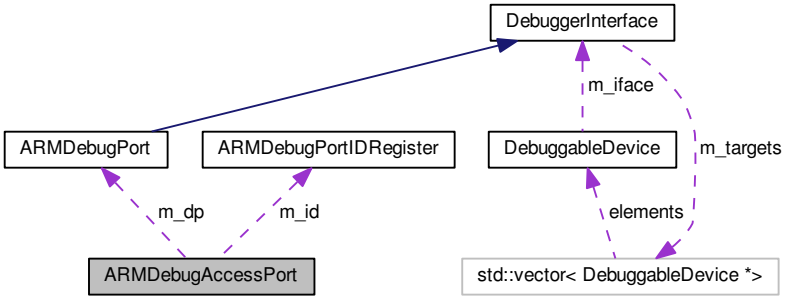
Base class for all access ports within an ARMDebugPort.

`#include <ARMDebugAccessPort.h>`

Inheritance diagram for ARMDebugAccessPort:




Collaboration diagram for ARMDebugAccessPort:



### Public Types

- enum **dap_type** {
  **DAP_JTAG** = 0, **DAP_AHB** = 1, **DAP_APB** = 2, **DAP_AXI** = 4,
  **DAP_INVALID** }

### Public Member Functions

- **ARMDebugAccessPort** (ARMDebugPort *dp, uint8_t apnum, ARMDebugPortIDRegister id)
- virtual void **Initialize** ()=0
- dap_type **GetBusType** ()
- unsigned int **GetVersion** ()
- virtual void **PrintStatusRegister** ()=0
- virtual bool **IsEnabled** ()=0
- virtual std::string **GetDescription** ()=0
- ARMDebugPort * **GetDebugPort** ()
- uint8_t **GetAPNumber** ()

### Public Attributes

- enum ARMDebugAccessPort::dap_type **__attribute__**

### Protected Attributes

- ARMDebugPort * **m_dp**
- uint8_t **m_apnum**
- ARMDebugPortIDRegister **m_id**
- dap_type **m_daptype**

#### 7.7.1 Detailed Description

Base class for all access ports within an ARMDebugPort.

The documentation for this class was generated from the following files:

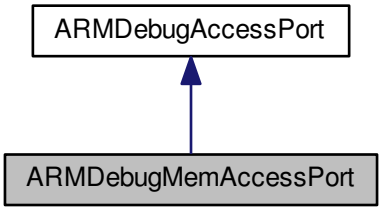
- ARMDebugAccessPort.h
- ARMDebugAccessPort.cpp

## 7.8 ARMDebugMemAccessPort Class Reference

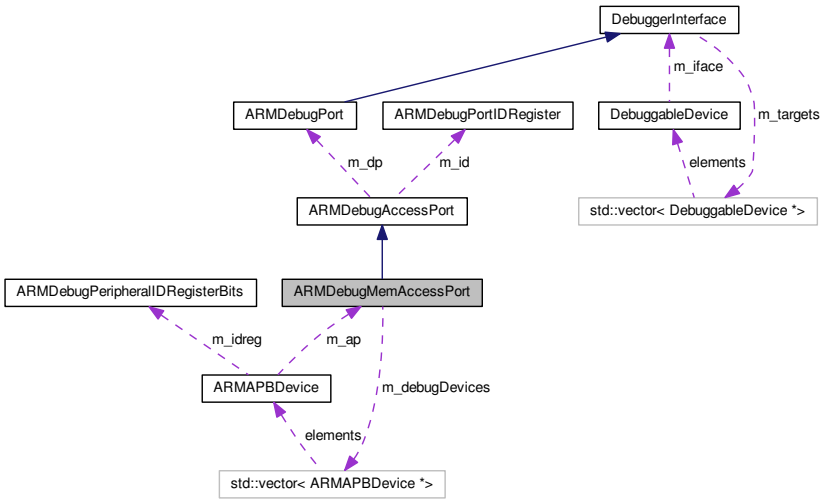
A bridge from an ARMDebugPort to an ARM memory bus.

`#include <ARMDebugMemAccessPort.h>`

Inheritance diagram for ARMDebugMemAccessPort:




Collaboration diagram for ARMDebugMemAccessPort:




### Public Types

- enum **AccessSize** { **ACCESS_BYTE** = 0, **ACCESS_HALFWORD** = 1, **ACCESS_WORD** = 2, **ACCESS_↩ INVALID** = 3 }
- enum **ComponentClass** { **CLASS_ROMTABLE** = 0x1, **CLASS_CORESIGHT** = 0x9, **CLASS_GENERIC_IP** = 0xe }

### Public Member Functions

- **ARMDebugMemAccessPort** (ARMDebugPort *dp, uint8_t apnum, ARMDebugPortIDRegister id)
- virtual void **Initialize** ()
- uint32_t **ReadWord** (uint32_t addr)
- void **WriteWord** (uint32_t addr, uint32_t value)
- virtual void **PrintStatusRegister** ()
- virtual std::string **GetDescription** ()
- ARMDebugMemAPControlStatusWord **GetStatusRegister** ()
- virtual bool **IsEnabled** ()
- uint32_t **GetDebugBaseAddress** ()
- size_t **GetDeviceCount** ()
- ARMAPBDevice * **GetDevice** (size_t i)

### Public Attributes

- enum ARMDebugMemAccessPort::AccessSize **__attribute__**

### Protected Member Functions

- void **FindRootRomTable** ()
- void **LoadROMTable** (uint32_t baseAddress)
- void ProcessDebugBlock (uint32_t base_address, uint32_t id_base, ARMDebugPeripheralIDRegister reg)

  *Reads the ROM table for a debug block to figure out what's going on.*

### Protected Attributes

- bool **m_debugBusIsDedicated**
- bool **m_hasDebugRom**
- uint32_t **m_debugBaseAddress**
- std::vector< ARMAPBDevice * > m_debugDevices

  *The list of devices found on the AP.*

#### 7.8.1 Detailed Description

A bridge from an ARMDebugPort to an ARM memory bus.

The documentation for this class was generated from the following files:

- ARMDebugMemAccessPort.h
- ARMDebugMemAccessPort.cpp

## 7.9 ARMDebugMemAPControlStatusWord Union Reference

Contents of the CSW register in a MEM-AP (see ADIv5 Architecture Specification 7.6.4)

```
#include <ARMDebugMemAccessPort.h>
```

### Public Member Functions

- struct {
  unsigned int size:3
  *Size of the access to perform.*
  unsigned int reserved_zero_1:1
  *Reserved, should be zero.*
  unsigned int auto_increment:2
  *Address increment/pack mode.*
  unsigned int enable:1
  *Debug port enable (RO)*
  unsigned int busy:1
  *Transfer in progress.*
  unsigned int mode:4
  *Operating mode (write as zero, read undefined)*
  unsigned int reserved_zero_2:11
  *Reserved, should be zero.*
  unsigned int secure_priv_debug:1
  *Secure privileged debug flag (not sure what this is)*
  unsigned int bus_protect:6
  *Bus access protection (implementation defined)*
  unsigned int nonsecure_transfer:1
  *Secure transfer (high=nonsecure)*
  unsigned int **reserved_zero_3**: 1
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word

  *The raw status register value.*

#### 7.9.1 Detailed Description

Contents of the CSW register in a MEM-AP (see ADIv5 Architecture Specification 7.6.4)

The documentation for this union was generated from the following file:

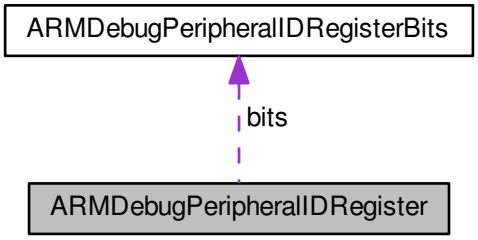
- ARMDebugMemAccessPort.h

## 7.10 ARMDebugPeripheralIDRegister Union Reference

ADI component ID register.

`#include <ARMDebugPeripheralIDRegister.h>`

Collaboration diagram for ARMDebugPeripheralIDRegister:




### Public Attributes

- ARMDebugPeripheralIDRegisterBits bits
  *The bitfield.*
- uint64_t word
  *The raw status register value.*

#### 7.10.1 Detailed Description

ADI component ID register.

The documentation for this union was generated from the following file:

- ARMDebugPeripheralIDRegister.h

## 7.11 ARMDebugPeripheralIDRegisterBits Class Reference

ADI component ID register bitfield.

```
#include <ARMDebugPeripheralIDRegister.h>
```

### Public Attributes

- unsigned int partnum:12
  *Part number (TODO)*
- unsigned int jep106_id:7
  *JEP106 identity code.*
- unsigned int jep106_used:1
  *Indicates if JEP106 code is valid.*
- unsigned int revnum:4
  *Peripheral revision number.*

- unsigned int cust_mod:4

  *Customer modification ID.*
- unsigned int revand:4

  *Manufacturer rev number (stepping)*
- unsigned int jep106_cont:4

  *JEP106 continuation code.*
- unsigned int log_4k_blocks:4

  *Log2(#4K address space blocks)*
- unsigned int reserved_zero:24

  *Unmapped.*

### 7.11.1 Detailed Description

ADI component ID register bitfield.

The documentation for this class was generated from the following file:

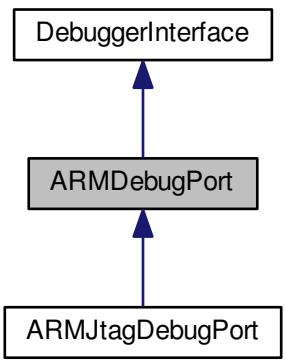
- ARMDebugPeripheralIDRegister.h

## 7.12 ARMDebugPort Class Reference

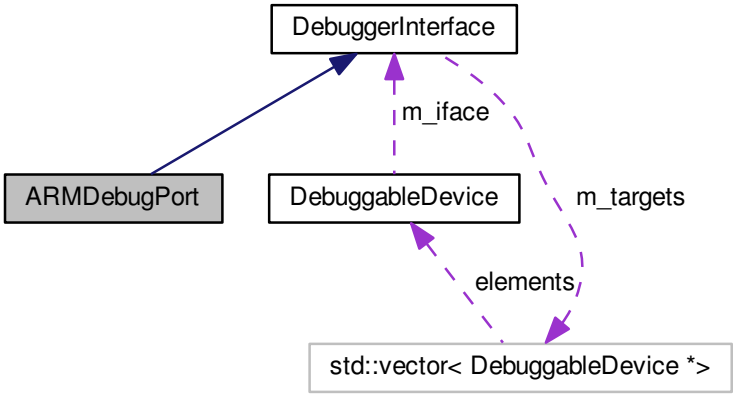
Base class for ARM debug ports (JTAG-DP, SWJ-DP, etc)

`#include <ARMDebugPort.h>`

Inheritance diagram for ARMDebugPort:



Collaboration diagram for ARMDebugPort:




### Public Types

- enum **ApReg** {
  **REG_MEM_CSW** = 0x00, **REG_MEM_TAR** = 0x04, **REG_MEM_DRW** = 0x0C, **REG_MEM_BASE** = 0xF8, **REG_IDR** = 0xFC }

### Public Member Functions

- virtual void **PrintStatusRegister** ()=0
- virtual uint32_t **ReadDebugRegister** (uint32_t address)=0
- virtual void **WriteDebugRegister** (uint32_t address, uint32_t value)=0

### Protected Member Functions

- virtual uint32_t **APRegisterRead** (uint8_t ap, ApReg addr)=0
- virtual void **APRegisterWrite** (uint8_t ap, ApReg addr, uint32_t wdata)=0

### Friends

- class **ARMDebugMemAccessPort**

### Additional Inherited Members

#### 7.12.1 Detailed Description

Base class for ARM debug ports (JTAG-DP, SWJ-DP, etc)

The documentation for this class was generated from the following files:

- ARMDebugPort.h
- ARMDebugPort.cpp

## 7.13 ARMDebugPortIDRegister Union Reference

ARM debug port identification register (see ADIv5 Architecture Specification figure 6-3)

`#include <ARMDebugAccessPort.h>`

### Public Member Functions

- struct {
  unsigned int type:4
  *Type of AP.*
  unsigned int variant:4
  *Variant of AP.*
  unsigned int reserved_zero:8
  *Reserved, SBZ.*
  unsigned int is_mem_ap:1
  *Class (1 = mem-AP, 0=not mem-AP)*
  unsigned int identity:7
  *Identity code (must be 0x3B)*
  unsigned int continuation:4
  *Continuation code (must be 0x4)*
  unsigned int revision: 4
  *Revision of the AP design.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word

  *The raw status register value.*

### 7.13.1 Detailed Description

ARM debug port identification register (see ADIv5 Architecture Specification figure 6-3)

The documentation for this union was generated from the following file:

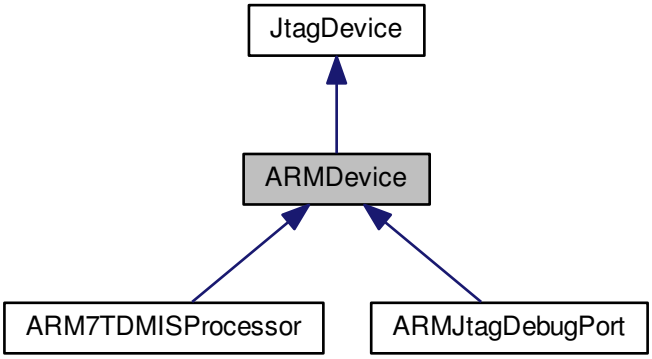
- ARMDebugAccessPort.h

## 7.14 ARMDevice Class Reference

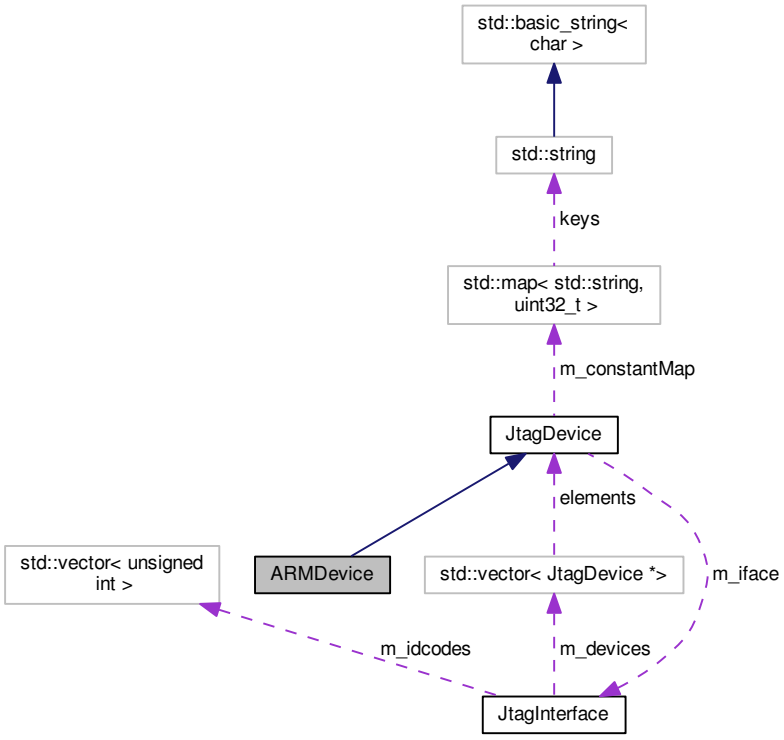
Abstract base class for all ARM Ltd JTAG devices (ADIv5 DAP or legacy CPUs with their own JTAG TAPs)

`#include <ARMDevice.h>`

Inheritance diagram for ARMDevice:




Collaboration diagram for ARMDevice:



### Public Member Functions

- ARMDevice (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~ARMDevice ()

  *Default virtual destructor.*

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int idcode, JtagInterface *iface, size_t pos)

  *Creates a ARMDevice given an ID code.*

### Additional Inherited Members

## 7.14.1 Detailed Description

Abstract base class for all ARM Ltd JTAG devices (ADIv5 DAP or legacy CPUs with their own JTAG TAPs)

## 7.14.2 Constructor & Destructor Documentation

### 7.14.2.1 ARMDevice()

```
ARMDevice::ARMDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

## 7.14.3 Member Function Documentation

#### 7.14.3.1 CreateDevice()

```
JtagDevice * ARMDevice::CreateDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a ARMDevice given an ID code.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the ID code supplied is not a valid Microchip device, or not a known family number |

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

**Returns**

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

The documentation for this class was generated from the following files:

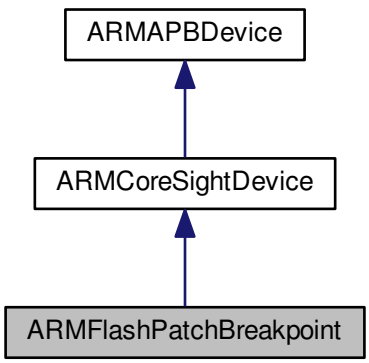
- ARMDevice.h
- ARMDevice.cpp

## 7.15 ARMFlashPatchBreakpoint Class Reference

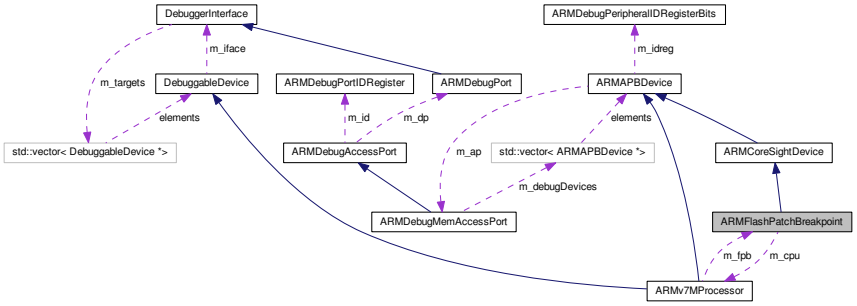
Cortex-M Flash Patch/Breakpoint Unit (see ARMv7-M architecture ref C1.11)

`#include <ARMFlashPatchBreakpoint.h>`

Inheritance diagram for ARMFlashPatchBreakpoint:



Collaboration diagram for ARMFlashPatchBreakpoint:




## Public Types

- enum **FpbRegisters** { **FP_CTRL** = 0, **FP_REMAP** = 1, **FP_COMP0** = 2 }

## Public Member Functions

- **ARMFlashPatchBreakpoint** (ARMv7MProcessor *cpu, ARMDebugMemAccessPort *ap, uint32_t address, ARMDebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()
- virtual void **PrintInfo** ()
- uint32_t **GetCodeComparatorIndex** (uint32_t i)
- uint32_t **GetLiteralComparatorIndex** (uint32_t i)
- uint32_t **GetCodeComparatorCount** ()
- uint32_t **GetLiteralComparatorCount** ()
- void **Enable** ()
- void **Disable** ()
- void **SetRemapTableBase** (uint32_t base)
- void **RemapFlashWord** (uint32_t slot, uint32_t flashAddress, uint32_t newValue)

## Protected Member Functions

- void **ProbeStatusRegisters** ()

## Protected Attributes

- ARMv7MProcessor * **m_cpu**
- uint32_t **m_codeComparators**
- uint32_t **m_literalComparators**
- bool **m_enabled**
- bool **m_canRemap**
- uint32_t **m_tableBase**
- uint32_t **m_sramBase**

### 7.15.1 Detailed Description

Cortex-M Flash Patch/Breakpoint Unit (see ARMv7-M architecture ref C1.11)

The documentation for this class was generated from the following files:

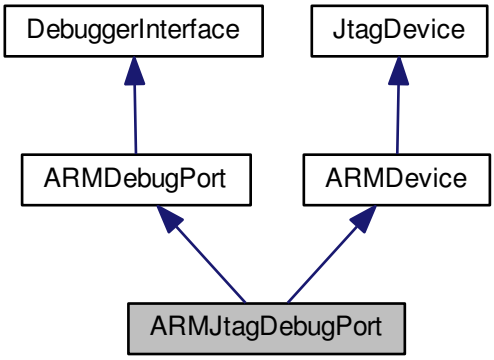
- ARMFlashPatchBreakpoint.h
- ARMFlashPatchBreakpoint.cpp

## 7.16 ARMJtagDebugPort Class Reference

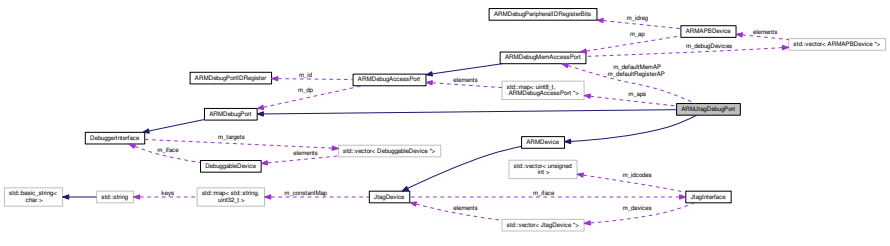
An ARM JTAG-DP (contains one or more APs and a DP)

`#include <ARMJtagDebugPort.h>`

Inheritance diagram for ARMJtagDebugPort:




Collaboration diagram for ARMJtagDebugPort:



### Public Types

- enum **instructions** { **INST_IDCODE** = 0x0e, **INST_ABORT** = 0x08, **INST_DPACC** = 0x0a, **INST_APACC** = 0x0b }
- enum **DapResult** { **OK_OR_FAULT** = 2, **WAIT** = 1 }
- enum **RWFlag** { **OP_WRITE** = 0, **OP_READ** = 1 }
- enum **DpReg** { **REG_CTRL_STAT** = 1, **REG_AP_SELECT** = 2, **REG_RDBUFF** = 3 }

## Public Member Functions

- **ARMJtagDebugPort** (unsigned int partnum, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual void **PrintInfo** ()
- virtual uint32_t ReadMemory (uint32_t address)

  *Read a single 32-bit word of memory (TODO support smaller sizes)*
- virtual void WriteMemory (uint32_t address, uint32_t value)

  *Writes a single 32-bit word of memory (TODO support smaller sizes)*
- virtual uint32_t **ReadDebugRegister** (uint32_t address)
- virtual void WriteDebugRegister (uint32_t address, uint32_t value)

  *Writes a single 32-bit word of memory.*
- ARMJtagDebugPortStatusRegister GetStatusRegister ()

  *Gets the status register.*
- void **PrintStatusRegister** (ARMJtagDebugPortStatusRegister reg, bool children=true)
- virtual void **PrintStatusRegister** ()

## Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int partnum, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

## Public Attributes

- enum ARMJtagDebugPort::instructions **__attribute__**

## Protected Member Functions

- void **ClearStatusRegisterErrors** ()
- uint32_t DPRegisterRead (DpReg addr)

  *Reads from a DP register.*
- void **DPRegisterWrite** (DpReg addr, uint32_t wdata)
- uint32_t APRegisterRead (uint8_t ap, ApReg addr)

  *Reads from an AP register.*
- void APRegisterWrite (uint8_t ap, ApReg addr, uint32_t wdata)

  *Writes to an AP register.*
- void **EnableDebugging** ()
- void DebugAbort ()

  *Aborts the current AP transaction.*
- void **SetIR** (unsigned char irval)
- void **SetIRDeferred** (unsigned char irval)

### Protected Attributes

- unsigned int m_rev

  *Stepping number.*
- unsigned int m_partnum

  *Part number (normally IDCODE_ARM_DAP_JTAG)*
- std::map< uint8_t, ARMDebugAccessPort * > m_aps

  *Access ports.*
- ARMDebugMemAccessPort * m_defaultMemAP

  *The default Mem-AP used for memory access.*
- ARMDebugMemAccessPort * **m_defaultRegisterAP**

### Friends

- class **ARMDebugMemAccessPort**

## 7.16.1 Detailed Description

An ARM JTAG-DP (contains one or more APs and a DP)

## 7.16.2 Member Function Documentation

### 7.16.2.1 APRegisterRead()

```
uint32_t ARMJtagDebugPort::APRegisterRead (
            uint8_t ap,
            ApReg addr )  [protected], [virtual]
```

Reads from an AP register.

**Parameters**

| | |
|---|---|
| *ap* | The number of the AP to access |
| *addr* | The ID of the AP register to read |

**Returns**

The value read

Implements ARMDebugPort.

#### 7.16.2.2 APRegisterWrite()

```
void ARMJtagDebugPort::APRegisterWrite (
            uint8_t ap,
            ApReg addr,
            uint32_t wdata )  [protected], [virtual]
```

Writes to an AP register.

**Parameters**

| | |
|---|---|
| *ap* | The number of the AP to access |
| *addr* | The ID of the AP register to read |
| *wdata* | The value to write |

Implements ARMDebugPort.

#### 7.16.2.3 DPRegisterRead()

```
uint32_t ARMJtagDebugPort::DPRegisterRead (
            DpReg addr )  [protected]
```

Reads from a DP register.

**Parameters**

| | |
|---|---|
| *addr* | The ID of the DP register to read |

**Returns**

The value read

#### 7.16.2.4 GetDescription()

```
std::string ARMJtagDebugPort::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.16.2.5 PostInitProbes()

```
void ARMJtagDebugPort::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

The documentation for this class was generated from the following files:

- ARMJtagDebugPort.h
- ARMJtagDebugPort.cpp

## 7.17 ARMJtagDebugPortStatusRegister Union Reference

ARM debug port status register (see ADIv5 Architecture Specification figure 6-3)

```
#include <ARMJtagDebugPort.h>
```

### Public Member Functions

- struct {
  unsigned int sticky_overrun_en:1
  *Set to 1 to enable overrun detection.*
  unsigned int sticky_overrun:1
  *Sticky buffer overrun (if enabled)*
  unsigned int transfer_mode:2
  *Transfer mode.*
  unsigned int sticky_compare:1
  *Sticky compare bit.*
  unsigned int sticky_err:1
  *Sticky error bit.*
  unsigned int read_ok:1
  *Read status flag.*
  unsigned int wr_data_err:1
  *Write data error flag.*
  unsigned int mask_lane:4
  *Byte mask.*
  unsigned int trans_count:12
  *Transaction counter.*
  unsigned int reserved_zero:2
  *Reserved, should be zero.*
  unsigned int debug_reset_req:1
  *Debug reset request.*
  unsigned int debug_reset_ack:1

*Debug reset acknowledgement.*
unsigned int debug_pwrup_req:1
*Powerup request.*
unsigned int debug_pwrup_ack:1
*Powerup acknowledgement.*
unsigned int sys_pwrup_req:1
*Powerup request.*
unsigned int sys_pwrup_ack:1
*Powerup acknowledgement.*
} **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word
  *The raw status register value.*

### 7.17.1 Detailed Description

ARM debug port status register (see ADIv5 Architecture Specification figure 6-3)

The documentation for this union was generated from the following file:

- ARMJtagDebugPort.h

## 7.18 ARMv7DebugIDRegister Union Reference

ARM debug ID register (see ARMv7 Architecture Reference Manual, C11.11.15)

```
#include <ARMv7Processor.h>
```

### Public Member Functions

-
  struct {
  unsigned int revision:4
  *Implementation defined CPU revision.*
  unsigned int variant:4
  *Implementation defined CPU variant.*
  unsigned int reserved:4
  *Reserved, undefined value.*
  unsigned int sec_ext:1
  *Indicates if security extensions are implemented.*
  unsigned int pcsr_legacy_addr:1
  *Indicates if PCSR is present at the legacy address.*
  unsigned int no_secure_halt:1
  *NO secure halting debug.*
  unsigned int has_dbgdevid:1
  *True if DBGDEVID is implemented.*
  ARMDebugArchVersion debug_arch_version:4

*Debug arch version.*
unsigned int context_bpoints_minus_one:4
*Number of breakpoints supporting context matching, zero based (0 means 1 implemented, etc)*
unsigned int bpoints_minus_one:4
*Number of breakpoints, zero based (0 means 1 implemented, etc)*
unsigned int wpoints_minus_one:4
*Number of watchpoints, zero based (0 means 1 implemented, etc)*
} **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word
  *The raw register value.*

### 7.18.1 Detailed Description

ARM debug ID register (see ARMv7 Architecture Reference Manual, C11.11.15)

The documentation for this union was generated from the following file:

- ARMv7Processor.h

## 7.19 ARMv7DebugStatusControlRegister Union Reference

ARM debug status/control register (see ARMv7 Architecture Reference Manual, C11.11.20)

```
#include <ARMv7Processor.h>
```

### Public Member Functions

-
struct {
unsigned int halted:1
*Set by the CPU when the processor is halted.*
unsigned int restarted:1
*Processor restarted flag.*
unsigned int entry_method:4
*Method of debug entry (TODO)*
unsigned int sticky_sync_abt:1
*Sticky sync abort.*
unsigned int sticky_async_abt:1
*Sticky async abort.*
unsigned int sticky_undef_instr:1
*Sticky undefined instruction.*
unsigned int reserved_sbz2:1
*Reserved.*
unsigned int force_dbg_ack:1
*Force debug acks regardless of cpu settings.*
unsigned int int_dis:1

*Disable interrupts.*
unsigned int user_dcc:1
*Enable user-mode access to the debug channel.*
unsigned int inst_txfr:1
*Enable instruction transfer.*
unsigned int halting_debug:1
*Enable halting-mode debug.*
unsigned int monitor_debug:1
*Set high by the CPU if it allows monitor-mode debugging.*
unsigned int secure_ni_debug:1
*Set high by the CPU if it allows invasive debug in secure mode.*
unsigned int deprecated:1
*Deprecated "secure noninvasive debug" bit.*
unsigned int nonsec:1
*Set high by the CPU if it is not in secure mode.*
unsigned int discard_async_abort:1
*Set high to discard async aborts.*
unsigned int ext_dcc_mode:2
*DCC access mode (TODO enum)*
unsigned int instr_complete:1
*Latching instruction-complete bit for single instruction issue.*
unsigned int pipelined_advancing:1
*Sticky "pipeline advancing" bit, set at unpredictable intervals when not halted.*
unsigned int tx_full_latch:1
*Latching TX-full bit.*
unsigned int rx_full_latch:1
*Latching RX-full bit.*
unsigned int tx_full:1
*Indicates DBGDTRTX has valid data.*
unsigned int rx_full:1
*Indicates DBGDTRRX has valid data.*
unsigned int reserved_sbz:1
*Reserved, should be zero.*
} **__attribute__** ((packed)) bits

## Public Attributes

- uint32_t word

  *The raw register value.*

### 7.19.1 Detailed Description

ARM debug status/control register (see ARMv7 Architecture Reference Manual, C11.11.20)

The documentation for this union was generated from the following file:

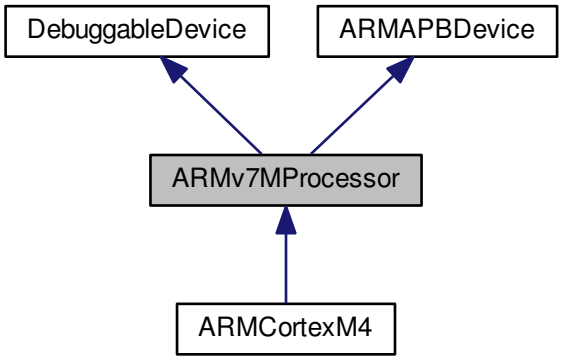
- ARMv7Processor.h

## 7.20 ARMv7MProcessor Class Reference

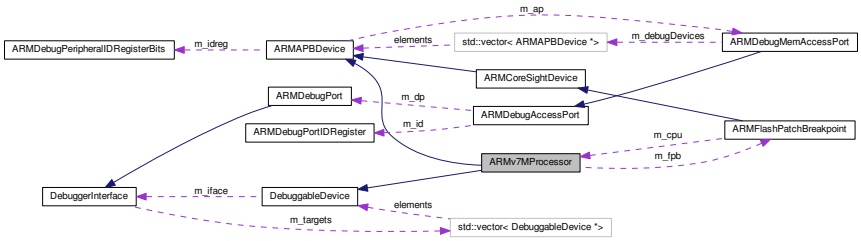
An ARMv7 Cortex-M CPU core, as seen over a CoreSight APB bus.

`#include <ARMv7MProcessor.h>`

Inheritance diagram for ARMv7MProcessor:




Collaboration diagram for ARMv7MProcessor:




### Public Types

- enum **ARM_V7M_SCS_REGISTERS** {
  **ACTLR** = 0x0002, **STCSR** = 0x0004, **STRVR** = 0x0005, **STCVR** = 0x0006,
  **STCR** = 0x0007, **CPUID** = 0x0340, **ICSR** = 0x0341, **VTOR** = 0x0342,
  **AIRCR** = 0x0343, **SCR** = 0x0344, **CCR** = 0x0345, **SHPR1** = 0x0346,
  **SHPR2** = 0x0347, **SHPR3** = 0x0348, **SHCSR** = 0x0349, **CFSR** = 0x034a,
  **HFSR** = 0x034b, **DFSR** = 0x034c, **MMFAR** = 0x034d, **BFAR** = 0x034e,
  **AFSR** = 0x034f, **ID_PFR0** = 0x0350, **ID_PFR1** = 0x0351, **ID_DFR0** = 0x0352,
  **ID_AFR0** = 0x0353, **ID_MMFR0** = 0x0354, **ID_MMFR1** = 0x0355, **ID_MMFR2** = 0x0356,
  **ID_MMFR3** = 0x0357, **ID_ISAR0** = 0x0358, **ID_ISAR1** = 0x0359, **ID_ISAR2** = 0x035a,
  **ID_ISAR3** = 0x035b, **ID_ISAR4** = 0x035c, **CPACR** = 0x0362, **DHCSR** = 0x037c,
  **DCRSR** = 0x037d, **DCRDR** = 0x037e, **DEMCR** = 0x037f, **STIR** = 0x03c0 }

- enum **ARM_V7M_CPU_REGISTERS** {
  **R0** = 0, **R1** = 1, **R2** = 2, **R3** = 3,
  **R4** = 4, **R5** = 5, **R6** = 6, **R7** = 7,
  **R8** = 8, **R9** = 9, **R10** = 10, **R11** = 11,
  **R12** = 12, **SP** = 13, **LR** = 14, **DBGRA** = 15,
  **XPSR** = 16, **MSP** = 17, **PSP** = 18, **CTRL** = 20 }

### Public Member Functions

- **ARMv7MProcessor** (DebuggerInterface *iface, ARMDebugMemAccessPort *ap, uint32_t address, ARMDebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()=0
- virtual void **PrintInfo** ()=0
- bool HaltedDueToUnrecoverableException ()

  *Checks if the CPU is halted due to a fatal error.*
- uint32_t **ReadCPURegister** (ARM_V7M_CPU_REGISTERS reg)
- const char * **GetRegisterName** (ARM_V7M_CPU_REGISTERS reg)
- virtual void DebugHalt ()

  *Halts the CPU and enters debug state.*
- virtual void **DebugResume** ()
- virtual void PrintRegisters ()

  *Prints out all CPU registers.*
- ARMFlashPatchBreakpoint * **GetFlashPatchBreakpoint** ()
- void **AddFlashPatchUnit** (ARMFlashPatchBreakpoint *fpb)

### Protected Attributes

- ARMFlashPatchBreakpoint * **m_fpb**

### Additional Inherited Members

## 7.20.1 Detailed Description

An ARMv7 Cortex-M CPU core, as seen over a CoreSight APB bus.

## 7.20.2 Member Function Documentation

#### 7.20.2.1 DebugHalt()

```
void ARMv7MProcessor::DebugHalt ( )  [virtual]
```

Halts the CPU and enters debug state.

See ARMv7-M arch manual C1-6

Implements DebuggableDevice.

The documentation for this class was generated from the following files:

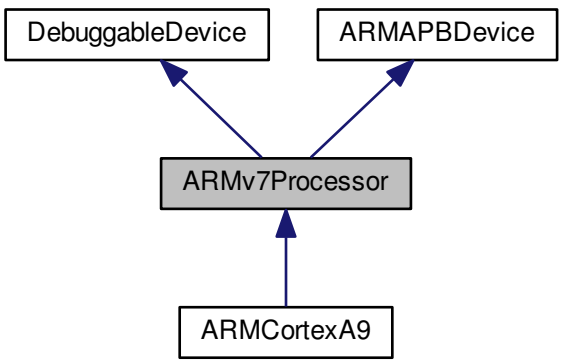
- ARMv7MProcessor.h
- ARMv7MProcessor.cpp

## 7.21 ARMv7Processor Class Reference

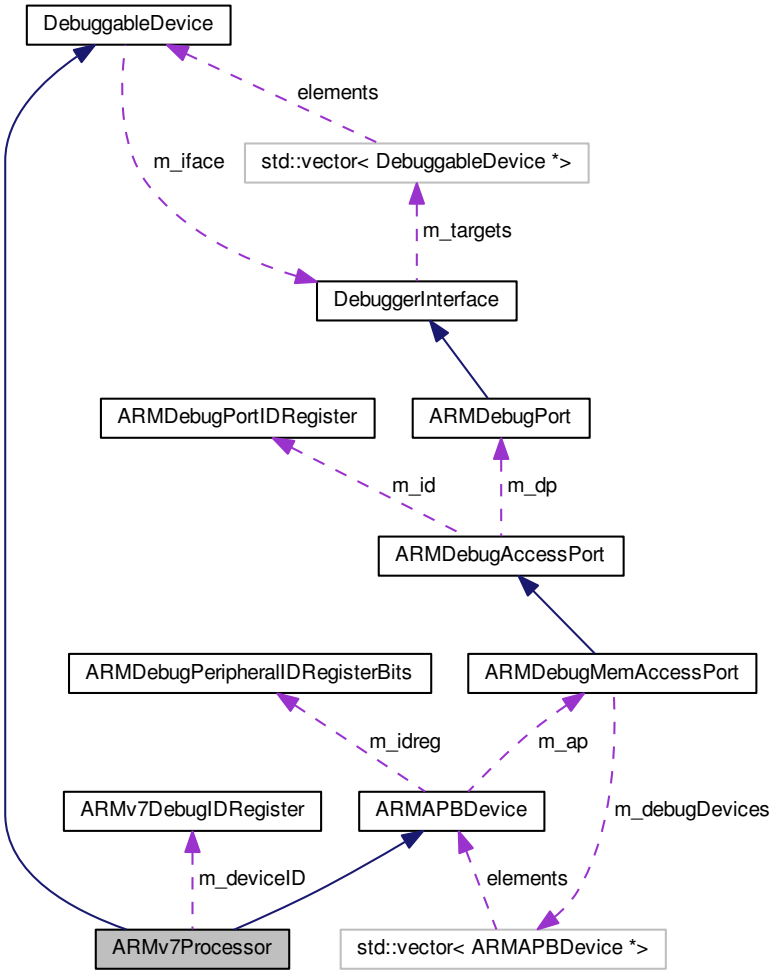
An ARMv7 Cortex-A CPU core, as seen over a CoreSight APB bus.

`#include <ARMv7Processor.h>`

Inheritance diagram for ARMv7Processor:



Collaboration diagram for ARMv7Processor:




## Public Types

- enum **ARM_V7_DEBUG_REGISTERS** {
  **DBGDIDR** = 0, **DBGDSCR_INT** = 1, **DBGDTRRX_INT** = 5, **DBGDTRTX_INT** = 5,
  **DBGWFAR** = 6, **DBGVCR** = 7, **DBGECR** = 9, **DBGDSCCR** = 10,
  **DBGDSMCR** = 11, **DBGDTRRX_EXT** = 32, **DBGITR** = 33, **DBGPCSR_LEGACY** = 33,
  **DBGDSCR_EXT** = 34, **DBGDTRTX_EXT** = 35, **DBGDRCR** = 36, **DBGEACR** = 37,
  **DBGPCSR** = 40, **DBGCIDSR** = 41, **DBGVIDSR** = 42, **DBGBVR_BASE** = 64,
  **DBGBCR_BASE** = 80, **DBGWVR_BASE** = 96, **DBGWCR_BASE** = 112, **DBGDRAR** = 128,
  **DBGBXVR_BASE** = 144, **DBGOSLAR** = 192, **DBGOSLSR** = 193, **DBGOSSRR** = 194,
  **DBGOSDLR** = 195, **DBGPRCR** = 196, **DBGPRSR** = 197, **DBGDSAR** = 256,
  **DBGPRID_BASE** = 832, **DBGITCTRL** = 960, **DBGCLAIMSET** = 1000, **DBGCLAIMCLR** = 1001,
  **DBGLAR** = 1004, **DBGLSR** = 1005, **DBGAUTHSTATUS** = 1006, **DBGDEVID** = 1010 }

## Public Member Functions

- **ARMv7Processor** (DebuggerInterface *iface, ARMDebugMemAccessPort *ap, uint32_t address, ARM↩ DebugPeripheralIDRegisterBits idreg)

- virtual std::string **GetDescription** ()=0
- virtual void **PrintInfo** ()=0

### Public Attributes

- enum ARMv7Processor::ARM_V7_DEBUG_REGISTERS **__attribute__**

### Protected Member Functions

- void **PrintIDRegister** (ARMv7DebugIDRegister did)
- virtual void DebugHalt ()

  *Halts the CPU and enters debug state.*
- virtual void **DebugResume** ()
- virtual void **PrintRegisters** ()

### Protected Attributes

- unsigned int **m_breakpoints**
- unsigned int **m_context_breakpoints**
- unsigned int **m_watchpoints**
- bool **m_hasDevid**
- bool **m_hasSecExt**
- bool **m_hasSecureHalt**
- unsigned int **m_revision**
- unsigned int **m_variant**
- ARMv7DebugIDRegister **m_deviceID**
- ARM_V7_DEBUG_REGISTERS m_pcsrIndex

  *Device-dependent address of the program counter sample register (PCSR)*

## 7.21.1 Detailed Description

An ARMv7 Cortex-A CPU core, as seen over a CoreSight APB bus.

## 7.21.2 Member Function Documentation

### 7.21.2.1 DebugHalt()

```
void ARMv7Processor::DebugHalt ( )  [protected], [virtual]
```

Halts the CPU and enters debug state.

See ARMv7-A/R arch ref manual, C11-2236

Implements DebuggableDevice.

The documentation for this class was generated from the following files:

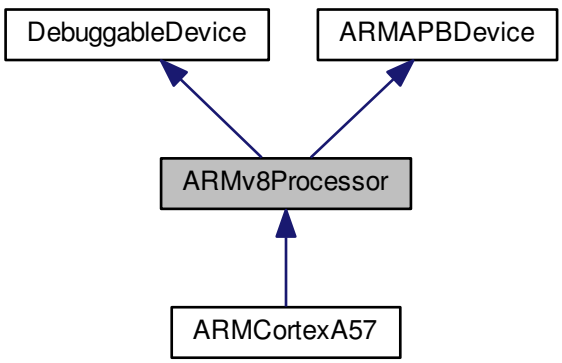
- ARMv7Processor.h
- ARMv7Processor.cpp

## 7.22 ARMv8Processor Class Reference

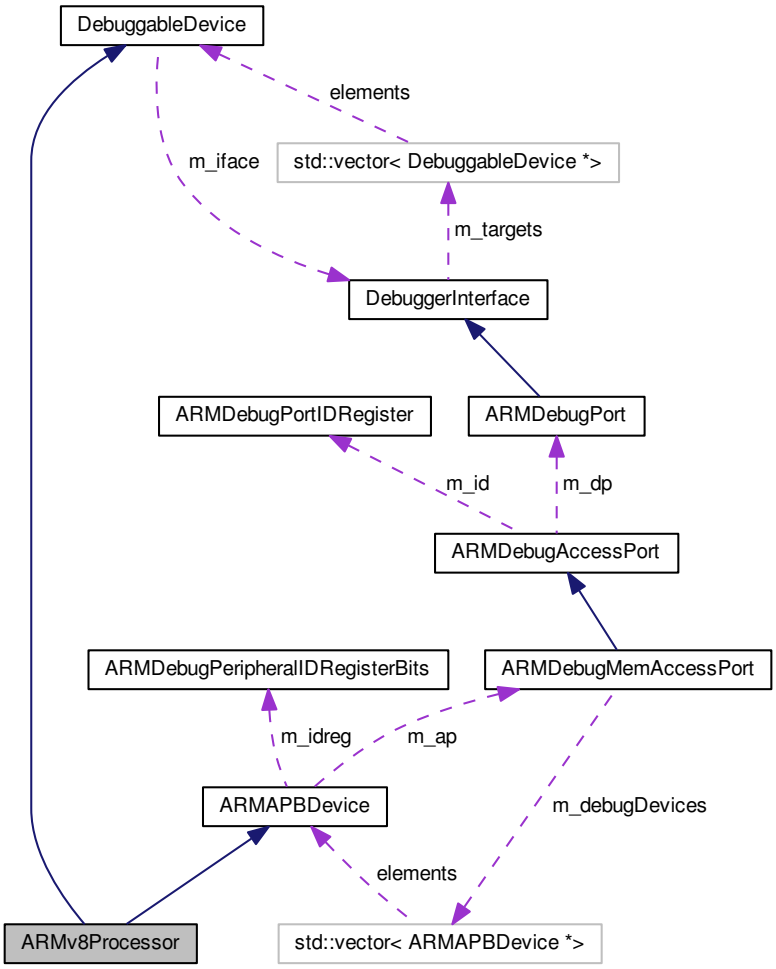
An ARMv8 Cortex-A CPU core, as seen over a CoreSight APB bus.

```
#include <ARMv8Processor.h>
```

Inheritance diagram for ARMv8Processor:



Collaboration diagram for ARMv8Processor:




## Public Types

- enum **ARM_V8_DEBUG_REGISTERS** {
  **DBGDTRRX_EL0** = 0x020, **DBGDTRTX_EL0** = 0x023, **MIDR_EL1** = 0x340, **DBGAUTHSTATUS_EL1** = 0x3ee,
  **DBGCLAIMSET_EL1** = 0x3e8, **DBGCLAIMCLR_EL1** = 0x3e9 }

## Public Member Functions

- **ARMv8Processor** (DebuggerInterface *iface, ARMDebugMemAccessPort *ap, uint32_t address, ARM↩DebugPeripheralIDRegisterBits idreg)
- virtual std::string **GetDescription** ()=0
- virtual void **PrintInfo** ()=0

### Protected Member Functions

- virtual void DebugHalt ()

  *Halts the CPU and enters debug state.*
- virtual void **DebugResume** ()
- virtual void **PrintRegisters** ()

### Additional Inherited Members

#### 7.22.1 Detailed Description

An ARMv8 Cortex-A CPU core, as seen over a CoreSight APB bus.

ARM debug ID register (see ARMv8 ARM, C11.11.15) ARM debug status/control register (see ARMv8 ARM, C11.↩
11.20)

The documentation for this class was generated from the following files:

- ARMv8Processor.h
- ARMv8Processor.cpp

## 7.23 AttachedMemoryDevice Class Reference

Base classes for devices which can connect to external memory devices.

`#include <AttachedMemoryDevice.h>`

### Public Member Functions

- virtual size_t **GetNumAttachedMemories** ()=0
- virtual ProgrammableDevice * **GetAttachedMemoryDevice** (size_t i)=0

#### 7.23.1 Detailed Description

Base classes for devices which can connect to external memory devices.

Example: FPGA with attached QSPI/BPI flash, MCU with external memory bus

The documentation for this class was generated from the following files:

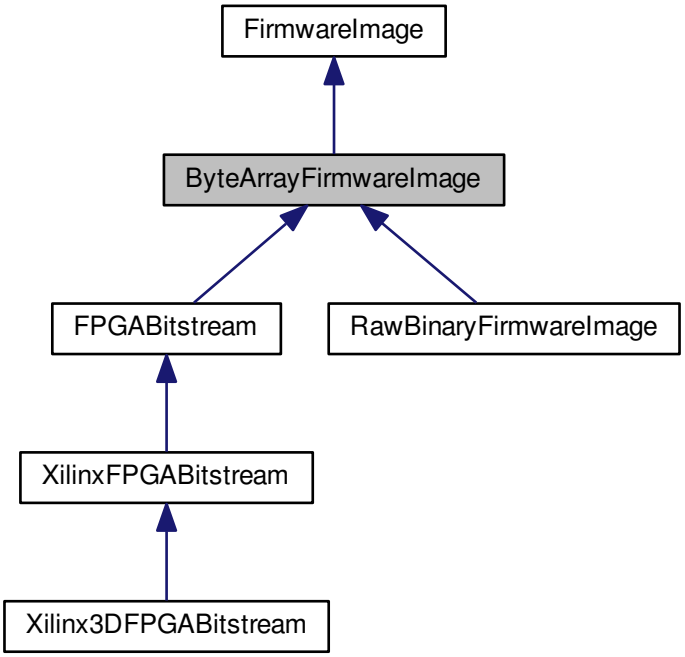
- AttachedMemoryDevice.h
- AttachedMemoryDevice.cpp

## 7.24 ByteArrayFirmwareImage Class Reference

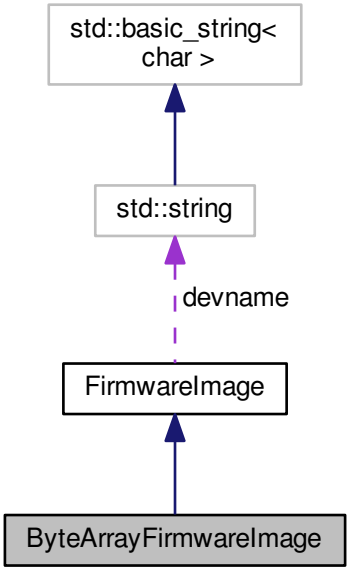
Generic base class for all firmware images consisting of an array of bytes.

```
#include <ByteArrayFirmwareImage.h>
```

Inheritance diagram for ByteArrayFirmwareImage:



Collaboration diagram for ByteArrayFirmwareImage:




### Public Member Functions

- ByteArrayFirmwareImage ()

  *Initializes this object to empty.*
- virtual ~ByteArrayFirmwareImage ()

  *Free bitstream memory.*

### Public Attributes

- uint8_t * raw_bitstream

  *Raw (header-less) bitstream data ready for sending to the device.*
- size_t raw_bitstream_len

  *Length of the raw bitstream, in bytes.*

### 7.24.1 Detailed Description

Generic base class for all firmware images consisting of an array of bytes.

The documentation for this class was generated from the following files:

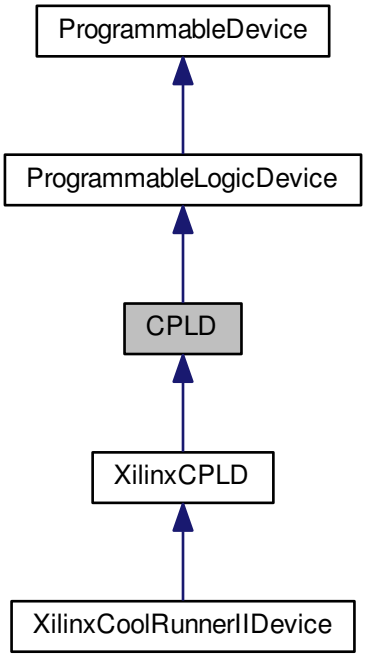
- ByteArrayFirmwareImage.h
- ByteArrayFirmwareImage.cpp

## 7.25 CPLD Class Reference

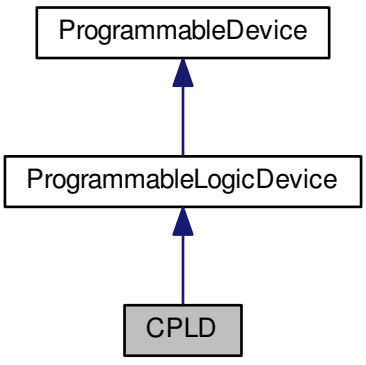
Generic base class for all complex programmable logic devices.

`#include <CPLD.h>`

Inheritance diagram for CPLD:




Collaboration diagram for CPLD:



### Public Member Functions

- virtual ~CPLD ()

  *Empty virtual destructor.*

### Static Public Member Functions

- static void ParseJEDFile (CPLDBitstream *bit, const unsigned char *data, size_t len)

  *Parses a JED file.*

### Static Protected Member Functions

- static int ReadIntLine (const char *cdata, size_t &pos, size_t len)

  *Reads a line containing an integer terminated by a *.*

## 7.25.1 Detailed Description

Generic base class for all complex programmable logic devices.

## 7.25.2 Member Function Documentation

### 7.25.2.1 ParseJEDFile()

```
void CPLD::ParseJEDFile (
            CPLDBitstream * bit,
            const unsigned char * data,
            size_t len )  [static]
```

Parses a JED file.

Reference: JEDEC Standard 3-C

**Exceptions**

| | |
|---|---|
| *JtagException* | if the file is malformed |

**Parameters**

| | |
|---|---|
| *bit* | Output bitstream |
| *data* | Data to load |
| *len* | Length of the file |

#### 7.25.2.2 ReadIntLine()

```
int CPLD::ReadIntLine (
            const char * cdata,
            size_t & pos,
            size_t len )  [static], [protected]
```

Reads a line containing an integer terminated by a *.

**Exceptions**

| | |
|---|---|
| *JtagException* | if malformed input |

**Parameters**

| | |
|---|---|
| *cdata* | Buffer to read |
| *pos* | Position to read from (updated at function return) |
| *len* | Length of the entire buffer |

**Returns**

The value

The documentation for this class was generated from the following files:

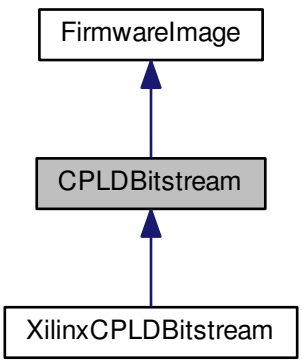
- CPLD.h
- CPLD.cpp

## 7.26 CPLDBitstream Class Reference

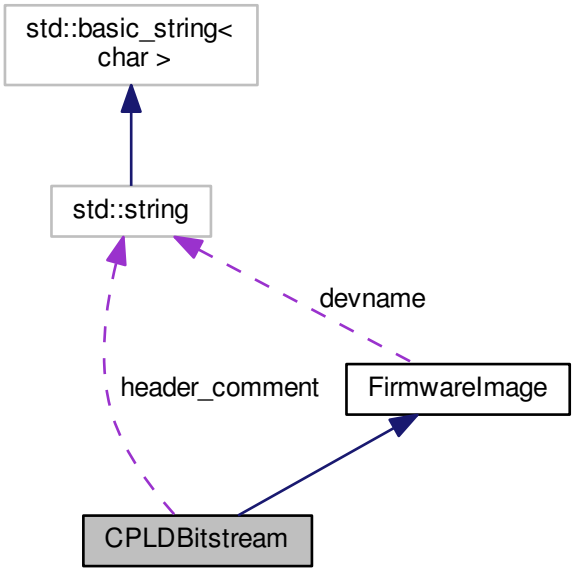
Abstract base class for CPLD configuration bitstreams.

`#include <CPLDBitstream.h>`

Inheritance diagram for CPLDBitstream:



Collaboration diagram for CPLDBitstream:




## Public Member Functions

- CPLDBitstream ()

  *Default constructor.*
- virtual ~CPLDBitstream ()

  *Empty virtual destructor.*

## Public Attributes

- std::string header_comment

  *Header comment.*
- uint16_t file_checksum

  *JED file checksum.*
- uint16_t fuse_checksum

  *Fuse array checksum.*
- unsigned int fuse_count

  *Number of fuses.*
- unsigned int pin_count

  *Number of pins.*
- bool * fuse_data

  *Fuse data.*

### 7.26.1 Detailed Description

Abstract base class for CPLD configuration bitstreams.

The documentation for this class was generated from the following files:

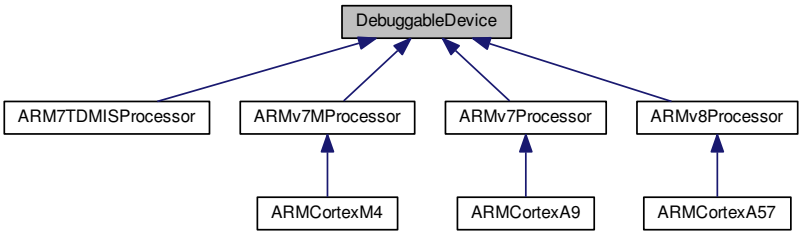
- CPLDBitstream.h
- CPLDBitstream.cpp

## 7.27 DebuggableDevice Class Reference

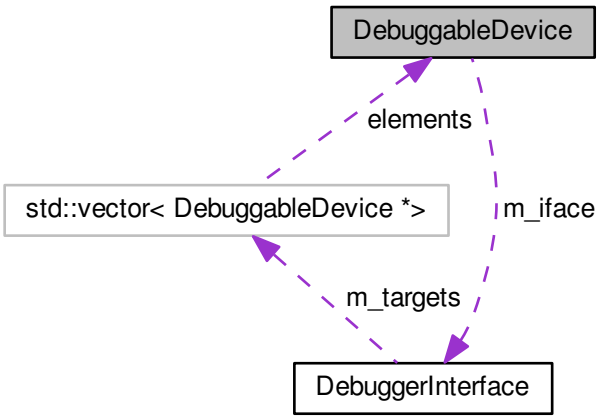
Generic base class for all debuggable devices (CPU cores etc)

`#include <DebuggableDevice.h>`

Inheritance diagram for DebuggableDevice:




Collaboration diagram for DebuggableDevice:



### Public Member Functions

- **DebuggableDevice** (DebuggerInterface *iface)
- virtual std::string **GetDescription** ()=0
- virtual uint32_t **ReadMemory** (uint32_t addr)
- virtual void **WriteMemory** (uint32_t addr, uint32_t value)
- virtual void **DebugHalt** ()=0
- virtual void **DebugResume** ()=0
- virtual void **PrintRegisters** ()=0

### Protected Attributes

- DebuggerInterface * **m_iface**

#### 7.27.1 Detailed Description

Generic base class for all debuggable devices (CPU cores etc)

The documentation for this class was generated from the following files:

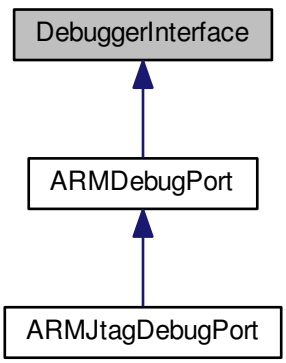
- DebuggableDevice.h
- DebuggableDevice.cpp

## 7.28 DebuggerInterface Class Reference

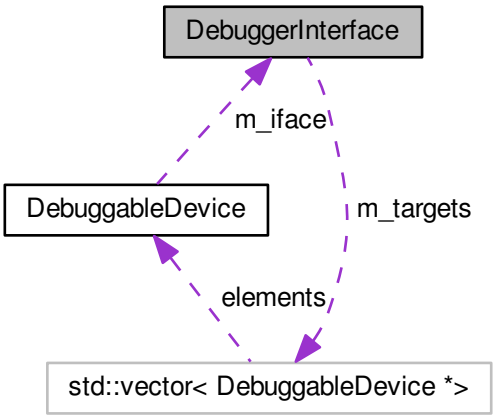
Generic base class for all debugger interfaces (may connect to multiple DebuggableDevice's in a SoC)

```
#include <DebuggerInterface.h>
```

Inheritance diagram for DebuggerInterface:



Collaboration diagram for DebuggerInterface:




### Public Member Functions

- virtual size_t GetNumTargets ()

  *Returns the number of DebuggableDevice's attached to this debugger.*
- virtual DebuggableDevice * GetTarget (size_t i)

  *Returns a specific DebuggableDevice.*
- void AddTarget (DebuggableDevice *target)

  *Adds a new debuggable device to this interface (called during topology discovery)*
- virtual uint32_t ReadMemory (uint32_t address)=0

  *Read a single 32-bit word of memory (TODO support smaller sizes)*
- virtual void WriteMemory (uint32_t address, uint32_t value)=0

  *Writes a single 32-bit word of memory (TODO support smaller sizes)*

### Protected Attributes

- std::vector< DebuggableDevice * > m_targets

  *The devices (NOT automatically deleted at destruction time)*

#### 7.28.1 Detailed Description

Generic base class for all debugger interfaces (may connect to multiple DebuggableDevice's in a SoC)

The documentation for this class was generated from the following files:

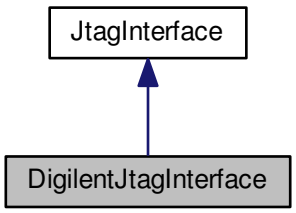
- DebuggerInterface.h
- DebuggerInterface.cpp

## 7.29 DigilentJtagInterface Class Reference

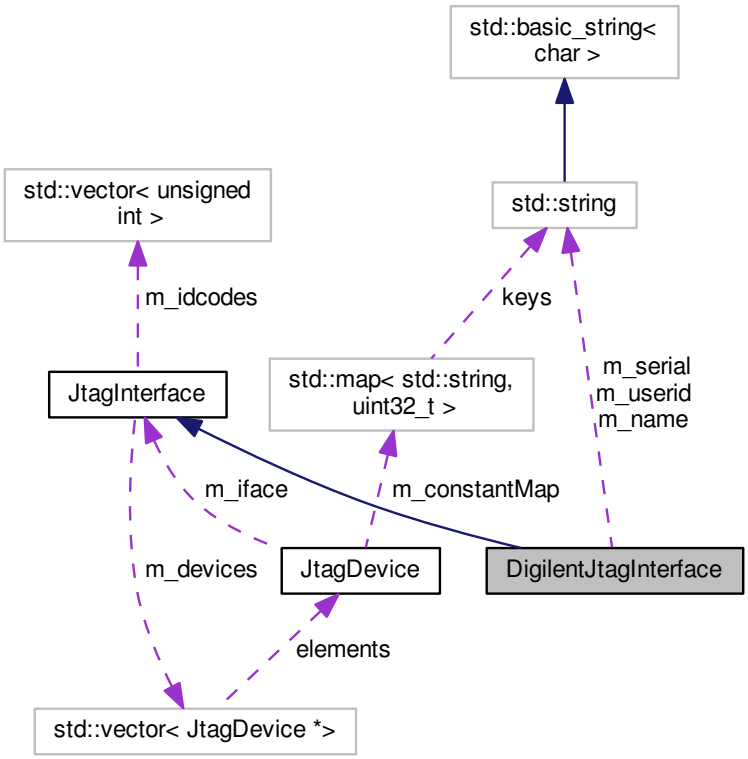
A JTAG adapter exposed through the Digilent Adept SDK.

`#include <DigilentJtagInterface.h>`

Inheritance diagram for DigilentJtagInterface:




Collaboration diagram for DigilentJtagInterface:



### Public Member Functions

- DigilentJtagInterface (int ndev)
  *Connects to a Digilent JTAG interface.*
- virtual ~DigilentJtagInterface ()
  *Interface destructor.*
- virtual std::string GetName ()
  *Gets the manufacturer-assigned name for this programming adapter.*
- virtual std::string GetSerial ()
  *Gets the manufacturer-assigned serial number for this programming adapter, if any.*
- virtual std::string GetUserID ()
  *Gets the user-assigned name for this JTAG adapter, if any.*
- virtual int GetFrequency ()
  *Gets the clock frequency, in Hz, of the JTAG interface.*
- virtual void ShiftData (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)
  *Shifts data through TDI to TDO.*
- virtual void SendDummyClocks (size_t n)
  *Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.*

### Static Public Member Functions

- static std::string GetAPIVersion ()
  *Gets the version number of the Digilent JTAG API.*
- static int GetInterfaceCount ()
  *Gets the number of interfaces on the system.*
- static std::string **GetName** (int i)
- static std::string **GetSerial** (int i)
- static std::string **GetUserID** (int i)
- static int **GetDefaultFrequency** (int i)

### Protected Member Functions

- virtual void ShiftTMS (bool tdi, const unsigned char *send_data, size_t count)
  *Shifts data into TMS to change TAP state.*

### Static Protected Member Functions

- static std::string GetLibraryError ()
  *Gets the last-error code of the Digilent API.*

### Protected Attributes

- std::string m_name
  *The adapter's name.*
- std::string m_serial
  *The adapter's serial number.*
- std::string m_userid
  *The adapter's user ID.*
- unsigned int m_hif
  *Digilent API interface handle.*
- int m_freq
  *The adapter's clock frequency.*

### 7.29.1 Detailed Description

A JTAG adapter exposed through the Digilent Adept SDK.

This includes Digilent-branded dev boards, Digilent-adapter cables such as the HS1, and OEM modules such as the JTAG-SMT2 which may be integrated into third party boards.

### 7.29.2 Constructor & Destructor Documentation

#### 7.29.2.1 DigilentJtagInterface()

```
DigilentJtagInterface::DigilentJtagInterface (
            int ndev )
```

Connects to a Digilent JTAG interface.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the connection could not be establishes or the index is invalid |

**Parameters**

| | |
|---|---|
| *ndev* | Zero-based index of the device to connect to |

#### 7.29.2.2 ~DigilentJtagInterface()

```
DigilentJtagInterface::~DigilentJtagInterface ( )  [virtual]
```

Interface destructor.

Closes handles and disconnects from the adapter.

### 7.29.3 Member Function Documentation

#### 7.29.3.1 GetFrequency()

```
int DigilentJtagInterface::GetFrequency ( )  [virtual]
```

Gets the clock frequency, in Hz, of the JTAG interface.

**Returns**

The clock frequency

Implements JtagInterface.

#### 7.29.3.2 GetName()

```
std::string DigilentJtagInterface::GetName ( )  [virtual]
```

Gets the manufacturer-assigned name for this programming adapter.

This is usually the model number but is sometimes something more generic like "Digilent Adept USB Device".

**Returns**

The device name

Implements JtagInterface.

#### 7.29.3.3 GetSerial()

```
std::string DigilentJtagInterface::GetSerial ( )  [virtual]
```

Gets the manufacturer-assigned serial number for this programming adapter, if any.

Derived classes may choose to return the user ID, an empty string, or another default value if no serial number has been assigned.

**Returns**

The serial number

Implements JtagInterface.

#### 7.29.3.4 GetUserID()

```
std::string DigilentJtagInterface::GetUserID ( )  [virtual]
```

Gets the user-assigned name for this JTAG adapter, if any.

Derived classes may choose to return the serial number, an empty string, or another default value if no name has been assigned.

**Returns**

The name for this adapter.

Implements JtagInterface.

#### 7.29.3.5 SendDummyClocks()

```
void DigilentJtagInterface::SendDummyClocks (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.

Since dummy clocks are often used as a delay element for programming algorithms etc, this function flushes the write buffer to ensure immediate execution.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Implements JtagInterface.

#### 7.29.3.6 ShiftData()

```
void DigilentJtagInterface::ShiftData (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Implements JtagInterface.

#### 7.29.3.7 ShiftTMS()

```
void DigilentJtagInterface::ShiftTMS (
            bool tdi,
            const unsigned char * send_data,
            size_t count )  [protected], [virtual]
```

Shifts data into TMS to change TAP state.

This is no longer a public API operation. It can only be accessed via the state-level interface.

Implementations of this class may choose to implement EITHER this function (and use the default JtagInterface-provided state-level functions) OR override this function with a private no-op stub and override the state-level functions instead.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *tdi* | Constant tdi value (normally 0) |
| *send_data* | Data to shift into TMS. Bit ordering is the same as for ShiftData(). |
| *count* | Number of bits to shift |

Implements JtagInterface.

The documentation for this class was generated from the following files:

- DigilentJtagInterface.h
- DigilentJtagInterface.cpp

## 7.30 EjtagControlRegister Union Reference

PIC32 EJTAG control register.

`#include <MicrochipPIC32Device.h>`

### Public Member Functions

- struct {
  unsigned int **reserved1**: 3
  unsigned int **debug_mode**: 1
  unsigned int **reserved2**: 8
  unsigned int **debug_irq**: 1
  unsigned int **reserved3**: 1
  unsigned int **debug_vector_pos**: 1
  unsigned int **probe_enable**: 1
  unsigned int **proc_reset**: 1
  unsigned int **reserved4**: 1
  unsigned int **proc_access**: 1
  unsigned int **proc_we**: 1
  unsigned int **periph_reset**: 1
  unsigned int **bus_halted**: 1
  unsigned int **low_power**: 1
  unsigned int **vpe_disable**: 1
  unsigned int **reserved5**: 5
  unsigned int **access_size**: 2
  unsigned int **reset_occurred**: 1
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word

  *The raw status register value.*

#### 7.30.1 Detailed Description

PIC32 EJTAG control register.

The documentation for this union was generated from the following file:

- MicrochipPIC32Device.h

## 7.31 EjtagImplementationCodeRegister Union Reference

MIPS EJTAG implementation register.

```
#include <MicrochipPIC32Device.h>
```

### Public Member Functions

- struct {
  unsigned int **processor_is_64**: 1
  unsigned int **reserved1**: 13
  unsigned int **no_ejtag_dma**: 1
  unsigned int **reserved2**: 1
  unsigned int **mips16_supported**: 1
  unsigned int **reserved3**: 4
  unsigned int **asid_size**: 2
  unsigned int **reserved4**: 1
  unsigned int **dint_supported**: 1
  unsigned int **reserved5**: 3
  unsigned int **r3k_priv**: 1
  unsigned int **ejtag_version**: 3
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word

  *The raw status register value.*

#### 7.31.1 Detailed Description

MIPS EJTAG implementation register.

The documentation for this union was generated from the following file:

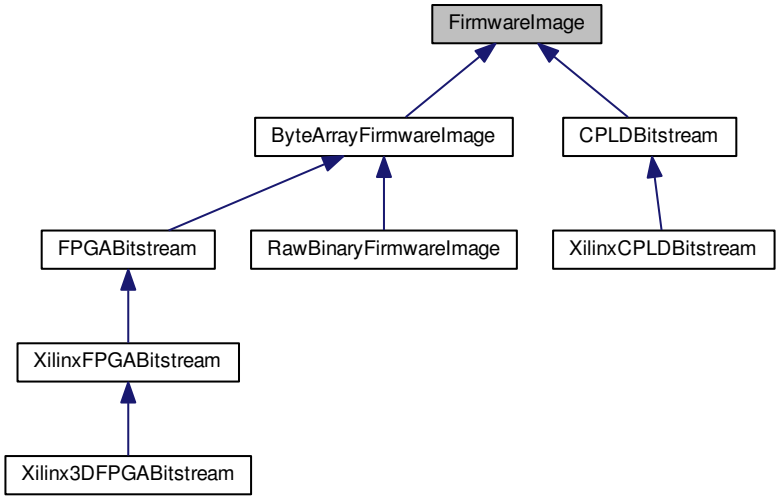
- MicrochipPIC32Device.h

## 7.32 FirmwareImage Class Reference

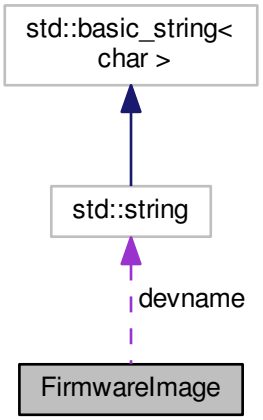
Generic base class for all firmware images for any kind of programmable device.

`#include <FirmwareImage.h>`

Inheritance diagram for FirmwareImage:




Collaboration diagram for FirmwareImage:




### Public Member Functions

- virtual std::string **GetDescription** ()

### Public Attributes

- unsigned int idcode

  *JTAG ID code of the device this firmware image is intended for.*
- std::string devname

  *Human-readable name of the device this bitstream is intended for.*

### 7.32.1 Detailed Description

Generic base class for all firmware images for any kind of programmable device.

### 7.32.2 Member Data Documentation

#### 7.32.2.1 idcode

```
unsigned int FirmwareImage::idcode
```

JTAG ID code of the device this firmware image is intended for.

The special value of all zeroes is not a valid JEDEC ID code and is used for softcores, ROM images, and other devices which are not directly exposed by JTAG.

The documentation for this class was generated from the following files:

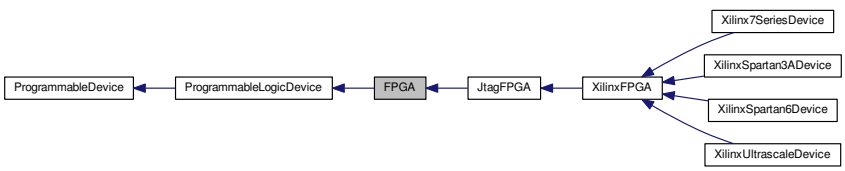
- FirmwareImage.h
- FirmwareImage.cpp

## 7.33 FPGA Class Reference

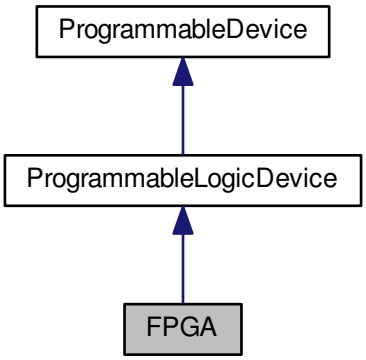
Generic base class for all field-programmable gate array devices.

```
#include <FPGA.h>
```

Inheritance diagram for FPGA:



Collaboration diagram for FPGA:




### Public Member Functions

- virtual ~FPGA ()

  *Empty virtual destructor.*

### 7.33.1 Detailed Description

Generic base class for all field-programmable gate array devices.

The documentation for this class was generated from the following files:

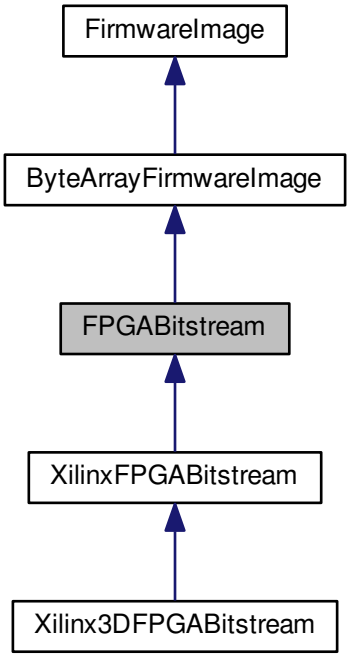
- FPGA.h
- FPGA.cpp

## 7.34 FPGABitstream Class Reference

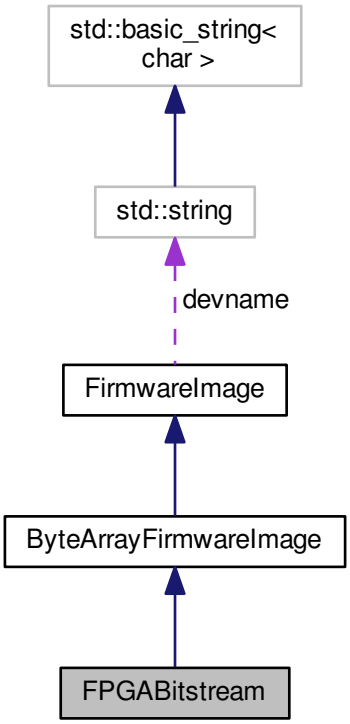
Abstract base class for FPGA configuration bitstreams.

```
#include <FPGABitstream.h>
```

Inheritance diagram for FPGABitstream:



Collaboration diagram for FPGABitstream:




### Public Member Functions

- FPGABitstream ()

  *Default constructor.*
- virtual ~FPGABitstream ()

  *Empty virtual destructor.*

### Additional Inherited Members

#### 7.34.1 Detailed Description

Abstract base class for FPGA configuration bitstreams.

The documentation for this class was generated from the following files:

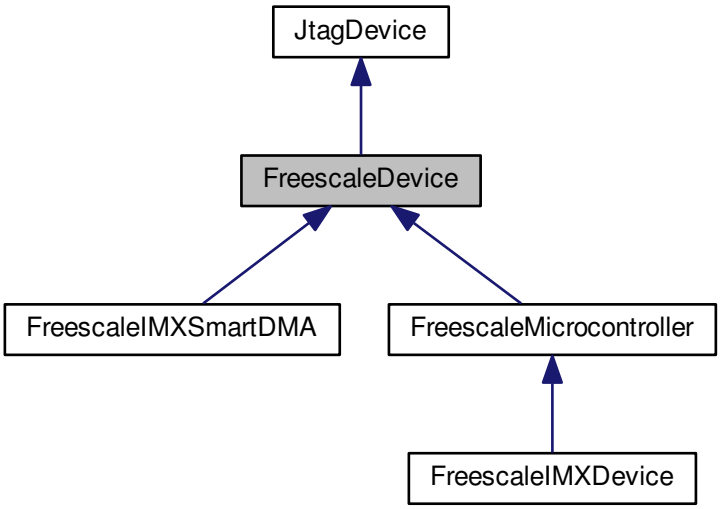
- FPGABitstream.h
- FPGABitstream.cpp

## 7.35 FreescaleDevice Class Reference

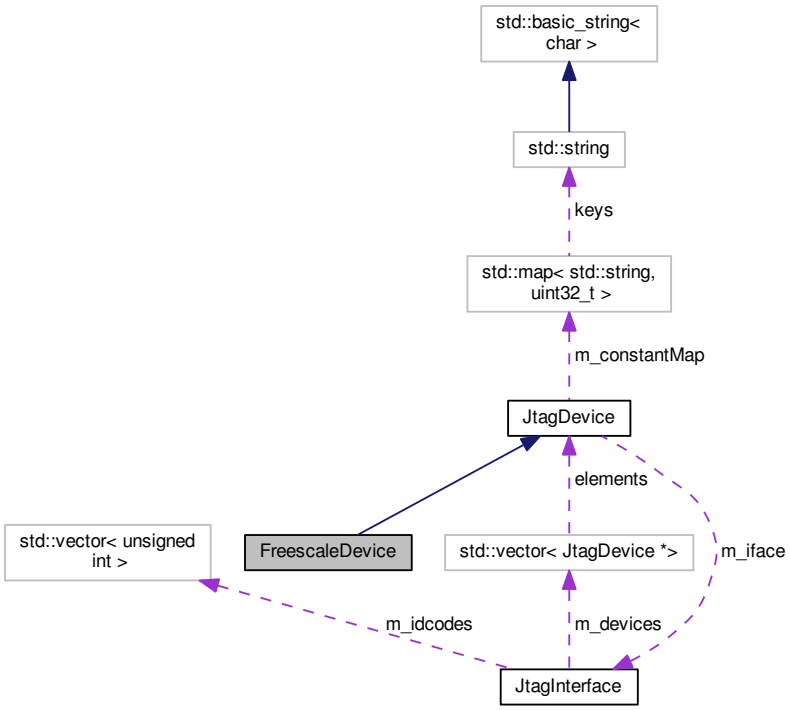
Abstract base class for all Freescale devices (typically MCUs or parts thereof)

```
#include <FreescaleDevice.h>
```

Inheritance diagram for FreescaleDevice:



Collaboration diagram for FreescaleDevice:




## Public Member Functions

- FreescaleDevice (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~FreescaleDevice ()

  *Default virtual destructor.*

## Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int idcode, JtagInterface *iface, size_t pos)

  *Creates a FreescaleDevice given an ID code.*

## Additional Inherited Members

### 7.35.1 Detailed Description

Abstract base class for all Freescale devices (typically MCUs or parts thereof)

### 7.35.2 Constructor & Destructor Documentation

#### 7.35.2.1 FreescaleDevice()

```
FreescaleDevice::FreescaleDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### 7.35.3 Member Function Documentation

#### 7.35.3.1 CreateDevice()

```
JtagDevice * FreescaleDevice::CreateDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a FreescaleDevice given an ID code.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the ID code supplied is not a valid Freescale device, or not a known family number |

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

**Returns**

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

The documentation for this class was generated from the following files:

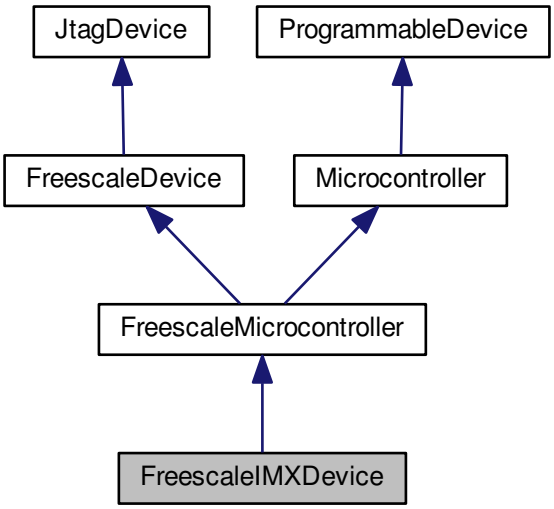
- FreescaleDevice.h
- FreescaleDevice.cpp

## 7.36 FreescaleIMXDevice Class Reference

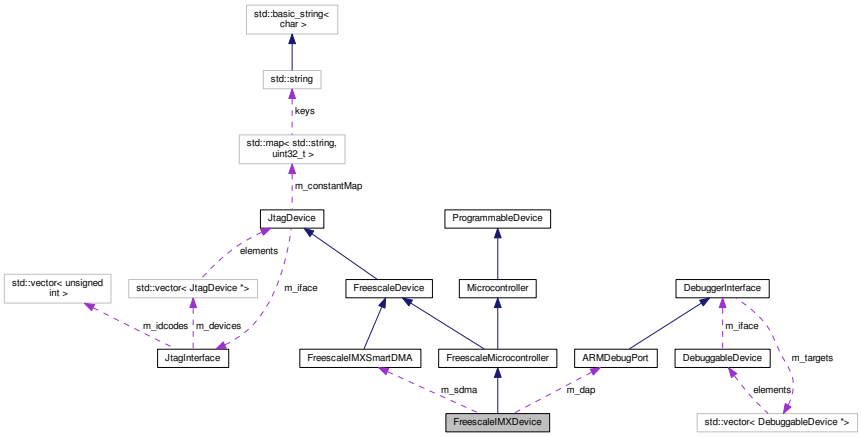
A Freescale i.mx applications processor.

`#include <FreescaleIMXDevice.h>`

Inheritance diagram for FreescaleIMXDevice:




Collaboration diagram for FreescaleIMXDevice:




### Public Types

- enum instructions {
  INST_IDCODE = 0x00, INST_SAMPLE_PRELOAD = 0x01, **INST_EXTEST** = 0x02, **INST_HIZ** = 0x03,

**INST_EXTEST_PULSE** = 0x08, **INST_EXTEST_TRAIN** = 0x09, **INST_EXTRADEBUG** = 0x04, **INST_ENTER_DEBUG** = 0x05,
**INST_SECURE_CHALL** = 0x0c, **INST_SECURE_RESP** = 0x0d, **INST_TAP_SELECT** = 0x07, **INST_BYPASS** = 0x1f }

*5-bit-wide JTAG instructions (from datasheet table 56-3)*

## Public Member Functions

- **FreescaleIMXDevice** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual ~FreescaleIMXDevice ()

  *Destructor.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- void **SetIR** (unsigned char irval)

## Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)

## Protected Attributes

- ImxDeviceIDs m_devid

  *Device ID code.*
- unsigned int m_stepping

  *Stepping number.*
- ARMDebugPort * **m_dap**
- FreescaleIMXSmartDMA * **m_sdma**

### 7.36.1 Detailed Description

A Freescale i.mx applications processor.

### 7.36.2 Member Enumeration Documentation

#### 7.36.2.1 instructions

```
enum FreescaleIMXDevice::instructions
```

5-bit-wide JTAG instructions (from datasheet table 56-3)

**Enumerator**

| | |
|---|---|
| INST_IDCODE | Read ID code. |
| INST_SAMPLE_PRELOAD | Boundary scan stuff. |

### 7.36.3 Member Function Documentation

#### 7.36.3.1 Erase()

```
void FreescaleIMXDevice::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.36.3.2 GetDescription()

```
string FreescaleIMXDevice::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.36.3.3 IsProgrammed()

```
bool FreescaleIMXDevice::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.36.3.4 PostInitProbes()

```
void FreescaleIMXDevice::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.36.3.5 Program()

```
void FreescaleIMXDevice::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

The documentation for this class was generated from the following files:

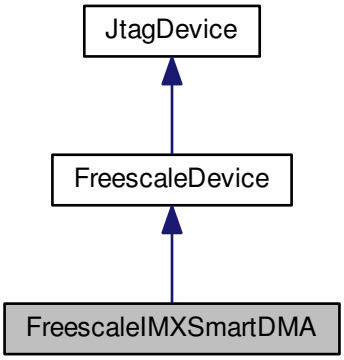
- FreescaleIMXDevice.h
- FreescaleIMXDevice.cpp

## 7.37 FreescaleIMXSmartDMA Class Reference

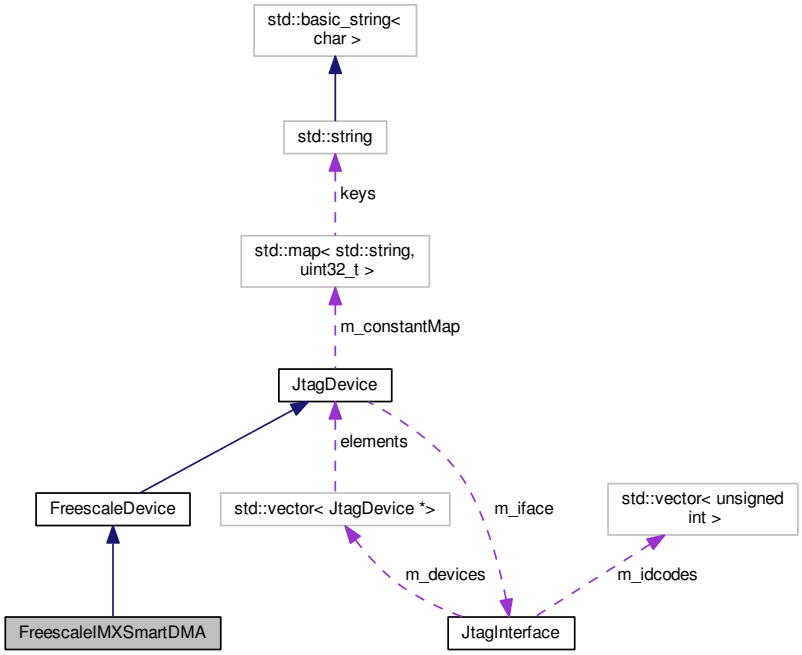
The SDMA in a Freescale i.mx SoC (Chapter 55 of i.mx6 reference manual)

```
#include <FreescaleIMXSmartDMA.h>
```

Inheritance diagram for FreescaleIMXSmartDMA:




Collaboration diagram for FreescaleIMXSmartDMA:




## Public Member Functions

- **FreescaleIMXSmartDMA** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual ~FreescaleIMXSmartDMA ()

  *Destructor.*

- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- void **SetIR** (unsigned char irval)

### Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)

### Additional Inherited Members

## 7.37.1 Detailed Description

The SDMA in a Freescale i.mx SoC (Chapter 55 of i.mx6 reference manual)

## 7.37.2 Member Function Documentation

### 7.37.2.1 GetDescription()

```
string FreescaleIMXSmartDMA::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

#### Returns

Device description

Implements JtagDevice.

### 7.37.2.2 PostInitProbes()

```
void FreescaleIMXSmartDMA::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

The documentation for this class was generated from the following files:

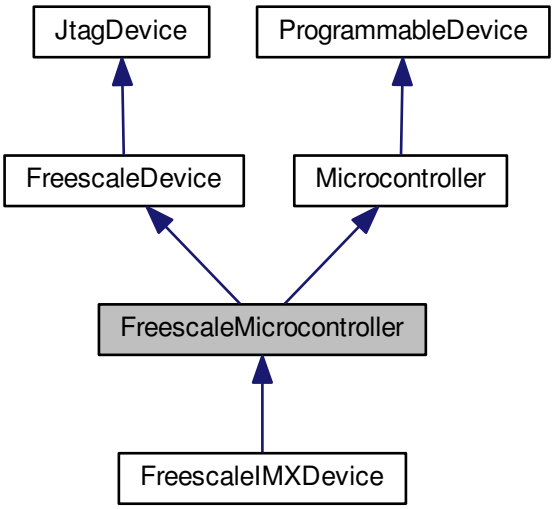
- FreescaleIMXSmartDMA.h
- FreescaleIMXSmartDMA.cpp

## 7.38 FreescaleMicrocontroller Class Reference

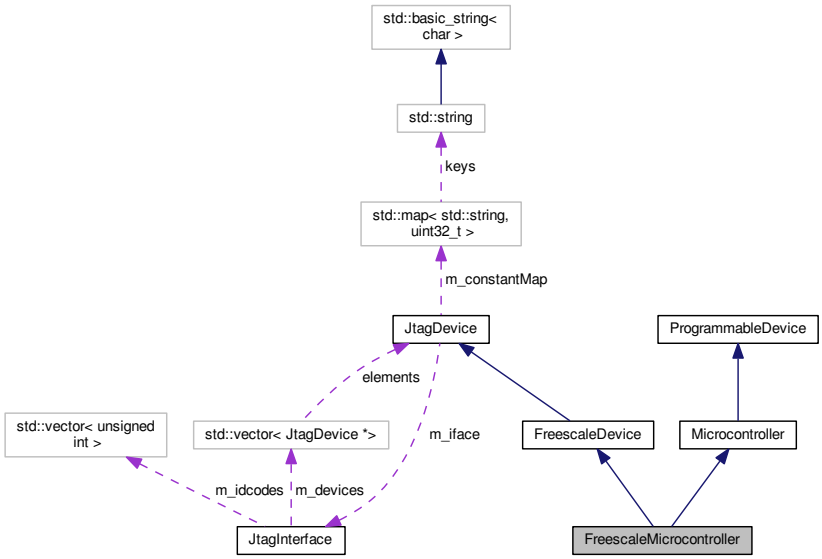
Generic base class for all Freescale MCUs.

```
#include <FreescaleMicrocontroller.h>
```

Inheritance diagram for FreescaleMicrocontroller:



Collaboration diagram for FreescaleMicrocontroller:




### Public Member Functions

- **FreescaleMicrocontroller** (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

### Additional Inherited Members

#### 7.38.1 Detailed Description

Generic base class for all Freescale MCUs.

The documentation for this class was generated from the following files:

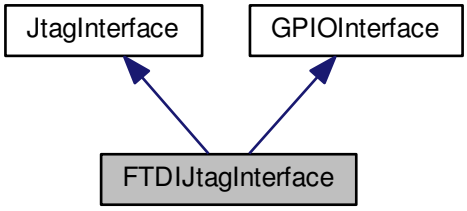
- FreescaleMicrocontroller.h
- FreescaleMicrocontroller.cpp

## 7.39 FTDIJtagInterface Class Reference

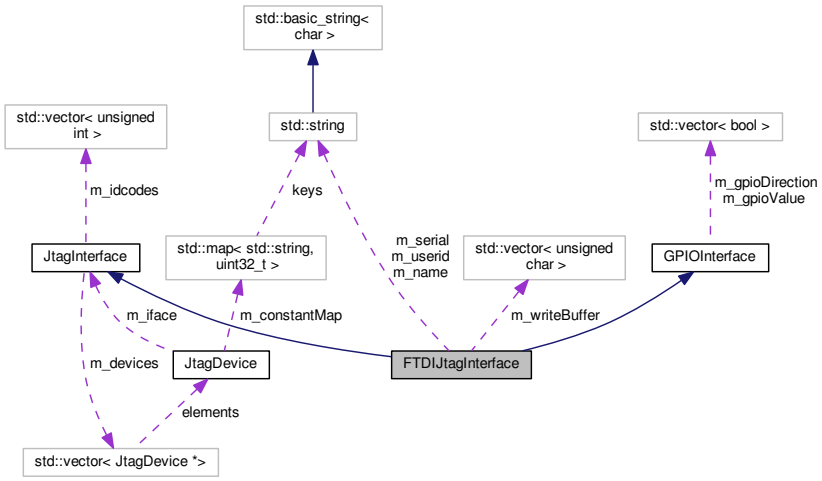
A JTAG adapter using the FTDI chipset, accessed through libftd2xx (proprietary driver from FTDI)

```
#include <FTDIJtagInterface.h>
```

Inheritance diagram for FTDIJtagInterface:




Collaboration diagram for FTDIJtagInterface:




## Public Member Functions

- FTDIJtagInterface (const std::string &serial, const std::string &layout)

  *Connects to an FTDI JTAG interface.*
- virtual ~FTDIJtagInterface ()

  *Interface destructor.*
- virtual std::string GetName ()

  *Gets the manufacturer-assigned name for this programming adapter.*
- virtual std::string GetSerial ()

  *Gets the manufacturer-assigned serial number for this programming adapter.*
- virtual std::string GetUserID ()

  *Gets the user-assigned name for this programming adapter.*
- virtual int GetFrequency ()

  *Gets the clock frequency, in Hz, of the JTAG interface.*
- virtual void ShiftData (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

*Shifts data through TDI to TDO.*

- virtual void SendDummyClocks (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.*
- virtual void SendDummyClocksDeferred (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.*
- virtual void Commit ()

  *Commits the outstanding transactions to the adapter.*
- virtual bool IsSplitScanSupported ()

  *Indicates if split (pipelined) DR scanning is supported.*
- virtual bool ShiftDataWriteOnly (bool last_tms, const unsigned char ∗send_data, unsigned char ∗rcv_data, size_t count)

  *Shifts data through TDI to TDO.*
- virtual bool ShiftDataReadOnly (unsigned char ∗rcv_data, size_t count)

  *Reads data from a ShiftDataWriteOnly() call.*
- virtual void ReadGpioState ()

  *Reads all of the device's GPIO pins into the internal buffer.*
- virtual void WriteGpioState ()

  *Writes all of the device's GPIO pin values to the device.*

## Static Public Member Functions

- static int GetDefaultFrequency (int index)

  *Returns the default clock frequency of the Nth device.*
- static bool IsJtagCapable (int index)

  *Checks if the requested FTDI device has a MPSSE (and is thus capable of being used for JTAG)*
- static std::string GetSerialNumber (int index)

  *Returns the description of the Nth device.*
- static std::string GetDescription (int index)

  *Returns the description of the Nth device.*
- static std::string GetAPIVersion ()

  *Gets the version of the API.*
- static int GetInterfaceCount ()

  *Gets the number of FTDI devices on the system (may include non-JTAG-capable devices)*

## Protected Member Functions

- virtual void ShiftTMS (bool tdi, const unsigned char ∗send_data, size_t count)

  *Shifts data into TMS to change TAP state.*
- void GenerateShiftPacket (const unsigned char ∗send_data, size_t count, bool want_read, bool last_tms, std::vector< unsigned char > &cmd_out)

  *Generates the MPSSE commands for a shift operation.*
- void DoReadback (unsigned char ∗rcv_data, size_t count)

  *Reads back data from a prior transaction.*
- void SharedCtorInit (uint32_t type, const std::string &layout)

  *Shared initialization used by all constructors.*
- void SyncCheck ()

  *Verifies that we're still in sync with the MPSSE.*
- void ReadData (void ∗data, size_t bytesToRead)

  *Wrapper around FT_Read() to work around some driver / API bugs.*
- void WriteDataRaw (const void ∗data, size_t bytesToWrite)

*Wrapper around FT_Write() to push the provided data buffer to hardware.*

- void WriteData (const void *data, size_t bytesToWrite)

  *Writes FTDI MPSSE data to the interface.*

- void WriteData (unsigned char cmd)

  *Wrapper around WriteData() to send a single byte.*

### Protected Attributes

- std::vector< unsigned char > m_writeBuffer

  *Buffer of data queued for the adapter, but not yet sent.*

- std::string m_name

  *Cached name of this adapter.*

- std::string m_serial

  *Cached serial number of this adapter.*

- std::string m_userid

  *Cached user ID of this adapter.*

- int m_freq

  *Cached clock frequency of this adapter.*

- void * m_context

  *Libftdi interface handle.*

#### 7.39.1 Detailed Description

A JTAG adapter using the FTDI chipset, accessed through libftd2xx (proprietary driver from FTDI)

This adapter supports split scanning and queues up to 4096 bytes of command+data before comitting to hardware.

GPIO pin mapping:

| Index | Name |
|---|---|
| 0 | GPIOL0 (ADBUS4) |
| 1 | GPIOL1 (ADBUS5) |
| 2 | GPIOL2 (ADBUS6) |
| 3 | GPIOL3 (ADBUS7) |
| 4 | GPIOH0 (ACBUS0) |
| 5 | GPIOH1 (ACBUS1) |
| 6 | GPIOH2 (ACBUS2) |
| 7 | GPIOH3 (ACBUS3) |
| 8 | GPIOH4 (ACBUS4) |
| 9 | GPIOH5 (ACBUS5) |
| 10 | GPIOH6 (ACBUS6) |
| 11 | GPIOH7 (ACBUS7) |

Supported layouts:

| Name | Example hardware | Pin configuration |
|---|---|---|
| hs1 | Digilent JTAG-HS1, Digilent JTAG-SMT2, azonenberg's usb-jtag-mini | ADBUS7 is active-high output enable |

| Name | Example hardware | Pin configuration |
|---|---|---|
| jtagkey | Amontec JTAGkey, Bus Blaster w/ JTAGkey compatible buffer | ADBUS4 is active-low output enable, ACBUS0 is TRST_N, ACBUS2 is active-low output enable for TRST_N |

### 7.39.2 Constructor & Destructor Documentation

#### 7.39.2.1 FTDIJtagInterface()

```
FTDIJtagInterface::FTDIJtagInterface (
            const std::string & serial,
            const std::string & layout )
```

Connects to an FTDI JTAG interface.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the connection could not be establishes or the serial number is invalid |

**Parameters**

| | |
|---|---|
| *serial* | Serial number of the device to connect to |
| *layout* | Adapter layout to use |

#### 7.39.2.2 ~FTDIJtagInterface()

```
FTDIJtagInterface::~FTDIJtagInterface ( )  [virtual]
```

Interface destructor.

Closes handles and disconnects from the adapter.

### 7.39.3 Member Function Documentation

#### 7.39.3.1 Commit()

```
void FTDIJtagInterface::Commit ( )  [virtual]
```

Commits the outstanding transactions to the adapter.

No-op unless the adapter supports queueing of multiple writes.

This function is automatically called when SendDummyClocks() is called or any readback is performed. Most adapter classes will automatically call it when the transmit queue reaches a certain size.

This function can be called at any time to ensure all pending operations have executed.

**Exceptions**

| | |
|---|---|
| *JtagException* | in case of error |

Reimplemented from JtagInterface.

#### 7.39.3.2 DoReadback()

```
void FTDIJtagInterface::DoReadback (
            unsigned char * rcv_data,
            size_t count )  [protected]
```

Reads back data from a prior transaction.

**Parameters**

| | |
|---|---|
| *rcv_data* | Output data buffer |
| *count* | Number of bits to read |

#### 7.39.3.3 GenerateShiftPacket()

```
void FTDIJtagInterface::GenerateShiftPacket (
            const unsigned char * send_data,
            size_t count,
            bool want_read,
            bool last_tms,
            std::vector< unsigned char > & cmd_out )  [protected]
```

Generates the MPSSE commands for a shift operation.

**Parameters**

| | |
|---|---|
| *send_data* | Data to send |
| *count* | Number of bits to send (not bytes) |
| *want_read* | True if read data is needed, false for a write-only transaction |
| *last_tms* | TMS value to use at the end of the shift operation (all other bits have TMS=0) |
| *cmd_out* | The generated command buffer |

#### 7.39.3.4 GetAPIVersion()

```
string FTDIJtagInterface::GetAPIVersion ( )  [static]
```

Gets the version of the API.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the FTD2xx call fails |

**Returns**

FTDI driver and API version

#### 7.39.3.5 GetDefaultFrequency()

```
int FTDIJtagInterface::GetDefaultFrequency (
            int index )  [static]
```

Returns the default clock frequency of the Nth device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is invalid or data could not be read |

**Returns**

Clock frequency

#### 7.39.3.6 GetDescription()

```
string FTDIJtagInterface::GetDescription (
            int index )  [static]
```

Returns the description of the Nth device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is invalid or data could not be read |

**Returns**

Description string

#### 7.39.3.7 GetInterfaceCount()

```
int FTDIJtagInterface::GetInterfaceCount ( )  [static]
```

Gets the number of FTDI devices on the system (may include non-JTAG-capable devices)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the FTD2xx call fails |

**Returns**

Number of interfaces found

#### 7.39.3.8 GetSerialNumber()

```
string FTDIJtagInterface::GetSerialNumber (
            int index )  [static]
```

Returns the description of the Nth device.

**Parameters**

| | |
|---|---|
| *index* | Zero-based index of the device to test |

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is invalid or data could not be read |

**Returns**

Serial number string

#### 7.39.3.9 IsJtagCapable()

```
bool FTDIJtagInterface::IsJtagCapable (
            int index )  [static]
```

Checks if the requested FTDI device has a MPSSE (and is thus capable of being used for JTAG)

Note that this function cannot tell if an MPSSE-capable chipset is actually configured for use as JTAG or as something else.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is invalid or data could not be read |

**Parameters**

| | |
|---|---|
| *index* | Zero-based index of the device to test |

**Returns**

True if the device has a MPSSE, false otherwise.

#### 7.39.3.10 IsSplitScanSupported()

```
bool FTDIJtagInterface::IsSplitScanSupported ( )  [virtual]
```

Indicates if split (pipelined) DR scanning is supported.

Split scanning allows the write halves of several scan operations to take place in one driver-level write call, followed by the read halves in order, to reduce the impact of driver/bus latency on throughput.

If split scanning is not supported, ScanDRSplitWrite() will behave identically to ScanDR() and ScanDRSplitRead() will be a no-op. This ensures that using the split write commands will work correctly regardless of whether the adapter supports split scanning in hardware.

Reimplemented from JtagInterface.

#### 7.39.3.11 ReadData()

```
void FTDIJtagInterface::ReadData (
            void * data,
            size_t bytesToRead )  [protected]
```

Wrapper around FT_Read() to work around some driver / API bugs.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Parameters**

| | |
|---|---|
| *data* | Data to write |
| *bytesToRead* | Number of bytes to read |

#### 7.39.3.12 SendDummyClocks()

```
void FTDIJtagInterface::SendDummyClocks (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.

Since dummy clocks are often used as a delay element for programming algorithms etc, this function flushes the write buffer to ensure immediate execution.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Implements JtagInterface.

#### 7.39.3.13 SendDummyClocksDeferred()

```
void FTDIJtagInterface::SendDummyClocksDeferred (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Reimplemented from JtagInterface.

#### 7.39.3.14 ShiftData()

```
void FTDIJtagInterface::ShiftData (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Implements JtagInterface.

#### 7.39.3.15 ShiftDataReadOnly()

```
bool FTDIJtagInterface::ShiftDataReadOnly (
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Reads data from a ShiftDataWriteOnly() call.

For more information on split (pipelined) scan operations see ShiftDataWriteOnly().

**Returns**

True if the read was executed, false if a no-op

**Parameters**

| | |
|---|---|
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.39.3.16 ShiftDataWriteOnly()

```
bool FTDIJtagInterface::ShiftDataWriteOnly (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

If split (pipelined) scanning is supported by the adapter, this function performs the write half of the shift operation only; the read is buffered in the JTAG adapter and no readback is performed until ShiftDataReadOnly() is called. This allows several shift operations to occur in sequence without incurring a USB turnaround delay or other driver latency overhead for each shift operation.

If split scanning is not supported this call is equivalent to ShiftData() and ShiftDataReadOnly() is a no-op.

This function MUST be followed by either another ShiftDataWriteOnly() call, a ShiftTMS() call, or a ShiftDataRead↩Only() call. There must be exactly one ShiftDataReadOnly() call for each ShiftDataWriteOnly() call and they must be in order with the same rcv_data and count values. The result of doing otherwise is undefined.

**Returns**

True if the read was deferred, false if not

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.39.3.17 ShiftTMS()

```
void FTDIJtagInterface::ShiftTMS (
            bool tdi,
            const unsigned char * send_data,
            size_t count )  [protected], [virtual]
```

Shifts data into TMS to change TAP state.

This is no longer a public API operation. It can only be accessed via the state-level interface.

Implementations of this class may choose to implement EITHER this function (and use the default JtagInterface-provided state-level functions) OR override this function with a private no-op stub and override the state-level functions instead.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *tdi* | Constant tdi value (normally 0) |
| *send_data* | Data to shift into TMS. Bit ordering is the same as for ShiftData(). |
| *count* | Number of bits to shift |

Implements JtagInterface.

#### 7.39.3.18 SyncCheck()

```
void FTDIJtagInterface::SyncCheck ( )  [protected]
```

Verifies that we're still in sync with the MPSSE.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an FTDI API call fails |

#### 7.39.3.19 WriteData() [1/2]

```
void FTDIJtagInterface::WriteData (
            const void * data,
            size_t bytesToWrite )  [protected]
```

Writes FTDI MPSSE data to the interface.

Writes may be deferred until Commit() is called to improve performance.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Parameters**

| | |
|---|---|
| *data* | Data to write |
| *bytesToWrite* | Number of bytes to write |

#### 7.39.3.20 WriteData() [2/2]

```
void FTDIJtagInterface::WriteData (
            unsigned char cmd )  [protected]
```

Wrapper around WriteData() to send a single byte.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Parameters**

| | |
|---|---|
| *cmd* | The single byte to write |

#### 7.39.3.21 WriteDataRaw()

```
void FTDIJtagInterface::WriteDataRaw (
            const void * data,
            size_t bytesToWrite )  [protected]
```

Wrapper around FT_Write() to push the provided data buffer to hardware.

Performs repeated write calls as needed to ensure the entire buffer is written.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Parameters**

| | |
|---|---|
| *data* | Data to write |
| *bytesToWrite* | Number of bytes to write |

The documentation for this class was generated from the following files:

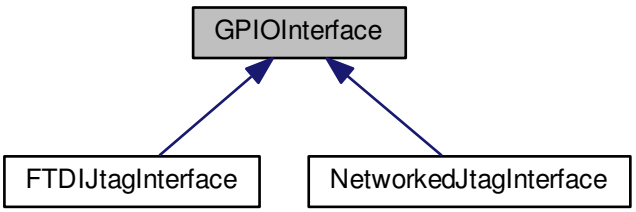
- FTDIJtagInterface.h
- FTDIJtagInterface.cpp

## 7.40 GPIOInterface Class Reference

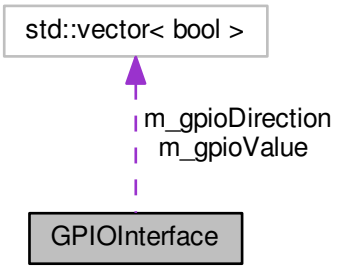
A GPIO bitbang interface. Many JTAG adapters have uncommitted GPIOs which may be used for test purposes.

`#include <GPIOInterface.h>`

Inheritance diagram for GPIOInterface:




Collaboration diagram for GPIOInterface:



### Public Member Functions

- int GetGpioCount ()

  *Gets the number of GPIO pins on the device.*
- virtual void ReadGpioState ()=0

  *Reads all of the device's GPIO pins into the internal buffer.*
- virtual void WriteGpioState ()=0

  *Writes all of the device's GPIO pin values to the device.*
- void SetGpioDirectionDeferred (int pin, bool output)

  *Updates the direction of a GPIO pin but does not push the changes to the device.*
- void SetGpioValueDeferred (int pin, bool value)

  *Updates the value of a GPIO pin but does not push the changes to the device.*
- bool GetGpioValueCached (int pin)

  *Reads the cached value of a GPIO pin but does not poll the device.*
- void SetGpioDirection (int pin, bool output)

  *Updates the direction of a GPIO pin and pushes changes to the device immediately.*
- void SetGpioValue (int pin, bool value)

  *Updates the value of a GPIO pin and pushes changes to the device immediately.*
- bool GetGpioValue (int pin)

  *Reads the current value of a GPIO pin, polling the device.*
- bool GetGpioDirection (int pin)

  *Reads the current direction of a GPIO pin.*

### Protected Attributes

- std::vector< bool > m_gpioValue

  *Value bits (1=high, contains the read value for inputs and the write value for outputs)*
- std::vector< bool > m_gpioDirection

  *Direction bits (1=output)*

### 7.40.1 Detailed Description

A GPIO bitbang interface. Many JTAG adapters have uncommitted GPIOs which may be used for test purposes.

The documentation for this class was generated from the following files:

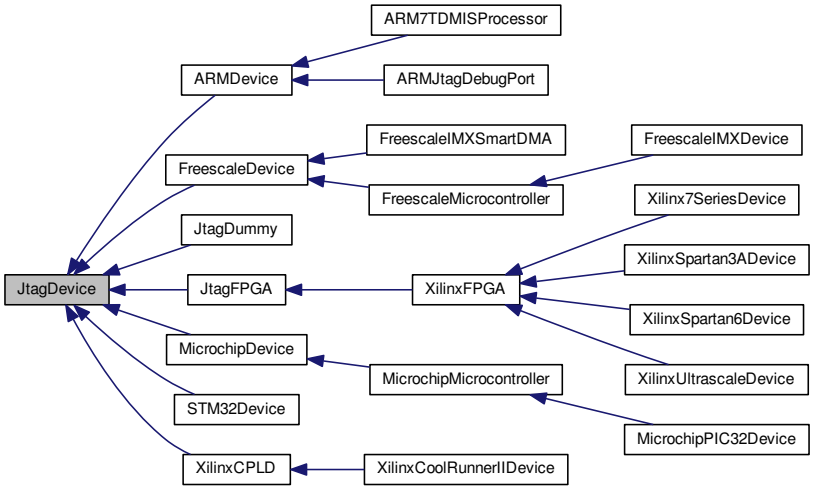
- GPIOInterface.h
- GPIOInterface.cpp

## 7.41 JtagDevice Class Reference

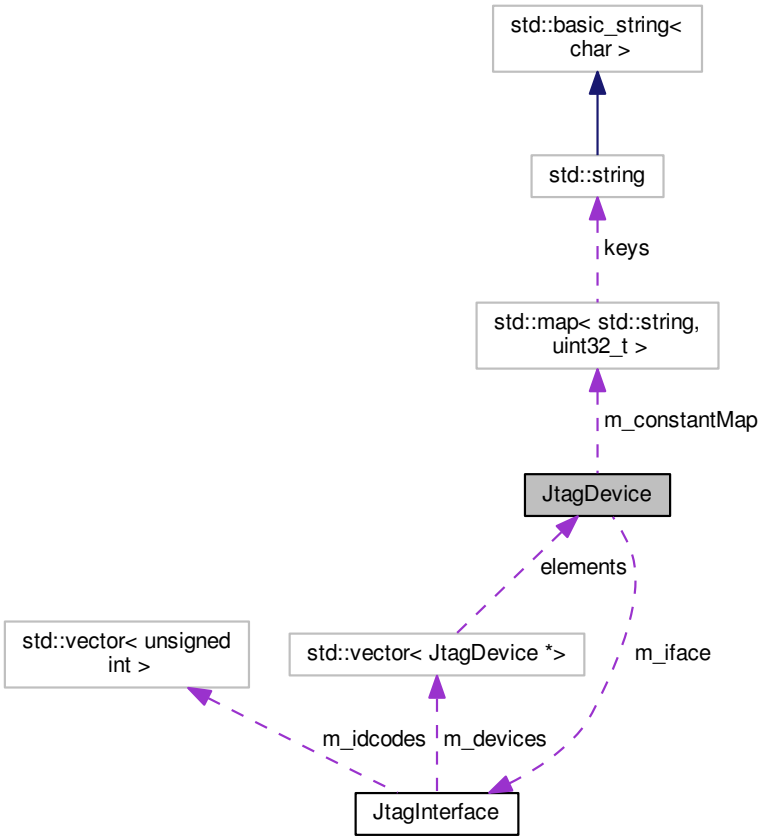
A single TAP in the JTAG chain. May not correspond 1:1 with physical silicon dies.

`#include <JtagDevice.h>`

Inheritance diagram for JtagDevice:



Collaboration diagram for JtagDevice:




## Public Member Functions

- JtagDevice (uint32_t idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~JtagDevice ()

  *Default virtual destructor.*
- virtual std::string GetDescription ()=0

  *Gets a human-readable description of this device.*
- unsigned int GetIDCode ()

  *Returns the JEDEC ID code of this device.*
- virtual void **PrintInfo** ()
- virtual void PostInitProbes (bool quiet)=0

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- bool **LookupConstant** (std::string name, uint32_t &value)
- void **SetIR** (const unsigned char *data)
- void **SetIRDeferred** (const unsigned char *data)
- void SetIR (const unsigned char *data, int count)

  *Wrapper around JtagInterface::SetIR()*
- void **SetIRDeferred** (const unsigned char *data, int count)

- void SetIR (const unsigned char *data, unsigned char *data_out, int count)

  *Wrapper around JtagInterface::SetIR()*
- void ScanDR (const unsigned char *send_data, unsigned char *rcv_data, int count)

  *Wrapper around JtagInterface::ScanDR()*
- void ScanDRDeferred (const unsigned char *send_data, int count)

  *Wrapper around JtagInterface::ScanDRDeferred()*
- bool IsSplitScanSupported ()

  *Wrapper around JtagInterface::IsSplitScanSupported()*
- void ScanDRSplitWrite (const unsigned char *send_data, unsigned char *rcv_data, int count)

  *Wrapper around JtagInterface::ScanDRSplitWrite()*
- void ScanDRSplitRead (unsigned char *rcv_data, int count)

  *Wrapper around JtagInterface::ScanDRSplitRead()*
- void SendDummyClocks (int n)

  *Wrapper around JtagInterface::SendDummyClocks()*
- void SendDummyClocksDeferred (int n)

  *Wrapper around JtagInterface::SendDummyClocksDeferred()*
- void ResetToIdle ()

  *Wrapper around JtagInterface::ResetToIdle()*
- void Commit ()

  *Wrapper around JtagInterface::Commit()*
- size_t **GetIRLength** ()
- size_t **GetChainIndex** ()
- uint32_t **GetIdcode** ()
- void EnterShiftDR ()

  *Wrapper around JtagInterface::EnterShiftDR()*
- void ShiftData (const unsigned char *send_data, unsigned char *rcv_data, int count)

  *Wrapper around JtagInterface::ShiftData()*

## Static Public Member Functions

- static JtagDevice * CreateDevice (uint32_t idcode, JtagInterface *iface, size_t pos)

  *Creates a JtagDevice given an ID code.*

## Protected Attributes

- size_t m_irlength

  *Length of this device's instruction register, in bits.*
- uint32_t m_idcode

  *32-bit JEDEC ID code of this device*
- JtagInterface * m_iface

  *The JTAGInterface associated with this device.*
- size_t m_pos

  *Position of this device in the interface's scan chain.*
- unsigned char m_cachedIR [4]

  *Cached IR.*
- std::map< std::string, uint32_t > **m_constantMap**

### 7.41.1 Detailed Description

A single TAP in the JTAG chain. May not correspond 1:1 with physical silicon dies.

### 7.41.2 Constructor & Destructor Documentation

#### 7.41.2.1 JtagDevice()

```
JtagDevice::JtagDevice (
            uint32_t idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

NOTE: Do not do probes/scans of the chain during the constructor, because we haven't initialized all TAPs yet.

Any initialization that involves querying the chain should be done in PostInitProbes().

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

### 7.41.3 Member Function Documentation

#### 7.41.3.1 Commit()

```
void JtagDevice::Commit ( )
```

Wrapper around JtagInterface::Commit()

See JtagInterface documentation for more details.

#### 7.41.3.2 CreateDevice()

```
JtagDevice * JtagDevice::CreateDevice (
            uint32_t idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a JtagDevice given an ID code.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

**Returns**

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

#### 7.41.3.3 EnterShiftDR()

```
void JtagDevice::EnterShiftDR ( )
```

Wrapper around JtagInterface::EnterShiftDR()

See JtagInterface documentation for more details.

#### 7.41.3.4 GetDescription()

```
virtual std::string JtagDevice::GetDescription ( )  [pure virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implemented in MicrochipPIC32Device, Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, XilinxCoolRunnerIIDevice, ARMJtagDebugPort, FreescaleIMXDevice, STM32Device, FreescaleIMXSmartDMA, and JtagDummy.

#### 7.41.3.5 IsSplitScanSupported()

```
bool JtagDevice::IsSplitScanSupported ( )
```

Wrapper around JtagInterface::IsSplitScanSupported()

See JtagInterface documentation for more details.

#### 7.41.3.6 PostInitProbes()

```
virtual void JtagDevice::PostInitProbes (
            bool quiet )  [pure virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implemented in MicrochipPIC32Device, ARMJtagDebugPort, XilinxCoolRunnerIIDevice, FreescaleIMXDevice, STM32Device, ARM7TDMISProcessor, FreescaleIMXSmartDMA, JtagDummy, and XilinxFPGA.

#### 7.41.3.7 ResetToIdle()

```
void JtagDevice::ResetToIdle ( )
```

Wrapper around JtagInterface::ResetToIdle()

See JtagInterface documentation for more details.

#### 7.41.3.8 ScanDR()

```
void JtagDevice::ScanDR (
            const unsigned char * send_data,
            unsigned char * rcv_data,
            int count )
```

Wrapper around JtagInterface::ScanDR()

See JtagInterface documentation for more details.

#### 7.41.3.9 ScanDRDeferred()

```
void JtagDevice::ScanDRDeferred (
            const unsigned char * send_data,
            int count )
```

Wrapper around JtagInterface::ScanDRDeferred()

See JtagInterface documentation for more details.

#### 7.41.3.10 ScanDRSplitRead()

```
void JtagDevice::ScanDRSplitRead (
            unsigned char * rcv_data,
            int count )
```

Wrapper around JtagInterface::ScanDRSplitRead()

See JtagInterface documentation for more details.

#### 7.41.3.11 ScanDRSplitWrite()

```
void JtagDevice::ScanDRSplitWrite (
            const unsigned char * send_data,
            unsigned char * rcv_data,
            int count )
```

Wrapper around JtagInterface::ScanDRSplitWrite()

See JtagInterface documentation for more details.

#### 7.41.3.12 SendDummyClocks()

```
void JtagDevice::SendDummyClocks (
            int n )
```

Wrapper around JtagInterface::SendDummyClocks()

See JtagInterface documentation for more details.

#### 7.41.3.13 SendDummyClocksDeferred()

```
void JtagDevice::SendDummyClocksDeferred (
            int n )
```

Wrapper around JtagInterface::SendDummyClocksDeferred()

See JtagInterface documentation for more details.

#### 7.41.3.14 SetIR() [1/2]

```
void JtagDevice::SetIR (
            const unsigned char * data,
            int count )
```

Wrapper around JtagInterface::SetIR()

See JtagInterface documentation for more details.

#### 7.41.3.15 SetIR() [2/2]

```
void JtagDevice::SetIR (
            const unsigned char * data,
            unsigned char * data_out,
            int count )
```

Wrapper around JtagInterface::SetIR()

See JtagInterface documentation for more details.

#### 7.41.3.16 ShiftData()

```
void JtagDevice::ShiftData (
            const unsigned char * send_data,
            unsigned char * rcv_data,
            int count )
```

Wrapper around JtagInterface::ShiftData()

See JtagInterface documentation for more details.

The documentation for this class was generated from the following files:

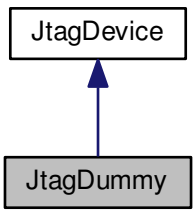
- JtagDevice.h
- JtagDevice.cpp

## 7.42 JtagDummy Class Reference

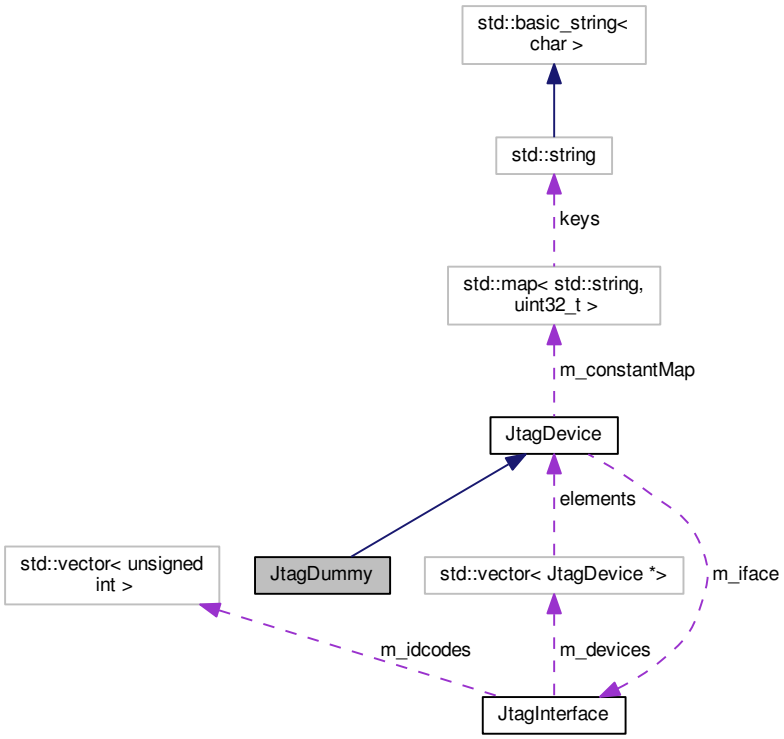
An unknown device (IDCODE not recognized, or no IDCODE present) on a JTAG chain.

```
#include <JtagDummy.h>
```

Inheritance diagram for JtagDummy:



Collaboration diagram for JtagDummy:




## Public Member Functions

- JtagDummy (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~JtagDummy ()

  *Default virtual destructor.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*

## Additional Inherited Members

### 7.42.1 Detailed Description

An unknown device (IDCODE not recognized, or no IDCODE present) on a JTAG chain.

Just exists to take up a slot in the chain and consume IR bits.

### 7.42.2 Constructor & Destructor Documentation

#### 7.42.2.1 JtagDummy()

```
JtagDummy::JtagDummy (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

### 7.42.3 Member Function Documentation

#### 7.42.3.1 GetDescription()

```
string JtagDummy::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.42.3.2 PostInitProbes()

```
void JtagDummy::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

The documentation for this class was generated from the following files:

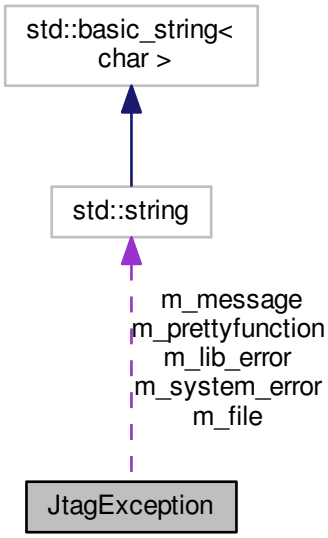
- JtagDummy.h
- JtagDummy.cpp

## 7.43 JtagException Class Reference

Base class for all exceptions thrown by libjtaghal.

`#include <JtagException.h>`

Collaboration diagram for JtagException:




### Public Member Functions

- JtagException (std::string message, std::string library_error, std::string prettyfunction, std::string file, int line)

  *Constructor for an exception object.*
- std::string GetDescription () const

  *Gets the description of this exception.*

### Static Public Member Functions

- static void ThrowDummyException ()

  *Throws an exception to test error handling code.*

### Protected Attributes

- std::string m_message

  *Error message.*
- std::string m_system_error

  *String version of errno.*
- std::string m_lib_error

  *String version of library error.*
- std::string m_prettyfunction

  *Pretty-printed function name.*
- std::string m_file

  *File name.*
- int m_line

  *Line number.*

## 7.43.1 Detailed Description

Base class for all exceptions thrown by libjtaghal.

## 7.43.2 Constructor & Destructor Documentation

### 7.43.2.1 JtagException()

```
JtagException::JtagException (
            std::string message,
            std::string library_error,
            std::string prettyfunction,
            std::string file,
            int line )
```

Constructor for an exception object.

The JtagExceptionWrapper() macro may be used to pass the last three parameters automatically.

**Parameters**

| | |
|---|---|
| *message* | Human-readable error message. Include as much detail as reasonably possible. |
| *library_error* | Human-readable error string returned from a library (ex: libusb) |
| *prettyfunction* | Pretty-printed name of the current function. Pass **PRETTY_FUNCTION** |
| *file* | The current source file. Pass **FILE** |
| *line* | The current line number. Pass **LINE** |

### 7.43.3 Member Function Documentation

#### 7.43.3.1 GetDescription()

```
string JtagException::GetDescription ( ) const
```

Gets the description of this exception.

The file name is truncated to the last 3 components for cleaner output.

Example output:

```
JtagException object thrown from static void JtagException::ThrowDummyException()
    File         : .../src/jtaghal/JtagException.cpp/
    Line         : 136
    Library error:
    System error : Permission denied
    Message      : Test exception
```

**Returns**

Printable exception description

The documentation for this class was generated from the following files:

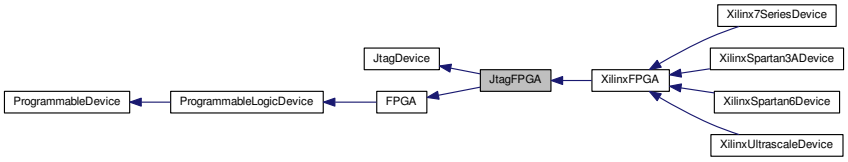
- JtagException.h
- JtagException.cpp

## 7.44 JtagFPGA Class Reference

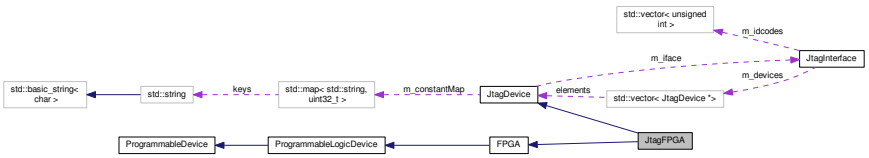
Abstract base class for all JTAG-programmed FPGAs.

```
#include <JtagFPGA.h>
```

Inheritance diagram for JtagFPGA:




Collaboration diagram for JtagFPGA:



### Public Member Functions

- JtagFPGA (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~JtagFPGA ()

  *Default virtual destructor.*
- virtual size_t GetNumUserInstructions ()=0

  *Get the number of JTAG instructions which are routed to FPGA fabric.*
- virtual void SelectUserInstruction (size_t index)=0

  *Sets the instruction register to the specified user instruction.*
- bool GetUserVIDPID (unsigned int &idVendor, unsigned int &idProduct)

  *Gets the vendor/product code in USER1 (if implemented)*

### Additional Inherited Members

## 7.44.1 Detailed Description

Abstract base class for all JTAG-programmed FPGAs.

## 7.44.2 Constructor & Destructor Documentation

#### 7.44.2.1 JtagFPGA()

```
JtagFPGA::JtagFPGA (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

## 7.44.3 Member Function Documentation

#### 7.44.3.1 GetUserVIDPID()

```
bool JtagFPGA::GetUserVIDPID (
            unsigned int & idVendor,
            unsigned int & idProduct )
```

Gets the vendor/product code in USER1 (if implemented)

Reference: https://github.com/azonenberg/jtaghal/wiki/FPGA-debug

**Returns**

false on error, or if no USER instructions

The documentation for this class was generated from the following files:

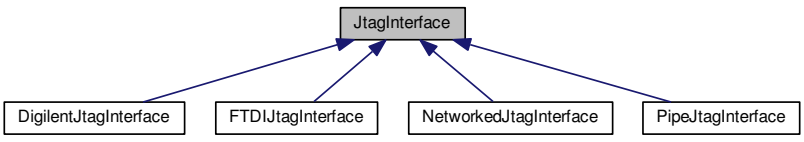
- JtagFPGA.h
- JtagFPGA.cpp

## 7.45 JtagInterface Class Reference

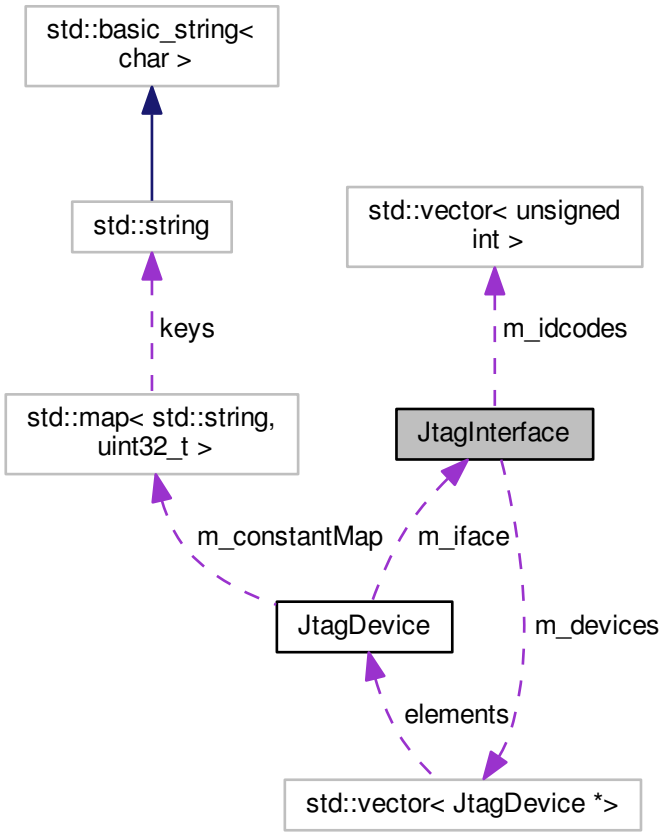
Abstract representation of a JTAG adapter.

```
#include <JtagInterface.h>
```

Inheritance diagram for JtagInterface:



Collaboration diagram for JtagInterface:




## Public Member Functions

- JtagInterface ()

  *Default constructor.*
- virtual ~JtagInterface ()

  *Interface destructor.*
- virtual std::string GetName ()=0

  *Gets the manufacturer-assigned name for this programming adapter.*
- virtual std::string GetSerial ()=0

  *Gets the manufacturer-assigned serial number for this programming adapter, if any.*
- virtual std::string GetUserID ()=0

  *Gets the user-assigned name for this JTAG adapter, if any.*
- virtual int GetFrequency ()=0

  *Gets the clock frequency, in Hz, of the JTAG interface.*
- virtual void Commit ()

  *Commits the outstanding transactions to the adapter.*
- virtual void ShiftData (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)=0

*Shifts data through TDI to TDO.*

- virtual void SendDummyClocks (size_t n)=0

  *Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.*
- virtual void SendDummyClocksDeferred (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.*
- virtual bool IsSplitScanSupported ()

  *Indicates if split (pipelined) DR scanning is supported.*
- virtual bool ShiftDataWriteOnly (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Shifts data through TDI to TDO.*
- virtual bool ShiftDataReadOnly (unsigned char *rcv_data, size_t count)

  *Reads data from a ShiftDataWriteOnly() call.*
- virtual void TestLogicReset ()

  *Enters Test-Logic-Reset state by shifting six ones into TMS.*
- virtual void EnterShiftIR ()

  *Enters Shift-IR state from Run-Test-Idle state.*
- virtual void LeaveExit1IR ()

  *Leaves Exit1-IR state and returns to Run-Test-Idle.*
- virtual void EnterShiftDR ()

  *Enters Shift-DR state from Run-Test-Idle state.*
- virtual void LeaveExit1DR ()

  *Leaves Exit1-DR state and returns to Run-Test-Idle.*
- virtual void ResetToIdle ()

  *Resets the TAP and enters Run-Test-Idle state.*
- void InitializeChain (bool quiet=false)

  *Initializes the scan chain and gets the number of devices present.*
- size_t GetDeviceCount ()

  *Returns the number of devices in the scan chain.*
- unsigned int GetIDCode (unsigned int device)

  *Returns the ID for the supplied device (zero-based indexing)*
- JtagDevice * GetDevice (unsigned int device)

  *Gets the Nth device in the chain.*
- void SetIR (unsigned int device, const unsigned char *data, size_t count)

  *Sets the IR for a specific device in the chain.*
- void SetIRDeferred (unsigned int device, const unsigned char *data, size_t count)

  *Sets the IR for a specific device in the chain.*
- void SetIR (unsigned int device, const unsigned char *data, unsigned char *data_out, size_t count)

  *Sets the IR for a specific device in the chain and returns the IR capture value.*
- void ScanDR (unsigned int device, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Sets the DR for a specific device in the chain and optionally returns the previous DR contents.*
- void ScanDRDeferred (unsigned int device, const unsigned char *send_data, size_t count)

  *Sets the DR for a specific device in the chain and defers the operation if possible.*
- void ScanDRSplitWrite (unsigned int device, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Sets the DR for a specific device in the chain and optionally returns the previous DR contents.*
- void ScanDRSplitRead (unsigned int device, unsigned char *rcv_data, size_t count)

  *Sets the DR for a specific device in the chain and optionally returns the previous DR contents.*
- void SwapOutDummy (size_t pos, JtagDevice *realdev)

  *Swap out a dummy device with a real device, once we've figured out by context/heuristics what it does.*
- virtual size_t GetShiftOpCount ()

  *Gets the number of shift operations performed on this interface.*

- virtual size_t GetRecoverableErrorCount ()

  *Gets the number of errors this interface has recovered from (USB retransmits, etc)*
- virtual size_t GetDataBitCount ()

  *Gets the number of data bits this interface has shifted.*
- virtual size_t GetModeBitCount ()

  *Gets the number of mode bits this interface has shifted.*
- virtual size_t GetDummyClockCount ()

  *Gets the number of dummy clocks this interface has sent.*
- virtual double GetShiftTime ()

  *Gets the number of dummy clocks this interface has sent.*

### Protected Member Functions

- virtual void ShiftTMS (bool tdi, const unsigned char ∗send_data, size_t count)=0

  *Shifts data into TMS to change TAP state.*
- void CreateDummyDevices ()

  *Creates dummy devices to fill out an incomplete chain.*
- void PrintChainFaultMessage ()

  *Prints an error when we fail to initialize the scan chain.*

### Protected Attributes

- size_t m_devicecount

  *Number of devices in the scan chain.*
- size_t m_irtotal

  *Total IR length of the chain.*
- std::vector< unsigned int > m_idcodes

  *Array of device ID codes.*
- std::vector< JtagDevice ∗ > m_devices

  *Array of devices.*
- size_t m_perfShiftOps

  *Number of shift operations performed on this interface.*
- size_t m_perfRecoverableErrs

  *Number of link errors successfully recovered from.*
- size_t m_perfDataBits

  *Number of data bits shifted.*
- size_t m_perfModeBits

  *Number of mode bits shifted.*
- size_t m_perfDummyClocks

  *Number of dummy clocks shifted.*
- double m_perfShiftTime

  *Total time spent on shift operations.*

## 7.45.1 Detailed Description

Abstract representation of a JTAG adapter.

A JTAG adapter provides access to a single scan chain containing zero or more JtagDevice objects.

The JtagInterface class provides three levels of abstraction for scan chain access.

#### Low level (bit level)

This is the most basic way to access a JTAG adapter - clocking raw bits in and out.

In order to support a new "dumb" JTAG adapter without any higher level protocol offload, create a new derived class and implement each of the following functions:

- GetName()
- GetSerial()
- GetUserID()
- GetFrequency()
- ShiftData()
- ShiftTMS()
- SendDummyClocks()

The low-level interface also includes support for pipelined / queued command execution. This can improve performance when using adapters connected to high-latency links such as USB.

The default implementations simply call the non-deferred versions and execute immediately. If an adapter supports queueing of commands, overriding these functions can result in higher performance.

- IsSplitScanSupported()
- SendDummyClocksDeferred()
- ShiftDataWriteOnly()
- ShiftDataReadOnly()
- Commit()

#### Mid level (state level)

By default, these functions are simple wrappers around ShiftTMS() for changing between chain states.

If the adapter supports server-side management of chain state, these can be overridden to simply push a command to the adapter.

- ResetToIdle()
- TestLogicReset()
- EnterShiftIR()
- LeaveExit1IR()
- EnterShiftDR()
- LeaveExit1DR()

#### High level (register level)

These functions provide access to individual registers of TAPs, providing padding as necessary.

By default these functions are simple wrappers around ShiftData() and the mid-level state functions.

If the adapter supports server-side padding insertion/removal, these can be overridden to reduce overhead.

The "deferred" versions of these functions may queue commands. To ensure that all previous queued commands have executed, call Commit() or any function which returns readback data from a scan transaction.

- SetIR()
- SetIRDeferred()
- ScanDR()
- ScanDRDeferred()
- ScanDRSplitRead()
- ScanDRSplitWrite()

#### Device management

These functions provide access to individual devices on the chain.

- InitializeChain()
- GetDeviceCount()
- GetIDCode()
- GetDevice()
- SwapOutDummy()

#### Performance profiling

These functions return stats on the amount of data shifted and the time spent waiting for the adapter.

These may be useful to compare different programming algorithms and optimizations to reduce unnecessary activity.

- GetShiftOpCount()
- GetRecoverableErrorCount()
- GetDataBitCount()
- GetModeBitCount()
- GetDummyClockCount()
- GetShiftTime()

#### NOTES

Devices are numbered such that TDI goes to device N and TDO goes to device 0.

### 7.45.2 Constructor & Destructor Documentation

#### 7.45.2.1 JtagInterface()

```
JtagInterface::JtagInterface ( )
```

Default constructor.

Initializes the interface to the empty state.

You should generally call InitializeChain() to detect devices before doing much of anything else.

#### 7.45.2.2 ~JtagInterface()

```
JtagInterface::~JtagInterface ( )  [virtual]
```

Interface destructor.

Destroys all JtagDevice objects in the scan chain

### 7.45.3 Member Function Documentation

#### 7.45.3.1 Commit()

```
void JtagInterface::Commit ( )  [virtual]
```

Commits the outstanding transactions to the adapter.

No-op unless the adapter supports queueing of multiple writes.

This function is automatically called when SendDummyClocks() is called or any readback is performed. Most adapter classes will automatically call it when the transmit queue reaches a certain size.

This function can be called at any time to ensure all pending operations have executed.

**Exceptions**

| | |
|---|---|
| *JtagException* | in case of error |

Reimplemented in FTDIJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.2 CreateDummyDevices()

```
void JtagInterface::CreateDummyDevices ( )  [protected]
```

Creates dummy devices to fill out an incomplete chain.

If this chain has exactly one device which is not supported or missing an IDCODE, create a dummy device to take up the space so we can correctly calculate IR padding.

If multiple unknown devices are present, it's impossible to recover since we don't know how long the IRs for each one are, and thus can't figure out boundaries.

#### 7.45.3.3 EnterShiftDR()

```
void JtagInterface::EnterShiftDR ( )  [virtual]
```

Enters Shift-DR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.4 EnterShiftIR()

```
void JtagInterface::EnterShiftIR ( )  [virtual]
```

Enters Shift-IR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.5 GetDataBitCount()

```
size_t JtagInterface::GetDataBitCount ( )  [virtual]
```

Gets the number of data bits this interface has shifted.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of data bits shifted

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.6 GetDevice()

```
JtagDevice * JtagInterface::GetDevice (
            unsigned int device )
```

Gets the Nth device in the chain.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is out of range |

**Parameters**

| | |
|---|---|
| *device* | Device index |

**Returns**

The device object

#### 7.45.3.7 GetDeviceCount()

```
size_t JtagInterface::GetDeviceCount ( )
```

Returns the number of devices in the scan chain.

**Returns**

Device count

#### 7.45.3.8 GetDummyClockCount()

```
size_t JtagInterface::GetDummyClockCount ( )  [virtual]
```

Gets the number of dummy clocks this interface has sent.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of dummy clocks sent

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.9 GetFrequency()

```
virtual int JtagInterface::GetFrequency ( )  [pure virtual]
```

Gets the clock frequency, in Hz, of the JTAG interface.

**Returns**

The clock frequency

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.10 GetIDCode()

```
unsigned int JtagInterface::GetIDCode (
            unsigned int device )
```

Returns the ID for the supplied device (zero-based indexing)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the index is out of range |

**Parameters**

| | |
|---|---|
| *device* | Device index |

**Returns**

The 32-bit JTAG ID code

#### 7.45.3.11 GetModeBitCount()

```
size_t JtagInterface::GetModeBitCount ( )  [virtual]
```

Gets the number of mode bits this interface has shifted.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of mode bits shifted

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.12 GetName()

```
virtual std::string JtagInterface::GetName ( )  [pure virtual]
```

Gets the manufacturer-assigned name for this programming adapter.

This is usually the model number but is sometimes something more generic like "Digilent Adept USB Device".

**Returns**

The device name

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.13 GetRecoverableErrorCount()

```
size_t JtagInterface::GetRecoverableErrorCount ( )  [virtual]
```

Gets the number of errors this interface has recovered from (USB retransmits, etc)

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of recoverable errors

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.14 GetSerial()

```
virtual std::string JtagInterface::GetSerial ( )  [pure virtual]
```

Gets the manufacturer-assigned serial number for this programming adapter, if any.

Derived classes may choose to return the user ID, an empty string, or another default value if no serial number has been assigned.

**Returns**

The serial number

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.15 GetShiftOpCount()

```
size_t JtagInterface::GetShiftOpCount ( )  [virtual]
```

Gets the number of shift operations performed on this interface.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of shift operations

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.16 GetShiftTime()

```
double JtagInterface::GetShiftTime ( )  [virtual]
```

Gets the number of dummy clocks this interface has sent.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of dummy clocks sent

#### 7.45.3.17 GetUserID()

```
virtual std::string JtagInterface::GetUserID ( )  [pure virtual]
```

Gets the user-assigned name for this JTAG adapter, if any.

Derived classes may choose to return the serial number, an empty string, or another default value if no name has been assigned.

**Returns**

The name for this adapter.

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.18 InitializeChain()

```
void JtagInterface::InitializeChain (
            bool quiet = false )
```

Initializes the scan chain and gets the number of devices present.

Assumes less than 1024 bits of total IR length.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any of the scan operations fails. |

#### 7.45.3.19 IsSplitScanSupported()

```
bool JtagInterface::IsSplitScanSupported ( )  [virtual]
```

Indicates if split (pipelined) DR scanning is supported.

Split scanning allows the write halves of several scan operations to take place in one driver-level write call, followed by the read halves in order, to reduce the impact of driver/bus latency on throughput.

If split scanning is not supported, ScanDRSplitWrite() will behave identically to ScanDR() and ScanDRSplitRead() will be a no-op. This ensures that using the split write commands will work correctly regardless of whether the adapter supports split scanning in hardware.

Reimplemented in FTDIJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.20 LeaveExit1DR()

```
void JtagInterface::LeaveExit1DR ( )  [virtual]
```

Leaves Exit1-DR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.21 LeaveExit1IR()

```
void JtagInterface::LeaveExit1IR ( )  [virtual]
```

Leaves Exit1-IR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.22 ResetToIdle()

```
void JtagInterface::ResetToIdle ( )  [virtual]
```

Resets the TAP and enters Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.23 ScanDR()

```
void JtagInterface::ScanDR (
            unsigned int device,
            const unsigned char * send_data,
```

```
            unsigned char * rcv_data,
            size_t count )
```

Sets the DR for a specific device in the chain and optionally returns the previous DR contents.

Starts and ends in Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are assumed to be in BYPASS mode and their DR is set to zero. |
| *send_data* | The data value to scan (see ShiftData() for bit/byte ordering) |
| *rcv_data* | Output data to scan, or NULL if no output is desired (faster) |
| *count* | Number of bits to scan |

#### 7.45.3.24 ScanDRDeferred()

```
void JtagInterface::ScanDRDeferred (
            unsigned int device,
            const unsigned char * send_data,
            size_t count )
```

Sets the DR for a specific device in the chain and defers the operation if possible.

The scan operation may not actually execute until Commit() is called. When the operation executes is dependent on whether the interface supports deferred writes, how full the interface's buffer is, and when the next operation forcing a commit (call to Commit() or a read operation) takes place.

Starts and ends in Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are assumed to be in BYPASS mode and their DR is set to zero. |
| *send_data* | The data value to scan (see ShiftData() for bit/byte ordering) |
| *count* | Number of bits to scan |

#### 7.45.3.25 ScanDRSplitRead()

```
void JtagInterface::ScanDRSplitRead (
            unsigned int device,
            unsigned char * rcv_data,
            size_t count )
```

Sets the DR for a specific device in the chain and optionally returns the previous DR contents.

Starts and ends in Run-Test-Idle state.

If split (pipelined) scanning is supported, this call performs the read half of the scan only.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are assumed to be in BYPASS mode and their DR is set to zero. |
| *rcv_data* | Output data to scan, or NULL if no output is desired (faster) |
| *count* | Number of bits to scan |

#### 7.45.3.26 ScanDRSplitWrite()

```
void JtagInterface::ScanDRSplitWrite (
            unsigned int device,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )
```

Sets the DR for a specific device in the chain and optionally returns the previous DR contents.

Starts and ends in Run-Test-Idle state.

If split (pipelined) scanning is supported, this call performs the write half of the scan only; the read is performed by ScanDRSplitRead(). Several writes may occur in a row, and must be followed by an equivalent number of reads with matching length values.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are assumed to be in BYPASS mode and their DR is set to zero. |
| *send_data* | The data value to scan (see ShiftData() for bit/byte ordering) |

**Parameters**

| | |
|---|---|
| *rcv_data* | Output data to scan, or NULL if no output is desired (faster) |
| *count* | Number of bits to scan |

#### 7.45.3.27 SendDummyClocks()

```
virtual void JtagInterface::SendDummyClocks (
            size_t n )  [pure virtual]
```

Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.

Since dummy clocks are often used as a delay element for programming algorithms etc, this function flushes the write buffer to ensure immediate execution.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.28 SendDummyClocksDeferred()

```
void JtagInterface::SendDummyClocksDeferred (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Reimplemented in FTDIJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.29 SetIR() [1/2]

```
void JtagInterface::SetIR (
            unsigned int device,
            const unsigned char * data,
            size_t count )
```

Sets the IR for a specific device in the chain.

Starts and ends in Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are set to BYPASS mode. |
| *data* | The IR value to scan (see ShiftData() for bit/byte ordering) |
| *count* | Instruction register length, in bits |

#### 7.45.3.30 SetIR() [2/2]

```
void JtagInterface::SetIR (
            unsigned int device,
            const unsigned char * data,
            unsigned char * data_out,
            size_t count )
```

Sets the IR for a specific device in the chain and returns the IR capture value.

Starts and ends in Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are set to BYPASS mode. |
| *data* | The IR value to scan (see ShiftData() for bit/byte ordering) |
| *data_out* | IR capture value |
| *count* | Instruction register length, in bits |

#### 7.45.3.31 SetIRDeferred()

```
void JtagInterface::SetIRDeferred (
            unsigned int device,
            const unsigned char * data,
            size_t count )
```

Sets the IR for a specific device in the chain.

Starts and ends in Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if any shift operation fails. |

**Parameters**

| | |
|---|---|
| *device* | Zero-based index of the target device. All other devices are set to BYPASS mode. |
| *data* | The IR value to scan (see ShiftData() for bit/byte ordering) |
| *count* | Instruction register length, in bits |

#### 7.45.3.32 ShiftData()

```
virtual void JtagInterface::ShiftData (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [pure virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Implemented in FTDIJtagInterface, DigilentJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.33 ShiftDataReadOnly()

```
bool JtagInterface::ShiftDataReadOnly (
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Reads data from a ShiftDataWriteOnly() call.

For more information on split (pipelined) scan operations see ShiftDataWriteOnly().

#### Returns

True if the read was executed, false if a no-op

#### Parameters

| | |
|---|---|
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented in FTDIJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

### 7.45.3.34 ShiftDataWriteOnly()

```
bool JtagInterface::ShiftDataWriteOnly (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

If split (pipelined) scanning is supported by the adapter, this function performs the write half of the shift operation only; the read is buffered in the JTAG adapter and no readback is performed until ShiftDataReadOnly() is called. This allows several shift operations to occur in sequence without incurring a USB turnaround delay or other driver latency overhead for each shift operation.

If split scanning is not supported this call is equivalent to ShiftData() and ShiftDataReadOnly() is a no-op.

This function MUST be followed by either another ShiftDataWriteOnly() call, a ShiftTMS() call, or a ShiftDataReadOnly() call. There must be exactly one ShiftDataReadOnly() call for each ShiftDataWriteOnly() call and they must be in order with the same rcv_data and count values. The result of doing otherwise is undefined.

#### Returns

True if the read was deferred, false if not

#### Parameters

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented in FTDIJtagInterface, NetworkedJtagInterface, and PipeJtagInterface.

#### 7.45.3.35 ShiftTMS()

```
virtual void JtagInterface::ShiftTMS (
            bool tdi,
            const unsigned char * send_data,
            size_t count )  [protected], [pure virtual]
```

Shifts data into TMS to change TAP state.

This is no longer a public API operation. It can only be accessed via the state-level interface.

Implementations of this class may choose to implement EITHER this function (and use the default JtagInterface-provided state-level functions) OR override this function with a private no-op stub and override the state-level functions instead.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *tdi* | Constant tdi value (normally 0) |
| *send_data* | Data to shift into TMS. Bit ordering is the same as for ShiftData(). |
| *count* | Number of bits to shift |

Implemented in FTDIJtagInterface, and DigilentJtagInterface.

#### 7.45.3.36 SwapOutDummy()

```
void JtagInterface::SwapOutDummy (
            size_t pos,
            JtagDevice * realdev )
```

Swap out a dummy device with a real device, once we've figured out by context/heuristics what it does.

Often when the chain is first being walked, unknown devices cannot be identified - but later on, once the remainder of the chain has been discovered, the unknown devices can be identified contextually (for example a no-idcode debug TAP followed by an IDCODE-capable boundary scan TAP).

This function allows a dummy device in the chain to be replaced with a non-dummy device.

#### 7.45.3.37 TestLogicReset()

```
void JtagInterface::TestLogicReset ( )  [virtual]
```

Enters Test-Logic-Reset state by shifting six ones into TMS.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented in NetworkedJtagInterface, and PipeJtagInterface.

The documentation for this class was generated from the following files:

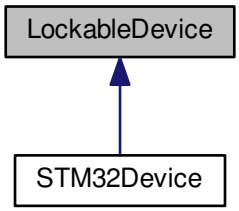
- JtagInterface.h
- JtagInterface.cpp

## 7.46 LockableDevice Class Reference

Generic base class for all devices which have some kind of read/write protection.

`#include <LockableDevice.h>`

Inheritance diagram for LockableDevice:




### Public Types

- enum AccessLevel { **ACCESS_EXECUTE** = 1, **ACCESS_WRITE** = 2, **ACCESS_READ** = 4 }

  *Levels of access being requested (may be ORed together)*

### Public Member Functions

- virtual void ProbeLocksNondestructive ()=0

  *Queries lock status in a non-destructive fashion (contents of the chip are untouched)*
- virtual void ProbeLocksDestructive ()=0

  *Queries lock status in a more invasive fashion. Gives more accurate data but may involve write transactions to memory.*
- virtual UncertainBoolean CheckMemoryAccess (uint32_t ptr, unsigned int access)=0

  *Checks if a given physical address has a given protection applied.*
- virtual UncertainBoolean IsDeviceReadLocked ()=0

  *Checks if the device is globally read protected or not.*
- virtual void PrintLockProbeDetails ()=0

  *Prints detailed information regarding the state of the read lock.*
- virtual void SetReadLock ()=0

  *Sets a global read-protection lock on the entire device.*
- virtual void ClearReadLock ()=0

  *Clears the global read-protection lock, if set in a non-permanent fashion.*

### 7.46.1 Detailed Description

Generic base class for all devices which have some kind of read/write protection.

Note that sometimes due to protections, it's not possible to get definite answers to all queries.

### 7.46.2 Member Function Documentation

#### 7.46.2.1 ClearReadLock()

```
virtual void LockableDevice::ClearReadLock ( )  [pure virtual]
```

Clears the global read-protection lock, if set in a non-permanent fashion.

In most parts, this will trigger a bulk flash erase.

Implemented in STM32Device.

#### 7.46.2.2 SetReadLock()

```
virtual void LockableDevice::SetReadLock ( )  [pure virtual]
```

Sets a global read-protection lock on the entire device.

This function only performs reversible locks that can be cleared with a bulk erase. Thus, it should not be able to brick the chip entirely.

Implemented in STM32Device.

The documentation for this class was generated from the following files:

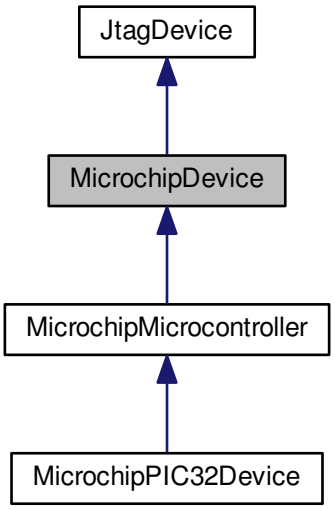
- LockableDevice.h
- LockableDevice.cpp

## 7.47 MicrochipDevice Class Reference

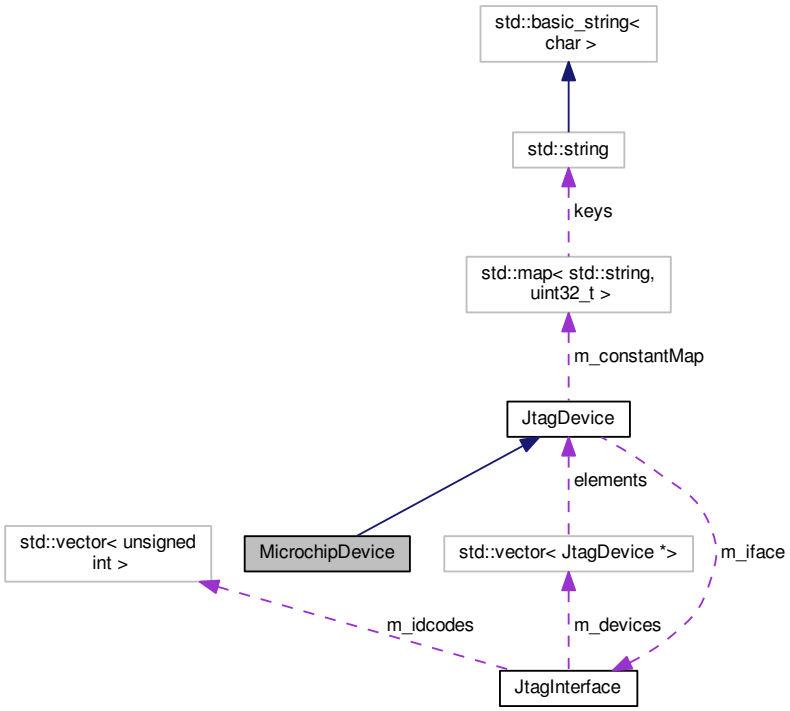
Abstract base class for all Microchip devices (typically MCUs)

```
#include <MicrochipDevice.h>
```

Inheritance diagram for MicrochipDevice:



Collaboration diagram for MicrochipDevice:




## Public Member Functions

- MicrochipDevice (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~MicrochipDevice ()

  *Default virtual destructor.*

## Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int idcode, JtagInterface *iface, size_t pos)

  *Creates a MicrochipDevice given an ID code.*

## Additional Inherited Members

### 7.47.1 Detailed Description

Abstract base class for all Microchip devices (typically MCUs)

### 7.47.2 Constructor & Destructor Documentation

#### 7.47.2.1 MicrochipDevice()

```
MicrochipDevice::MicrochipDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

### 7.47.3 Member Function Documentation

#### 7.47.3.1 CreateDevice()

```
JtagDevice * MicrochipDevice::CreateDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a MicrochipDevice given an ID code.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the ID code supplied is not a valid Microchip device, or not a known family number |

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

**Returns**

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

The documentation for this class was generated from the following files:

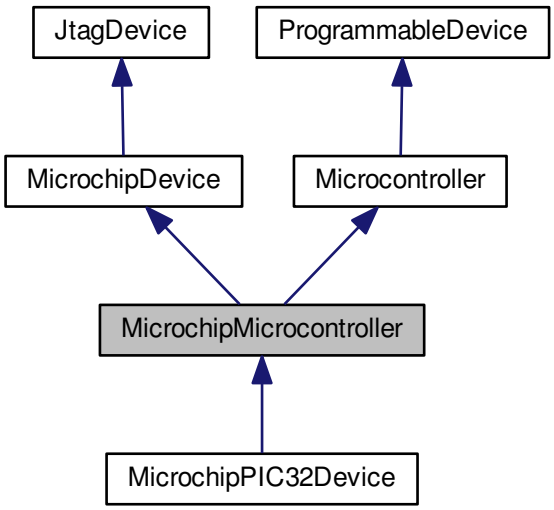
- MicrochipDevice.h
- MicrochipDevice.cpp

## 7.48 MicrochipMicrocontroller Class Reference

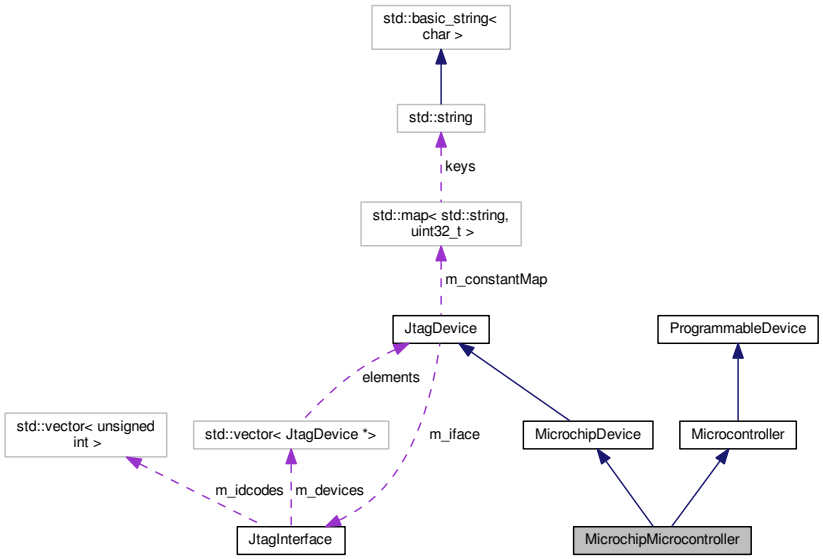
Generic base class for all Microchip MCUs.

`#include <MicrochipMicrocontroller.h>`

Inheritance diagram for MicrochipMicrocontroller:




Collaboration diagram for MicrochipMicrocontroller:



### Public Member Functions

- **MicrochipMicrocontroller** (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

### Additional Inherited Members

#### 7.48.1 Detailed Description

Generic base class for all Microchip MCUs.

The documentation for this class was generated from the following files:

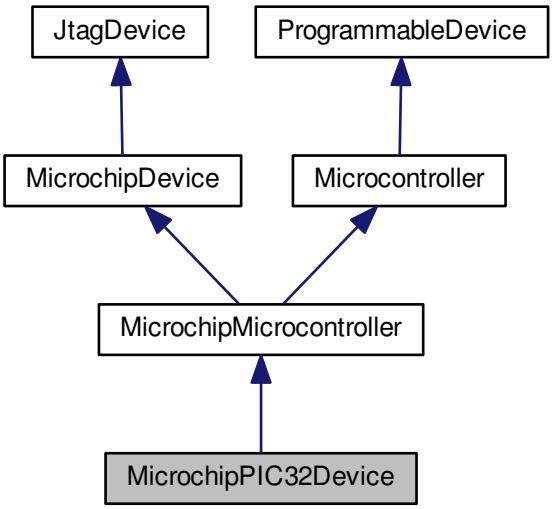
- MicrochipMicrocontroller.h
- MicrochipMicrocontroller.cpp

## 7.49 MicrochipPIC32Device Class Reference

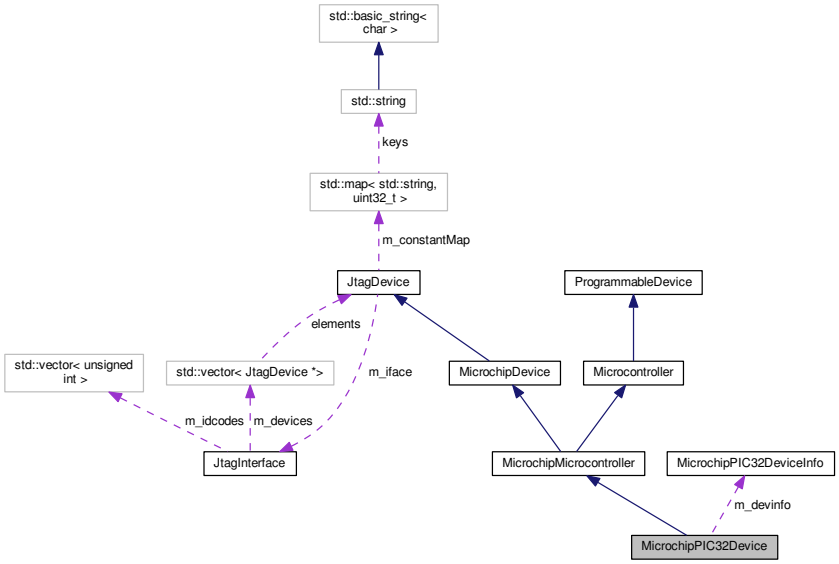
A Microchip PIC32 microcontroller (MX, MZ, MM, etc)

```
#include <MicrochipPIC32Device.h>
```

Inheritance diagram for MicrochipPIC32Device:



Collaboration diagram for MicrochipPIC32Device:




## Public Types

- enum families {
  **FAMILY_MX12**, **FAMILY_MX34**, **FAMILY_MX567**, **FAMILY_MM**,
  **FAMILY_MZ** }

  *Device families.*
- enum cpus { **CPU_M4K**, **CPU_MAPTIV** }

  *CPU types.*
- enum deviceids {
  **PIC32MX110F016B** = 0x4a07, **PIC32MX110F016C** = 0x4a09, **PIC32MX110F016D** = 0x4a0b, **PIC32M↩X120F032B** = 0x4a06,
  **PIC32MX120F032C** = 0x4a08, **PIC32MX120F032D** = 0x4a0a, **PIC32MX130F064B** = 0x4d07, **PIC32M↩X130F064C** = 0x4d09,
  **PIC32MX130F064D** = 0x4d0b, **PIC32MX150F128B** = 0x4d06, **PIC32MX150F128C** = 0x4d08, **PIC32M↩X150F128D** = 0x4d0a,
  **PIC32MX210F016B** = 0x4a01, **PIC32MX210F016C** = 0x4a03, **PIC32MX210F016D** = 0x4a05, **PIC32M↩X220F032B** = 0x4a00,
  **PIC32MX220F032C** = 0x4a02, **PIC32MX220F032D** = 0x4a04, **PIC32MX230F064B** = 0x4d01, **PIC32M↩X230F064C** = 0x4d03,
  **PIC32MX230F064D** = 0x4d05, **PIC32MX250F128B** = 0x4d00, **PIC32MX250F128C** = 0x4d02, **PIC32M↩X250F128D** = 0x4d04,
  **PIC32MX330F064H** = 0x5600, **PIC32MX330F064L** = 0x5601, **PIC32MX340F512H** = 0x0916, **PIC32M↩X350F128H** = 0x570c,
  **PIC32MX350F256H** = 0x570d, **PIC32MX350F256L** = 0x5705, **PIC32MX430F064H** = 0x5602, **PIC32M↩X430F064L** = 0x5603,
  **PIC32MX450F128H** = 0x570e, **PIC32MX450F128L** = 0x570f, **PIC32MX450F256H** = 0x5706, **PIC32MX450↩F256L** = 0x5707,
  **PIC32MX534F064H** = 0x440c, **PIC32MX564F064H** = 0x4401, **PIC32MX564F064L** = 0x440d, **PIC32M↩X564F128H** = 0x4403,
  **PIC32MX564F128L** = 0x440f, **PIC32MX664F064H** = 0x4405, **PIC32MX664F064L** = 0x4411, **PIC32MX664↩F128H** = 0x4407,

**PIC32MX664F128L** = 0x4413, **PIC32MX695F512L** = 0x4341, **PIC32MX764F128H** = 0x440b, **PIC32MX764F128L** = 0x4417,
**PIC32MX795F512L** = 0x4307, **PIC32MM0016GPL020** = 0x6b04, **PIC32MM0032GPL020** = 0x6b0c, **PIC32MM0064GPL020** = 0x6b14,
**PIC32MM0016GPL028** = 0x6b02, **PIC32MM0032GPL028** = 0x6b0a, **PIC32MM0064GPL028** = 0x6b12, **PIC32MM0016GPL036** = 0x6b06,
**PIC32MM0032GPL036** = 0x6b0b, **PIC32MM0064GPL036** = 0x6b16, **PIC32MM0064GPM028** = 0x7708, **PIC32MM0128GPM028** = 0x7710,
**PIC32MM0256GPM028** = 0x7718, **PIC32MM0064GPM036** = 0x770a, **PIC32MM0128GPM036** = 0x7712, **PIC32MM0256GPM036** = 0x771a,
**PIC32MM0064GPM048** = 0x772c, **PIC32MM0128GPM048** = 0x7734, **PIC32MM0256GPM048** = 0x773c, **PIC32MM0064GPM064** = 0x770e,
**PIC32MM0128GPM064** = 0x7716, **PIC32MM0256GPM064** = 0x771e }

*JTAG device IDs (from BSDL files and/or flash programming spec)*

- enum instructions {
  INST_BYPASS = 0x1F, INST_IDCODE = 0x01, INST_IMPCODE = 0x03, INST_MTAP_SW_MCHP = 0x04, INST_MTAP_SW_EJTAG = 0x05, INST_MTAP_COMMAND = 0x07, INST_ADDRESS = 0x08, INST_DATA = 0x09,
  INST_CONTROL = 0x0A, INST_ALL = 0x0B, INST_DEBUGBOOT = 0x0C, INST_NORMALBOOT = 0x0D, INST_FASTDATA = 0x0E, **INST_PCSAMPLE** = 0x14 }

  *5-bit-wide JTAG instructions (from BSDL file and datasheet)*
- enum mtap_instructions {
  MCHP_STATUS = 0x00, MCHP_ASSERT_RST = 0xD1, MCHP_DE_ASSERT_RST = 0xD0, MCHP_ERASE = 0xFC,
  MCHP_FLASH_ENABLE = 0xFE, MCHP_FLASH_DISABLE = 0xFD, MCHP_READ_CONFIG = 0xFF }

  *8-bit instructions for Microchip virtual TAP (write to INST_MTAP_COMMAND data register)*

## Public Member Functions

- **MicrochipPIC32Device** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual ~MicrochipPIC32Device ()

  *Destructor.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- void **SetIR** (unsigned char irval)

## Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)

## Public Attributes

- enum MicrochipPIC32Device::families **__attribute__**

### Protected Member Functions

- void **EnterMtapMode** ()
- uint8_t SendMchpCommand (uint8_t cmd)

  *Sends a MTAP command. Requires TAP to be in MCHP mode, not EJTAG mode.*
- void **EnterEjtagMode** ()
- void **EnterSerialExecMode** ()
- void SerialExecuteInstruction (uint32_t insn, bool first=false)

  *Executes a single MIPS32 instruction in serial-exec mode.*
- void **SerialExecuteMemoryWrite** (uint32_t addr, uint32_t data)
- uint32_t **SerialExecuteMemoryRead** (uint32_t addr)
- EjtagControlRegister **WaitForEjtagMemoryOperation** (bool first=false)
- void **SerialExecHelper** ()
- MicrochipPIC32DeviceStatusRegister **GetStatus** ()
- EjtagImplementationCodeRegister **GetImpCode** ()

### Protected Attributes

- unsigned int m_devid

  *Device ID code.*
- unsigned int m_stepping

  *Stepping number.*
- const MicrochipPIC32DeviceInfo * m_devinfo

  *Device info.*

## 7.49.1 Detailed Description

A Microchip PIC32 microcontroller (MX, MZ, MM, etc)

## 7.49.2 Member Enumeration Documentation

### 7.49.2.1 instructions

`enum MicrochipPIC32Device::instructions`

5-bit-wide JTAG instructions (from BSDL file and datasheet)

**Enumerator**

| | |
|---|---|
| INST_BYPASS | Standard JTAG bypass. |
| INST_IDCODE | Read ID code. |
| INST_IMPCODE | Read implementation code. |
| INST_MTAP_SW_MCHP | Selects Microchip scan chain. |
| INST_MTAP_SW_EJTAG | Selects EJTAG scan chain. |
| INST_MTAP_COMMAND | Command to Microchip virtualized JTAG. |
| INST_ADDRESS | Select address register for memory ops. |
| INST_DATA | Select data register for memory ops. |
| INST_CONTROL | Control register of some sort? |
| INST_ALL | Selects address, data, control end to end in one DR. |
| INST_DEBUGBOOT | Makes the CPU trap to debugger after a reset. |
| INST_NORMALBOOT | Boots normally after reset. |

#### 7.49.2.2 mtap_instructions

```
enum MicrochipPIC32Device::mtap_instructions
```

8-bit instructions for Microchip virtual TAP (write to INST_MTAP_COMMAND data register)

**Enumerator**

| | |
|---|---|
| MCHP_STATUS | Get status. |
| MCHP_ASSERT_RST | Begin chip reset. |
| MCHP_DE_ASSERT_RST | End chip reset. |
| MCHP_ERASE | Bulk-erase flash. |
| MCHP_FLASH_ENABLE | Enable connecting the CPU to flash. |
| MCHP_FLASH_DISABLE | Disconnect the CPU from flash. |
| MCHP_READ_CONFIG | Force re-read of device config. |

### 7.49.3 Member Function Documentation

#### 7.49.3.1 Erase()

```
void MicrochipPIC32Device::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.49.3.2 GetDescription()

```
std::string MicrochipPIC32Device::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.49.3.3 IsProgrammed()

```
bool MicrochipPIC32Device::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.49.3.4 PostInitProbes()

```
void MicrochipPIC32Device::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.49.3.5 Program()

```
void MicrochipPIC32Device::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

The documentation for this class was generated from the following files:

- MicrochipPIC32Device.h
- MicrochipPIC32Device.cpp

## 7.50 MicrochipPIC32DeviceInfo Struct Reference

Internal data structure storing properties of a single SKU in the PIC32 family.

`#include <MicrochipPIC32Device.h>`

### Public Attributes

- uint16_t devid
  *JTAG device ID.*
- const char * name
  *String name of device.*
- unsigned int family
  *Device family.*
- unsigned int cpu
  *CPU type.*
- unsigned int sram_size
  *SRAM capacity (kB)*
- unsigned int program_flash_size
  *Main program flash size (kB)*
- float boot_flash_size
  *Boot flash size (kB)*

### 7.50.1 Detailed Description

Internal data structure storing properties of a single SKU in the PIC32 family.

The documentation for this struct was generated from the following file:

- MicrochipPIC32Device.h

## 7.51 MicrochipPIC32DeviceStatusRegister Union Reference

Status register for a Microchip PIC32 device.

`#include <MicrochipPIC32Device.h>`

### Public Member Functions

- struct {
  unsigned int **reset_active**:1
  unsigned int **flash_en**:1
  unsigned int **flash_busy**:1
  unsigned int **cfg_rdy**:1
  unsigned int **reserved2**:1
  unsigned int **nvm_error**:1
  unsigned int **reserved1**:1
  unsigned int **code_protect_off**:1
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint8_t word
  *The raw status register value.*

#### 7.51.1 Detailed Description

Status register for a Microchip PIC32 device.

The documentation for this union was generated from the following file:

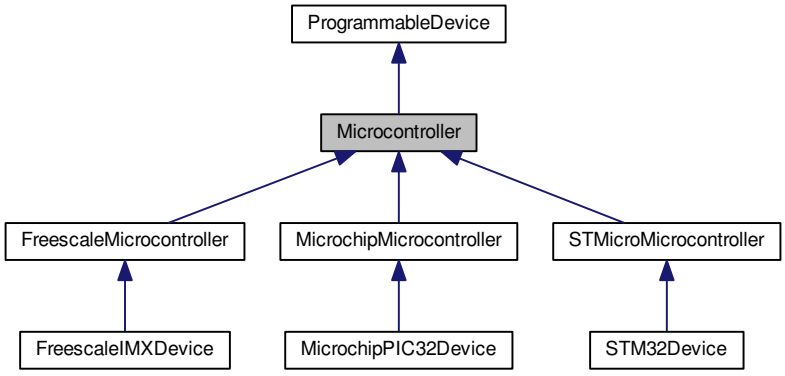
- MicrochipPIC32Device.h

## 7.52 Microcontroller Class Reference

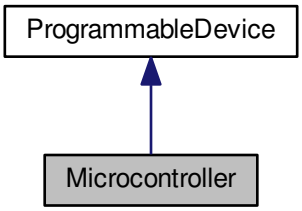
Generic base class for all microcontrollers.

`#include <Microcontroller.h>`

Inheritance diagram for Microcontroller:



Collaboration diagram for Microcontroller:




## Public Member Functions

- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*

### 7.52.1 Detailed Description

Generic base class for all microcontrollers.

### 7.52.2 Member Function Documentation

#### 7.52.2.1 LoadFirmwareImage()

```
FirmwareImage * Microcontroller::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

Reimplemented in STM32Device.

The documentation for this class was generated from the following files:

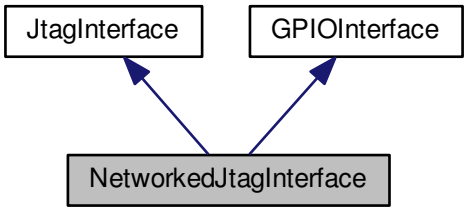
- Microcontroller.h
- Microcontroller.cpp

## 7.53 NetworkedJtagInterface Class Reference

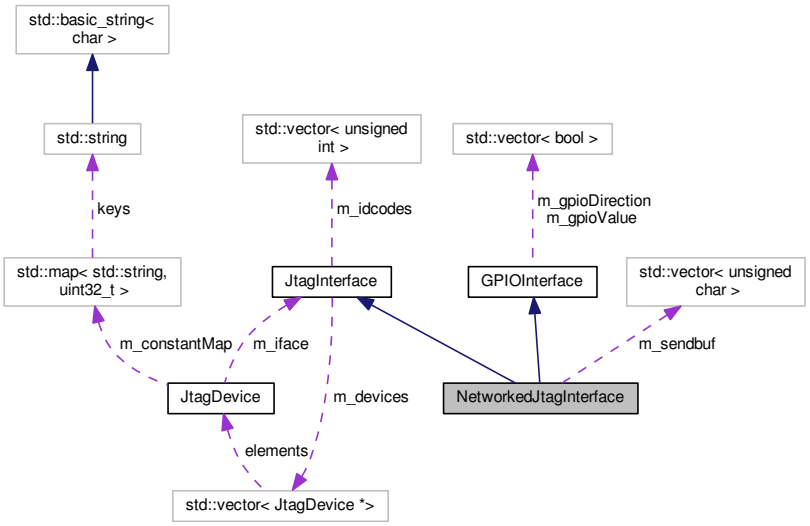
Thin wrapper around TCP sockets for talking to a jtagd instance.

`#include <NetworkedJtagInterface.h>`

Inheritance diagram for NetworkedJtagInterface:




Collaboration diagram for NetworkedJtagInterface:



## Public Member Functions

- NetworkedJtagInterface ()

  *Creates the interface object but does not connect to a server.*
- virtual ~NetworkedJtagInterface ()

  *Disconnects from the server.*
- void Connect (const std::string &server, uint16_t port)

  *Connects to a jtagd server.*
- virtual std::string GetName ()

  *Gets the manufacturer-assigned name for this programming adapter.*
- virtual std::string GetSerial ()

  *Gets the manufacturer-assigned serial number for this programming adapter, if any.*
- virtual std::string GetUserID ()

  *Gets the user-assigned name for this JTAG adapter, if any.*
- virtual int GetFrequency ()

  *Gets the clock frequency, in Hz, of the JTAG interface.*
- virtual void ShiftData (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Shifts data through TDI to TDO.*
- virtual void SendDummyClocks (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.*
- virtual void SendDummyClocksDeferred (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.*
- virtual void Commit ()

  *Commits the outstanding transactions to the adapter.*
- virtual bool IsSplitScanSupported ()

  *Indicates if split (pipelined) DR scanning is supported.*
- virtual bool ShiftDataWriteOnly (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Shifts data through TDI to TDO.*
- virtual bool ShiftDataReadOnly (unsigned char *rcv_data, size_t count)

  *Reads data from a ShiftDataWriteOnly() call.*
- virtual void TestLogicReset ()

  *Enters Test-Logic-Reset state by shifting six ones into TMS.*
- virtual void EnterShiftIR ()

  *Enters Shift-IR state from Run-Test-Idle state.*
- virtual void LeaveExit1IR ()

  *Leaves Exit1-IR state and returns to Run-Test-Idle.*
- virtual void EnterShiftDR ()

  *Enters Shift-DR state from Run-Test-Idle state.*
- virtual void LeaveExit1DR ()

  *Leaves Exit1-DR state and returns to Run-Test-Idle.*
- virtual void ResetToIdle ()

  *Resets the TAP and enters Run-Test-Idle state.*
- virtual void ReadGpioState ()

  *Reads all of the device's GPIO pins into the internal buffer.*
- virtual void WriteGpioState ()

  *Writes all of the device's GPIO pin values to the device.*
- bool **IsGPIOCapable** ()

### Static Public Member Functions

- static std::string GetAPIVersion ()

  *Returns the protocol version.*
- static int GetInterfaceCount ()

  *Returns the constant 1.*

### Protected Member Functions

- virtual size_t GetShiftOpCount ()

  *Gets the number of shift operations performed on this interface.*
- virtual size_t GetRecoverableErrorCount ()

  *Gets the number of errors this interface has recovered from (USB retransmits, etc)*
- virtual size_t GetDataBitCount ()

  *Gets the number of data bits this interface has shifted.*
- virtual size_t GetModeBitCount ()

  *Gets the number of mode bits this interface has shifted.*
- virtual size_t GetDummyClockCount ()

  *Gets the number of dummy clocks this interface has sent.*
- void **BufferedSend** (const unsigned char *buf, int count)
- void **SendFlush** ()

### Protected Attributes

- Socket m_socket

  *Our socket.*
- std::vector< unsigned char > **m_sendbuf**

## 7.53.1 Detailed Description

Thin wrapper around TCP sockets for talking to a jtagd instance.

## 7.53.2 Member Function Documentation

#### 7.53.2.1 Commit()

```
void NetworkedJtagInterface::Commit ( )  [virtual]
```

Commits the outstanding transactions to the adapter.

No-op unless the adapter supports queueing of multiple writes.

This function is automatically called when SendDummyClocks() is called or any readback is performed. Most adapter classes will automatically call it when the transmit queue reaches a certain size.

This function can be called at any time to ensure all pending operations have executed.

**Exceptions**

| | |
|---|---|
| *JtagException* | in case of error |

Reimplemented from JtagInterface.

#### 7.53.2.2 Connect()

```
void NetworkedJtagInterface::Connect (
            const std::string & server,
            uint16_t port )
```

Connects to a jtagd server.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the connection could not be established |

**Parameters**

| | |
|---|---|
| *server* | Hostname of the server to connect to |
| *port* | Port number (in host byte ordering) the server is running on |

#### 7.53.2.3 EnterShiftDR()

```
void NetworkedJtagInterface::EnterShiftDR ( )  [virtual]
```

Enters Shift-DR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.53.2.4 EnterShiftIR()

```
void NetworkedJtagInterface::EnterShiftIR ( )  [virtual]
```

Enters Shift-IR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.53.2.5 GetDataBitCount()

```
size_t NetworkedJtagInterface::GetDataBitCount ( )  [protected], [virtual]
```

Gets the number of data bits this interface has shifted.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of data bits shifted

Reimplemented from JtagInterface.

#### 7.53.2.6 GetDummyClockCount()

```
size_t NetworkedJtagInterface::GetDummyClockCount ( )  [protected], [virtual]
```

Gets the number of dummy clocks this interface has sent.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of dummy clocks sent

Reimplemented from JtagInterface.

#### 7.53.2.7 GetFrequency()

```
int NetworkedJtagInterface::GetFrequency ( )  [virtual]
```

Gets the clock frequency, in Hz, of the JTAG interface.

**Returns**

The clock frequency

Implements JtagInterface.

#### 7.53.2.8 GetModeBitCount()

```
size_t NetworkedJtagInterface::GetModeBitCount ( )  [protected], [virtual]
```

Gets the number of mode bits this interface has shifted.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of mode bits shifted

Reimplemented from JtagInterface.

#### 7.53.2.9 GetName()

```
std::string NetworkedJtagInterface::GetName ( )  [virtual]
```

Gets the manufacturer-assigned name for this programming adapter.

This is usually the model number but is sometimes something more generic like "Digilent Adept USB Device".

**Returns**

The device name

Implements JtagInterface.

#### 7.53.2.10 GetRecoverableErrorCount()

```
size_t NetworkedJtagInterface::GetRecoverableErrorCount ( )  [protected], [virtual]
```

Gets the number of errors this interface has recovered from (USB retransmits, etc)

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of recoverable errors

Reimplemented from JtagInterface.

#### 7.53.2.11 GetSerial()

```
std::string NetworkedJtagInterface::GetSerial ( )  [virtual]
```

Gets the manufacturer-assigned serial number for this programming adapter, if any.

Derived classes may choose to return the user ID, an empty string, or another default value if no serial number has been assigned.

**Returns**

The serial number

Implements JtagInterface.

#### 7.53.2.12 GetShiftOpCount()

```
size_t NetworkedJtagInterface::GetShiftOpCount ( )  [protected], [virtual]
```

Gets the number of shift operations performed on this interface.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of shift operations

Reimplemented from JtagInterface.

#### 7.53.2.13 GetUserID()

```
std::string NetworkedJtagInterface::GetUserID ( )  [virtual]
```

Gets the user-assigned name for this JTAG adapter, if any.

Derived classes may choose to return the serial number, an empty string, or another default value if no name has been assigned.

**Returns**

The name for this adapter.

Implements JtagInterface.

#### 7.53.2.14 IsSplitScanSupported()

```
bool NetworkedJtagInterface::IsSplitScanSupported ( )  [virtual]
```

Indicates if split (pipelined) DR scanning is supported.

Split scanning allows the write halves of several scan operations to take place in one driver-level write call, followed by the read halves in order, to reduce the impact of driver/bus latency on throughput.

If split scanning is not supported, ScanDRSplitWrite() will behave identically to ScanDR() and ScanDRSplitRead() will be a no-op. This ensures that using the split write commands will work correctly regardless of whether the adapter supports split scanning in hardware.

Reimplemented from JtagInterface.

#### 7.53.2.15 LeaveExit1DR()

```
void NetworkedJtagInterface::LeaveExit1DR ( )  [virtual]
```

Leaves Exit1-DR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.53.2.16 LeaveExit1IR()

```
void NetworkedJtagInterface::LeaveExit1IR ( )  [virtual]
```

Leaves Exit1-IR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.53.2.17 ResetToIdle()

```
void NetworkedJtagInterface::ResetToIdle ( )  [virtual]
```

Resets the TAP and enters Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.53.2.18 SendDummyClocks()

```
void NetworkedJtagInterface::SendDummyClocks (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.

Since dummy clocks are often used as a delay element for programming algorithms etc, this function flushes the write buffer to ensure immediate execution.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Implements JtagInterface.

#### 7.53.2.19 SendDummyClocksDeferred()

```
void NetworkedJtagInterface::SendDummyClocksDeferred (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Reimplemented from JtagInterface.

#### 7.53.2.20 ShiftData()

```
void NetworkedJtagInterface::ShiftData (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Implements JtagInterface.

#### 7.53.2.21 ShiftDataReadOnly()

```
bool NetworkedJtagInterface::ShiftDataReadOnly (
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Reads data from a ShiftDataWriteOnly() call.

For more information on split (pipelined) scan operations see ShiftDataWriteOnly().

**Returns**

True if the read was executed, false if a no-op

**Parameters**

| | |
|---|---|
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.53.2.22 ShiftDataWriteOnly()

```
bool NetworkedJtagInterface::ShiftDataWriteOnly (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

If split (pipelined) scanning is supported by the adapter, this function performs the write half of the shift operation only; the read is buffered in the JTAG adapter and no readback is performed until ShiftDataReadOnly() is called. This allows several shift operations to occur in sequence without incurring a USB turnaround delay or other driver latency overhead for each shift operation.

If split scanning is not supported this call is equivalent to ShiftData() and ShiftDataReadOnly() is a no-op.

This function MUST be followed by either another ShiftDataWriteOnly() call, a ShiftTMS() call, or a ShiftDataRead↩Only() call. There must be exactly one ShiftDataReadOnly() call for each ShiftDataWriteOnly() call and they must be in order with the same rcv_data and count values. The result of doing otherwise is undefined.

**Returns**

True if the read was deferred, false if not

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.53.2.23 TestLogicReset()

```
void NetworkedJtagInterface::TestLogicReset ( )  [virtual]
```

Enters Test-Logic-Reset state by shifting six ones into TMS.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

The documentation for this class was generated from the following files:

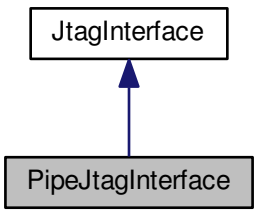
- NetworkedJtagInterface.h
- NetworkedJtagInterface.cpp

## 7.54 PipeJtagInterface Class Reference

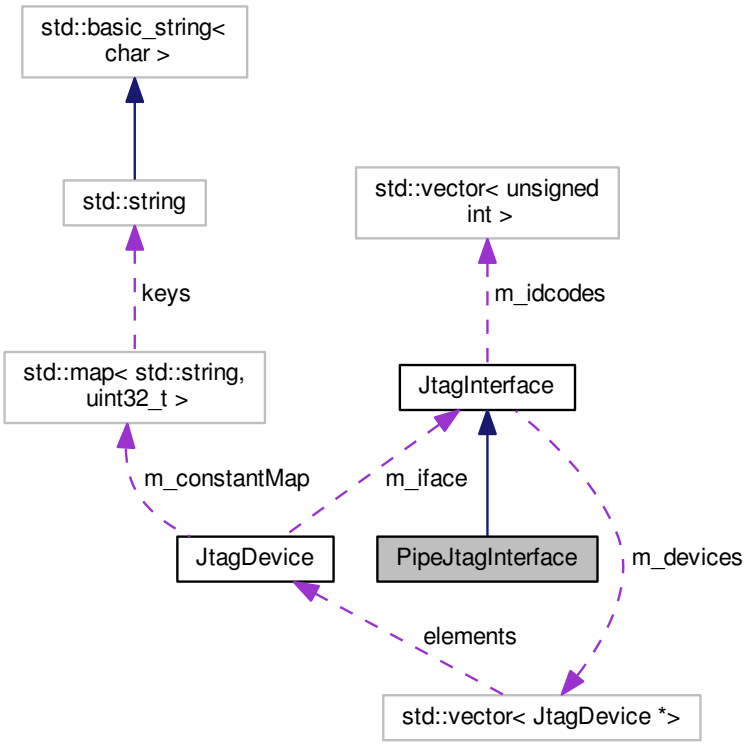
Thin wrapper around pipes for talking to an openfpga JtagPipeBridge.

```
#include <PipeJtagInterface.h>
```

Inheritance diagram for PipeJtagInterface:



Collaboration diagram for PipeJtagInterface:




## Public Member Functions

- PipeJtagInterface ()

  *Creates the interface object and connects to the pipes (TODO: support more than one)*
- virtual ~PipeJtagInterface ()

  *Disconnects from the server.*
- virtual std::string GetName ()

  *Gets the manufacturer-assigned name for this programming adapter.*
- virtual std::string GetSerial ()

  *Gets the manufacturer-assigned serial number for this programming adapter, if any.*
- virtual std::string GetUserID ()

  *Gets the user-assigned name for this JTAG adapter, if any.*
- virtual int GetFrequency ()

  *Gets the clock frequency, in Hz, of the JTAG interface.*
- virtual void ShiftData (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Shifts data through TDI to TDO.*
- virtual void SendDummyClocks (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.*
- virtual void SendDummyClocksDeferred (size_t n)

  *Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.*
- virtual void Commit ()

*Commits the outstanding transactions to the adapter.*

- virtual bool IsSplitScanSupported ()

  *Indicates if split (pipelined) DR scanning is supported.*

- virtual bool ShiftDataWriteOnly (bool last_tms, const unsigned char *send_data, unsigned char *rcv_data, size_t count)

  *Shifts data through TDI to TDO.*

- virtual bool ShiftDataReadOnly (unsigned char *rcv_data, size_t count)

  *Reads data from a ShiftDataWriteOnly() call.*

- virtual void TestLogicReset ()

  *Enters Test-Logic-Reset state by shifting six ones into TMS.*

- virtual void EnterShiftIR ()

  *Enters Shift-IR state from Run-Test-Idle state.*

- virtual void LeaveExit1IR ()

  *Leaves Exit1-IR state and returns to Run-Test-Idle.*

- virtual void EnterShiftDR ()

  *Enters Shift-DR state from Run-Test-Idle state.*

- virtual void LeaveExit1DR ()

  *Leaves Exit1-DR state and returns to Run-Test-Idle.*

- virtual void ResetToIdle ()

  *Resets the TAP and enters Run-Test-Idle state.*

## Static Public Member Functions

- static std::string GetAPIVersion ()

  *Returns the protocol version.*

- static int GetInterfaceCount ()

  *Returns the constant 1.*

## Protected Member Functions

- virtual size_t GetShiftOpCount ()

  *Gets the number of shift operations performed on this interface.*

- virtual size_t GetRecoverableErrorCount ()

  *Gets the number of errors this interface has recovered from (USB retransmits, etc)*

- virtual size_t GetDataBitCount ()

  *Gets the number of data bits this interface has shifted.*

- virtual size_t GetModeBitCount ()

  *Gets the number of mode bits this interface has shifted.*

- virtual size_t GetDummyClockCount ()

  *Gets the number of dummy clocks this interface has sent.*

## Protected Attributes

- FILE * m_readpipe

  *Our pipe.*

- FILE * **m_writepipe**

### 7.54.1 Detailed Description

Thin wrapper around pipes for talking to an openfpga JtagPipeBridge.

### 7.54.2 Member Function Documentation

#### 7.54.2.1 Commit()

```
void PipeJtagInterface::Commit ( )  [virtual]
```

Commits the outstanding transactions to the adapter.

No-op unless the adapter supports queueing of multiple writes.

This function is automatically called when SendDummyClocks() is called or any readback is performed. Most adapter classes will automatically call it when the transmit queue reaches a certain size.

This function can be called at any time to ensure all pending operations have executed.

**Exceptions**

| | |
|---|---|
| *JtagException* | in case of error |

Reimplemented from JtagInterface.

#### 7.54.2.2 EnterShiftDR()

```
void PipeJtagInterface::EnterShiftDR ( )  [virtual]
```

Enters Shift-DR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.54.2.3 EnterShiftIR()

```
void PipeJtagInterface::EnterShiftIR ( )  [virtual]
```

Enters Shift-IR state from Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.54.2.4 GetDataBitCount()

```
size_t PipeJtagInterface::GetDataBitCount ( )  [protected], [virtual]
```

Gets the number of data bits this interface has shifted.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of data bits shifted

Reimplemented from JtagInterface.

#### 7.54.2.5 GetDummyClockCount()

```
size_t PipeJtagInterface::GetDummyClockCount ( )  [protected], [virtual]
```

Gets the number of dummy clocks this interface has sent.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of dummy clocks sent

Reimplemented from JtagInterface.

#### 7.54.2.6 GetFrequency()

```
int PipeJtagInterface::GetFrequency ( )  [virtual]
```

Gets the clock frequency, in Hz, of the JTAG interface.

**Returns**

The clock frequency

Implements JtagInterface.

#### 7.54.2.7 GetModeBitCount()

```
size_t PipeJtagInterface::GetModeBitCount ( )  [protected], [virtual]
```

Gets the number of mode bits this interface has shifted.

**Exceptions**

| *JtagException* | on failure |
|---|---|

**Returns**

Number of mode bits shifted

Reimplemented from JtagInterface.

#### 7.54.2.8 GetName()

```
string PipeJtagInterface::GetName ( )  [virtual]
```

Gets the manufacturer-assigned name for this programming adapter.

This is usually the model number but is sometimes something more generic like "Digilent Adept USB Device".

**Returns**

The device name

Implements JtagInterface.

#### 7.54.2.9 GetRecoverableErrorCount()

```
size_t PipeJtagInterface::GetRecoverableErrorCount ( )  [protected], [virtual]
```

Gets the number of errors this interface has recovered from (USB retransmits, etc)

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of recoverable errors

Reimplemented from JtagInterface.

#### 7.54.2.10 GetSerial()

```
string PipeJtagInterface::GetSerial ( )  [virtual]
```

Gets the manufacturer-assigned serial number for this programming adapter, if any.

Derived classes may choose to return the user ID, an empty string, or another default value if no serial number has been assigned.

**Returns**

The serial number

Implements JtagInterface.

#### 7.54.2.11 GetShiftOpCount()

```
size_t PipeJtagInterface::GetShiftOpCount ( )  [protected], [virtual]
```

Gets the number of shift operations performed on this interface.

**Exceptions**

| | |
|---|---|
| *JtagException* | on failure |

**Returns**

Number of shift operations

Reimplemented from JtagInterface.

#### 7.54.2.12 GetUserID()

```
string PipeJtagInterface::GetUserID ( )  [virtual]
```

Gets the user-assigned name for this JTAG adapter, if any.

Derived classes may choose to return the serial number, an empty string, or another default value if no name has been assigned.

**Returns**

The name for this adapter.

Implements JtagInterface.

#### 7.54.2.13 IsSplitScanSupported()

```
bool PipeJtagInterface::IsSplitScanSupported ( )  [virtual]
```

Indicates if split (pipelined) DR scanning is supported.

Split scanning allows the write halves of several scan operations to take place in one driver-level write call, followed by the read halves in order, to reduce the impact of driver/bus latency on throughput.

If split scanning is not supported, ScanDRSplitWrite() will behave identically to ScanDR() and ScanDRSplitRead() will be a no-op. This ensures that using the split write commands will work correctly regardless of whether the adapter supports split scanning in hardware.

Reimplemented from JtagInterface.

#### 7.54.2.14 LeaveExit1DR()

```
void PipeJtagInterface::LeaveExit1DR ( )  [virtual]
```

Leaves Exit1-DR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.54.2.15 LeaveExit1IR()

```
void PipeJtagInterface::LeaveExit1IR ( )  [virtual]
```

Leaves Exit1-IR state and returns to Run-Test-Idle.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.54.2.16 ResetToIdle()

```
void PipeJtagInterface::ResetToIdle ( )  [virtual]
```

Resets the TAP and enters Run-Test-Idle state.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

#### 7.54.2.17 SendDummyClocks()

```
void PipeJtagInterface::SendDummyClocks (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and flushes the command to the interface.

Since dummy clocks are often used as a delay element for programming algorithms etc, this function flushes the write buffer to ensure immediate execution.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Implements JtagInterface.

#### 7.54.2.18 SendDummyClocksDeferred()

```
void PipeJtagInterface::SendDummyClocksDeferred (
            size_t n )  [virtual]
```

Sends the requested number of dummy clocks with TMS=0 and does not flush the write pipeline.

**Exceptions**

| | |
|---|---|
| *JtagException* | may be thrown if the scan operation fails |

**Parameters**

| | |
|---|---|
| *n* | Number of dummy clocks to send |

Reimplemented from JtagInterface.

#### 7.54.2.19 ShiftData()

```
void PipeJtagInterface::ShiftData (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Implements JtagInterface.

#### 7.54.2.20 ShiftDataReadOnly()

```
bool PipeJtagInterface::ShiftDataReadOnly (
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Reads data from a ShiftDataWriteOnly() call.

For more information on split (pipelined) scan operations see ShiftDataWriteOnly().

**Returns**

True if the read was executed, false if a no-op

**Parameters**

| | |
|---|---|
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.54.2.21 ShiftDataWriteOnly()

```
bool PipeJtagInterface::ShiftDataWriteOnly (
            bool last_tms,
            const unsigned char * send_data,
            unsigned char * rcv_data,
            size_t count )  [virtual]
```

Shifts data through TDI to TDO.

The LSB of send_data[0] is sent first; the MSB of send_data[0] is followed by the LSB of send_data[1].

If split (pipelined) scanning is supported by the adapter, this function performs the write half of the shift operation only; the read is buffered in the JTAG adapter and no readback is performed until ShiftDataReadOnly() is called. This allows several shift operations to occur in sequence without incurring a USB turnaround delay or other driver latency overhead for each shift operation.

If split scanning is not supported this call is equivalent to ShiftData() and ShiftDataReadOnly() is a no-op.

This function MUST be followed by either another ShiftDataWriteOnly() call, a ShiftTMS() call, or a ShiftDataRead↩Only() call. There must be exactly one ShiftDataReadOnly() call for each ShiftDataWriteOnly() call and they must be in order with the same rcv_data and count values. The result of doing otherwise is undefined.

**Returns**

True if the read was deferred, false if not

**Parameters**

| | |
|---|---|
| *last_tms* | Different TMS value to use for last bit |
| *send_data* | Data to shift into TDI |
| *rcv_data* | Data to shift out of TDO (may be NULL) |
| *count* | Number of bits to shift |

Reimplemented from JtagInterface.

#### 7.54.2.22 TestLogicReset()

```
void PipeJtagInterface::TestLogicReset ( )  [virtual]
```

Enters Test-Logic-Reset state by shifting six ones into TMS.

**Exceptions**

| | |
|---|---|
| *JtagException* | if ShiftTMS() fails |

Reimplemented from JtagInterface.

The documentation for this class was generated from the following files:

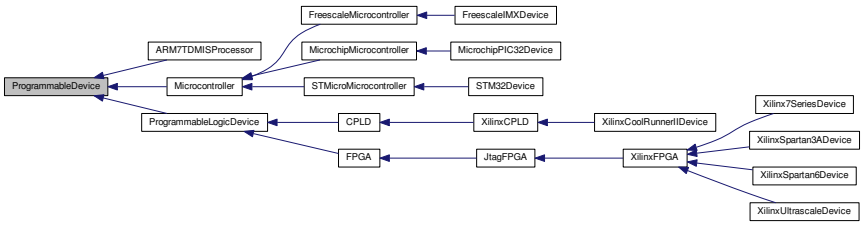
- PipeJtagInterface.h
- PipeJtagInterface.cpp

## 7.55 ProgrammableDevice Class Reference

Generic base class for all programmable devices (PLD, MCU, flash, etc)

`#include <ProgrammableDevice.h>`

Inheritance diagram for ProgrammableDevice:




### Public Member Functions

- virtual bool IsProgrammed ()=0

  *Determines if this device is programmed or blank.*
- FirmwareImage * LoadFirmwareImage (std::string fname)

  *Wrapper for LoadFirmwareImage().*
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)=0

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Erase ()=0

  *Erases the device configuration and restores the device to a blank state.*
- virtual void Program (FirmwareImage *image)=0

  *Loads a new firmware image onto the device.*

### 7.55.1 Detailed Description

Generic base class for all programmable devices (PLD, MCU, flash, etc)

### 7.55.2 Member Function Documentation

#### 7.55.2.1 Erase()

```
virtual void ProgrammableDevice::Erase ( )  [pure virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implemented in MicrochipPIC32Device, Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, XilinxCoolRunnerIIDevice, ARM7TDMISProcessor, FreescaleIMXDevice, and STM32↩ Device.

#### 7.55.2.2 IsProgrammed()

```
virtual bool ProgrammableDevice::IsProgrammed ( )  [pure virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implemented in MicrochipPIC32Device, Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, XilinxCoolRunnerIIDevice, ARM7TDMISProcessor, FreescaleIMXDevice, and STM32↩ Device.

#### 7.55.2.3 LoadFirmwareImage() [1/2]

```
FirmwareImage * ProgrammableDevice::LoadFirmwareImage (
            std::string fname )
```

Wrapper for LoadFirmwareImage().

Loads the file and passes it to LoadFirmwareImage()

**Exceptions**

| | |
|---|---|
| *JtagException* | if the file could not be opened or the image is invalid |

**Parameters**

| | |
|---|---|
| *fname* | Name of the image to load |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Program().

#### 7.55.2.4 LoadFirmwareImage() [2/2]

```
virtual FirmwareImage* ProgrammableDevice::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [pure virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implemented in Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, XilinxCoolRunnerIIDevice, ARM7TDMISProcessor, STM32Device, and Microcontroller.

#### 7.55.2.5 Program()

```
virtual void ProgrammableDevice::Program (
            FirmwareImage * image )  [pure virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implemented in MicrochipPIC32Device, Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, XilinxCoolRunnerIIDevice, ARM7TDMISProcessor, FreescaleIMXDevice, and STM32↩ Device.

The documentation for this class was generated from the following files:

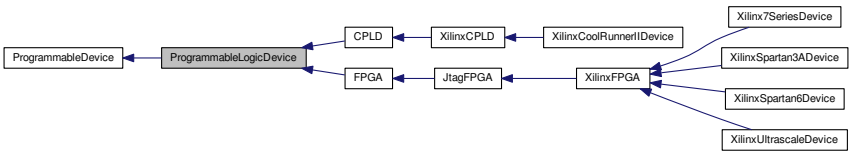
- ProgrammableDevice.h
- ProgrammableDevice.cpp

## 7.56 ProgrammableLogicDevice Class Reference

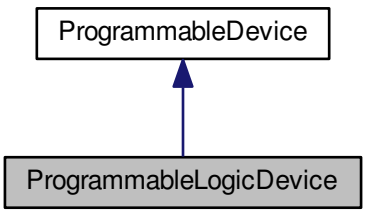
Generic base class for all programmable logic devices (FPGA and CPLD)

```
#include <ProgrammableLogicDevice.h>
```

Inheritance diagram for ProgrammableLogicDevice:




Collaboration diagram for ProgrammableLogicDevice:



### Additional Inherited Members

### 7.56.1 Detailed Description

Generic base class for all programmable logic devices (FPGA and CPLD)

The documentation for this class was generated from the following files:

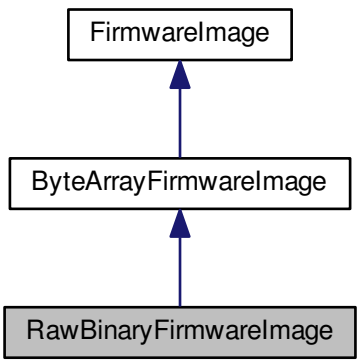
- ProgrammableLogicDevice.h
- ProgrammableLogicDevice.cpp

## 7.57 RawBinaryFirmwareImage Class Reference

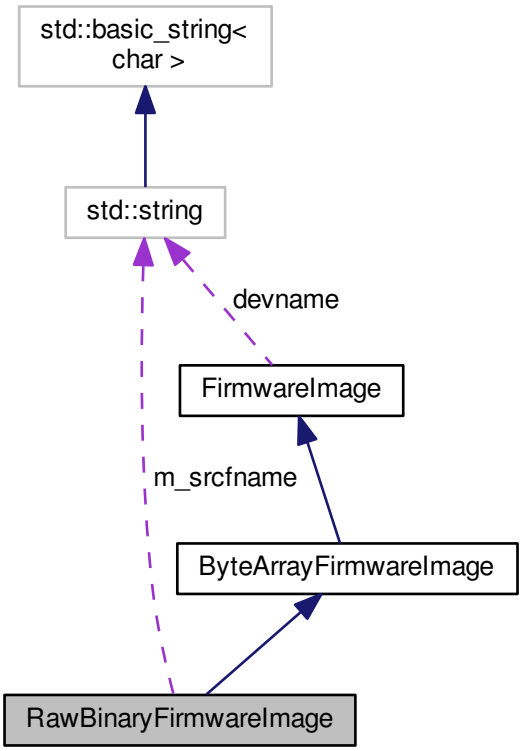
Raw binary firmware image loaded from a file.

```
#include <RawBinaryFirmwareImage.h>
```

Inheritance diagram for RawBinaryFirmwareImage:



Collaboration diagram for RawBinaryFirmwareImage:




### Public Member Functions

- RawBinaryFirmwareImage (std::string fname, std::string sdevname)
  *Initializes this object to empty.*
- virtual ~RawBinaryFirmwareImage ()
  *Free bitstream memory.*
- virtual std::string **GetDescription** ()

### Public Attributes

- std::string m_srcfname
  *Source file name.*

### 7.57.1 Detailed Description

Raw binary firmware image loaded from a file.

The documentation for this class was generated from the following files:

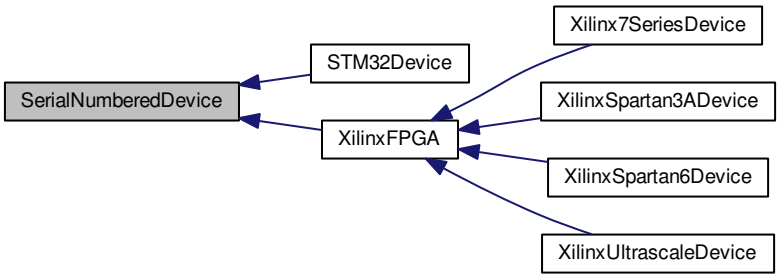
- RawBinaryFirmwareImage.h
- RawBinaryFirmwareImage.cpp

## 7.58 SerialNumberedDevice Class Reference

Abstract base class for all devices that have a unique die serial number.

`#include <SerialNumberedDevice.h>`

Inheritance diagram for SerialNumberedDevice:




### Public Member Functions

- virtual bool ReadingSerialRequiresReset ()=0

  *True if reading this serial number requires a device reset.*
- virtual int GetSerialNumberLength ()=0

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*
- virtual int GetSerialNumberLengthBits ()=0

  *Gets the length of the device's unique serial number, in bits.*
- virtual void GetSerialNumber (unsigned char *data)=0

  *Gets the device's unique serial number.*
- virtual std::string GetPrettyPrintedSerialNumber ()

  *Returns a pretty-printed serial number.*

### 7.58.1 Detailed Description

Abstract base class for all devices that have a unique die serial number.

### 7.58.2 Member Function Documentation

#### 7.58.2.1 GetPrettyPrintedSerialNumber()

```
string SerialNumberedDevice::GetPrettyPrintedSerialNumber ( )  [virtual]
```

Returns a pretty-printed serial number.

Most serial numbers have no inherent meaning but some contain encoded lot numbers etc.

This function returns a human-readable version of the serial number, if such exists. Otherwise, a hex encoding of GetSerialNumber() is returned.

Reimplemented in STM32Device.

#### 7.58.2.2 GetSerialNumber()

```
virtual void SerialNumberedDevice::GetSerialNumber (
            unsigned char * data )  [pure virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implemented in Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, and STM32Device.

#### 7.58.2.3 GetSerialNumberLength()

```
virtual int SerialNumberedDevice::GetSerialNumberLength ( )  [pure virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implemented in Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, and STM32Device.

#### 7.58.2.4 GetSerialNumberLengthBits()

```
virtual int SerialNumberedDevice::GetSerialNumberLengthBits ( )  [pure virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implemented in Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, XilinxSpartan3ADevice, and STM32Device.

#### 7.58.2.5 ReadingSerialRequiresReset()

```
virtual bool SerialNumberedDevice::ReadingSerialRequiresReset ( )  [pure virtual]
```

True if reading this serial number requires a device reset.

Applications may choose not to display the serial number to avoid disrupting the running code.

Implemented in STM32Device, and XilinxFPGA.

The documentation for this class was generated from the following files:

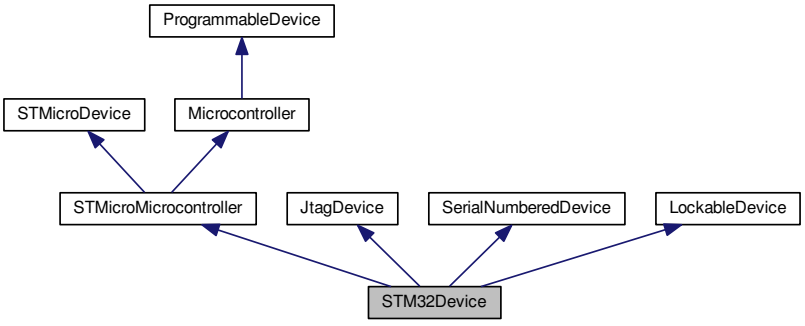
- SerialNumberedDevice.h
- SerialNumberedDevice.cpp

## 7.59 STM32Device Class Reference

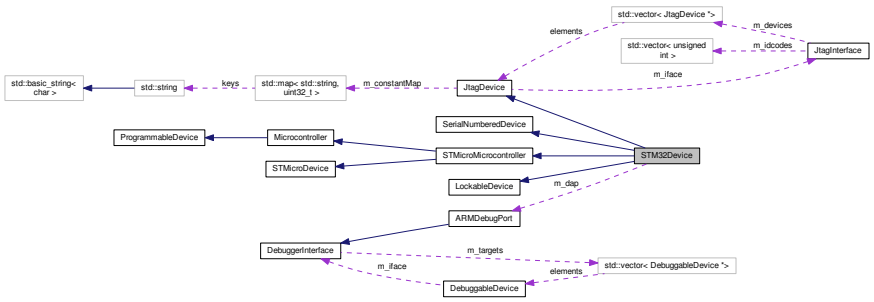
A STM32 microcontroller.

```
#include <STM32Device.h>
```

Inheritance diagram for STM32Device:



Collaboration diagram for STM32Device:




## Public Types

- enum **FlashSfrOffsets** {
  **FLASH_KEYR** = 0x04, **FLASH_OPTKEYR** = 0x08, **FLASH_SR** = 0x0c, **FLASH_CR** = 0x10,
  **FLASH_OPTCR** = 0x14 }

## Public Member Functions

- **STM32Device** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual ~STM32Device ()

  *Destructor.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void Program (FirmwareImage *image)

  *Programs a firmware image to the device.*
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Loads the firmware.*
- virtual bool ReadingSerialRequiresReset ()

  *True if reading this serial number requires a device reset.*
- virtual int GetSerialNumberLength ()

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*
- virtual int GetSerialNumberLengthBits ()

  *Gets the length of the device's unique serial number, in bits.*
- virtual void GetSerialNumber (unsigned char *data)

  *Gets the device's unique serial number.*
- virtual std::string GetPrettyPrintedSerialNumber ()

  *Returns a pretty-printed serial number.*
- virtual void ProbeLocksNondestructive ()

  *Queries lock status in a non-destructive fashion (contents of the chip are untouched)*

- virtual void ProbeLocksDestructive ()

  *Queries lock status in a more invasive fashion. Gives more accurate data but may involve write transactions to memory.*
- virtual UncertainBoolean CheckMemoryAccess (uint32_t ptr, unsigned int access)

  *Checks if a given physical address has a given protection applied.*
- virtual UncertainBoolean IsDeviceReadLocked ()

  *Checks if the device is globally read protected or not.*
- virtual void SetReadLock ()

  *Sets a global read-protection lock on the entire device.*
- virtual void ClearReadLock ()

  *Clears the global read-protection lock, if set in a non-permanent fashion.*
- virtual void PrintLockProbeDetails ()

  *Prints detailed information regarding the state of the read lock.*
- int **GetProtectionLevel** ()
- ARMv7MProcessor * **GetCPU** ()
- void **SetIR** (unsigned char irval)

### Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int devid, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)

### Protected Member Functions

- void **UnlockFlash** ()
- void **PollUntilFlashNotBusy** ()
- bool **BlankCheck** ()
- void **UnlockFlashOptions** ()

### Protected Attributes

- ARMDebugPort * **m_dap**
- unsigned int **m_deviceID**
- unsigned int **m_flashKB**
- unsigned int **m_ramKB**
- uint32_t **m_waferX**
- uint32_t **m_waferY**
- int **m_waferNum**
- char **m_waferLot** [8]
- uint8_t **m_serialRaw** [12]
- uint32_t **m_flashSfrBase**
- uint32_t **m_flashMemoryBase**
- uint32_t **m_sramMemoryBase**
- bool **m_locksProbed**
- int **m_protectionLevel**

### 7.59.1 Detailed Description

A STM32 microcontroller.

## 7.59.2 Member Function Documentation

### 7.59.2.1 ClearReadLock()

```
void STM32Device::ClearReadLock ( )  [virtual]
```

Clears the global read-protection lock, if set in a non-permanent fashion.

In most parts, this will trigger a bulk flash erase.

Implements LockableDevice.

### 7.59.2.2 Erase()

```
void STM32Device::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

### 7.59.2.3 GetDescription()

```
string STM32Device::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.59.2.4 GetPrettyPrintedSerialNumber()

```
string STM32Device::GetPrettyPrintedSerialNumber ( )  [virtual]
```

Returns a pretty-printed serial number.

Most serial numbers have no inherent meaning but some contain encoded lot numbers etc.

This function returns a human-readable version of the serial number, if such exists. Otherwise, a hex encoding of GetSerialNumber() is returned.

Reimplemented from SerialNumberedDevice.

#### 7.59.2.5 GetSerialNumber()

```
void STM32Device::GetSerialNumber (
            unsigned char * data )  [virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implements SerialNumberedDevice.

#### 7.59.2.6 GetSerialNumberLength()

```
int STM32Device::GetSerialNumberLength ( )  [virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.59.2.7 GetSerialNumberLengthBits()

```
int STM32Device::GetSerialNumberLengthBits ( )  [virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.59.2.8 IsProgrammed()

```
bool STM32Device::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.59.2.9 LoadFirmwareImage()

```
FirmwareImage * STM32Device::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Loads the firmware.

For now assume it's a raw ROM image, no ELF etc supported

Reimplemented from Microcontroller.

#### 7.59.2.10 PostInitProbes()

```
void STM32Device::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.59.2.11 Program()

```
void STM32Device::Program (
            FirmwareImage * image )  [virtual]
```

Programs a firmware image to the device.

For now, assume we are blank when we start.

For now. assume the image is a flat binary to be burned to flash.

Implements ProgrammableDevice.

#### 7.59.2.12 ReadingSerialRequiresReset()

```
bool STM32Device::ReadingSerialRequiresReset ( )  [virtual]
```

True if reading this serial number requires a device reset.

Applications may choose not to display the serial number to avoid disrupting the running code.

Implements SerialNumberedDevice.

#### 7.59.2.13 SetReadLock()

```
void STM32Device::SetReadLock ( )  [virtual]
```

Sets a global read-protection lock on the entire device.

This function only performs reversible locks that can be cleared with a bulk erase. Thus, it should not be able to brick the chip entirely.

Implements LockableDevice.

The documentation for this class was generated from the following files:

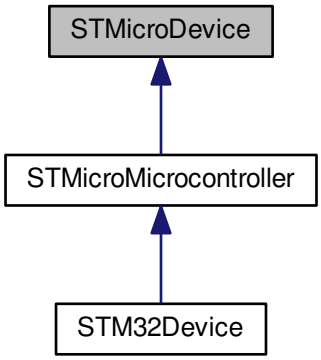
- STM32Device.h
- STM32Device.cpp

## 7.60 STMicroDevice Class Reference

Abstract base class for all STMicro devices.

`#include <STMicroDevice.h>`

Inheritance diagram for STMicroDevice:




### Public Member Functions

- **STMicroDevice** (unsigned int devicetype, unsigned int stepping)
- virtual ~STMicroDevice ()

  *Default virtual destructor.*

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int idcode, JtagInterface *iface, size_t pos)

  *Creates a STMicroDevice given an ID code.*

### Protected Attributes

- unsigned int **m_devicetype**
- unsigned int **m_stepping**

### 7.60.1 Detailed Description

Abstract base class for all STMicro devices.

### 7.60.2 Member Function Documentation

#### 7.60.2.1 CreateDevice()

```
JtagDevice * STMicroDevice::CreateDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a STMicroDevice given an ID code.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the ID code supplied is not a valid STMicro device, or not a known family number |

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

**Returns**

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

The documentation for this class was generated from the following files:

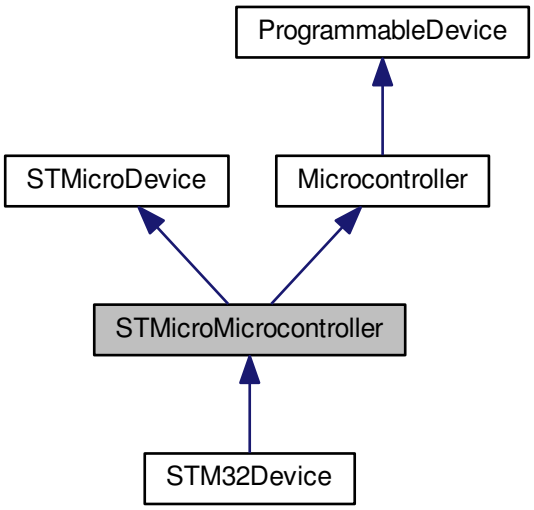
- STMicroDevice.h
- STMicroDevice.cpp

## 7.61 STMicroMicrocontroller Class Reference

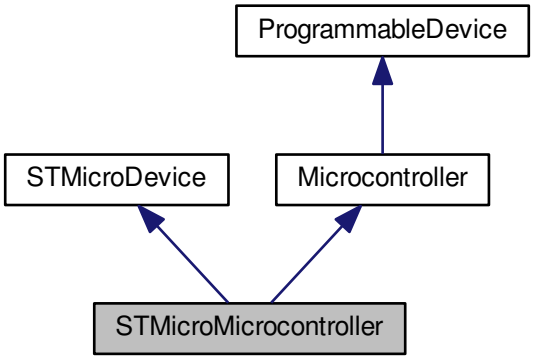
Generic base class for all STMicro MCUs.

```
#include <STMicroMicrocontroller.h>
```

Inheritance diagram for STMicroMicrocontroller:




Collaboration diagram for STMicroMicrocontroller:




## Public Member Functions

- **STMicroMicrocontroller** (unsigned int devicetype, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)

### Additional Inherited Members

#### 7.61.1 Detailed Description

Generic base class for all STMicro MCUs.

The documentation for this class was generated from the following files:

- STMicroMicrocontroller.h
- STMicroMicrocontroller.cpp

## 7.62 UncertainBoolean Class Reference

A boolean value with an attached level of uncertainty.

`#include <LockableDevice.h>`

### Public Types

- enum **CertaintyLevel** { **USELESS**, **INCONSISTENT**, **VERY_LIKELY**, **CERTAIN** }

### Public Member Functions

- **UncertainBoolean** (bool b, CertaintyLevel level)
- CertaintyLevel **GetCertainty** ()
- bool **GetValue** ()
- const char * **GetCertaintyAsText** ()

### Protected Attributes

- bool **m_value**
- CertaintyLevel **m_certainty**

#### 7.62.1 Detailed Description

A boolean value with an attached level of uncertainty.

The documentation for this class was generated from the following file:

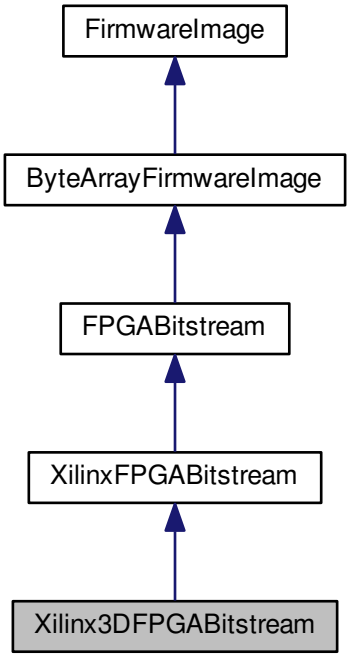
- LockableDevice.h

## 7.63 Xilinx3DFPGABitstream Class Reference

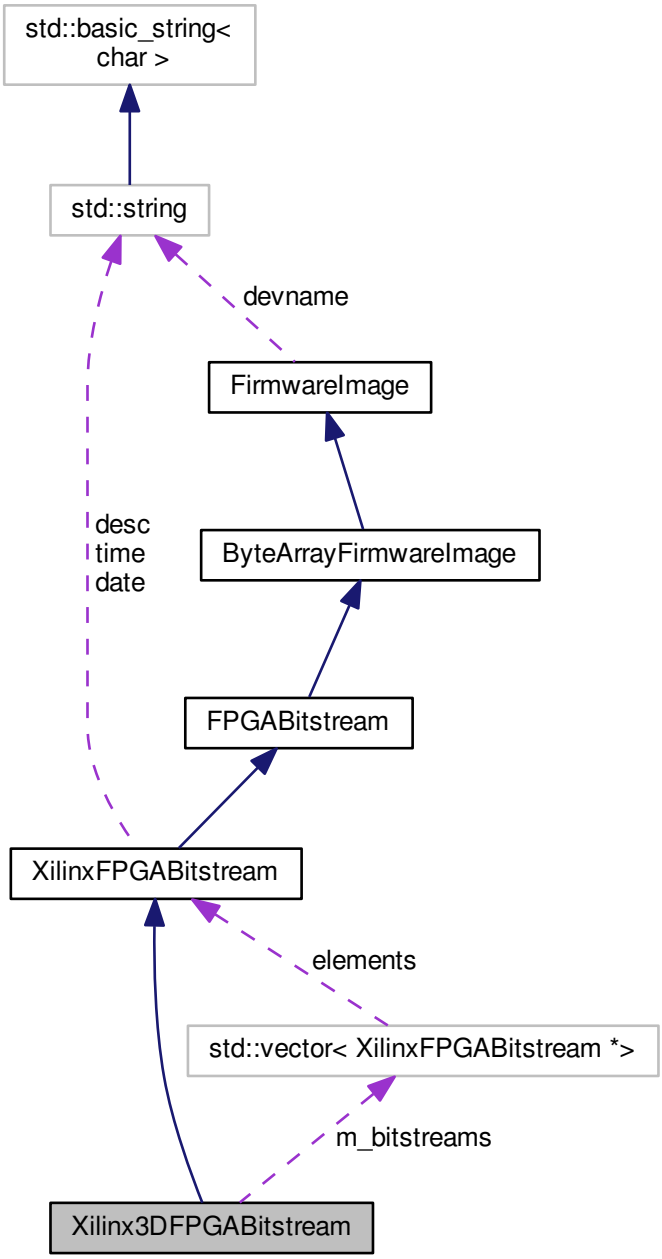
A bitstream for Xilinx 3D FPGAs (multiple dies on a passive interposer, each with their own bitstream)

`#include <Xilinx3DFPGABitstream.h>`

Inheritance diagram for Xilinx3DFPGABitstream:



Collaboration diagram for Xilinx3DFPGABitstream:




## Public Member Functions

- Xilinx3DFPGABitstream ()

  *Initializes this object to empty.*
- virtual ~Xilinx3DFPGABitstream ()

  *Free bitstream memory.*
- virtual std::string **GetDescription** ()

### Public Attributes

- std::vector< XilinxFPGABitstream * > **m_bitstreams**

### 7.63.1 Detailed Description

A bitstream for Xilinx 3D FPGAs (multiple dies on a passive interposer, each with their own bitstream)

The documentation for this class was generated from the following files:

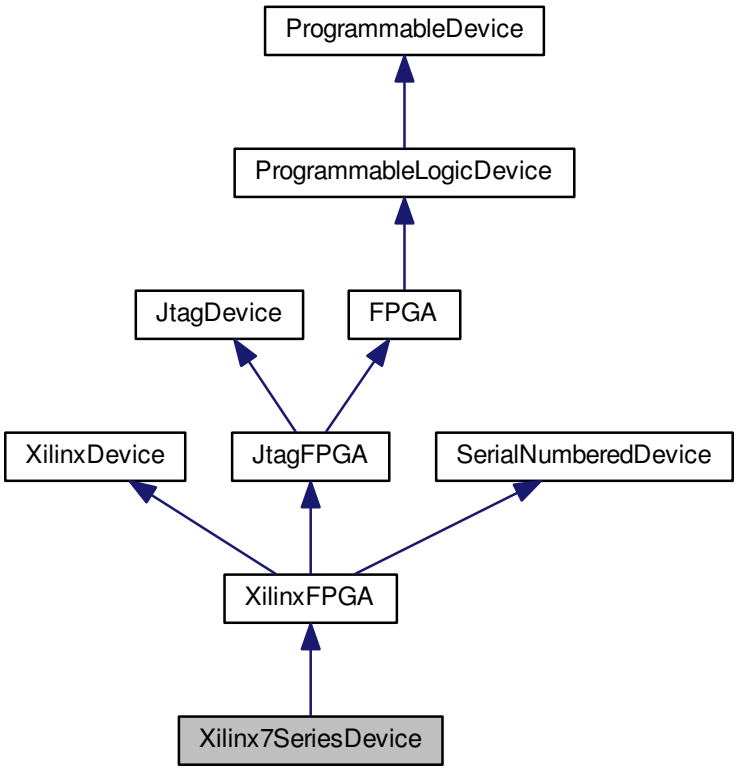
- Xilinx3DFPGABitstream.h
- Xilinx3DFPGABitstream.cpp

## 7.64 Xilinx7SeriesDevice Class Reference

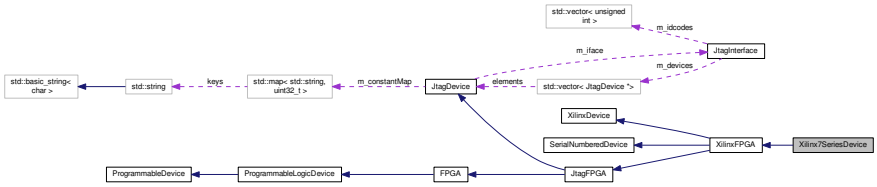
A Xilinx 7-series FPGA device.

`#include <Xilinx7SeriesDevice.h>`

Inheritance diagram for Xilinx7SeriesDevice:



Collaboration diagram for Xilinx7SeriesDevice:




## Public Types

- enum deviceids {
  **SPARTAN7_6** = 0x022, **SPARTAN7_15** = 0x020, **SPARTAN7_25** = 0x1c4, **SPARTAN7_50** = 0x02f, **SPARTAN7_75** = 0x1c8, **SPARTAN7_100** = 0x1c7, **ARTIX7_12T** = 0x1c3, **ARTIX7_15T** = 0x02e, **ARTIX7_25T** = 0x1c2, **ARTIX7_35T** = 0x02d, **ARTIX7_50T** = 0x02c, **ARTIX7_75T** = 0x032, **ARTIX7_100T** = 0x031, **ARTIX7_200T** = 0x036, **KINTEX7_70T** = 0x047, **KINTEX7_160T** = 0x04c, **ZYNQ_010** = 0x122 }

  *JTAG device IDs.*
- enum instructions {
  INST_USER1 = 0x02, INST_USER2 = 0x03, INST_USER3 = 0x22, INST_USER4 = 0x23, INST_CFG_OUT = 0x04, INST_CFG_IN = 0x05, INST_USERCODE = 0x08, INST_IDCODE = 0x09, INST_JPROGRAM = 0x0B, INST_JSTART = 0x0C, INST_JSHUTDOWN = 0x0D, INST_ISC_ENABLE = 0x10, INST_ISC_DISABLE = 0x16, INST_XSC_DNA = 0x17, INST_XADC_DRP = 0x37, INST_BYPASS = 0x3F }

  *6-bit-wide JTAG instructions (see BSDL file). Mostly, but not entirely, same as Spartan-6.*

## Public Member Functions

- Xilinx7SeriesDevice (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Initializes this device.*
- virtual ~Xilinx7SeriesDevice ()

  *Empty virtual destructor.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual void **PrintStatusRegister** ()
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual int GetSerialNumberLength ()

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*
- virtual int GetSerialNumberLengthBits ()

  *Gets the length of the device's unique serial number, in bits.*
- virtual void GetSerialNumber (unsigned char *data)

  *Gets the device's unique serial number.*
- virtual size_t GetNumUserInstructions ()

  *Get the number of JTAG instructions which are routed to FPGA fabric.*
- virtual void SelectUserInstruction (size_t index)

  *Sets the instruction register to the specified user instruction.*
- virtual void Erase ()

*Erases the device configuration and restores the device to a blank state.*

- virtual void **InternalErase** ()
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- virtual void Reboot ()

  *Reboots the FPGA and loads from external memory, if possible.*

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Factory method.*

### Public Attributes

- enum Xilinx7SeriesDevice::deviceids **__attribute__**

### Protected Types

- enum x7_config_opcodes { **X7_CONFIG_OP_NOP** = 0, **X7_CONFIG_OP_READ** = 1, **X7_CONFIG_OP_WRITE** = 2 }

  *7-series configuration opcodes (see UG470 page 87). Same as for Spartan-6.*
- enum x7_config_frame_types { **X7_CONFIG_FRAME_TYPE_1** = 1, **X7_CONFIG_FRAME_TYPE_2** = 2 }

  *7-series configuration frame types (see UG470 page 87). Same as for Spartan-6.*
- enum x7_config_regs {
  **CONFIG_CRC** = 0x00, **CONFIG_FAR** = 0x01, **CONFIG_FDRI** = 0x02, **CONFIG_FDRO** = 0x03,
  **CONFIG_CMD** = 0x04, **CONFIG_CTL0** = 0x05, **CONFIG_MASK** = 0x06, **CONFIG_STAT** = 0x07,
  **CONFIG_LOUT** = 0x08, **CONFIG_COR0** = 0x09, **CONFIG_MFWR** = 0x0A, **CONFIG_CBC** = 0x0B,
  **CONFIG_IDCODE** = 0x0C, **CONFIG_AXSS** = 0x0D, **CONFIG_COR1** = 0x0E, **CONFIG_WBSTAR** = 0x10,
  **CONFIG_TIMER** = 0x11, **CONFIG_BOOTSTS** = 0x16, **CONFIG_CTL1** = 0x18, **CONFIG_BSPI** = 0x1F,
  **CONFIG_MAX** }

  *7-series configuration registers (see UG470 page 104). Not same as Spartan-6.*
- enum x7_cmd_values {
  **X7_CMD_NULL** = 0x00, **X7_CMD_WCFG** = 0x01, **X7_CMD_MFW** = 0x02, **X7_CMD_LFRM** = 0x03,
  **X7_CMD_RCFG** = 0x04, **X7_CMD_START** = 0x05, **X7_CMD_RCAP** = 0x06, **X7_CMD_RCRC** = 0x07,
  **X7_CMD_AGHIGH** = 0x08, **X7_CMD_SWITCH** = 0x09, **X7_CMD_GRESTORE** = 0x0a, **X7_CMD_SHUTDOWN** = 0x0b,
  **X7_CMD_GCAPTURE** = 0x0c, **X7_CMD_DESYNC** = 0x0d, **X7_CMD_IPROG** = 0x0f, **X7_CMD_CRCC** = 0x10,
  **X7_CMD_LTIMER** = 0x11, **X7_CMD_MAX** }

  *7-series CMD register values (see UG470 page 89-90)*

### Protected Member Functions

- uint32_t ReadWordConfigRegister (unsigned int reg)

  *Reads a single 32-bit word from a config register.*
- void **ReadWordsConfigRegister** (unsigned int reg, uint32_t *dout, unsigned int count)
- void **WriteWordConfigRegister** (unsigned int reg, uint32_t value)
- virtual void ParseBitstreamInternals (const unsigned char *data, size_t len, XilinxFPGABitstream *bitstream, size_t fpos)

  *Reads several 16-bit words from a config register.*
- void **SetIR** (unsigned char irval)
- void **SetIRDeferred** (unsigned char irval)

### Protected Attributes

- unsigned m_arraysize

  *Array size (the specific 7-series device we are)*
- unsigned int m_rev

  *Stepping number.*

## 7.64.1 Detailed Description

A Xilinx 7-series FPGA device.

## 7.64.2 Member Enumeration Documentation

### 7.64.2.1 instructions

`enum Xilinx7SeriesDevice::instructions`

6-bit-wide JTAG instructions (see BSDL file). Mostly, but not entirely, same as Spartan-6.

**Enumerator**

| | |
|---|---|
| INST_USER1 | User-defined instruction 1. |
| INST_USER2 | User-defined instruction 2. |
| INST_USER3 | User-defined instruction 3 Not same as Spartan-6 |
| INST_USER4 | User-defined instruction 4 Not same as Spartan-6 |
| INST_CFG_OUT | Read configuration register. |
| INST_CFG_IN | Write configuration register. |
| INST_USERCODE | Read user ID code. |
| INST_IDCODE | Read ID code. |
| INST_JPROGRAM | Enters programming mode (erases FPGA configuration) |
| INST_JSTART | Runs the FPGA startup sequence (must supply dummy clocks after) |
| INST_JSHUTDOWN | Runs the FPGA shutdown sequence (must supply dummy clocks after) |
| INST_ISC_ENABLE | Enters In-System Configuration mode (must load INST_JPROGRAM before) |
| INST_ISC_DISABLE | Leaves In-System Configuration mode. |
| INST_XSC_DNA | Read device DNA (must load INST_ISC_ENABLE before and INST_ISC_DISABLE after) Not same as Spartan-6 |
| INST_XADC_DRP | Access to the ADC Not present in Spartan-6 |
| INST_BYPASS | Standard JTAG bypass. |

## 7.64.3 Constructor & Destructor Documentation

#### 7.64.3.1 Xilinx7SeriesDevice()

```
Xilinx7SeriesDevice::Xilinx7SeriesDevice (
            unsigned int arraysize,
            unsigned int rev,
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *arraysize* | Array size from JTAG ID code |
| *rev* | Revision number from JTAG ID code |
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### 7.64.4 Member Function Documentation

#### 7.64.4.1 Erase()

```
void Xilinx7SeriesDevice::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.64.4.2 GetDescription()

```
string Xilinx7SeriesDevice::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.64.4.3 GetSerialNumber()

```
void Xilinx7SeriesDevice::GetSerialNumber (
            unsigned char * data )  [virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implements SerialNumberedDevice.

#### 7.64.4.4 GetSerialNumberLength()

```
int Xilinx7SeriesDevice::GetSerialNumberLength ( )  [virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.64.4.5 GetSerialNumberLengthBits()

```
int Xilinx7SeriesDevice::GetSerialNumberLengthBits ( )  [virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.64.4.6 IsProgrammed()

```
bool Xilinx7SeriesDevice::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.64.4.7 LoadFirmwareImage()

```
FirmwareImage * Xilinx7SeriesDevice::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.64.4.8 ParseBitstreamInternals()

```
void Xilinx7SeriesDevice::ParseBitstreamInternals (
            const unsigned char * data,
            size_t len,
            XilinxFPGABitstream * bitstream,
            size_t fpos )  [protected], [virtual]
```

Reads several 16-bit words from a config register.

The current implementation uses type 1 packets and is thus limited to reading less than 32 words.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |
| *dout* | Buffer to read into |
| *count* | Number of 16-bit words to read |

Implements XilinxFPGA.

#### 7.64.4.9 Program()

```
void Xilinx7SeriesDevice::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

#### 7.64.4.10 ReadWordConfigRegister()

```
uint32_t Xilinx7SeriesDevice::ReadWordConfigRegister (
            unsigned int reg )  [protected], [virtual]
```

Reads a single 32-bit word from a config register.

Reference: UG470 page 87

Note that 7-series devices expect data clocked in MSB first but the JTAG API clocks data LSB first. Some swapping is required as a result.

Clock data into CFG_IN register Synchronization word Nop Read STAT register Two dummy words to flush packet buffer

Read from CFG_OUT register

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |

Implements XilinxFPGA.

The documentation for this class was generated from the following files:

- Xilinx7SeriesDevice.h
- Xilinx7SeriesDevice.cpp

## 7.65 Xilinx7SeriesDeviceConfigurationFrame Union Reference

7-series configuration frame (see UG470 page 87)

```
#include <Xilinx7SeriesDevice.h>
```

### Public Member Functions

- struct {
  unsigned int count:11
  *Count field.*
  unsigned int reserved:2
  *Reserved, must be zero.*
  unsigned int reg_addr:14
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits
- struct {
  unsigned int count:27
  *Count field.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits_type2

### Public Attributes

- uint32_t word
  *The raw configuration word.*

### 7.65.1 Detailed Description

7-series configuration frame (see UG470 page 87)

### 7.65.2 Member Data Documentation

#### 7.65.2.1 op

```
unsigned int Xilinx7SeriesDeviceConfigurationFrame::op
```

Opcode.

Must be one of the following:

- Xilinx7SeriesDevice::X7_CONFIG_OP_NOP
- Xilinx7SeriesDevice::X7_CONFIG_OP_READ
- Xilinx7SeriesDevice::X7_CONFIG_OP_WRITE

Must be zero

#### 7.65.2.2 type

```
unsigned int Xilinx7SeriesDeviceConfigurationFrame::type
```

Frame type.

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_1

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_2

The documentation for this union was generated from the following file:

- Xilinx7SeriesDevice.h

## 7.66 Xilinx7SeriesDeviceStatusRegister Union Reference

7-series status register (see UG470 table 5-28)

```
#include <Xilinx7SeriesDevice.h>
```

## Public Member Functions

- struct {
  unsigned int crc_err:1
  *Indicates that the device failed to configure due to a CRC error.*
  unsigned int part_secured:1
  *Indicates that the device is in secure mode (encrypted bitstream)*
  unsigned int mmcm_lock:1
  *Indicates MMCMs are locked.*
  unsigned int dci_match:1
  *Indicates DCI is matched.*
  unsigned int eos:1
  *End-of-Startup signal.*
  unsigned int gts_cfg_b:1
  *Status of GTS_CFG net.*
  unsigned int gwe:1
  *Status of GWE net.*
  unsigned int ghigh_b:1
  *Status of GHIGH_B net.*
  unsigned int mode_pins:3
  *Status of mode pins.*
  unsigned int init_complete:1
  *Internal init-finished signal.*
  unsigned int init_b:1
  *Status of INIT_B pin.*
  unsigned int release_done:1
  *Indicates DONE was released.*
  unsigned int done:1
  *Actual value on DONE pin.*
  unsigned int id_error:1
  *Indicates an ID code error occurred (write with wrong bitstream)*
  unsigned int dec_error:1
  *Decryption error.*
  unsigned int xadc_over_temp:1
  *Indicates board is too hot.*
  unsigned int startup_state:3
  *Status of startup state machine.*
  unsigned int reserved_1:4
  *Reserved.*
  unsigned int bus_width:2
  *Config bus width (see table 5-26)*
  unsigned int reserved_2:5
  *Reserved.*
  } **__attribute__** ((packed)) bits

## Public Attributes

- uint32_t word
  *The raw status register value.*

### 7.66.1 Detailed Description

7-series status register (see UG470 table 5-28)

The documentation for this union was generated from the following file:

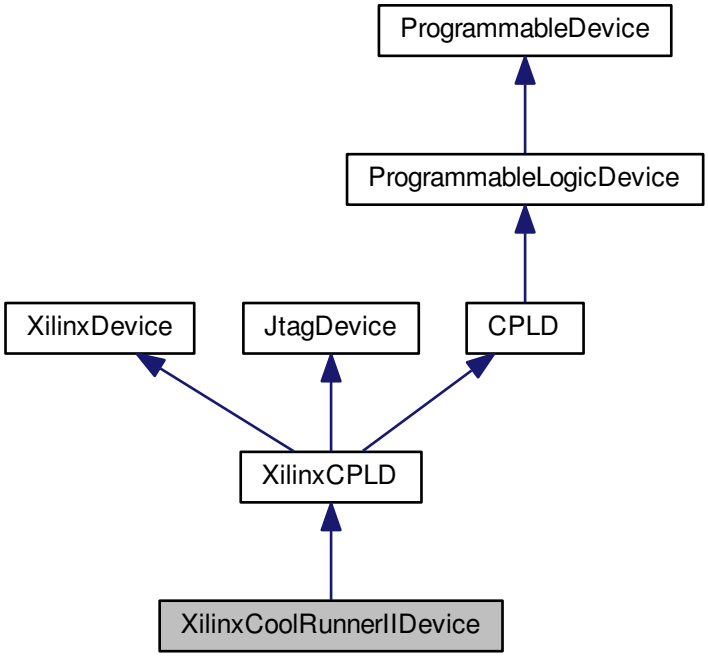
- Xilinx7SeriesDevice.h

## 7.67 XilinxCoolRunnerIIDevice Class Reference

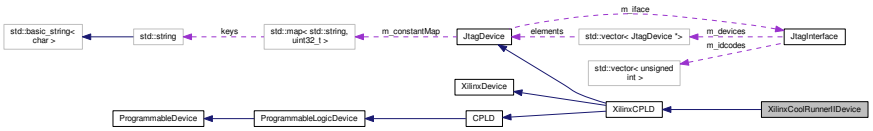
A Xilinx CoolRunner-II device.

`#include <XilinxCoolRunnerIIDevice.h>`

Inheritance diagram for XilinxCoolRunnerIIDevice:




Collaboration diagram for XilinxCoolRunnerIIDevice:




### Public Types

- enum deviceids {
  **XC2C32** = 0x01, **XC2C32A** = 0x21, **XC2C64** = 0x05, **XC2C64A** = 0x25,
  **XC2C128** = 0x18, **XC2C256** = 0x14, **XC2C384** = 0x15, **XC2C512** = 0x17 }

  *JTAG device IDs.*

- enum packages {
  QFG32 = 1, VQG44 = 2, QFG48 = 3, CPG56 = 4,
  VQG100 = 5, CPG132 = 6, TQG144 = 7, PQG208 = 8,
  FTG256 = 9, FGG324 = 10 }
- enum instructions {
  **INST_IDCODE** = 0x01, INST_BYPASS = 0xFF, INST_ISC_ENABLE = 0xE8, **INST_ISC_ENABLEOTF** = 0xE4,
  **INST_ISC_SRAM_READ** = 0xE7, **INST_ISC_SRAM_WRITE** = 0xE6, INST_ISC_ERASE = 0xED, INST_ISC_PROGRAM = 0xEA,
  INST_ISC_INIT = 0xF0, INST_ISC_DISABLE = 0xC0, INST_ISC_READ = 0xEE }

  *6-bit-wide JTAG instructions (from BSDL file)*
- enum **fusevalues** { **FUSE_VALUE_TRANSFER** = -1, **FUSE_VALUE_DONTCARE** = -2 }

## Public Member Functions

- **XilinxCoolRunnerIIDevice** (unsigned int devid, unsigned int package_decoded, unsigned int stepping, unsigned int idcode, JtagInterface *iface, size_t pos)
- virtual ~XilinxCoolRunnerIIDevice ()

  *Destructor.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- std::string GetDeviceName ()

  *Returns the device name.*
- std::string GetDevicePackage ()

  *Returns the device package.*
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- XilinxCoolRunnerIIDeviceStatusRegister GetStatusRegister ()

  *Returns the device status register.*
- void **SetIR** (unsigned char irval)
- int GetShiftRegisterWidth ()

  *Gets the width of the shift register for this device.*
- int GetShiftRegisterDepth ()

  *Gets the depth of the shift register for this device.*
- int GetFuseCount ()

  *Gets the number of fuses in the device.*
- int GetAddressSize ()

  *Gets the number of address bits.*
- int GetPaddingSize ()

  *Gets the number of padding bits to add.*
- unsigned char * GeneratePermutedFuseData (XilinxCPLDBitstream *bit, int *permtable)

  *Permutes the bitstream and adds transfer bits if the device needs them.*
- unsigned char * GenerateVerificationTable ()

*Generates the verification table.*

- int * GeneratePermutationTable ()

  *Generates the permutation table.*
- int GetZIAWidth ()

  *Returns the width of one function block's ZIA in bits.*
- int GetFunctionBlockCount ()

  *Returns the number of function blocks in the device.*
- int GetFunctionBlockPairCount ()

  *Returns the number of function block pairs in the device.*
- int GetFunctionBlockGridWidth ()

  *Returns the width of the FB grid, in FB pairs.*
- int GetFunctionBlockGridHeight ()

  *Returns the height of the FB grid, in FBs.*
- int MirrorCoordinate (int x, int end, bool mirror)

  *Mirrors a coordinate within a certain range.*
- int GrayEncode (int address)

  *Gray code encoder.*
- unsigned int **GetDensity** ()

### Static Public Member Functions

- static JtagDevice * **CreateDevice** (unsigned int idcode, JtagInterface *iface, size_t pos)
- static std::string GetPackageName (int pknum)

  *Gets the name of a given package enum.*

### Public Attributes

- enum XilinxCoolRunnerIIDevice::deviceids **__attribute__**

### Protected Attributes

- unsigned int m_devid

  *Device ID code.*
- unsigned int m_package

  *Package code.*
- unsigned int m_stepping

  *Stepping number.*

### Additional Inherited Members

## 7.67.1 Detailed Description

A Xilinx CoolRunner-II device.

## 7.67.2 Member Enumeration Documentation

#### 7.67.2.1 instructions

`enum XilinxCoolRunnerIIDevice::instructions`

6-bit-wide JTAG instructions (from BSDL file)

**Enumerator**

| | |
|---|---|
| INST_BYPASS | Standard JTAG bypass. |
| INST_ISC_ENABLE | Enter in-system configuration mode. |
| INST_ISC_ERASE | Erase the EEPROM array. |
| INST_ISC_PROGRAM | Program the EEPROM array. |
| INST_ISC_INIT | Discharge high voltage and/or boot device (depends on context) |
| INST_ISC_DISABLE | Leave ISC mode. |
| INST_ISC_READ | Verify. |

#### 7.67.2.2 packages

```
enum XilinxCoolRunnerIIDevice::packages
```

**Enumerator**

| | |
|---|---|
| QFG32 | 32-pin QFN (0.5mm pitch) |
| VQG44 | 44-pin VQFP (0.8mm pitch) |
| QFG48 | 48-pin QFN (0.5mm pitch) |
| CPG56 | 56-ball CSBGA (0.5mm pitch) |
| VQG100 | 100-pin VQFP (0.5mm pitch) |
| CPG132 | 132-ball CSBGA (0.5mm pitch) |
| TQG144 | 144-pin TQFP (0.5mm pitch) |
| PQG208 | 208-pin PQFP (0.5mm pitch) |
| FTG256 | 256-ball FTBGA (1mm pitch) |
| FGG324 | 324-ball FGBGA (1mm pitch) |

### 7.67.3 Member Function Documentation

#### 7.67.3.1 Erase()

```
void XilinxCoolRunnerIIDevice::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.67.3.2 GeneratePermutationTable()

```
int * XilinxCoolRunnerIIDevice::GeneratePermutationTable ( )
```

Generates the permutation table.

The table is generated in *row major* order to simplify the code, but for typical use should probably be column major.

#### 7.67.3.3 GetDescription()

```
std::string XilinxCoolRunnerIIDevice::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.67.3.4 GetPaddingSize()

```
int XilinxCoolRunnerIIDevice::GetPaddingSize ( )
```

Gets the number of padding bits to add.

See table 10 of programmer spec

#### 7.67.3.5 GetShiftRegisterDepth()

```
int XilinxCoolRunnerIIDevice::GetShiftRegisterDepth ( )
```

Gets the depth of the shift register for this device.

Does not include sec/done or UES words.

#### 7.67.3.6 GetShiftRegisterWidth()

```
int XilinxCoolRunnerIIDevice::GetShiftRegisterWidth ( )
```

Gets the width of the shift register for this device.

Includes transfer bits.

#### 7.67.3.7 IsProgrammed()

```
bool XilinxCoolRunnerIIDevice::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.67.3.8 LoadFirmwareImage()

```
FirmwareImage * XilinxCoolRunnerIIDevice::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.67.3.9 PostInitProbes()

```
void XilinxCoolRunnerIIDevice::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.67.3.10 Program()

```
void XilinxCoolRunnerIIDevice::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

The documentation for this class was generated from the following files:

- XilinxCoolRunnerIIDevice.h
- XilinxCoolRunnerIIDevice.cpp

## 7.68 XilinxCoolRunnerIIDeviceStatusRegister Union Reference

Status register for a Xilinx CoolRunner-II device.

`#include <XilinxCoolRunnerIIDevice.h>`

### Public Member Functions

- struct {
  unsigned int padding_one:2
  *Constant '01'.*
  unsigned int done:1
  *True if configured.*
  unsigned int sec:1
  *True if secured.*
  unsigned int isc_en:1
  *True if in ISC_ENABLE state.*
  unsigned int isc_dis:1
  *True if in ISC_DISABLE state.*
  unsigned int padding_zero:2
  *Constant '00'.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint8_t word

  *The raw status register value.*

### 7.68.1 Detailed Description

Status register for a Xilinx CoolRunner-II device.

The documentation for this union was generated from the following file:

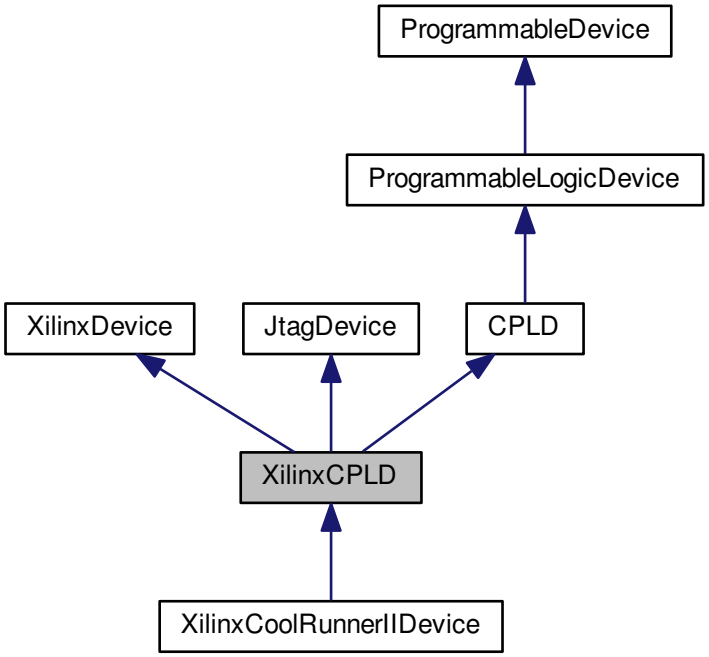
- XilinxCoolRunnerIIDevice.h

## 7.69 XilinxCPLD Class Reference

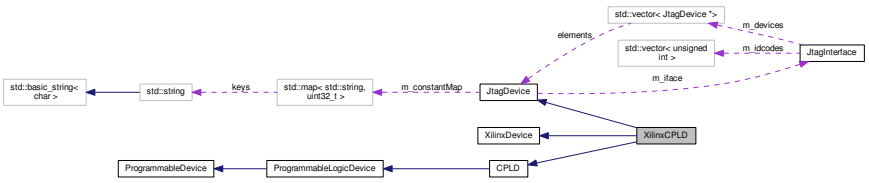
Generic base class for all Xilinx CPLD devices.

```
#include <XilinxCPLD.h>
```

Inheritance diagram for XilinxCPLD:



Collaboration diagram for XilinxCPLD:




### Public Member Functions

- **XilinxCPLD** (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

### Additional Inherited Members

#### 7.69.1 Detailed Description

Generic base class for all Xilinx CPLD devices.

The documentation for this class was generated from the following files:

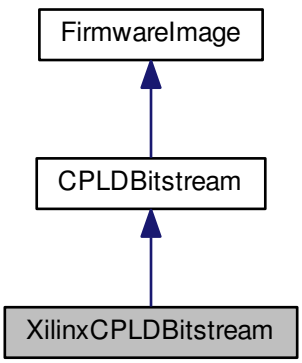
- XilinxCPLD.h
- XilinxCPLD.cpp

## 7.70 XilinxCPLDBitstream Class Reference

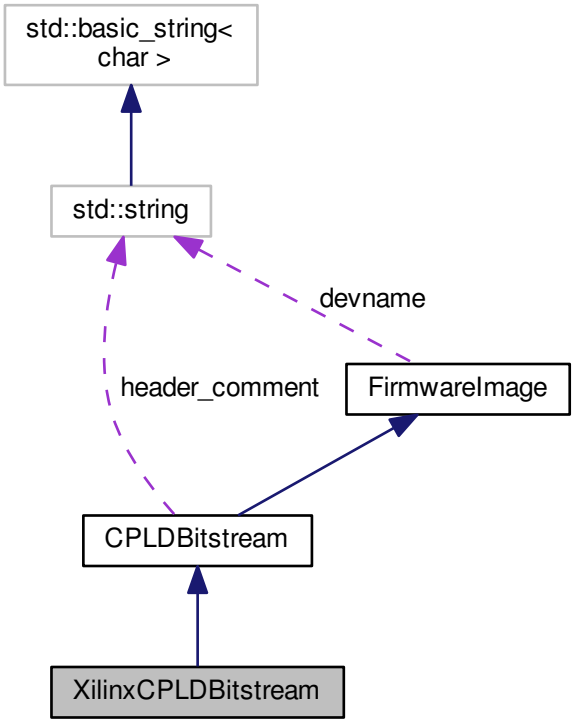
A bitstream for Xilinx CPLDs.

`#include <XilinxCPLDBitstream.h>`

Inheritance diagram for XilinxCPLDBitstream:



Collaboration diagram for XilinxCPLDBitstream:




### Public Member Functions

- XilinxCPLDBitstream ()

  *Initializes this object to empty.*
- virtual ~XilinxCPLDBitstream ()

  *Free bitstream memory.*
- virtual std::string **GetDescription** ()

### Additional Inherited Members

### 7.70.1 Detailed Description

A bitstream for Xilinx CPLDs.

The documentation for this class was generated from the following files:

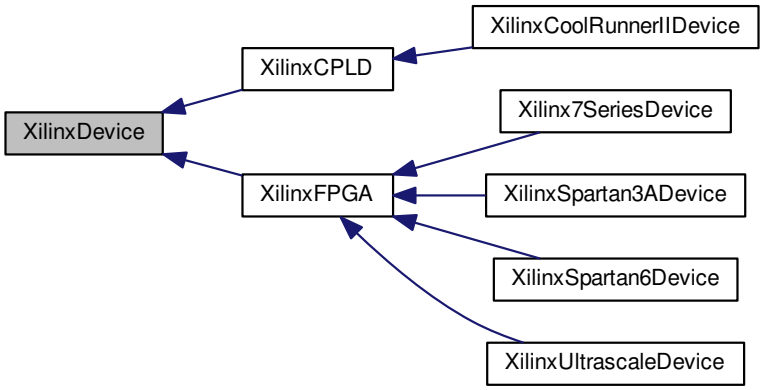
- XilinxCPLDBitstream.h
- XilinxCPLDBitstream.cpp

## 7.71 XilinxDevice Class Reference

Abstract base class for all Xilinx devices (FPGA, CPLD, flash, etc)

`#include <XilinxDevice.h>`

Inheritance diagram for XilinxDevice:




### Public Member Functions

- virtual ~XilinxDevice ()
  *Default virtual destructor.*

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int idcode, JtagInterface *iface, size_t pos)
  *Creates a XilinxDevice given an ID code.*

### 7.71.1 Detailed Description

Abstract base class for all Xilinx devices (FPGA, CPLD, flash, etc)

### 7.71.2 Member Function Documentation

#### 7.71.2.1 CreateDevice()

```
JtagDevice * XilinxDevice::CreateDevice (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )  [static]
```

Creates a XilinxDevice given an ID code.

### Exceptions

| | |
|---|---|
| *JtagException* | if the ID code supplied is not a valid Xilinx device, or not a known family number |

### Parameters

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### Returns

A valid JtagDevice object, or NULL if the vendor ID was not recognized.

The documentation for this class was generated from the following files:

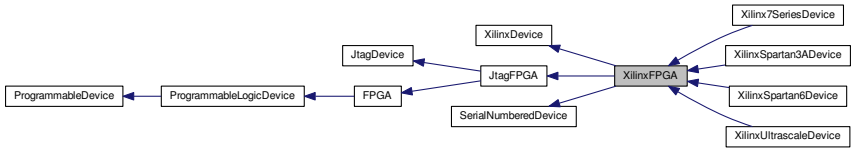
- XilinxDevice.h
- XilinxDevice.cpp

## 7.72 XilinxFPGA Class Reference

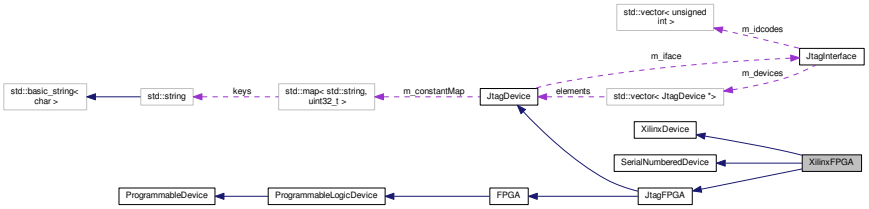
Abstract base class for all Xilinx FPGAs.

`#include <XilinxFPGA.h>`

Inheritance diagram for XilinxFPGA:




Collaboration diagram for XilinxFPGA:



### Public Member Functions

- XilinxFPGA (unsigned int idcode, JtagInterface *iface, size_t pos, size_t irlength)

  *Initializes this device.*
- virtual ~XilinxFPGA ()

  *Default virtual destructor.*
- virtual void PostInitProbes (bool quiet)

  *Does a post-initialization probe of the device to read debug ROMs etc.*
- virtual uint32_t **ReadWordConfigRegister** (unsigned int reg)=0
- virtual void **PrintStatusRegister** ()=0
- virtual void Reboot ()=0

  *Reboots the FPGA and loads from external memory, if possible.*

### Protected Member Functions

- void ParseBitstreamCore (XilinxFPGABitstream *bitstream, const unsigned char *data, size_t len)

  *Parse a bitstream image (common to all Xilinx devices)*
- virtual void ParseBitstreamInternals (const unsigned char *data, size_t len, XilinxFPGABitstream *bitstream, size_t fpos)=0

  *Parse a full bitstream image (specific to the derived FPGA family)*
- virtual bool ReadingSerialRequiresReset ()

  *True if reading this serial number requires a device reset.*

### Additional Inherited Members

## 7.72.1 Detailed Description

Abstract base class for all Xilinx FPGAs.

## 7.72.2 Constructor & Destructor Documentation

### 7.72.2.1 XilinxFPGA()

```
XilinxFPGA::XilinxFPGA (
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos,
            size_t irlength )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### 7.72.3 Member Function Documentation

#### 7.72.3.1 ParseBitstreamCore()

```
void XilinxFPGA::ParseBitstreamCore (
            XilinxFPGABitstream * bitstream,
            const unsigned char * data,
            size_t len )  [protected]
```

Parse a bitstream image (common to all Xilinx devices)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the bitstream is malformed or for the wrong device family |

**Parameters**

| | |
|---|---|
| *bitstream* | The bitstream object being initialized |
| *data* | Pointer to the bitstream data |
| *len* | Length of the bitstream |

**Returns**

A bitstream suitable for loading into this device

Bitstream format

13 unknown bytes (magic number?) 00 09 0f f0 0f f0 0f f0 0f f0 00 00 01 Records Record type (1 byte, lowercase letter) Null byte Record length (1 byte)

#### 7.72.3.2 ParseBitstreamInternals()

```
virtual void XilinxFPGA::ParseBitstreamInternals (
            const unsigned char * data,
            size_t len,
            XilinxFPGABitstream * bitstream,
            size_t fpos )  [protected], [pure virtual]
```

Parse a full bitstream image (specific to the derived FPGA family)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the bitstream is malformed or for the wrong device family |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the bitstream data |

**Parameters**

| | |
|---|---|
| *len* | Length of the bitstream |
| *bitstream* | The bitstream object to load into |
| *fpos* | Position in the bitstream image to start parsing (after the end of headers) |
| *bVerbose* | Set to true for verbose debug output on bitstream internals |

Implemented in Xilinx7SeriesDevice, XilinxUltrascaleDevice, XilinxSpartan6Device, and XilinxSpartan3ADevice.

#### 7.72.3.3 PostInitProbes()

```
void XilinxFPGA::PostInitProbes (
            bool quiet )  [virtual]
```

Does a post-initialization probe of the device to read debug ROMs etc.

**Parameters**

| | |
|---|---|
| *quiet* | Do minimal probing to avoid triggering security lockdowns |

Implements JtagDevice.

#### 7.72.3.4 ReadingSerialRequiresReset()

```
bool XilinxFPGA::ReadingSerialRequiresReset ( )  [protected], [virtual]
```

True if reading this serial number requires a device reset.

Applications may choose not to display the serial number to avoid disrupting the running code.

Implements SerialNumberedDevice.

The documentation for this class was generated from the following files:

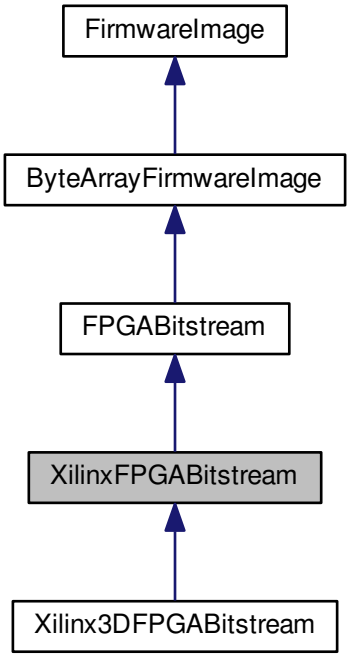
- XilinxFPGA.h
- XilinxFPGA.cpp

## 7.73 XilinxFPGABitstream Class Reference

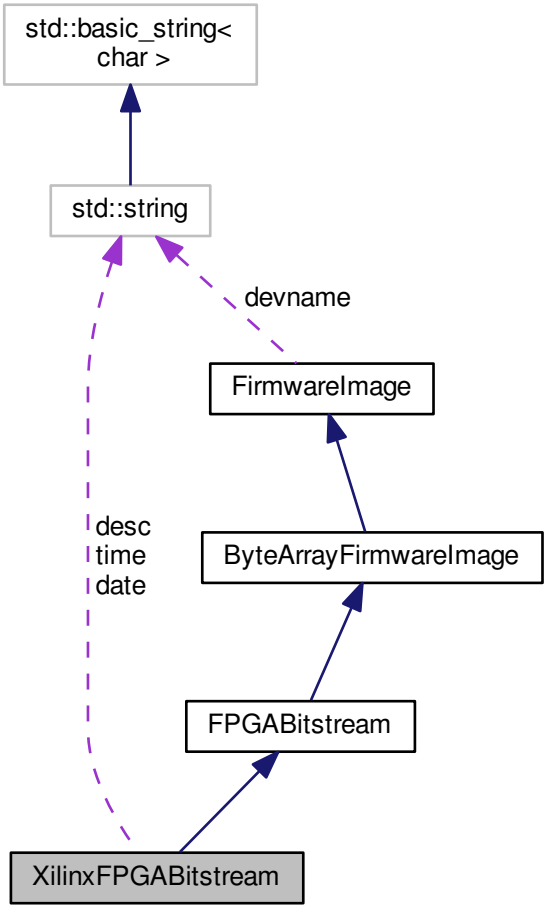
A bitstream for Xilinx FPGAs.

```
#include <XilinxFPGABitstream.h>
```

Inheritance diagram for XilinxFPGABitstream:



Collaboration diagram for XilinxFPGABitstream:




## Public Member Functions

- XilinxFPGABitstream ()

  *Initializes this object to empty.*
- virtual ~XilinxFPGABitstream ()

  *Free bitstream memory.*
- virtual std::string **GetDescription** ()

## Public Attributes

- std::string desc

  *Description of the bitstream, inserted by bitgen. Format is "ncdfile.ncd;UserID=0xdeadbeef".*
- std::string date

  *Date the bitstream was created, inserted by bitgen.*
- std::string time

  *Time the bitstream was created, inserted by bitgen.*

### 7.73.1 Detailed Description

A bitstream for Xilinx FPGAs.

The documentation for this class was generated from the following files:

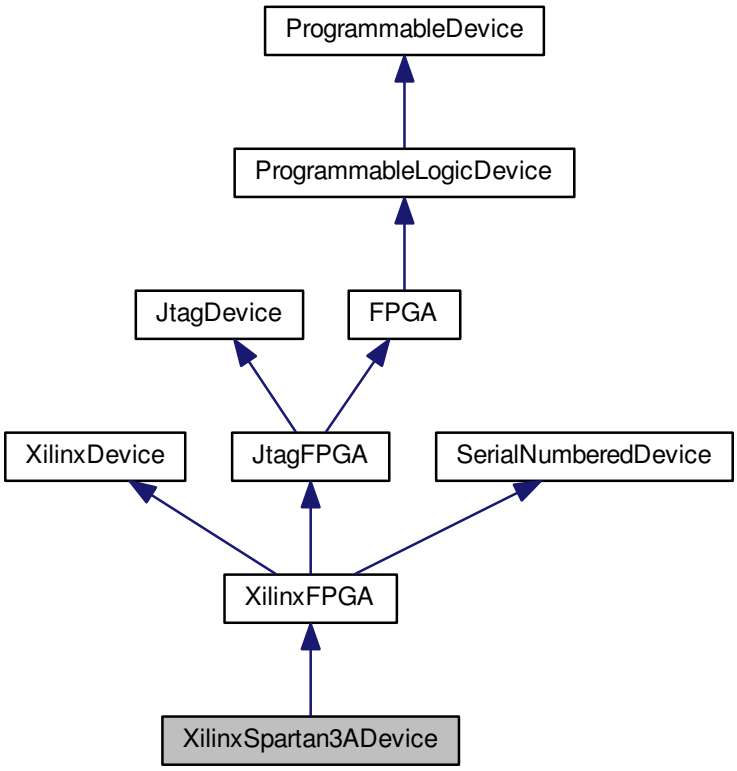
- XilinxFPGABitstream.h
- XilinxFPGABitstream.cpp

## 7.74 XilinxSpartan3ADevice Class Reference

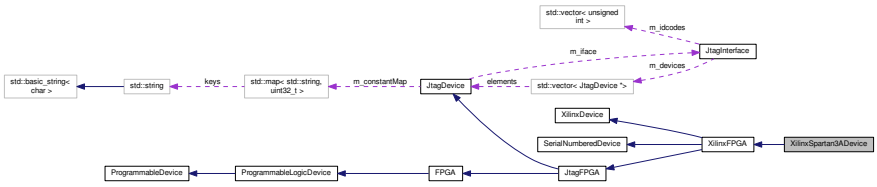
A Xilinx Spartan-3A FPGA device.

```
#include <XilinxSpartan3ADevice.h>
```

Inheritance diagram for XilinxSpartan3ADevice:



Collaboration diagram for XilinxSpartan3ADevice:




## Public Types

- enum deviceids { SPARTAN3A_50A = 0x10 }

  *JTAG device IDs.*
- enum instructions {
  INST_USER1 = 0x02, INST_USER2 = 0x03, INST_CFG_OUT = 0x04, INST_CFG_IN = 0x05,
  INST_USERCODE = 0x08, INST_IDCODE = 0x09, INST_JPROGRAM = 0x0B, INST_JSTART = 0x0C,
  INST_JSHUTDOWN = 0x0D, INST_ISC_ENABLE = 0x10, INST_ISC_DISABLE = 0x16, INST_ISC_DNA = 0x31,
  INST_BYPASS = 0x3F }

  *6-bit-wide JTAG instructions (see UG332 table 9-5 on page 207)*

## Public Member Functions

- XilinxSpartan3ADevice (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Initializes this device.*
- virtual ~XilinxSpartan3ADevice ()

  *Empty virtual destructor.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual void **PrintStatusRegister** ()
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual int GetSerialNumberLength ()

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*
- virtual int GetSerialNumberLengthBits ()

  *Gets the length of the device's unique serial number, in bits.*
- virtual void GetSerialNumber (unsigned char *data)

  *Gets the device's unique serial number.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void **InternalErase** ()
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- virtual void Reboot ()

  *Reboots the FPGA and loads from external memory, if possible.*
- virtual size_t GetNumUserInstructions ()

  *Get the number of JTAG instructions which are routed to FPGA fabric.*
- virtual void SelectUserInstruction (size_t index)

  *Sets the instruction register to the specified user instruction.*
- unsigned int **GetArraySize** ()

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Factory method.*

### Public Attributes

- enum XilinxSpartan3ADevice::deviceids **__attribute__**

### Protected Types

- enum spartan3a_config_opcodes { **S3A_CONFIG_OP_NOP** = 0, **S3A_CONFIG_OP_READ** = 1, **S3A_CONFIG_OP_WRITE** = 2 }

  *Spartan-3A configuration opcodes (see UG332 page 323)*
- enum spartan3a_config_frame_types { **S3A_CONFIG_FRAME_TYPE_1** = 1, **S3A_CONFIG_FRAME_TYPE_2** = 2 }

  *Spartan-3A configuration frame types (see UG332 page 323)*
- enum spartan3a_config_regs {
  **S3A_CONFIG_REG_CRC** = 0x00, **S3A_CONFIG_REG_FAR_MAJ** = 0x01, **S3A_CONFIG_REG_FAR_MIN** = 0x02, **S3A_CONFIG_REG_FDRI** = 0x03,
  **S3A_CONFIG_REG_FDRO** = 0x04, **S3A_CONFIG_REG_CMD** = 0x05, **S3A_CONFIG_REG_CTL** = 0x06, **S3A_CONFIG_REG_MASK** = 0x07,
  **S3A_CONFIG_REG_STAT** = 0x08, **S3A_CONFIG_REG_LOUT** = 0x09, **S3A_CONFIG_REG_COR1** = 0x0a, **S3A_CONFIG_REG_COR2** = 0x0b,
  **S3A_CONFIG_REG_PWRDN** = 0x0c, **S3A_CONFIG_REG_FLR** = 0x0d, **S3A_CONFIG_REG_IDCODE** = 0x0e, **S3A_CONFIG_REG_HCOPT** = 0x10,
  **S3A_CONFIG_REG_CSBO** = 0x12, **S3A_CONFIG_REG_GENERAL1** = 0x13, **S3A_CONFIG_REG_GENERAL2** = 0x14, **S3A_CONFIG_REG_MODE_REG** = 0x15,
  **S3A_CONFIG_REG_PU_GWE** = 0x16, **S3A_CONFIG_REG_PU_GTS** = 0x17, **S3A_CONFIG_REG_MFWR** = 0x18, **S3A_CONFIG_REG_CCLK_FREQ** = 0x19,
  **S3A_CONFIG_REG_SEU_OPT** = 0x1a, **S3A_CONFIG_REG_EXP_SIGN** = 0x1b, **S3A_CONFIG_REG_RDBK_SIGN** = 0x1c, **S3A_CONFIG_REG_MAX** }

  *Spartan-3A configuration registers (see UG332 page 325)*
- enum spartan3a_cmd_values {
  **S3A_CMD_NULL** = 0x0, **S3A_CMD_WCFG** = 0x1, **S3A_CMD_MFWR** = 0x2, **S3A_CMD_LFRM** = 0x3,
  **S3A_CMD_RCFG** = 0x4, **S3A_CMD_START** = 0x5, **S3A_CMD_RCAP** = 0x6, **S3A_CMD_RCRC** = 0x7,
  **S3A_CMD_AGHIGH** = 0x8, **S3A_CMD_GRESTORE** = 0xa, **S3A_CMD_SHUTDOWN** = 0xb, **S3A_CMD_GCAPTURE** = 0xc,
  **S3A_CMD_DESYNC** = 0xd, **S3A_CMD_REBOOT** = 0xe }

  *Spartan-3A CMD register values (see UG332 page 325-326)*

### Protected Member Functions

- virtual uint32_t ReadWordConfigRegister (unsigned int reg)

  *Reads a single 32-bit word from a config register.*
- virtual void ParseBitstreamInternals (const unsigned char *data, size_t len, XilinxFPGABitstream *bitstream, size_t fpos)

  *Reads several 16-bit words from a config register.*
- void **SetIR** (unsigned char irval)
- void **SetIRDeferred** (unsigned char irval)

### Protected Attributes

- unsigned int m_arraysize

  *Array size (the specific Spartan-6 device we are)*
- unsigned int m_rev

  *Stepping number.*

## 7.74.1 Detailed Description

A Xilinx Spartan-3A FPGA device.

## 7.74.2 Member Enumeration Documentation

### 7.74.2.1 deviceids

`enum XilinxSpartan3ADevice::deviceids`

JTAG device IDs.

**Enumerator**

| | |
|---|---|
| SPARTAN3A_50A | XC3S50A. |

### 7.74.2.2 instructions

`enum XilinxSpartan3ADevice::instructions`

6-bit-wide JTAG instructions (see UG332 table 9-5 on page 207)

**Enumerator**

| | |
|---|---|
| INST_USER1 | User-defined instruction 1. |
| INST_USER2 | User-defined instruction 2. |
| INST_CFG_OUT | Read configuration register. |
| INST_CFG_IN | Write configuration register. |
| INST_USERCODE | Read user ID code. |
| INST_IDCODE | Read ID code. |
| INST_JPROGRAM | Enters programming mode (erases FPGA configuration) |
| INST_JSTART | Runs the FPGA startup sequence (must supply dummy clocks after) |
| INST_JSHUTDOWN | Runs the FPGA shutdown sequence (must supply dummy clocks after) |
| INST_ISC_ENABLE | Enters In-System Configuration mode (must load INST_JPROGRAM before) |
| INST_ISC_DISABLE | Leaves In-System Configuration mode. |
| INST_ISC_DNA | Read device DNA (must load INST_ISC_ENABLE before and INST_ISC_DISABLE after) Note that this opcode isn't the same as Spartan-6. |
| INST_BYPASS | Standard JTAG bypass. |

### 7.74.3 Constructor & Destructor Documentation

#### 7.74.3.1 XilinxSpartan3ADevice()

```
XilinxSpartan3ADevice::XilinxSpartan3ADevice (
            unsigned int arraysize,
            unsigned int rev,
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *arraysize* | Array size from JTAG ID code |
| *rev* | Revision number from JTAG ID code |
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### 7.74.4 Member Function Documentation

#### 7.74.4.1 Erase()

```
void XilinxSpartan3ADevice::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.74.4.2 GetDescription()

```
string XilinxSpartan3ADevice::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.74.4.3 GetSerialNumber()

```
void XilinxSpartan3ADevice::GetSerialNumber (
            unsigned char * data )  [virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implements SerialNumberedDevice.

#### 7.74.4.4 GetSerialNumberLength()

```
int XilinxSpartan3ADevice::GetSerialNumberLength ( )  [virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.74.4.5 GetSerialNumberLengthBits()

```
int XilinxSpartan3ADevice::GetSerialNumberLengthBits ( )  [virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.74.4.6 IsProgrammed()

```
bool XilinxSpartan3ADevice::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.74.4.7 LoadFirmwareImage()

```
FirmwareImage * XilinxSpartan3ADevice::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.74.4.8 ParseBitstreamInternals()

```
void XilinxSpartan3ADevice::ParseBitstreamInternals (
            const unsigned char * data,
            size_t len,
            XilinxFPGABitstream * bitstream,
            size_t fpos )  [protected], [virtual]
```

Reads several 16-bit words from a config register.

The current implementation uses type 1 packets and is thus limited to reading less than 32 words.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |
| *dout* | Buffer to read into |
| *count* | Number of 16-bit words to read |

Implements XilinxFPGA.

#### 7.74.4.9 Program()

```
void XilinxSpartan3ADevice::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

#### 7.74.4.10 ReadWordConfigRegister()

```
uint32_t XilinxSpartan3ADevice::ReadWordConfigRegister (
            unsigned int reg )  [protected], [virtual]
```

Reads a single 32-bit word from a config register.

Note that Spartan-3A devices expect data clocked in MSB first but the JTAG API clocks data LSB first. Some swapping is required as a result.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |

Implements XilinxFPGA.

The documentation for this class was generated from the following files:

- XilinxSpartan3ADevice.h
- XilinxSpartan3ADevice.cpp

## 7.75 XilinxSpartan3ADeviceConfigurationFrame Union Reference

Spartan-3A configuration frame header (see UG332 page 323)

```
#include <XilinxSpartan3ADevice.h>
```

### Public Member Functions

- struct {
  unsigned int count:5
  *Count field.*
  unsigned int reg_addr:6
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint16_t word
  *The raw configuration word.*

### 7.75.1 Detailed Description

Spartan-3A configuration frame header (see UG332 page 323)

### 7.75.2 Member Data Documentation

#### 7.75.2.1 count

```
unsigned int XilinxSpartan3ADeviceConfigurationFrame::count
```

Count field.

- Type 1 packets: word count
- Type 2 packets: don't care

#### 7.75.2.2 op

```
unsigned int XilinxSpartan3ADeviceConfigurationFrame::op
```

Opcode.

Must be one of the following:

- XilinxSpartan3ADevice::S3_CONFIG_OP_NOP
- XilinxSpartan3ADevice::S3_CONFIG_OP_READ
- XilinxSpartan3ADevice::S3_CONFIG_OP_WRITE

#### 7.75.2.3 type

```
unsigned int XilinxSpartan3ADeviceConfigurationFrame::type
```

Frame type.

Must be one of the following:

- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_1
- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_2

The documentation for this union was generated from the following file:

- XilinxSpartan3ADevice.h

## 7.76 XilinxSpartan3ADeviceStatusRegister Union Reference

Spartan-3A status register (see UG332 table 17-13, pages 327-328)

`#include <XilinxSpartan3ADevice.h>`

### Public Member Functions

- struct {
  unsigned int crc_err:1
  *Indicates that the device failed to configure due to a CRC error.*
  unsigned int idcode_err:1
  *Indicates that the device failed to configure due to the bitstream having the wrong ID code.*
  unsigned int dcm_lock:1
  *Asserted once all DCM/PLL instances used in the design have locked on.*
  unsigned int gts_cfg_b:1
  *Status of global tristate net.*
  unsigned int gwe:1
  *Status of global write-enable net.*
  unsigned int ghigh:1
  *Status of GHIGH (TODO: describe what this is)*
  unsigned int vsel:3
  *Status of the SPI variant select pins.*
  unsigned int mode:3
  *Status of the mode bits.*
  unsigned int init_b:1
  *Status of the INIT_B pin.*
  unsigned int done:1
  *Status of the DONE pin.*
  unsigned int seu_err:1
  *True if there was a post-config CRC error.*
  unsigned int sync_timeout:1
  *True if the config watchdog timer ran out.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word
  *The raw status register value.*

### 7.76.1 Detailed Description

Spartan-3A status register (see UG332 table 17-13, pages 327-328)

The documentation for this union was generated from the following file:

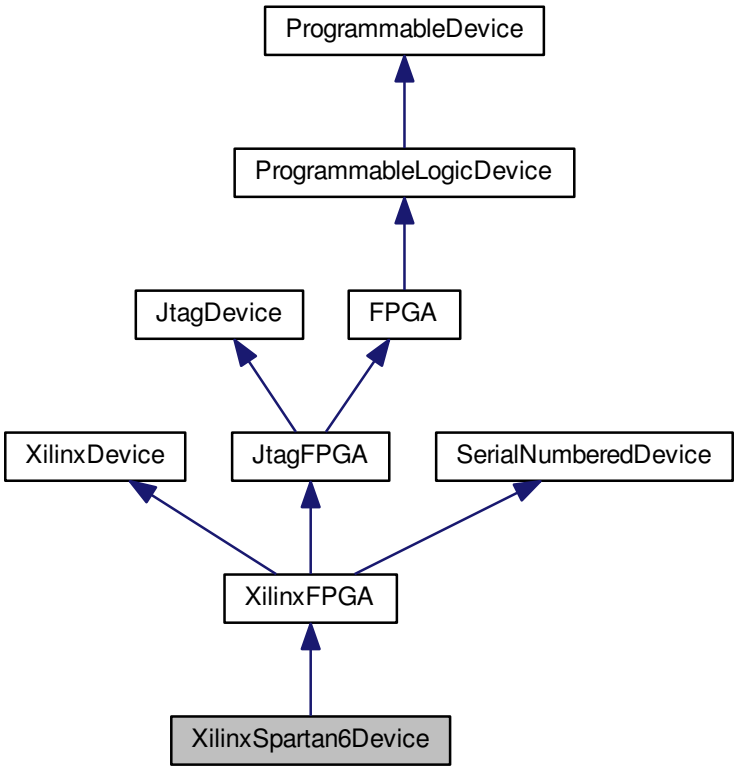
- XilinxSpartan3ADevice.h

## 7.77 XilinxSpartan6Device Class Reference

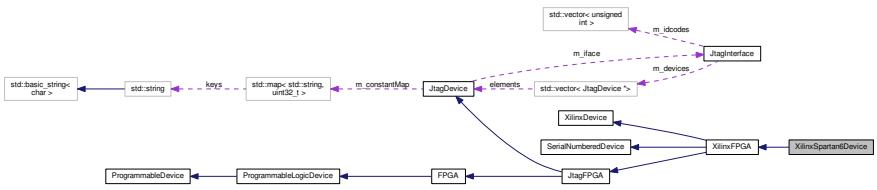
A Xilinx Spartan-6 FPGA device.

`#include <XilinxSpartan6Device.h>`

Inheritance diagram for XilinxSpartan6Device:




Collaboration diagram for XilinxSpartan6Device:




### Public Types

- enum deviceids { SPARTAN6_LX9 = 1, SPARTAN6_LX16 = 2, SPARTAN6_LX25 = 4, SPARTAN6_LX45 = 8 }

*JTAG device IDs.*

- enum instructions {
  INST_USER1 = 0x02, INST_USER2 = 0x03, INST_USER3 = 0x1A, INST_USER4 = 0x1B,
  INST_CFG_OUT = 0x04, INST_CFG_IN = 0x05, INST_IDCODE = 0x09, INST_JPROGRAM = 0x0B,
  INST_JSTART = 0x0C, INST_JSHUTDOWN = 0x0D, INST_ISC_ENABLE = 0x10, INST_ISC_DISABLE = 0x16,
  INST_ISC_DNA = 0x30, INST_BYPASS = 0x3F }

  *6-bit-wide JTAG instructions (see UG380 table 10-2)*

## Public Member Functions

- XilinxSpartan6Device (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Initializes this device.*
- virtual ~XilinxSpartan6Device ()

  *Empty virtual destructor.*
- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*
- virtual void **PrintStatusRegister** ()
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*
- virtual int GetSerialNumberLength ()

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*
- virtual int GetSerialNumberLengthBits ()

  *Gets the length of the device's unique serial number, in bits.*
- virtual void GetSerialNumber (unsigned char *data)

  *Gets the device's unique serial number.*
- virtual size_t GetNumUserInstructions ()

  *Get the number of JTAG instructions which are routed to FPGA fabric.*
- virtual void SelectUserInstruction (size_t index)

  *Sets the instruction register to the specified user instruction.*
- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*
- virtual void **InternalErase** ()
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*
- virtual void Program (FirmwareImage *image)

  *Loads a new firmware image onto the device.*
- virtual void Reboot ()

  *Reboots the FPGA and loads from external memory, if possible.*
- unsigned int **GetArraySize** ()

## Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int arraysize, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Factory method.*

## Public Attributes

- enum XilinxSpartan6Device::deviceids **__attribute__**

### Protected Types

- enum spartan6_config_opcodes { **S6_CONFIG_OP_NOP** = 0, **S6_CONFIG_OP_READ** = 1, **S6_CONFIG_OP_WRITE** = 2 }

  *Spartan-6 configuration opcodes (see UG380 page 90)*
- enum spartan6_config_frame_types { **S6_CONFIG_FRAME_TYPE_1** = 1, **S6_CONFIG_FRAME_TYPE_2** = 2 }

  *Spartan-6 configuration frame types (see UG380 page 91)*
- enum spartan6_config_regs {
  **S6_CONFIG_REG_CRC** = 0x00, **S6_CONFIG_REG_FAR_MAJ** = 0x01, **S6_CONFIG_REG_FAR_MIN** = 0x02, **S6_CONFIG_REG_FDRI** = 0x03,
  **S6_CONFIG_REG_FDRO** = 0x04, **S6_CONFIG_REG_CMD** = 0x05, **S6_CONFIG_REG_CTL** = 0x06, **S6_CONFIG_REG_MASK** = 0x07,
  **S6_CONFIG_REG_STAT** = 0x08, **S6_CONFIG_REG_LOUT** = 0x09, **S6_CONFIG_REG_COR1** = 0x0a, **S6_CONFIG_REG_COR2** = 0x0b,
  **S6_CONFIG_REG_PWRDN** = 0x0c, **S6_CONFIG_REG_FLR** = 0x0d, **S6_CONFIG_REG_IDCODE** = 0x0e, **S6_CONFIG_REG_CWDT** = 0x0f,
  **S6_CONFIG_REG_HC_OPT** = 0x10, **S6_CONFIG_REG_CSBO** = 0x12, **S6_CONFIG_REG_GENERAL1** = 0x13, **S6_CONFIG_REG_GENERAL2** = 0x14,
  **S6_CONFIG_REG_GENERAL3** = 0x15, **S6_CONFIG_REG_GENERAL4** = 0x16, **S6_CONFIG_REG_GENERAL5** = 0x17, **S6_CONFIG_REG_MODE** = 0x18,
  **S6_CONFIG_REG_PU_GWE** = 0x19, **S6_CONFIG_REG_PU_GTS** = 0x1a, **S6_CONFIG_REG_MFWR** = 0x1b, **S6_CONFIG_REG_CCLK_FREQ** = 0x1c,
  **S6_CONFIG_REG_SEU_OPT** = 0x1d, **S6_CONFIG_REG_EXP_SIGN** = 0x1e, **S6_CONFIG_REG_RDBK_SIGN** = 0x1f, **S6_CONFIG_REG_BOOTSTS** = 0x20,
  **S6_CONFIG_REG_EYE_MASK** = 0x21, **S6_CONFIG_REG_CBC** = 0x22, **S6_CONFIG_REG_MAX** }

  *Spartan-6 configuration registers (see UG380 page 92)*
- enum spartan6_cmd_values {
  **S6_CMD_NULL** = 0x0, **S6_CMD_WCFG** = 0x1, **S6_CMD_MFW** = 0x2, **S6_CMD_LFRM** = 0x3,
  **S6_CMD_RCFG** = 0x4, **S6_CMD_START** = 0x5, **S6_CMD_RCRC** = 0x7, **S6_CMD_AGHIGH** = 0x8,
  **S6_CMD_GRESTORE** = 0xa, **S6_CMD_SHUTDOWN** = 0xb, **S6_CMD_DESYNC** = 0xd, **S6_CMD_IPROG** = 0xe }

  *Spartan-6 CMD register values (see UG380 page 94-95)*

### Protected Member Functions

- virtual uint32_t ReadWordConfigRegister (unsigned int reg)

  *Reads a single 16-bit word from a config register.*
- void ReadWordsConfigRegister (unsigned int reg, uint16_t *dout, unsigned int count)

  *Reads several 16-bit words from a config register.*
- void **WriteWordConfigRegister** (unsigned int reg, uint16_t value)
- virtual void ParseBitstreamInternals (const unsigned char *data, size_t len, XilinxFPGABitstream *bitstream, size_t fpos)

  *Parse a full bitstream image (specific to the derived FPGA family)*
- void **SetIR** (unsigned char irval)
- void **SetIRDeferred** (unsigned char irval)

### Protected Attributes

- unsigned int m_arraysize

  *Array size (the specific Spartan-6 device we are)*
- unsigned int m_rev

  *Stepping number.*

### 7.77.1 Detailed Description

A Xilinx Spartan-6 FPGA device.

### 7.77.2 Member Enumeration Documentation

#### 7.77.2.1 deviceids

enum XilinxSpartan6Device::deviceids

JTAG device IDs.

**Enumerator**

| | |
|---|---|
| SPARTAN6_LX9 | XC6SLX9. |
| SPARTAN6_LX16 | XC6SLX16. |
| SPARTAN6_LX25 | XC6SLX25. |
| SPARTAN6_LX45 | XC6SLX45. |

#### 7.77.2.2 instructions

enum XilinxSpartan6Device::instructions

6-bit-wide JTAG instructions (see UG380 table 10-2)

**Enumerator**

| | |
|---|---|
| INST_USER1 | User-defined instruction 1. |
| INST_USER2 | User-defined instruction 2. |
| INST_USER3 | User-defined instruction 3. |
| INST_USER4 | User-defined instruction 4. |
| INST_CFG_OUT | Read configuration register. |
| INST_CFG_IN | Write configuration register. |
| INST_IDCODE | Read ID code. |
| INST_JPROGRAM | Enters programming mode (erases FPGA configuration) |
| INST_JSTART | Runs the FPGA startup sequence (must supply dummy clocks after) |
| INST_JSHUTDOWN | Runs the FPGA shutdown sequence (must supply dummy clocks after) |
| INST_ISC_ENABLE | Enters In-System Configuration mode (must load INST_JPROGRAM before) |
| INST_ISC_DISABLE | Leaves In-System Configuration mode. |
| INST_ISC_DNA | Read device DNA (must load INST_ISC_ENABLE before and INST_ISC_DISABLE after) |
| INST_BYPASS | Standard JTAG bypass. |

### 7.77.3 Constructor & Destructor Documentation

#### 7.77.3.1 XilinxSpartan6Device()

```
XilinxSpartan6Device::XilinxSpartan6Device (
            unsigned int arraysize,
            unsigned int rev,
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *arraysize* | Array size from JTAG ID code |
| *rev* | Revision number from JTAG ID code |
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |

### 7.77.4 Member Function Documentation

#### 7.77.4.1 Erase()

```
void XilinxSpartan6Device::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.77.4.2 GetDescription()

```
string XilinxSpartan6Device::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.77.4.3 GetSerialNumber()

```
void XilinxSpartan6Device::GetSerialNumber (
            unsigned char * data )  [virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implements SerialNumberedDevice.

#### 7.77.4.4 GetSerialNumberLength()

```
int XilinxSpartan6Device::GetSerialNumberLength ( )  [virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.77.4.5 GetSerialNumberLengthBits()

```
int XilinxSpartan6Device::GetSerialNumberLengthBits ( )  [virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.77.4.6 IsProgrammed()

```
bool XilinxSpartan6Device::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.77.4.7 LoadFirmwareImage()

```
FirmwareImage * XilinxSpartan6Device::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.77.4.8 ParseBitstreamInternals()

```
void XilinxSpartan6Device::ParseBitstreamInternals (
            const unsigned char * data,
            size_t len,
            XilinxFPGABitstream * bitstream,
            size_t fpos )  [protected], [virtual]
```

Parse a full bitstream image (specific to the derived FPGA family)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the bitstream is malformed or for the wrong device family |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the bitstream data |
| *len* | Length of the bitstream |
| *bitstream* | The bitstream object to load into |
| *fpos* | Position in the bitstream image to start parsing (after the end of headers) |
| *bVerbose* | Set to true for verbose debug output on bitstream internals |

Implements XilinxFPGA.

#### 7.77.4.9 Program()

```
void XilinxSpartan6Device::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

#### 7.77.4.10 ReadWordConfigRegister()

```
uint32_t XilinxSpartan6Device::ReadWordConfigRegister (
            unsigned int reg )  [protected], [virtual]
```

Reads a single 16-bit word from a config register.

Reference: UG380 page 115-116 Table 6-5

Note that Spartan-6 devices expect data clocked in MSB first but the JTAG API clocks data LSB first. Some swapping is required as a result.

Clock data into CFG_IN register Synchronization word Read STAT register Type = 1 001 Op = Read 01 Addr of reg xxxxxx Word count = 1 00001 = 0x2901 Two dummy words to flush packet buffer

Read from CFG_OUT register

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |

**Returns**

The register value. Note that only the low 16 bits are valid but XilinxFPGA's API has 32 in the return type

Implements XilinxFPGA.

#### 7.77.4.11 ReadWordsConfigRegister()

```
void XilinxSpartan6Device::ReadWordsConfigRegister (
            unsigned int reg,
            uint16_t * dout,
            unsigned int count )  [protected]
```

Reads several 16-bit words from a config register.

The current implementation uses type 1 packets and is thus limited to reading less than 32 words.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |
| *dout* | Buffer to read into |
| *count* | Number of 16-bit words to read |

The documentation for this class was generated from the following files:

- XilinxSpartan6Device.h
- XilinxSpartan6Device.cpp

## 7.78 XilinxSpartan6DeviceConfigurationFrame Union Reference

Spartan-6 configuration frame (see UG380 page 91)

```
#include <XilinxSpartan6Device.h>
```

### Public Member Functions

- struct {
  unsigned int count:5
  *Count field.*
  unsigned int reg_addr:6
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint16_t word
  *The raw configuration word.*

### 7.78.1 Detailed Description

Spartan-6 configuration frame (see UG380 page 91)

For type 2 packets, the header is followed by a 32-bit big-endian length value

### 7.78.2 Member Data Documentation

#### 7.78.2.1 count

```
unsigned int XilinxSpartan6DeviceConfigurationFrame::count
```

Count field.

- Type 1 packets: word count
- Type 2 packets: don't care

#### 7.78.2.2 op

```
unsigned int XilinxSpartan6DeviceConfigurationFrame::op
```

Opcode.

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_OP_NOP
- XilinxSpartan6Device::S6_CONFIG_OP_READ
- XilinxSpartan6Device::S6_CONFIG_OP_WRITE

#### 7.78.2.3 type

```
unsigned int XilinxSpartan6DeviceConfigurationFrame::type
```

Frame type.

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_1
- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_2

The documentation for this union was generated from the following file:

- XilinxSpartan6Device.h

## 7.79 XilinxSpartan6DeviceStatusRegister Union Reference

Spartan-6 status register (see UG380 table 5-35)

```
#include <XilinxSpartan6Device.h>
```

## Public Member Functions

- struct {
  unsigned int crc_err:1
  *Indicates that the device failed to configure due to a CRC error.*
  unsigned int idcode_err:1
  *Indicates that the device failed to configure due to the bitstream having the wrong ID code.*
  unsigned int dcm_lock:1
  *Asserted once all DCM/PLL instances used in the design have locked on.*
  unsigned int gts_cfg_b:1
  *Status of global tristate net.*
  unsigned int gwe:1
  *Status of global write-enable net.*
  unsigned int ghigh:1
  *Status of GHIGH (TODO: describe what this is)*
  unsigned int decrypt_err:1
  *Decryption error flag.*
  unsigned int decrypt_en:1
  *Bitstream encryption enable flag.*
  unsigned int hswapen:1
  *Status of the HSWAPEN pin.*
  unsigned int m0:1
  *Status of the M0 mode bit.*
  unsigned int m1:1
  *Status of the M1 mode bit.*
  unsigned int reserved:1
  *Reserved.*
  unsigned int init_b:1
  *Status of the INIT_B pin.*
  unsigned int done:1
  *Status of the DONE pin.*
  unsigned int suspend:1
  *Suspend state.*
  unsigned int fallback:1
  *Configuration fallback state.*
  } **__attribute__** ((packed)) bits

## Public Attributes

- uint16_t word
  *The raw status register value.*

### 7.79.1 Detailed Description

Spartan-6 status register (see UG380 table 5-35)

Typical status register bits:

- [0] CRC ERROR : 0
- [1] IDCODE ERROR : 0
- [2] DCM LOCK STATUS : 1

- [3] GTS_CFG_B STATUS : 1
- [4] GWE STATUS : 1
- [5] GHIGH STATUS : 1
- [6] DECRYPTION ERROR : 0
- [7] DECRYPTOR ENABLE : 0
- [8] HSWAPEN PIN : 1
- [9] MODE PIN M[0] : 1
- [10] MODE PIN M[1] : 1
- [11] RESERVED : 0
- [12] INIT_B PIN : 1
- [13] DONE PIN : 1
- [14] SUSPEND STATUS : 0
- [15] FALLBACK STATUS : 0

The documentation for this union was generated from the following file:

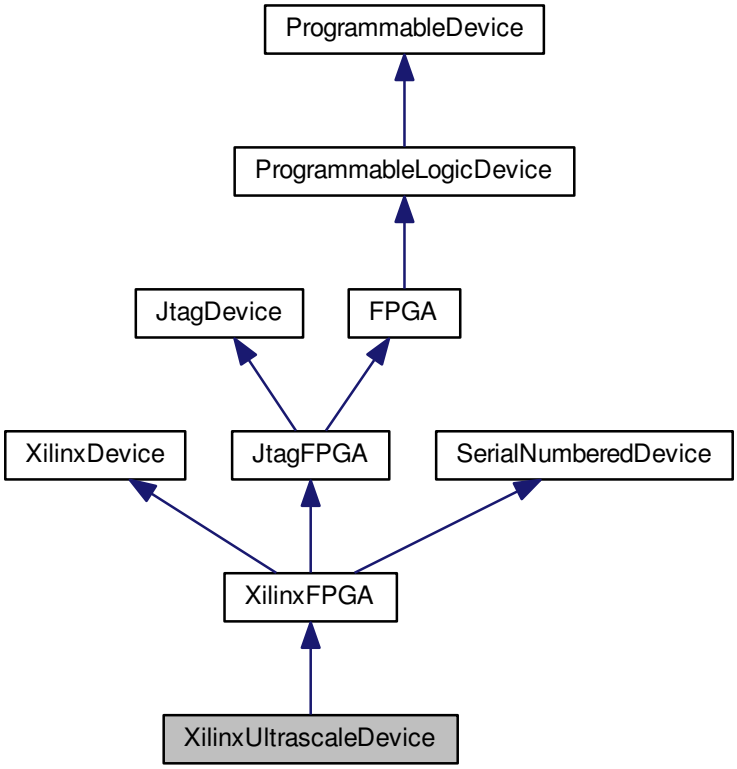
- XilinxSpartan6Device.h

## 7.80 XilinxUltrascaleDevice Class Reference

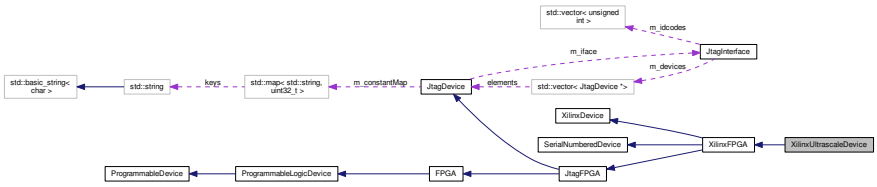
A Xilinx Ultrascale or Ultrascale+ FPGA device.

```
#include <XilinxUltrascaleDevice.h>
```

Inheritance diagram for XilinxUltrascaleDevice:




Collaboration diagram for XilinxUltrascaleDevice:




## Public Types

- enum deviceids { **VUPLUS_9** = 0x131 }

  *JTAG device IDs.*
- enum instructions {
  INST_SLR_BYPASS = 0x24, INST_CFG_OUT = 0x04, INST_CFG_IN = 0x05, INST_IDCODE = 0x09,
  INST_JPROGRAM = 0x0B, INST_JSTART = 0x0C, INST_ISC_ENABLE = 0x10, **INST_ISC_NOOP** = 0x14,
  INST_ISC_DISABLE = 0x16, INST_XSC_DNA = 0x17, INST_BYPASS = 0x3F }

  *6-bit-wide JTAG instructions (see BSDL file). Seems to be mostly same as 7 series*
- enum config_opcodes { **CONFIG_OP_NOP** = 0, **CONFIG_OP_READ** = 1, **CONFIG_OP_WRITE** = 2 }

*UltraScale configuration opcodes (see UG570 page 159). Same as for Spartan-6 and 7 series.*

- enum config_frame_types { **CONFIG_FRAME_TYPE_1** = 1, **CONFIG_FRAME_TYPE_2** = 2 }

  *UltraScale configuration frame types (see UG570 page 158). Same as for Spartan-6 and 7 series.*

- enum ultrascale_config_regs {
  **CONFIG_REG_CRC** = 0x00, **CONFIG_REG_FAR** = 0x01, **CONFIG_REG_FDRI** = 0x02, **CONFIG_REG_FDRO** = 0x03,
  **CONFIG_REG_CMD** = 0x04, **CONFIG_REG_CTL0** = 0x05, **CONFIG_REG_MASK** = 0x06, **CONFIG_REG_STAT** = 0x07,
  **CONFIG_REG_LOUT** = 0x08, **CONFIG_REG_COR0** = 0x09, **CONFIG_REG_MFWR** = 0x0A, **CONFIG_REG_CBC** = 0x0B,
  **CONFIG_REG_IDCODE** = 0x0C, **CONFIG_REG_AXSS** = 0x0D, **CONFIG_REG_COR1** = 0x0E, **CONFIG_REG_WBSTAR** = 0x10,
  **CONFIG_REG_TIMER** = 0x11, **CONFIG_REG_BOOTSTS** = 0x16, **CONFIG_REG_CTL1** = 0x18, **CONFIG_REG_BSPI** = 0x1F,
  **CONFIG_REG_MAX** }

  *UltraScale configuration registers (see UG570 page 159). Seems to be same as 7 series.*

- enum cmd_values {
  **CMD_NULL** = 0x00, **CMD_WCFG** = 0x01, **CMD_MFW** = 0x02, **CMD_LFRM** = 0x03,
  **CMD_RCFG** = 0x04, **CMD_START** = 0x05, **CMD_RCRC** = 0x07, **CMD_AGHIGH** = 0x08,
  **CMD_SWITCH** = 0x09, **CMD_GRESTORE** = 0x0a, **CMD_SHUTDOWN** = 0x0b, **CMD_DESYNC** = 0x0d,
  **CMD_IPROG** = 0x0f, **CMD_CRCC** = 0x10, **CMD_LTIMER** = 0x11, **CMD_BSPI_READ** = 0x12,
  **CMD_FALL_EDGE** = 0x13, **CMD_MAX** }

  *UltraScale CMD register values (see UG570 page table 9-22).*

## Public Member Functions

- XilinxUltrascaleDevice (unsigned int arraysize, unsigned int family, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Initializes this device.*

- virtual ~XilinxUltrascaleDevice ()

  *Empty virtual destructor.*

- virtual std::string GetDescription ()

  *Gets a human-readable description of this device.*

- virtual void **PrintStatusRegister** ()
- virtual bool IsProgrammed ()

  *Determines if this device is programmed or blank.*

- virtual int GetSerialNumberLength ()

  *Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).*

- virtual int GetSerialNumberLengthBits ()

  *Gets the length of the device's unique serial number, in bits.*

- virtual void GetSerialNumber (unsigned char *data)

  *Gets the device's unique serial number.*

- virtual size_t GetNumUserInstructions ()

  *Get the number of JTAG instructions which are routed to FPGA fabric.*

- virtual void SelectUserInstruction (size_t index)

  *Sets the instruction register to the specified user instruction.*

- virtual void Erase ()

  *Erases the device configuration and restores the device to a blank state.*

- virtual void **InternalErase** ()
- virtual FirmwareImage * LoadFirmwareImage (const unsigned char *data, size_t len)

  *Parses an in-memory image of a firmware image into a format suitable for loading into the device.*

- virtual void Program (FirmwareImage *image)

*Loads a new firmware image onto the device.*

- virtual void Reboot ()

  *Reboots the FPGA and loads from external memory, if possible.*
- void **AnalyzeSVF** (std::string path)

### Static Public Member Functions

- static JtagDevice * CreateDevice (unsigned int arraysize, unsigned int family, unsigned int rev, unsigned int idcode, JtagInterface *iface, size_t pos)

  *Factory method.*

### Public Attributes

- enum XilinxUltrascaleDevice::deviceids **__attribute__**

### Protected Member Functions

- virtual uint32_t ReadWordConfigRegister (unsigned int reg)

  *Reads a single 32-bit word from a config register.*
- virtual void ParseBitstreamInternals (const unsigned char *data, size_t len, XilinxFPGABitstream *bitstream, size_t fpos)

  *Parse a full bitstream image (specific to the derived FPGA family)*
- bool **ParseType1ConfigFrame** (XilinxUltrascaleDeviceConfigurationFrame frame, const unsigned char *data, size_t len, size_t &fpos, uint32_t &idcode, bool &desync, bool flip_bit_order=false)
- bool **GetSVFLine** (FILE *fp, std::string &line)
- std::string **GetSVFOpcode** (std::string &line)
- void **SetIRForMasterSLR** (unsigned char irval, bool defer=false)
- void **SetIRForAllSLRs** (unsigned char irval, bool defer=false)
- size_t InitializePartDimensions (unsigned int arraysize, unsigned int family)

  *Set up SLR count etc and return total IR size.*

### Protected Attributes

- unsigned int m_arraysize

  *Array size (the specific device we are)*
- unsigned int m_family

  *Family (Ultrascale or Ultrascale+)*
- unsigned int m_rev

  *Stepping number.*
- unsigned int m_slrCount

  *Number of SLRs in the device.*
- unsigned int m_masterSLR

  *Index of the master SLR (zero-based). Always 0 for monolithic devices.*

## 7.80.1 Detailed Description

A Xilinx Ultrascale or Ultrascale+ FPGA device.

### 7.80.2 Member Enumeration Documentation

#### 7.80.2.1 cmd_values

```
enum XilinxUltrascaleDevice::cmd_values
```

UltraScale CMD register values (see UG570 page table 9-22).

Seems to be mostly same as 7 series but a few things changed (commented)

#### 7.80.2.2 instructions

```
enum XilinxUltrascaleDevice::instructions
```

6-bit-wide JTAG instructions (see BSDL file). Seems to be mostly same as 7 series

**Enumerator**

| | |
|---|---|
| INST_SLR_BYPASS | Turn off the JTAG subsystem for a SLR we're not talking to. |
| INST_CFG_OUT | Read configuration register. |
| INST_CFG_IN | Write configuration register. |
| INST_IDCODE | Read user ID code. Read ID code |
| INST_JPROGRAM | Enters programming mode (erases FPGA configuration) |
| INST_JSTART | Runs the FPGA startup sequence (must supply dummy clocks after) |
| INST_ISC_ENABLE | Runs the FPGA shutdown sequence (must supply dummy clocks after) Enters In-System Configuration mode (must load INST_JPROGRAM before) |
| INST_ISC_DISABLE | Leaves In-System Configuration mode. |
| INST_XSC_DNA | Read device DNA (must load INST_ISC_ENABLE before and INST_ISC_DISABLE after) Same as 7-series but not same as Spartan-6 |
| INST_BYPASS | Standard JTAG bypass. Access to the ADC Not present in Spartan-6 |

### 7.80.3 Constructor & Destructor Documentation

#### 7.80.3.1 XilinxUltrascaleDevice()

```
XilinxUltrascaleDevice::XilinxUltrascaleDevice (
            unsigned int arraysize,
            unsigned int family,
            unsigned int rev,
            unsigned int idcode,
            JtagInterface * iface,
            size_t pos )
```

Initializes this device.

**Parameters**

| | |
|---|---|
| *arraysize* | Array size from JTAG ID code |
| *family* | Family from JTAG ID code (needed since this class handles both ultrascale and ultrascale+) |
| *rev* | Revision number from JTAG ID code |
| *idcode* | The ID code of this device |
| *iface* | The JTAG adapter this device was discovered on |
| *pos* | Position in the chain that this device was discovered |
| *irlength* | Length of the JTAG instruction register |

### 7.80.4 Member Function Documentation

#### 7.80.4.1 Erase()

```
void XilinxUltrascaleDevice::Erase ( )  [virtual]
```

Erases the device configuration and restores the device to a blank state.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

Implements ProgrammableDevice.

#### 7.80.4.2 GetDescription()

```
string XilinxUltrascaleDevice::GetDescription ( )  [virtual]
```

Gets a human-readable description of this device.

Example: "Xilinx XC6SLX45 stepping 3"

**Returns**

Device description

Implements JtagDevice.

#### 7.80.4.3 GetSerialNumber()

```
void XilinxUltrascaleDevice::GetSerialNumber (
            unsigned char * data )  [virtual]
```

Gets the device's unique serial number.

Note that some architectures, such as Spartan-6, cannot read the serial number over JTAG without erasing the FPGA configuration. If this is the case, calling this function will automatically erase the FPGA.

Call ReadingSerialRequiresReset() to see if this is the case.

**Exceptions**

| | |
|---|---|
| *JtagException* | if an error occurs during the read operation |

**Parameters**

| | |
|---|---|
| *data* | Buffer to store the serial number into. Must be at least as large as the size given by GetSerialNumberLength(). |

Implements SerialNumberedDevice.

#### 7.80.4.4 GetSerialNumberLength()

```
int XilinxUltrascaleDevice::GetSerialNumberLength ( )  [virtual]
```

Gets the length of the device's unique serial number, in bytes (rounded up to the nearest whole byte).

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.80.4.5 GetSerialNumberLengthBits()

```
int XilinxUltrascaleDevice::GetSerialNumberLengthBits ( )  [virtual]
```

Gets the length of the device's unique serial number, in bits.

**Returns**

Serial number length

Implements SerialNumberedDevice.

#### 7.80.4.6 IsProgrammed()

```
bool XilinxUltrascaleDevice::IsProgrammed ( )  [virtual]
```

Determines if this device is programmed or blank.

**Returns**

true if programmed, false if blank

Implements ProgrammableDevice.

#### 7.80.4.7 LoadFirmwareImage()

```
FirmwareImage * XilinxUltrascaleDevice::LoadFirmwareImage (
            const unsigned char * data,
            size_t len )  [virtual]
```

Parses an in-memory image of a firmware image into a format suitable for loading into the device.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the image is malformed |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the start of the firmware image, including headers |
| *len* | Length of the firmware image |

**Returns**

Pointer to an FirmwareImage object suitable for passing to Configure().

Implements ProgrammableDevice.

#### 7.80.4.8 ParseBitstreamInternals()

```
void XilinxUltrascaleDevice::ParseBitstreamInternals (
            const unsigned char * data,
            size_t len,
            XilinxFPGABitstream * bitstream,
            size_t fpos )  [protected], [virtual]
```

Parse a full bitstream image (specific to the derived FPGA family)

**Exceptions**

| | |
|---|---|
| *JtagException* | if the bitstream is malformed or for the wrong device family |

**Parameters**

| | |
|---|---|
| *data* | Pointer to the bitstream data |
| *len* | Length of the bitstream |
| *bitstream* | The bitstream object to load into |
| *fpos* | Position in the bitstream image to start parsing (after the end of headers) |
| *bVerbose* | Set to true for verbose debug output on bitstream internals |

Implements XilinxFPGA.

#### 7.80.4.9 Program()

```
void XilinxUltrascaleDevice::Program (
            FirmwareImage * image )  [virtual]
```

Loads a new firmware image onto the device.

After this function is called, regardless of success or failure, all existing connections to on-chip code become invalid.

**Exceptions**

| | |
|---|---|
| *JtagException* | if the erase operation fails |

**Parameters**

| | |
|---|---|
| *image* | The parsed image to load |

Implements ProgrammableDevice.

#### 7.80.4.10 ReadWordConfigRegister()

```
uint32_t XilinxUltrascaleDevice::ReadWordConfigRegister (
            unsigned int reg )  [protected], [virtual]
```

Reads a single 32-bit word from a config register.

Reference: UG570 page 164

Note that UltraScale devices expect data clocked in MSB first but the JTAG API clocks data LSB first. Some swapping is required as a result.

Clock data into CFG_IN register Synchronization word Nop Read STAT register Two dummy words to flush packet buffer

Read from CFG_OUT register

**Exceptions**

| | |
|---|---|
| *JtagException* | if the read fails |

**Parameters**

| | |
|---|---|
| *reg* | The configuration register to read |

Implements XilinxFPGA.

The documentation for this class was generated from the following files:

- XilinxUltrascaleDevice.h
- XilinxUltrascaleDevice.cpp

## 7.81 XilinxUltrascaleDeviceConfigurationFrame Union Reference

UltraScale configuration frame (see UG570 page 158)

```
#include <XilinxUltrascaleDevice.h>
```

### Public Member Functions

- struct {
  unsigned int count:11
  *Count field.*
  unsigned int reserved:2
  *Reserved, must be zero.*
  unsigned int reg_addr:14
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits
- struct {
  unsigned int count:27
  *Count field.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits_type2

### Public Attributes

- uint32_t word

  *The raw configuration word.*

## 7.81.1 Detailed Description

UltraScale configuration frame (see UG570 page 158)

Same as 7 series

## 7.81.2 Member Data Documentation

### 7.81.2.1 op

```
unsigned int XilinxUltrascaleDeviceConfigurationFrame::op
```

Opcode.

Must be one of the following:

- XilinxUltrascaleDevice::CONFIG_OP_NOP
- XilinxUltrascaleDevice::CONFIG_OP_READ
- XilinxUltrascaleDevice::CONFIG_OP_WRITE

Must be zero

### 7.81.2.2 type

```
unsigned int XilinxUltrascaleDeviceConfigurationFrame::type
```

Frame type.

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_1

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_2

The documentation for this union was generated from the following file:

- XilinxUltrascaleDevice.h

## 7.82 XilinxUltrascaleDeviceStatusRegister Union Reference

UltraScale status register (see UG570 table 9-25)

`#include <XilinxUltrascaleDevice.h>`

### Public Member Functions

- struct {
  unsigned int crc_err:1
  *Indicates that the device failed to configure due to a CRC error.*
  unsigned int decryptor_enabled:1
  *Indicates that the crypto subsystem is active.*
  unsigned int mmcm_lock:1
  *Indicates MMCMs and PLLs are locked.*
  unsigned int dci_match:1
  *Indicates DCI is matched.*
  unsigned int eos:1
  *End-of-Startup signal.*
  unsigned int gts_cfg_b:1
  *Status of GTS_CFG net.*
  unsigned int gwe:1
  *Status of GWE net.*
  unsigned int ghigh_b:1
  *Status of GHIGH_B net.*
  unsigned int mode_pins:3
  *Status of mode pins.*
  unsigned int init_complete:1
  *Internal init-finished signal.*
  unsigned int init_b:1
  *Status of INIT_B pin.*
  unsigned int release_done:1
  *Indicates DONE was released.*
  unsigned int done:1
  *Actual value on DONE pin.*
  unsigned int id_error:1
  *Indicates an ID code error occurred (write with wrong bitstream)*
  unsigned int security_error:1
  *Security / crypto error.*
  unsigned int sysmon_over_temp:1
  *Indicates board is too hot.*
  unsigned int startup_state:3
  *Status of startup state machine.*
  unsigned int reserved_1:4
  *Reserved.*
  unsigned int bus_width:2
  *Config bus width (see table 5-26)*
  unsigned int reserved_2:5
  *Reserved.*
  } **__attribute__** ((packed)) bits

### Public Attributes

- uint32_t word
  *The raw status register value.*

### 7.82.1 Detailed Description

UltraScale status register (see UG570 table 9-25)

Very similar to the 7-series status register but with a few fields renamed.

The documentation for this union was generated from the following file:

- XilinxUltrascaleDevice.h

# Chapter 8

# File Documentation

## 8.1 ARM7TDMISProcessor.cpp File Reference

Implementation of ARM7TDMISProcessor.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
```

Include dependency graph for ARM7TDMISProcessor.cpp:

### 8.1.1 Detailed Description

Implementation of ARM7TDMISProcessor.

**Author**

Andrew D. Zonenberg

## 8.2 ARM7TDMISProcessor.h File Reference

Declaration of ARM7TDMISProcessor.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARM7TDMISProcessor

  *An ARM7TDMI-S CPU core supporting the ARMv4 architecture, as seen over JTAG (no CoreSight support)*

### 8.2.1 Detailed Description

Declaration of ARM7TDMISProcessor.

**Author**

Andrew D. Zonenberg

## 8.3 ARMAPBDevice.cpp File Reference

Implementation of ARMAPBDevice.

```
#include "jtaghal.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMAPBDevice.h"
```

Include dependency graph for ARMAPBDevice.cpp:

### 8.3.1 Detailed Description

Implementation of ARMAPBDevice.

**Author**

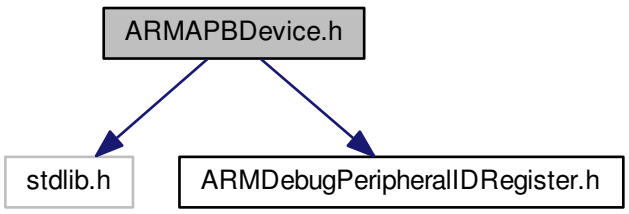
Andrew D. Zonenberg

## 8.4 ARMAPBDevice.h File Reference

Declaration of ARMAPBDevice.

```
#include <stdlib.h>
#include "ARMDebugPeripheralIDRegister.h"
```

Include dependency graph for ARMAPBDevice.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class ARMAPBDevice

  *A device attached to an ARM APB bus (may be a debug core or something else)*

### 8.4.1 Detailed Description

Declaration of ARMAPBDevice.

**Author**

Andrew D. Zonenberg

## 8.5 ARMCoreSightDevice.cpp File Reference

Base class for ARM CoreSight components on a debug APB bus.

```
#include "jtaghal.h"
#include "ARMAPBDevice.h"
#include "ARMCoreSightDevice.h"
```

Include dependency graph for ARMCoreSightDevice.cpp:

### 8.5.1 Detailed Description

Base class for ARM CoreSight components on a debug APB bus.

**Author**

Andrew D. Zonenberg

## 8.6 ARMCoreSightDevice.h File Reference

Declaration of ARMCoreSightDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMCoreSightDevice

  *Base class for ARM CoreSight components (other than CPU cores) on a debug APB bus.*

### 8.6.1 Detailed Description

Declaration of ARMCoreSightDevice.

**Author**

Andrew D. Zonenberg

## 8.7 ARMCortexA57.cpp File Reference

Implementation of ARMCortexA57.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMCortexA57.h"
```

Include dependency graph for ARMCortexA57.cpp:

### 8.7.1 Detailed Description

Implementation of ARMCortexA57.

**Author**

Andrew D. Zonenberg

## 8.8 ARMCortexA57.h File Reference

Declaration of ARMCortexA57.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMCortexA57

  *An ARM Cortex-A57 CPU core, as seen over a CoreSight APB bus.*

### 8.8.1 Detailed Description

Declaration of ARMCortexA57.

**Author**

Andrew D. Zonenberg

## 8.9 ARMCortexA9.cpp File Reference

Implementation of ARMCortexA9.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMCortexA9.h"
```

Include dependency graph for ARMCortexA9.cpp:

### 8.9.1 Detailed Description

Implementation of ARMCortexA9.

**Author**

Andrew D. Zonenberg

## 8.10 ARMCortexA9.h File Reference

Declaration of ARMCortexA9.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMCortexA9

  *An ARM Cortex-A9 CPU core, as seen over a CoreSight APB bus.*

### 8.10.1 Detailed Description

Declaration of ARMCortexA9.

**Author**

Andrew D. Zonenberg

## 8.11 ARMCortexM4.cpp File Reference

Implementation of ARMCortexM4.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMCortexM4.h"
```

Include dependency graph for ARMCortexM4.cpp:

### 8.11.1 Detailed Description

Implementation of ARMCortexM4.

**Author**

Andrew D. Zonenberg

## 8.12 ARMCortexM4.h File Reference

Declaration of ARMCortexM4.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMCortexM4

  *An ARM Cortex-M4 CPU core, as seen over a CoreSight APB bus.*

### 8.12.1 Detailed Description

Declaration of ARMCortexM4.

**Author**

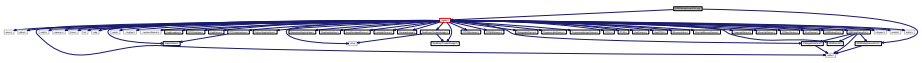
Andrew D. Zonenberg

## 8.13 ARMDebugAccessPort.cpp File Reference

Implementation of ARMDebugAccessPort.

```
#include "jtaghal.h"
#include "ARMDebugAccessPort.h"
```

Include dependency graph for ARMDebugAccessPort.cpp:



### 8.13.1 Detailed Description

Implementation of ARMDebugAccessPort.

**Author**

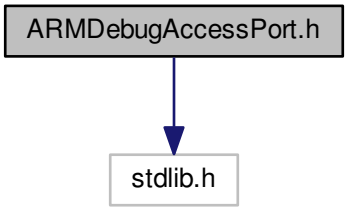
Andrew D. Zonenberg

## 8.14 ARMDebugAccessPort.h File Reference

Declaration of ARMDebugAccessPort.

```
#include <stdlib.h>
```

Include dependency graph for ARMDebugAccessPort.h:




This graph shows which files directly or indirectly include this file:

### Classes

- union ARMDebugPortIDRegister
  *ARM debug port identification register (see ADIv5 Architecture Specification figure 6-3)*
- class ARMDebugAccessPort
  *Base class for all access ports within an ARMDebugPort.*

### Functions

- union ARMDebugPortIDRegister **__attribute__** ((packed))

### Variables

- unsigned int type
  *Type of AP.*
- unsigned int variant
  *Variant of AP.*
- unsigned int reserved_zero
  *Reserved, SBZ.*
- unsigned int is_mem_ap
  *Class (1 = mem-AP, 0=not mem-AP)*
- unsigned int identity
  *Identity code (must be 0x3B)*
- unsigned int continuation
  *Continuation code (must be 0x4)*
- unsigned int revision
  *Revision of the AP design.*
- uint32_t word
  *The raw status register value.*
- class ARMDebugAccessPort **__attribute__**

## 8.14.1 Detailed Description

Declaration of ARMDebugAccessPort.

**Author**

Andrew D. Zonenberg

## 8.14.2 Variable Documentation

### 8.14.2.1 reserved_zero

```
unsigned int reserved_zero
```

Reserved, SBZ.

Reserved, should be zero.

#### 8.14.2.2 revision

```
unsigned int revision
```

Revision of the AP design.

Implementation defined CPU revision.

#### 8.14.2.3 type

```
unsigned int type
```

Type of AP.

Frame type.

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_2

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_1

Must be one of the following:

- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_1
- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_2

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_1
- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_2

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_2

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_1

#### 8.14.2.4 variant

```
unsigned int variant
```

Variant of AP.

Implementation defined CPU variant.

#### 8.14.2.5 word

```
uint32_t word
```

The raw status register value.

The raw register value.

## 8.15 ARMDebugMemAccessPort.cpp File Reference

Implementation of ARMDebugMemAccessPort.

```
#include "jtaghal.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMCoreSightDevice.h"
```

Include dependency graph for ARMDebugMemAccessPort.cpp:

### 8.15.1 Detailed Description

Implementation of ARMDebugMemAccessPort.

**Author**

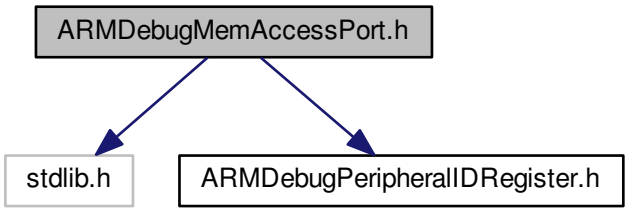
Andrew D. Zonenberg

## 8.16 ARMDebugMemAccessPort.h File Reference

Declaration of ARMDebugMemAccessPort.

```
#include <stdlib.h>
#include "ARMDebugPeripheralIDRegister.h"
```

Include dependency graph for ARMDebugMemAccessPort.h:




This graph shows which files directly or indirectly include this file:

### Classes

- union ARMDebugMemAPControlStatusWord

  *Contents of the CSW register in a MEM-AP (see ADIv5 Architecture Specification 7.6.4)*
- class ARMDebugMemAccessPort

  *A bridge from an ARMDebugPort to an ARM memory bus.*

### Functions

- union ARMDebugMemAPControlStatusWord **__attribute__** ((packed))

### Variables

- unsigned int size

  *Size of the access to perform.*
- unsigned int reserved_zero_1

  *Reserved, should be zero.*
- unsigned int auto_increment

  *Address increment/pack mode.*
- unsigned int enable

  *Debug port enable (RO)*
- unsigned int busy

  *Transfer in progress.*
- unsigned int mode

  *Operating mode (write as zero, read undefined)*
- unsigned int reserved_zero_2

  *Reserved, should be zero.*
- unsigned int secure_priv_debug

  *Secure privileged debug flag (not sure what this is)*
- unsigned int bus_protect

  *Bus access protection (implementation defined)*
- unsigned int nonsecure_transfer

  *Secure transfer (high=nonsecure)*
- unsigned int **reserved_zero_3**
- uint32_t word

  *The raw status register value.*
- ARMDebugMemAccessPort **__attribute__**

## 8.16.1 Detailed Description

Declaration of ARMDebugMemAccessPort.

**Author**

Andrew D. Zonenberg

## 8.16.2 Variable Documentation

#### 8.16.2.1 mode

```
unsigned int mode
```

Operating mode (write as zero, read undefined)

Status of the mode bits.

## 8.17 ARMDebugPeripheralIDRegister.h File Reference

Declaration of ARMDebugPeripheralIDRegister.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMDebugPeripheralIDRegisterBits
  *ADI component ID register bitfield.*
- union ARMDebugPeripheralIDRegister
  *ADI component ID register.*

### Functions

- class ARMDebugPeripheralIDRegisterBits **__attribute__** ((packed))

### Variables

- unsigned int partnum
  *Part number (TODO)*
- unsigned int jep106_id
  *JEP106 identity code.*
- unsigned int jep106_used
  *Indicates if JEP106 code is valid.*
- unsigned int revnum
  *Peripheral revision number.*
- unsigned int cust_mod
  *Customer modification ID.*
- unsigned int revand
  *Manufacturer rev number (stepping)*
- unsigned int jep106_cont
  *JEP106 continuation code.*
- unsigned int log_4k_blocks
  *Log2(#4K address space blocks)*
- unsigned int reserved_zero
  *Unmapped.*
- ARMDebugPeripheralIDRegisterBits bits
  *The bitfield.*
- uint64_t word
  *The raw status register value.*

### 8.17.1 Detailed Description

Declaration of ARMDebugPeripheralIDRegister.

**Author**

Andrew D. Zonenberg

## 8.18 ARMDebugPort.h File Reference

Declaration of ARMDebugPort.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMDebugPort

  *Base class for ARM debug ports (JTAG-DP, SWJ-DP, etc)*

### Variables

- ARMDebugPort **__attribute__**

### 8.18.1 Detailed Description

Declaration of ARMDebugPort.

**Author**

Andrew D. Zonenberg

## 8.19 ARMDevice.cpp File Reference

Implementation of ARMDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
```

Include dependency graph for ARMDevice.cpp:

### 8.19.1 Detailed Description

Implementation of ARMDevice.

**Author**

Andrew D. Zonenberg

## 8.20 ARMDevice.h File Reference

Declaration of ARMDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMDevice
  *Abstract base class for all ARM Ltd JTAG devices (ADIv5 DAP or legacy CPUs with their own JTAG TAPs)*

### Enumerations

- enum ARM_IDCODES { **IDCODE_ARM_DAP_JTAG** = 0xBA00, **IDCODE_ARM_7TDMI_S** = 0xF1F0 }
  *JTAG part number for ARM JTAG DAP.*

### 8.20.1 Detailed Description

Declaration of ARMDevice.

**Author**

Andrew D. Zonenberg

## 8.21 ARMFlashPatchBreakpoint.cpp File Reference

ARM Cortex-M Flash Patch/Breakpoint.

```
#include "jtaghal.h"
#include "ARMAPBDevice.h"
#include "ARMFlashPatchBreakpoint.h"
```

Include dependency graph for ARMFlashPatchBreakpoint.cpp:

### 8.21.1 Detailed Description

ARM Cortex-M Flash Patch/Breakpoint.

**Author**

Andrew D. Zonenberg

## 8.22 ARMFlashPatchBreakpoint.h File Reference

Declaration of ARMFlashPatchBreakpoint.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMFlashPatchBreakpoint

  *Cortex-M Flash Patch/Breakpoint Unit (see ARMv7-M architecture ref C1.11)*

### 8.22.1 Detailed Description

Declaration of ARMFlashPatchBreakpoint.

**Author**

Andrew D. Zonenberg

## 8.23 ARMJtagDebugPort.cpp File Reference

Implementation of ARMJtagDebugPort.

```
#include "jtaghal.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMAPBDevice.h"
```

Include dependency graph for ARMJtagDebugPort.cpp:

### 8.23.1 Detailed Description

Implementation of ARMJtagDebugPort.

**Author**

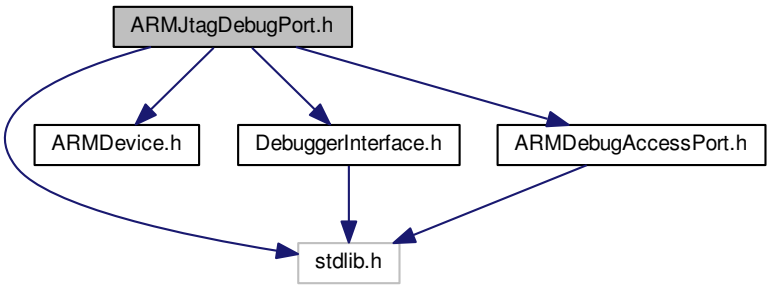
Andrew D. Zonenberg

## 8.24 ARMJtagDebugPort.h File Reference

Declaration of ARMJtagDebugPort.

```
#include <stdlib.h>
#include "ARMDevice.h"
#include "DebuggerInterface.h"
#include "ARMDebugAccessPort.h"
```

Include dependency graph for ARMJtagDebugPort.h:




This graph shows which files directly or indirectly include this file:

### Classes

- union ARMJtagDebugPortStatusRegister

  *ARM debug port status register (see ADIv5 Architecture Specification figure 6-3)*
- class ARMJtagDebugPort

  *An ARM JTAG-DP (contains one or more APs and a DP)*

### Functions

- union ARMJtagDebugPortStatusRegister **__attribute__** ((packed))

### Variables

- unsigned int sticky_overrun_en

  *Set to 1 to enable overrun detection.*
- unsigned int sticky_overrun

  *Sticky buffer overrun (if enabled)*
- unsigned int transfer_mode

  *Transfer mode.*
- unsigned int sticky_compare

*Sticky compare bit.*

- unsigned int sticky_err
  *Sticky error bit.*
- unsigned int read_ok
  *Read status flag.*
- unsigned int wr_data_err
  *Write data error flag.*
- unsigned int mask_lane
  *Byte mask.*
- unsigned int trans_count
  *Transaction counter.*
- unsigned int reserved_zero
  *Reserved, should be zero.*
- unsigned int debug_reset_req
  *Debug reset request.*
- unsigned int debug_reset_ack
  *Debug reset acknowledgement.*
- unsigned int debug_pwrup_req
  *Powerup request.*
- unsigned int debug_pwrup_ack
  *Powerup acknowledgement.*
- unsigned int sys_pwrup_req
  *Powerup request.*
- unsigned int sys_pwrup_ack
  *Powerup acknowledgement.*
- uint32_t word
  *The raw status register value.*
- ARMJtagDebugPort **__attribute__**

### 8.24.1 Detailed Description

Declaration of ARMJtagDebugPort.

**Author**

Andrew D. Zonenberg

## 8.25 ARMv7MProcessor.cpp File Reference

Implementation of ARMv7MProcessor.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMv7MProcessor.h"
```

Include dependency graph for ARMv7MProcessor.cpp:

### 8.25.1 Detailed Description

Implementation of ARMv7MProcessor.

**Author**

Andrew D. Zonenberg

## 8.26 ARMv7MProcessor.h File Reference

Declaration of ARMv7MProcessor.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMv7MProcessor

  *An ARMv7 Cortex-M CPU core, as seen over a CoreSight APB bus.*

### 8.26.1 Detailed Description

Declaration of ARMv7MProcessor.

**Author**

Andrew D. Zonenberg

## 8.27 ARMv7Processor.cpp File Reference

Implementation of ARMv7Processor.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMv7Processor.h"
```

Include dependency graph for ARMv7Processor.cpp:

### 8.27.1 Detailed Description

Implementation of ARMv7Processor.

**Author**

Andrew D. Zonenberg

## 8.28 ARMv7Processor.h File Reference

Declaration of ARMv7Processor.

This graph shows which files directly or indirectly include this file:

### Classes

- union ARMv7DebugIDRegister

  *ARM debug ID register (see ARMv7 Architecture Reference Manual, C11.11.15)*
- union ARMv7DebugStatusControlRegister

  *ARM debug status/control register (see ARMv7 Architecture Reference Manual, C11.11.20)*
- class ARMv7Processor

  *An ARMv7 Cortex-A CPU core, as seen over a CoreSight APB bus.*

### Enumerations

- enum ARMDebugArchVersion {
  ARM_DEBUG_V6 = 1, ARM_DEBUG_V6_P1 = 2, ARM_DEBUG_V7_FULL = 3, ARM_DEBUG_V7_MIN = 4,
  ARM_DEBUG_V7_P1 = 5 }

### Functions

- union ARMv7DebugIDRegister **__attribute__** ((packed))

### Variables

- unsigned int revision

  *Implementation defined CPU revision.*
- unsigned int variant

  *Implementation defined CPU variant.*
- unsigned int reserved

  *Reserved, undefined value.*
- unsigned int sec_ext

  *Indicates if security extensions are implemented.*
- unsigned int pcsr_legacy_addr

  *Indicates if PCSR is present at the legacy address.*
- unsigned int no_secure_halt

  *NO secure halting debug.*
- unsigned int has_dbgdevid

  *True if DBGDEVID is implemented.*
- ARMDebugArchVersion debug_arch_version

  *Debug arch version.*
- unsigned int context_bpoints_minus_one

  *Number of breakpoints supporting context matching, zero based (0 means 1 implemented, etc)*
- unsigned int bpoints_minus_one

  *Number of breakpoints, zero based (0 means 1 implemented, etc)*
- unsigned int wpoints_minus_one

  *Number of watchpoints, zero based (0 means 1 implemented, etc)*
- uint32_t word

  *The raw register value.*
- unsigned int halted

  *Set by the CPU when the processor is halted.*
- unsigned int restarted

  *Processor restarted flag.*
- unsigned int entry_method

  *Method of debug entry (TODO)*
- unsigned int sticky_sync_abt

  *Sticky sync abort.*
- unsigned int sticky_async_abt

  *Sticky async abort.*
- unsigned int sticky_undef_instr

  *Sticky undefined instruction.*
- unsigned int reserved_sbz2

  *Reserved.*
- unsigned int force_dbg_ack

  *Force debug acks regardless of cpu settings.*
- unsigned int int_dis

  *Disable interrupts.*
- unsigned int user_dcc

  *Enable user-mode access to the debug channel.*
- unsigned int inst_txfr

  *Enable instruction transfer.*
- unsigned int halting_debug

  *Enable halting-mode debug.*
- unsigned int monitor_debug

*Set high by the CPU if it allows monitor-mode debugging.*

- unsigned int secure_ni_debug

  *Set high by the CPU if it allows invasive debug in secure mode.*
- unsigned int deprecated

  *Deprecated "secure noninvasive debug" bit.*
- unsigned int nonsec

  *Set high by the CPU if it is not in secure mode.*
- unsigned int discard_async_abort

  *Set high to discard async aborts.*
- unsigned int ext_dcc_mode

  *DCC access mode (TODO enum)*
- unsigned int instr_complete

  *Latching instruction-complete bit for single instruction issue.*
- unsigned int pipelined_advancing

  *Sticky "pipeline advancing" bit, set at unpredictable intervals when not halted.*
- unsigned int tx_full_latch

  *Latching TX-full bit.*
- unsigned int rx_full_latch

  *Latching RX-full bit.*
- unsigned int tx_full

  *Indicates DBGDTRTX has valid data.*
- unsigned int rx_full

  *Indicates DBGDTRRX has valid data.*
- unsigned int reserved_sbz

  *Reserved, should be zero.*
- ARMv7Processor **__attribute__**

### 8.28.1 Detailed Description

Declaration of ARMv7Processor.

**Author**

Andrew D. Zonenberg

### 8.28.2 Enumeration Type Documentation

#### 8.28.2.1 ARMDebugArchVersion

```
enum ARMDebugArchVersion
```

**Enumerator**

| | |
|---|---|
| ARM_DEBUG_V6 | ARMv6, v6 debug arch. |
| ARM_DEBUG_V6_P1 | ARMv6, v6.1 debug arch. |
| ARM_DEBUG_V7_FULL | ARMv7, v7 debug, full CP14. |
| ARM_DEBUG_V7_MIN | ARMv7, v7 debug, only baseline cp14. |
| ARM_DEBUG_V7_P1 | ARMv7, v7.1 debug. |

### 8.28.3 Variable Documentation

#### 8.28.3.1 reserved

```
unsigned int reserved
```

Reserved, undefined value.

Reserved.

Reserved, must be zero.

## 8.29 ARMv8Processor.cpp File Reference

Implementation of ARMv8Processor.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
#include "ARMAPBDevice.h"
#include "ARMDebugAccessPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMv8Processor.h"
```

Include dependency graph for ARMv8Processor.cpp:

### 8.29.1 Detailed Description

Implementation of ARMv8Processor.

**Author**

Andrew D. Zonenberg

## 8.30 ARMv8Processor.h File Reference

Declaration of ARMv8Processor.

This graph shows which files directly or indirectly include this file:

### Classes

- class ARMv8Processor

  *An ARMv8 Cortex-A CPU core, as seen over a CoreSight APB bus.*

### 8.30.1 Detailed Description

Declaration of ARMv8Processor.

**Author**

Andrew D. Zonenberg

## 8.31 AttachedMemoryDevice.h File Reference

Declaration of AttachedMemoryDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class AttachedMemoryDevice

  *Base classes for devices which can connect to external memory devices.*

### 8.31.1 Detailed Description

Declaration of AttachedMemoryDevice.

**Author**

Andrew D. Zonenberg

## 8.32 ByteArrayFirmwareImage.cpp File Reference

Implementation of ByteArrayFirmwareImage.

```
#include "jtaghal.h"
```

Include dependency graph for ByteArrayFirmwareImage.cpp:

### 8.32.1 Detailed Description

Implementation of ByteArrayFirmwareImage.

**Author**

Andrew D. Zonenberg

## 8.33 ByteArrayFirmwareImage.h File Reference

Declaration of ByteArrayFirmwareImage.

This graph shows which files directly or indirectly include this file:

### Classes

- class ByteArrayFirmwareImage

  *Generic base class for all firmware images consisting of an array of bytes.*

### 8.33.1 Detailed Description

Declaration of ByteArrayFirmwareImage.

**Author**

Andrew D. Zonenberg

## 8.34 CPLD.cpp File Reference

Implementation of CPLD.

```
#include "jtaghal.h"
```

Include dependency graph for CPLD.cpp:

### 8.34.1 Detailed Description

Implementation of CPLD.

**Author**

Andrew D. Zonenberg

## 8.35 CPLD.h File Reference

Declaration of CPLD.

This graph shows which files directly or indirectly include this file:

### Classes

- class CPLD

  *Generic base class for all complex programmable logic devices.*

### 8.35.1 Detailed Description

Declaration of CPLD.

**Author**

Andrew D. Zonenberg

## 8.36 CPLDBitstream.cpp File Reference

Implementation of CPLDBitstream.

```
#include "jtaghal.h"
```

Include dependency graph for CPLDBitstream.cpp:

### 8.36.1 Detailed Description

Implementation of CPLDBitstream.

**Author**

Andrew D. Zonenberg

## 8.37 CPLDBitstream.h File Reference

Declaration of CPLDBitstream.

This graph shows which files directly or indirectly include this file:

### Classes

- class CPLDBitstream

  *Abstract base class for CPLD configuration bitstreams.*

### 8.37.1 Detailed Description

Declaration of CPLDBitstream.

#### Author

Andrew D. Zonenberg

## 8.38 DebuggableDevice.cpp File Reference

Implementation of DebuggableDevice.

```
#include "jtaghal.h"
#include "DebuggableDevice.h"
```

Include dependency graph for DebuggableDevice.cpp:

### 8.38.1 Detailed Description

Implementation of DebuggableDevice.

#### Author

Andrew D. Zonenberg

## 8.39 DebuggableDevice.h File Reference

Declaration of DebuggableDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class DebuggableDevice

  *Generic base class for all debuggable devices (CPU cores etc)*

### 8.39.1 Detailed Description

Declaration of DebuggableDevice.

**Author**

Andrew D. Zonenberg

## 8.40 DebuggerInterface.cpp File Reference

Implementation of DebuggerInterface.

```
#include "jtaghal.h"
#include "DebuggerInterface.h"
```

Include dependency graph for DebuggerInterface.cpp:

### 8.40.1 Detailed Description

Implementation of DebuggerInterface.

**Author**

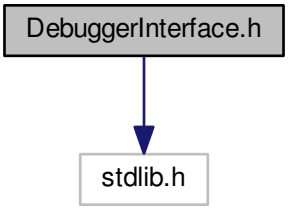
Andrew D. Zonenberg

## 8.41 DebuggerInterface.h File Reference

Declaration of DebuggerInterface.

```
#include <stdlib.h>
```

Include dependency graph for DebuggerInterface.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class DebuggerInterface

  *Generic base class for all debugger interfaces (may connect to multiple DebuggableDevice's in a SoC)*

#### 8.41.1 Detailed Description

Declaration of DebuggerInterface.

**Author**

Andrew D. Zonenberg

## 8.42 DigilentJtagInterface.cpp File Reference

Implementation of DigilentJtagInterface.

```
#include "jtaghal.h"
#include <digilent/adept/dpcdecl.h>
#include <digilent/adept/dpcdefs.h>
#include <digilent/adept/dpcutil.h>
#include <digilent/adept/djtg.h>
#include <digilent/adept/dmgr.h>
```

Include dependency graph for DigilentJtagInterface.cpp:

#### 8.42.1 Detailed Description

Implementation of DigilentJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.43 DigilentJtagInterface.h File Reference

Declaration of DigilentJtagInterface.

This graph shows which files directly or indirectly include this file:

### Classes

- class DigilentJtagInterface

  *A JTAG adapter exposed through the Digilent Adept SDK.*

### 8.43.1 Detailed Description

Declaration of DigilentJtagInterface.

#### Author

Andrew D. Zonenberg

## 8.44 FirmwareImage.cpp File Reference

Implementation of FirmwareImage.

```
#include "jtaghal.h"
```

Include dependency graph for FirmwareImage.cpp:

### 8.44.1 Detailed Description

Implementation of FirmwareImage.

#### Author

Andrew D. Zonenberg

## 8.45 FirmwareImage.h File Reference

Declaration of FirmwareImage.

This graph shows which files directly or indirectly include this file:

### Classes

- class FirmwareImage

  *Generic base class for all firmware images for any kind of programmable device.*

### 8.45.1 Detailed Description

Declaration of FirmwareImage.

**Author**

Andrew D. Zonenberg

## 8.46 FPGA.cpp File Reference

Implementation of FPGA.

```
#include "jtaghal.h"
```

Include dependency graph for FPGA.cpp:

### 8.46.1 Detailed Description

Implementation of FPGA.

**Author**

Andrew D. Zonenberg

## 8.47 FPGA.h File Reference

Declaration of FPGA.

This graph shows which files directly or indirectly include this file:

### Classes

- class FPGA

  *Generic base class for all field-programmable gate array devices.*

### 8.47.1 Detailed Description

Declaration of FPGA.

**Author**

Andrew D. Zonenberg

## 8.48 FPGABitstream.cpp File Reference

Implementation of FPGABitstream.

```
#include "jtaghal.h"
```

Include dependency graph for FPGABitstream.cpp:

### 8.48.1 Detailed Description

Implementation of FPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.49 FPGABitstream.h File Reference

Declaration of FPGABitstream.

This graph shows which files directly or indirectly include this file:

### Classes

- class FPGABitstream

  *Abstract base class for FPGA configuration bitstreams.*

### 8.49.1 Detailed Description

Declaration of FPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.50 FreescaleDevice.cpp File Reference

Implementation of FreescaleDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
```

Include dependency graph for FreescaleDevice.cpp:

### 8.50.1 Detailed Description

Implementation of FreescaleDevice.

**Author**

Andrew D. Zonenberg

## 8.51 FreescaleDevice.h File Reference

Declaration of FreescaleDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class FreescaleDevice

  *Abstract base class for all Freescale devices (typically MCUs or parts thereof)*

### 8.51.1 Detailed Description

Declaration of FreescaleDevice.

**Author**

Andrew D. Zonenberg

## 8.52 FreescaleIMXDevice.cpp File Reference

Implementation of FreescaleIMXDevice.

```
#include "jtaghal.h"
#include "FreescaleIMXDevice.h"
#include "memory.h"
```

Include dependency graph for FreescaleIMXDevice.cpp:

### 8.52.1 Detailed Description

Implementation of FreescaleIMXDevice.

**Author**

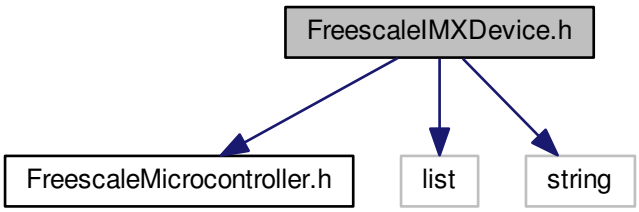
Andrew D. Zonenberg

## 8.53 FreescaleIMXDevice.h File Reference

Declaration of FreescaleIMXDevice.

```
#include "FreescaleMicrocontroller.h"
#include <list>
#include <string>
```

Include dependency graph for FreescaleIMXDevice.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class FreescaleIMXDevice

  *A Freescale i.mx applications processor.*

### Enumerations

- enum **ImxDeviceIDs** { **IMX_6_SOLO** = 0x891B, **IMX_6_DUAL_LITE** = 0x891A }

### 8.53.1 Detailed Description

Declaration of FreescaleIMXDevice.

**Author**

Andrew D. Zonenberg

## 8.54 FreescaleIMXSmartDMA.cpp File Reference

Implementation of FreescaleIMXSmartDMA.

```
#include "jtaghal.h"
#include "FreescaleIMXSmartDMA.h"
#include "STMicroDeviceID_enum.h"
#include "memory.h"
```

Include dependency graph for FreescaleIMXSmartDMA.cpp:

### 8.54.1 Detailed Description

Implementation of FreescaleIMXSmartDMA.

**Author**

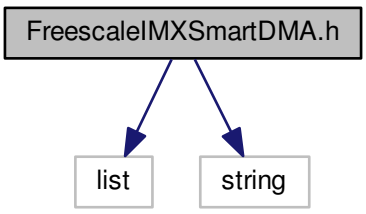
Andrew D. Zonenberg

## 8.55 FreescaleIMXSmartDMA.h File Reference

Declaration of FreescaleIMXSmartDMA.

```
#include <list>
#include <string>
```

Include dependency graph for FreescaleIMXSmartDMA.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class FreescaleIMXSmartDMA

  *The SDMA in a Freescale i.mx SoC (Chapter 55 of i.mx6 reference manual)*

### 8.55.1 Detailed Description

Declaration of FreescaleIMXSmartDMA.

#### Author

Andrew D. Zonenberg

## 8.56 FreescaleMicrocontroller.cpp File Reference

Implementation of FreescaleMicrocontroller.

```
#include "jtaghal.h"
```

Include dependency graph for FreescaleMicrocontroller.cpp:

### 8.56.1 Detailed Description

Implementation of FreescaleMicrocontroller.

#### Author

Andrew D. Zonenberg

## 8.57 FreescaleMicrocontroller.h File Reference

Declaration of FreescaleMicrocontroller.

This graph shows which files directly or indirectly include this file:

### Classes

- class FreescaleMicrocontroller

  *Generic base class for all Freescale MCUs.*

### 8.57.1 Detailed Description

Declaration of FreescaleMicrocontroller.

**Author**

Andrew D. Zonenberg

## 8.58 FTDIJtagInterface.cpp File Reference

Implementation of FTDIJtagInterface.

```
#include "jtaghal.h"
#include <ftd2xx/ftd2xx.h>
```

Include dependency graph for FTDIJtagInterface.cpp:

### Macros

- #define **FTDI_VID** 0x0403 /* FTDI's USB vendor ID */
- #define **PID_232H_JTAG** 0x8028 /* Product ID for azonenberg's FT232H based JTAG system */
- #define **BIT_MODE_RESET** 0x00 /* Reset the MPSSE */
- #define **BIT_MODE_MPSSE** 0x02 /* MPSSE mode */

### Enumerations

- enum **MPSSE_Commands** {
  **MPSSE_TX_BYTES** = 0x19, **MPSSE_TX_BITS** = 0x1b, **MPSSE_TXRX_BYTES** = 0x39, **MPSSE_TXRX_BITS** = 0x3b,
  **MPSSE_TX_TMS_BITS** = 0x4b, **MPSSE_TXRX_TMS_BITS** = 0x6b, **MPSSE_SET_DATA_LOW** = 0x80, **MPSSE_GET_DATA_LOW** = 0x81,
  **MPSSE_SET_DATA_HIGH** = 0x82, **MPSSE_GET_DATA_HIGH** = 0x83, **MPSSE_DISABLE_LOOPBACK** = 0x85, **MPSSE_SET_CLKDIV** = 0x86,
  **MPSSE_FLUSH** = 0x87, **MPSSE_DISABLE_DIV5** = 0x8a, **MPSSE_DISABLE_3PHA** = 0x8d, **MPSSE_DUMMY_CLOCK_BITS** = 0x8e,
  **MPSSE_DUMMY_CLOCK_BYTES** = 0x8f, **MPSSE_DISABLE_ADAPTIVE_CLK** = 0x97, **MPSSE_INVALID_COMMAND** = 0xAA, **MPSSE_INVALID_COMMAND_RESPONSE** = 0xFA }

### 8.58.1 Detailed Description

Implementation of FTDIJtagInterface.

**Author**

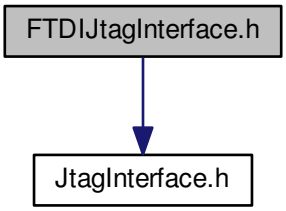
Andrew D. Zonenberg

## 8.59 FTDIJtagInterface.h File Reference

Declaration of FTDIJtagInterface.

```
#include "JtagInterface.h"
```

Include dependency graph for FTDIJtagInterface.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class FTDIJtagInterface

  *A JTAG adapter using the FTDI chipset, accessed through libftd2xx (proprietary driver from FTDI)*

### 8.59.1 Detailed Description

Declaration of FTDIJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.60 GPIOInterface.cpp File Reference

Implementation of GPIOInterface.

```
#include "jtaghal.h"
```

Include dependency graph for GPIOInterface.cpp:

### 8.60.1 Detailed Description

Implementation of GPIOInterface.

**Author**

Andrew D. Zonenberg

## 8.61 GPIOInterface.h File Reference

Declaration of GPIOInterface.

This graph shows which files directly or indirectly include this file:

### Classes

- class GPIOInterface

  *A GPIO bitbang interface. Many JTAG adapters have uncommitted GPIOs which may be used for test purposes.*

### 8.61.1 Detailed Description

Declaration of GPIOInterface.

**Author**

Andrew D. Zonenberg

## 8.62 JtagDevice.cpp File Reference

Implementation of JtagDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
#include "UserVID_enum.h"
#include "UserPID_enum.h"
```

Include dependency graph for JtagDevice.cpp:

### 8.62.1 Detailed Description

Implementation of JtagDevice.

**Author**

Andrew D. Zonenberg

## 8.63 JtagDevice.h File Reference

Declaration of JtagDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class JtagDevice

  *A single TAP in the JTAG chain. May not correspond 1:1 with physical silicon dies.*

### Macros

- #define **RegisterConstant**(c) m_constantMap[(#c)] = c

### 8.63.1 Detailed Description

Declaration of JtagDevice.

**Author**

Andrew D. Zonenberg

## 8.64 JtagDummy.cpp File Reference

Implementation of JtagDummy.

```
#include "jtaghal.h"
```

Include dependency graph for JtagDummy.cpp:

### 8.64.1 Detailed Description

Implementation of JtagDummy.

**Author**

Andrew D. Zonenberg

## 8.65 JtagDummy.h File Reference

Declaration of JtagDummy.

This graph shows which files directly or indirectly include this file:

### Classes

- class JtagDummy

  *An unknown device (IDCODE not recognized, or no IDCODE present) on a JTAG chain.*

### 8.65.1 Detailed Description

Declaration of JtagDummy.

**Author**

Andrew D. Zonenberg

## 8.66 JtagException.cpp File Reference

Implementation of JtagException.

```
#include "jtaghal.h"
```

Include dependency graph for JtagException.cpp:

### 8.66.1 Detailed Description

Implementation of JtagException.

**Author**

Andrew D. Zonenberg

## 8.67 JtagException.h File Reference

Declaration of JtagException.

This graph shows which files directly or indirectly include this file:

### Classes

- class JtagException

  *Base class for all exceptions thrown by libjtaghal.*

### Macros

- #define JtagExceptionWrapper(err, lib_err) JtagException(err, lib_err, __PRETTY_FUNCTION__, __FILE↩ __, __LINE__)

  *Wrapper for JtagException constructor that passes function, file, and line number automatically.*

### 8.67.1 Detailed Description

Declaration of JtagException.

**Author**

Andrew D. Zonenberg

### 8.67.2 Macro Definition Documentation

#### 8.67.2.1 JtagExceptionWrapper

```
#define JtagExceptionWrapper(
            err,
            lib_err ) JtagException(err, lib_err, __PRETTY_FUNCTION__, __FILE__, __LINE__)
```

Wrapper for JtagException constructor that passes function, file, and line number automatically.

**Parameters**

| | |
|---|---|
| *err* | Human-readable error message. Include as much detail as reasonably possible. |
| *lib_err* | Human-readable error string returned from a library (ex: libusb) |

## 8.68 JtagFPGA.cpp File Reference

Implementation of JtagFPGA.

```
#include "jtaghal.h"
```
Include dependency graph for JtagFPGA.cpp:

### 8.68.1 Detailed Description

Implementation of JtagFPGA.

**Author**

Andrew D. Zonenberg

## 8.69 JtagFPGA.h File Reference

Declaration of JtagFPGA.

This graph shows which files directly or indirectly include this file:

### Classes

- class JtagFPGA

  *Abstract base class for all JTAG-programmed FPGAs.*

### 8.69.1 Detailed Description

Declaration of JtagFPGA.

**Author**

Andrew D. Zonenberg

## 8.70 jtaghal.cpp File Reference

Implementation of global functions.

```
#include "jtaghal.h"
```
Include dependency graph for jtaghal.cpp:

## Functions

- bool PeekBit (const unsigned char *data, int nbit)

  *Extracts a bit from a bit string.*
- void PokeBit (unsigned char *data, int nbit, bool val)

  *Writes a bit to a bit string.*
- unsigned char FlipByte (unsigned char c)

  *Flips the bits in a byte.*
- void FlipByteArray (unsigned char *data, int len)

  *Reverses an array of bytes in place without changing bit ordering.*
- void FlipBitArray (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, but does not change byte ordering.*
- void MirrorBitArray (unsigned char *data, int bitlen)

  *Reverses the bit ordering in an array of bits (need not be integer byte size)*
- void FlipEndianArray (unsigned char *data, int len)

  *Swaps endianness in an array of 16-bit values.*
- void FlipEndian32Array (unsigned char *data, int len)

  *Swaps endianness in an array of 32-bit values.*
- void FlipBitAndEndianArray (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 16-bit endianness.*
- void FlipBitAndEndian32Array (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 32-bit endianness.*
- uint16_t GetBigEndianUint16FromByteArray (const unsigned char *data, size_t offset)

  *Casts (data+offset) to a uint16_t and dereferences it with big-endian ordering.*
- uint32_t GetBigEndianUint32FromByteArray (const unsigned char *data, size_t offset)

  *Casts (data+offset) to a uint32_t and dereferences it with big-endian ordering.*
- double GetTime ()

  *Returns a timestamp suitable for performance measurement.*

### 8.70.1 Detailed Description

Implementation of global functions.

**Author**

Andrew D. Zonenberg

### 8.70.2 Function Documentation

#### 8.70.2.1 GetBigEndianUint16FromByteArray()

```
uint16_t GetBigEndianUint16FromByteArray (
            const unsigned char * data,
            size_t offset )
```

Casts (data+offset) to a uint16_t and dereferences it with big-endian ordering.

Byte-level accesses are used to ensure safety for machines requiring aligned access to words.

#### 8.70.2.2 GetBigEndianUint32FromByteArray()

```
uint32_t GetBigEndianUint32FromByteArray (
            const unsigned char * data,
            size_t offset )
```

Casts (data+offset) to a uint32_t and dereferences it with big-endian ordering.

Byte-level accesses are used to ensure safety for machines requiring aligned access to words.

## 8.71 jtaghal.h File Reference

Main library include file.

```
#include <inttypes.h>
#include <unistd.h>
#include <stdint.h>
#include <errno.h>
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <memory.h>
#include <time.h>
#include <list>
#include <map>
#include <string>
#include <vector>
#include "../log/log.h"
#include "../xptools/Socket.h"
#include "JtagException.h"
#include "GPIOInterface.h"
#include "JtagDevice.h"
#include "JtagInterface.h"
#include "DigilentJtagInterface.h"
#include "FTDIJtagInterface.h"
#include "NetworkedJtagInterface.h"
#include "PipeJtagInterface.h"
#include "SerialNumberedDevice.h"
#include "LockableDevice.h"
#include "FirmwareImage.h"
#include "ByteArrayFirmwareImage.h"
#include "RawBinaryFirmwareImage.h"
#include "CPLDBitstream.h"
#include "FPGABitstream.h"
#include "DebuggerInterface.h"
#include "DebuggableDevice.h"
#include "ProgrammableDevice.h"
#include "ProgrammableLogicDevice.h"
#include "CPLD.h"
#include "FPGA.h"
#include "JtagDummy.h"
#include "JtagFPGA.h"
#include "Microcontroller.h"
#include "AttachedMemoryDevice.h"
#include "ARMDevice.h"
```

```
#include "FreescaleDevice.h"
#include "MicrochipDevice.h"
#include "STMicroDevice.h"
#include "XilinxDevice.h"
#include "ARMDebugPort.h"
#include "ARMJtagDebugPort.h"
#include "ARMDebugMemAccessPort.h"
#include "ARMAPBDevice.h"
#include "ARMCoreSightDevice.h"
#include "ARMFlashPatchBreakpoint.h"
#include "ARMv7Processor.h"
#include "ARMv8Processor.h"
#include "ARMv7MProcessor.h"
#include "ARMCortexA57.h"
#include "ARMCortexA9.h"
#include "ARMCortexM4.h"
#include "ARM7TDMISProcessor.h"
#include "FreescaleMicrocontroller.h"
#include "FreescaleIMXDevice.h"
#include "FreescaleIMXSmartDMA.h"
#include "MicrochipMicrocontroller.h"
#include "STMicroMicrocontroller.h"
#include "STM32Device.h"
#include "XilinxCPLD.h"
#include "XilinxCPLDBitstream.h"
#include "XilinxCoolRunnerIIDevice.h"
#include "XilinxFPGABitstream.h"
#include "Xilinx3DFPGABitstream.h"
#include "XilinxFPGA.h"
#include "Xilinx7SeriesDevice.h"
#include "XilinxUltrascaleDevice.h"
#include "XilinxSpartan6Device.h"
#include "XilinxSpartan3ADevice.h"
```

## Macros

- #define **__STDC_FORMAT_MACROS**
- #define **ZFILE_DESCRIPTOR** int

## Functions

- bool PeekBit (const unsigned char *data, int nbit)

  *Extracts a bit from a bit string.*
- void PokeBit (unsigned char *data, int nbit, bool val)

  *Writes a bit to a bit string.*
- unsigned char FlipByte (unsigned char c)

  *Flips the bits in a byte.*
- void FlipByteArray (unsigned char *data, int len)

  *Reverses an array of bytes in place without changing bit ordering.*
- void FlipBitArray (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, but does not change byte ordering.*
- void FlipEndianArray (unsigned char *data, int len)

  *Swaps endianness in an array of 16-bit values.*

- void FlipEndian32Array (unsigned char *data, int len)

  *Swaps endianness in an array of 32-bit values.*
- void FlipBitAndEndianArray (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 16-bit endianness.*
- void FlipBitAndEndian32Array (unsigned char *data, int len)

  *Reverses the bit ordering in an array of bytes, as well as 32-bit endianness.*
- void MirrorBitArray (unsigned char *data, int bitlen)

  *Reverses the bit ordering in an array of bits (need not be integer byte size)*
- uint16_t GetBigEndianUint16FromByteArray (const unsigned char *data, size_t offset)

  *Casts (data+offset) to a uint16_t and dereferences it with big-endian ordering.*
- uint32_t GetBigEndianUint32FromByteArray (const unsigned char *data, size_t offset)

  *Casts (data+offset) to a uint32_t and dereferences it with big-endian ordering.*
- double GetTime ()

  *Returns a timestamp suitable for performance measurement.*

### 8.71.1 Detailed Description

Main library include file.

**Author**

Andrew D. Zonenberg

### 8.71.2 Function Documentation

#### 8.71.2.1 GetBigEndianUint16FromByteArray()

```
uint16_t GetBigEndianUint16FromByteArray (
            const unsigned char * data,
            size_t offset )
```

Casts (data+offset) to a uint16_t and dereferences it with big-endian ordering.

Byte-level accesses are used to ensure safety for machines requiring aligned access to words.

#### 8.71.2.2 GetBigEndianUint32FromByteArray()

```
uint32_t GetBigEndianUint32FromByteArray (
            const unsigned char * data,
            size_t offset )
```

Casts (data+offset) to a uint32_t and dereferences it with big-endian ordering.

Byte-level accesses are used to ensure safety for machines requiring aligned access to words.

## 8.72 JtagInterface.cpp File Reference

Implementation of JtagInterface.

```
#include "jtaghal.h"
```

Include dependency graph for JtagInterface.cpp:

### 8.72.1 Detailed Description

Implementation of JtagInterface.

**Author**

Andrew D. Zonenberg

## 8.73 JtagInterface.h File Reference

Declaration of JtagInterface.

This graph shows which files directly or indirectly include this file:

### Classes

- class JtagInterface

  *Abstract representation of a JTAG adapter.*

### 8.73.1 Detailed Description

Declaration of JtagInterface.

**Author**

Andrew D. Zonenberg

## 8.74 LockableDevice.cpp File Reference

Implementation of LockableDevice.

```
#include "jtaghal.h"
#include "LockableDevice.h"
```

Include dependency graph for LockableDevice.cpp:

### 8.74.1 Detailed Description

Implementation of LockableDevice.

**Author**

Andrew D. Zonenberg

## 8.75 LockableDevice.h File Reference

Declaration of LockableDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class UncertainBoolean

  *A boolean value with an attached level of uncertainty.*
- class LockableDevice

  *Generic base class for all devices which have some kind of read/write protection.*

### 8.75.1 Detailed Description

Declaration of LockableDevice.

**Author**

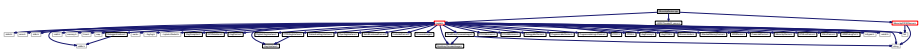
Andrew D. Zonenberg

## 8.76 MicrochipDevice.cpp File Reference

Implementation of MicrochipDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
#include "MicrochipPIC32Device.h"
```

Include dependency graph for MicrochipDevice.cpp:



### 8.76.1 Detailed Description

Implementation of MicrochipDevice.

**Author**

Andrew D. Zonenberg

## 8.77 MicrochipDevice.h File Reference

Declaration of MicrochipDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class MicrochipDevice

  *Abstract base class for all Microchip devices (typically MCUs)*

### 8.77.1 Detailed Description

Declaration of MicrochipDevice.

**Author**

Andrew D. Zonenberg

## 8.78 MicrochipMicrocontroller.cpp File Reference

Implementation of MicrochipMicrocontroller.

```
#include "jtaghal.h"
```

Include dependency graph for MicrochipMicrocontroller.cpp:

### 8.78.1 Detailed Description

Implementation of MicrochipMicrocontroller.

**Author**

Andrew D. Zonenberg

## 8.79 MicrochipMicrocontroller.h File Reference

Declaration of MicrochipMicrocontroller.

This graph shows which files directly or indirectly include this file:

### Classes

- class MicrochipMicrocontroller

  *Generic base class for all Microchip MCUs.*

### 8.79.1 Detailed Description

Declaration of MicrochipMicrocontroller.

**Author**

Andrew D. Zonenberg

## 8.80 MicrochipPIC32Device.cpp File Reference

Implementation of MicrochipPIC32Device.

```
#include "jtaghal.h"
#include "MicrochipPIC32Device.h"
#include "memory.h"
```

Include dependency graph for MicrochipPIC32Device.cpp:

### 8.80.1 Detailed Description

Implementation of MicrochipPIC32Device.

**Author**

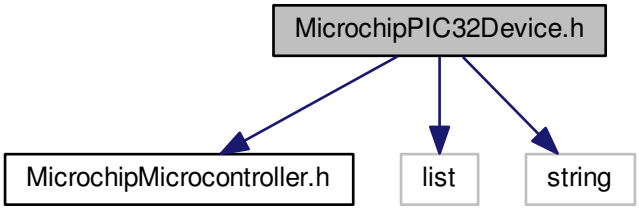
Andrew D. Zonenberg

## 8.81 MicrochipPIC32Device.h File Reference

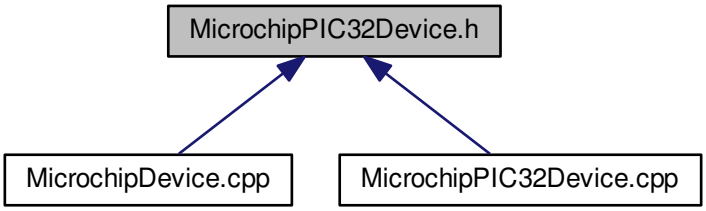
Declaration of MicrochipPIC32Device.

```
#include "MicrochipMicrocontroller.h"
#include <list>
#include <string>
```

Include dependency graph for MicrochipPIC32Device.h:




This graph shows which files directly or indirectly include this file:




### Classes

- union MicrochipPIC32DeviceStatusRegister

  *Status register for a Microchip PIC32 device.*
- union EjtagImplementationCodeRegister

  *MIPS EJTAG implementation register.*
- union EjtagControlRegister

  *PIC32 EJTAG control register.*
- struct MicrochipPIC32DeviceInfo

  *Internal data structure storing properties of a single SKU in the PIC32 family.*
- class MicrochipPIC32Device

  *A Microchip PIC32 microcontroller (MX, MZ, MM, etc)*

### Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))

### Variables

- unsigned int **reset_active**
- unsigned int **flash_en**
- unsigned int **flash_busy**
- unsigned int **cfg_rdy**
- unsigned int **reserved2**
- unsigned int **nvm_error**
- unsigned int **reserved1**
- unsigned int **code_protect_off**
- uint8_t word

  *The raw status register value.*
- unsigned int **processor_is_64**
- unsigned int **no_ejtag_dma**
- unsigned int **mips16_supported**
- unsigned int **reserved3**
- unsigned int **asid_size**
- unsigned int **reserved4**
- unsigned int **dint_supported**
- unsigned int **reserved5**
- unsigned int **r3k_priv**
- unsigned int **ejtag_version**
- unsigned int **debug_mode**
- unsigned int **debug_irq**
- unsigned int **debug_vector_pos**
- unsigned int **probe_enable**
- unsigned int **proc_reset**
- unsigned int **proc_access**
- unsigned int **proc_we**
- unsigned int **periph_reset**
- unsigned int **bus_halted**
- unsigned int **low_power**
- unsigned int **vpe_disable**
- unsigned int **access_size**
- unsigned int **reset_occurred**
- struct MicrochipPIC32DeviceInfo **__attribute__**

#### 8.81.1 Detailed Description

Declaration of MicrochipPIC32Device.

**Author**

Andrew D. Zonenberg

## 8.82 Microcontroller.cpp File Reference

Implementation of Microcontroller.

```
#include "jtaghal.h"
```

Include dependency graph for Microcontroller.cpp:

### 8.82.1 Detailed Description

Implementation of Microcontroller.

**Author**

Andrew D. Zonenberg

## 8.83 Microcontroller.h File Reference

Declaration of Microcontroller.

This graph shows which files directly or indirectly include this file:

### Classes

- class Microcontroller

  *Generic base class for all microcontrollers.*

### 8.83.1 Detailed Description

Declaration of Microcontroller.

**Author**

Andrew D. Zonenberg

## 8.84 NetworkedJtagInterface.cpp File Reference

Implementation of NetworkedJtagInterface.

```
#include "jtaghal.h"
#include "jtagd_opcodes_enum.h"
```

Include dependency graph for NetworkedJtagInterface.cpp:

### 8.84.1 Detailed Description

Implementation of NetworkedJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.85 NetworkedJtagInterface.h File Reference

Declaration of NetworkedJtagInterface.

This graph shows which files directly or indirectly include this file:

### Classes

- class NetworkedJtagInterface

  *Thin wrapper around TCP sockets for talking to a jtagd instance.*

### 8.85.1 Detailed Description

Declaration of NetworkedJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.86 PipeJtagInterface.cpp File Reference

Implementation of PipeJtagInterface.

```
#include "jtaghal.h"
#include "jtagd_opcodes_enum.h"
```

Include dependency graph for PipeJtagInterface.cpp:

### 8.86.1 Detailed Description

Implementation of PipeJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.87 PipeJtagInterface.h File Reference

Declaration of PipeJtagInterface.

This graph shows which files directly or indirectly include this file:

### Classes

- class PipeJtagInterface

  *Thin wrapper around pipes for talking to an openfpga JtagPipeBridge.*

### 8.87.1 Detailed Description

Declaration of PipeJtagInterface.

**Author**

Andrew D. Zonenberg

## 8.88 ProgrammableDevice.cpp File Reference

Implementation of ProgrammableDevice.

```
#include "jtaghal.h"
```

Include dependency graph for ProgrammableDevice.cpp:

### 8.88.1 Detailed Description

Implementation of ProgrammableDevice.

**Author**

Andrew D. Zonenberg

## 8.89 ProgrammableDevice.h File Reference

Declaration of ProgrammableDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class ProgrammableDevice

  *Generic base class for all programmable devices (PLD, MCU, flash, etc)*

### 8.89.1 Detailed Description

Declaration of ProgrammableDevice.

**Author**

Andrew D. Zonenberg

## 8.90 ProgrammableLogicDevice.cpp File Reference

Implementation of ProgrammableLogicDevice.

```
#include "jtaghal.h"
```

Include dependency graph for ProgrammableLogicDevice.cpp:

### 8.90.1 Detailed Description

Implementation of ProgrammableLogicDevice.

**Author**

Andrew D. Zonenberg

## 8.91 ProgrammableLogicDevice.h File Reference

Declaration of ProgrammableLogicDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class ProgrammableLogicDevice

  *Generic base class for all programmable logic devices (FPGA and CPLD)*

### 8.91.1 Detailed Description

Declaration of ProgrammableLogicDevice.

**Author**

Andrew D. Zonenberg

## 8.92 RawBinaryFirmwareImage.cpp File Reference

Implementation of RawBinaryFirmwareImage.

```
#include "jtaghal.h"
```

Include dependency graph for RawBinaryFirmwareImage.cpp:

### 8.92.1 Detailed Description

Implementation of RawBinaryFirmwareImage.

**Author**

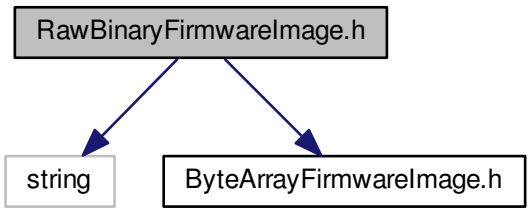
Andrew D. Zonenberg

## 8.93 RawBinaryFirmwareImage.h File Reference

Declaration of RawBinaryFirmwareImage.

```
#include <string>
#include "ByteArrayFirmwareImage.h"
```

Include dependency graph for RawBinaryFirmwareImage.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class RawBinaryFirmwareImage

  *Raw binary firmware image loaded from a file.*

### 8.93.1 Detailed Description

Declaration of RawBinaryFirmwareImage.

**Author**

Andrew D. Zonenberg

## 8.94 SerialNumberedDevice.cpp File Reference

Implementation of SerialNumberedDevice.

```
#include "jtaghal.h"
```

Include dependency graph for SerialNumberedDevice.cpp:

### 8.94.1 Detailed Description

Implementation of SerialNumberedDevice.

**Author**

Andrew D. Zonenberg

## 8.95 SerialNumberedDevice.h File Reference

Declaration of SerialNumberedDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class SerialNumberedDevice

  *Abstract base class for all devices that have a unique die serial number.*

### 8.95.1 Detailed Description

Declaration of SerialNumberedDevice.

**Author**

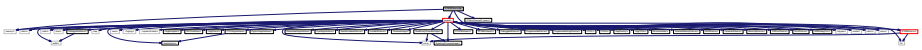
Andrew D. Zonenberg

## 8.96 STM32Device.cpp File Reference

Implementation of STM32Device.

```
#include "jtaghal.h"
#include "STM32Device.h"
#include "STMicroDeviceID_enum.h"
#include "memory.h"
```

Include dependency graph for STM32Device.cpp:



### 8.96.1 Detailed Description

Implementation of STM32Device.

**Author**

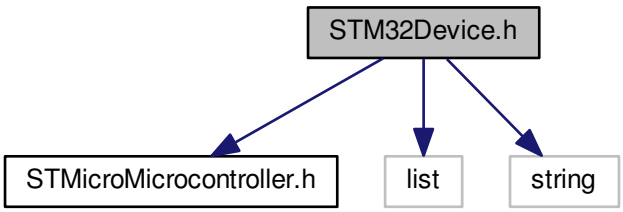
Andrew D. Zonenberg

## 8.97 STM32Device.h File Reference

Declaration of STM32Device.

```
#include "STMicroMicrocontroller.h"
#include <list>
#include <string>
```

Include dependency graph for STM32Device.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class STM32Device

  *A STM32 microcontroller.*

#### 8.97.1 Detailed Description

Declaration of STM32Device.

**Author**

Andrew D. Zonenberg

## 8.98 STMicroDevice.cpp File Reference

Implementation of STMicroDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
#include "STMicroDeviceID_enum.h"
```

Include dependency graph for STMicroDevice.cpp:

#### 8.98.1 Detailed Description

Implementation of STMicroDevice.

**Author**

Andrew D. Zonenberg

## 8.99 STMicroDevice.h File Reference

Declaration of STMicroDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class STMicroDevice

  *Abstract base class for all STMicro devices.*

### 8.99.1 Detailed Description

Declaration of STMicroDevice.

**Author**

Andrew D. Zonenberg

## 8.100 STMicroMicrocontroller.cpp File Reference

Implementation of STMicroMicrocontroller.

```
#include "jtaghal.h"
```

Include dependency graph for STMicroMicrocontroller.cpp:

### 8.100.1 Detailed Description

Implementation of STMicroMicrocontroller.

**Author**

Andrew D. Zonenberg

## 8.101 STMicroMicrocontroller.h File Reference

Declaration of STMicroMicrocontroller.

This graph shows which files directly or indirectly include this file:

### Classes

- class STMicroMicrocontroller

  *Generic base class for all STMicro MCUs.*

### 8.101.1 Detailed Description

Declaration of STMicroMicrocontroller.

**Author**

Andrew D. Zonenberg

## 8.102 Xilinx3DFPGABitstream.cpp File Reference

Implementation of Xilinx3DFPGABitstream.

```
#include "jtaghal.h"
```

Include dependency graph for Xilinx3DFPGABitstream.cpp:

### 8.102.1 Detailed Description

Implementation of Xilinx3DFPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.103 Xilinx3DFPGABitstream.h File Reference

Declaration of Xilinx3DFPGABitstream.

This graph shows which files directly or indirectly include this file:

### Classes

- class Xilinx3DFPGABitstream

  *A bitstream for Xilinx 3D FPGAs (multiple dies on a passive interposer, each with their own bitstream)*

### 8.103.1 Detailed Description

Declaration of Xilinx3DFPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.104 Xilinx7SeriesDevice.cpp File Reference

Implementation of Xilinx7SeriesDevice.

```
#include "jtaghal.h"
```

Include dependency graph for Xilinx7SeriesDevice.cpp:

### 8.104.1 Detailed Description

Implementation of Xilinx7SeriesDevice.

**Author**

Andrew D. Zonenberg

## 8.105 Xilinx7SeriesDevice.h File Reference

Declaration of Xilinx7SeriesDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- union Xilinx7SeriesDeviceConfigurationFrame

  *7-series configuration frame (see UG470 page 87)*
- union Xilinx7SeriesDeviceStatusRegister

  *7-series status register (see UG470 table 5-28)*
- class Xilinx7SeriesDevice

  *A Xilinx 7-series FPGA device.*

### Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))
-

  struct {
  unsigned int count:11
  *Count field.*
  unsigned int reserved:2
  *Reserved, must be zero.*
  unsigned int reg_addr:14
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits

### Variables

- unsigned int count
  *Count field.*
- unsigned int reserved
  *Reserved, must be zero.*
- unsigned int reg_addr
  *Register address.*
- unsigned int op
  *Opcode.*
- unsigned int type
  *Frame type.*
- uint32_t word
  *The raw configuration word.*
- unsigned int crc_err
  *Indicates that the device failed to configure due to a CRC error.*
- unsigned int part_secured
  *Indicates that the device is in secure mode (encrypted bitstream)*
- unsigned int mmcm_lock
  *Indicates MMCMs are locked.*
- unsigned int dci_match
  *Indicates DCI is matched.*
- unsigned int eos
  *End-of-Startup signal.*
- unsigned int gts_cfg_b
  *Status of GTS_CFG net.*
- unsigned int gwe
  *Status of GWE net.*
- unsigned int ghigh_b
  *Status of GHIGH_B net.*
- unsigned int mode_pins
  *Status of mode pins.*
- unsigned int init_complete
  *Internal init-finished signal.*
- unsigned int init_b
  *Status of INIT_B pin.*
- unsigned int release_done
  *Indicates DONE was released.*
- unsigned int done
  *Actual value on DONE pin.*
- unsigned int id_error
  *Indicates an ID code error occurred (write with wrong bitstream)*
- unsigned int dec_error
  *Decryption error.*
- unsigned int xadc_over_temp
  *Indicates board is too hot.*
- unsigned int startup_state
  *Status of startup state machine.*
- unsigned int reserved_1
  *Reserved.*
- unsigned int bus_width
  *Config bus width (see table 5-26)*
- unsigned int reserved_2
  *Reserved.*
- Xilinx7SeriesDevice **__attribute__**

### 8.105.1 Detailed Description

Declaration of Xilinx7SeriesDevice.

**Author**

Andrew D. Zonenberg

### 8.105.2 Variable Documentation

#### 8.105.2.1 count

```
unsigned int count
```

Count field.

- Type 1 packets: word count
- Type 2 packets: don't care

#### 8.105.2.2 done

```
unsigned int done
```

Actual value on DONE pin.

Status of the DONE pin.

True if configured.

#### 8.105.2.3 gts_cfg_b

```
unsigned int gts_cfg_b
```

Status of GTS_CFG net.

Status of global tristate net.

#### 8.105.2.4 gwe

```
unsigned int gwe
```

Status of GWE net.

Status of global write-enable net.

#### 8.105.2.5 init_b

```
unsigned int init_b
```

Status of INIT_B pin.

Status of the INIT_B pin.

#### 8.105.2.6 mmcm_lock

```
unsigned int mmcm_lock
```

Indicates MMCMs are locked.

Indicates MMCMs and PLLs are locked.

#### 8.105.2.7 op

```
unsigned int op
```

Opcode.

Must be one of the following:

- Xilinx7SeriesDevice::X7_CONFIG_OP_NOP
- Xilinx7SeriesDevice::X7_CONFIG_OP_READ
- Xilinx7SeriesDevice::X7_CONFIG_OP_WRITE

Must be zero

Must be one of the following:

- XilinxSpartan3ADevice::S3_CONFIG_OP_NOP
- XilinxSpartan3ADevice::S3_CONFIG_OP_READ
- XilinxSpartan3ADevice::S3_CONFIG_OP_WRITE

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_OP_NOP
- XilinxSpartan6Device::S6_CONFIG_OP_READ
- XilinxSpartan6Device::S6_CONFIG_OP_WRITE

Must be one of the following:

- XilinxUltrascaleDevice::CONFIG_OP_NOP
- XilinxUltrascaleDevice::CONFIG_OP_READ
- XilinxUltrascaleDevice::CONFIG_OP_WRITE

#### 8.105.2.8 type

```
unsigned int type
```

Frame type.

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_1

Must be Xilinx7SeriesDevice::X7_CONFIG_FRAME_TYPE_2

#### 8.105.2.9 word

```
uint32_t word
```

The raw configuration word.

The raw status register value.

## 8.106 XilinxCoolRunnerIIDevice.cpp File Reference

Implementation of XilinxCoolRunnerIIDevice.

```
#include "jtaghal.h"
#include "XilinxCoolRunnerIIDevice.h"
#include "XilinxCPLDBitstream.h"
#include "memory.h"
```

Include dependency graph for XilinxCoolRunnerIIDevice.cpp:

### 8.106.1 Detailed Description

Implementation of XilinxCoolRunnerIIDevice.

**Author**

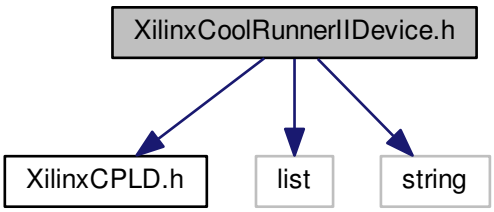
Andrew D. Zonenberg

## 8.107 XilinxCoolRunnerIIDevice.h File Reference

Declaration of XilinxCoolRunnerIIDevice.

```
#include "XilinxCPLD.h"
#include <list>
#include <string>
```

Include dependency graph for XilinxCoolRunnerIIDevice.h:




This graph shows which files directly or indirectly include this file:

### Classes

- union XilinxCoolRunnerIIDeviceStatusRegister
  *Status register for a Xilinx CoolRunner-II device.*
- class XilinxCoolRunnerIIDevice
  *A Xilinx CoolRunner-II device.*

### Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))
- struct {
  unsigned int padding_one:2
  *Constant '01'.*
  unsigned int done:1
  *True if configured.*
  unsigned int sec:1
  *True if secured.*
  unsigned int isc_en:1
  *True if in ISC_ENABLE state.*
  unsigned int isc_dis:1
  *True if in ISC_DISABLE state.*
  unsigned int padding_zero:2
  *Constant '00'.*
  } **__attribute__** ((packed)) bits

### Variables

- unsigned int padding_one

  *Constant '01'.*
- unsigned int done

  *True if configured.*
- unsigned int sec

  *True if secured.*
- unsigned int isc_en

  *True if in ISC_ENABLE state.*
- unsigned int isc_dis

  *True if in ISC_DISABLE state.*
- unsigned int padding_zero

  *Constant '00'.*
- uint8_t word

  *The raw status register value.*
- XilinxCoolRunnerIIDevice **__attribute__**

### 8.107.1 Detailed Description

Declaration of XilinxCoolRunnerIIDevice.

**Author**

Andrew D. Zonenberg

## 8.108 XilinxCPLD.cpp File Reference

Implementation of XilinxCPLD.

```
#include "jtaghal.h"
```

Include dependency graph for XilinxCPLD.cpp:

### 8.108.1 Detailed Description

Implementation of XilinxCPLD.

**Author**

Andrew D. Zonenberg

## 8.109 XilinxCPLD.h File Reference

Declaration of XilinxCPLD.

This graph shows which files directly or indirectly include this file:

### Classes

- class XilinxCPLD

  *Generic base class for all Xilinx CPLD devices.*

### 8.109.1 Detailed Description

Declaration of XilinxCPLD.

**Author**

Andrew D. Zonenberg

## 8.110 XilinxCPLDBitstream.cpp File Reference

Implementation of XilinxCPLDBitstream.

```
#include "jtaghal.h"
#include "XilinxCPLDBitstream.h"
#include <stdio.h>
```

Include dependency graph for XilinxCPLDBitstream.cpp:

### 8.110.1 Detailed Description

Implementation of XilinxCPLDBitstream.

**Author**

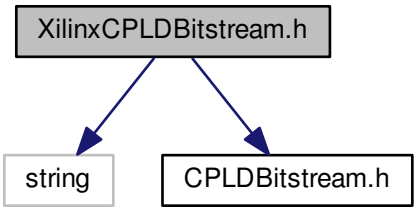
Andrew D. Zonenberg

## 8.111 XilinxCPLDBitstream.h File Reference

Declaration of XilinxCPLDBitstream.

```
#include <string>
#include "CPLDBitstream.h"
```

Include dependency graph for XilinxCPLDBitstream.h:




This graph shows which files directly or indirectly include this file:

### Classes

- class XilinxCPLDBitstream

  *A bitstream for Xilinx CPLDs.*

### 8.111.1 Detailed Description

Declaration of XilinxCPLDBitstream.

**Author**

Andrew D. Zonenberg

## 8.112 XilinxDevice.cpp File Reference

Implementation of XilinxDevice.

```
#include "jtaghal.h"
#include "JEDECVendorID_enum.h"
#include "XilinxDeviceID_enum.h"
```

Include dependency graph for XilinxDevice.cpp:

### 8.112.1 Detailed Description

Implementation of XilinxDevice.

**Author**

Andrew D. Zonenberg

## 8.113 XilinxDevice.h File Reference

Declaration of XilinxDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- class XilinxDevice

  *Abstract base class for all Xilinx devices (FPGA, CPLD, flash, etc)*

### 8.113.1 Detailed Description

Declaration of XilinxDevice.

**Author**

Andrew D. Zonenberg

## 8.114 XilinxFPGA.cpp File Reference

Implementation of XilinxFPGA.

```
#include "jtaghal.h"
```

Include dependency graph for XilinxFPGA.cpp:

### 8.114.1 Detailed Description

Implementation of XilinxFPGA.

**Author**

Andrew D. Zonenberg

## 8.115 XilinxFPGA.h File Reference

Declaration of XilinxFPGA.

This graph shows which files directly or indirectly include this file:

### Classes

- class XilinxFPGA

  *Abstract base class for all Xilinx FPGAs.*

### 8.115.1 Detailed Description

Declaration of XilinxFPGA.

**Author**

Andrew D. Zonenberg

## 8.116 XilinxFPGABitstream.cpp File Reference

Implementation of XilinxFPGABitstream.

```
#include "jtaghal.h"
```

Include dependency graph for XilinxFPGABitstream.cpp:

### 8.116.1 Detailed Description

Implementation of XilinxFPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.117 XilinxFPGABitstream.h File Reference

Declaration of XilinxFPGABitstream.

This graph shows which files directly or indirectly include this file:

### Classes

- class XilinxFPGABitstream

  *A bitstream for Xilinx FPGAs.*

### 8.117.1 Detailed Description

Declaration of XilinxFPGABitstream.

**Author**

Andrew D. Zonenberg

## 8.118 XilinxSpartan3ADevice.cpp File Reference

Implementation of XilinxSpartan3ADevice.

```
#include "jtaghal.h"
#include <stdio.h>
#include <memory.h>
#include "XilinxSpartan3ADevice.h"
#include "XilinxFPGABitstream.h"
```

Include dependency graph for XilinxSpartan3ADevice.cpp:

### 8.118.1 Detailed Description

Implementation of XilinxSpartan3ADevice.

**Author**

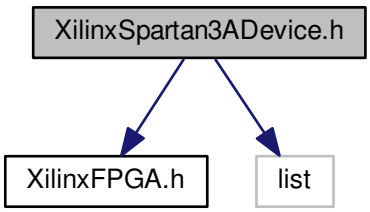
Andrew D. Zonenberg

## 8.119 XilinxSpartan3ADevice.h File Reference

Declaration of XilinxSpartan3ADevice.

```
#include "XilinxFPGA.h"
#include <list>
```

Include dependency graph for XilinxSpartan3ADevice.h:




This graph shows which files directly or indirectly include this file:

## Classes

- union XilinxSpartan3ADeviceConfigurationFrame

  *Spartan-3A configuration frame header (see UG332 page 323)*
- union XilinxSpartan3ADeviceStatusRegister

  *Spartan-3A status register (see UG332 table 17-13, pages 327-328)*
- class XilinxSpartan3ADevice

  *A Xilinx Spartan-3A FPGA device.*

## Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))
-

  struct {
    unsigned int count:5
      *Count field.*
    unsigned int reg_addr:6
      *Register address.*
    unsigned int op:2
      *Opcode.*
    unsigned int type:3
      *Frame type.*
  } **__attribute__** ((packed)) bits

### Variables

- unsigned int count

  *Count field.*
- unsigned int reg_addr

  *Register address.*
- unsigned int op

  *Opcode.*
- unsigned int type

  *Frame type.*
- uint16_t word

  *The raw configuration word.*
- unsigned int crc_err

  *Indicates that the device failed to configure due to a CRC error.*
- unsigned int idcode_err

  *Indicates that the device failed to configure due to the bitstream having the wrong ID code.*
- unsigned int dcm_lock

  *Asserted once all DCM/PLL instances used in the design have locked on.*
- unsigned int gts_cfg_b

  *Status of global tristate net.*
- unsigned int gwe

  *Status of global write-enable net.*
- unsigned int ghigh

  *Status of GHIGH (TODO: describe what this is)*
- unsigned int vsel

  *Status of the SPI variant select pins.*
- unsigned int mode

  *Status of the mode bits.*
- unsigned int init_b

  *Status of the INIT_B pin.*
- unsigned int done

  *Status of the DONE pin.*
- unsigned int seu_err

  *True if there was a post-config CRC error.*
- unsigned int sync_timeout

  *True if the config watchdog timer ran out.*
- XilinxSpartan3ADevice **__attribute__**

### 8.119.1 Detailed Description

Declaration of XilinxSpartan3ADevice.

**Author**

Andrew D. Zonenberg

### 8.119.2 Variable Documentation

#### 8.119.2.1 count

```
unsigned int count
```

Count field.

- Type 1 packets: word count
- Type 2 packets: don't care

#### 8.119.2.2 op

```
unsigned int op
```

Opcode.

Must be one of the following:

- XilinxSpartan3ADevice::S3_CONFIG_OP_NOP
- XilinxSpartan3ADevice::S3_CONFIG_OP_READ
- XilinxSpartan3ADevice::S3_CONFIG_OP_WRITE

#### 8.119.2.3 type

```
unsigned int type
```

Frame type.

Must be one of the following:

- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_1
- XilinxSpartan3ADevice::S3A_CONFIG_FRAME_TYPE_2

#### 8.119.2.4 word

```
uint32_t word
```

The raw configuration word.

The raw status register value.

## 8.120 XilinxSpartan6Device.cpp File Reference

Implementation of XilinxSpartan6Device.

```
#include "jtaghal.h"
```

Include dependency graph for XilinxSpartan6Device.cpp:

### 8.120.1 Detailed Description

Implementation of XilinxSpartan6Device.

**Author**

Andrew D. Zonenberg

## 8.121 XilinxSpartan6Device.h File Reference

Declaration of XilinxSpartan6Device.

This graph shows which files directly or indirectly include this file:

### Classes

- union XilinxSpartan6DeviceConfigurationFrame
  *Spartan-6 configuration frame (see UG380 page 91)*
- union XilinxSpartan6DeviceStatusRegister
  *Spartan-6 status register (see UG380 table 5-35)*
- class XilinxSpartan6Device
  *A Xilinx Spartan-6 FPGA device.*

### Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))
-
  struct {
  unsigned int count:5
  *Count field.*
  unsigned int reg_addr:6
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits

### Variables

- unsigned int count
  *Count field.*
- unsigned int reg_addr
  *Register address.*
- unsigned int op
  *Opcode.*
- unsigned int type
  *Frame type.*
- uint16_t word
  *The raw configuration word.*
- unsigned int crc_err
  *Indicates that the device failed to configure due to a CRC error.*
- unsigned int idcode_err
  *Indicates that the device failed to configure due to the bitstream having the wrong ID code.*
- unsigned int dcm_lock
  *Asserted once all DCM/PLL instances used in the design have locked on.*
- unsigned int gts_cfg_b
  *Status of global tristate net.*
- unsigned int gwe
  *Status of global write-enable net.*
- unsigned int ghigh
  *Status of GHIGH (TODO: describe what this is)*
- unsigned int decrypt_err
  *Decryption error flag.*
- unsigned int decrypt_en
  *Bitstream encryption enable flag.*
- unsigned int hswapen
  *Status of the HSWAPEN pin.*
- unsigned int m0
  *Status of the M0 mode bit.*
- unsigned int m1
  *Status of the M1 mode bit.*
- unsigned int reserved
  *Reserved.*
- unsigned int init_b
  *Status of the INIT_B pin.*
- unsigned int done
  *Status of the DONE pin.*
- unsigned int suspend
  *Suspend state.*
- unsigned int fallback
  *Configuration fallback state.*
- XilinxSpartan6Device **__attribute__**

## 8.121.1 Detailed Description

Declaration of XilinxSpartan6Device.

**Author**

Andrew D. Zonenberg

### 8.121.2 Variable Documentation

#### 8.121.2.1 count

```
unsigned int count
```

Count field.

- Type 1 packets: word count
- Type 2 packets: don't care

#### 8.121.2.2 op

```
unsigned int op
```

Opcode.

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_OP_NOP
- XilinxSpartan6Device::S6_CONFIG_OP_READ
- XilinxSpartan6Device::S6_CONFIG_OP_WRITE

#### 8.121.2.3 type

```
unsigned int type
```

Frame type.

Must be one of the following:

- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_1
- XilinxSpartan6Device::S6_CONFIG_FRAME_TYPE_2

#### 8.121.2.4 word

```
uint16_t word
```

The raw configuration word.

The raw status register value.

## 8.122 XilinxUltrascaleDevice.cpp File Reference

Implementation of XilinxUltrascaleDevice.

```
#include "jtaghal.h"
#include "XilinxDeviceID_enum.h"
```

Include dependency graph for XilinxUltrascaleDevice.cpp:

### 8.122.1 Detailed Description

Implementation of XilinxUltrascaleDevice.

**Author**

Andrew D. Zonenberg

## 8.123 XilinxUltrascaleDevice.h File Reference

Declaration of XilinxUltrascaleDevice.

This graph shows which files directly or indirectly include this file:

### Classes

- union XilinxUltrascaleDeviceConfigurationFrame

  *UltraScale configuration frame (see UG570 page 158)*
- union XilinxUltrascaleDeviceStatusRegister

  *UltraScale status register (see UG570 table 9-25)*
- class XilinxUltrascaleDevice

  *A Xilinx Ultrascale or Ultrascale+ FPGA device.*

## Functions

- union MicrochipPIC32DeviceStatusRegister **__attribute__** ((packed))
- struct {
  unsigned int count:11
  *Count field.*
  unsigned int reserved:2
  *Reserved, must be zero.*
  unsigned int reg_addr:14
  *Register address.*
  unsigned int op:2
  *Opcode.*
  unsigned int type:3
  *Frame type.*
  } **__attribute__** ((packed)) bits

## Variables

- unsigned int count
  *Count field.*
- unsigned int reserved
  *Reserved, must be zero.*
- unsigned int reg_addr
  *Register address.*
- unsigned int op
  *Opcode.*
- unsigned int type
  *Frame type.*
- uint32_t word
  *The raw configuration word.*
- unsigned int crc_err
  *Indicates that the device failed to configure due to a CRC error.*
- unsigned int decryptor_enabled
  *Indicates that the crypto subsystem is active.*
- unsigned int mmcm_lock
  *Indicates MMCMs and PLLs are locked.*
- unsigned int dci_match
  *Indicates DCI is matched.*
- unsigned int eos
  *End-of-Startup signal.*
- unsigned int gts_cfg_b
  *Status of GTS_CFG net.*
- unsigned int gwe
  *Status of GWE net.*
- unsigned int ghigh_b
  *Status of GHIGH_B net.*
- unsigned int mode_pins
  *Status of mode pins.*
- unsigned int init_complete
  *Internal init-finished signal.*

- unsigned int init_b
  *Status of INIT_B pin.*
- unsigned int release_done
  *Indicates DONE was released.*
- unsigned int done
  *Actual value on DONE pin.*
- unsigned int id_error
  *Indicates an ID code error occurred (write with wrong bitstream)*
- unsigned int security_error
  *Security / crypto error.*
- unsigned int sysmon_over_temp
  *Indicates board is too hot.*
- unsigned int startup_state
  *Status of startup state machine.*
- unsigned int reserved_1
  *Reserved.*
- unsigned int bus_width
  *Config bus width (see table 5-26)*
- unsigned int reserved_2
  *Reserved.*
- XilinxUltrascaleDevice **__attribute__**

### 8.123.1 Detailed Description

Declaration of XilinxUltrascaleDevice.

**Author**

Andrew D. Zonenberg

### 8.123.2 Variable Documentation

#### 8.123.2.1 op

```
unsigned int op
```

Opcode.

Must be one of the following:

- XilinxUltrascaleDevice::CONFIG_OP_NOP
- XilinxUltrascaleDevice::CONFIG_OP_READ
- XilinxUltrascaleDevice::CONFIG_OP_WRITE

Must be zero

#### 8.123.2.2 type

```
unsigned int type
```

Frame type.

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_1

Must be XilinxUltrascaleDevice::CONFIG_FRAME_TYPE_2

#### 8.123.2.3 word

```
uint32_t word
```

The raw configuration word.

The raw status register value.

# Index