



ALPHA DATA

ADMXRC3 API 1.4.0 Specification

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1 Introduction

This document describes the ADMXRC3 Application Programming Interface, which supports a new generation of reconfigurable computing hardware from Alpha Data. The key features of this API are:

- Platform-independent (with a few exceptions).
- Functionality includes querying hardware, configuring hardware, CPU-initiated data transfer and DMA data transfers.
- Thread-safe.
- Non-blocking versions of certain functions.

1.1 New in ADMXRC3 API version 1.1.0

1.1.1 New model

The datatype `ADMXRC3_MODEL_TYPE` now defines the value `ADMXRC3_MODEL_ADMXRC6T1`.

1.1.2 Extended card information

ADMXRC3 API 1.1.0 introduces the function `ADMXRC3_GetCardInfoEx` in order to expose more features of Gen 3 Alpha Data reconfigurable computing hardware.

1.1.3 Hardware monitoring

ADMXRC3 API 1.1.0 introduces a set of functions and datatypes for monitoring the health of Gen 3 Alpha Data reconfigurable computing hardware. See [Section 3.8.7, "Hardware monitoring"](#) for an overview.

1.1.4 I/O personality modules

ADMXRC3 API 1.1.0 introduces the function `ADMXRC3_GetModuleInfo`, which returns information about what I/O personality modules (if any) are fitted to a Gen 3 Alpha Data reconfigurable computing device. Refer to [Section 3.8.8, "I/O personality modules"](#) for further details.

1.1.5 Direct-call mechanism for consuming notifications

ADMXRC3 API 1.1.0 introduces the functions `ADMXRC3_StartNotificationWait` and `ADMXRC3_FinishNotificationWait`. While these functions are intended to offer Linux applications a mechanism to consume notifications (such as a target FPGA interrupt), they are also available in Windows and Linux. Refer to [Section 3.5, "Notifications"](#) for an overview.

These functions are necessary because the GNU/Linux operating system lacks a general mechanism for registering wait objects (such as POSIX semaphores) with a kernel-mode driver. Instead of registering a wait object with the API, a Linux application uses `ADMXRC3_StartNotificationWait` and `ADMXRC3_FinishNotificationWait`.

1.1.6 VxWorks-specific API functions for consuming notifications

The functions `ADMXRC3_RegisterVxwSem` and `ADMXRC3_UnregisterVxwSem` are now available, offering equivalent functionality to `ADMXRC3_RegisterWin32Event` and `ADMXRC3_UnregisterWin32Event`.

1.2 New in ADMXRC3 API version 1.2.0

1.2.1 DMA functions for 64-bit local addresses

ADMXRC3 API 1.2.0 introduces a set of functions that accept 64-bit local addresses. These functions are named as the existing DMA functions but with an added "Ex" postfix. For example, **ADMXRC3_ReadDMAEx** is the 64-bit local address counterpart of **ADMXRC3_ReadDMA**.

Note that some models do not use all 64 bits of the local address. The **ADMXRC3 API Hardware Addendum** defines how many DMA address bits are available for each supported model.

1.3 New in ADMXRC3 API version 1.3.0

1.3.1 Support for new models

ADMXRC3 API 1.3.0 introduces two more models: the ADM-XRC-6TGE and the ADM-XRC-6T-ADV8. The enumerated type **ADMXRC3_MODEL_TYPE** now includes values corresponding to those types.

1.3.2 New value for ADMXRC3_STATUS

ADMXRC3 API 1.3.0 introduces a new value for the **ADMXRC3_STATUS** enumerated type: **ADMXRC3_NOT_SUPPORTED**. This value is returned when the hardware does not support a particular function, or does not support the particular set of parameters passed to that function. For example, the **ADM-XRC-6T-ADV8** has a user-programmable PCI Express to OCP bridge, where some or all of the DMA engines may be configured for transferring data in one direction only (in order to conserve FPGA resources for user-created functions). Attempting a DMA transfer in a direction that is not supported by a particular DMA engine results in a return value of **ADMXRC3_NOT_SUPPORTED**.

1.4 New in ADMXRC3 API version 1.4.0

1.4.1 Support for DMA to bus addresses

ADMXRC3 API 1.4.0 introduces some new API functions which enable the DMA engines in a Gen 3 reconfigurable computing device to transfer data to arbitrary bus addresses:

- **ADMXRC3_ReadDMABus**
- **ADMXRC3_StartReadDMABus**
- **ADMXRC3_StartWriteDMABus**
- **ADMXRC3_WriteDMABus**

These functions enable bulk data transfer between peers on a bus, bypassing system memory. For example, a Gen 3 reconfigurable computing device such as the ADM-XRC-6T1 can, as bus master, read or write another PCI Express endpoint directly, provided that the PCI Express memory space address of the other endpoint is known.

1.4.2 New flag ADMXRC3_FPGA_NOTCONFIGURABLE

To better support models such as the **ADM-XRC-6T-ADV8**, that have a single user-programmable FPGA that is both the PCI Express interface and the target FPGA, the flag **ADMXRC3_FPGA_NOTCONFIGURABLE** has been added. When this flag is present in the **Flags** field of **ADMXRC3_FPGA_INFO**, it indicates that the FPGA in question is not reconfigurable via functions such as **ADMXRC3_ConfigureFromFile**. Application software can use this flag in order to determine whether or not it should attempt to configure the target FPGA.

1.4.3 New value ADMXRC3_UNIT_S for enumerated type ADMXRC3_UNIT_TYPE

A new value **ADMXRC3_UNIT_S**, meaning 'seconds', for the enumerated type **ADMXRC3_UNIT_TYPE** has been added.

2 Building C and C++ applications

2.1 Building applications for Windows

2.1.1 Compiling for Windows

C or C++ source/header files that require the ADMXRC3 API must include `<admxrc3.h>` as follows:

```
#include <admxrc3.h>
```

This header file can be found in `$(ADMXRC3_SDK)\include\`, where `$(ADMXRC3_SDK)` is where the ADMXRC3 SDK is installed. In Microsoft Visual Studio, this path can be added to the list of `#include` search paths in a project's properties, or to the global list of `#include` search paths (under **Tools->Options**).

2.1.2 Linking for Windows

Windows applications should be linked with one of the ADMXRC3 API import libraries from the ADMXRC3 SDK. There are several different binaries, compatible with Microsoft Visual Studio 2003 onwards and corresponding to different application platforms and configurations:

Configuration	Platform	Relative Path in ADMXRC3 SDK
Debug	x86	\$(ADMXRC3_SDK)\lib\win32\msvc\admxrcd.lib
Release	x86	\$(ADMXRC3_SDK)\lib\win32\msvc\admxrc.lib
Debug	x64	\$(ADMXRC3_SDK)\lib64\win32\msvc\admxrcd.lib
Release	x64	\$(ADMXRC3_SDK)\lib64\win32\msvc\admxrc.lib

where `$(ADMXRC3_SDK)` is where the ADMXRC3 SDK is installed.

2.2 Building applications for Linux

2.2.1 Compiling for Linux

C or C++ source/header files that require the ADMXRC3 API must include `<admxrc3.h>` as follows:

```
#include <admxrc3.h>
```

This header file can be found in `$(ADMXRC3_SDK)\include\`, where `$(ADMXRC3_SDK)` is where the ADMXRC3 SDK is installed. This path can be specified using the `-I` option if using the `gcc` or `g++` compiler.

2.2.2 Linking for Linux

Linux applications should link with the ADMXRC3 API shared library (`libadmxrc3.so`).

When building an application natively (as opposed cross-building), an application normally need only specify `-ladmxrc3` on the linker command line. This **requires** that the ADMXRC3 driver has already been correctly installed so that the ADMXRC3 API shared library is in `/usr/lib` (and additionally in `/usr/lib64` in 64-bit Linux).

If cross-building, it is likely that in addition to `-ladmxrc3`, the cross-linker must be told how to find the ADMXRC3 API shared library. Recent versions of the GNU toolchain provide the `--sysroot` option, which specifies where the target machine's root filesystem is located on the development machine. In most cases, this provides sufficient information for the cross-linker.

2.3 Building applications for VxWorks

2.3.1 Compiling for VxWorks

C or C++ source/header files that require the ADMXRC3 API must include `<admxrc3.h>` as follows:

```
#include <admxrc3.h>
```

This header file can be found in `$(ADMXRC3_SDK)/include/`, where `$(ADMXRC3_SDK)` is where the ADMXRC3 SDK is installed. As there are numerous versions of VxWorks and the Tornado / Workbench IDEs, detailed instructions for setting up a VxWorks project to locate the ADMXRC3 API header files are outside of the scope of this document. Please refer to the ADMXRC3 SDK User Guide for further information.

2.3.2 Linking for VxWorks

The ADMXRC3 API functions are provided by the **ADB3 Driver for VxWorks**. Because the driver is either compiled into the VxWorks kernel image or downloaded after boot as a module, there is no explicit linking step when building a VxWorks application that uses the ADMXRC3 API.

3 Concepts

There are several concepts that must be understood in order to make full use of the ADMXRC3 API. These are:

- Hardware, devices and device handles
- Multithreading
- Non-blocking operations
- Queuing
- CPU-Initiated data transfer
- DMA and user-space buffers
- Hardware resources, like target FPGAs

3.1 Hardware, devices and device handles

A *device* is a unit of reconfigurable computing hardware. An example of a device is an Alpha Data ADM-XRC-6TL card. Before a device can be used by an application, the application must first open the device. Opening a device returns a *device handle* of type **ADMXRC3_HANDLE** that the application may subsequently use to perform operations on that device. A device handle identifies a particular device, and is required because there may be multiple devices in a given system.

The **ADMXRC3_Open** and **ADMXRC3_OpenEx** functions are the means by which an application obtains a device handle. These functions accept an 'index' parameter, which tells the ADMXRC3 API which device the application wants to open, and is zero in the case where the application wants to open the first or only device. Once the application obtains a device handle, it may use it to call the other functions in the ADMXRC3 API.

When finished with a device handle, a well-behaved application should close it using the **ADMXRC3_Close** function. This enables the API and operating system to clean up any resources that the application did not explicitly free.

Should a process terminate without closing a device handle, then the operating system will typically close the device handle and free any associated resources. This is true of Windows and Linux, but not of VxWorks. The VxWorks kernel does not in general perform automatic cleanup, so it is the application's responsibility to ensure that resources are not leaked.

Some applications, such as those that use non-blocking API calls, must open a device multiple times to obtain multiple file handles. This must be done by calling **ADMXRC3_Open** or **ADMXRC3_OpenEx** multiple times, rather than using an OS-specific mechanism such as **DuplicateHandle** (Windows) or **dup** (Linux / VxWorks). For an explanation of this issue, refer to **Appendix A, "Duplicating device handles"**.

3.2 Multithreading

In general, the ADMXRC3 API allows any number of concurrent API calls to a given *device* at a given moment. Note that this statement is not equivalent to allowing any number of ongoing API calls to a given *device handle* at a given moment.

For the purposes of this discussion, the ADMXRC3 API can be divided into two groups of functions:

- Blocking functions, such as **ADMXRC3_Read**.
- Non-blocking functions, such as **ADMXRC3_StartReadDMAEx**. Refer to **Section 3.3, "Non-blocking operations"** for a discussion of non-blocking operations.

The multithreading rules for the blocking functions are different to those of the non-blocking functions, and are explained in the following subsections.

3.2.1 Multithreading with blocking API functions

The ADMXRC3 allows any number of threads to simultaneously call blocking API functions for the same device handle.

3.2 Multithreading with non-blocking API functions

The non-blocking functions of the ADMXRC3 API have more restrictive threading rules than the blocking functions. The rule is that each device handle may have at most one ongoing non-blocking operation at a given moment. A 'non-blocking operation' is defined to last from the instant it is initiated to the instant that it is finished. For example, the following code performs a non-blocking DMA operation (error handling omitted for clarity):

```
/* A */
status = ADMXRC3_StartReadDMAEx(hDevice, ...);
...
status = ADMXRC3_FinishDMA(hDevice, ...);
/* B */
```

The code between points A and B is a non-blocking operation. Another thread cannot use 'hDevice' to perform another non-blocking operation while the first thread is performing its non-blocking operation. Attempting to do results in undefined behavior.

Therefore, when an application must perform simultaneous non-blocking operations, it should open a device as many times as it needs, obtaining multiple device handles. It then typically uses each device handle for one thread, guaranteeing that the above rule is obeyed.

3.3 Non-blocking operations

The ADMXRC3 API has non-blocking variants of some functions. The functions eligible for having non-blocking variants are the ones that may block the calling thread for a significant length of time (or indefinitely). Non-blocking functions are provided for applications in which multithreading is inconvenient or impossible.

Performing a non-blocking operation requires at least two ADMXRC3 API calls:

1. First, call one of the non-blocking API functions. These functions have names of the form **ADMXRC3_StartXxx** where **ADMXRC3_FinishXxx** is its corresponding blocking counterpart. This function call will return as soon as possible, without waiting for anything. If the return value is **ADMXRC3_PENDING**, the non-blocking operation was successfully started. Otherwise, no non-blocking operation was started.
2. If the non-blocking operation was successfully started, the application must eventually call one of the **ADMXRC3_FinishXxx** functions in order to finish it. The **ADMXRC3_FinishXxx** function that is appropriate depends on which **ADMXRC3_StartXxx** function was called. The return value of **ADMXRC3_FinishXxx** generally indicates whether or not the operation was successful.

A device handle can support at most one unfinished non-blocking operation at a given moment. It is the application's responsibility to ensure that there is at most one unfinished non-blocking operation for a given device handle at any time. This can be achieved by opening a device multiple times using **ADMXRC3_Open** in order to obtain multiple device handles.

The following code fragment illustrates how to perform a non-blocking DMA transfer, with error-handling:

```
/* A */
status = ADMXRC3_StartReadDMAEx(hDevice, pTicket, ...);
if (ADMXRC3_PENDING != status) {
    /* Handle error - B1 */
    ...
} else {
    /* Started operation successfully */
    ... other code ...
    ... calls poll() / WaitForMultipleObjects() ...
    ... other code ...
    status = ADMXRC3_FinishDMA(hDevice, pTicket, FALSE);
    if (ADMXRC3_SUCCESS != status) {
        if (ADMXRC3_INVALID_HANDLE == status) {
            /* C1 - indicates that 'hDevice' may have been corrupted */

```

```

    } else if (ADMXRC3_PENDING == status) {
        /* C2 - operation still in progress - should not happen as already waited */
    } else {
        /* B2 - handle error */
        ...
    }
    } else {
        /* B3 - success */
    }
}

```

Point A is the beginning of the non-blocking operation. Points B1, B2 and B3 are possible finish points at which the non-blocking operation can be considered finished. The program should never reach points C1 or C2, but if it does, it indicates that 'hDevice' may have been corrupted somehow and the status of the non-blocking operation is indeterminate. A program may not be able to recover from such an error except by opening the device again, possibly leaking resources.

The 'hWait' argument of `ADMXRC3_FinishDMA` is FALSE in this example because the application itself waits for completion using operating system specific wait functions such as `poll` or `WaitForMultipleObjects`.

3.3.1 Multithreading and non-blocking operations

When a single-threaded application wishes to perform many concurrent non-blocking operations, a practical strategy is as follows:

1. Initiate as many non-blocking operations as desired, using multiple device handles and multiple tickets.
2. Use an OS-specific function to wait for some or all of the non-blocking operations to complete. In Windows, `ADMXRC3_HANDLE` is a typedef of `HANDLE`, so an array of `ADMXRC3_HANDLE` can be passed to `WaitForMultipleObjects`. In Linux, an `ADMXRC3_HANDLE` is a file descriptor, so it may be used to initialize a `pollfd` struct for use with the `poll` system call.
3. Finish each completed non-blocking operation using one of the `ADMXRC3_FinishXxx` functions, passing FALSE for the `bWait` parameter.

3.3.2 Tickets

In order for the ADMXRC3 API to be able to keep track of each non-blocking operation, an application must pass an initialized object of type `ADMXRC3_TICKET` to all `ADMXRC3_StartXxx` and `ADMXRC3_FinishXxx` functions. A given ticket object must be valid from start to finish of a non-blocking operation, and must not be used in more than one concurrent non-blocking operation. The behavior resulting from violating this rule is undefined.

The ADMXRC3 API cannot completely hide OS-specific implementation details of non-blocking operations, so the initialization that must be performed for a ticket depends upon the operating system. It is necessary to initialize a ticket only once, although a ticket may be reinitialized provided it is not being used in a non-blocking operation at that moment. The following sections describe how to initialize a ticket on each supported operating system.

3.3.2.1 Tickets in Windows

An `ADMXRC3_TICKET` object should be first initialized with a call to `ADMXRC3_InitializeTicket`, and the `Overlapped.hEvent` member must then be set to a valid non-auto-reset Win32 Event handle. As with a ticket, the Win32 Event must be valid from start to finish of a non-blocking operation, and must not be used in more than one concurrent non-blocking operation. The behavior resulting from violating this rule is undefined.

3.3.2.2 Tickets in Linux and VxWorks

An `ADMXRC3_TICKET` object should be initialized with a call to `ADMXRC3_InitializeTicket`.

3.4 Queueing

Some ADMXRC3 API functions place calling threads into a queue. In abstract terms, if several threads attempt to perform an operation on the same resource at the same time, the threads will be queued on a first-come, first-served basis (a FIFO queue). Each thread's operation will be performed in its entirety before another thread is dequeued and allowed access to the resource.

For example, if several threads each call [ADMXRC3_WriteDMAEx](#) at the same time, and each thread specifies the same DMA channel, then the API automatically queues them. Once a thread's DMA transfer is started, it will be performed in its entirety, until the entire byte count is satisfied or an error occurs, before another thread is dequeued and its DMA transfer performed.

Resources are generally independent of each other, meaning that a queue exists for each resource. Thus, there is a queue for DMA channel 0, another independent queue for DMA channel 1, and so on.

Queueing is performed transparently by the ADMXRC3 API where appropriate, but for some API functions, flags exist that can modify queueing behavior.

3.5 Notifications

The ADMXRC3 API provides a set of functions to enable applications to consume notifications from a Gen 3 reconfigurable computing device. A notification is some event that occurs asynchronously within a device that applications may wish to know about. Types of notification include target FPGA interrupts and overtemperature alerts. There are two sets of functions provided for consuming notifications, as described in the following subsections.

3.5.1 Event / Semaphore registration

In Windows, it is possible to register a Win32 Event handle (type [HANDLE](#)) for a particular event, using [ADMXRC3_RegisterWin32Event](#). When the specified event occurs, the Win32 Event is signalled.

In VxWorks, it is possible to register a semaphore [SEM_ID](#) for a particular event, using [ADMXRC3_RegisterVxwSem](#). When the specified event occurs, the semaphore is signalled.

In Linux, there is no function equivalent to [ADMXRC3_RegisterWin32Event](#) or [ADMXRC3_RegisterVxwSem](#), but the next subsection describes how equivalent functionality is provided in the form of direct-call notification.

3.5.2 Direct-call notification

The functions [ADMXRC3_StartNotificationWait](#) and [ADMXRC3_FinishNotificationWait](#) provide a direct-call mechanism for applications to consume notifications from a device. Unlike the methods described in the previous subsection, these functions exist for all supported operating systems.

A thread uses these functions as follows:

1. A thread initializes a ticket suitable for non-blocking operations, using [ADMXRC3_InitializeTicket](#).
2. A thread calls [ADMXRC3_StartNotificationWait](#), specifying the type of notification that it wishes to wait for.
3. The thread then performs some other task, such as starting an operation on the hardware.
4. The thread then waits for the requested notification, which can be done in one of several ways:
 - (a) The thread can call [ADMXRC3_FinishNotificationWait](#) specifying TRUE for the bWait argument. This works on all supported operating systems.
 - (b) In Windows, the thread can call [WaitForSingleObject](#) or [WaitForMultipleObjects](#) using the event handle in the ticket. It can then call [ADMXRC3_FinishNotificationWait](#) specifying FALSE for the bWait argument.
 - (c) In Linux, the thread can call [poll](#) using the device handle used in [ADMXRC3_StartNotificationWait](#). It can then call [ADMXRC3_FinishNotificationWait](#) specifying FALSE for the bWait argument.

- (d) In VxWorks, the thread can call [select](#) using the device handle used in [ADMXRC3_StartNotificationWait](#). It can then call [ADMXRC3_FinishNotificationWait](#) specifying FALSE for the bWait argument.
5. After calling [ADMXRC3_FinishNotificationWait](#), the thread takes appropriate action in order to handle the notification. If the thread is running in a loop, it returns to step 2 in order to wait for another notification.

3.6 Endian issues

The ADMXRC3 API does not perform any endian-conversion in functions that transfer blocks of data, such as [ADMXRC3_Write](#), [ADMXRC3_ReadVPD](#), [ADMXRC3_StartReadDMAEx](#) etc. There are two possible approaches to handling endian-conversion issues:

- Make the FPGA design capable of accepting data of the same endianness as the CPU. For example, if the CPU is a PowerPC operating in big-endian mode, then the FPGA design should expect big-endian data.
- Make the FPGA design little-endian, but use endian-conversion macros in software:
 - Linux has a set of macros `__cpu_to_le32` etc. in the header file `<asm/byteorder.h>`.
 - VxWorks has the `LONGSWAP` and `WORDSWAP` macros. The `_BYTE_ORDER` macro indicates endianness of the CPU for which the code is being compiled, so a set of macros equivalent to `__cpu_to_le32` in Linux etc. can be defined.
 - In Windows, it is possible to verify that the CPU for which the code is being compiled is little-endian, using predefined macros such as `_M_IX86`. A set of trivial macros equivalent to `__cpu_to_le32` in Linux etc. can then be defined, which return the argument unmodified.

3.7 String encoding issues

The ADMXRC3 API has support for applications that use `char` or `wchar_t` strings. API functions that return or expect `char` strings have names that end in `-A`, whereas functions that return or expect `wchar_t` strings have names that end in `-W`. The encoding of strings in the `char` case is slightly different between Windows and Linux, and the following table summarizes these differences:

Operating system	Encoding of <code>char</code> strings
Windows	ANSI, using the default codepage
Linux	UTF-8
VxWorks	Depends on how the host interprets <code>char</code> strings.

Table 1: `char` string encoding in ADMXRC3 API by operating system

For convenience, the ADMXRC3 API defines a number of macros for portability, depending on whether or not the `_UNICODE` preprocessor symbol is defined. An example is the macro [ADMXRC3_FPGA_INFO](#):

- When `_UNICODE` is not defined, [ADMXRC3_FPGA_INFO](#) is an alias for [ADMXRC3_FPGA_INFOA](#). The strings in the [ADMXRC3_FPGA_INFOA](#) structure are NUL-terminated `char` strings.
- When `_UNICODE` is defined, [ADMXRC3_FPGA_INFO](#) is an alias for [ADMXRC3_FPGA_INFOW](#). The strings in the [ADMXRC3_FPGA_INFOW](#) structure are NUL-terminated `wchar_t` strings.

Note that the `_UNICODE` preprocessor symbol, which is conventionally defined in Win32 applications that use `wchar_t` strings, really means "UTF-16 encoding". In VxWorks, there is no support for wide-character strings to speak of, so the `_UNICODE` symbol should not be defined.

3.8 Hardware features

3.8.1 Target FPGAs

A reconfigurable computing device has one or more user-programmable FPGAs, and the ADMXRC3 API provides functions for configuring them. The term "target FPGA" shall be used in place of "user-programmable FPGA" for the remainder of this document. Functions are provided for:

- Obtaining information about target FPGAs on a device, e.g. [ADMXRC3_GetFpgaInfo](#)
- Loading .BIT files into memory and unloading them, e.g. [ADMXRC3_LoadBitstream](#)
- Configuring a target FPGA with a .BIT (bitstream) file, e.g. [ADMXRC3_ConfigureFromFile](#)
- Configuring a target FPGA with in-memory configuration frame data, e.g. [ADMXRC3_ConfigureFromBuffer](#)
- Unconfiguring a target FPGA, e.g. [ADMXRC3_Unconfigure](#)

3.8.1.1 Full reconfiguration

By default, functions such as [ADMXRC3_ConfigureFromFile](#) perform a full reconfiguration of a target FPGA. This means that the target FPGA is first cleared, destroying any existing configuration, and the FPGA is then completely configured with a new bitstream. In this mode of operation, the ADMXRC3 API performs the following steps:

1. Assert PROG# on the target FPGA.
2. Wait until the target FPGA asserts INIT# and deasserts DONE.
3. Deassert PROG# on the target FPGA.
4. Wait until the target FPGA deasserts INIT#. At this point, the target FPGA is now ready to accept a bitstream.
5. The configuration frame data, either from a .BIT file or an in-memory buffer, is now written to the target FPGA's SelectMap interface.
6. Wait until one of the following events occurs:
 - (a) DONE is asserted, which terminates the procedure successfully.
 - (b) DONE is deasserted and INIT# is asserted, which indicates that the target FPGA detected an error in the configuration frame data, and terminates the procedure unsuccessfully.

In all of the above steps that wait, a timeout is possible. If a timeout occurs, the procedure is unsuccessful. If the procedure is unsuccessful, the ADMXRC3 API unconfigures the target FPGA (whose state is now indeterminate) as a safety measure in case an invalid bitstream had somehow been used.

3.8.1.2 Partial reconfiguration

The ADMXRC3 API also allows a target FPGA to be partially reconfigured. In this mode of operation, the ADMXRC3 API simply downloads configuration frame data, either from a .BIT file or an in-memory buffer, to the target FPGA's SelectMap interface without asserting PROG# and without monitoring the DONE and INIT# pins of the target FPGA.

3.8.1.3 Unconfiguration

A target FPGA can be unconfigured by calling [ADMXRC3_Unconfigure](#). This might be useful for reducing power consumption when an application knows that there is nothing to do. The unconfiguration sequence is the same as the first four steps of the full reconfiguration sequence, namely:

1. Assert PROG# on the target FPGA.
2. Wait until the target FPGA asserts INIT# and deasserts DONE.
3. Deassert PROG# on the target FPGA.
4. Wait until the target FPGA deasserts INIT#.

It should be noted that at this point, the target FPGA is unconfigured, but also in a state where it can receive configuration data.

3.8.1.4 Target FPGA ownership

In order to reduce the risk of one process inadvertently reconfiguring the target FPGA that another process is using, the ADMXRC3 API has an ownership mechanism for target FPGAs. An application may choose to opt-out of this mechanism by passing the flag `ADMXRC3_CONFIGURE_SHARE` to functions such as `ADMXRC3_ConfigureFromBuffer`.

Assuming that an application opts into the ownership mechanism, a device handle that is successfully used to configure a target FPGA becomes the owner of that target FPGA. The owning device handle must voluntarily relinquish a target FPGA before a different device handle can be used to reconfigure the same target FPGA. The rules governing the ownership mechanism are as follows:

- When a function such as `ADMXRC3_ConfigureFromBuffer` is called, the ADMXRC3 API verifies that the target FPGA is either (i) free, or (ii) owned by the device handle that is calling `ADMXRC3_ConfigureFromBuffer`. If this check fails, the function returns an error. If the check succeeds, then configuration operation is allowed to proceed. Additionally, the target FPGA changes ownership to the device handle used in the call to `ADMXRC3_ConfigureFromBuffer` provided that all of the following conditions are met:
 - The target FPGA is free
 - The flags parameter **does not** contain `ADMXRC3_CONFIGURE_SHARE`
 - The configuration operation is successful

As implied above, an application can pass `ADMXRC3_CONFIGURE_SHARE` in the flags parameter in order to avoid its device handle becoming the new owner of a target FPGA.

- When `ADMXRC3_Unconfigure` is called, the ADMXRC3 API verifies that the target FPGA is owned by the device handle passed to `ADMXRC3_Unconfigure`. If this check fails, the function returns an error. If the check succeeds, the target FPGA becomes free unless the `ADMXRC3_CONFIGURE_SHARE` flag is passed.
- If `ADMXRC3_Close` is called for the device handle that owns a particular target FPGA, that target FPGA automatically becomes free.

The following state machine illustrates the ownership mechanism, from the perspective of a target FPGA:

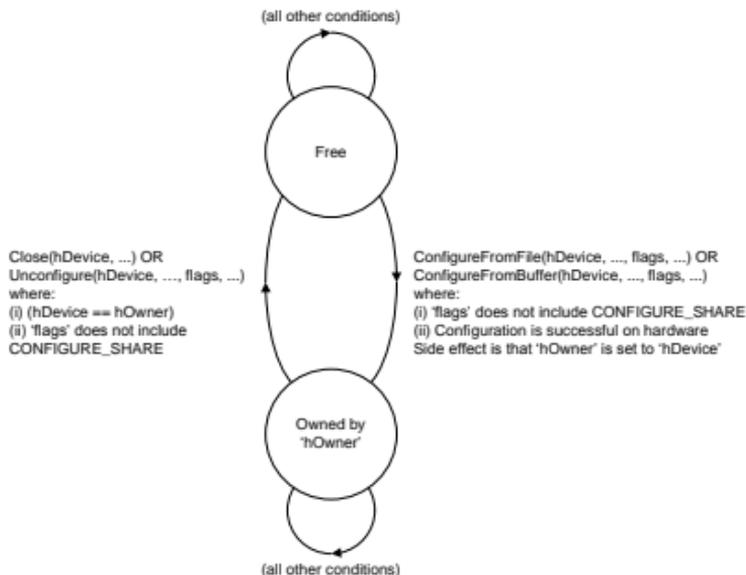


Figure 1: Target FPGA ownership state machine

3.8.2 Memory windows

The ADMXRC3 API exposes a set of *memory windows* for each reconfigurable computing device in the system. These memory windows are an abstraction of the device's presence on the host computer's I/O bus. This abstraction permits the ADMXRC3 API to be I/O-bus-agnostic, so that applications need not be aware of the what kind of I/O bus is used in the system (PCI, PCI-X, PCI Express, HyperTransport etc.).

For example, in a PCI Express system, a PCI Express device has one or more Base Address Registers (BARs) which reside in the device's configuration space. System-level firmware (e.g. BIOS on an x86 PC) configures the BARs at boot time, which places the device at a definite address on the host system's I/O bus. There is a mapping between PCI Express BARs and *memory windows* in the ADMXRC3 API. This mapping is model-specific, and not necessarily one-to-one, for reasons related to the technicalities of the various I/O bus standards. The actual mapping for each supported model is defined in the **ADMXRC3 API Hardware Addendum**. **Figure 2** shows how a reconfigurable computing device's BARs, each corresponding to a memory window (or possibly more than one memory window), might be located in the CPU's physical address space:

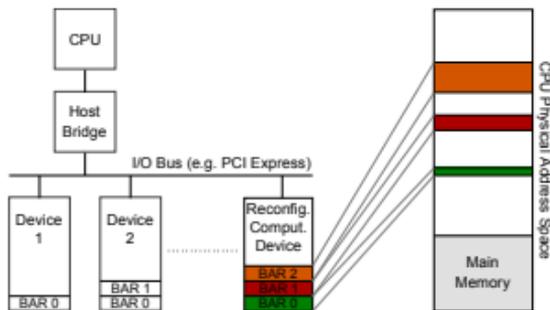


Figure 2: BARs in a reconfigurable computing device

The ADMXRC3 API permits an application to access a reconfigurable computing device via its memory windows. Each memory window on a device serves a different purpose - for example, one window may provide access to the target FPGA in the device, and another window may allow an application to manipulate registers in the device, if necessary. Note that manipulating registers in the device is normally done by the driver and not by an application, but occasionally an application may need to read or write device registers for debugging or troubleshooting. The **ADMXRC3 API Hardware Addendum** defines the memory windows and their purposes for each model supported by the API.

The API function [ADMXRC3_GetWindowInfo](#) allows an application to enumerate and obtain information about each memory window in a device.

3.8.2.1 Mapping memory windows into user-space

In order to avoid the recurring overhead of calling the ADMXRC3 API and underlying driver when accessing a device, the [ADMXRC3_MapWindow](#) function is provided for mapping some or all of a memory window into the address space of a process. The [ADMXRC3_MapWindow](#) function returns a user-space pointer to where the window (or window region) is mapped, and the window can then be accessed by dereferencing the pointer. [ADMXRC3_UnmapWindow](#) performs the inverse, deleting the mapping and invalidating the pointer.

A device typically advertises several register windows to applications via the [ADMXRC3_GetWindowInfo](#) function, of which one (or more) provides access to the target FPGA (or target FPGAs). Other windows correspond to device-specific registers that should normally only be manipulated by the driver, but it is possible for an application to access those registers for debug or diagnostic purposes.

3.8.3 FPGA data transfer

There are several ways to transfer data between the host CPU/memory and an FPGA in a reconfigurable computing device. [Figure 3](#) illustrates the 4 main modes available in the ADMXRC3 API:

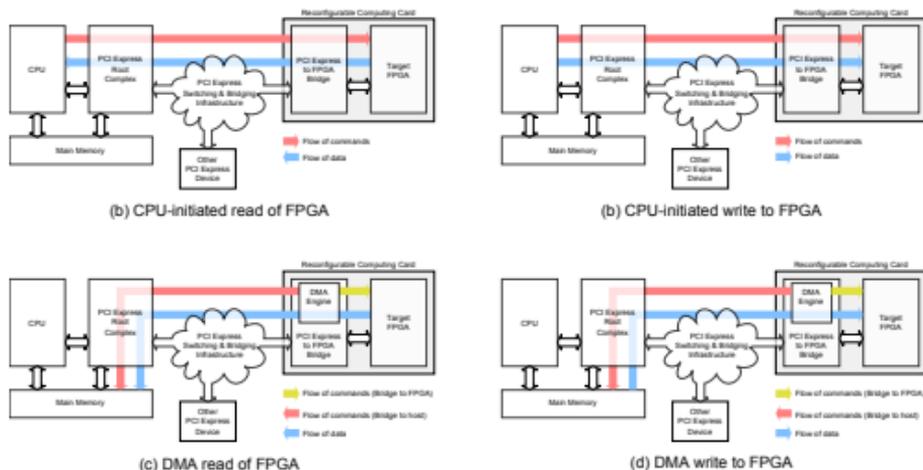


Figure 3: Methods of FPGA data transfer

In **CPU-initiated data transfer**, the CPU drives the transfer of data, whereas in **DMA transfers**, a DMA engine in the reconfigurable computing device drives the data transfer.

CPU-initiated data transfer is generally appropriate for random access to FPGA registers, due to its relatively low latency. However, CPU-initiated data transfer yields poor throughput for bulk data transfer on most platforms. **DMA transfers** offer higher average throughput for blocks of data larger than a certain threshold, with the additional advantage of lower CPU utilization. **Table 2** summarizes the available methods of data transfer:

Method	Throughput	CPU utilization	Software overhead
CPU-initiated read/write, via mapped pointer	poor	1 CPU core	negligible
CPU-initiated read/write, via API	poor	1 CPU core	low
DMA read/write	high	<< 1 CPU core	moderate

Table 2: Methods of FPGA data transfer

The above table indicates the relative characteristics of the various methods of data transfer; it should be noted that for DMA transfers, block size strongly influences throughput, CPU utilization and overhead. Using DMA transfers for small blocks of data (e.g. 128 byte blocks) is highly inefficient.

3.8.3.1 CPU-initiated transfers

The functions **ADMXRC3_Read** and **ADMXRC3_Write** read and write a particular memory window using the CPU to drive the data transfer, as illustrated by **Figure 4** and **Figure 5**:

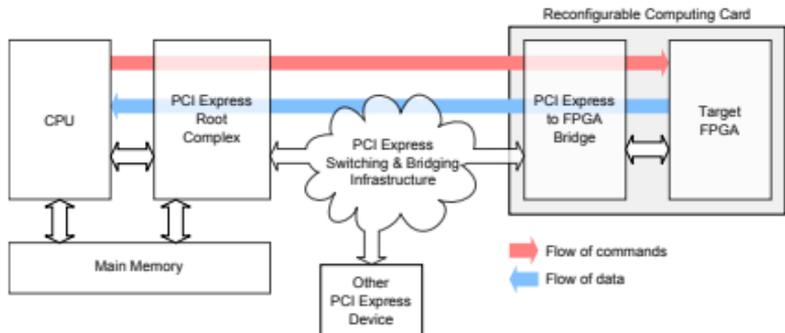


Figure 4: CPU-initiated read of a target FPGA

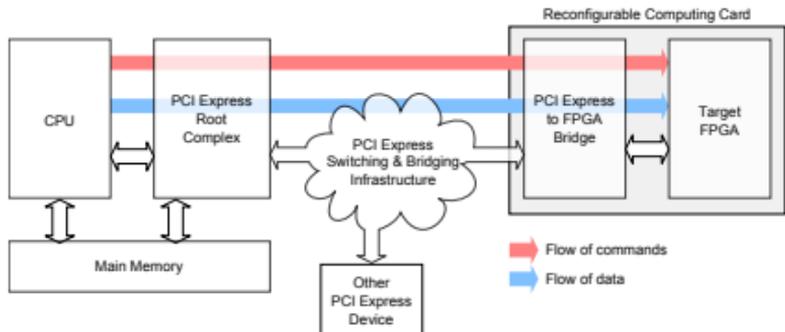


Figure 5: CPU-initiated write of a target FPGA

Some points to bear in mind when using these functions for bulk data transfer are:

- As mentioned previously, a CPU-initiated data transfer will in general consume an entire CPU core for the duration of the transfer.
- It's possible that the performance of other CPU cores on the same die (besides the one used for the transfer) may be negatively affected if they may share the same bus interface unit.
- Writes generally transfer data quicker than reads because writes are "fire and forget". In other words, when the CPU executes a store instruction, it does not need to wait for any confirmation at the destination that the write has been completed. Thus, subject to available write buffer space, the next write can be issued immediately. In addition, on some platforms, the CPU and/or any write buffers in the datapath may also be intelligent enough to coalesce sequential writes into a burst.
- Read performance is generally extremely poor due to two factors:
 1. When the CPU executes a load instruction, it issues a read command via its bus interface. Then CPU has to wait for read command to reach the destination, for the destination to fetch the data, and finally for the data to propagate back through any buffers along the datapath. These latencies are additive and can be in the order of a microsecond on modern PCI Express platforms.

Many CPUs will not issue the next load instruction until the data from the current load instruction has been returned by the system.

For these reasons, it is strongly recommended that CPU-initiated data transfer be avoided for bulk data transfer, and DMA transfer used instead.

3.8.3.2 DMA transfers with host memory

The ADMXRC3 API includes a set of functions for rapidly transferring data between host memory and the target FPGA(s) on a device using DMA transfers. [Figure 6](#) and [Figure 7](#) illustrate DMA transfers:

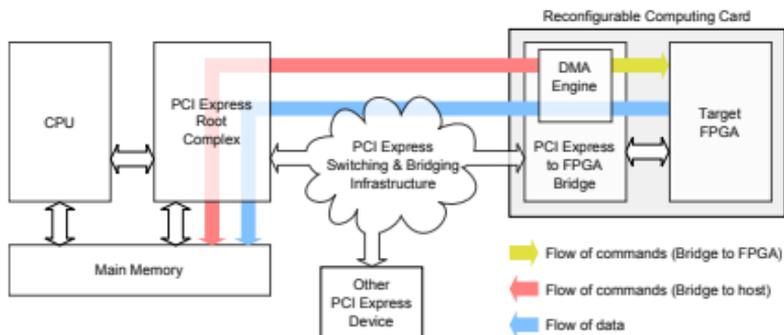


Figure 6: DMA read of a target FPGA

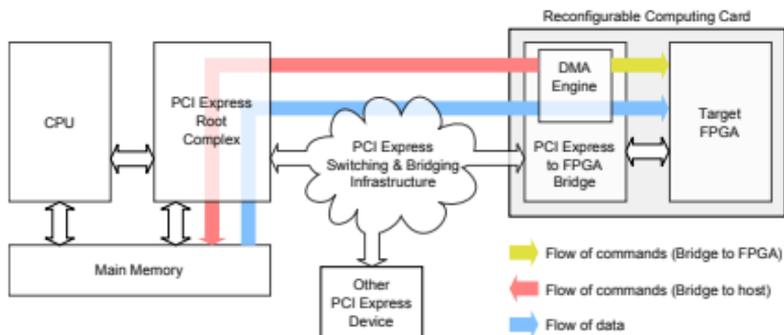


Figure 7: DMA write of a target FPGA

Depending on the runtime platform, DMA transfers have a throughput that is typically one to two orders of magnitude faster than CPU-initiated transfers. The disadvantage of DMA transfers is that each transfer must be 'set up', and later 'torn down'. Although set-up and tear-down are performed transparently by the API, the overhead and latency in execution time may be noticeable for small DMA transfers. DMA transfers, therefore, are best used for bulk data transfer. **CPU-initiated transfers** are best used for random reads and writes of registers in the target FPGA(s), or for transferring small blocks of data.

The ADMXRC3 API provides two groups of functions for performing DMA transfers:

- 'Unlocked' functions, such as [ADMXRC3_WriteDMAEx](#) and [ADMXRC3_StartReadDMA](#).
- 'Locked' functions, such as [ADMXRC3_StartReadDMALockedEx](#) and [ADMXRC3_WriteDMALocked](#).

The following subsections describe the above two groups of DMA functions and their pros and cons.

3.8.3.2.1 Unlocked DMA functions

The Unlocked DMA functions in the ADMXRC3 API accept a description of a user-space buffer that consists simply of (i) a pointer to a buffer and (ii) a byte count. The set-up performed by these functions consists mainly of locking the user-space buffer in memory (so that it cannot be paged out by the operating system), while tear-down consists mainly of unlocking the user-space buffer so that the operating system is once again free to page it in and out of memory.

The advantage of these functions is ease-of-use; there is no need for an application to explicitly lock a user-space buffer prior to calling them. The disadvantage is that, compared to the Locked DMA functions, there is a greater overhead per DMA transfer.

3.8.3.2.2 Locked DMA functions

The Locked DMA functions accept a description of a user-space buffer that consists of (i) a handle to an already-locked buffer, (ii) an offset into that buffer and (iii) a byte count. Locking a user-space buffer is done via the [ADMXRC3_Lock](#) function, which (if successful) returns a handle to the locked buffer. The buffer handle can then be passed to functions such as [ADMXRC3_ReadDMALockedEx](#). Once a user-space buffer is locked, the operating system cannot page the buffer out of main memory during a DMA transfer, which is necessary to ensure that corruption of main memory cannot occur. Handles to locked buffers are global to the system, so that if another process can determine the handle of a locked buffer, it can use that buffer, even with a different device.

The inverse of [ADMXRC3_Lock](#) is [ADMXRC3_Unlock](#), which allows the operating system to once again page the buffer in and out of main memory. Although buffer handles are global to the system, only the device handle that was used to lock a buffer can be used to unlock it. If an application attempts to unlock a user-space buffer while a DMA transfer is in progress, the call to [ADMXRC3_Unlock](#) is successful, but the buffer remains locked (via a reference counting mechanism) until the DMA transfer finishes. This avoids the possibility of memory corruption.

The advantage of using the Locked DMA functions is that the overhead of set-up and tear-down is considerably reduced on most platforms, in comparison to the Unlocked DMA functions. The Locked DMA functions should be used in performance-critical or latency-critical applications. The disadvantage is ease-of-use; an application must first lock any user-space buffers that it wishes to use prior to performing Locked DMA transfers.

3.8.3.3 DMA transfers with peer devices

As of revision 1.4.0, the ADMXRC3 API includes a set of functions for rapidly transferring data between a peer device and the target FPGA(s) on a device using DMA transfers. In order to use these functions, the bus address of the peer device must be known. [Figure 8](#) and [Figure 9](#) illustrate DMA transfers between a target FPGA on a reconfigurable computing device and a peer PCI Express device:

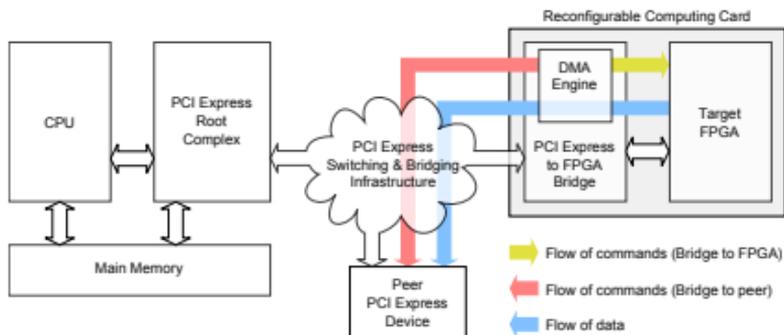


Figure 8: DMA transfer from a target FPGA to a peer device

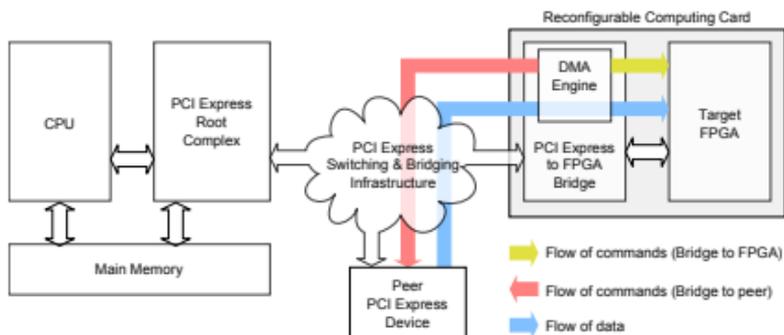


Figure 9: DMA transfer from a peer device to a target FPGA

Depending on the runtime platform, peer DMA transfers have a throughput that is typically one to two orders of magnitude faster than CPU-initiated transfers. The disadvantage of peer DMA transfers is that each transfer must be 'set up', and later 'torn down'. Compared to **host memory DMA transfer**, the overhead for peer DMA transfers is relatively low, because no virtual memory management is performed. The available peer DMA transfer functions in the ADMXRC3 API are:

- [ADMXRC3_ReadDMABus](#)
- [ADMXRC3_StartReadDMABus](#)
- [ADMXRC3_StartWriteDMABus](#)
- [ADMXRC3_WriteDMABus](#)

3.8.4 Clock generators

Most models in Alpha Data's reconfigurable computing range contain one or more programmable clock generators. These are software-programmable and able to generate a large number of discrete frequencies in order to approximate a continuous frequency range. The output of a clock generator is usually routed to a target FPGA, but may also be connected to other functions on a card. The number of clock generators on a card and the purpose of each is model-specific. Consult the User Guide for the model in question to learn details of the available clock generators.

The ADMXRC3 API provides the following functions for manipulating clock generators:

- [ADMXRC3_GetClockFrequency](#)
- [ADMXRC3_SetClockFrequency](#)

3.8.5 Flash memory

A device may contain one or more banks of Flash (nonvolatile) memory that is used to store bitstreams for the target FPGA. The address map of each bank of Flash memory is specific to each model, so the User Guide for a particular model should be consulted when writing applications that access Flash memory.

The ADMXRC3 API provides several functions for programming Flash memory:

- [ADMXRC3_GetFlashInfo](#)
- [ADMXRC3_GetFlashBlockInfo](#)
- [ADMXRC3_EraseFlash](#)
- [ADMXRC3_ReadFlash](#)
- [ADMXRC3_SyncFlash](#)
- [ADMXRC3_WriteFlash](#)

3.8.5.1 Flash memory caching

Since most Flash devices are block-oriented, modifying a single byte results in a read-merge-erase-write cycle being performed for the block containing the location being written. To hide the latency of block erase operations, and to enable applications to treat a Flash memory bank as a uniform array of bytes, the ADMXRC3 API implements a cache for each Flash memory bank. Consequently, in order to ensure that the hardware has been synchronized with the cache, an application must call [ADMXRC3_SyncFlash](#) when appropriate.

Alternatively, an application may effectively disable the cache for a Flash memory bank by passing the flag `ADMXRC3_FLASH_SYNC` to those API functions that accept it. The effect of this flag is to perform synchronization before the function returns, as if [ADMXRC3_SyncFlash](#) were called.

A side effect of having a cache means that calling [ADMXRC3_ReadFlash](#) may sometimes require block-erase and block-write operations to be performed when a dirty block must be written back to the hardware. This means that if the hardware is faulty, error codes that would normally not be expected for a read operation may be returned.

3.8.6 Vital Product Data

Alpha Data reconfigurable computing hardware stores its Vital Product Data (VPD) in a nonvolatile memory. This memory may be Flash, EEPROM or something else. The ADMXRC3 API provides functions for reading and writing VPD:

- [ADMXRC3_ReadVPD](#)
- [ADMXRC3_WriteVPD](#)

The data structures in the VPD memory are model-specific in general. Information about a particular model's VPD structures is available as application note.

The VPD memory can always be read, but in order to write to the VPD memory, the VPD write-protection mechanism must first be disabled. The VPD write-protection mechanism is operating-system dependent; refer to the release notes for the ADB3 driver specific to your operating system for details.

3.8.7 Hardware monitoring

Gen 3 Alpha Data reconfigurable computing hardware typically includes a number of on-board sensors that measure supply voltages, currents, temperatures etc. Version 1.1.0 and later of the ADMXRC3 API provides functions for reading these sensors:

- [ADMXRC3_GetSensorInfo](#)
- [ADMXRC3_ReadSensor](#)

The number of sensors in a device and the type of each is model-specific. The functions [ADMXRC3_GetCardInfoEx](#) and [ADMXRC3_GetSensorInfo](#) can be used together to enumerate the sensors and obtain information about them.

3.8.8 I/O personality modules

Gen 3 Alpha Data reconfigurable computing hardware typically has at least one site for fitting an I/O personality module. Version 1.1.0 and later of the ADMXRC3 API provides the function [ADMXRC3_GetModuleInfo](#) for obtaining information about what module, if any, is fitted to a module site.

The number of I/O module sites is model-specific, and is 1 on most models that have a small to medium-sized form factor such as a PCI Express plug-in card, PMC or XMC. However, a device that comes in larger form factor such as VME or CompactPCI may feature multiple I/O module sites. The functions [ADMXRC3_GetCardInfoEx](#) and [ADMXRC3_GetModuleInfo](#) can be used together to enumerate the module sites and obtain information about what is fitted.

4 ADMXRC3 API Reference

4.1 ADMXRC3 API constants and macros

4.1.1 ADMXRC3_BITSTREAM

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_BITSTREAMW`, if `_UNICODE` is defined
- `ADMXRC3_BITSTREAMA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.2 ADMXRC3_ConfigureFromFile

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_ConfigureFromFileW`, if `_UNICODE` is defined
- `ADMXRC3_ConfigureFromFileA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.3 ADMXRC3_FLASH_INFO

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_FLASH_INFOW`, if `_UNICODE` is defined
- `ADMXRC3_FLASH_INFOA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.4 ADMXRC3_FPGA_INFO

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_FPGA_INFOW`, if `_UNICODE` is defined
- `ADMXRC3_FPGA_INFOA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.5 ADMXRC3_GetFlashInfo

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_GetFlashInfoW`, if `_UNICODE` is defined
- `ADMXRC3_GetFlashInfoA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.6 ADMXRC3_GetFpgaInfo

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_GetFpgaInfoW`, if `_UNICODE` is defined
- `ADMXRC3_GetFpgaInfoA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.7 ADMXRC3_GetModuleInfo

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_GetModuleInfoW`, if `_UNICODE` is defined
- `ADMXRC3_GetModuleInfoA`, otherwise

Remarks

This macro is available in ADMXRC3 API version 1.1.0 and later.

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.8 ADMXRC3_GetSensorInfo

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_GetSensorInfoW`, if `_UNICODE` is defined
- `ADMXRC3_GetSensorInfoA`, otherwise

Remarks

This macro is available in ADMXRC3 API version 1.1.0 and later.

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.9 ADMXRC3_GetStatusString

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_GetStatusStringW`, if `_UNICODE` is defined
- `ADMXRC3_GetStatusStringA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.10 ADMXRC3_HANDLE_INVALID_VALUE

Datatype

[ADMXRC3_HANDLE](#)

Description

Value that represents an invalid device handle, typically used to initialize a variable of type [ADMXRC3_HANDLE](#).

4.1.11 ADMXRC3_LoadBitstream

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the [_UNICODE](#) preprocessor symbol is defined, as follows:

- [ADMXRC3_LoadBitstreamW](#), if [_UNICODE](#) is defined
- [ADMXRC3_LoadBitstreamA](#), otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.12 ADMXRC3_MODULE_INFO

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the [_UNICODE](#) preprocessor symbol is defined, as follows:

- [ADMXRC3_MODULE_INFOW](#), if [_UNICODE](#) is defined
- [ADMXRC3_MODULE_INFOA](#), otherwise

Remarks

This macro is available in ADMXRC3 API version 1.1.0 and later.

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.13 ADMXRC3_SENSOR_INFO

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_SENSOR_INFOW`, if `_UNICODE` is defined
- `ADMXRC3_SENSOR_INFOA`, otherwise

Remarks

This macro is available in ADMXRC3 API version 1.1.0 and later.

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.1.14 ADMXRC3_UnloadBitstream

Description

A macro that can be used in code that is intended to be portable between UTF-8 (Linux), ANSI (Windows) and Unicode versions of an application. The value of this macro depends on whether or not the `_UNICODE` preprocessor symbol is defined, as follows:

- `ADMXRC3_UnloadBitstreamW`, if `_UNICODE` is defined
- `ADMXRC3_UnloadBitstreamA`, otherwise

Remarks

Refer to [Section 3.7, "String encoding issues"](#) for an explanation of how the ADMXRC3 API handles string encodings.

4.2 ADMXRC3 API datatypes

4.2.1 ADMXRC3_BANK_INFO

Declaration

```
typedef structure ... {
    uint64_t    MaximumFrequency;
    uint64_t    MinimumFrequency;
    uint64_t    PhysicalSize;
    uint16_t    PhysicalDataWidth;
    uint16_t    PhysicalECCWidth;
    uint16_t    PhysicalWidth;
    uint16_t    Reserved1;
    uint32_t    TypeMask;
    uint32_t    ConnectivityMask;
    boolean_t   Present;
} ADMXRC3_BANK_INFO;
```

The members of this structure are as follows:

MaximumFrequency

Maximum operating frequency of the memory devices, in Hz.

If this value is 0, then both the maximum and minimum operating frequency of the device must be considered unknown. In this case, software must either use an alternative method of determining operating frequency, or avoid making assumptions about operating frequency.

MinimumFrequency

Minimum operating frequency of the memory devices, in Hz. This member must be considered invalid if MaximumFrequency is 0.

PhysicalSize

Physical size of the memory bank, in physical words.

PhysicalDataWidth

Number of physical data bits in the data bus of the memory bank, excluding error correction bits.

PhysicalECCWidth

Number of physical error correction bits in the data bus of the memory bank. Error correction bits can take the form of parity bits, ECC bits or other error correction schemes. For most types of memory, error correction bits can be used either as additional data bits, or for the purpose of error detection and correction.

PhysicalWidth

Number of physical data and error correction bits in the data bus of the memory bank. This member is always the sum of the PhysicalDataWidth and PhysicalECCWidth members.

Reserved1

Must be ignored by application software.

TypeMask

Bitwise-OR of flags that represent the operating modes that the memory bank can support, of which at least one bit must be 1. Certain types of memory, notably ZBT SSRAM, can operate in more than one mode. Supported operating modes are:

- ADMXRC3_BANK_ZBT_FT is flowthrough ZBT SSRAM
- ADMXRC3_BANK_ZBT_P is pipelined ZBT SSRAM
- ADMXRC3_BANK_SDRAM_DDR is DDR SDRAM
- ADMXRC3_BANK_SSRAM_DDR2 is DDR-II SSRAM
- ADMXRC3_BANK_SDRAM_SDR is single data rate SDRAM
- ADMXRC3_BANK_SDRAM_DDR2 is pipelined ZBT SSRAM
- ADMXRC3_BANK_SSRAM_QDR is QDR SSRAM
- ADMXRC3_BANK_SDRAM_DDR3 is DDR-3 SDRAM

ConnectivityMask

This member is a bitmask indicating which target FPGA(s) the memory bank is connected to. In most cases, a single bit is set. However, some models may connect a memory bank to more than one target FPGA, and in such cases more than one bit is set. Examples:

- Assume that the NumFpga member of [ADMXRC3_CARD_INFOEX](#) is 1, indicating that the device has one target FPGA whose index is 0. The ConnectivityMask for all memory banks must therefore be 0x1, since bit 0 corresponds to target FPGA 0.
- Assume that the NumFpga member of [ADMXRC3_CARD_INFOEX](#) is 2, indicating that the device has two target FPGAs whose indices are 0 and 1. A ConnectivityMask of 0x1 indicates that the memory bank is connected to target FPGA 0, while a connectivity mask of 0x2 indicates that the memory bank is connected to target FPGA 1. A ConnectivityMask of 0x3 indicates that the memory bank is connected to both target FPGAs.

Present

If this member is nonzero, it indicates that the bank is fully populated with memory devices. If zero, the bank is unpopulated. Memory banks are normally fully populated, but may be unpopulated for two reasons:

- The target FPGA may not have sufficient bonded I/O pins in order to be able to use all memory banks. This can occur for the smaller devices in an FPGA family.
- On request by a customer, Alpha Data can manufacture cards with a subset of memory banks populated, as cost-saving measure for volume orders.

Description

A structure that describes a memory bank, obtained by call to [ADMXRC3_GetBankInfo](#).

4.2.2 ADMXRC3_BITSTREAMA

Declaration

```
typedef structure ... {  
    char    Identifier[32];  
    uint32_t Length;  
    uint8_t  Data[4];  
} ADMXRC3_BITSTREAMA;
```

The members of this structure are as follows:

Identifier

A NUL-terminated **char** string that identifies an FPGA device and package, in the same format as in the Identifier member of [ADMXRC3_FPGA_INFOA](#). This string is typically used to verify that a bitstream (.BIT) file matches the target FPGA in a device, by comparing it with the Identifier member of [ADMXRC3_FPGA_INFOA](#).

Length

The number of bytes in the variable-length array that begins with the Data member.

Data

The bitstream data, as a variable-length array. Although this member is defined to be an array of length 4, the actual number of bytes in the array is given by the Length member. This variable length array is suitable for passing to [ADMXRC3_ConfigureFromBuffer](#).

Description

This structure represents a bitstream suitable for configuring a target FPGA, and is typically allocated and initialized by a call to [ADMXRC3_LoadBitstreamA](#). Although applying the `sizeof` operator to this structure returns a value of a few tens of bytes, the structure should be regarded as the beginning of an object that could be many megabytes in size (for the latest FPGAs). The inverse function is [ADMXRC3_UnloadBitstreamA](#), which deallocates the memory used by the object.

Remarks

This is the ANSI / UTF-8 version of the [ADMXRC3_BITSTREAM](#) structure. [ADMXRC3_BITSTREAM](#) is actually a macro defined to be either [ADMXRC3_BITSTREAMW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_BITSTREAMA](#).

4.2.3 ADMXRC3_BITSTREAMW

Declaration

```
typedef structure ... {
    wchar_t Identifier[32];
    uint32_t Length;
    uint8_t Data[4];
} ADMXRC3_BITSTREAMW;
```

The members of this structure are as follows:

Identifier

A NUL-terminated `wchar_t` string that identifies an FPGA device and package, in the same format as in the Identifier member of [ADMXRC3_FPGA_INFOW](#). This string is typically used to verify that a bitstream (.BIT) file matches the target FPGA in a device, by comparing it with the Identifier member of [ADMXRC3_FPGA_INFOW](#).

Length

The number of bytes in the variable-length array that begins with the Data member.

Data

The bitstream data, as a variable-length array. Although this member is defined to be an array of length 4, the actual number of bytes in the array is given by the Length member. This variable length array is suitable for passing to [ADMXRC3_ConfigureFromBuffer](#).

Description

This structure represents a bitstream suitable for configuring a target FPGA, and is typically allocated and initialized by a call to [ADMXRC3_LoadBitstreamW](#). Although applying the `sizeof` operator to this structure returns a value of a few tens of bytes, the structure should be regarded as the beginning of an object that could be many megabytes in size (for the latest FPGAs). The inverse function is [ADMXRC3_UnloadBitstreamW](#), which deallocates the memory used by the object.

Remarks

This is the Unicode version of the `ADMXRC3_BITSTREAM` structure. `ADMXRC3_BITSTREAM` is actually a macro defined to be either `ADMXRC3_BITSTREAMW` if the `_UNICODE` preprocessor symbol is defined, or else `ADMXRC3_BITSTREAMA`.

4.2.4 ADMXRC3_BUFFER_HANDLE

Declaration

```
typedef ... ADMXRC3_BUFFER_HANDLE;
```

Description

This type is a handle representing a buffer that is locked into physical memory. A buffer handle is obtained by a call to `ADMXRC3_Lock`, and invalidated by a call to the inverse function, `ADMXRC3_Unlock`.

The following functions accept a parameter of this type, which identifies the buffer that a DMA transfer is to target:

- `ADMXRC3_StartReadDMALocked`
- `ADMXRC3_StartWriteDMALocked`
- `ADMXRC3_ReadDMALocked`
- `ADMXRC3_WriteDMALocked`

A value of zero is always invalid for a variable of type `ADMXRC3_BUFFER_HANDLE`. Buffer handles returned by `ADMXRC3_Lock` are always greater than zero.

Buffer handles are global to the system, so that if one process can lock a buffer and communicate the buffer handle to a second process, the second process can use it to perform DMA transfers.

Remarks

It is good practice to initialize variables of this type to zero, and to set such variables to zero after calling `ADMXRC3_Unlock`.

This type is a 32-bit unsigned integer. In Windows, it is a typedef of `UINT32`, while in Linux it is a typedef of `uint32_t`.

4.2.5 ADMXRC3_CARD_INFO

Declaration

```
typedef structure ... {  
    uint32_t      SerialNumber;  
    uint32_t      Reserved1;  
    ADMXRC3_MODEL_TYPE Model;  
    unsigned int  NumClockGen;  
    unsigned int  NumDmaChannel;  
    unsigned int  NumFlashBank;  
    unsigned int  NumMemoryBank;  
    unsigned int  NumTargetPpga;  
    unsigned int  NumWindow;  
    uint32_t      MemoryBankPresent;  
} ADMXRC3_CARD_INFO;
```

The members of this structure are as follows:

SerialNumber

SerialNumber is the serial number of device. Alpha Data guarantees serial numbers to be unique only for a particular model; it is possible for two devices that are different models to have the same serial number.

Reserved1

Must be ignored by application software.

Model

Model identifies the model or product, and is of type [ADMXRC3_MODEL_TYPE](#).

NumClockGen

NumClockGen is the number of independently programmable clock generators in the device. The clockIndex parameter of the clock generator programming functions [ADMXRC3_GetClockFrequency](#) and [ADMXRC3_SetClockFrequency](#) must be less than this value.

NumDmaChannel

NumDmaChannel is the number of independently programmable DMA channels in the device. The dmaChannel parameter of the DMA functions such as [ADMXRC3_ReadDMA](#) must be less than this value.

NumFlashBank

NumFlashBank is the number of independent Flash memory banks in the device. The flashIndex parameter of Flash functions such as [ADMXRC3_GetFlashInfo](#) and [ADMXRC3_GetFlashBlockInfo](#) must be less than this value.

NumMemoryBank

NumMemoryBank is the number of independent memory banks in the device. The bankIndex parameter of [ADMXRC3_GetBankInfo](#) must be less than this value.

NumTargetFpga

NumFpga is the number of target FPGAs in the device. The 'targetIndex' parameter of the target FPGA configuration functions such as [ADMXRC3_ConfigureFromBuffer](#) must be less than this value.

NumWindow

NumWindow is the number of independent register/memory access windows in the device. The windowIndex parameter of functions that allow access to target FPGA registers (such as [ADMXRC3_GetWindowInfo](#)) must be less than this value.

MemoryBankPresent

MemoryBankPresent is a bitmask where each bit that is 1 indicates that the corresponding memory bank is present. For example, if MemoryBankPresent were 0x0000000F and NumMemoryBank were 6, it would indicate that banks 0, 1, 2 and 3 are present whilst banks 4 and 5 are not present.

Description

A structure that describes a device, obtained from a call to [ADMXRC3_GetCardInfo](#).

4.2.6 ADMXRC3_CARD_INFOEX

Declaration

```
typedef structure ... {  
    uint32_t      SerialNumber;  
    uint32_t      Reserved1;  
    ADMXRC3_MODEL_TYPE Model;  
    unsigned int  NumClockGen;  
    unsigned int  NumDmaChannel;  
    unsigned int  NumFlashBank;  
    unsigned int  NumMemoryBank;  
    unsigned int  NumTargetFpga;  
    unsigned int  NumWindow;  
    uint32_t      MemoryBankPresent;  
    unsigned int  NumSensor;  
    unsigned int  NumModuleSite;  
} ADMXRC3_CARD_INFOEX;
```

The members of this structure are as follows:

SerialNumber

SerialNumber is the serial number of device. Alpha Data guarantees serial numbers to be unique only for a particular model; it is possible for two devices that are different models to have the same serial number.

Reserved1

Must be ignored by application software.

Model

Model identifies the model or product, and is of type [ADMXRC3_MODEL_TYPE](#).

NumClockGen

NumClockGen is the number of independently programmable clock generators in the device. The clockIndex parameter of the clock generator programming functions [ADMXRC3_GetClockFrequency](#) and [ADMXRC3_SetClockFrequency](#) must be less than this value.

NumDmaChannel

NumDmaChannel is the number of independently programmable DMA channels in the device. The dmaChannel parameter of the DMA functions such as [ADMXRC3_ReadDMA](#) must be less than this value.

NumFlashBank

NumFlashBank is the number of independent Flash memory banks in the device. The flashIndex parameter of [ADMXRC3_GetFlashInfo](#) and [ADMXRC3_GetFlashBlockInfo](#) must be less than this value.

NumMemoryBank

NumMemoryBank is the number of independent (non-Flash) memory banks in the device. The bankIndex parameter of [ADMXRC3_GetBankInfo](#) must be less than this value.

NumTargetFpga

NumFpga is the number of target FPGAs in the device. The 'targetIndex' parameter of the target FPGA configuration functions such as [ADMXRC3_ConfigureFromBuffer](#) must be less than this value.

NumWindow

NumWindow is the number of independent register/memory access windows in the device. The windowIndex parameter of functions that allow access to target FPGA registers (such as [ADMXRC3_GetWindowInfo](#)) must be less than this value.

MemoryBankPresent

MemoryBankPresent is a bitmask where each bit that is 1 indicates that the corresponding memory bank is present. For example, if MemoryBankPresent were 0x0000000F and NumMemoryBank were 6, it would indicate that banks 0, 1, 2 and 3 are present whilst banks 4 and 5 are not present.

NumSensor

NumSensor is the number of sensors (for voltage, current, temperature etc.) in the device. The sensorIndex parameter of [ADMXRC3_GetSensorInfo](#) and [ADMXRC3_ReadSensor](#) must be less than this value.

NumModuleSite

NumModuleSite is the number of I/O personality module sites in the device. The moduleIndex parameter of [ADMXRC3_GetModuleInfo](#) must be less than this value.

Description

A structure that describes a device, obtained from a call to [ADMXRC3_GetCardInfoEx](#).

Remarks

The information in this structure is a superset of that of [ADMXRC3_CARD_INFO](#), and can therefore be used instead of [ADMXRC3_CARD_INFO](#) in most situations.

4.2.7 ADMXRC3_DATA_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_DATA_BOOL           = 0,           Type of sensor values is BOOL (Windows) or int (Linux)
    ADMXRC3_DATA_DOUBLE        = 1,           Type of sensor values is double.
    ADMXRC3_DATA_INT32         = 2,           Type of sensor values is a INT32 (Windows) or int32_t
    ADMXRC3_DATA_UINT32       = 3,           Type of sensor values is UINT32 (Windows) or uint32_t
    ADMXRC3_DATA_LASTVALUE    = 4,           Reserved for future expansion
    ADMXRC3_DATA_FORCE32BITS  = 0x7FFFFFFF   Force type to be at least 32 bits
} ADMXRC3_DATA_TYPE;
```

Description

An enumerated type used to represent the type of data returned by the [ADMXRC3_ReadSensor](#) function. Values ADMXRC3_DATA_LASTVALUE and greater are reserved for adding new datatypes in future revisions of the API.

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

4.2.8 ADMXRC3_FAMILY_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_FAMILY_4K          = 0,          Xilinx XC4xxx
    ADMXRC3_FAMILY_VIRTEX     = 1,          Xilinx Virtex
    ADMXRC3_FAMILY_VIRTEX2    = 2,          Xilinx Virtex-II
    ADMXRC3_FAMILY_VIRTEX2P   = 3,          Xilinx Virtex-II Pro
    ADMXRC3_FAMILY_VIRTEX4    = 4,          Xilinx Virtex-4
    ADMXRC3_FAMILY_VIRTEX5    = 5,          Xilinx Virtex-5
    ADMXRC3_FAMILY_VIRTEX6    = 6,          Xilinx Virtex-6
    ADMXRC3_FAMILY_LASTVALUE  = 7,          Reserved for future products
    ADMXRC3_FAMILY_FORCE32BITS = 0x7FFFFFFF Force type to be at least 32 bits
} ADMXRC3_FAMILY_TYPE;
```

Description

An enumerated type used to represent an FPGA device family. Values ADMXRC3_FPGA_LASTVALUE and greater are reserved for adding support for future models.

ADMXRC3_FAMILY_VIRTEX

4.2.9 ADMXRC3_FLASH_INFOA

Declaration

```
typedef structure ... {
    char    Identifier[32];
    uint64_t Size;
    uint64_t UseableStart;
    uint64_t UseableLength;
} ADMXRC3_FLASH_INFOA;
```

The members of this structure are as follows:

Identifier

A NUL-terminated **char** string containing the name of the Flash device, provided primarily for diagnostic purposes.

Size

The total size of the Flash memory bank, in bytes.

UseableStart

The starting address within the Flash memory bank of the region that is available for use by applications.

UseableLength

The length, in bytes, of the region that is available for use by applications.

Description

This structure provides high-level information about a Flash memory bank. It is returned by a call to [ADMXRC3_GetFlashInfo](#).

On some models, only a part of a Flash memory bank is available for use by applications. The `UseableStart` and `UseableLength` members indicate the bounds of this region. Attempting to erase, read or write data outside of this region using [ADMXRC3_EraseFlash](#) etc. fails.

Remarks

This is the ANSI / UTF-8 version of the [ADMXRC3_FLASH_INFO](#) structure. [ADMXRC3_FLASH_INFO](#) is actually a macro defined to be either [ADMXRC3_FLASH_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_FLASH_INFOA](#).

4.2.10 ADMXRC3_FLASH_INFOW

Declaration

```
typedef structure ... {  
    wchar_t  Identifier[32];  
    uint64_t Size;  
    uint64_t UseableStart;  
    uint64_t UseableLength;  
} ADMXRC3_FLASH_INFOW;
```

The members of this structure are as follows:

Identifier

A NUL-terminated `wchar_t` string containing the name of the Flash device, provided primarily for diagnostic purposes.

Size

The total size, in bytes, of the Flash memory bank.

UseableStart

The starting byte address within the Flash memory bank of the region that is available for use by applications.

UseableLength

The length, in bytes, of the region that is available for use by applications.

Description

This structure provides high-level information about a Flash memory bank. It is returned by a call to [ADMXRC3_GetFlashInfo](#).

On some models, only a part of a Flash memory bank is available for use by applications. The `UseableStart` and `UseableLength` members indicate the bounds of this region. Attempting to erase, read or write data outside of this region using [ADMXRC3_EraseFlash](#) etc. fails.

Remarks

This is the Unicode version of the [ADMXRC3_FLASH_INFO](#) structure. [ADMXRC3_FLASH_INFO](#) is actually a macro defined to be either [ADMXRC3_FLASH_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_FLASH_INFOA](#).

4.2.11 ADMXRC3_FLASHBLOCK_INFO

Declaration

```
typedef structure ... {  
    uint64_t Address;  
    uint64_t Length;  
    uint32_t Flags;  
} ADMXRC3_FLASHBLOCK_INFO;
```

The members of this structure are as follows:

Address

The starting address, in bytes, of the Flash block.

Length

The length, in bytes, of the Flash block.

Flags

Bitwise-OR of flags that represent attributes of the Flash block. Currently, the following flags are defined:

- `ADMXRC3_FLASHBLOCK_BOOT`
Indicates that the block is a "boot block".

Description

This structure specifies the bounds of a Flash block within a Flash memory bank. An application determines which Flash block contains a particular location by calling [ADMXRC3_GetFlashBlockInfo](#), which returns this structure.

Remarks

Flash devices that do not have a block-oriented architecture simply define a single block that is the entire Flash device.

4.2.12 ADMXRC3_FPGA_INFOA

Declaration

```
typedef structure ... {  
    char Identifier[32];  
    ADMXRC3_FPGA_TYPE DeviceCode;  
    ADMXRC3_FAMILY_TYPE FamilyCode;  
    ADMXRC3_SUBFAMILY_TYPE SubfamilyCode;  
    ADMXRC3_PACKAGE_TYPE PackageCode;  
    char Device[16];  
    char Package[16];  
    uint32_t Flags;  
    char SpeedGrade[8];  
    char Stepping[8];  
    boolean_t Present;  
} ADMXRC3_FPGA_INFOA;
```

The members of this structure are as follows:

Identifier

A NUL-terminated **char** string that identifies an FPGA die and package. The string is in a format compatible with that of a bitstream (.BIT) file, and thus may be usefully compared with the Identifier member of **ADMXRC3_BITSTREAMA** to determine whether or not a target FPGA matches the bitstream file. An example string is "5vsx240tff1738".

DeviceCode

Identifies the FPGA family and die size of the target FPGA, but yields no information about the package. This member is one of the values of **ADMXRC3_FPGA_TYPE**.

FamilyCode

Identifies the FPGA family to which the target FPGA belongs. This member is one of the values of **ADMXRC3_FAMILY_TYPE**.

SubfamilyCode

Identifies the FPGA subfamily to which the target FPGA belongs. This member is one of the values of **ADMXRC3_SUBFAMILY_TYPE**.

PackageCode

The package of the FPGA is encoded in this member. Refer to **ADMXRC3_PACKAGE_TYPE** for information on how a package is encoded.

Device

A NUL-terminated **char** string that identifies an FPGA die, excluding the package. For example, "5VLX220T".

Package

A NUL-terminated **char** string that identifies an FPGA package. For example, "FG456".

Flags

A bitwise-OR of flags that indicate which of the following members are valid. Currently, the following flags are defined:

- **ADMXRC3_FPGA_SPEEDVALID**
Indicates that the SpeedGrade member is valid.
- **ADMXRC3_FPGA_STEPPINGVALID**
Indicates that the Stepping member is valid.
- **ADMXRC3_FPGA_NOTCONFIGURABLE**
Indicates that FPGA in question is not configurable via functions such as **ADMXRC3_ConfigureFromFile**. This flag is available in ADMXRC3 API version 1.4.0 and later; see remarks below.

SpeedGrade

A NUL-terminated **char** string that identifies the speed grade and temperature grade. If the Flags member (see above) contains ADMXRC3_FPGA_SPEEDVALID, then this member is valid. Otherwise, it is not valid, and speed grade information is not available for the target FPGA.

The last character of the string represents the temperature grade, which can be 'I' for industrial or 'C' for commercial. Example strings are are: "4C" (Virtex-II commercial), "1C" (Virtex-5 commercial), and "10I" (Virtex-4 industrial). Correct interpretation of speed grade strings requires knowledge of the FPGA family and subfamily.

Stepping

A NUL-terminated **char** string that identifies the stepping level. If the Flags member (see above) contains ADMXRC3_FPGA_STEPPINGVALID, then this member is valid. Otherwise, it is not valid, and stepping level information is not available for the target FPGA.

Example strings are "ES", "0", "1", etc. Correct interpretation of stepping level strings requires knowledge of the FPGA family and subfamily.

Present

TRUE if the site for the target FPGA is physically populated with an FPGA, otherwise FALSE. If this member is FALSE, none of the above members are valid.

Description

This structure describes a target FPGA and is returned by [ADMXRC3_GetFpgaInfoA](#).

Remarks

This is the ANSI / UTF-8 version of the [ADMXRC3_FPGA_INFO](#) structure. [ADMXRC3_FPGA_INFO](#) is actually a macro defined to be either [ADMXRC3_FPGA_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_FPGA_INFO](#).

The most common reason for the [ADMXRC3_FPGA_NOTCONFIGURABLE](#) flag being present is that the FPGA in question is both the PCI Express interface and the target FPGA. Reconfiguring it would destroy all PCI-E configuration state, rendering it unusable until the next system reset. An FPGA for which this flag is present uses an alternative method of programming such as (i) JTAG or (ii) by programming a bitstream into a nonvolatile memory, from which the FPGA is automatically configured at power-up.

4.2.13 ADMXRC3_FPGA_INFOW

Declaration

```
typedef structure ... {
    wchar_t          Identifier[32];
    ADMXRC3_FPGA_TYPE DeviceCode;
    ADMXRC3_FAMILY_TYPE FamilyCode;
    ADMXRC3_SUBFAMILY_TYPE SubfamilyCode;
    ADMXRC3_PACKAGE_TYPE PackageCode;
    wchar_t          Device[16];
    wchar_t          Package[16];
    uint32_t         Flags;
    wchar_t          SpeedGrade[8];
    wchar_t          Stepping[8];
    boolean_t        Present;
} ADMXRC3_FPGA_INFOW;
```

The members of this structure are as follows:

Identifier

A NUL-terminated **wchar_t** string that identifies an FPGA die and package. The string is in a format compatible with that of a bitstream (.BIT) file, and thus may be usefully compared with the Identifier member of **ADMXRC3_BITSTREAMA** to determine whether or not a target FPGA matches the bitstream file. An example string is "5vsx240tff1738".

DeviceCode

Identifies the FPGA family and die size of the target FPGA, but yields no information about the package. This member is one of the values of **ADMXRC3_FPGA_TYPE**.

FamilyCode

Identifies the FPGA family to which the target FPGA belongs. This member is one of the values of **ADMXRC3_FAMILY_TYPE**.

SubfamilyCode

Identifies the FPGA subfamily to which the target FPGA belongs. This member is one of the values of **ADMXRC3_SUBFAMILY_TYPE**.

PackageCode

The package of the FPGA is encoded in this member. Refer to **ADMXRC3_PACKAGE_TYPE** for information on how a package is encoded.

Device

A NUL-terminated **wchar_t** string that identifies an FPGA die, excluding the package. For example, "5VLX220T".

Package

A NUL-terminated **wchar_t** string that identifies an FPGA package. For example, "FG456".

Flags

A bitwise-OR of flags that indicate which of the following members are valid. Currently, the following flags are defined:

- **ADMXRC3_FPGA_SPEEDVALID**
Indicates that the SpeedGrade member is valid.
- **ADMXRC3_FPGA_STEPPINGVALID**
Indicates that the Stepping member is valid.

SpeedGrade

A NUL-terminated **wchar_t** string that identifies the speed grade and temperature grade. If the Flags member (see above) contains **ADMXRC3_FPGA_SPEEDVALID**, then this member is valid. Otherwise, it is not valid, and speed grade information is not available for the target FPGA.

The last character of the string represents the temperature grade, which can be 'I' for industrial or 'C' for commercial. Example strings are are: "4C" (Virtex-II commercial), "1C" (Virtex-5 commercial), and "10I" (Virtex-4 industrial). Correct interpretation of speed grade strings requires knowledge of the FPGA family and subfamily.

Stepping

A NUL-terminated `wchar_t` string that identifies the stepping level. If the `Flags` member (see above) contains `ADMXRC3_FPGA_STEPPINGVALID`, then this member is valid. Otherwise, it is not valid, and stepping level information is not available for the target FPGA.

Example strings are "ES", "0", "1", etc. Correct interpretation of stepping level strings requires knowledge of the FPGA family and subfamily.

Present

TRUE if the site for the target FPGA is physically populated with an FPGA, otherwise FALSE. If this member is FALSE, none of the above members are valid.

Description

This structure describes a target FPGA and is returned by `ADMXRC3_GetFpgaInfoW`.

Remarks

This is the Unicode version of the `ADMXRC3_FPGA_INFO` structure. `ADMXRC3_FPGA_INFO` is actually a macro defined to be either `ADMXRC3_FPGA_INFOW` if the `_UNICODE` preprocessor symbol is defined, or else `ADMXRC3_FPGA_INFO`.

4.2.14 ADMXRC3_FPGA_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_FPGA_V1000      = 4,          Xilinx XC1000 (Virtex)
    ADMXRC3_FPGA_V400       = 5,          Xilinx XC4000 (Virtex)
    ADMXRC3_FPGA_V600       = 6,          Xilinx XC6000 (Virtex)
    ADMXRC3_FPGA_V800       = 7,          Xilinx XC8000 (Virtex)
    ADMXRC3_FPGA_V2000E    = 8,          Xilinx XC2000E (Virtex-E)
    ADMXRC3_FPGA_V1000E    = 9,          Xilinx XC1000E (Virtex-E)
    ADMXRC3_FPGA_V1600E    = 10,         Xilinx XC1600E (Virtex-E)
    ADMXRC3_FPGA_V3200E    = 11,         Xilinx XC3200E (Virtex-E)
    ADMXRC3_FPGA_V812E     = 12,         Xilinx XC812E (Virtex-EM)
    ADMXRC3_FPGA_V405E     = 13,         Xilinx XC405E (Virtex-EM)
    ADMXRC3_FPGA_V1000     = 32,         Xilinx XC2V1000 (Virtex-II)
    ADMXRC3_FPGA_V1500     = 33,         Xilinx XC2V1500 (Virtex-II)
    ADMXRC3_FPGA_V2000     = 34,         Xilinx XC2V2000 (Virtex-II)
    ADMXRC3_FPGA_V3000     = 35,         Xilinx XC2V3000 (Virtex-II)
    ADMXRC3_FPGA_V4000     = 36,         Xilinx XC2V4000 (Virtex-II)
    ADMXRC3_FPGA_V6000     = 37,         Xilinx XC2V6000 (Virtex-II)
    ADMXRC3_FPGA_V8000     = 38,         Xilinx XC2V8000 (Virtex-II)
    ADMXRC3_FPGA_V10000    = 39,         Xilinx XC2V10000 (Virtex-II)
    ADMXRC3_FPGA_V2P2     = 64,         Xilinx XC2VP2 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P4     = 65,         Xilinx XC2VP4 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P7     = 66,         Xilinx XC2VP7 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P20    = 67,         Xilinx XC2VP20 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P30    = 68,         Xilinx XC2VP30 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P40    = 69,         Xilinx XC2VP40 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P50    = 70,         Xilinx XC2VP50 (Virtex-II Pro)
    ADMXRC3_FPGA_V2P100   = 71,         Xilinx XC2VP100 (Virtex-II Pro)
```

ADMXRC3_FPGA_2VP125	= 72,	Xilinx XC2VP125 (Virtex-II Pro)
ADMXRC3_FPGA_2VP70	= 73,	Xilinx XC2VP70 (Virtex-II Pro)
ADMXRC3_FPGA_4VLX15	= 96,	Xilinx XC4VLX15 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX25	= 97,	Xilinx XC4VLX25 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX40	= 98,	Xilinx XC4VLX40 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX60	= 99,	Xilinx XC4VLX60 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX100	= 100,	Xilinx XC4VLX100 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX160	= 101,	Xilinx XC4VLX160 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX200	= 102,	Xilinx XC4VLX200 (Virtex-4 LX)
ADMXRC3_FPGA_4VLX80	= 103,	Xilinx XC4VLX80 (Virtex-4 LX)
ADMXRC3_FPGA_4V5X25	= 104,	Xilinx XC4V5X25 (Virtex-4 SX)
ADMXRC3_FPGA_4V5X35	= 105,	Xilinx XC4V5X35 (Virtex-4 SX)
ADMXRC3_FPGA_4V5X55	= 106,	Xilinx XC4V5X55 (Virtex-4 SX)
ADMXRC3_FPGA_4VFX12	= 112,	Xilinx XC4VFX12 (Virtex-4 FX)
ADMXRC3_FPGA_4VFX20	= 113,	Xilinx XC4VFX20 (Virtex-4 FX)
ADMXRC3_FPGA_4VFX40	= 114,	Xilinx XC4VFX40 (Virtex-4 FX)
ADMXRC3_FPGA_4VFX60	= 115,	Xilinx XC4VFX60 (Virtex-4 FX)
ADMXRC3_FPGA_4VFX100	= 116,	Xilinx XC4VFX100 (Virtex-4 FX)
ADMXRC3_FPGA_4VFX140	= 117,	Xilinx XC4VFX140 (Virtex-4 FX)
ADMXRC3_FPGA_5VLX30	= 128,	Xilinx XC5VLX30 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX50	= 129,	Xilinx XC5VLX50 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX85	= 130,	Xilinx XC5VLX85 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX110	= 131,	Xilinx XC5VLX110 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX220	= 132,	Xilinx XC5VLX220 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX330	= 133,	Xilinx XC5VLX330 (Virtex-5 LX)
ADMXRC3_FPGA_5VLX30T	= 136,	Xilinx XC5VLX30T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX50T	= 137,	Xilinx XC5VLX50T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX85T	= 138,	Xilinx XC5VLX85T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX110T	= 139,	Xilinx XC5VLX110T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX330T	= 140,	Xilinx XC5VLX330T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX220T	= 141,	Xilinx XC5VLX220T (Virtex-5 LXT)
ADMXRC3_FPGA_5VLX155T	= 142,	Xilinx XC5VLX155T (Virtex-5 LXT)
ADMXRC3_FPGA_5V5X35T	= 144,	Xilinx XC5V5X35T (Virtex-5 SXT)
ADMXRC3_FPGA_5V5X50T	= 145,	Xilinx XC5V5X50T (Virtex-5 SXT)
ADMXRC3_FPGA_5V5X95T	= 146,	Xilinx XC5V5X95T (Virtex-5 SXT)
ADMXRC3_FPGA_5V5X240T	= 147,	Xilinx XC5V5X240T (Virtex-5 SXT)
ADMXRC3_FPGA_5VFX100T	= 152,	Xilinx XC5VFX100T (Virtex-5 FXT)
ADMXRC3_FPGA_5VFX130T	= 153,	Xilinx XC5VFX130T (Virtex-5 FXT)
ADMXRC3_FPGA_5VFX200T	= 154,	Xilinx XC5VFX200T (Virtex-5 FXT)
ADMXRC3_FPGA_5VFX30T	= 155,	Xilinx XC5VFX30T (Virtex-5 FXT)
ADMXRC3_FPGA_5VFX70T	= 156,	Xilinx XC5VFX70T (Virtex-5 FXT)
ADMXRC3_FPGA_6VLX760	= 160,	Xilinx XC6VLX760 (Virtex-6 LX)
ADMXRC3_FPGA_6VLX75T	= 168,	Xilinx XC6VLX75T (Virtex-6 LXT)
ADMXRC3_FPGA_6VLX130T	= 169,	Xilinx XC6VLX130T (Virtex-6 LXT)
ADMXRC3_FPGA_6VLX195T	= 170,	Xilinx XC6VLX195T (Virtex-6 LXT)
ADMXRC3_FPGA_6VLX240T	= 171,	Xilinx XC6VLX240T (Virtex-6 LXT)
ADMXRC3_FPGA_6VLX365T	= 172,	Xilinx XC6VLX365T (Virtex-6 LXT)
ADMXRC3_FPGA_6VLX550T	= 173,	Xilinx XC6VLX550T (Virtex-6 LXT)
ADMXRC3_FPGA_6V5X315T	= 176,	Xilinx XC6VLX315T (Virtex-6 SXT)
ADMXRC3_FPGA_6V5X475T	= 177,	Xilinx XC6VLX475T (Virtex-6 SXT)
ADMXRC3_FPGA_6VHX250T	= 184,	Xilinx XC6VHX250T (Virtex-6 HXT)
ADMXRC3_FPGA_6VHX255T	= 185,	Xilinx XC6VHX255T (Virtex-6 HXT)
ADMXRC3_FPGA_6VHX385T	= 186,	Xilinx XC6VHX385T (Virtex-6 HXT)
ADMXRC3_FPGA_6VHX565T	= 187,	Xilinx XC6VHX565T (Virtex-6 HXT)
ADMXRC3_FPGA_LASTVALUE	= 188,	Reserved for future products
ADMXRC3_FPGA_FORCE32BITS	= 0x7FFFFFFF	Force type to be at least 32 bits
} ADMXRC3_FPGA_TYPE;		

Description

An enumerated type used to represent an FPGA device, excluding package and speed grade information. Values beginning with ADMXRC3_FPGA_LASTVALUE are reserved for adding support for future models.

4.2.15 ADMXRC3_HANDLE

Declaration

```
typedef ... ADMXRC3_HANDLE;
```

Description

A handle type used to represent a device handle. Most functions in the ADMXRC3 API require a valid device handle of type **ADMXRC3_HANDLE** as the first parameter. A valid device handle is obtained via a call to **ADMXRC3_Open**. When an application has finished with a device handle, it should close it by calling **ADMXRC3_Close**.

Remarks

It is good practice to initialize device handles (i.e. variables of type **ADMXRC3_HANDLE**) to the value **ADMXRC3_HANDLE_INVALID_VALUE**, and to always set such variables to **ADMXRC3_HANDLE_INVALID_VALUE** after closing them with **ADMXRC3_Close**. This enables an application to avoid attempting to close invalid device handles.

In Windows, this type is a typedef of **HANDLE**. A value of type **ADMXRC3_HANDLE** can therefore be usefully passed to certain functions that accept a **HANDLE**, notably **WaitForSingleObject** and **WaitForMultipleObjects**. **CloseHandle** should not be used to close a device handle, as this prevents the user-mode part of the ADMXRC3 API from performing cleanup operations, resulting in resource leaks. Instead, **ADMXRC3_Close** should be used.

In Linux and VxWorks, this type is a typedef of a file descriptor, i.e. **int**. A value of type **ADMXRC3_HANDLE** can therefore be usefully passed to certain functions that accept file descriptors, such as **poll**. The **close** system call should not be used to close a device handle, as this prevents the user-mode part of the ADMXRC3 API from performing cleanup operations, resulting in resource leaks. Instead, **ADMXRC3_Close** should be used.

4.2.16 ADMXRC3_MODEL_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_MODEL_GENERIC           = 0,           Unknown model
    ADMXRC3_MODEL_ADMXRC2          = 4,           ADM-XRC-II
    ADMXRC3_MODEL_ADPEXRC5T        = 0x100,      ADPe-XRC-5T
    ADMXRC3_MODEL_ADMXRC6TL        = 0x101,      ADM-XRC-6TL
    ADMXRC3_MODEL_ADMXRC6T1        = 0x102,      ADM-XRC-6T1
    ADMXRC3_MODEL_ADMXRC6TGE       = 0x103,      ADM-XRC-6TGE
    ADMXRC3_MODEL_ADMXRC6TADV8     = 0x104,      ADM-XRC-6T-ADV8
    ADMXRC3_MODEL_LASTVALUE        = 0x105,      Reserved for future models
    ADMXRC3_MODEL_FORCE32BITS      = 0x7FFFFFFF   Force type to be at least 32 bits
} ADMXRC3_MODEL_TYPE;
```

Description

A datatype used to represent a model or product in Alpha Data's reconfigurable computing range. Legacy hardware is represented by a value that is nonzero and less than 0x100. The API does not return the value **ADMXRC3_MODEL_GENERIC** under normal circumstances, but if it does, it may indicate that the device is experimental or development hardware. Values beginning with **ADMXRC3_MODEL_LASTVALUE** are reserved for future models.

Remarks

The values **ADMXRC3_MODEL_ADMXRC6TGE** and **ADMXRC3_MODEL_ADMXRC6TADV8** are available in ADMXRC3 API version 1.3.0 and later.

4.2.17 ADMXRC3_MODULE_INFOA

Declaration

```
typedef structure ... {
    char    Product[64];
    char    PartNumber[64];
    char    Manufacturer[64];
    char    SerialNumber[64];
    double  IoVoltage;
    uint32_t ManufactureDate;
    uint32_t Flags;
    bool_t  Present;
} ADMXRC3_MODULE_INFOA;
```

The members of this structure are as follows:

Product

A NUL-terminated **char** string that identifies the product name of the module, for example "XRM-OPT". See description below about validity.

PartNumber

A NUL-terminated **char** string that identifies the part number of the module, for example "XRM2-OPT/1/LNK-ST11/125". See description below about validity.

Manufacturer

A NUL-terminated **char** string that identifies the manufacturer of the module, for example "Alpha Data". See description below about validity.

SerialNumber

A NUL-terminated **char** string that is the serial number of the module, for example "340". The string is not restricted to numeric digits, and may contain letters and dashes, for example. See description below about validity.

IoVoltage

The nominal I/O voltage required by the module, measured in Volts. See description below about validity.

ManufactureDate

This value is the number of minutes since 00:00 1/1/1996 when the module was manufactured. See description below about validity.

Flags

This value is a bitmask of properties that may apply to the module. The value consists of zero or more of the following flags. ORed together:

- **ADMXRC3_MODULE_LEGACYXRM**
Indicates that the module fitted is a legacy XRM, which does not possess a FRU ROM. If this flag is present, then none of the Product, PartNumber, Manufacturer, SerialNumber or ManufactureDate members are valid.

- **ADMXRC3_MODULE_FORCE2V5**
Indicates that the module fitted asserts the FORCE2V5 signal, indicating that it always requires a 2.5V I/O voltage supply. This flag typically occurs for legacy XRM's, as they have no other means of indicating the required I/O voltage.
- **ADMXRC3_MODULE_ROMERROR**
Indicates that the driver detected an error in the data structure of the FRU ROM for the module. As a result, the data in the first six members of this structure should be considered unreliable, and may be incomplete, undefined or corrupted.
- **ADMXRC3_MODULE_CSUMERROR**
Indicates that the driver detected an error in the checksum of at least one area in the data structure of the FRU ROM for the module. As a result, the data in the first six members of this structure should be considered unreliable, and may be incomplete, undefined or corrupted.

See description below about validity.

Present

Indicates whether or not a module is fitted to the specified module site. If FALSE, then none of the other members of this structure are valid.

Description

This structure is returned by [ADMXRC3_GetModuleInfoA](#) and contains information about what, if anything, is fitted to an I/O module site.

When inspecting this structure, the following algorithm is suggested:

1. If the Present member is FALSE, then nothing was detected in the site and none of the other members of the structure are valid.
2. Otherwise, the Flags member is inspected. If the ADMXRC3_MODULE_LEGACYXRM flag is present, then none of the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members are valid.
3. Otherwise, if either the ADMXRC3_MODULE_ROMERROR or ADMXRC3_MODULE_CSUMERROR flags are present, then the data in the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members should be considered unreliable.
4. Otherwise, the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members are valid.

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

This is the ANSI / UTF-8 version of the [ADMXRC3_MODULE_INFO](#) structure. [ADMXRC3_MODULE_INFO](#) is actually a macro defined to be either [ADMXRC3_MODULE_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_MODULE_INFOA](#).

4.2.18 ADMXRC3_MODULE_INFOW

Declaration

```
typedef structure ... {
    wchar_t    Product[64];
    wchar_t    PartNumber[64];
    wchar_t    Manufacturer[64];
    wchar_t    SerialNumber[64];
    double     IoVoltage;
    uint32_t   ManufactureDate;
    uint32_t   Flags;
    bool_t     Present;
} ADMXRC3_MODULE_INFOW;
```

The members of this structure are as follows:

Product

A NUL-terminated **wchar_t** string that identifies the product name of the module, for example "XRM-OPT". See description below about validity.

PartNumber

A NUL-terminated **wchar_t** string that identifies the part number of the module, for example "XRM2-OPT/1/LNK-ST11/125". See description below about validity.

Manufacturer

A NUL-terminated **wchar_t** string that identifies the manufacturer of the module, for example "Alpha Data". See description below about validity.

SerialNumber

A NUL-terminated **wchar_t** string that is the serial number of the module, for example "340". The string is not restricted to numeric digits, and may contain letters and dashes, for example. See description below about validity.

IoVoltage

The nominal I/O voltage required by the module, measured in Volts. See description below about validity.

ManufactureDate

This value is the number of minutes since 00:00 1/1/1996 when the module was manufactured. See description below about validity.

Flags

This value is a bitmask of properties that may apply to the module. The value consists of zero or more of the following flags. ORed together:

- **ADMXRC3_MODULE_LEGACYXRM**
Indicates that the module fitted is a legacy XRM, which does not possess a FRU ROM. If this flag is present, then none of the Product, PartNumber, Manufacturer, SerialNumber or ManufactureDate members are valid.

- **ADMXRC3_MODULE_FORCE2V5**
Indicates that the module fitted asserts the FORCE2V5 signal, indicating that it always requires a 2.5V I/O voltage supply. This flag typically occurs for legacy XRM's, as they have no other means of indicating the required I/O voltage.
- **ADMXRC3_MODULE_ROMERROR**
Indicates that the driver detected an error in the data structure of the FRU ROM for the module. As a result, the data in the first six members of this structure should be considered unreliable, and may be incomplete, undefined or corrupted.
- **ADMXRC3_MODULE_CSUMERROR**
Indicates that the driver detected an error in the checksum of at least one area in the data structure of the FRU ROM for the module. As a result, the data in the first six members of this structure should be considered unreliable, and may be incomplete, undefined or corrupted.

See description below about validity.

Present

Indicates whether or not a module is fitted to the specified module site. If FALSE, then none of the other members of this structure are valid.

Description

This structure is returned by [ADMXRC3_GetModuleInfoW](#) and contains information about what, if anything, is fitted to an I/O module site.

When inspecting this structure, the following algorithm is suggested:

1. If the Present member is FALSE, then nothing is fitted to the site and none of the other members of the structure are valid.
2. Otherwise, the Flags member is inspected. If the ADMXRC3_MODULE_LEGACYXRM flag is present, then none of the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members are valid.
3. Otherwise, if either the ADMXRC3_MODULE_ROMERROR or ADMXRC3_MODULE_CSUMERROR flags are present, then the data in the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members should be considered unreliable.
4. Otherwise, the Product, PartNumber, Manufacturer, SerialNumber, IoVoltage and ManufactureDate members are valid.

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

This is the Unicode version of the [ADMXRC3_MODULE_INFO](#) structure. [ADMXRC3_MODULE_INFO](#) is actually a macro defined to be either [ADMXRC3_MODULE_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_MODULE_INFOA](#).

4.2.19 ADMXRC3_PACKAGE_TYPE

Declaration

```
typedef ... ADMXRC3_PACKAGE_TYPE;
```

Description

A type used to represent the package code of an FPGA device. It is a 32-bit unsigned integer composed of three bit-fields:

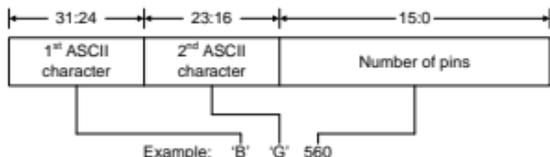


Figure 10: ADMXRC3_PACKAGE_TYPE bit fields

The following macros are available for manipulating values of type **ADMXRC3_PACKAGE_TYPE**:

- **ADMXRC3_PACKAGE_GETPINS(n)** returns the number of pins in the package, as a 16-bit unsigned integer value. For example, **ADMXRC3_PACKAGE_GETTYPE1(ADMXRC3_PACKAGE_MAKEFG(456))** returns 456.
- **ADMXRC3_PACKAGE_GETTYPE0(n)** returns the first package type character. For example, **ADMXRC3_PACKAGE_GETTYPE0(ADMXRC3_PACKAGE_MAKEFG(456))** returns the ASCII character 'F'.
- **ADMXRC3_PACKAGE_GETTYPE1(n)** returns the second package type character. For example, **ADMXRC3_PACKAGE_GETTYPE1(ADMXRC3_PACKAGE_MAKEFG(456))** returns the ASCII character 'G'.
- **ADMXRC3_PACKAGE_MAKE(t0, t1, n)** constructs a package code, given the ASCII type characters *t0*, *t1* and a pin count *n*. For example, **ADMXRC3_PACKAGE_MAKE('B', 'G', 560)** constructs a value corresponding to the BG560 package.
- **ADMXRC3_PACKAGE_MAKEBG(n)** constructs a code representing a BG package, where *n* is the number of pins. For example, **ADMXRC3_PACKAGE_MAKEBG(560)** constructs a value corresponding to the BG560 package.
- **ADMXRC3_PACKAGE_MAKEFF(n)** constructs a code representing an FF package, where *n* is the number of pins. For example, **ADMXRC3_PACKAGE_MAKEFF(1738)** constructs a value corresponding to the FF1738 package.
- **ADMXRC3_PACKAGE_MAKEFG(n)** constructs a code representing an FG package, where *n* is the number of pins. For example, **ADMXRC3_PACKAGE_MAKEFG(456)** constructs a value corresponding to the FG456 package.

Remarks

This datatype is a 32-bit unsigned integer. In Windows, this type is a typedef of `UINT32`, while in Linux it is a typedef of `uint32_t`.

4.2.20 ADMXRC3_SENSOR_INFOA

Declaration

```
typedef structure ... {  
    char                Description[28];  
    uint32_t            Capabilities;  
    uint32_t            Error;  
    ADMXRC3_DATA_TYPE  DataType;  
    ADMXRC3_UNIT_TYPE  Unit;  
    int                 Exponent;  
} ADMXRC3_SENSOR_INFOA;
```

The members of this structure are as follows:

Description

A NUL-terminated **char** string that describes the sensor, for example "1.5V supply rail".

Capabilities

A bitmask of flags that indicate the sensor's capabilities. The following flags are defined:

- **ADMXRC3_SENSOR_SWVALUE**
The sensor does not represent a physical sensor, and the values are generated in software. Such a sensor might be used for returning statistics about something.

Error

A value that indicates the accuracy of the sensor, as the maximum positive or negative deviation from the actual value. Error values are scaled in the same way as values read from the sensor using [ADMXRC3_ReadSensor](#).

DataType

A value of type **ADMXRC3_DATA_TYPE** that indicates the type of the data (boolean, double, integer etc.) returned by the sensor.

Unit

A value of type **ADMXRC3_UNIT_TYPE** that indicates the unit of measurement (amperes, volts, degrees Celsius etc.) of the data returned by the sensor.

Exponent

A value that indicates the exponent (power of 10) by which the Error member and values read from the sensor are scaled.

Description

This structure is returned by [ADMXRC3_GetSensorInfoA](#) and contains information about a sensor.

Example:

Assume that for a given sensor, Error is 0.4, DataType is **ADMXRC3_UNIT_DOUBLE**, Unit is **ADMXRC3_UNIT_V** and Exponent is -3. Assume also that [ADMXRC3_ReadSensor](#) returns 9.5. The unit is therefore mV, and the absolute value read from the sensor is 9.5 mV. Furthermore, the error is ± 0.4 mV.

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

For boolean values (where `DataType` is `ADMXRC3_DATA_BOOL`), the `Error` and `Exponent` members are not valid and should be ignored. The `Unit` member is always `ADMXRCD_UNIT_NONE`.

This is the ANSI / UTF-8 version of the `ADMXRC3_SENSOR_INFO` structure. `ADMXRC3_SENSOR_INFO` is actually a macro defined to be either `ADMXRC3_SENSOR_INFOW` if the `_UNICODE` preprocessor symbol is defined, or else `ADMXRC3_SENSOR_INFOA`.

4.2.21 ADMXRC3_SENSOR_INFOW

Declaration

```
typedef structure ... {
    wchar_t      Description[28];
    uint32_t     Capabilities;
    uint32_t     Error;
    ADMXRC3_DATA_TYPE  DataType;
    ADMXRC3_UNIT_TYPE  Unit;
    int         Exponent;
} ADMXRC3_SENSOR_INFOW;
```

The members of this structure are as follows:

Description

A NUL-terminated `wchar_t` string that describes the sensor, for example "1.5V supply rail".

Capabilities

A bitmask of flags that indicate the sensor's capabilities. The following flags are defined:

- `ADMXRC3_SENSOR_SWVALUE`
The sensor does not represent a physical sensor, and the values are generated in software. Such a sensor might be used for returning statistics about something.

Error

A value that indicates the accuracy of the sensor, as the maximum positive or negative deviation from the actual value. Error values are scaled in the same way as values read from the sensor using `ADMXRC3_ReadSensor`.

DataType

A value of type `ADMXRC3_DATA_TYPE` that indicates the type of the data (boolean, double, integer etc.) returned by the sensor.

Unit

A value of type `ADMXRC3_UNIT_TYPE` that indicates the unit of measurement (amperes, volts, degrees Celsius etc.) of the data returned by the sensor.

Exponent

A value that indicates the exponent (power of 10) by which the Error member and values read from the sensor are scaled.

Description

This structure is returned by [ADMXRC3_GetSensorInfoW](#) and contains information about a sensor.

Example:

Assume that for a given sensor, Error is 0.4, DataType is ADMXRC3_UNIT_DOUBLE, Unit is ADMXRC3_UNIT_V and Exponent is -3. Assume also that [ADMXRC3_ReadSensor](#) returns 9.5. The unit is therefore mV, and the absolute value read from the sensor is 9.5 mV. Furthermore, the error is ± 0.4 mV.

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

For boolean values (where DataType is ADMXRC3_DATA_BOOL), the Error and Exponent members are not valid and should be ignored. The Unit member is always ADMXRC3_UNIT_NONE.

This is the Unicode version of the [ADMXRC3_SENSOR_INFO](#) structure. [ADMXRC3_SENSOR_INFO](#) is actually a macro defined to be either [ADMXRC3_SENSOR_INFOW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_SENSOR_INFOA](#).

4.2.22 ADMXRC3_SENSOR_VALUE

Declaration

```
typedef union ... {
    bool_t    Bool;
    double    Double;
    int32_t   Int32;
    uint32_t  UInt32;
} ADMXRC3_SENSOR_VALUE;
```

The members of this union are as follows:

Bool

The current reading from the sensor.

Double

The current reading from the sensor.

Int32

The current reading from the sensor.

UInt32

The current reading from the sensor.

Description

This union is returned by [ADMXRC3_ReadSensor](#) and contains the current readings from the sensor.

As this datatype is a union, interpretation of its value depends on the `DataType` member of the [ADMXRC3_SENSOR_INFO](#) structure for the sensor in question, as returned by [ADMXRC3_GetSensorInfo](#). It is the application's responsibility to correctly interpret the value by using the appropriate member from the union (`Bool`, `Double`, etc.).

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later.

4.2.23 ADMXRC3_STATUS

Declaration

```
typedef enum ... {
    ADMXRC3_SUCCESS                = 0,           Success
    ADMXRC3_INTERNAL_ERROR        = 0x100,       An error in the API logic occurred
    ADMXRC3_UNEXPECTED_ERROR     = 0x101,       An unexpected error caused the operation to fail
    ADMXRC3_BAD_DRIVER            = 0x102,       The driver may not be correctly installed
    ADMXRC3_NO_MEMORY             = 0x103,       Couldn't allocate memory required to complete operation
    ADMXRC3_ACCESS_DENIED        = 0x104,       The calling process does not have permission to open the device
    ADMXRC3_DEVICE_NOT_FOUND     = 0x105,       Failed to open the device with the specified index
    ADMXRC3_FILE_NOT_FOUND       = 0x106,       Failed to open the .BIT file with the specified filename
    ADMXRC3_HARDWARE_ERROR       = 0x107,       An error in the hardware was detected
    ADMXRC3_FPGA_MISMATCH        = 0x108,       The FPGA on the card did not match that of the bitstream
    ADMXRC3_INVALID_BITSTREAM    = 0x109,       The .BIT file appeared to be corrupt
    ADMXRC3_INVALID_BUFFER       = 0x10A,       The supplied buffer was invalid and could not be read
    ADMXRC3_INVALID_FLAG        = 0x10B,       A flag was invalid or not recognized
    ADMXRC3_INVALID_FREQUENCY    = 0x10C,       The frequency was not possible for the specified device
    ADMXRC3_INVALID_HANDLE      = 0x10D,       The device handle was invalid
    ADMXRC3_INVALID_INDEX       = 0x10E,       The index parameter was invalid
    ADMXRC3_INVALID_REGION      = 0x10F,       The offset and/or length parameters were invalid
    ADMXRC3_NULL_POINTER        = 0x110,       A NULL pointer was passed where non-NULL was required
    ADMXRC3_BUSY                = 0x111,       There is already an operation in progress for the device
    ADMXRC3_CANCEL_FAILED       = 0x112,       There is nothing to cancel
    ADMXRC3_CANCELLED           = 0x113,       The operation was cancelled
    ADMXRC3_RESOURCE_LIMIT      = 0x114,       A resource limit was reached
    ADMXRC3_REGION_TOO_LARGE    = 0x115,       The specified region was too large for a single operation
    ADMXRC3_MUST_WAIT           = 0x116,       The specified operation couldn't be started immediately
    ADMXRC3_NOT_OWNER           = 0x117,       The buffer handle belongs to a different device handle
    ADMXRC3_PENDING             = 0x118,       The non-blocking operation is not yet complete
    ADMXRC3_NONBLOCK_IDLE       = 0x119,       The non-blocking operation is not yet complete
    ADMXRC3_INVALID_BUFFER_HANDLE = 0x11A,       The buffer handle was invalid
    ADMXRC3_INVALID_LOCAL_REGION = 0x11B,       The local address region was invalid
    ADMXRC3_DATATYPE_MISMATCH   = 0x11C,       The datatype was invalid for the specified sensor
    ADMXRC3_NOT_SUPPORTED       = 0x11D,       The hardware does not support the requested operation
    ADMXRC3_STATUS_FORCE32BITS  = 0x7FFFFFFF    Force type to be at least 32 bits
} ADMXRC3_STATUS;
```

Description

An enumerated type used as the return value from most ADMXRC3 API functions. A value of zero corresponds to `ADMXRC3_SUCCESS`, and indicates success for most functions. However, the `ADMXRC3_StartXxx` functions such as [ADMXRC3_StartReadDMA](#) return `ADMXRC3_PENDING` in order to indicate that a non-blocking operation was successfully started.

4.2.24 ADMXRC3_SUBFAMILY_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_SUBFAMILY_NONE           = 0,           Not in a subfamily
    ADMXRC3_SUBFAMILY_E              = 16,         Xilinx Virtex-E
    ADMXRC3_SUBFAMILY_EM             = 17,         Xilinx Virtex-EM
    ADMXRC3_SUBFAMILY_2PROX          = 48,         Xilinx Virtex-II Pro-X
    ADMXRC3_SUBFAMILY_4PX            = 64,         Xilinx Virtex-4 PX
    ADMXRC3_SUBFAMILY_4LX            = 65,         Xilinx Virtex-4 LX
    ADMXRC3_SUBFAMILY_4SX            = 66,         Xilinx Virtex-4 SX
    ADMXRC3_SUBFAMILY_5LX            = 80,         Xilinx Virtex-5 LX
    ADMXRC3_SUBFAMILY_5FXT           = 84,         Xilinx Virtex-5 FXT
    ADMXRC3_SUBFAMILY_5LXT           = 85,         Xilinx Virtex-5 LXT
    ADMXRC3_SUBFAMILY_5SXT           = 86,         Xilinx Virtex-5 SXT
    ADMXRC3_SUBFAMILY_6LX            = 96,         Xilinx Virtex-6 LX
    ADMXRC3_SUBFAMILY_6HXT           = 97,         Xilinx Virtex-6 HXT
    ADMXRC3_SUBFAMILY_6LXT           = 98,         Xilinx Virtex-6 LXT
    ADMXRC3_SUBFAMILY_6SXT           = 99,         Xilinx Virtex-6 SXT
    ADMXRC3_SUBFAMILY_FORCE32BITS    = 0x7FFFFFFF Force type to be at least 32 bits
} ADMXRC3_SUBFAMILY_TYPE;
```

Description

An enumerated type used to represent a subfamily within an FPGA device family.

4.2.25 ADMXRC3_TICKET

Declaration

```
typedef ... ADMXRC3_TICKET;
```

Description

A ticket used to keep track of a non-blocking operation. Every non-blocking operation requires a ticket, which must be unique to that operation and valid from when the operation is initiated until it is finished. A ticket may be reused for further non-blocking operations once the current non-blocking operation has finished.

In Windows, this is a structure that should be considered partially opaque by applications, and contains an **OVERLAPPED** structure. It is initialized by first calling [ADMXRC3_InitializeTicket](#) and then setting the **Overlapped.hEvent** member to a **HANDLE** value representing a non-auto-reset Win32 event. The event must be used in at most one non-blocking operation at any given moment.

In Linux or VxWorks, this type should be considered fully opaque. It is initialized by [ADMXRC3_InitializeTicket](#).

On all platforms, a ticket must be initialized at least once before its first use, regardless of how many times it is used. Reinitializing a ticket (and/or changing the event in the case of Windows) between non-blocking operations is permitted.

A ticket is required by the following functions:

- [ADMXRC3_FinishDMA](#)
- [ADMXRC3_FinishNotificationWait](#)
- [ADMXRC3_StartNotificationWait](#)
- [ADMXRC3_StartReadDMA](#)
- [ADMXRC3_StartReadDMALocked](#)
- [ADMXRC3_StartWriteDMA](#)

- [ADMXRC3_StartWriteDMALocked](#)

4.2.26 ADMXRC3_UNIT_TYPE

Declaration

```
typedef enum ... {
    ADMXRC3_UNIT_NONE           = 0,           Unitless data
    ADMXRC3_UNIT_A              = 1,           Ampere
    ADMXRC3_UNIT_V              = 2,           Volt
    ADMXRC3_UNIT_C              = 3,           Degrees Celsius
    ADMXRC3_UNIT_HZ             = 4,           Frequency
    ADMXRC3_UNIT_RPM            = 5,           Revolutions per minute
    ADMXRC3_UNIT_S              = 6,           Seconds
    ADMXRC3_UNIT_LASTVALUE     = 7,           Reserved for adding new units
    ADMXRC3_UNIT_FORCE32BITS    = 0x7FFFFFFF  Force type to be at least 32 bits
} ADMXRC3_UNIT_TYPE;
```

Description

An enumerated type used to indicate the unit of measurement of the values returned by the [ADMXRC3_ReadSensor](#) function. Values beginning with ADMXRC3_UNIT_LASTVALUE are reserved for adding new units in future revisions of the API.

ADMXRC3_UNIT_HZ

Remarks

This datatype is available in ADMXRC3 API version 1.1.0 and later. The [ADMXRC3_UNIT_S](#) value is available in ADMXRC3 API version 1.4.0 and later.

4.2.27 ADMXRC3_VERSION_INFO

Declaration

```
typedef structure ... {
    struct {
        uint16_t Major;
        uint16_t Minor;
        uint16_t Bugfix;
    } Api;
    struct {
        uint16_t Major;
        uint16_t Minor;
        uint16_t Bugfix;
    } Driver;
} ADMXRC3_VERSION_INFO;
```

The members of this structure are as follows:

Api

Api.Major

Major version number of ADMXRC3 API library.

Api.Minor

Minor version number of ADMXRC3 API library.

Api.Bugfix

Bugfix version number of ADMXRC3 API library.

Driver

Driver.Major

Major version number of ADMXRC3 driver.

Driver.Minor

Minor version number of ADMXRC3 driver.

Driver.Bugfix

Bugfix version number of ADMXRC3 driver.

Description

This structure is returned by [ADMXRC3_GetVersionInfo](#) and indicates the version numbers of the components of the ADMXRC3 API.

Remarks

The Major and Minor members may be incremented when functionality is added, such as support for new models, or new API functions. The Bugfix member is incremented when defects are corrected, but is also reset to zero when either the Major or Minor members are incremented.

4.2.28 ADMXRC3_WINDOW_INFO

Declaration

```
typedef structure ... {  
    uint64_t BusSize;  
    uint64_t BusBase;  
    uint64_t LocalSize;  
    uint64_t LocalBase;  
    uint64_t VirtualSize;  
} ADMXRC3_WINDOW_INFO;
```

The members of this structure are as follows:

BusSize

The size, in bytes, of the window on its device's bus (typically PCI, PCI-X or PCI Express).

BusBase

The base address, in bytes, of the window on its device's bus (typically PCI, PCI-X or PCI Express).

LocalSize

The size, in bytes, of the region of local address space that the window occupies.

If this member is nonzero, it is typically a window onto a target FPGA in the device. A target FPGA decodes the local address in order to determine what function within the target FPGA is being accessed.

If this member is zero, it means that the window terminates within the bus interface of the device and does not occupy any local address space. Such windows provide access to device registers in the bus interface of a reconfigurable computing card.

LocalBase

The absolute base address, in bytes, of the region of local address space that the window occupies. This member is not valid if the LocalSize member is zero.

VirtualSize

The size, in bytes, of the window if it were mapped in its entirety into a process' virtual address space. This is the same as the BusSize member on most CPU architectures, but may be larger for a CPU architecture that uses *sparse I/O addressing*. The topic of *sparse I/O addressing* is outside the scope of this document, but in such architectures, attributes of load and store operations (alignment, byte mask, etc.) are encoded in the addresses used to perform such loads and stores.

Description

This structure is returned by [ADMXRC3_GetWindowInfo](#) and indicates the size and base addresses, in various address spaces, of a window provided by a device. An application may use this information to avoid errors when calling [ADMXRC3_MapWindow](#).

Remarks

In general, each model in Alpha Data's reconfigurable computing range provides a different set of windows, and the purpose of each window can vary between models. In order to know which windows to map, an application requires knowledge of the model in use. The model that is in use can be obtained by calling [ADMXRC3_GetCardInfoEx](#) and inspecting the Model member of the returned [ADMXRC3_CARD_INFOEX](#) structure.

4.3 ADMXRC3 API functions

This section describes the functions available in the ADMXRC3 API. The semantics of "direction" for a function parameter are as follows

- (in) means that the parameter is used to pass data to a function, either by value or by reference to a data structure that is read by the function.
- (out) means that the parameter is used to return data from a function, by reference to a data structure that is filled in by the function.
- (inout) means that the parameter is used to both pass data to and return data from a function, by reference to a data structure that is read and potentially modified by the function.

4.3.1 ADMXRC3_Cancel

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_Cancel(  
    __in    ADMXRC3_HANDLE  hDevice);
```

The parameters of this function are as follows:

hDevice (in)

The device handle for which any ongoing API calls should be cancelled.

Description

The **ADMXRC3_Cancel** function forces any ongoing ADMXRC3 API calls for a given device handle to return as soon as possible. Function calls that return early due to a call to **ADMXRC3_Cancel** return a status value of **ADMXRC3_CANCELLED**. However, a function call that happens to be completed, whether successfully or unsuccessfully, at the same time as **ADMXRC3_Cancel** is called may return a status value other than **ADMXRC3_CANCELLED**. The purpose of **ADMXRC3_Cancel** is to force any threads that are blocked inside ADMXRC3 API functions to return early, so that error recovery mechanisms such as timeouts and watchdogs can be implemented by an application.

ADMXRC3_Cancel itself does not wait for ongoing ADMXRC3 API calls to return; it returns as soon as action has been taken to ensure that all other ongoing ADMXRC3 API calls for the specified handle will return.

ADMXRC3_Cancel affects *only* function calls made using the specified device handle. Function calls made using other device handles are entirely unaffected.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_CANCEL_FAILED	There was nothing to cancel.

Remarks

ADMXRC3_Cancel does not affect ADMXRC3 API functions that do not block the calling thread for a significant length of time. An example of such a function is **ADMXRC3_GetCardInfoEx**. In general, if an API function is guaranteed not to block the caller for a user-perceptible length of time, **ADMXRC3_Cancel** has no effect on it.

ADMXRC3_Cancel can cancel only those ADMXRC3 API function calls that occur before **ADMXRC3_Cancel** is called. For example, if thread A calls **ADMXRC3_Cancel**, and thread B calls **ADMXRC3_ReadDMAEx**, a degree of uncertainty exists about whether **ADMXRC3_Cancel** occurs before or after **ADMXRC3_ReadDMAEx**, because either thread may be preemptively descheduled in most operating systems. Applications should therefore not rely on cancelled ADMXRC3 API calls always returning **ADMXRC3_CANCELLED**, because this represents a race condition.

4.3.2 ADMXRC3_Close

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_Close(  
    __in    ADMXRC3_HANDLE  hDevice);
```

The parameters of this function are as follows:

hDevice (in)

The device handle that is to be closed.

Description

This function closes a device handle, invalidating it. It should be called when an application has finished with a device handle.

If a thread closes a device handle using **ADMXRC3_Close** when other threads are executing inside ADMXRC3 API functions using the same device handle or there is an ongoing non-blocking operation using the same device handle, then the thread calling **ADMXRC3_Close** may either:

- Block until all of the ADMXRC3 API calls of other threads have returned and any non-blocking operations are finished, OR
- Return without blocking, but cause the ADMXRC3 API calls of other threads to return early with an error status value such as **ADMXRC3_CANCELLED**, as if **ADMXRC3_Cancel** were called.

Which of these two behaviors occurs is operating-system dependent.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.

Remarks

Well-behaved applications should clean up by calling **ADMXRC3_Close** when finished with a device handle. Failure to do so may lead to resource leaks, although leaked resources are reclaimed by the driver / operating system when an application terminates (with the exception of VxWorks, which performs very little automatic cleanup). The following cleanup is performed by **ADMXRC3_Close**:

- Mapped memory windows (that were mapped using the same device handle) are unmapped, as if **ADMXRC3_UnmapWindow** were called.
- Locked user-space buffers (that were locked using the same the device handle) are unlocked, as if **ADMXRC3_Unlock** were called.
- If the device handle owns any target FPGAs, those target FPGAs become free again.

- For each Flash memory bank in the device, if there exists a dirty block as a result of the device handle being used to call [ADMXRC3_EraseFlash](#) or [ADMXRC3_WriteFlash](#), the Flash memory bank is synchronized as if [ADMXRC3_SyncFlash](#) were called. In other words, explicitly calling [ADMXRC3_SyncFlash](#) before [ADMXRC3_Close](#) avoids a noticeable delay in the execution of [ADMXRC3_Close](#).
- In Windows, any Win32 Events registered with the device handle are unregistered, as if [ADMXRC3_UnregisterWin32Event](#) were called.
- In VxWorks, any semaphores registered with the device handle are unregistered, as if [ADMXRC3_UnregisterVxwSem](#) were called.

It is good practice to set variables of type [ADMXRC3_HANDLE](#) to [ADMXRC3_HANDLE_INVALID_VALUE](#) after closing them with [ADMXRC3_Close](#).

4.3.3 ADMXRC3_ConfigureFromBuffer

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_ConfigureFromBuffer(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int   targetIndex,  
    __in uint32_t       flags,  
    __in const void*   pBuffer,  
    __in size_t         length);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the target FPGA to be configured.

targetIndex (in)

The zero-based index of the target FPGA to be configured. This value must be less than the [NumTargetFpga](#) member of [ADMXRC3_CARD_INFOEX](#).

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- [ADMXRC3_CONFIGURE_PARTIAL](#)
Causes a partial reconfiguration to be performed. A partial reconfiguration does not clear the target FPGA's existing configuration before downloading the bitstream. If this flag is omitted, a full reconfiguration is performed.
- [ADMXRC3_CONFIGURE_SHARE](#)
Causes the device handle passed in `hDevice` **not** to take ownership of the target FPGA if configuration is successful.

pBuffer (in)

Points to the bitstream data to be downloaded to the target FPGA.

length (in)

The number of bytes of bitstream data to be downloaded to the target FPGA.

Description

This function downloads the bitstream data in a buffer to the specified device. The bitstream data is typically obtained from the Data member of an **ADMXRC3_BITSTREAM** object, returned by **ADMXRC3_LoadBitstream**, but an application may elect to use its own .BIT file loader to obtain the data. See the remarks below about the format of the data.

The default behavior is that full reconfiguration of the target FPGA is performed, where the bitstream download is preceded by unconfiguring the target FPGA. Full reconfiguration is described in **Section 3.8.1.1, "Full reconfiguration"**.

Partial reconfiguration of the target FPGA, as described in **Section 3.8.1.2, "Partial reconfiguration"**, is performed if the flags parameter contains **ADMXRC3_CONFIGURE_PARTIAL**.

In order to avoid the possibility that a target FPGA is inadvertently reconfigured (perhaps by another process) whilst it is in use, an ownership mechanism exists for target FPGAs. This ownership mechanism is described in **Section 3.8.1.4, "Target FPGA ownership"**.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	Configuring the target FPGA with the bitstream was not successful due to a hardware error.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NOT_OWNER	The specified device handle is not the owner of the target FPGA.
ADMXRC3_NULL_POINTER	The pBuffer parameter was a NULL pointer.

Remarks

As already mentioned, an application can load a .BIT file into memory using **ADMXRC3_LoadBitstream**, or by using its own loader functions. If using its own loader, an application should parse the .BIT file, keeping only the configuration frame data from the .BIT file. The record structure in the header of the .BIT file should not be in the data passed to **ADMXRC3_ConfigureFromBuffer**. The configuration frame data inside a .BIT file is a stream of bytes, where each byte maps to the SelectMap data bits D0..D7 as follows:



Figure 11: SelectMap D0..D7 byte mapping

As can be seen from the above figure, SelectMap D0 is found in bit 7 of each byte and SelectMap D7 in bit 0. Despite this, it is **not** necessary for an application to reorder the bits within each byte of the configuration frame data, because [ADMXRC3_ConfigureFromBuffer](#) expects bitstream data in the above format, exactly as read from a .BIT file. If necessary for the model in use, the data is automatically re-ordered by [ADMXRC3_ConfigureFromBuffer](#).

Passing the ADMXRC3_CONFIGURE_PARTIAL flag with a length of zero can be used to take ownership of a take FPGA without actually changing its configuration state.

An important difference between [ADMXRC3_LoadBitstream](#) and the legacy [ADMXRC2_LoadBitstream](#) function is that [ADMXRC2_LoadBitstream](#) may reorder bits within each byte of the configuration frame data for some models, and not for others. By contrast, [ADMXRC3_LoadBitstream](#) **never** reorders; it returns the configuration frame data as it is found in the .BIT file.

4.3.4 ADMXRC3_ConfigureFromFileA

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ConfigureFromFileA(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int targetIndex,
    __in uint32_t flags,
    __in const char* pFilename);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the target FPGA to be configured.

targetIndex (in)

The zero-based index of the target FPGA to be configured. This value must be less than the [NumTargetFpga](#) member of [ADMXRC3_CARD_INFOEX](#).

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- [ADMXRC3_CONFIGURE_PARTIAL](#)
Causes a partial reconfiguration to be performed. A partial reconfiguration does not clear the target FPGA's existing configuration before downloading the bitstream. If this flag is omitted, a full reconfiguration is performed.
- [ADMXRC3_CONFIGURE_SHARE](#)
Causes the device handle passed in hDevice **not** to take ownership of the target FPGA if configuration is successful.

pFilename (in)

Specifies the name of a .BIT file to be downloaded to the target FPGA.

Description

This function downloads the data in a bitstream (.BIT) file to the specified device. As a .BIT file contains a record that specifies for what kind of FPGA it was generated, this function verifies that the .BIT file FPGA type matches that of the device, and returns an error if there is a mismatch.

The default behavior is that full reconfiguration of the target FPGA is performed, where the bitstream download is preceded by unconfiguring the target FPGA. Full reconfiguration is described in [Section 3.8.1.1, "Full reconfiguration"](#).

Partial reconfiguration of the target FPGA, as described in [Section 3.8.1.2, "Partial reconfiguration"](#), is performed if the flags parameter contains ADMXRC3_CONFIGURE_PARTIAL.

In order to avoid the possibility that a target FPGA is inadvertently reconfigured (perhaps by another process) whilst it is in use, an ownership mechanism exists for target FPGAs. This ownership mechanism is described in [Section 3.8.1.4, "Target FPGA ownership"](#).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_FILE_NOT_FOUND	The file identified by the pFilename parameter could not be opened.
ADMXRC3_FPGA_MISMATCH	The FPGA in the .BIT file header does not match the target FPGA in the specified device.
ADMXRC3_HARDWARE_ERROR	Configuring the target FPGA with the bitstream was not successful due to a hardware error.
ADMXRC3_INVALID_BITSTREAM	The file identified by the pFilename parameter is not a valid .BIT file.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NOT_OWNER	The specified device handle is not the owner of the target FPGA.
ADMXRC3_NO_MEMORY	Memory to hold the bitstream data could not be allocated.
ADMXRC3_NULL_POINTER	The pFilename parameter was a NULL pointer.

Remarks

This is the ANSI / UTF-8 version of [ADMXRC3_ConfigureFromFile](#). [ADMXRC3_ConfigureFromFile](#) is actually a macro defined to be either [ADMXRC3_ConfigureFromFileW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_ConfigureFromFileA](#).

4.3.5 ADMXRC3_ConfigureFromFileW

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_ConfigureFromFileW(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int targetIndex,  
    __in uint32_t flags,  
    __in const wchar_t* pFilename);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the target FPGA to be configured.

targetIndex (in)

The zero-based index of the target FPGA to be configured. This value must be less than the [NumTargetFpga](#) member of [ADMXRC3_CARD_INFOEX](#).

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_CONFIGURE_PARTIAL**
Causes a partial reconfiguration to be performed. A partial reconfiguration does not clear the target FPGA's existing configuration before downloading the bitstream. If this flag is omitted, a full reconfiguration is performed.
- **ADMXRC3_CONFIGURE_SHARE**
Causes the device handle passed in `hDevice` **not** to take ownership of the target FPGA if configuration is successful.

pFilename (in)

Specifies the name of a .BIT file to be downloaded to the target FPGA.

Description

This function downloads the data in a bitstream (.BIT) file to the specified device. As a .BIT file contains a record that specifies for what kind of FPGA it was generated, this function verifies that the .BIT file FPGA type matches that of the device, and returns an error if there is a mismatch.

The default behavior is that full reconfiguration of the target FPGA is performed, where the bitstream download is preceded by unconfiguring the target FPGA. Full reconfiguration is described in [Section 3.8.1.1, "Full reconfiguration"](#).

Partial reconfiguration of the target FPGA, as described in [Section 3.8.1.2, "Partial reconfiguration"](#), is performed if the flags parameter contains ADMXRC3_CONFIGURE_PARTIAL.

In order to avoid the possibility that a target FPGA is inadvertently reconfigured (perhaps by another process) whilst it is in use, an ownership mechanism exists for target FPGAs. This ownership mechanism is described in [Section 3.8.1.4, "Target FPGA ownership"](#).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_FILE_NOT_FOUND	The file identified by the pFilename parameter could not be opened.
ADMXRC3_FPGA_MISMATCH	The FPGA in the .BIT file header does not match the target FPGA in the specified device.
ADMXRC3_HARDWARE_ERROR	Configuring the target FPGA with the bitstream was not successful due to a hardware error.
ADMXRC3_INVALID_BITSTREAM	The file identified by the pFilename parameter is not a valid .BIT file.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NOT_OWNER	The specified device handle is not the owner of the target FPGA.
ADMXRC3_NO_MEMORY	Memory to hold the bitstream data could not be allocated.
ADMXRC3_NULL_POINTER	The pFilename parameter was a NULL pointer.

Remarks

This is the Unicode version of [ADMXRC3_ConfigureFromFile](#). [ADMXRC3_ConfigureFromFile](#) is actually a macro defined to be either [ADMXRC3_ConfigureFromFileW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_ConfigureFromFileA](#).

4.3.6 ADMXRC3_EraseFlash

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_EraseFlash(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int flashIndex,  
    __in uint32_t flags,  
    __in uint64_t offset,  
    __in uint64_t length);
```

The parameters of this function are as follows:

hDevice (in)

The device handle of the device that contains the Flash memory bank of interest.

flashIndex (in)

Identifies the Flash memory bank of interest, within the specified device.

flags (in)

Flags that modify how the operation is performed. Currently, the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_FLASH_SYNC**
Causes this erase operation, as well as any previously pending erase and write operations, to be committed to hardware before the function returns.

offset (in)

Offset, in bytes, into the Flash memory bank of the beginning of region that is to be erased.

length (in)

Length, in bytes, of the region that is to be erased.

Description

The [ADMXRC3_EraseFlash](#) function erases a region of a Flash memory bank.

Depending on the model, not all locations in a Flash memory bank may be erased using this function. This is required in order to prevent inadvertent corruption of VPD, firmware etc. on some models. To determine the region of a Flash memory bank that is modifiable, an application calls [ADMXRC3_GetFlashInfo](#). Attempts to modify any location outside of the modifiable region will fail.

[ADMXRC3_EraseFlash](#) performs a read-erase-write cycle when the region specified by offset and length does not start and end exactly on block boundaries. Applications are therefore not required to have knowledge of the block-architecture of Flash chips, and can treat a Flash memory bank as an array of bytes.

The ADMXRC3 API implements a caching mechanism for each Flash memory bank. Passing the `ADMXRC3_FLASH_SYNC` flag ensures that the cache for the specified Flash memory bank is synchronized with the hardware before the function returns. An alternative way of ensuring synchronization is to call [ADMXRC3_SyncFlash](#).

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_ACCESS_DENIED</code>	The device handle was opened with insufficient privileges for modifying device state.
<code>ADMXRC3_CANCELLED</code>	During the operation, another thread called <code>ADMXRC3_Cancel</code> on the device handle, or the device handle was closed.
<code>ADMXRC3_HARDWARE_ERROR</code>	Erasing the Flash region was not successful due to a hardware error.
<code>ADMXRC3_INVALID_FLAG</code>	The flags parameter contains an unrecognized flag.
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter is not a valid device handle.
<code>ADMXRC3_INVALID_INDEX</code>	The <code>flashIndex</code> parameter is out of range.
<code>ADMXRC3_INVALID_REGION</code>	The offset and length parameters specify a region that is partially or wholly out of bounds of the specified Flash bank.

Remarks

Erasing a region of Flash memory results in all bytes in the erased region returning `0xFF` when subsequently read.

Depending on the model, a Flash memory bank may hold several kinds of data:

1. Vital Product Data (VPD)
2. "Soft jumper" information, such as default clock frequencies
3. Non-target FPGA firmware images
4. Target FPGA bitstreams

Of these types of data, the first three cannot be erased using `ADMXRC3_EraseFlash`, because they always lie outside of the user-programmable region in the Flash memory bank. Attempting to do so results in an error being returned. This is done as a safety measure to protect against inadvertent corruption of data that is vital to the operation of the hardware. The fourth type of data, target FPGA bitstreams, is usually stored in the user-programmable area and can therefore be erased or written.

For information about a particular model's Flash address map, refer to the User Guide for that model.

4.3.7 ADMXRC3_FinishDMA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_FinishDMA(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET* pTicket,  
    __in bool_t bWait);
```

The parameters of this function are as follows:

hDevice (in)

The device handle for which a non-blocking DMA operation is pending.

pTicket (in)

Points to the ticket used for the non-blocking operation. Ticket structures must be initialized according to [Section 3.3.2, "Tickets"](#).

bWait (in)

Specifies whether to wait for completion, or poll for completion.

Description

This function can be used to finish a previously-started non-blocking DMA operation, optionally waiting for it to be completed in the hardware (if bWait is TRUE). If bWait is FALSE, the function polls for whether or not the operation has been completed, returning ADMXRC3_PENDING if not.

This function is suitable for use with the following functions that initiate non-blocking operations:

- [ADMXRC3_StartReadDMA](#)
- [ADMXRC3_StartReadDMABus](#)
- [ADMXRC3_StartReadDMAEx](#)
- [ADMXRC3_StartReadDMALocked](#)
- [ADMXRC3_StartReadDMALockedEx](#)
- [ADMXRC3_StartWriteDMA](#)
- [ADMXRC3_StartWriteDMABus](#)
- [ADMXRC3_StartWriteDMAEx](#)
- [ADMXRC3_StartWriteDMALocked](#)
- [ADMXRC3_StartWriteDMALockedEx](#)

Every non-blocking operation that is successfully initiated on a given device handle using one of the above set of functions (that is, ADMXRC3_PENDING was returned from one of the above set of functions) must eventually be finished by a call to [ADMXRC3_FinishDMA](#). Failure to obey this rule means that attempting to start further non-blocking operations using the same device handle results in undefined behavior.

Return Value

A value of ADMXRC3_SUCCESS indicates that the non-blocking operation was completed successfully. Otherwise, the following values may be returned:

Return Value	Description
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	The DMA transfer failed due to a hardware error.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_NONBLOCK_IDLE	There was no non-blocking operation to finish.
ADMXRC3_PENDING	The non-blocking operation is ongoing. This value should never be returned if bWait is TRUE.

Remarks

Refer to [Section 3.3, "Non-blocking operations"](#) for an overview of the non-blocking functions in the ADMXRC3 API.

4.3.8 ADMXRC3_FinishNotificationWait

Declaration

```
ADMXRC3_STATUS
ADMXRC3_FinishNotificationWait(
    __in ADMXRC3_HANDLE hDevice,
    __in ADMXRC3_TICKET* pTicket,
    __in bool_t bWait);
```

The parameters of this function are as follows:

hDevice (in)

The device handle for which a non-blocking operation is pending.

pTicket (in)

Points to the ticket used for the non-blocking operation. Ticket structures must be initialized according to [Section 3.3.2, "Tickets"](#).

bWait (in)

Specifies whether to wait for completion, or poll for completion.

Description

This function is the counterpart of [ADMXRC3_StartNotificationWait](#). It must be called to finish a non-blocking operation that was successfully started with [ADMXRC3_StartNotificationWait](#) (i.e. ADMXRC3_PENDING was returned).

Return Value

A value of ADMXRC3_SUCCESS indicates that the non-blocking operation was completed successfully. Otherwise, the following values may be returned:

Return Value	Description
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_NONBLOCK_IDLE	There was no non-blocking operation to finish.
ADMXRC3_PENDING	The non-blocking operation is ongoing. This value should never be returned if bWait is TRUE.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

Refer to [Section 3.3, "Non-blocking operations"](#) for an overview of the non-blocking functions in the ADMXRC3 API.

4.3.9 ADMXRC3_GetBankInfo

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetBankInfo(
    __in   ADMXRC3_HANDLE   hDevice,
    __in   unsigned int    bankIndex,
    __out  ADMXRC3_BANK_INFO* pBankInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the memory bank for which information is required.

bankIndex (in)

Specifies the memory bank within the device for which information is required. This is a zero-based index that must be less than the **NumMemoryBank** member of **ADMXRC3_CARD_INFOEX**.

pBankInfo (out)

Points to an object of type **ADMXRC3_BANK_INFO** in which to return information about the memory bank.

Description

This function returns information about a memory bank in a device.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved due to an error reading the device's Vital Product Data.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The bankIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pBankInfo parameter is NULL.

4.3.10 ADMXRC3_GetCardInfo

Declaration

```

ADMXRC3_STATUS
ADMXRC3_GetCardInfo(
    __in   ADMXRC3_HANDLE   hDevice,
    __out  ADMXRC3_CARD_INFO* pCardInfo);

```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which information is required.

pCardInfo (out)

Points to an object of type [ADMXRC3_CARD_INFO](#) in which to return information about the device.

Description

This function returns information about a device.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved due to an error reading the device's Vital Product Data.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_NULL_POINTER	The pCardInfo parameter is NULL.

Remarks

[ADMXRC3_GetCardInfo](#) has been superseded by [ADMXRC3_GetCardInfoEx](#), as the latter returns a superset of the information returned by [ADMXRC3_GetCardInfo](#).

4.3.11 ADMXRC3_GetCardInfoEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_GetCardInfoEx(  
    __in    ADMXRC3_HANDLE    hDevice,  
    __out   ADMXRC3_CARD_INFOEX* pCardInfoEx);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which information is required.

pCardInfoEx (out)

Points to an object of type [ADMXRC3_CARD_INFOEX](#) in which to return information about the device.

Description

This function returns information about a device.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved due to an error reading the device's Vital Product Data.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_NULL_POINTER	The pCardInfoEx parameter is NULL.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later, and supersedes [ADMXRC3_GetCardInfo](#). The information returned by [ADMXRC3_GetCardInfoEx](#) is a superset of that of [ADMXRC3_GetCardInfo](#).

4.3.12 ADMXRC3_GetClockFrequency

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_GetClockFrequency(  
    __in    ADMXRC3_HANDLE    hDevice,  
    __in    unsigned int      clockIndex,  
    __out   double*           pActualFrequency);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the clock generator whose current frequency is to be returned.

clockIndex (in)

Specifies the clock generator within the device whose current frequency is to be returned. This is a zero-based index that must be less than the **NumClockGen** member of **ADMXRC3_CARD_INFOEX**.

pActualFrequency (out)

Points to an object of type **double** in which to return the current frequency of the clock generator.

Description

This function returns the current frequency being output by a clock generator in a device.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The clockIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pActualFrequency parameter is NULL .

4.3.13 ADMXRC3_GetFlashBlockInfo

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetFlashBlockInfo(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int flashIndex,
    __in uint64_t address,
    __out ADMXRC3_FLASHBLOCK_INFO* pFlashBlockInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the Flash memory bank of interest.

flashIndex (in)

Identifies the Flash memory bank of interest, within the device. This is a zero-based index that must be less than the **NumFlashBank** member of **ADMXRC3_CARD_INFOEX**.

address (in)

An address, in bytes, within the Flash memory bank of interest.

pFlashBlockInfo (out)

Points to an object of type **ADMXRC3_FLASHBLOCK_INFO** in which to return information about the Flash block.

Description

This function returns information about a Flash block, given any address within that block.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved because the Flash device is malfunctioning or not present.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter is out of range.
ADMXRC3_INVALID_REGION	The address parameter is out of range.
ADMXRC3_NULL_POINTER	The pFlashBlockInfo parameter is NULL.

4.3.14 ADMXRC3_GetFlashInfoA

Declaration

```

ADMXRC3_STATUS
ADMXRC3_GetFlashInfoA(
    __in   ADMXRC3_HANDLE   hDevice,
    __in   unsigned int     flashIndex,
    __out  ADMXRC3_FLASH_INFOA* pFlashInfo);
    
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the Flash memory bank of interest.

flashIndex (in)

Identifies the Flash memory bank of interest, within the device. This is a zero-based index that must be less than the **NumFlashBank** member of **ADMXRC3_CARD_INFOEX**.

pFlashInfo (out)

Points to an object of type **ADMXRC3_FLASH_INFOA** in which to return information about the Flash memory bank.

Description

This function returns information about a Flash memory bank.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved because the Flash device is malfunctioning or not present.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pFlashInfo parameter is NULL.

Remarks

This is the ANSI / UTF-8 version of [ADMXRC3_GetFlashInfo](#). [ADMXRC3_GetFlashInfo](#) is actually a macro defined to be either [ADMXRC3_GetFlashInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetFlashInfoA](#).

4.3.15 ADMXRC3_GetFlashInfoW

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetFlashInfoW(
    __in  ADMXRC3_HANDLE    hDevice,
    __in  unsigned int      flashIndex,
    __out ADMXRC3_FLASH_INFO* pFlashInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the Flash memory bank of interest.

flashIndex (in)

Identifies the Flash memory bank of interest, within the device. This is a zero-based index that must be less than the [NumFlashBank](#) member of [ADMXRC3_CARD_INFOEX](#).

pFlashInfo (out)

Points to an object of type [ADMXRC3_FLASH_INFOW](#) in which to return information about the Flash memory bank.

Description

This function returns information about a Flash memory bank.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved because the Flash device is malfunctioning or not present.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pFlashInfo parameter is NULL.

Remarks

This is the Unicode version of [ADMXRC3_GetFlashInfo](#). [ADMXRC3_GetFlashInfo](#) is actually a macro defined to be either [ADMXRC3_GetFlashInfoW](#) if the `__UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetFlashInfoA](#).

4.3.16 ADMXRC3_GetFpgaInfoA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_GetFpgaInfoA(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int targetIndex,  
    __out ADMXRC3_FPGA_INFOA* pFpgaInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the target FPGA of interest.

targetIndex (in)

Identifies the target FPGA of interest, within the device. This is a zero-based index that must be less than the [NumTargetFpga](#) member of [ADMXRC3_CARD_INFOEX](#).

pFpgaInfo (out)

Points to an object of type [ADMXRC3_FPGA_INFOA](#) in which to return information about the target FPGA.

Description

This function returns information about a target FPGA.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved due to an error reading the device's Vital Product Data.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pFpgaInfo parameter is NULL.

Remarks

This is the ANSI / UTF-8 version of [ADMXRC3_GetFpgaInfo](#). [ADMXRC3_GetFpgaInfo](#) is actually a macro defined to be either [ADMXRC3_GetFpgaInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetFpgaInfoA](#).

4.3.17 ADMXRC3_GetFpgaInfoW

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetFpgaInfoW(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int targetIndex,
    __out ADMXRC3_FPGA_INFOW* pFpgaInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the target FPGA of interest.

targetIndex (in)

Identifies the target FPGA of interest, within the device. This is a zero-based index that must be less than the [NumTargetFpga](#) member of [ADMXRC3_CARD_INFOEX](#).

pFpgaInfo (out)

Points to an object of type [ADMXRC3_FPGA_INFOW](#) in which to return information about the target FPGA.

Description

This function returns information about a target FPGA.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	The information could not be retrieved due to an error reading the device's Vital Product Data.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pFpgalInfo parameter is NULL.

Remarks

This is the Unicode version of [ADMXRC3_GetFpgalInfo](#). [ADMXRC3_GetFpgalInfo](#) is actually a macro defined to be either [ADMXRC3_GetFpgalInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetFpgalInfoA](#).

4.3.18 ADMXRC3_GetModuleInfoA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_GetModuleInfoA(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int moduleIndex,  
    __out ADMXRC3_MODULE_INFOA* pModuleInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the module site of interest.

moduleIndex (in)

Identifies the module site of interest, within the device. This is a zero-based index that must be less than the [NumModuleSite](#) member of [ADMXRC3_CARD_INFOEX](#).

pModuleInfo (out)

Points to an object of type [ADMXRC3_MODULE_INFOA](#) in which to return information about the module.

Description

This function returns information about an I/O personality module site.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The moduleIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pModuleInfo parameter is NULL.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

This is the ANSI / UTF-8 version of [ADMXRC3_GetModuleInfo](#). [ADMXRC3_GetModuleInfo](#) is actually a macro defined to be either [ADMXRC3_GetModuleInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetModuleInfoA](#).

4.3.19 ADMXRC3_GetModuleInfoW

Declaration

```

ADMXRC3_STATUS
ADMXRC3_GetModuleInfoW(
    __in  ADMXRC3_HANDLE    hDevice,
    __in  unsigned int      moduleIndex,
    __out ADMXRC3_MODULE_INFO* pModuleInfo);

```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the module site of interest.

moduleIndex (in)

Identifies the module site of interest, within the device. This is a zero-based index that must be less than the [NumModuleSite](#) member of [ADMXRC3_CARD_INFOEX](#).

pModuleInfo (out)

Points to an object of type [ADMXRC3_MODULE_INFO](#) in which to return information about the module.

Description

This function returns information about an I/O personality module site.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The moduleIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pModuleInfo parameter is NULL.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

This is the Unicode version of [ADMXRC3_GetModuleInfo](#). [ADMXRC3_GetModuleInfo](#) is actually a macro defined to be either [ADMXRC3_GetModuleInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetModuleInfoA](#).

4.3.20 ADMXRC3_GetSensorInfoA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_GetSensorInfoA(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int sensorIndex,  
    __out ADMXRC3_SENSOR_INFOA* pSensorInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the sensor of interest.

sensorIndex (in)

Identifies the sensor of interest, within the device. This is a zero-based index that must be less than the [NumSensor](#) member of [ADMXRC3_CARD_INFOEX](#).

pSensorInfo (out)

Points to an object of type [ADMXRC3_SENSOR_INFOA](#) in which to return information about the sensor.

Description

This function returns information about a sensor.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The sensorIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pSensorInfo parameter is NULL.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

This is the ANSI / UTF-8 version of [ADMXRC3_GetSensorInfo](#). [ADMXRC3_GetSensorInfo](#) is actually a macro defined to be either [ADMXRC3_GetSensorInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetSensorInfoA](#).

4.3.21 ADMXRC3_GetSensorInfoW

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetSensorInfoW(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int sensorIndex,
    __out ADMXRC3_SENSOR_INFOW* pSensorInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the sensor of interest.

sensorIndex (in)

Identifies the sensor of interest, within the device. This is a zero-based index that must be less than the [NumSensor](#) member of [ADMXRC3_CARD_INFOEX](#).

pSensorInfo (out)

Points to an object of type [ADMXRC3_SENSOR_INFOW](#) in which to return information about the sensor.

Description

This function returns information about a sensor.

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The sensorIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pSensorInfo parameter is NULL.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

This is the Unicode version of [ADMXRC3_GetSensorInfo](#). [ADMXRC3_GetSensorInfo](#) is actually a macro defined to be either [ADMXRC3_GetSensorInfoW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetSensorInfoA](#).

4.3.22 ADMXRC3_GetStatusStringA

Declaration

```
const char*
ADMXRC3_GetStatusStringA(
    __in ADMXRC3_STATUS code,
    __in boolean_t bShort);
```

The parameters of this function are as follows:

code (in)

Identifies the device that contains the target FPGA of interest.

bShort (in)

Specifies whether the description should be the full description, or merely a string of the corresponding symbolic value as defined by the ADMXRC3 API.

Description

This function returns a textual description of an [ADMXRC3_STATUS](#) code. The following example illustrates how the 'code' parameter affects the returned string:

FALSE

Return Value

The return value is a pointer to a NUL-terminated [char](#) string that describes the error code.

Remarks

The returned string is statically allocated, so an application must treat it as read-only.

This is the ANSI / UTF-8 version of [ADMXRC3_GetStatusString](#). [ADMXRC3_GetStatusString](#) is actually a macro defined to be either [ADMXRC3_GetStatusStringW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_GetStatusStringA](#).

4.3.23 ADMXRC3_GetStatusStringW

Declaration

```
const wchar_t*
ADMXRC3_GetStatusStringW(
    __in ADMXRC3_STATUS code,
    __in boolean_t bShort);
```

The parameters of this function are as follows:

code (in)

Identifies the device that contains the target FPGA of interest.

bShort (in)

Specifies whether the description should be the full description, or merely a string of the corresponding symbolic value as defined by the ADMXRC3 API.

Description

This function returns a textual description of an [ADMXRC3_STATUS](#) code. The following example illustrates how the 'code' parameter affects the returned string:

```
FALSE
```

Return Value

The return value is a pointer to a NUL-terminated [wchar_t](#) string that describes the error code.

Remarks

The returned string is statically allocated, so an application must treat it as read-only.

This is the Unicode version of [ADMXRC3_GetStatusString](#). [ADMXRC3_GetStatusString](#) is actually a macro defined to be either [ADMXRC3_GetStatusStringW](#) if the [_UNICODE](#) preprocessor symbol is defined, or else [ADMXRC3_GetStatusStringA](#).

4.3.24 ADMXRC3_GetVersionInfo

Declaration

```
ADMXRC3_STATUS
ADMXRC3_GetVersionInfo(
    __in ADMXRC3_HANDLE hDevice,
    __out ADMXRC3_VERSION_INFO* pVersionInfo);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device handle to use to retrieve version information.

pVersionInfo (out)

Points to an object of type [ADMXRC3_VERSION_INFO](#) in which to return version information.

Description

This function returns version information for the ADMXRC3 API library and ADMXRC3 driver.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter is not a valid device handle.
<code>ADMXRC3_NULL_POINTER</code>	The <code>pVersionInfo</code> parameter is NULL.

4.3.25 ADMXRC3_GetWindowInfo

Declaration

```

ADMXRC3_STATUS
ADMXRC3_GetWindowInfo(
    __in  ADMXRC3_HANDLE      hDevice,
    __in  unsigned int        windowIndex,
    __out ADMXRC3_WINDOW_INFO* pWindowInfo);
    
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the memory window of interest.

windowIndex (in)

Identifies the memory window of interest, within the device. This is a zero-based index that must be less than the `NumWindow` member of `ADMXRC3_CARD_INFOEX`.

pWindowInfo (out)

Points to an object of type `ADMXRC3_WINDOW_INFO` in which to return information about the memory window.

Description

This function returns information about a memory window that can be used to access device registers and/or target FPGAs.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The windowIndex parameter is out of range.
ADMXRC3_NULL_POINTER	The pWindowInfo parameter is NULL.

4.3.26 ADMXRC3_InitializeTicket

Declaration

```
void
ADMXRC3_InitializeTicket(
    __out ADMXRC3_TICKET* pTicket);
```

The parameters of this function are as follows:

pTicket (out)

Points to the ticket to be initialized.

Description

This function initializes an [ADMXRC3_TICKET](#) structure, and must be called in order to initialize a ticket.

In Windows, after calling [ADMXRC3_InitializeTicket](#), the [Overlapped.hEvent](#) member of the ticket must also be set to a valid event handle, as described in [ADMXRC3_TICKET](#).

Attempting to use an uninitialized ticket for a non-blocking operation may result in an error being returned, or undefined behavior.

Remarks

In some operating systems, this function is a macro that does nothing.

4.3.27 ADMXRC3_LoadBitstreamA

Declaration

```
ADMXRC3_STATUS
ADMXRC3_LoadBitstreamA(
    __in  const char* pFilename,
    __out ADMXRC3_BITSTREAMA** ppBitstream);
```

The parameters of this function are as follows:

pFilename (in)

NUL-terminated [char](#) string that specifies the name of bitstream (.BIT) file.

ppBitstream (out)

Points to a variable of type [ADMXRC3_BITSTREAMA*](#), which is initialized to point to an [ADMXRC3_BITSTREAMA](#) object.

Description

This function loads a bitstream (.BIT) file into memory, returning a pointer to an object of type **ADMXRC3_BITSTREAMA** via the **ppBitstream** parameter. The **Data** member of the **ADMXRC3_BITSTREAMA** object represents the beginning of an array containing configuration frame data suitable for passing to **ADMXRC3_ConfigureFromBuffer**.

ADMXRC3_LoadBitstreamW allocates memory to hold the entire bitstream, and an application eventually must free the object using **ADMXRC3_UnloadBitstreamW**.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_FILE_NOT_FOUND	The file identified by the pFilename parameter could not be opened.
ADMXRC3_INVALID_BITSTREAM	The file identified by the pFilename parameter is not a valid .BIT file.
ADMXRC3_NO_MEMORY	Memory to hold the bitstream data could not be allocated.
ADMXRC3_NULL_POINTER	The pFilename and / or ppBitstream parameter is a NULL pointer.

Remarks

This is the ANSI / UTF-8 version of **ADMXRC3_LoadBitstream**. **ADMXRC3_LoadBitstream** is actually a macro defined to be either **ADMXRC3_LoadBitstreamW** if the **_UNICODE** preprocessor symbol is defined, or else **ADMXRC3_LoadBitstreamA**.

4.3.28 ADMXRC3_LoadBitstreamW

Declaration

```
ADMXRC3_STATUS
ADMXRC3_LoadBitstreamW(
    __in  const wchar_t*  pFilename,
    __out ADMXRC3_BITSTREAMW** ppBitstream);
```

The parameters of this function are as follows:

pFilename (in)

NUL-terminated **wchar_t** string that specifies the name of bitstream (.BIT) file.

ppBitstream (out)

Points to a variable of type **ADMXRC3_BITSTREAMW***, which is initialized to point to an **ADMXRC3_BITSTREAMW** object.

Description

This function loads a bitstream (.BIT) file into memory, returning a pointer to an object of type **ADMXRC3_BITSTREAMW** via the `ppBitstream` parameter. The `Data` member of the **ADMXRC3_BITSTREAMW** object represents the beginning of an array containing configuration frame data suitable for passing to **ADMXRC3_ConfigureFromBuffer**.

ADMXRC3_LoadBitstreamW allocates memory to hold the entire bitstream, and an application eventually must free the object using **ADMXRC3_UnloadBitstreamW**.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_FILE_NOT_FOUND	The file identified by the <code>pFilename</code> parameter could not be opened.
ADMXRC3_INVALID_BITSTREAM	The file identified by the <code>pFilename</code> parameter is not a valid .BIT file.
ADMXRC3_NO_MEMORY	Memory to hold the bitstream data could not be allocated.
ADMXRC3_NULL_POINTER	The <code>pFilename</code> and / or <code>ppBitstream</code> parameter is a NULL pointer.

Remarks

This is the Unicode version of **ADMXRC3_LoadBitstream**. **ADMXRC3_LoadBitstream** is actually a macro defined to be either **ADMXRC3_LoadBitstreamW** if the `_UNICODE` preprocessor symbol is defined, or else **ADMXRC3_LoadBitstreamA**.

4.3.29 ADMXRC3_Lock

Declaration

```
ADMXRC3_STATUS
ADMXRC3_Lock(
    __in ADMXRC3_HANDLE hDevice,
    __in const void* pBuffer,
    __in size_t length,
    __out ADMXRC3_BUFFER_HANDLE* phBuffer);
```

The parameters of this function are as follows:

hDevice (in)

The device handle that is to be the owner of the locked buffer.

pBuffer (in)

Points to the buffer to be locked.

length (in)

The size of the buffer to be locked, in bytes.

phBuffer (out)

Points to a variable of type [ADMXRC3_BUFFER_HANDLE](#) that is to receive the handle to the locked buffer.

Description

This function locks a user-space buffer into memory so that the operating system cannot swap it out to backing store. If successful, then the function returns a handle of type [ADMXRC3_BUFFER_HANDLE](#), and guarantees that the buffer will be wholly resident in physical memory until:

- The application unlocks the buffer with an inverse call to [ADMXRC3_Unlock](#), or
- The application closes the device handle with a call to [ADMXRC3_Close](#), or
- The application terminates without cleaning up; in this case, the buffer is unlocked when the system automatically closes any open device handles. However, this does not happen in VxWorks because it does not automatically close device handles when a task exits.

Use of this function reduces the overhead incurred in performing DMA transfers by eliminating the need to lock and unlock a user-space buffer for every DMA transfer. A user-space buffer can be locked once when an application initializes, used in an arbitrary number of DMA transfers, and unlocked when the application terminates. The following DMA functions target a locked user-space buffer:

- [ADMXRC3_StartReadDMALocked](#)
- [ADMXRC3_StartReadDMALockedEx](#)
- [ADMXRC3_StartWriteDMALocked](#)
- [ADMXRC3_StartWriteDMALockedEx](#)
- [ADMXRC3_ReadDMALocked](#)
- [ADMXRC3_ReadDMALockedEx](#)
- [ADMXRC3_WriteDMALocked](#)
- [ADMXRC3_WriteDMALockedEx](#)

[ADMXRC3_BUFFER_HANDLE](#) values are global to the system. This enables one process to lock a buffer, and if it can somehow communicate the buffer handle to another process, the other process can also use the buffer handle to perform DMA transfers. However, every buffer handle has an owner, which is the device handle that was used to create it. Only the owning device handle used can be used to successfully call [ADMXRC3_Unlock](#).

A user-space buffer can be wholly or partially locked multiple times if necessary. If a user-space buffer is locked several times, yielding several buffer handles, it will only become swappable after every one of the buffer handles has been passed to [ADMXRC3_Unlock](#).

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_NO_MEMORY	Memory for keeping track of the locked buffer could not be allocated.
ADMXRC3_NULL_POINTER	The pBuffer parameter was a NULL pointer.
ADMXRC3_RESOURCE_LIMIT	The maximum number of locked buffers was already reached.

Remarks

Applications should avoid locking so much memory that the system no longer has enough physical memory left for the working sets of other processes in the system, such as applications and system services.

In order to avoid potential system memory corruption due to a badly behaved application, locked buffers have a reference counting mechanism. A locked user-space buffer begins with a reference count of 1. Calling **ADMXRC3_Unlock** invalidates the buffer handle and decrements the reference count. Each DMA transfer performed using the buffer increments the reference count when it begins and decrements the reference count when complete. When the reference count reaches zero, the user-space buffer is made swappable again. Thus, while a DMA transfer is in progress on a buffer, that buffer is not swappable, even if **ADMXRC3_Unlock** is called during the DMA transfer.

Locking is implemented with a page granularity by the operating system, where each user-space page has a lock count (separate to that of the reference count of buffer). Therefore, to be precise, the effect of this function is to iterate over each page of the user-space buffer and increment its lock count by 1. The implication of this is that any part of a user-space buffer can be locked multiple times, regardless of whether or not those parts are disjoint or overlapping. As long as there are matching calls to **ADMXRC3_Unlock**, the lock counts of all pages eventually return to 0.

4.3.30 ADMXRC3_MapWindow

Declaration

```
ADMXRC3_STATUS
ADMXRC3_MapWindow(
    __in   ADMXRC3_HANDLE  hDevice,
    __in   unsigned int    windowIndex,
    __in   uint64_t        offset,
    __in   uint64_t        length,
    __out  void**          ppVirtualBase);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the window of interest.

windowIndex (in)

Identifies the window of interest in the device.

offset (in)

The byte offset in the window of interest of the region to be mapped.

length (in)

The length of the region to be mapped, in bytes.

ppVirtualBase (out)

Points to a variable of type **void*** that is to receive the address of where the region is mapped in the caller's address space.

Description

This function maps a region of a memory window into a caller's address space. If successful, the returned pointer can then be dereferenced in order to read and write the mapped region. The region remains mapped until one of the following occurs:

- The region is unmapped by a call to [ADMXRC3_UnmapWindow](#).
- The device handle used to map the window is closed by a call to [ADMXRC3_Close](#).
- The process terminates without cleaning up, in which case the mapping is lost as the device handle is automatically closed by the operating system and the process is destroyed.

A device's windows can be enumerated by calling [ADMXRC3_GetWindowInfo](#) in order to avoid errors when calling [ADMXRC3_MapWindow](#). It is legal to wholly or partially map a window more than once.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The windowIndex parameter specifies a nonexistent window.
ADMXRC3_INVALID_REGION	The offset and length parameters specify an invalid region of the specified window.
ADMXRC3_NO_MEMORY	Memory could not be allocated for keeping track of the mapping.
ADMXRC3_NULL_POINTER	The ppVirtualBase parameter was a NULL pointer.
ADMXRC3_REGION_TOO_LARGE	The region specified by the offset and length parameters was too large to be mapped in a single operation. See remarks below.

Remarks

This function is useful for mapping a target FPGA's registers in a caller's address space. As described in [Section 3.8.2.1, "Mapping memory windows into user-space"](#), reading and writing using pointer dereference avoids the overhead of calling the ADMXRC3 API that is incurred with [ADMXRC3_Read](#) and [ADMXRC3_Write](#).

There are a number of issues to be aware of when dereferencing the returned pointer to perform reads and writes, notably write buffers, load / store ordering and barriers. A discussion of these issues is outside the scope of this document, but applications must take account of them in order to guarantee the desired behavior.

The mapped region will generally be noncacheable by the CPU, as memory windows usually correspond to device registers or target FPGAs.

If `ADMXRC3_REGION_TOO_LARGE` is returned, the specified region is larger than the OS-dependent limit for a single map operation. The region should be split into two or more smaller regions which should then be mapped separately.

In VxWorks, this function does very little other than return a pointer to the region to be mapped, as VxWorks typically has a single global address space shared by the kernel and tasks alike.

4.3.31 ADMXRC3_Open

Declaration

```
ADMXRC3_STATUS
ADMXRC3_Open(
    __in  unsigned int   index,
    __out ADMXRC3_HANDLE* phCard);
```

The parameters of this function are as follows:

index (in)

Identifies the device to open.

phCard (out)

Points to a variable of type `ADMXRC3_HANDLE` that is to receive the handle to the opened device.

Description

This function opens a device and returns a handle to it that can be used in subsequent ADMXRC3 API calls. The handle remains valid until `ADMXRC3_Close` is called. A given device can be opened multiple times, by the same process or different processes.

It is equivalent to calling `ADMXRC3_OpenEx` where the `bPassive` parameter is `FALSE` and the `cooperativeLevel` parameter is 0. Therefore, assuming the call succeeds, there are no restrictions on what API functions can be used with the returned device handle.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_ACCESS_DENIED</code>	The calling process does not have sufficient privileges to open the device.
<code>ADMXRC3_DEVICE_NOT_FOUND</code>	The index parameter specifies a device that does not exist in the system.
<code>ADMXRC3_NO_MEMORY</code>	Memory could not be allocated for keeping track of a new device handle.

Remarks

With the exception of VxWorks, the operating system automatically closes any open handles if a process terminates without cleaning up.

4.3.32 ADMXRC3_OpenEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_OpenEx(  
    __in    unsigned int    index,  
    __in    bool_t         bPassive,  
    __in    uint32_t        cooperativeLevel,  
    __out   ADMXRC3_HANDLE* phCard);
```

The parameters of this function are as follows:

index (in)

Identifies the device to open.

bPassive (in)

Specifies how the device is to be opened.

cooperativeLevel (in)

Must currently be zero.

phCard (out)

Points to a variable of type [ADMXRC3_HANDLE](#) that is to receive the handle to the opened device.

Description

This function opens a device and returns a handle to it that can be used in subsequent ADMXRC3 API calls. The handle remains valid until [ADMXRC3_Close](#) is called. A given device can be opened multiple times, by the same process or different processes.

The bPassive parameter controls how the device is opened:

- If the bPassive parameter is TRUE, the device is opened in "passive" mode. This allows unprivileged processes to open the device, but any subsequent calls using the returned device handle that modify device state will fail with the error [ADMXRC3_ACCESS_DENIED](#). Most informational functions, such as [ADMXRC3_GetCardInfoEx](#) are callable, along with the diagnostic functions such as [ADMXRC3_ReadSensor](#).
- If the bPassive parameter is FALSE, the device is opened in "active" mode. Only privileged processes can open a device in this manner, but unlike the passive case, there is no restriction on what API functions can be used with the returned device handle. If an unprivileged process attempts to call [ADMXRC3_OpenEx](#) in active mode, the call will fail and return an error code of [ADMXRC3_ACCESS_DENIED](#).

This function is useful for monitoring applications that do not modify device state. The following is the list of functions that can be used with a device handle that has been opened in passive mode:

- `ADMXRC3_Cancel`
- `ADMXRC3_Close`
- `ADMXRC3_FinishNotificationWait`
- `ADMXRC3_GetBankInfo`
- `ADMXRC3_GetCardInfo`
- `ADMXRC3_GetCardInfoEx`
- `ADMXRC3_GetClockFrequency`
- `ADMXRC3_GetFlashBlockInfo`
- `ADMXRC3_GetFlashInfoA`
- `ADMXRC3_GetFlashInfoW`
- `ADMXRC3_GetFpgaInfoA`
- `ADMXRC3_GetFpgaInfoW`
- `ADMXRC3_GetSensorInfoA`
- `ADMXRC3_GetSensorInfoW`
- `ADMXRC3_GetVersionInfo`
- `ADMXRC3_GetWindowInfo`
- `ADMXRC3_ReadSensor`
- `ADMXRC3_RegisterWin32Event`
- `ADMXRC3_RegisterVxwSem`
- `ADMXRC3_StartNotificationWait`
- `ADMXRC3_UnregisterWin32Event`
- `ADMXRC3_UnregisterVxwSem`

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_ACCESS_DENIED</code>	The calling process does not have sufficient privileges to open the device.
<code>ADMXRC3_DEVICE_NOT_FOUND</code>	The index parameter specifies a device that does not exist in the system.
<code>ADMXRC3_NO_MEMORY</code>	Memory could not be allocated for keeping track of a new device handle.

Remarks

With the exception of VxWorks, the operating system automatically closes any open handles if a process terminates without cleaning up.

4.3.33 ADMXRC3_Read

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_Read(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    unsigned int    windowIndex,  
    __in    uint32_t        flags,  
    __in    size_t          offset,  
    __in    size_t          length,  
    __out   void*           pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the window to be read.

windowIndex (in)

Identifies the window within the device to be read.

flags (in)

Flags that modify the behavior of the function. There are no flags currently defined, and so this parameter must be zero.

offset (in)

The byte offset into the window at which reading is to begin.

length (in)

The number of bytes to read.

pBuffer (out)

Points to the buffer to receive the the data read from the window.

Description

This function reads data from a memory window in a device, starting at the specified offset within the window. The data transfer is performed by the CPU, and is therefore CPU intensive for large blocks of data.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The windowIndex parameter specifies a nonexistent window.
ADMXRC3_INVALID_REGION	The offset and length parameters specify an invalid region of the specified window.

Remarks

Calling [ADMXRC3_Read](#) incurs a certain overhead, but is acceptable for tasks that are not performance-critical, such as reading registers during initialization of an application. As described in [Section 3.8.2.1, "Mapping memory windows into user-space"](#), mapping a memory window into the caller's address space and using pointer dereferencing is generally faster when many register reads must be performed.

For large blocks of data, consider using DMA transfers, as described in [Section 3.8.3.2, "DMA transfers with host memory"](#).

If this function is used to read data from a target FPGA, the FPGA design must be able to cope with arbitrary byte enables being presented during reads, and side-effects on reads are best avoided. This is because the operand size used for load instructions in the data copying routines used by the ADMXRC3 API may vary depending upon CPU architecture, buffer alignment, etc. and even upon timing.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.34 ADMXRC3_ReadDMA

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadDMA(
    __in    ADMXRC3_HANDLE  hDevice,
    __in    unsigned int    dmaChannel,
    __in    uint32_t        flags,
    __out   void*           pBuffer,
    __in    size_t          length,
    __in    uint32_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- `ADMXRC3_DMA_FIXEDLOCAL`
Causes the local address to be held constant throughout the entire DMA transfer.
- `ADMXRC3_DMA_DONOTQUEUE`
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (out)

Points to the buffer that is to receive the data read from the device.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the `ADMXRC3_DMA_DONOTQUEUE` flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, `ADMXRC3_ReadDMALocked` may be more appropriate than `ADMXRC3_ReadDMA`.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.35 ADMXRC3_ReadDMABus

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadDMABus(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in uint64_t busAddress,
    __in size_t length,
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.

- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

busAddress (in)

The starting bus address at which data read from the device is stored.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function is intended for scenarios where data must be transferred directly between two peers on a bus, where at least one of the devices is a Gen 3 reconfigurable computing device. It reads a block of data from a device, starting at the specified local address, and writes it beginning at the specified bus address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.3, "DMA transfers with peer devices"](#).

DMA transfers are subject to a queuing mechanism unless the `ADMXRC3_DMA_DONOTQUEUE` flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Unlike [ADMXRC3_ReadDMA](#) and [ADMXRC3_ReadDMAEx](#), this function does not lock anything into memory because the data is read directly from the device specified by `hDevice` and written to the bus address specified by `busAddress`. Thus, in some CPU architectures and platforms, there can be significantly less overhead in calling [ADMXRC3_ReadDMA](#) compared to [ADMXRC3_ReadDMA](#) or [ADMXRC3_ReadDMAEx](#).

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.4.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

The way in which the **busAddress** parameter is interpreted depends upon the I/O bus standard used by the device specified by **hDevice**. For example, if **hDevice** refers to an ADM-XRC-6T1, which has a PCI Express host interface, **busAddress** is a PCI Express memory space address.

In models that have a PCI Express host interface, it is not possible to determine when no PCI Express endpoint claims the address specified by **busAddress**. This is because PCI Express does not provide a standard mechanism for this type of error to be reported to the bus master. In such cases, the data that was read from the device is silently discarded and (assuming no other detectable errors occur) the return value is **ADMXRC3_SUCCESS**.

4.3.36 ADMXRC3_ReadDMAEx

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadDMAEx(
    __in   ADMXRC3_HANDLE  hDevice,
    __in   unsigned int    dmaChannel,
    __in   uint32_t        flags,
    __out  void*            pBuffer,
    __in   size_t          length,
    __in   uint64_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (out)

Points to the buffer that is to receive the data read from the device.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, [ADMXRC3_ReadDMALockedEx](#) may be more appropriate than [ADMXRC3_ReadDMAEx](#).

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.2.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.37 ADMXRC3_ReadDMALocked

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadDMALocked(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in ADMXRC3_BUFFER_HANDLE pBuffer,
    __in size_t offset,
    __in size_t length,
    __in uint32_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer where data read from the device should be placed.

offset (in)

Offset into the locked buffer where data read from the device should be placed.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a locked buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the `ADMXRC3_DMA_DONOTQUEUE` flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_ReadDMALocked](#) has less overhead than [ADMXRC3_ReadDMA](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.38 ADMXRC3_ReadDMALockedEx

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadDMALockedEx(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in ADMXRC3_BUFFER_HANDLE hBuffer,
    __in size_t offset,
    __in size_t length,
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer where data read from the device should be placed.

offset (in)

Offset into the locked buffer where data read from the device should be placed.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a locked buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_ReadDMALockedEx](#) has less overhead than [ADMXRC3_ReadDMAEx](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.39 ADMXRC3_ReadFlash

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadFlash(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int flashIndex,
    __in uint32_t flags,
    __in size_t address,
    __in size_t length,
    __out void* pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device containing the Flash memory bank to be read.

flashIndex (in)

Specifies which Flash memory bank in the device is to be read.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_FLASH_SYNC**
Causes the cache for the Flash memory bank to be synchronized with the hardware before the function returns. For a description of the caching mechanism, refer to [Section 3.8.5.1, "Flash memory caching"](#)

address (in)

The byte address in the Flash memory bank at which to begin reading.

length (in)

Number of bytes to read from the Flash memory bank.

pBuffer (out)

The buffer that should receive the data read from the Flash memory bank.

Description

This function reads a block of data from Flash memory bank in a device. The data transfer is performed by the CPU, so is CPU intensive for large blocks.

The region of the Flash memory bank that is read, which is specified by the address and length parameters, can be of arbitrary alignment and does not (for example) need to be aligned to block boundaries. The region must be inside the user-programmable region, the bounds of which can be determined by calling [ADMXRC3_GetFlashInfo](#).

The ADMXRC3 API implements a caching mechanism for each Flash memory bank. Passing the `ADMXRC3_FLASH_SYNC` flag ensures that the cache for the specified Flash memory bank is synchronized with the hardware before the function returns.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while reading the Flash memory bank.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter specifies a nonexistent Flash memory bank.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the Flash memory bank.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the Flash read operation.

Remarks

Although the region specified by the address and length parameters need not bear any relationship to Flash block boundaries, an application can call [ADMXRC3_GetFlashBlockInfo](#) in order to determine which block contains a particular address. An application can enumerate every block in a Flash memory bank by beginning at address 0 and repeatedly calling [ADMXRC3_GetFlashBlockInfo](#) until the end of the bank is reached.

Although this function reads a Flash memory bank, in the event of an error, the returned error code may imply that a write or erase operation failed. This can occur because the caching mechanism may need to write a dirty block back to the hardware before another block is read.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.40 ADMXRC3_ReadSensor

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadSensor(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int sensorIndex,
    __out ADMXRC3_SENSOR_VALUE* pValue);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the sensor of interest.

sensorIndex (in)

Identifies the sensor of interest within the device. This is a zero-based index that must be less than the [NumSensor](#) member of [ADMXRC3_CARD_INFOEX](#).

pValue (out)

Points to an object of type [ADMXRC3_SENSOR_VALUE](#) in which to return the sensor reading.

Description

This function reads a sensor, returning the current reading via the union [ADMXRC3_SENSOR_VALUE](#).

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while reading the sensor.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The sensorIndex parameter specifies a nonexistent sensor.
ADMXRC3_NULL_POINTER	The pValue parameter was a NULL pointer.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

The datatype of the sensor, as returned by [ADMXRC3_GetSensorInfo](#), determines how an application should interpret a value of type [ADMXRC3_SENSOR_VALUE](#). It is the application's responsibility to be aware of a sensor's datatype and correctly interpret the returned sensor value.

4.3.41 ADMXRC3_ReadVPD

Declaration

```
ADMXRC3_STATUS
ADMXRC3_ReadVPD(
    __in    ADMXRC3_HANDLE  hDevice,
    __in    uint32_t        flags,
    __in    size_t          offset,
    __in    size_t          length,
    __out   void*           pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device from which to read the VPD.

flags (in)

Flags that modify how the operation is performed. Currently no flags are defined, so this parameter must be zero.

offset (in)

The byte offset into the VPD memory at which to begin reading.

length (in)

Number of bytes to read from the VPD memory.

pBuffer (out)

The buffer that should receive the data read from the VPD memory.

Description

This function reads a block of Vital Product Data (VPD) from a device. The data transfer is performed by the CPU, so is CPU intensive for large blocks. For an overview, refer to [Section 3.8.6, "Vital Product Data"](#).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while reading the VPD memory.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the VPD memory.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the VPD read operation.

Remarks

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.42 ADMXRC3_RegisterWin32Event

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_RegisterWin32Event(  
    __in    ADMXRC3_HANDLE    hDevice,  
    __in    uint32_t          notification,  
    __in    HANDLE            hEvent);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which the Win32 Event should be registered.

notification (in)

The type of notification for which the Win32 Event should be registered.

hEvent (in)

The handle to the Win32 Event that is to be registered.

Description

This Windows-specific function registers a Win32 Event that is signalled whenever a certain event occurs within a device. The prototype for this function exists only for Windows; it is not defined for other operating systems.

The type of notification must be one of the following values:

- `ADMXRC3_EVENT_FPGAALERT(targetIndex)`
Notification of overtemperature alerts for a target FPGA, where 'targetIndex' is the index of the target FPGA.
- `ADMXRC3_EVENT_FPGAINTERRUPT(targetIndex)`
Notification of interrupts generated by a target FPGA, where 'targetIndex' is the index of the target FPGA.

A Win32 Event that is registered using this function is associated with the device handle used to register it. It is legal to register the same Win32 Event with several different devices, although the application will not be able to determine why the Win32 Event was signalled unless it checks each device in some application-specific manner. Multiple events may be registered with the same device handle for the same notification type, if necessary.

To unregister a Win32 Event so that it will no longer be signalled, an application calls [ADMXRC3_UnregisterWin32Event](#) using the same device handle that was used to register it. Attempting to unregister a Win32 Event using a different device handle to the one used to register it will fail.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle, or the hEvent parameter is not a valid Win32 Event handle.
ADMXRC3_INVALID_INDEX	The notification parameter specifies a type of notification that the API does not recognize.
ADMXRC3_NO_MEMORY	Memory could not be allocated for keeping track of the registered Win32 Event.

Remarks

When a notification is delivered, a Win32 Event registered for that notification is signalled regardless of whether or not it is already in a signalled state.

There is no queuing or counting of notifications in the ADMXRC3 API. A notification that occurs when there is no Win32 Event registered for it is lost. If a second notification is delivered via a Win32 Event before the application responds to the first notification, the application will see only one notification.

There are no restrictions on the parameters to the Win32 [CreateEvent](#) function when creating an event for use with [ADMXRC3_RegisterWin32Event](#).

The ADMXRC3 API automatically unregisters any Win32 Events when a device handle is closed. This can occur either because of call to [ADMXRC3_Close](#), or when a device handle is automatically closed by the operating system, as the result of a process terminating without cleaning up.

4.3.43 ADMXRC3_RegisterVxwSem

Declaration

```
ADMXRC3_STATUS
ADMXRC3_RegisterVxwSem(
    __in  ADMXRC3_HANDLE  hDevice,
    __in  uint32_t        notification,
    __in  SEM_ID          semId);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which the semaphore should be registered.

notification (in)

The type of notification for which the semaphore should be registered.

semId (in)

The ID of the VxWorks semaphore that is to be registered.

Description

This VxWorks-specific function registers a semaphore that is signalled whenever a certain event occurs within a device. The prototype for this function exists only for VxWorks; it is not defined for other operating systems.

The type of notification must be one of the following values:

- `ADMXRC3_EVENT_FPGAALERT(targetIndex)`
Notification of overtemperature alerts for a target FPGA, where 'targetIndex' is the index of the target FPGA.
- `ADMXRC3_EVENT_FPGA_INTERRUPT(targetIndex)`
Notification of interrupts generated by a target FPGA, where 'targetIndex' is the index of the target FPGA.

A VxWorks semaphore that is registered using this function is associated with the device handle used to register it. It is legal to register the same semaphore with several different devices, although the application will not be able to determine why the semaphore was signalled unless it checks each device in some application-specific manner. Multiple semaphores may be registered with the same device handle for the same notification type, if necessary.

To unregister a semaphore so that it will no longer be signalled, an application calls `ADMXRC3_UnregisterVxwSem` using the same device handle that was used to register it. Attempting to unregister a semaphore using a different device handle to the one used to register it will fail.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter was not a valid device handle, or the <code>semId</code> parameter is not a valid VxWorks semaphore ID.
<code>ADMXRC3_INVALID_INDEX</code>	The notification parameter specifies a type of notification that the API does not recognize.
<code>ADMXRC3_NO_MEMORY</code>	Memory could not be allocated for keeping track of the registered VxWorks semaphore.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

When a notification is delivered, a semaphore registered for that notification is signalled regardless of whether or not it is already in a signalled state.

There is no queuing or counting of notifications in the ADMXRC3 API. A notification that occurs when there is no semaphore registered for it is lost. If a second notification is delivered via a semaphore before the application responds to the first notification, the application will see only one notification unless a counting semaphore is used.

There are no restrictions on the type of VxWorks semaphore (binary, counting etc.) when creating a semaphore for use with `ADMXRC3_RegisterVxwSem`.

The ADMXRC3 API automatically unregisters any semaphores when a device handle is closed.

4.3.44 ADMXRC3_SetClockFrequency

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_SetClockFrequency(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    unsigned int    clockIndex,  
    __in    uint32_t        flags,  
    __in    double          frequency,  
    __out   double*         pActualFrequency);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the clock generator of interest.

clockIndex (in)

Specifies which clock generator within the device is of interest. This is a zero-based index that must be less than the **NumClockGen** member of **ADMXRC3_CARD_INFOEX**.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_SETCLOCK_TESTONLY**
Causes the actual frequency to be calculated, but does not actually program the hardware.
- **ADMXRC3_SETCLOCK_MAXIMUM**
Causes the algorithm that generates the programming information for the clock generator to return an actual frequency that is not greater than the requested frequency.
- **ADMXRC3_SETCLOCK_MINIMUM**
Causes the algorithm that generates the programming information for the clock generator to return an actual frequency that is not less than the requested frequency.

frequency (in)

Specifies the requested frequency, in Hz.

pActualFrequency (out)

Points to an object of type **double** in which to return the actual frequency (in Hz) that is (or would be) programmed into the clock generator. This parameter may be NULL if an application does not require the actual programmed frequency.

Description

This function programs a clock generator in a device to output a clock signal at a specified frequency.

Clock generator chips are typically implemented as a phase-locked loop with programmable division and multiplication factors. This means that a clock generator does not have a continuous frequency range, but is capable generating a large number of discrete frequencies. Thus **ADMXRC3_SetClockFrequency** returns the achievable frequency that is closest to the requested frequency.

The ADMXRC3_SETCLOCK_TESTONLY flag can be passed when an application wishes to determine how close the actual frequency will be to the requested frequency, before actually programming the hardware. It causes the function to return without actually programming the hardware.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while programming the clock generator.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_FREQUENCY	The requested frequency could not be programmed. See remarks below.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The clockIndex parameter specifies a nonexistent clock generator.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the clock programming operation.

Remarks

Depending on the model, this function may take up 50 milliseconds to execute, as some clock generator chips require a significant length of time to lock to the new frequency. During the transition period, the clock signal does not exhibit discontinuities or glitches.

Passing both the ADMXRC3_SETCLOCK_MAXIMUM and ADMXRC3_SETCLOCK_MINIMUM flags together means that if the clock generator cannot generate the exact requested frequency, it returns an error.

If the function returns ADMXRC3_INVALID_FREQUENCY, it may be because the flags were too restrictive (e.g. ADMXRC3_SETCLOCK_MINIMUM and ADMXRC3_SETCLOCK_MAXIMUM passed together, requiring the frequency to be "exact"), or because the requested frequency is too high or low for the clock generator in question.

4.3.45 ADMXRC3_StartNotificationWait

Declaration

```
ADMXRC3_STATUS
ADMXRC3_StartNotificationWait(
    __in ADMXRC3_HANDLE hDevice,
    __in ADMXRC3_TICKET pTicket,
    __in uint32_t notification);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which to perform the wait.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

notification (in)

The type of notification for which to wait.

Description

This function begins a non-blocking operation that waits for a notification from a device. The type of notification must be one of the following values:

- `ADMXRC3_EVENT_FPGAALERT(targetIndex)`
Notification of overtemperature alerts for a target FPGA, where 'targetIndex' is the index of the target FPGA.
- `ADMXRC3_EVENT_FPGAINTERRUPT(targetIndex)`
Notification of interrupts generated by a target FPGA, where 'targetIndex' is the index of the target FPGA.

The counterpart to this function is [ADMXRC3_FinishNotificationWait](#), which finishes the non-blocking operation. Every call to [ADMXRC3_StartNotificationWait](#) that succeeds (i.e. returns `ADMXRC3_PENDING`) must be finished with a call to [ADMXRC3_FinishNotificationWait](#).

Return Value

A value of `ADMXRC3_PENDING` indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter was not a valid device handle.
<code>ADMXRC3_INVALID_INDEX</code>	The notification parameter specifies a type of notification that the API does not recognize.
<code>ADMXRC3_NO_MEMORY</code>	A control block could not be allocated for keeping track of the notification wait operation.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later, and provides a mechanism that is broadly equivalent to [ADMXRC3_RegisterWin32Event](#) or [ADMXRC3_RegisterVxwSem](#), except that instead of registering a wait object with the API, it is a direct-call mechanism.

There is no queuing of notifications. If some event occurs in a device and no thread is waiting for that notification, the event is lost.

4.3.46 ADMXRC3_StartReadDMA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartReadDMA(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    ADMXRC3_TICKET pTicket,  
    __in    unsigned int    dmaChannel,  
    __in    uint32_t        flags,  
    __out   void*           pBuffer,  
    __in    size_t          length,  
    __in    uint32_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (out)

Points to the buffer that is to receive the data read from the device.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_ReadDMA](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queuing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, [ADMXRC3_StartReadDMALocked](#) may be more appropriate than [ADMXRC3_StartReadDMA](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.47 ADMXRC3_StartReadDMABus

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartReadDMABus(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in uint64_t busAddress,  
    __in size_t length,  
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

busAddress (in)

The starting bus address at which data read from the device is stored.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function is intended for scenarios where data must be transferred directly between two peers on a bus, where at least one of the devices is a Gen 3 reconfigurable computing device. It reads a block of data from a device, starting at the specified local address, and writes it beginning at the specified bus address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.3, "DMA transfers with peer devices"](#).

This is the non-blocking version of [ADMXRC3_ReadDMABus](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Unlike [ADMXRC3_StartReadDMA](#) and [ADMXRC3_StartReadDMAEx](#), this function does not lock anything into memory because the data is read directly from the device specified by **hDevice** and written to the bus address specified by **busAddress**. Thus, in some CPU architectures and platforms, there can be significantly less overhead in calling [ADMXRC3_StartReadDMABus](#) compared to [ADMXRC3_StartReadDMA](#) or [ADMXRC3_StartReadDMAEx](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.4.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

The way in which the **busAddress** parameter is interpreted depends upon the I/O bus standard used by the device specified by **hDevice**. For example, if **hDevice** refers to an ADM-XRC-6T1, which has a PCI Express host interface, **busAddress** is a PCI Express memory space address.

In models that have a PCI Express host interface, it is not possible to determine when no PCI Express endpoint claims the address specified by **busAddress**. This is because PCI Express does not provide a standard mechanism for this type of error to be reported to the bus master. In such cases, the data that was read from the device is silently discarded and (assuming no other detectable errors occur) the return value from **ADMXRC3_FinishDMA** is **ADMXRC3_SUCCESS**.

4.3.48 ADMXRC3_StartReadDMAEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartReadDMAEx(  
    __in     ADMXRC3_HANDLE  hDevice,  
    __in     ADMXRC3_TICKET pTicket,  
    __in     unsigned int    dmaChannel,  
    __in     uint32_t        flags,  
    __out    void*           pBuffer,  
    __in     size_t          length,  
    __in     uint64_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (out)

Points to the buffer that is to receive the data read from the device.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_ReadDMAEx](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, [ADMXRC3_StartReadDMALockedEx](#) may be more appropriate than [ADMXRC3_StartReadDMAEx](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.2.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.49 ADMXRC3_StartReadDMALocked

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartReadDMALocked(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in ADMXRC3_BUFFER_HANDLE hBuffer,  
    __in size_t offset,  
    __in size_t length,  
    __in uint32_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer where data read from the device should be placed.

offset (in)

Offset into the locked buffer where data read from the device should be placed.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a locked buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_ReadDMALocked](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_StartReadDMALocked](#) has less overhead than [ADMXRC3_StartReadDMA](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.50 ADMXRC3_StartReadDMALockedEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartReadDMALockedEx(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in ADMXRC3_BUFFER_HANDLE hBuffer,  
    __in size_t offset,  
    __in size_t length,  
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer where data read from the device should be placed.

offset (in)

Offset into the locked buffer where data read from the device should be placed.

length (in)

Number of bytes to read from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin reading.

Description

This function reads a block of data from a device into a locked buffer, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_ReadDMALockedEx](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_StartReadDMALockedEx](#) has less overhead than [ADMXRC3_StartReadDMAEx](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.51 ADMXRC3_StartWriteDMA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartWriteDMA(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    ADMXRC3_TICKET pTicket,  
    __in    unsigned int    dmaChannel,  
    __in    uint32_t        flags,  
    __in    const void*     pBuffer,  
    __in    size_t          length,  
    __in    uint32_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (in)

Points to the buffer that contains data to write to the device.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_WriteDMA](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, [ADMXRC3_StartWriteDMALocked](#) may be more appropriate than [ADMXRC3_StartWriteDMA](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.52 ADMXRC3_StartWriteDMABus

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartWriteDMABus(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in uint64_t busAddress,  
    __in size_t length,  
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

busAddress (in)

The starting bus address from which data is read.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function is intended for scenarios where data must be transferred directly between two peers on a bus, where at least one of the devices is a Gen 3 reconfigurable computing device. It reads a block of data, starting at the specified bus address, and writes it to the specified device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.3, "DMA transfers with peer devices"](#).

This is the non-blocking version of [ADMXRC3_WriteDMABus](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Unlike [ADMXRC3_StartWriteDMA](#) and [ADMXRC3_StartWriteDMAEx](#), this function does not lock anything into memory because the data is read directly from the bus address specified by **busAddress** and written to the device specified by **hDevice**. Thus, in some CPU architectures and platforms, there can be significantly less overhead in calling [ADMXRC3_StartWriteDMABus](#) compared to [ADMXRC3_StartWriteDMA](#) or [ADMXRC3_StartWriteDMAEx](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.4.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

The way in which the **busAddress** parameter is interpreted depends upon the I/O bus standard used by the device specified by **hDevice**. For example, if **hDevice** refers to an ADM-XRC-6T1, which has a PCI Express host interface, **busAddress** is a PCI Express memory space address.

When no PCI Express endpoint claims the address specified by **busAddress**, the DMA engine will not receive any data and will time out within a few tens of microseconds of beginning the DMA transfer. In such cases, the return value from **ADMXRC3_FinishDMA** is **ADMXRC3_HARDWARE_ERROR**.

4.3.53 ADMXRC3_StartWriteDMAEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartWriteDMAEx(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    ADMXRC3_TICKET pTicket,  
    __in    unsigned int    dmaChannel,  
    __in    uint32_t        flags,  
    __in    const void*     pBuffer,  
    __in    size_t          length,  
    __in    uint64_t        localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (in)

Points to the buffer that contains data to write to the device.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_WriteDMAEx](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, [ADMXRC3_StartWriteDMALockedEx](#) may be more appropriate than [ADMXRC3_StartWriteDMAEx](#).

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.2.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.54 ADMXRC3_StartWriteDMALocked

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartWriteDMALocked(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in ADMXRC3_BUFFER_HANDLE hBuffer,  
    __in size_t offset,  
    __in size_t length,  
    __in uint32_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer that contains the data to be written to the device.

offset (in)

Offset into the locked buffer where the data to be written to the device is located.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a locked buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_WriteDMALocked](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_StartWriteDMALocked](#) has less overhead than [ADMXRC3_StartWriteDMA](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.55 ADMXRC3_StartWriteDMALockedEx

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_StartWriteDMALockedEx(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_TICKET pTicket,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in ADMXRC3_BUFFER_HANDLE hBuffer,  
    __in size_t offset,  
    __in size_t length,  
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

pTicket (in)

A ticket used to keep track of the non-blocking operation.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer that contains the data to be written to the device.

offset (in)

Offset into the locked buffer where the data to be written to the device is located.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a locked buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

This is the non-blocking version of [ADMXRC3_WriteDMALockedEx](#), and the pTicket parameter must follow the rules laid out in [Section 3.3, "Non-blocking operations"](#). To finish the non-blocking operation and determine the success or failure of the DMA transfer, call [ADMXRC3_FinishDMA](#).

DMA transfers are subject to a queuing mechanism unless the ADMXRC3_DMA_DONOTQUEUE flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_StartWriteDMALockedEx](#) has less overhead than [ADMXRC3_StartWriteDMAEx](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of ADMXRC3_PENDING indicates that the function executed successfully and that a non-blocking operation was started. Otherwise, if an error occurs, a non-blocking operation was not started and the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.56 ADMXRC3_SyncFlash

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_SyncFlash(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int flashIndex,  
    __in uint32_t flags);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device containing the Flash memory bank to be synchronized.

flashIndex (in)

Specifies which Flash memory bank in the device is to be synchronized.

flags (in)

Flags that modify how the operation is performed. Currently there are no flags defined, so this parameter must be zero.

Description

This function ensures that the cache for a Flash memory bank is "clean" before returning. Applications can call it to ensure that write or erase operations have been committed to the hardware. The caching mechanism for Flash memory banks is described in [Section 3.8.5.1, "Flash memory caching"](#).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while synchronizing the Flash memory bank.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter specifies a nonexistent Flash memory bank.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the Flash synchronization operation.

Remarks

For Flash memory banks that use chips with a block-oriented architecture, calling this function may result in noticeable delays in execution, because some Flash chips have noticeable block erase and programming periods.

4.3.57 ADMXRC3_Unconfigure

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_Unconfigure(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int flashIndex,  
    __in uint32_t flags);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device containing the target FPGA of interest.

flashIndex (in)

Specifies which target FPGA within a device is of interest.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- ADMXRC3_CONFIGURE_PARTIAL
Causes the target FPGA not to be unconfigured.
- ADMXRC3_CONFIGURE_SHARE
Causes ownership to be unchanged.

Description

This function unconfigures a target FPGA and/or relinquishes ownership.

Passing the ADMXRC3_CONFIGURE_PARTIAL flag causes an unconfiguration sequence, as described in [Section 3.8.1.3, "Unconfiguration"](#), not to be performed on the target FPGA.

Passing the ADMXRC3_CONFIGURE_SHARE flag causes the target FPGA's ownership state to be unchanged.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	Unconfiguring the target FPGA was not successful. See remarks below.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter is not a valid device handle.
ADMXRC3_INVALID_INDEX	The targetIndex parameter is out of range.
ADMXRC3_NOT_OWNER	The specified device handle is not the owner of the target FPGA.

Remarks

Passing only the ADMXRC3_CONFIGURE_PARTIAL flag is how a device handle can relinquish ownership of a target FPGA without unconfiguring it.

Passing only the ADMXRC3_CONFIGURE_SHARE flag is how a device handle can unconfigure a target FPGA without relinquishing ownership.

Passing both the ADMXRC3_CONFIGURE_PARTIAL and ADMXRC3_CONFIGURE_SHARE flags is legal but results in a no-operation.

If the function returns ADMXRC3_HARDWARE_ERROR, the target FPGA will be in an indeterminate state (may or may not be configured).

4.3.58 ADMXRC3_UnloadBitstreamA

Declaration

```
ADMXRC3_STATUS
ADMXRC3_UnloadBitstreamA(
    __inout ADMXRC3_BITSTREAMA* pBitstream);
```

The parameters of this function are as follows:

pBitstream (inout)

Points to the object of type [ADMXRC3_BITSTREAMA](#) that is to be freed.

Description

This function unloads a bitstream (.BIT) file, freeing the memory used by it. It is the inverse of [ADMXRC3_LoadBitstreamA](#).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_NULL_POINTER	The pBitstream parameter was a NULL pointer.

Remarks

This is the ANSI / UTF-8 version of [ADMXRC3_UnloadBitstream](#). [ADMXRC3_UnloadBitstream](#) is actually a macro defined to be either [ADMXRC3_UnloadBitstreamW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_UnloadBitstreamA](#).

This function must be used to deallocate an object of type [ADMXRC3_BITSTREAMA](#), rather than `free`. In Windows, attempting to use `free` results in heap corruption because memory must be freed using the same heap that was used to allocate it.

4.3.59 ADMXRC3_UnloadBitstreamW

Declaration

```
ADMXRC3_STATUS
ADMXRC3_UnloadBitstreamW(
    _inout ADMXRC3_BITSTREAMW* pBitstream);
```

The parameters of this function are as follows:

pBitstream (inout)

Points to the object of type [ADMXRC3_BITSTREAMW](#) that is to be freed.

Description

This function unloads a bitstream (.BIT) file, freeing the memory used by it. It is the inverse of [ADMXRC3_LoadBitstreamW](#).

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_NULL_POINTER	The pBitstream parameter was a NULL pointer.

Remarks

This is the ANSI / UTF-8 version of [ADMXRC3_UnloadBitstream](#). [ADMXRC3_UnloadBitstream](#) is actually a macro defined to be either [ADMXRC3_UnloadBitstreamW](#) if the `_UNICODE` preprocessor symbol is defined, or else [ADMXRC3_UnloadBitstreamA](#).

This function must be used to deallocate an object of type [ADMXRC3_BITSTREAMW](#), rather than `free`. In Windows, attempting to use `free` results in heap corruption because memory must be freed using the same heap that was used to allocate it.

4.3.60 ADMXRC3_Unlock

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_Unlock(  
    __in ADMXRC3_HANDLE hDevice,  
    __in ADMXRC3_BUFFER_HANDLE hBuffer);
```

The parameters of this function are as follows:

hDevice (in)

The device handle that was used to create the locked buffer.

hBuffer (in)

Identifies the locked buffer that is to be unlocked.

Description

This function unlocks a locked user-space buffer so that the operating system can again swap it out to backing store. An application should assume that an operating system may begin swapping the buffer out as soon as this function is called. [ADMXRC3_Unlock](#) is the inverse of [ADMXRC3_Lock](#).

[ADMXRC3_BUFFER_HANDLE](#) values are global to the system. However, every buffer handle has an owner, which is the device handle that was used to create it. Only the device handle used to lock a buffer can be used to successfully call [ADMXRC3_Unlock](#).

A user-space buffer can be locked multiple times if necessary. If a user-space buffer is locked several times, yielding several buffer handles, it will only become swappable once more after every one of the locked buffer handles has been passed to [ADMXRC3_Unlock](#).

Return Value

A value of [ADMXRC3_SUCCESS](#) indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_BUFFER_INVALID_HANDLE	The hBuffer parameter was not a valid handle to a locked buffer.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_NOT_OWNER	The locked buffer was created using a different device handle.

Remarks

In order to avoid potential system memory corruption due to a badly behaved application, locked buffers have a reference counting mechanism. A locked user-space buffer begins with a reference count of 1. Calling [ADMXRC3_Unlock](#) invalidates the buffer handle and decrements the reference count. Each DMA transfer performed using the buffer increments the reference count when it begins and decrements the reference count when complete. When the reference count reaches zero, the user-space buffer is made swappable again. Thus, while a DMA transfer is in progress on a buffer, that buffer is not swappable, even if [ADMXRC3_Unlock](#) is called during the DMA transfer.

Locking is implemented with a page granularity by the operating system, where each user-space page has a lock count. Therefore, to be precise, this function iterates through each page of the user-space buffer and decrements its lock count by 1. The implication of this is that any part of a user-space buffer can be locked multiple times, regardless of whether or not those parts are disjoint or overlapping. As long as there are matching calls to [ADMXRC3_Unlock](#), the lock counts of all pages eventually return to 0.

4.3.61 ADMXRC3_UnmapWindow

Declaration

```
ADMXRC3_STATUS
ADMXRC3_UnmapWindow(
    __in ADMXRC3_HANDLE hDevice,
    __in void* pVirtualBase);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the window of interest.

pVirtualBase (in)

The base virtual address of a region that was mapped using [ADMXRC3_MapWindow](#).

Description

This function unmaps a region of a memory window from the caller's address space, and is the inverse of [ADMXRC3_MapWindow](#). An application must consider the region that pVirtualBase points to invalid as soon as this function is called.

Partially unmapping a region is not possible, so the pVirtualBase parameter must be the value previously returned by [ADMXRC3_MapWindow](#), and cannot be offset by some amount.

If an application terminates without unmapping any regions that it mapped, automatic cleanup is performed by the operating system (except in VxWorks).

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_REGION	The pVirtualBase parameter is recognized as the base address of a mapped region of device memory.
ADMXRC3_NULL_POINTER	The pVirtualBase was a NULL pointer.

Remarks

In VxWorks, this function is a essentially a no-operation, as VxWorks typically has a single global address space shared by the kernel and tasks alike.

4.3.62 ADMXRC3_UnregisterWin32Event

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_UnregisterWin32Event(  
    __in ADMXRC3_HANDLE hDevice,  
    __in uint32_t notification,  
    __in HANDLE hEvent);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which the Win32 Event should no longer be registered.

notification (in)

The type of notification for which the Win32 Event should no longer be registered.

hEvent (in)

The handle to the Win32 Event that is to be unregistered.

Description

This Windows-specific function unregisters a Win32 Event that was previously registered using [ADMXRC3_RegisterWin32Event](#). The prototype for this function exists only for Windows; it is not defined for other operating systems.

The type of notification must be one of the following values:

- `ADMXRC3_EVENT_FPGAALERT(targetIndex)`
Notification of overtemperature alerts for a target FPGA, where 'targetIndex' is the index of the target FPGA.
- `ADMXRC3_EVENT_FPGAINTERRUPT(targetIndex)`
Notification of interrupts generated by a target FPGA, where 'targetIndex' is the index of the target FPGA.

Unregistering a Win32 Event fails if the Win32 Event is not currently registered for the specified notification for the specified device handle.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter was not a valid device handle, or the <code>hEvent</code> was not recognized as a valid Win32 Event registered with the specified device handle.
<code>ADMXRC3_INVALID_INDEX</code>	The notification parameter specifies a type of notification that the API does not recognize.

Remarks

The ADMXRC3 API automatically unregisters any Win32 Events when a device handle is closed. This can occur either because of call to [ADMXRC3_Close](#), or when a device handle is automatically closed by the operating system, as the result of a process terminating without cleaning up.

4.3.63 ADMXRC3_UnregisterVxwSem

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_UnregisterVxwSem(  
    __in    ADMXRC3_HANDLE  hDevice,  
    __in    uint32_t        notification,  
    __in    SEM_ID         semId);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device for which the semaphore should no longer be registered.

notification (in)

The type of notification for which the semaphore should no longer be registered.

semId (in)

Identifies the semaphore that is to be unregistered.

Description

This VxWorks-specific function unregisters a VxWorks semaphore that was previously registered using [ADMXRC3_RegisterVxwSem](#). The prototype for this function exists only for VxWorks; it is not defined for other operating systems.

The type of notification must be one of the following values:

- `ADMXRC3_EVENT_FPGAALERT(targetIndex)`
Notification of overtemperature alerts for a target FPGA, where 'targetIndex' is the index of the target FPGA.
- `ADMXRC3_EVENT_FPGAINTERRUPT(targetIndex)`
Notification of interrupts generated by a target FPGA, where 'targetIndex' is the index of the target FPGA.

Unregistering a semaphore fails if the semaphore is not currently registered for the specified notification type for the specified device handle.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle, or the semId parameter was not recognized as a valid VxWorks semaphore registered with the specified device handle.
ADMXRC3_INVALID_INDEX	The notification parameter specifies a type of notification that the API does not recognize.

Remarks

This function is available in ADMXRC3 API version 1.1.0 and later.

The ADMXRC3 API automatically unregisters any semaphores when a device handle is closed.

4.3.64 ADMXRC3_Write

Declaration

```
ADMXRC3_STATUS
ADMXRC3_Write(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int   windowIndex,
    __in uint32_t       flags,
    __in size_t         offset,
    __in size_t         length,
    __in const void*    pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device that contains the window to be written.

windowIndex (in)

Identifies the window within the device to be written.

flags (in)

Flags that modify the behavior of the function. There are no flags currently defined, and so this parameter must be zero.

offset (in)

The byte offset into the window at which writing is to begin.

length (in)

The number of bytes to write.

pBuffer (in)

Points to the buffer containing the data to be written to the window.

Description

This function writes data from a buffer to a memory window in a device, starting at the specified offset within the window. The data transfer is performed by the CPU, and is therefore CPU intensive for large blocks of data.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
<code>ADMXRC3_ACCESS_DENIED</code>	The device handle was opened with insufficient privileges for modifying device state.
<code>ADMXRC3_INVALID_BUFFER</code>	The <code>pBuffer</code> and <code>length</code> parameters represent a buffer that is not valid in the caller's address space.
<code>ADMXRC3_INVALID_FLAG</code>	The <code>flags</code> parameter contains an unrecognized flag.
<code>ADMXRC3_INVALID_HANDLE</code>	The <code>hDevice</code> parameter was not a valid device handle.
<code>ADMXRC3_INVALID_INDEX</code>	The <code>windowIndex</code> parameter specifies a nonexistent window.
<code>ADMXRC3_INVALID_REGION</code>	The <code>offset</code> and <code>length</code> parameters specify an invalid region of the specified window.

Remarks

Calling `ADMXRC3_Write` incurs a certain overhead, but is acceptable for tasks that are not performance-critical, such as writing to registers during initialization of an application. As described in [Section 3.8.2.1, "Mapping memory windows into user-space"](#), mapping a memory window into the caller's address space and using pointer dereferencing is generally faster when many register writes must be performed.

For large blocks of data, consider using DMA transfers, as described in [Section 3.8.3.2, "DMA transfers with host memory"](#).

If this function is used to write data to a target FPGA, the FPGA design must be able to cope with arbitrary byte enables being presented during writes. Side-effects during writes are allowed, but should always be qualified by byte enables. This is because the operand size used for store instructions in the data copying routines used by the ADMXRC3 API may vary depending upon CPU architecture, buffer alignment, etc. and even upon timing.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.65 ADMXRC3_WriteDMA

Declaration

```
ADMXRC3_STATUS  
ADMXRC3_WriteDMA(  
    __in ADMXRC3_HANDLE hDevice,  
    __in unsigned int dmaChannel,  
    __in uint32_t flags,  
    __in const void* pBuffer,  
    __in size_t length,  
    __in uint32_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (in)

Points to the buffer that contains the data to write to the device.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, **ADMXRC3_WriteDMALocked** may be more appropriate than **ADMXRC3_WriteDMA**.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function does not perform any endian-conversion on the data. Refer to **Section 3.6, "Endian issues"** for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.66 ADMXRC3_WriteDMABus

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteDMABus(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in uint64_t busAddress,
    __in size_t length,
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

busAddress (in)

The starting bus address from which data is read.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function is intended for scenarios where data must be transferred directly between two peers on a bus, where at least one of the devices is a Gen 3 reconfigurable computing device. It reads a block of data, starting at the specified bus address, and writes it to the specified device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.3, "DMA transfers with peer devices"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Unlike [ADMXRC3_WriteDMA](#) and [ADMXRC3_WriteDMAEx](#), this function does not lock anything into memory because the data is read directly from the bus address specified by **busAddress** and written to the the device specified by **hDevice**. Thus, in some CPU architectures and platforms, there can be significantly less overhead in calling [ADMXRC3_WriteDMA](#) compared to [ADMXRC3_WriteDMA](#) or [ADMXRC3_WriteDMAEx](#).

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.4.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

The way in which the **busAddress** parameter is interpreted depends upon the I/O bus standard used by the device specified by **hDevice**. For example, if **hDevice** refers to an ADM-XRC-6T1, which has a PCI Express host interface, **busAddress** is a PCI Express memory space address.

When no PCI Express endpoint claims the address specified by **busAddress**, the DMA engine will not receive any data and will time out within a few tens of microseconds of beginning the DMA transfer. In such cases, the return value is **ADMXRC3_HARDWARE_ERROR**.

4.3.67 ADMXRC3_WriteDMAEx

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteDMAEx(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in const void* pBuffer,
    __in size_t length,
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

pBuffer (in)

Points to the buffer that contains the data to write to the device.

length (in)

Number of bytes to write to the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from buffer into a device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

Because buffers in user-space may be wholly or partially swapped out to backing store at any time in most operating systems, this function locks the buffer into physical memory before starting the DMA transfer proper. When the DMA transfer is finished, the buffer is unlocked and made swappable again. Locking and unlocking a user-space buffer incurs a certain overhead, so for performance-critical applications, **ADMXRC3_WriteDMALockedEx** may be more appropriate than **ADMXRC3_WriteDMAEx**.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

This function is available in ADMXRC3 API version 1.2.0 and later.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.68 ADMXRC3_WriteDMALocked

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteDMALocked(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in ADMXRC3_BUFFER_HANDLE pBuffer,
    __in size_t offset,
    __in size_t length,
    __in uint32_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer that contains the data to be written to the device.

offset (in)

Offset into the locked buffer where the data to be written to the device is located.

length (in)

Number of bytes to write from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a locked buffer into device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the `ADMXRC3_DMA_DONOTQUEUE` flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_WriteDMALocked](#) has less overhead than [ADMXRC3_WriteDMA](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.69 ADMXRC3_WriteDMALockedEx

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteDMALockedEx(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int dmaChannel,
    __in uint32_t flags,
    __in ADMXRC3_BUFFER_HANDLE hBuffer,
    __in size_t offset,
    __in size_t length,
    __in uint64_t localAddress);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device to perform the DMA transfer.

dmaChannel (in)

Specifies which DMA channel in the device is to be used to perform the DMA transfer.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_DMA_FIXEDLOCAL**
Causes the local address to be held constant throughout the entire DMA transfer.
- **ADMXRC3_DMA_DONOTQUEUE**
Causes the function to return an error immediately, rather than wait in a queue, if the DMA transfer cannot be started immediately due to another DMA transfer ongoing on the same DMA channel.

hBuffer (in)

Handle to the locked buffer that contains the data to be written to the device.

offset (in)

Offset into the locked buffer where the data to be written to the device is located.

length (in)

Number of bytes to write from the device.

localAddress (in)

The local address (in bytes) in the device at which to begin writing.

Description

This function writes a block of data from a locked buffer into device, starting at the specified local address. The data transfer is performed by a DMA engine within the device. DMA transfers in the ADMXRC3 API are described in general terms in [Section 3.8.3.2, "DMA transfers with host memory"](#).

DMA transfers are subject to a queuing mechanism unless the **ADMXRC3_DMA_DONOTQUEUE** flag is passed. This flag causes the function to give up immediately and return an error if it finds that another DMA transfer is in progress on the same DMA channel. The queuing mechanism is described in general terms in [Section 3.4, "Queueing"](#).

This function must be passed a handle to an already locked buffer, obtained by calling [ADMXRC3_Lock](#). [ADMXRC3_WriteDMALockedEx](#) has less overhead than [ADMXRC3_WriteDMAEx](#), since it does not need to lock anything in physical memory before starting the DMA transfer.

Return Value

A value of **ADMXRC3_SUCCESS** indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred during the DMA transfer.
ADMXRC3_INVALID_BUFFER_HANDLE	The hBuffer parameter is not a valid handle to a locked buffer.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The dmaChannel parameter specifies a nonexistent DMA channel.
ADMXRC3_INVALID_LOCAL_REGION	The localAddress and length parameters specify a region of local bus address space that is invalid.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the locked buffer.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the DMA transfer.

Remarks

Before starting DMA transfer in the hardware, this function increments the reference count of the locked buffer so that it cannot be inadvertently unlocked if a badly-behaved application calls [ADMXRC3_Unlock](#) before the DMA transfer finishes. When the DMA transfer finishes, the locked buffer's reference count is decremented.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.70 ADMXRC3_WriteFlash

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteFlash(
    __in ADMXRC3_HANDLE hDevice,
    __in unsigned int flashIndex,
    __in uint32_t flags,
    __in size_t address,
    __in size_t length,
    __in const void* pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device containing the Flash memory bank to be written.

flashIndex (in)

Specifies which Flash memory bank in the device is to be written.

flags (in)

Flags that modify how the operation is performed. Currently the following flags are defined, which may be bitwise ORed together:

- **ADMXRC3_FLASH_SYNC**
Causes the cache for the Flash memory bank to be synchronized with the hardware before the function returns. For a description of the caching mechanism, refer to [Section 3.8.5.1, "Flash memory caching"](#)

address (in)

The byte address in the Flash memory bank at which to begin writing.

length (in)

Number of bytes to write to the Flash memory bank.

pBuffer (in)

The buffer that contains the data to be written to the the Flash memory bank.

Description

This function writes a block of data from a buffer into a Flash memory bank in a device. The data transfer is performed by the CPU, so is CPU intensive for large blocks.

Depending on the model, not all locations in Flash memory bank may be writable using this function. This is required in order to prevent inadvertant corruption of VPD, firmware etc. on some models. To determine the region of a Flash memory bank that is modifiable, an application calls [ADMXRC3_GetFlashInfo](#). Attempts to modify any location outside of the modifiable region will fail.

The region of the Flash memory bank that is written, which is specified by the address and length parameters, can be of arbitrary alignment and does not (for example) need to be aligned to block boundaries. The region must be inside the user-programmable region, the bounds of which can be determined by calling [ADMXRC3_GetFlashInfo](#).

The ADMXRC3 API implements a caching mechanism for each Flash memory bank. Passing the `ADMXRC3_FLASH_SYNC` flag ensures that the cache for the specified Flash memory bank is synchronized with the hardware before the function returns. An alternative way of ensuring synchronization is to call [ADMXRC3_SyncFlash](#).

Return Value

A value of `ADMXRC3_SUCCESS` indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while writing to the Flash memory bank.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_INDEX	The flashIndex parameter specifies a nonexistent Flash memory bank.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the Flash memory bank.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the Flash write operation.

Remarks

Although the region specified by the address and length parameters need not bear any relationship to a Flash block boundaries, an application can call [ADMXRC3_GetFlashBlockInfo](#) in order to determine which block contains a particular address. An application can enumerate every block in a Flash memory bank by beginning at address 0 and repeatedly calling [ADMXRC3_GetFlashBlockInfo](#) until the end of the bank is reached.

For Flash memory banks that use chips with block-oriented architectures, calling this function may result in noticeable delays in execution because of the caching mechanism and block erase and programming delays.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

4.3.71 ADMXRC3_WriteVPD

Declaration

```
ADMXRC3_STATUS
ADMXRC3_WriteVPD(
    __in ADMXRC3_HANDLE hDevice,
    __in uint32_t flags,
    __in size_t offset,
    __in size_t length,
    __in const void* pBuffer);
```

The parameters of this function are as follows:

hDevice (in)

Identifies the device whose VPD is to be written.

flags (in)

Flags that modify how the operation is performed. Currently no flags are defined, so this parameter must be zero.

offset (in)

The byte offset into the VPD memory at which to begin writing.

length (in)

Number of bytes to write to the VPD memory.

pBuffer (in)

The buffer that contains the data to be written to the VPD memory.

Description

This function writes a block of Vital Product Data (VPD) to a device. The data transfer is performed by the CPU, so is CPU intensive for large blocks. For an overview, refer to [Section 3.8.6, "Vital Product Data"](#).

VPD memory area is normally read-only and protected by a write-protection mechanism. The VPD write-protection mechanism is operating-system dependent; refer to the release notes for the ADB3 driver specific to your operating system for details.

Return Value

A value of ADMXRC3_SUCCESS indicates that the function executed successfully. Otherwise, if an error occurs, the following values may be returned:

Return Value	Description
ADMXRC3_ACCESS_DENIED	The device handle was opened with insufficient privileges for modifying device state.
ADMXRC3_CANCELLED	During the operation, another thread called ADMXRC3_Cancel on the device handle, or the device handle was closed.
ADMXRC3_HARDWARE_ERROR	A hardware error occurred while writing to the VPD memory. This may indicate that the write-protection mechanism has not been disabled.
ADMXRC3_INVALID_BUFFER	The pBuffer and length parameters represent a buffer that is not valid in the caller's address space.
ADMXRC3_INVALID_FLAG	The flags parameter contains an unrecognized flag.
ADMXRC3_INVALID_HANDLE	The hDevice parameter was not a valid device handle.
ADMXRC3_INVALID_REGION	The offset and length parameters represent a region that exceeds the bounds of the VPD memory.
ADMXRC3_NO_MEMORY	A control block could not be allocated for keeping track of the VPD write operation.

Remarks

VPD may be stored in a Flash device, an EEPROM device, or something else, depending on the model. For some types of nonvolatile memory that have block-oriented architectures, calling this function may result in noticeable delays in execution due to block erase and block programming delays.

This function does not perform any endian-conversion on the data. Refer to [Section 3.6, "Endian issues"](#) for a discussion of how to make an application portable between big- and little-endian CPU architectures.

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Appendix A: Duplicating device handles

Most operating systems provide a means of duplicating a file handle. Windows has `DuplicateHandle`, whilst Linux and VxWorks have the `dup` and `dup2` system calls. These functions are not suitable as a means of duplicating a device handle of type `ADMXRC3_HANDLE`. The reason is that at the kernel level, a device driver is unable to distinguish between the duplicated handle and the original one. The following example illustrates this.

First, a Linux or VxWorks application opens a device using `ADMXRC3_Open`. After the call returns, the device handle can be envisaged as follows:

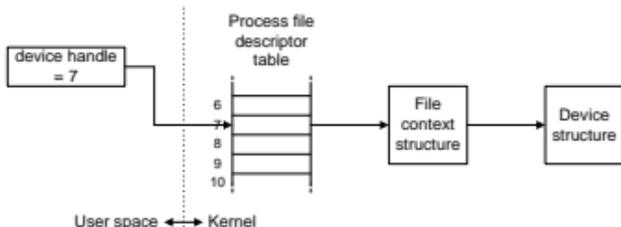


Figure 1: An open device handle

Next, the application duplicates the handle using `dup`. After the call returns, the device handles can be envisaged as follows:

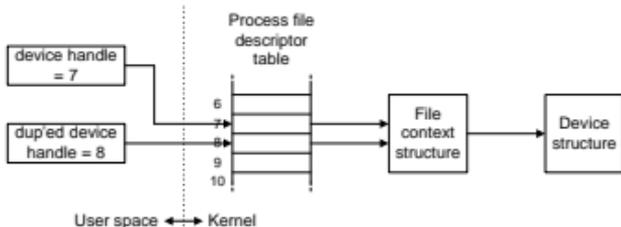


Figure 2: After duplicating a device handle

This should be contrasted with the result of calling `ADMXRC3_Open` again instead of `dup`:

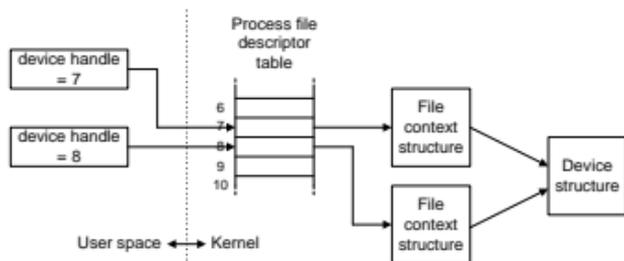


Figure 3: After opening a device twice

In Windows the terminology is different, but the same principle applies. The device driver maintains per-device-handle state in the file context structure, so it is essential for [ADMXRC3_Open](#) or [ADMXRC3_OpenEx](#) to be used in order for the driver to be able to distinguish between two device handles. This is important for non-blocking operations, as described in [Section 3.3, "Non-blocking operations"](#).

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Revision History:

Date	Revision	Nature of Change		
14/04/2010	1.0	Initial version.		
09/07/2010	1.1	General corrections and clarifications. Added commonly-encountered error codes for ADMXRC API functions. Documented changes in ADMXRC3 API version 1.1.0. Added subsection about string encoding issues and changed references to ASCII strings to ANSI / UTF-8. Corrected NumMemoryBank and NumTargetFpga shown in the wrong order in the section for ADMXRC3_CARD_INFO.		
21/09/2010	1.2	Added VxWorks-specific API functions ADMXRC3_RegisterVxwSem and ADMXRC3_UnregisterVxwSem Clarified information about linking VxWorks applications that use the ADMXRC3 API.		
04/03/2011	1.3	Added ADMXRC3_*DMA*Ex functions. Documented changes in ADMXRC3 API version 1.2.0. Corrected datatype for localAddress parameters of non-Ex DMA functions; was incorrectly documented as uint64_t but is actually uint32_t. Reorganized the sections about hardware features and added figures illustrating memory windows and methods of data transfer.		
24/06/2011	1.4	Documented changes in ADMXRC3 API version 1.3.0. Added new enum values for models ADM-XRC-6TGE and ADM-XRC-6T-ADV8. Added new value ADMXRC3_NOT_SUPPORTED for ADMXRC3_STATUS enumerated type.		
05/08/2011	1.5	Documented changes in ADMXRC3 API version 1.4.0: Added new API functions ADMXRC3_ReadDMABus	ADMXRC3_S-tartReadMABus	ADMXRC3_S-tartWriteDMABus and ADMXRC3_WriteDMABus. Added new flag ADMXRC3_FPGA_NOTCONFIGURABLE. Added new value ADMXRC3_UNIT_S to ADMXRC3_UNIT_TYPE enumerated type.

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