ADQAPI Reference Guide

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Worldwide Sales and Technical Support
www.teledyne-spdevices.com

SP Devices Corporate Headquarters
Teknikringen 6
SE-583 30 Linköping
Sweden
Phone: +46 (0)13 465 0600
Fax: +46 (0)13 991 3044
Email: info@spdevices.com

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1 Functions of the ADQAPI

The functions of the ADQAPI are categorized into three main sets.

**ADQAPI Specific Functions** Purely related to the API itself and not to the operation of digitizers.

**ADQControlUnit Functions** Interface with the device driver for tasks such as finding and initializing digitizers

**ADQ Functions** Interface directly with a specific digitizer

The functions of the ADQAPI may be called in a number of ways. Typically, they are interfaced as C-functions, but they may also be interfaced directly through a C++ class object. If running Windows, the functions may also be interfaced through a Matlab mex file or the .NET framework.

1.1 C-API

When interfacing the C-API, all functions other than the ADQControlUnit Functions and the ADQAPI Specific Functions are called by prepending the function name with 'ADQ_' and adding the previously created ADQ-ControlUnit and the unit ID as inputs. Below is a simple example of how to setup a unit and call the 'Blink' function using the C-API:

```c
void* adq_cu_ptr = CreateADQControlUnit(); // Creates an ADQControlUnit called adq_cu_ptr
if(adq_cu_ptr != NULL)
{
    int nof_devices = ADQControlUnit_FindDevices(); // Finds and starts all devices, also returns the number started
    if (nof_devices > 0)
    {
        ADQ_Blink(adq_cu_ptr, 1); // Blinks one of the LEDs for the device number 1 (the first started)
    }
}
DeleteADQControlUnit(ADQCU);
```

The C-API may be used from several programming languages (e.g. Python has excellent support for this), which makes it the most general.

1.2 Cpp-API

Once an ADQControlUnit is created and at least one unit has been found, the function ADQControlUnit_GetADQ may be used to return a pointer to a C++ class object that can be used to access all functions that operates on the unit. These functions are then called with the name and inputs listed later in the document. Below is a simple example of how to set up a unit and call the 'Blink' function using the C++-API:

```cpp
void* adq_cu_ptr = CreateADQControlUnit(); // Creates an ADQControlUnit called adq_cu_ptr
if(adq_cu_ptr != NULL)
{
    int nof_devices = ADQControlUnit_FindDevices(); // Finds and starts all devices, also returns the number started
    if (nof_devices > 0)
    {
        ADQInterface* ADQDevice = ADQControlUnit_GetADQ(adq_cu_ptr, 1); // Sends command to device number 1 (the first started)
        ADQDevice->Blink(); // Blinks one of the device LEDs
    }
}
DeleteADQControlUnit(ADQCU);
```

The ADQControlUnit Functions and the ADQAPI Specific Functions are always interfaced as C-API functions.
For the C++ API it is very important to assure that header files linked when building the application and the actually loaded DLL are of the exact same revision, otherwise corrupt behaviour may be the result. Typically incompatibility is due to installing a new API on the computer but forgetting to update to the new header files in the application development environment. This can be checked in code with the helper macro IS_VALID_DLL_REVISION:

```c
int apiRev = ADQAPI_GetRevision();
if (!IS_VALID_DLL_REVISION(apiRev))
{
    printf("ERROR: The linked header file and the loaded DLL are of different revisions. This may cause corrupt behavior.\n\n");
    return -1;
}
```

### 1.3 Matlab

For Windows, there is an interface that should feel familiar for Matlab users. This is implemented in the DLL named mex_ADQ.dll, which is installed with the other DLLs. For convenient interfacing, there is also a wrapper file called interface_ADQ.m.

### 1.4 dot-NET

For users of the .NET framework, the ADQAPI has been wrapped using SWIG. The wrapper DLLs are installed together with the Windows installer. In the .NET framework, the C-API functions are interfaced using a .NET class object. More information is found in the ADQAPI & .NET User's Guide.
2 ADQAPI Specific Functions

Enumerations

- enum ADQAPIObjectID {
  ADQAPI_OBJECT_RESERVED = 0,
  ADQAPI_OBJECT_ATD_WFA_STRUCT = 1,
  ADQAPI_OBJECT_ADQ_RECORD_HEADER = 2,
  ADQAPI_OBJECT_ADQ_INFO_LIST_ENTRY = 3,
  ADQAPI_OBJECT_ADQ_INFO_LIST_PRE_ALLO_ARRAY = 4,
  ADQAPI_OBJECT_SD_CARD_CONFIGURATION = 5,
  ADQAPI_OBJECT_ADQ_DAISY_CHAIN_TRIGGER_INFORMATION = 7,
  ADQAPI_OBJECT_ADQ_DAISY_CHAIN_DEVICE_INFORMATION = 8
}

Object IDs for ADQAPI_GetObjectSize()

Functions

- int ADQAPI_GetRevision ()
  Gets the ADQAPI revision.

- int ADQAPI_ValidateVersion (int major, int minor)
  Validate the struct definitions in the ADQAPI.

- void * CreateADQControlUnit ()
  Creates an ADQControlUnit.

- void DeleteADQControlUnit (void * adq_cu_ptr)
  Destroys and instance of ADQControlUnit.

- unsigned int ValidateDll ()
  Checks that a C++ application is compiled with the correct ADQAPI.h.

2.1 Detailed Description

Functions used for retrieving information about the ADQAPI and creating and deleting an ADQControlUnit, which is used to set up and control the ADQs.

2.2 Enumeration Type Documentation

2.2.1 ADQAPIObjectID

enum ADQAPIObjectID

Object IDs for ADQAPI_GetObjectSize()
2.3 Function Documentation

2.3.1 ADQAPI_GetRevision()

```c
int ADQAPI_GetRevision ( )
```

Gets the ADQAPI revision.

**Returns** The revision of the ADQAPI

2.3.2 ADQAPI_ValidateVersion()

```c
int ADQAPI_ValidateVersion ( int major,
                              int minor )
```

Validate the struct definitions in the ADQAPI.

This function allows an application to perform run-time validation of the struct definitions provided by the ADQAPI. An application should add a call to this function as:

```c
switch ( ADQAPI_ValidateVersion(ADQAPI_VERSION_MAJOR,
                                  ADQAPI_VERSION_MINOR) )
{
    case 0:
        // Compatible
        break;
    case -1:
        // Incompatible: the application needs to be recompiled and relinked
        // with the installed ADQAPI. This is equivalent to an error.
        return;
    case -2:
        // Backwards compatible: it’s recommended to recompile and relink the
        // application with the installed ADQAPI. This is equivalent to a warning.
        break;
}
```

This function call will be added to the binary with static arguments. If an application is ever executed on a system with an incompatible ADQAPI, this function will return an error and allow you to exit with a message informing the user that the application needs to be recompiled and relinked with the new ADQAPI.
Parameters

<table>
<thead>
<tr>
<th>major</th>
<th>The major version number. Should be set to ADQAPI_VERSION_MAJOR.</th>
</tr>
</thead>
<tbody>
<tr>
<td>minor</td>
<td>The minor version number. Should be set to ADQAPI_VERSION_MINOR.</td>
</tr>
</tbody>
</table>

Returns 0 if compatible, -1 if backwards compatible, -2 if incompatible.

### 2.3.3 CreateADQControlUnit()

```c
void* CreateADQControlUnit() {
    Creates an ADQControlUnit.
    Creates an instance of ADQControlUnit, that may be used to find and setup ADQ devices
    Returns A pointer to the ADQControlUnit
    Note Only call this function once for stable behaviour
    See also DeleteADQControlUnit()
}
```

### 2.3.4 DeleteADQControlUnit()

```c
void DeleteADQControlUnit( void * adq_cu_ptr ) {
    Destroys an instance of ADQControlUnit.
    Parameters
    |
    | adq_cu_ptr |
    | Pointer to the control unit that is to be destroyed |
    
    See also CreateADQControlUnit()
}
```

### 2.3.5 ValidateDll()

```c
unsigned int ValidateDll() {
    Checks that a C++ application is compiled with the correct ADQAPI.h.
    Only usable with the C++ API. Use one of the following macros to check the validity:
    VALIDATE_DLL(ADQInterface* p)
    Exits the application on failure
}
ISVALID_DLL(ADQInterface∗ p)
Returns 1 for valid dll and 0 otherwise

Returns 0x11AABEEF if no error was found

3 ADQControlUnit Functions

Data Structures

- struct ADQInfoListEntry
  Info list structure returned by ADQControlUnit_ListDevices(). More...
- struct ADQInfoListPreAlloArray
  Structure with list of ADQInfoListEntries for use with ADQControlUnit_ListDevices(). More...

Functions

- unsigned int ADQControlUnit_ClearLastFailedDeviceError (void ∗adq_cu_ptr)
  Clear last failed device error.
- void ADQControlUnit_DeleteADQ (void ∗adq_cu_ptr, int ADQ_num)
  Deletes an ADQ object.
- unsigned int ADQControlUnit_EnableErrorTrace (void ∗adq_cu_ptr, unsigned int trace_level, const char ∗trace_file_dir)
  Enables error logging to file.
- unsigned int ADQControlUnit_EnableErrorTraceAppend (void ∗adq_cu_ptr, unsigned int trace_level, const char ∗trace_file_dir)
  Enables error logging and appends to earlier file.
- int ADQControlUnit_EnableEthernetScan (void ∗adq_cu_ptr, int eth_scn)
  Enables Ethernet communication.
- int ADQControlUnit_FindDevices (void ∗adq_cu_ptr)
  Finds and starts all devices.
- ADQInterface × ADQControlUnit_GetADQ (void ∗adq_cu_ptr, int adq_num)
  Gets the pointer to a specific ADQ device.
- int ADQControlUnit_GetFailedDeviceCount (void ∗adq_cu_ptr)
  Gets the number of units that failed startup.
- unsigned int ADQControlUnit_GetLastFailedDeviceError (void ∗adq_cu_ptr)
  Get last failed device error.
- unsigned int ADQControlUnit_GetLastFailedDeviceErrorWithText (void ∗adq_cu_ptr, char ∗errstr)
  Get last failed device error (together with error code in clear textual form)
- unsigned int ADQControlUnit_ListDevices (void ∗adq_cu_ptr, struct ADQInfoListEntry ∗∗retList, unsigned int ∗retLen)
  Lists devices connected to the system.
- int ADQControlUnit_NoADQ (void *adq_cu_ptr)
  Gets the number of ADQs.
- int ADQControlUnit_NoADQ108 (void *adq_cu_ptr)
  Gets the number of ADQ108.
- int ADQControlUnit_NoADQ112 (void *adq_cu_ptr)
  Gets the number of ADQ112.
- int ADQControlUnit_NoADQ114 (void *adq_cu_ptr)
  Gets the number of ADQ114.
- int ADQControlUnit_NoADQ12 (void *adq_cu_ptr)
  Gets the number of ADQ12.
- int ADQControlUnit_NoADQ14 (void *adq_cu_ptr)
  Gets the number of ADQ14.
- int ADQControlUnit_NoADQ1600 (void *adq_cu_ptr)
  Gets the number of ADQ1600.
- int ADQControlUnit_NoADQ208 (void *adq_cu_ptr)
  Gets the number of ADQ208.
- int ADQControlUnit_NoADQ212 (void *adq_cu_ptr)
  Gets the number of ADQ212.
- int ADQControlUnit_NoADQ214 (void *adq_cu_ptr)
  Gets the number of ADQ214.
- int ADQControlUnit_NoADQ412 (void *adq_cu_ptr)
  Gets the number of ADQ412.
- int ADQControlUnit_NoADQ7 (void *adq_cu_ptr)
  Gets the number of ADQ7.
- int ADQControlUnit_NoADQ8 (void *adq_cu_ptr)
  Gets the number of ADQ8.
- int ADQControlUnit_NoADQDSP (void *adq_cu_ptr)
  Gets the number of ADQDSP.
- int ADQControlUnit_NoDSU (void *adq_cu_ptr)
  Gets the number of DSU.
- int ADQControlUnit_NoEV12AS350_EVM (void *adq_cu_ptr)
  Gets the number of EV12AS350_EVM.
- int ADQControlUnit_NoSDR14 (void *adq_cu_ptr)
  Gets the number of SDR14.
- int ADQControlUnit_NoSphinxAA (void *adq_cu_ptr)
  Gets the number of SphinxAA.
- unsigned int ADQControlUnit_OpenDeviceInterface (void *adq_cu_ptr, int ADQInfoListEntryNumber)
  Opens an interface to a specific device.
- unsigned int ADQControlUnit_ResetDevice (void *adq_cu_ptr, int ADQInfoListEntryNumber, int level)
- int ADQControlUnit_SetGeneralParameter (void *adq_cu_ptr, int param_index, int param_value)
  Sets general parameters.
- unsigned int ADQControlUnit_SetupDevice (void *adq_cu_ptr, int ADQInfoListEntryNumber)
- unsigned int ADQControlUnit_UserLogMessage (void *adq_cu_ptr, unsigned int trace_level, const char *message, ...)
  Used by the user to add custom log messages when using ADQAPI.
- unsigned int ADQControlUnit_UserLogMessageAtLine (void *adq_cu_ptr, unsigned int trace_level, const char *loc_file, const char *loc_func, const int loc_line, const char *message, ...)
  Used by the user to add custom log messages when using ADQAPI.

### 3.1 Detailed Description

These ADQControlUnit is used to find, setup, and delete devices objects.

### 3.2 Data Structure Documentation

#### 3.2.1 struct ADQInfoListEntry

Info list structure returned by ADQControlUnit_ListDevices().

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned int</td>
<td>AddressField1</td>
</tr>
<tr>
<td>unsigned int</td>
<td>AddressField2</td>
</tr>
<tr>
<td>char</td>
<td>DevFile[64]</td>
</tr>
<tr>
<td>unsigned int</td>
<td>DeviceInterfaceOpened</td>
</tr>
<tr>
<td>unsigned int</td>
<td>DeviceSetupCompleted</td>
</tr>
<tr>
<td>enum ADQHWIFEnum</td>
<td>HWIFType</td>
</tr>
<tr>
<td>enum ADQProductID_Enum</td>
<td>ProductID</td>
</tr>
<tr>
<td>unsigned int</td>
<td>VendorID</td>
</tr>
</tbody>
</table>

#### 3.2.2 struct ADQInfoListPreAlloArray

Structure with list of ADQInfoListEntries for use with ADQControlUnit_ListDevices().

```c
struct ADQInfoListEntry ADQlistArray[128]
```

### 3.3 Function Documentation
3.3.1 ADQControlUnit_ClearLastFailedDeviceError()

```c
unsigned int ADQControlUnit_ClearLastFailedDeviceError(
    void * adq_cu_ptr )
```

Clear last failed device error.

Parameters

- **adq_cu_ptr**: The ADQControlUnit instance

Returns 1 for successful operation and 0 for failure

See also ADQControlUnit_EnableErrorTrace(), ADQControlUnit_GetLastFailedDeviceError()

3.3.2 ADQControlUnit_DeleteADQ()

```c
void ADQControlUnit_DeleteADQ(
    void * adq_cu_ptr,
    int ADQ_num )
```

Deletes an ADQ object.

This function will rearrange the list of ADQ devices and a given number for an ADQ device will maybe no longer refer to the same object as before.

1 <= ADQ_num <= NofADQ

Parameters

- **adq_cu_ptr**: The ADQControlUnit instance
- **ADQ_num**: The number of the ADQ device to delete

Note: Uses 1-based index (reasons of legacy)

See also ADQControlUnit_FindDevices()

3.3.3 ADQControlUnit_EnableErrorTrace()

```c
unsigned int ADQControlUnit_EnableErrorTrace(
    void * adq_cu_ptr,
    unsigned int trace_level,
    const char * trace_file_dir )
```

Enables error logging to file.

Enables log file output from the connected devices and the ADQControlUnit. Each device opens a separate log file.
Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
<tr>
<td>trace_level</td>
<td>Trace level</td>
</tr>
<tr>
<td>trace_level = 0</td>
<td>No error logging</td>
</tr>
<tr>
<td>trace_level = 1</td>
<td>Error logging</td>
</tr>
<tr>
<td>trace_level = 2</td>
<td>Error and warnings logging</td>
</tr>
<tr>
<td>trace_level = 3</td>
<td>Error, warning, info logging</td>
</tr>
<tr>
<td></td>
<td>Additionally if bit 11 is set (e.g. by ORing 2048 with the trace_level), timestamping will be enabled in the log.</td>
</tr>
<tr>
<td>trace_file_dir</td>
<td>Path to the directory to put the log files in. If this path points to a file, all trace will be appended to that single file instead.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Note: Windows style directory separator `\` should be escaped by using `\` instead. Devices to get a single, non-conflicting log file as the result.

See also: ADQControlUnit_EnableErrorTraceAppend()

### 3.3.4 ADQControlUnit_EnableErrorTraceAppend()

```c
unsigned int ADQControlUnit_EnableErrorTraceAppend ( 
    void * adq_cu_ptr, 
    unsigned int trace_level, 
    const char * trace_file_dir )
```

Enables error logging and appends to earlier file.

Enables log file output from the connected devices and the ADQControlUnit. Each device opens a separate log file. The difference between this function and ADQControlUnit_EnableErrorTrace() is that this function appends the log outputs to any previously created log files.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>
### trace_level

Trace level

- `trace_level = 0`: No error logging
- `trace_level = 1`: Error logging
- `trace_level = 2`: Error and warnings logging
- `trace_level = 3`: Error, warning, info logging

Additionally if bit 11 is set (e.g. by ORing 2048 with the `trace_level`), timestamping will be enabled in the log.

### trace_file_dir

Path to the directory to put the log files in

Returns 1 for successful operation and 0 for failure

See also ADQControlUnit_EnableErrorTrace()

---

#### 3.3.5 ADQControlUnit_EnableEthernetScan()  

```c

int ADQControlUnit_EnableEthernetScan (  
    void * adq_cu_ptr,  
    int eth_scn )
```

Enables Ethernet communication.

`EnableEthernetScan()` enables lookup of ADQ units connected over Ethernet. Set to 1 to search for ADQ14, 2 to search for ADQ7 and 3 to search for ADQ12.

`EnableEthernetScan()` has to be run before the device listing functions, e.g. `ADQControlUnit_ListDevices()`, `ADQControlUnit_OpenDeviceInterface()`, `ADQControlUnit_SetupDevice()`

**Parameters**

- **adq_cu_ptr**
  
  The ADQControlUnit instance

- **eth_scn**

  Enable ethernet scan.
  
  - 0: Disable scan (default)
  - 1: Enable lookup of ADQ14
  - 2: Enable lookup of ADQ7
  - 3: Enable lookup of ADQ12

Returns Always returns 1

See also ADQControlUnit_ListDevices(), ADQControlUnit_OpenDeviceInterface(), ADQControlUnit_SetupDevice()
3.3.6 ADQControlUnit_FindDevices()

```c
int ADQControlUnit_FindDevices ( 
    void * adq_cu_ptr )
```

Finds and starts all devices.

Finds all ADQ units connected to the computer and creates/updates a list of all ADQs within the input ADQControlUnit. The order of the devices is determined by their USB bus addresses and/or their PXIe address.

**Parameters**

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The control unit that will be used to control the units.</td>
</tr>
</tbody>
</table>

**Returns** The total number of ADQs found.

**Note** If it is not desired to start all units at once, ADQControlUnit_SetupDevice may be used to start a specific device.

**See also** CreateADQControlUnit(), ADQControlUnit_SetupDevice()

3.3.7 ADQControlUnit_GetADQ()

```c
ADQInterface* ADQControlUnit_GetADQ ( 
    void * adq_cu_ptr, 
    int adq_num )
```

Gets the pointer to a specific ADQ device.

The pointer may be used to interface the device as a class object in C++.

**Parameters**

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

| adq_num |
| The number of the ADQ device |

**Returns** A pointer to to the ADQInterface object for the ADQ.

**Note** Uses 1-based index (reasons of legacy)

3.3.8 ADQControlUnit_GetFailedDeviceCount()

```c
int ADQControlUnit_GetFailedDeviceCount ( 
    void * adq_cu_ptr )
```

 Gets the number of units that failed startup.
After a call to ADQControlUnit_FindDevices this function returns the number of units found, which were not possible to start correctly (error reported during start of device).

If zero is returned no devices failed to start.

Cause of failure can be one of:

- Incompatible HW device version
- Power-off during setup phase
- Malfunctioning FPGA code (if used with ADQ Development Kit)

Parameters

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns The number of units that failed to start

See also ADQControlUnit_GetLastFailedDeviceError(), ADQControlUnit_FindDevices()

### 3.3.9 ADQControlUnit_GetLastFailedDeviceError()

```c
unsigned int ADQControlUnit_GetLastFailedDeviceError ( void * adq_cu_ptr )
```

Get last failed device error.

Parameters

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns The last error code from the last failing device

See also ADQControlUnit_EnableErrorTrace(), ADQControlUnit_ClearLastFailedDeviceError()

### 3.3.10 ADQControlUnit_GetLastFailedDeviceErrorWithText()

```c
unsigned int ADQControlUnit_GetLastFailedDeviceErrorWithText ( void * adq_cu_ptr, char * errstr )
```

Get last failed device error (together with error code in clear textual form)

Parameters

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>
errstr

char buffer with of at least size 256

Returns The last error code and error text from the last failing device

See also ADQControlUnit_EnableErrorTrace(), ADQControlUnit_ClearLastFailedDeviceError()

3.3.11 ADQControlUnit_ListDevices()

unsigned int ADQControlUnit_ListDevices (
    void * adq_cu_ptr,
    struct ADQInfoListEntry ** retList,
    unsigned int * retLen )

Lists devices connected to the system.

The ListDevices/OpenDeviceInterface/SetupDevice functions are intended as a more versatile replacement for FindDevices.

ListDevices creates a list of available ADQ devices without attempting to boot any firmware or set up any communication channels.

The function requires pointers to a list pointer and a length integer to be provided. The list is then returned as an array which can be indexed from retList[0] to retList[retLen-1], with each entry corresponding to an ADQ device.

The ADQInfoListEntry structure is found in the ADQAPI.h header file and contains all information which can be read non-destructively from the device:

struct ADQInfoListEntry {
    enum ADQHWIFEnum HWIFType;
    enum ADQProductID_Enum ProductID;
    unsigned int VendorID;
    unsigned int AddressField1;
    unsigned int AddressField2;
    char DevFile[64];
    unsigned int DeviceInterfaceOpened;
    unsigned int DeviceSetupCompleted;
};

enum ADQProductID_Enum {
    PID_ADQ214 = 0x0001,
    PID_ADQ114 = 0x0003,
    PID_ADQ112 = 0x0005,
    PID_SphinxHS = 0x000B,
    PID_SphinxLS = 0x000C,
    PID_ADQ108 = 0x000D,
    PID_ADQDSP = 0x000F,
    PID_SphinxAA14 = 0x0011,
    PID_SphinxAA16 = 0x0012,
    PID_ADQ412 = 0x0014,
    PID_ADQ212 = 0x0015,
    PID_SphinxAA_LS2 = 0x0016,
    PID_SphinxHS_LS2 = 0x0017,
    PID_DS314 = 0x0018,
    PID_ADQ1600 = 0x001C,
    PID_SphinxXT = 0x001D,
    PID_ADQ208 = 0x001E,
    PID_DSU = 0x001F,
    PID_ADQ14 = 0x0020,
PID_EV12A3350_EVM = 0x0022,
PID_ADQ7 = 0x0023,
PID_ADQ8 = 0x0026,
PID_ADQ12 = 0x0027,
};

enum ADQHWIFEnum { 
  HWIF_USB,
  HWIF_PCIE,
  HWIF_USB3
};

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
<tr>
<td>retList</td>
<td>Pointer to list pointers. The list is returned as an array which can be indexed from retList[0] to retList[retLen-1], with each entry corresponding to an ADQ device.</td>
</tr>
<tr>
<td>retLen</td>
<td>Length of the number of list elements that may be returned maximum. This is used to ensure that the function doesn't write outside of the allocated space.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

See also ADQControlUnit_OpenDeviceInterface(), ADQControlUnit_SetupDevice()

3.3.12 ADQControlUnit_NofADQ()

int ADQControlUnit_NofADQ ( 
  void ∗ adq_cu_ptr )

Gets the number of ADQs.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns the number of ADQs found

3.3.13 ADQControlUnit_NofADQ108()

int ADQControlUnit_NofADQ108 ( 
  void ∗ adq_cu_ptr )

Gets the number of ADQ108.

Parameters
The ADQControlUnit instance

Returns the number of ADQ108 found

3.3.14 ADQControlUnit_NofADQ112()

int ADQControlUnit_NofADQ112 ( 
    void * adq_cu_ptr )

Gets the number of ADQ112.

Parameters

The ADQControlUnit instance

Returns the number of ADQ112 found

3.3.15 ADQControlUnit_NofADQ114()

int ADQControlUnit_NofADQ114 ( 
    void * adq_cu_ptr )

Gets the number of ADQ114.

Parameters

The ADQControlUnit instance

Returns the number of ADQ114 found

3.3.16 ADQControlUnit_NofADQ12()

int ADQControlUnit_NofADQ12 ( 
    void * adq_cu_ptr )

Gets the number of ADQ12.

Parameters

The ADQControlUnit instance
Returns the number of ADQ12 found

3.3.17 ADQControlUnit__NofADQ14()

```c
int ADQControlUnit__NofADQ14 (
    void ∗ adq_cu_ptr )
```

Gets the number of ADQ14.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>adq_cu_ptr</code></td>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns the number of ADQ14 found

3.3.18 ADQControlUnit__NofADQ1600()

```c
int ADQControlUnit__NofADQ1600 (
    void ∗ adq_cu_ptr )
```

Gets the number of ADQ1600.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>adq_cu_ptr</code></td>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns the number of ADQ1600 found

3.3.19 ADQControlUnit__NofADQ208()

```c
int ADQControlUnit__NofADQ208 (
    void ∗ adq_cu_ptr )
```

Gets the number of ADQ208.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>adq_cu_ptr</code></td>
<td>The ADQControlUnit instance</td>
</tr>
</tbody>
</table>

Returns the number of ADQ208 found
3.3.20 ADQControlUnit_NofADQ212()

```c
int ADQControlUnit_NofADQ212 ( void * adq_cu_ptr )
```

Gets the number of ADQ212.

**Parameters**

- **adq_cu_ptr**
  
The ADQControlUnit instance

**Returns** the number of ADQ212 found

3.3.21 ADQControlUnit_NofADQ214()

```c
int ADQControlUnit_NofADQ214 ( void * adq_cu_ptr )
```

Gets the number of ADQ214.

**Parameters**

- **adq_cu_ptr**
  
The ADQControlUnit instance

**Returns** the number of ADQ214 found

3.3.22 ADQControlUnit_NofADQ412()

```c
int ADQControlUnit_NofADQ412 ( void * adq_cu_ptr )
```

Gets the number of ADQ412.

**Parameters**

- **adq_cu_ptr**
  
The ADQControlUnit instance

**Returns** the number of ADQ412 found

3.3.23 ADQControlUnit_NofADQ7()

```c
int ADQControlUnit_NofADQ7 ( void * adq_cu_ptr )
```
Gets the number of ADQ7.

Parameters

```
adq_cu_ptr
The ADQControlUnit instance
```

Returns the number of ADQ7 found

### 3.3.24 ADQControlUnit_NofADQ8()

```
int ADQControlUnit_NofADQ8 ( void * adq_cu_ptr )
```

Gets the number of ADQ8.

Parameters

```
adq_cu_ptr
The ADQControlUnit instance
```

Returns the number of ADQ8 found

### 3.3.25 ADQControlUnit_NofADQDSP()

```
int ADQControlUnit_NofADQDSP ( void * adq_cu_ptr )
```

Gets the number of ADQDSP.

Parameters

```
adq_cu_ptr
The ADQControlUnit instance
```

Returns the number of ADQDSP found

### 3.3.26 ADQControlUnit_NofDSU()

```
int ADQControlUnit_NofDSU ( void * adq_cu_ptr )
```

Gets the number of DSU.

Parameters
The ADQControlUnit instance

Returns the number of DSU found

3.3.27 ADQControlUnit_NofEV12AS350_EVM()

int ADQControlUnit_NofEV12AS350_EVM ( void * adq_cu_ptr )

Gets the number of EV12AS350_EVM.

Parameters

The ADQControlUnit instance

Returns the number of EV12AS350_EVM found

3.3.28 ADQControlUnit_NofSDR14()

int ADQControlUnit_NofSDR14 ( void * adq_cu_ptr )

Gets the number of SDR14.

Parameters

The ADQControlUnit instance

Returns the number of SDR14 found

3.3.29 ADQControlUnit_NofSphinxAA()

int ADQControlUnit_NofSphinxAA ( void * adq_cu_ptr )

Gets the number of SphinxAA.

Parameters

The ADQControlUnit instance
Returns the number of SphinxAA found

3.3.30 ADQControlUnit_OpenDeviceInterface()

unsigned int ADQControlUnit_OpenDeviceInterface (  
    void * adq_cu_ptr,  
    int ADQInfoListEntryNumber )

Opens an interface to a specific device.

After running ListDevices and finding an entry of interest in the device list, OpenDeviceInterface is used to
open a communications channel towards the device.

The ADQInfoListEntryNumber argument should be the array index of the listdevices entry you want to open,
 i.e. if you want to open the device corresponding to retList[0], pass 0 to this function.

Using this function will add an ADQ object to the internal lists of the ADQControlUnit. This means that the
ADQ will show up when using functions such as ADQControlUnit_GetADQ or ADQControlUnit_NofADQ, etc.
Simple tasks such as reading and writing registers can be done at this stage, but data collection and similar
requires ADQControlUnit_SetupDevice() to be run also.

Please note that the device number when using GetADQ/NofADQ/etc will not have anything to do with the
index number used in this function.

Parameters

<table>
<thead>
<tr>
<th>adq_cu_ptr</th>
<th>The ADQControlUnit instance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQInfoListEntryNumber</td>
<td>Array index of the listdevices entry you want to open</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

See also ADQControlUnit_ListDevices(), ADQControlUnit_SetupDevice()

3.3.31 ADQControlUnit_ResetDevice()

unsigned int ADQControlUnit_ResetDevice (  
    void * adq_cu_ptr,  
    int ADQInfoListEntryNumber,  
    int level )

This function can be used to issue a reset command to the digitizer without setting up the device. The device
needs to be opened using OpenDeviceInterface().

This currently only works specifically with USB3 and reset level 18.

After resetting the device the device will be closed, a new call to ListDevices may be needed after reset.

Parameters
```c
int ADQControlUnit_SetGeneralParameter( 
        void * adq_cu_ptr, 
        int param_index, 
        int param_value )
```

Sets general parameters.

SetGeneralParameter sets parameters that is used when starting devices with SetupDevice. It is intended to be used only when default parameters do not work well enough for the system used. There is no check that the parameter is valid or parameter value is valid.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
<tr>
<td>param_index</td>
<td>The index of the parameter to set</td>
</tr>
<tr>
<td>param_value</td>
<td>The value of the parameter</td>
</tr>
</tbody>
</table>

**Returns** Always returns 1 if there is available room for new parameter

See also ADQControlUnit_SetupDevice()
After running ListDevices and having used OpenDeviceInterface to open a communication channel towards a specific device, this function is used to do everything necessary to make the device ready for use, such as initializing API variables, calibrating PLLs, calibrating ADC data interfaces, resetting internal logic, etc. After this, the digitizer is ready for use.

This function takes the same index number as was used with OpenDeviceInterface, i.e. the ListDevices array index corresponding to your device.

Please note that the device number when using GetADQ/NofADQ/etc will not have anything to do with the index number used in this function.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
<tr>
<td>ADQInfoListEntryNumber</td>
<td>Array index of the listDevices entry you want to open</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note  Zero-based index used. When using later for adq_num in C API or C++ API, 1-based index is used so you need to add 1 to the index.

See also ADQControlUnit_ListDevices(), ADQControlUnit_OpenDeviceInterface()

3.3.34 ADQControlUnit_UserLogMessage()

unsigned int ADQControlUnit_UserLogMessage (  
    void * adq_cu_ptr,  
    unsigned int trace_level,  
    const char * message,  
    ... )  

Used by the user to add custom log messages when using ADQAPI.

The log messages will be written to the same file and path given when calling ADQControlUnit_EnableErrorTrace.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance</td>
</tr>
<tr>
<td>trace_level</td>
<td>Set the desired log level for the message (see ADQControlUnit_EnableErrorTrace).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>trace_level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trace_level = 0</td>
<td>Message will be printed out normally (No tag)</td>
</tr>
<tr>
<td>trace_level = 1</td>
<td>Message will be tagged as Error</td>
</tr>
<tr>
<td>trace_level = 2</td>
<td>Message will be tagged as Warning</td>
</tr>
<tr>
<td>trace_level = 3</td>
<td>Message will be tagged as Info</td>
</tr>
</tbody>
</table>
message
A string containing the log message.

Returns 1 for successful operation and 0 for failure

Note The input message should be terminated with newline (\n) in order to appear immediately in ADQUpdaterGUI. Otherwise the output message may be delayed until the next newline character.

See also ADQControlUnit_EnableErrorTrace()

3.3.35 ADQControlUnit_UserLogMessageAtLine()

unsigned int ADQControlUnit_UserLogMessageAtLine (  
   void * adq_cu_ptr, 
   unsigned int trace_level, 
   const char * loc_file, 
   const char * loc_func, 
   const int loc_line, 
   const char * message,  
   ... )

Used by the user to add custom log messages when using ADQAPI.

The log messages will be written to the same file and path given when calling ADQControlUnit_EnableErrorTrace.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>adq_cu_ptr</td>
<td>The ADQControlUnit instance.</td>
</tr>
<tr>
<td>trace_level</td>
<td>Set the desired log level for the message (see ADQControlUnit_EnableErrorTrace).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>trace_level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trace_level = 0 : Message will be printed out normally (No tag)</td>
<td></td>
</tr>
<tr>
<td>trace_level = 1 : Message will be tagged as Error</td>
<td></td>
</tr>
<tr>
<td>trace_level = 2 : Message will be tagged as Warning</td>
<td></td>
</tr>
<tr>
<td>trace_level = 3 : Message will be tagged as Info</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>loc_file</td>
<td>Should be set to FILE</td>
</tr>
<tr>
<td>loc_func</td>
<td>Should be set to FUNCTION</td>
</tr>
<tr>
<td>loc_line</td>
<td>Should be set to LINE</td>
</tr>
<tr>
<td>message</td>
<td>A string containing the log message.</td>
</tr>
</tbody>
</table>
Returns 1 for successful operation and 0 for failure

Note  The input message should be terminated with newline (\n) in order to appear immediately in ADQUpdaterGUI. Otherwise the output message may be delayed until the next newline character.

See also  ADQControlUnit_EnableErrorTrace()

## 4 ADQ Hardware and Firmware Info

**Enumerations**

- `enum ADQHWIFEnum`
  ```c
  enum ADQHWIFEnum {
    HWIF_USB = 0,
    HWIF_PCIE = 1,
    HWIF_USB3 = 2,
    HWIF_PCIE_LITE = 3,
    HWIF_ETH_ADQ7 = 4,
    HWIF_ETH_ADQ14 = 5,
    HWIF_VIRTUAL = 6,
    HWIF_QPCI = 7,
    HWIF_OTHER = 8
  }
  
  IDs for different hardware interface types.
  ```

- `enum ADQProductID_Enum`
  ```c
  enum ADQProductID_Enum {
    PID_ADQ214 = 0x0001,
    PID_ADQ114 = 0x0003,
    PID_ADQ112 = 0x0005,
    PID_SphinxHS = 0x000B,
    PID_SphinxLS = 0x000C,
    PID_ADQ108 = 0x000E,
    PID_ADQDSP = 0x000F,
    PID_SphinxAA14 = 0x0011,
    PID_SphinxAA16 = 0x0012,
    PID_ADQ412 = 0x0014,
    PID_ADQ212 = 0x0015,
    PID_SphinxAA_LS2 = 0x0016,
    PID_SphinxHS_LS2 = 0x0017,
    PID_SDR14 = 0x001B,
    PID_ADQ1600 = 0x001C,
    PID_SphinxXT = 0x001D,
    PID_ADQ208 = 0x001E,
    PID_DSU = 0x001F,
    PID_ADQ14 = 0x0020,
    PID_SDR14RF = 0x0021,
    PID_EV12AS350_EVM = 0x0022,
    PID_ADQ7 = 0x0023,
    PID_ADQ8 = 0x0026,
    PID_ADQ12 = 0x0027,
    PID_ADQ7Virtual = 0x0030,
    PID_ADQ3 = 0x0031,
  }
  ```
PID_ADQSM = 0x0032,
PID_TX320 = 0x201A,
PID_RX320 = 0x201C,
PID_S6000 = 0x2019

Product IDs for different device types.

Functions

- int Blink ()
  
  Blinks a LED to identify the unit.
- const char * GetADQDSPOption ()
  
  Gets the motherboard option.
- int GetADQType ()
  
  Gets the ADQ type as an integer.
- char * GetBoardProductName ()
  
  Gets the product name of the ADQ.
- char * GetBoardSerialNumber ()
  
  Returns the serial number of the ADQ device.
- int GetCalibrationInformation (unsigned int index, int *int_info, char *str_info)
  
  Returns specified calibration information from a device.
- const char * GetCardOption ()
  
  Gets the card option string.
- unsigned int GetHardwareAssemblyPartNumber (char *partnum)
  
  Read the hardware assembly part number of the device.
- unsigned int GetHardwareSubassemblyPartNumber (char *partnum)
  
  Read the hardware sub-assembly part number of the device.
- const char * GetNGCPartNumber ()
  
  Gets the part number of firmware framework.
- unsigned int GetPCBAssemblyPartNumber (char *partnum)
  
  Read the PCB assembly part number of the device.
- unsigned int GetPCBPartNumber (char *partnum)
  
  Read the PCB part number of the device.
- unsigned int GetPCIeAddress ()
  
  Gets the bus address of the a PCIe, PXIe or MTCA unit.
- unsigned int GetProductFamily (unsigned int *family)
  
  Gets the product family of the device.
- unsigned int GetProductID ()
  
  Gets the product ID of the unit.
- unsigned int GetProductVariant (unsigned int *ProductVariant)
  
  Gets an integer describing the Product Variant.
• int * GetRevision ()
  Returns the firmware revision numbers of the device.
• unsigned int GetUSBAddress ()
  Gets the bus address of the a USB unit.
• int HasFeature (const char *featurename)
  Check for card feature.
• int IsMTCADevice ()
  Checks whether device is connected over a MTCA interface.
• int IsPCIeDevice ()
  Checks whether device is connected over a PCIe/PXie/MTCA interface.
• int IsPCIeLiteDevice ()
  Checks whether device is connected over a PCIe/PXie/MTCA interface with the Lite driver stack.
• unsigned int IsStartedOK ()
  Checks whether the device has started up OK.
• int IsUSB3Device ()
  Checks whether device is connected over a USB3 interface.
• int IsUSBDevice ()
  Checks whether device is connected over a USB2 interface.

4.1 Detailed Description

These functions give information about the ADQ device. Values returned by these functions are constant for
the hardware or firmware, and does thus not change during operation of the unit.

4.2 Enumeration Type Documentation

4.2.1 ADQHWIFEnum

enum ADQHWIFEnum

IDs for different hardware interface types.
4.3 Function Documentation

4.3.1 Blink()

```cpp
virtual int Blink ()
```

Blinks a LED to identify the unit.

Makes the green status LED on the board front panel blink on and off. This can for example be used to identify a specific digitizer in a multi-digitizer system.

Returns 1 for successful operation and 0 for failure

Valid for ADQ108, ADQ112, ADQ114, ADQ1600, ADQ208, ADQ212, ADQ214, ADQ412, ADQDSP, DSU, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

4.3.2 GetADQDSPOption()

```cpp
virtual const char* GetADQDSPOption ()
```

Gets the motherboard option.

Returns A null terminated string containing motherboard options

Valid for ADQ412, ADQ1600, SDR14, ADQ108, ADQ208, ADQDSP, DSU

See also GetCardOption()

4.3.3 GetADQType()

```cpp
virtual int GetADQType ()
```

Gets the ADQ type as an integer.

---

| HWIF_USB   | USB2 |
| HWIF_PCIE  | PCIe |
| HWIF_USB3  | USB3 |
| HWIF_PCIE_LITE | PCIe lite |
| HWIF_ETH_ADQ7    | 10Gb Ethernet for ADQ7 |
| HWIF_ETH_ADQ14   | 10Gb Ethernet for ADQ7 |
| HWIF_VIRTUAL     | Virtual device |
| HWIF_Q_PCIE      | PCIe |
| HWIF_OTHER       | Reserved |
Returns An integer describing the unit, for example 412 for ADQ412.
Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
See also GetProductFamily()

4.3.4 GetBoardProductName()

virtual char* GetBoardProductName() 

Gets the product name of the ADQ.
Returns A NULL-terminated string containing the product number. The returned field is 32 positions long.
Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also GetBoardSerialNumber()

4.3.5 GetBoardSerialNumber()

virtual char* GetBoardSerialNumber() 

Returns the serial number of the ADQ device.
Returns a char* pointer to a 16 bytes long string (null-terminated).
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

4.3.6 GetCalibrationInformation()

virtual int GetCalibrationInformation ( 
    unsigned int index, 
    int* int_info, 
    char* str_info )

Returns specified calibration information from a device.
Parameters
index

The index of the calibration item to read. Dependent on item, the result will be returned as an integer or a
string. Unavailable/unprogrammed information will return NULL or 'UNKNOWN'.

- 100: Factory calibration date string, format YYYY-MM-DD
- 101: Last recalibration date string, format YYYY-MM-DD
- 102: Last field calibration date string, format YYYY-MM-DD
- 103: Last product validation date string, format YYYY-MM-DD
- 104: Registered in service date string, format YYYY-MM-DD
- 1101: Last recalibration type unsigned 32b integer
- 1102: Last field calibration type unsigned 32b integer
- 1103: Modification counter unsigned 32b integer

int_info
NULL or pointer to a 32b integer container

str_info
NULL or pointer to a string container (needs to be able to carry a maximum of 256 byte string)

Returns 1 for success and 0 for error
Valid for ADQ7

4.3.7 GetCardOption()

virtual const char* GetCardOption( )

Gets the card option string.

Example: "-3G" for ADQ412 specifies ADQ412-3G card option.

Returns A null terminated string containing the card option
Valid for ADQ412, ADQ1600, SDR14, ADQ208, ADQ12, ADQ14, ADQ7, ADQ8
See also GetADQDSPOption(), GetBoardProductName()

4.3.8 GetHardwareAssemblyPartNumber()

virtual unsigned int GetHardwareAssemblyPartNumber( 
char * partnum )

Read the hardware assembly part number of the device.

Parameters

partnum
Pointer to a 16-byte character array for storing the part number string:

Returns 1 for successful operation and 0 for failure
4.3.9 GetHardwareSubassemblyPartNumber()

virtual unsigned int GetHardwareSubassemblyPartNumber ( char * partnum )

Read the hardware sub-assembly part number of the device.

Parameters

partnum
Pointer to a 16-byte character array for storing the part number string:

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ8

4.3.10 GetNGCPartNumber()

virtual const char* GetNGCPartNumber ( )

Gets the part number of firmware framework.
This part number cannot be modified from inside an ADQ DevKit (apart from replacing the framework NGC).

Returns A NULL-terminated string, consisting of three three-digit numbers followed by a revision letter. For example, 400-200-002-A.

Note Older firmware revisions do not contain part number registers and will always be read out as 000-000-000-A.
Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU
See also GetUserLogicPartNumber()

4.3.11 GetPCBAssemblyPartNumber()

virtual unsigned int GetPCBAssemblyPartNumber ( char * partnum )

Read the PCB assembly part number of the device.

Parameters

partnum
Pointer to a 16-byte character array for storing the part number string:
Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ8

4.3.12 GetPCBPartNumber()

virtual unsigned int GetPCBPartNumber ( char * partnum )
Read the PCB part number of the device.
Parameters

partnum
Pointer to a 16-byte character array for storing the part number string:

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ8

4.3.13 GetPCIeAddress()

virtual unsigned int GetPCIeAddress ( )
Gets the bus address of the a PCIe, PXIe or MTCA unit.
Returns The address, or 0 if the ADQ was not connected PCIe, PXIe, or MTCA. The address is a 32-bit unsigned integer containing: Bits 31-16: Bus number Bits 15-0: Slot number
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
See also GetUSBAddress()

4.3.14 GetProductFamily()

virtual unsigned int GetProductFamily ( unsigned int * family )
Gets the product family of the device.
Parameters
family
Pointer to where the result is to be stored. This is the meaning of the valid values:
- 1: Reserved
- 5: V5 family, (ADQ214, ADQ114, ADQ212, ADQ112)
- 6: V6 family, (ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, SDR14TX, ADQDSP, DSU)
- 7: 7 family, (ADQ12, ADQ14, ADQ7, ADQ8)

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, SDR14TX, ADQDSP, DSU, ADQ214, ADQ212, ADQ114, ADQ112, ADQ12, ADQ14, ADQ7, ADQ8
See also GetADQType()

4.3.15 GetProductID()

virtual unsigned int GetProductID ( )

Gets the product ID of the unit.

Returns the product ID of the unit
Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also GetADQType

4.3.16 GetProductVariant()

virtual unsigned int GetProductVariant ( unsigned int * ProductVariant )

Gets an integer describing the Product Variant.

Parameters

ProductVariant
an allocated integer which receives the product variant integer. A return value of 0 means this parameter is undefined for the device
- On SDR14: 1: Standard SDR14 2: SDR14RF

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14
See also GetCardOption()
4.3.17 GetRevision()

virtual int* GetRevision() 

Returns the firmware revision numbers of the device.

Fields 0-2 contain information for FPGA #2 (Comm FPGA) and fields 3-5 contain information for FPGA #1 (Alg FPGA). The returned field (int* revision) is 6 positions long and contains:

- revision[0 and 3]: revision number
- revision[1 and 4]:
  - 0: SVN Managed
  - 1: Local Copy
- revision[2 and 5]:
  - 0: SVN Updated
  - 1: Mixed Revision

Where revision is the returned pointer.

Returns a pointer to a 6 integer long memory space

Note V6 products do only have one FPGA and only revision[0-2] is valid

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also GetBoardProductName()

4.3.18 GetUSBAddress()

virtual unsigned int GetUSBAddress() 

Gets the bus address of the a USB unit.

Returns The address, or 0 if the ADQ was not connected over USB

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also GetPCIeAddress()

4.3.19 HasFeature()

virtual int HasFeature(const char* featurename) 

Check for card feature.

Check whether the card has a specific feature
Parameters

**featurename**
String containing the name of the feature to check for
- FWDAQ (ADQ8 only)
- FWATD (Advanced time-domain, Waveform averaging)
- FWPD (Pulse detection)
- FWSDR (Software defined radio)
- FW4DDC (Software defined radio with quad DDCs)
- UserLogicFilter (Configurable linear phase FIR filter)

Returns 0 if check failed, -1 if feature is not supported, 1 if feature is supported

Valid for ADQ12, ADQ14, ADQ7, ADQ8

4.3.20  **IsMTCADevice()**

```cpp
virtual int IsMTCADevice ( )
```

Checks whether device is connected over a MTCA interface.

Returns 1 for MTCA device and 0 for other interfaces.

Valid for ADQ14, ADQ7, ADQ8

See also IsUSBDevice(), IsUSB3Device()

4.3.21  **IsPCIeDevice()**

```cpp
virtual int IsPCIeDevice ( )
```

Checks whether device is connected over a PCIe/PXIe/MTCA interface.

Returns 1 for PCIe/PXIe/MTCA device and 0 for other interfaces.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also IsUSBDevice(), IsUSB3Device()

4.3.22  **IsPCIeLiteDevice()**

```cpp
virtual int IsPCIeLiteDevice ( )
```

Checks whether device is connected over a PCIe/PXIe/MTCA interface with the Lite driver stack.

Returns 1 for PCIe/PXIe/MTCA device with Lite driver stack and 0 for other interfaces.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ8
4.3.23  IsStartedOK()

virtual unsigned int IsStartedOK()

Checks whether the device has started up OK.
Returns 1 for OK status and 0 for error/failure during configuration.
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also IsAlive()

4.3.24  IsUSB3Device()

virtual int IsUSB3Device()

Checks whether device is connected over a USB3 interface.
Returns 1 for USB3 device and 0 for other interfaces.
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also IsUSBDevice(), IsPCIeDevice()

4.3.25  IsUSBDevice()

virtual int IsUSBDevice()

Checks whether device is connected over a USB2 interface.
Returns 1 for USB2 device and 0 for other interfaces.
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also IsUSB3Device(), IsPCIeDevice()

5  ADQ Status

Functions

- unsigned int GetCurrentFloat(unsigned int index, float *current)
  
  Get on board current measurement.
- unsigned int GetCurrentSensorName(unsigned int index, char *name)
Get descriptive name for current sensor.

- unsigned int GetDataFormat ()

  Gets the current data format of the ADQ.

- unsigned int GetErrorVector ()

  Checks whether device is still communicable (alive)

- unsigned int GetLastError ()

  Gets the last error code.

- int GetNofAdcCores (unsigned int *nof_adc_cores)

  Get the number of ADC cores.

- unsigned int GetNofChannels ()

  Gets the number of analog input channels.

- unsigned int GetNofCurrentSensors (void)

  Get number of current sensors.

- int GetNofProcessingChannels ()

  Gets the number of processing channels.

- unsigned int GetOutputWidth ()

  Gets the width of the output data in number of bits.

- unsigned int GetPCIeLinkRate ()

  Gets the current PCIe link generation.

- unsigned int GetPCIeLinkWidth ()

  Gets the current PCIe link width.

- unsigned int GetPCIeTLPSize ()

  Gets the current PCIe TLP size.

- int GetStatus (enum ADQStatusId id, void *const status)

  Reads a status variable from the digitizer instance.

- unsigned int GetTemperature (unsigned int addr)

  Gets the current on-board temperatures.

- unsigned int GetTemperatureFloat (unsigned int addr, float *temperature)

  Gets the current on-board temperatures.

- unsigned int IsAlive ()

  Checks whether device is still communicable (alive)

5.1 Detailed Description

These functions are used to retrieve the current status of the device. Values returned by these functions may change during operation of the units.
5.2 Function Documentation

5.2.1 GetCurrentFloat()

virtual unsigned int GetCurrentFloat ( 
    unsigned int index, 
    float * current )

Get on board current measurement.

Parameters

<table>
<thead>
<tr>
<th>index</th>
<th>The sensor index. For valid addresses, see GetNofCurrentSensors().</th>
</tr>
</thead>
<tbody>
<tr>
<td>current</td>
<td>The measured current for the sensor index is written to the float pointed to. The measurement unit is Ampere. Index starts at zero. If the index is out of range a zero will be written to current and zero will be returned.</td>
</tr>
</tbody>
</table>

Returns 1 if successful or 0 if an error occurred

Valid for -

See also GetCurrentSensorName, GetNofCurrentSensors

5.2.2 GetCurrentSensorName()

virtual unsigned int GetCurrentSensorName ( 
    unsigned int index, 
    char * name )

Get descriptive name for current sensor.

Parameters

<table>
<thead>
<tr>
<th>index</th>
<th>The sensor index. For valid addresses, see GetNofCurrentSensors().</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>The name of the current sensor at index is written to the char array pointed to. This function guarantees that the returned string is zero-terminated and less than or equal to 256 bytes including the zero terminator. Index starts at zero. If the index is out of range, an empty string will be written to name and zero will be returned.</td>
</tr>
</tbody>
</table>

Returns 1 if successful or 0 if an error occurred

Valid for -

See also GetCurrentFloat, GetNofCurrentSensors
5.2.3 GetDataFormat()

virtual unsigned int GetDataFormat ( )

Gets the current data format of the ADQ.

Please see SetDataFormat() for information on the values.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ108, ADQ208, ADQ212, ADQ112, ADQ114, ADQ214, SDR14

See also SetDataFormat()

5.2.4 GetErrorVector()

virtual unsigned int GetErrorVector ( )

Checks whether device is still communicable (alive)

Returns 0 if no error has been detected, otherwise non-zero. Bold-face marked conditions are irreversible and needs a power-cycling. Others may affect functionality in different ways, but the ADQ board will continue to operate.

**Bit 0: Board turned off - detected overheat condition**

Bit 1: Detected broken contact bridge between FPGA #1 and #2

Bit 3: Detected fan fault

All detected error conditions will also cause the front panel STATUS LED to flash slowly.

Returns 0 for no error and non-zero for detected errors

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU

See also GetLastError()

5.2.5 GetLastError()

virtual unsigned int GetLastError ( )

Gets the last error code.

Returns 0 if no error was detected and the error code otherwise.

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU

See also GetErrorVector(), ADQControlUnit_EnableErrorTrace()
5.2.6 GetNofAdcCores()

virtual int GetNofAdcCores ( 
    unsigned int ∗ nof_adc_cores )

Get the number of ADC cores.

Parameters

<table>
<thead>
<tr>
<th>nof_adc_cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference to memory where the number of ADC cores is returned.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14

5.2.7 GetNofChannels()

virtual unsigned int GetNofChannels ( )

Gets the number of analog input channels.

Returns The number of analog input channels

Valid for ADQ412, ADQ212, ADQ214, ADQ114, ADQ112, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

5.2.8 GetNofCurrentSensors()

virtual unsigned int GetNofCurrentSensors ( 
    void )

Get number of current sensors.

Returns 0 if the device does not have user readable current sensors, otherwise the number of readable sensors is returned. For GetCurrentFloat() and GetCurrentSensorName() indices from 0 to the number of readable sensors minus one can be used.

Valid for -

See also GetCurrentFloat, GetCurrentSensorName

5.2.9 GetNofProcessingChannels()

virtual int GetNofProcessingChannels ( )

Gets the number of processing channels.

A processing channel is an output channel. This number may be different from the number of analog input channels reported by GetNofChannels().
Returns  The number of processing channels
Valid for  ADQ7, ADQ14, ADQ12, ADQ8

5.2.10  GetOutputWidth()

virtual unsigned int GetOutputWidth ( )

Gets the width of the output data in number of bits.

Returns  the default number of bits per sample

Note  Sample bit width returned by this function is only valid for the standard acquisition modes. It is not
valid for other acquisition mode such as averaging or custom streaming solutions.

Valid for  ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ14,
ADQ7, ADQ8

See also  GetNofBytesPerSample()

5.2.11  GetPCIeLinkRate()

virtual unsigned int GetPCIeLinkRate ( )

Gets the current PCIe link generation.

Returns  The PCIe generation used for the connection between ADQ and host. Returns 0 if the ADQ is not
connected through PCIe.

Valid for  ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

5.2.12  GetPCIeLinkWidth()

virtual unsigned int GetPCIeLinkWidth ( )

Gets the current PCIe link width.

Returns  The number of lanes used for the PCIe connection between ADQ and host. Returns 0 if the ADQ
is not connected through PCIe.

Valid for  ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

5.2.13  GetPCIeTLPSize()

virtual unsigned int GetPCIeTLPSize ( )

Gets the current PCIe TLP size.

Returns  The TLP (Transfer Layer Packet) size that the board currently uses. Returns 0 if the ADQ is not
connected through PCIe
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU

5.2.14 GetStatus()  

virtual int GetStatus (  
    enum ADQStatusId id,  
    void *const status )  

Reads a status variable from the digitizer instance.  

Parameters

<table>
<thead>
<tr>
<th>id</th>
<th>Status ID. Available IDs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ_STATUS_ID_OVERFLOW</td>
<td>Overflow status</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>status</th>
<th>Pointer to the status destination. Type depends on id.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ_STATUS_ID_OVERFLOW</td>
<td>status should point to an unsigned integer. *status &gt; 0 means overflow condition has occurred.</td>
</tr>
</tbody>
</table>

Returns 1 for success and 0 for error  
Valid for ADQ14, ADQ7, ADQ8  
See also GetStreamOverflow()

5.2.15 GetTemperature()  

virtual unsigned int GetTemperature (  
    unsigned int addr )  

Gets the current on-board temperatures.  

Parameters
addr

The temperature to read. Valid addresses are:

- ADQ214, ADQ114, ADQ212, ADQ112:
  - 1: Temperature sensor 1, alg. FPGA
  - 2: Temperature sensor 2, comm. FPGA

- ADQ108, ADQ412, ADQ208, ADQ1600, SDR14, DSU, ADQDSP:
  - 0: Sensor controller local temperature
  - 1: Temperature sensor 1 (ADC0)
  - 2: Temperature sensor 2 (ADC1)
  - 3: Temperature sensor 3 (FPGA)
  - 4: Temperature sensor 4 (PCB)

- ADQ12 / ADQ14:
  - 0: Temperature sensor 0 (PCB)
  - 1: Temperature sensor 1 (ADC1)
  - 2: Temperature sensor 2 (ADC2)
  - 3: Temperature sensor 3 (FPGA)
  - 4: Temperature sensor 4 (DCDC2A)
  - 5: Temperature sensor 5 (DCDC2B)
  - 6: Temperature sensor 6 (DCDC1)

- ADQ7:
  - 0: Temperature sensor 0 (PCB)
  - 1: Temperature sensor 1 (ADC1)
  - 2: Temperature sensor 2 (ADC2)
  - 3: Temperature sensor 3 (FPGA)
  - 4: Temperature sensor 4 (DCDC2A)
  - 5: Temperature sensor 5 (DCDC2B)
  - 6: Temperature sensor 6 (DCDC1)
  - 7: Temperature sensor 7 (RSVD)

- ADQ8:
  - 0: Temperature sensor 0 (PCB)
  - 1: Temperature sensor 1 (ADC1)
  - 2: Temperature sensor 2 (ADC2)
  - 3: Temperature sensor 3 (FPGA)
  - 4: Temperature sensor 4 (DCDC1)
  - 5: Temperature sensor 5 (DCDC2)
  - 6: Temperature sensor 6 (DCDC3)

Returns The temperature as the actual temperature in Celsius times 256

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also GetTemperatureFloat

5.2.16 GetTemperatureFloat()
float * temperature )

Gets the current on-board temperatures.

Parameters

<table>
<thead>
<tr>
<th>addr</th>
<th>The sensor address to read from. For valid addresses, see GetTemperature().</th>
</tr>
</thead>
<tbody>
<tr>
<td>temperature</td>
<td>Temperature is returned via this pointer, in degrees Celsius.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Note A returned value of 0x1000 (256 Celsius) is signaling a not valid/not available temperature.

For ADQ14 and ADQ12, a value below 0.01 degrees Celsius signals a not valid temperature measurement.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also GetTemperature

5.2.17 IsAlive()

virtual unsigned int IsAlive( )

Checks whether device is still communicable (alive)

Returns 1 for alive status and 0 for not communicable.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also IsStartedOK()

6 ADQ General Setup

Functions

- int GetSampleRate (int mode, double *sampleratehz)
  
  Read out the sample rate of the digitizer.
- unsigned int PowerStandby ( )
  
  Issues power standby mode for device. Will require a full new setup of device for operation.
- unsigned int ReBootADQFromFlash (unsigned int partition)
  
  Reboots the ADQ over PCIe.
- unsigned int ResetDevice (int resetlevel)
  
  Resets the device in different ways.
- int ResetOverheat ( )
Reset the device from an overheat condition.

- int SetDataFormat (unsigned int format)
  
  Sets the sample format.
- unsigned int SetInterleavingMode (char interleaving)
  
  Sets the interleaving mode.

6.1 Detailed Description

These functions are used to preform general setup of the device.

6.2 Function Documentation

6.2.1 GetSampleRate()

virtual int GetSampleRate ( 
  int mode,
  double ∗ sampleratehz )

Read out the sample rate of the digitizer.

Parameters

<table>
<thead>
<tr>
<th>mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 0: base sample rate of the digitizer, 1: sample rate including sample skip / decimation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>sampleratehz</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pointer to where the sampling frequency (in Hz) will be stored as a double</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

6.2.2 PowerStandby()

virtual unsigned int PowerStandby ( )

Issues power standby mode for device. Will require a full new setup of device for operation.

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14
6.2.3 ReBootADQFromFlash()

virtual unsigned int ReBootADQFromFlash (  
    unsigned int  partition )

Reboots the ADQ over PCIe.

Reads the PCIe configuration header from the ADQ, reboots it, and then writes the header back.

This effectively power cycles the FPGA of the ADQ. The ADQ must then be re-enumerated using e.g. ADQ-ControlUnit_FindDevices().

Parameters

partition
The partition to reboot the fpga into. 0 for bootloader partition. 1 for firmware partition

Returns 1 for successful operation and 0 for failure

Note Make sure the partition you want to reboot into does exist in the flash memory.

Valid for ADQ108, ADQ1600, ADQ208, ADQ412, ADQDSP, DSU, SDR14

See also ResetDevice(), ADQControlUnit_FindDevices()

6.2.4 ResetDevice()

virtual unsigned int ResetDevice (  
    int          resetlevel )

Resets the device in different ways.

Parameters

resetlevel
The level of the reset, according to this list:
- resetlevel = 2: Soft reset, restores to default power-on state [valid for all devices]
- resetlevel = 8: Soft reset of communication link [valid for all devices]
- resetlevel = 16: Hard reset (hardware device) [only for USB, ADQ V5 digitizers]
- resetlevel = 18: USB 3.0 hardware link reset [only for USB 3.0 digitizers]
- resetlevel = 100: Reset of the digital data path in the ADC [only for ADQ14/ADQ12 digitizers]

Returns 1 for successful operation and 0 for failure

Note After ResetDevice with resetlevel 16 or 18 is issued, hardware must be re-enumerated through the ADQControlUnit by issuing ADQControlUnit_FindDevices. This reset makes the connection between the API and the hardware invalid.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ7, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
6.2.5 ResetOverheat()

virtual int ResetOverheat ( )

Reset the device from an overheat condition.
Device will be initiated to a default configuration.
Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208, ADQ412, SDR14, ADQ1600
See also ResetDevice()

6.2.6 SetDataFormat()

virtual int SetDataFormat ( unsigned int format )

Sets the sample format.
This function will call SetNoFBits, SetSampleWidth and WriteAlgoRegister and set all parameters needed for a
sample width and/or alignment change. Use the following macros for setting a specific sample format:

**ADQ214 & ADQ114:**
ADQxxx_DATA_FORMAT_PACKED_14BIT
ADQxxx_DATA_FORMAT_UNPACKED_14BIT
ADQxxx_DATA_FORMAT_UNPACKED_16BIT
ADQxxx_DATA_FORMAT_UNPACKED_32BIT

**ADQ112 & ADQ212:**
ADQxxx_DATA_FORMAT_PACKED_12BIT
ADQxxx_DATA_FORMAT_UNPACKED_12BIT
ADQxxx_DATA_FORMAT_UNPACKED_16BIT
ADQxxx_DATA_FORMAT_UNPACKED_32BIT

**ADQ108 & ADQ208:**
0 = ADQ108_DATA_FORMAT_PACKED_8BIT
2 = ADQ108_DATA_FORMAT_UNPACKED_16BIT
3 = ADQ108_DATA_FORMAT_UNPACKED_32BIT

**ADQ412:**
0 = ADQ412_DATA_FORMAT_PACKED_12BIT
1 = ADQ412_DATA_FORMAT_UNPACKED_12BIT
2 = ADQ412_DATA_FORMAT_UNPACKED_16BIT
3 = ADQ412_DATA_FORMAT_UNPACKED_32BIT

**ADQ1600 & SDR14:**
0 = XXXX_DATA_FORMAT_PACKED_16BIT
1 = XXXX_DATA_FORMAT_UNPACKED_16BIT
3 = XXXX_DATA_FORMAT_UNPACKED_32BIT

**ADQ8:**
0 = XXXX_DATA_FORMAT_UNPACKED_16BIT
3 = XXXX_DATA_FORMAT_UNPACKED_32BIT

The packed format will configure the ADQ to store samples for minimal memory footprint, unpacking after transfer to the host PC is done automatically when using multi-record mode. Using streaming mode, unpacking will not be done and is not recommended for use.

Unpacked mode should be used for streaming, this configures the ADQ to store samples padded to 16 bits. 12 & 14 bit modes are stored with sign-extended MSBs. 16 bit mode is stored with zero-padded LSBs.

Unpacked 32 bit mode is used for decimation data, data is stored with zero-padded LSBs.

Parameters

<table>
<thead>
<tr>
<th>format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data format to select</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ8

See also SetStreamStatus()

6.2.7 SetInterleavingMode()

virtual unsigned int SetInterleavingMode (char interleaving)

Sets the interleaving mode.

This function is used for units where the interleaving mode is configurable by software.

Parameters

<table>
<thead>
<tr>
<th>interleaving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interleaving mode selection. This parameter has different values for different units:</td>
</tr>
<tr>
<td>• ADQ412:</td>
</tr>
<tr>
<td>‒ interleaving = 0: Four channel mode (default)</td>
</tr>
<tr>
<td>‒ interleaving = 1: Two channel mode, inputs A and C used</td>
</tr>
<tr>
<td>‒ interleaving = 2: Two channel mode, inputs B and D used</td>
</tr>
<tr>
<td>‒ interleaving = 3: Two channel mode, all inputs active</td>
</tr>
<tr>
<td>• ADQ208:</td>
</tr>
<tr>
<td>‒ interleaving = 0: Two channel mode</td>
</tr>
<tr>
<td>‒ interleaving = 1: One channel mode (default)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ208
7 Front-End Options

Functions

- unsigned int GetAdjustableBias (unsigned int channel, int *ADCcodes)
  
  *Reads the current DC-bias level of a specified input channel.*

- unsigned int GetAfeSwitch (unsigned char Channel, unsigned char *afemode)
  
  *Gets the current analog front mode.*

- unsigned int GetCalibratedInputImpedance (unsigned int channel, float *impedance)
  
  *Gets the calibrated input impedance of the ADQ412DC frontend.*

- int GetInputImpedance (unsigned int channel, unsigned int *mode)
  
  *Gets the current input impedance mode for a specific analog input channel.*

- unsigned int GetInputRange (unsigned int channel, float *InpRange)
  
  *Reads the current input range of a specified input channel.*

- unsigned int RunCalibrationADQ412DC (unsigned int calmode)
  
  *Schedules a recalibration for the ADQ412DC frontend.*

- unsigned int SetAdjustableBias (unsigned int channel, int ADCcodes)
  
  *Sets the DC-bias level for a specified input channel.*

- int SetAfeSwitch (unsigned int afe)
  
  *Sets the analog front for DC or AC mode.*

- unsigned int SetCalibrationModeADQ412DC (unsigned int calibmode)
  
  *Sets up the continuous temperature compensation of the ADQ412DC frontend.*

- int SetInputImpedance (unsigned int channel, unsigned int mode)
  
  *Allows for switching between different input impedances for the analog inputs of the digitizer.*

- unsigned int SetInputRange (unsigned int channel, float inputrangemVpp, float *result)
  
  *Sets a desired input range.*

- unsigned int SetOvervoltageProtection (unsigned int enabled)
  
  *Allows turning the overvoltage protection on the digitizer inputs on/off.*

7.1 Detailed Description

Some units have special options for their front-end. These functions are for example used for selecting analog bias level and DC/AC measurement mode. Please note that not all variants of a product can use all options. For example, ADQ412DC has adjustable bias, while the standard ADQ412 does not.

7.2 Function Documentation
7.2.1 GetAdjustableBias()

virtual unsigned int GetAdjustableBias (  
    unsigned int channel,  
    int ∗ ADCcodes )

Reads the current DC-bias level of a specified input channel.  
Hardware with support for adjustable bias is required.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
<th>Channel of interest (channels are numbered from 1 and up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADCCodes</td>
<td>The resulting bias value in ADC codes is returned via this pointer</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation, 0 for failure

Note: The function is only valid for adjustable bias devices, and will not return the correct value for fixed bias devices with positive/negative bias circuitry.

No actual measurements of the bias seen in the ADC data are performed, the value returned is the expected value based on the current settings.

Valid for ADQ412, ADQ1600, ADQ108, ADQ12, ADQ14, ADQ7, ADQ8

See also HasAdjustableBias(), SetAdjustableBias()

7.2.2 GetAfeSwitch()

virtual unsigned int GetAfeSwitch (  
    unsigned char Channel,  
    unsigned char ∗ afemode )

Gets the current analog front mode.

ADQ214 and ADQ212 has the option to select either a DC or AC coupled input for the front end. This function is used to get the current front end setup for a specified channel.

Parameters

<table>
<thead>
<tr>
<th>Channel</th>
<th>The channel for which to read the status. 1 for channel A and 2 for channel B</th>
</tr>
</thead>
</table>
| afemode | Pointer to where to store the result. These results are possible:  
          | • 0: Signal path in AC mode  
          | • 1: Signal path in DC mode |

Returns 1 for successful operation and 0 for failure
Valid for ADQ214, ADQ212
See also SetAfeSwitch()

7.2.3 GetCalibratedInputImpedance()

virtual unsigned int GetCalibratedInputImpedance (  
    unsigned int channel,  
    float * impedance )

Gets the calibrated input impedance of the ADQ412DC frontend.
The front end setting of the ADQ412DC affects the input impedance. This function will provide the current value.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The channel to get the value for</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where the result is to be stored</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ412DC

7.2.4 GetInputImpedance()

virtual int GetInputImpedance (  
    unsigned int channel,  
    unsigned int * mode )

Gets the current input impedance mode for a specific analog input channel.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The channel to set the impedance for. Indexed from 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>mode</th>
</tr>
</thead>
</table>
| Pointer to where the mode value will be stored.  
  - 0: 50 Ohm  
  - 1: 1 MOhm |

Returns int status
Valid for ADQ8
See also GetInputImpedance()
7.2.5 GetInputRange()

```cpp
template<>
virtual unsigned int GetInputRange (
    unsigned int channel,
    float * InpRange )
```

Reads the current input range of a specified input channel.

Hardware with support for adjustable input range is required.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
<th>Channel of interest (channels are numbered from 1 and up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>InpRange</td>
<td>The resulting input range value in millivolts peak-to-peak is returned via this pointer</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

**Note** The function is only valid for adjustable input range devices, and will not return the correct value for devices with fixed input range.

**Valid for** ADQ412DC, ADQ12(-VG), ADQ14(-VG), ADQ8(-VG)

**See also** HasAdjustableInputRange(), SetInputRange()

---

7.2.6 RunCalibrationADQ412DC()

```cpp
template<>
virtual unsigned int RunCalibrationADQ412DC (
    unsigned int calmode )
```

Schedules a recalibration for the ADQ412DC frontend.

The user may specify which calibration routines that should be run an when. There are two calibration routines: **Input offset zeroing**, which removes any input offset present on the digitizer inputs. This removes any DC offsets caused by the input offset in combination with source impedance. During this calibration, the input signals are disconnected for a short amount of time (less than 900ms). The auto-zero calibration uses filtered DACs and therefore does not fully take effect until after about 4 seconds.

**Bias calibration.** After setting a desired bias using SetAdjustableBias(), this calibration can be performed to digitally adjust the bias even closer to the desired value. During this calibration, the input signals are disconnected for a short amount of time (less than 900ms). Make sure to wait at least 4 seconds after setting the bias before running this calibration, since the bias needs to be stable.

**Parameters**
calmode
Option parameter that specifies which calibration routine to run and when. These are the values that may be used:

- 0: Run input offset zeroing calibration immediately
- 1: Run bias calibration immediately
- 2: Run auto-zero once the next data collection finishes
- 3: Run bias calibration once the next data collection finishes
- 4: Run both auto-zero and bias calibration in turn. Each one will run after a data collection finishes, and the firmware will automatically wait 4 seconds between the calibration routines

Returns 1 for successful operation and 0 for failure
Valid for ADQ412DC
See also SetCalibrationModeADQ412DC()

### 7.2.7 SetAdjustableBias()

virtual unsigned int SetAdjustableBias (
    unsigned int channel,
    int ADCcodes )

Sets the DC-bias level for a specified input channel.
Hardware with support for adjustable bias is required.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
<th>Channel to set bias for (channels are numbered from 1 and up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADCCodes</td>
<td>The desired DC-bias, in ADC codes</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation, 0 for failure

Note The DC-biasing circuitry is heavily filtered, and a change in bias level will typically take around half a second to take effect.

Valid for ADQ412, ADQ1600, ADQ108, ADQ12, ADQ14, ADQ7, ADQ8
See also HasAdjustableBias(), GetAdjustableBias()

### 7.2.8 SetAfeSwitch()

virtual int SetAfeSwitch (
    unsigned int afe )

Sets the analog front for DC or AC mode.
ADQ214 and ADQ212 has the option to select either a DC or AC coupled input for the front end. This function is used to switch between them. ADQ7 can be selected to use INX input or INA/INB inputs. To actually use the digitizer in 1ch or 2ch modes, the corresponding firmware must be loaded.

**Parameters**

### afe

For ADQ214: Bitmask to set the analog front end. The different bits have the functions below

- 0: 0 for AC mode and 1 for DC mode on channel A
- 1: 0 for AC mode and 1 for DC mode on channel B
- 2: 0 to deactivate and 1 to activate LF amplification on channel A
- 3: 0 to deactivate and 1 to activate LF amplification on channel B

For example:

- afe = 0x0000 gives AC coupled front end for both channels
- afe = 0x0005 gives DC coupled front end for channel A and AC for channel B
- afe = 0x000A gives AC coupled front end for channel A and DC for channel B
- afe = 0x000F gives DC coupled front end for both channels

For ADQ7: This command only sets the frontend relays. To actually use the digitizer in 1ch or 2ch modes, the corresponding firmware must be loaded.

- 0: Set to INA and INB active mode
- 1: Set to INX active mode

Returns 1 for successful operation and 0 for failure

Valid for ADQ214, ADQ212, ADQ7

See also GetAfeSwitch()
7.2.10 SetInputImpedance()

virtual int SetInputImpedance ( 
        unsigned int channel, 
        unsigned int mode )

Allows for switching between different input impedances for the analog inputs of the digitizer.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>channel</td>
<td>The channel to set the impedance for. Indexed from 1</td>
</tr>
</tbody>
</table>
| mode        | - 0: 50 Ohm  
             | - 1: 1 MOhm             |

Returns int status

Valid for ADQ8

See also GetInputImpedance()

7.2.11 SetInputRange()

virtual unsigned int SetInputRange ( 
        unsigned int channel, 
        float inputrangemVpp, 
        float *result )

Sets a desired input range.

One channel is set for each call, according to the parameter listing below.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>channel</td>
<td>Selects which channel to operate on (channels are numbered from 1 and up)</td>
</tr>
<tr>
<td>inputrangemVpp</td>
<td>The desired input range in millivolts peak-to-peak</td>
</tr>
<tr>
<td>result</td>
<td>The software will calculate the closest approximation to the desired input range that it can achieve. The value is returned via this pointer.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ412DC, ADQ12(-VG), ADQ14(-VG), ADQ8(-VG)
7.2.12 SetOvervoltageProtection()

```c
virtual unsigned int SetOvervoltageProtection (
    unsigned int enabled
)
```

Allows turning the overvoltage protection on the digitizer inputs on/off.

Disabling the overvoltage protection improves linearity, but also makes the device frontend susceptible to damage if large-amplitude signals are used.

**Parameters**

<table>
<thead>
<tr>
<th>enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 0 to disable all overvoltage protection, 1 to enable (default after board startup).</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

**Valid for** ADQ12, ADQ14

### 8 Peripheral Setup

**Data Structures**

- `struct ADQDaisyChainDeviceInformation`
  
  *Daisy chain device info struct used with SDCardBackupDaisyChainGetTriggerInformation(). More...*

- `struct ADQDaisyChainTriggerInformation`
  
  *Daisy chain trigger info struct used with SDCardBackupDaisyChainGetTriggerInformation(). More...*

- `struct SDCardConfiguration`
  
  *SD Card configuration struct used with SDCardBackupGetConfiguration(). More...*

**Functions**

- `unsigned int EnableClockRefOut (unsigned int enable)`
  
  *Enables or disables the clock reference output signal.*

- `int EnableGPIOPort (unsigned int port, unsigned int enable)`
  
  *Enables GPIO mode for a specified I/O port.*

- `int EnableGPIOSupplyOutput (unsigned int enable)`
  
  *Enable GPIO supply voltage output.*

- `unsigned int HasAdjustableBias ()`
  
  *Checks whether the device supports adjustable DC-biasing of the ADC frontends.*

- `unsigned int HasAdjustableInputRange ()`
  
  *Checks whether the device supports adjustable frontend input range.*

- `unsigned int HasGPIOHardware ()`
  
  *Checks whether the device has GPIO hardware.*

- `unsigned int HasTrigHardware (unsigned int trignum)`
Checks if variable trigger threshold is available for the unit.

- unsigned int HasTrigoutHardware (unsigned int trignum)

Checks if a specific external trigger output exists on the unit.

- unsigned int HasVariableTrigThreshold (unsigned int trignum)

Checks if variable trigger threshold is available for the unit.

- unsigned int ReadEEPROM (unsigned int addr)
  
  Reads one byte from the on-board EEPROM.

- unsigned int ReadEEPROMDB (unsigned int addr)
  
  Reads one byte from the daughterboard EEPROM.

- unsigned int ReadGPIO ()
  
  Gets the state of the GPIO pins.

- int ReadGPIOPort (unsigned int port, unsigned int *data)
  
  Reads the value seen by the GPIO pins for a specified GPIO port.

- int SDCardBackupDaisyChainGetTriggerInformation (unsigned int source, unsigned int edge, int level, unsigned int channel, unsigned int nof_records, unsigned int record_length, struct ADQDaisyChainDeviceInfo *device_info, unsigned int nof_devices, struct ADQDaisyChainTriggerInformation *trig_info)
  
  Get the daisy chain trigger information from SD card.

- int SDCardBackupEnable (int enable)
  
  Enables the backup of data to microSD card.

- int SDCardBackupGetConfiguration (struct SDCardConfiguration *sdc_config)
  
  Read the device configuration uses for data stored on SD card.

- int SDCardBackupGetData (void **target_buffers, void *target_headers, unsigned int target_buffer_size, unsigned char target_bytes_per_sample, unsigned int start_record_number, unsigned int number_of_records, unsigned char channel_mask, unsigned int start_sample, unsigned int nof_samples)
  
  Read data from SD card. See GetDataWHTS()

- int SDCardBackupGetProgress (unsigned int *percent)
  
  Get the progress of the backup process in percent.

- int SDCardBackupGetStatus (unsigned int *status)
  
  Get the status of the SD card backup procedure.

- int SDCardBackupResetWriterProcess ()
  
  Reset the SD card backup process.

- int SDCardBackupSetAdditionalData (unsigned int daisy_chain_position)
  
  Set addition information required to parse data from SD card.

- int SDCardErase (unsigned int start_block, unsigned int stop_block)
  
  Commands the SD Card to erase blocks from start_block to stop_block (inclusive). start_block - stop_block must be larger than one. A block has a fixed size of 512B.

- unsigned int SDCardGetNofSectors ()
  
  Get the number of sectors required to store data.

- int SDCardInit ()
  
  Attempts to bring the compatible high capacaty SD-Card through initialization. This should be done before erasing, writing or reading from/to the SD-Card.
- int SDCardIsInserted (int *is_inserted)
  Check if the micro SD card is inserted.
- int SDCardRead (unsigned int *dst, unsigned int start_block, unsigned int number_of_blocks)
  Reads the specified number_of_blocks starting from start_block params. A block has a fixed size of 512B.
- int SDCardWriterStatus (unsigned int *status)
  Retrieves the status of the microblaze mem Writer process.
- unsigned int SetConfigurationTrig (unsigned int mode, unsigned int pulselength, unsigned int invertoutput)
  Sets the configuration of the trig connector.
- unsigned int SetDACOffsetVoltage (unsigned char channel, float v)
  Sets the common-mode voltage for the DAC outputs of SDR14.
- int SetDirectionGPIO (unsigned int direction, unsigned int mask)
  Sets the direction of the GPIO pins.
- int SetDirectionGPIOPort (unsigned int port, unsigned int direction, unsigned int mask)
  Sets the input/output state of the GPIO pins for a specified GPIO port.
- int SetDirectionTrig (int direction)
  Sets the direction of the trig connector.
- unsigned int SetFanControl (unsigned int fan_control)
  Sets the fan control of the device.
- int SetFunctionGPIOPort (unsigned int port, int function_id, int gpio_id)
  Control the GPIO output functions.
- unsigned int SetupTriggerOutput (int outputnum, unsigned int mode, unsigned int pulselength, unsigned int invertoutput)
  Sets the configuration of the trig connector.
- int SetupUserRangeGPIO (unsigned int channel, int threshold_high, int threshold_low)
  Configure User Range GPIO function.
- unsigned int TrigoutEnable (unsigned int bitflags)
  Selects which trigout connectors to send a trigger output to.
- unsigned int WriteEEPROM (unsigned int addr, unsigned int data, unsigned int accesscode)
  Writes one byte to the on-board EEPROM.
- unsigned int WriteEEPROMDB (unsigned int addr, unsigned int data, unsigned int accesscode)
  Writes one byte to the daughterboard EEPROM.
- int WriteGPIO (unsigned int data, unsigned int mask)
  Sets the state of the GPIO pins.
- int WriteGPIOPort (unsigned int port, unsigned int data, unsigned int mask)
  Sets the output value of the GPIO pins for a specified GPIO port.
- int WriteTrig (int data)
  Sets the output level for the trig output.
8.1 Detailed Description

These functions may be used to access and configure some of the hardware on the device.

8.2 Data Structure Documentation

8.2.1 struct ADQDaisyChainDeviceInformation

Daisy chain device info struct used with SDCardBackupDaisyChainGetTriggerInformation().

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>int64_t</td>
<td>Position</td>
</tr>
<tr>
<td>int64_t</td>
<td>PretriggerSamples</td>
</tr>
<tr>
<td>int64_t</td>
<td>SampleRate</td>
</tr>
<tr>
<td>int64_t</td>
<td>TriggerDelaySamples</td>
</tr>
</tbody>
</table>

8.2.2 struct ADQDaisyChainTriggerInformation

Daisy chain trigger info struct used with SDCardBackupDaisyChainGetTriggerInformation().

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>double *</td>
<td>ExtendedPrecision</td>
</tr>
<tr>
<td>int64_t *</td>
<td>RecordStart</td>
</tr>
<tr>
<td>uint64_t</td>
<td>Timestamp</td>
</tr>
</tbody>
</table>

8.2.3 struct SDCardConfiguration

SD Card configuration struct used with SDCardBackupGetConfiguration().
8.3 Function Documentation

8.3.1 EnableClockRefOut()

```cpp
virtual unsigned int EnableClockRefOut(
    unsigned int enable )
```

Enables or disables the clock reference output signal.

**Parameters**

- `enable`
  
  Output enable selection. Set to 1 for enabled and 0 for disabled.

**Returns**

1 for successful operation and 0 for failure

**Valid for** ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

**See also** SetClockSource()
8.3.2 EnableGPIOPort()

virtual int EnableGPIOPort(
    unsigned int port,
    unsigned int enable)

Enables GPIO mode for a specified I/O port.

Parameters

<table>
<thead>
<tr>
<th>port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port number.</td>
</tr>
</tbody>
</table>

- ADQ7:
  - Port 0: GPIO (always enabled)
  - Port 1: GPDO
  - Port 2: External trigger
  - Port 3: SYNC
- ADQ12/ADQ14:
  - Port 0: GPIO (always enabled)
  - Port 1: GPIOCTRL (always enabled)
  - Port 2: External trigger
  - Port 3: SYNC
- ADQ8:
  - Port 0: Unused
  - Port 1: Unused
  - Port 2: External trigger
  - Port 3: SYNC

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 1 to enable GPIO control of the port</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note  When SYNC is enabled as GPIO, the API SetTriggerInputImpedance will not have any effect for SYNC pin.

Valid for  ADQ12, ADQ14, ADQ7, ADQ8

See also  SetTriggerInputImpedance()

8.3.3 EnableGPIOSupplyOutput()

virtual int EnableGPIOSupplyOutput(
    unsigned int enable)

Enable GPIO supply voltage output.

Parameters
enable
Set to 1 to enable the supply voltage output in the GPIO connector

Returns 1 for success, 0 otherwise
Valid for ADQ12, ADQ14, ADQ7

8.3.4 HasAdjustableBias()

virtual unsigned int HasAdjustableBias ()
Checks whether the device supports adjustable DC-biasing of the ADC frontends.
Returns 1 if adjustable biasing is supported, 0 otherwise
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQ214, ADQ212, ADQ114, ADQ112, ADQ12, ADQ14, ADQ7, ADQ8
See also SetAdjustableBias(), GetAdjustableBias

8.3.5 HasAdjustableInputRange()

virtual unsigned int HasAdjustableInputRange ()
Checks whether the device supports adjustable frontend input range.
Returns 1 if adjustable input range is supported, 0 otherwise
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQ214, ADQ212, ADQ114, ADQ112, ADQ12, ADQ14, ADQ7, ADQ8
See also SetInputRange(), GetInputRange()

8.3.6 HasGPIOHardware()

virtual unsigned int HasGPIOHardware ()
Checks whether the device has GPIO hardware.
Returns 1 if unit has GPIO hardware, 0 otherwise
Valid for ADQ12, ADQ14
8.3.7 HasTrigHardware()

virtual unsigned int HasTrigHardware (  
    unsigned int   trignum  )

Checks if variable trigger threshold is available for the unit.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trignum</td>
<td>The number of the trigger to check</td>
</tr>
</tbody>
</table>

Returns 1 if the specified external trigger input exists in the board hardware.

Valid for ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also HasVariableTrigThreshold()

8.3.8 HasTrigoutHardware()

virtual unsigned int HasTrigoutHardware (  
    unsigned int   trignum  )

Checks if a specific external trigger output exists on the unit.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trignum</td>
<td>The number of the trigger to check</td>
</tr>
</tbody>
</table>

Returns 1 if the specified external trigger output exists in the board hardware.

Valid for ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also

8.3.9 HasVariableTrigThreshold()

virtual unsigned int HasVariableTrigThreshold (  
    unsigned int   trignum  )

Checks if variable trigger threshold is available for the unit.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>trignum</td>
<td>The number of the trigger to check</td>
</tr>
</tbody>
</table>

Returns 1 if the specified external trigger input supports variation of the trigger threshold voltage (via the SetExtTrigThreshold() command).
Valid for ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8
See also SetExtTrigThreshold(), HasTrigHardware()

### 8.3.10 ReadEEPROM()

```c
virtual unsigned int ReadEEPROM( 
    unsigned int addr )
```

Reads one byte from the on-board EEPROM.

**Parameters**

<table>
<thead>
<tr>
<th>addr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The byte address to read</td>
</tr>
</tbody>
</table>

**Returns**
The byte read

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
See also WriteEEPROM(), ReadEEPROMDB(), WriteEEPROMDB()

### 8.3.11 ReadEEPROMDB()

```c
virtual unsigned int ReadEEPROMDB( 
    unsigned int addr )
```

Reads one byte from the daughterboard EEPROM.

**Parameters**

<table>
<thead>
<tr>
<th>addr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The byte address to read</td>
</tr>
</tbody>
</table>

**Returns**
The byte read

Valid for ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14, ADQ8
See also WriteEEPROMDB(), WriteEEPROM(), ReadEEPROM()

### 8.3.12 ReadGPIO()

```c
virtual unsigned int ReadGPIO( )
```

Gets the state of the GPIO pins.

**Returns**
The state as a bit field, where bit 0 corresponds to the value of GPIO pin 1, bit 1 to pin 2, and so on.
Example If the returned value is 9, pin 1 and 4 are high, because $9 = 2^3 + 2^0$

Note For firmware older than revision 3991, bit 2 corresponds to pin 2, bit 3 to pin 1, and bit 5 to pin 5.

Valid for ADQ214, ADQ112, ADQ114, ADQ214, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14

See also SetDirectionGPIO(), WriteGPIO()

8.3.13 ReadGPIOPort()

virtual int ReadGPIOPort ( 
    unsigned int  port, 
    unsigned int *  data )

Reads the value seen by the GPIO pins for a specified GPIO port.

Parameters

<table>
<thead>
<tr>
<th>port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port number.</td>
</tr>
<tr>
<td>• ADQ7:</td>
</tr>
<tr>
<td>- Port 0: GPIO (12 bits)</td>
</tr>
<tr>
<td>- Port 1: GPDI (4 bits)</td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
</tr>
<tr>
<td>• ADQ12/ADQ14:</td>
</tr>
<tr>
<td>- Port 0: GPIO (16 bits)</td>
</tr>
<tr>
<td>- Port 1: GPIOCTRL (5 bits)</td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
</tr>
<tr>
<td>• ADQ8</td>
</tr>
<tr>
<td>- Port 0: Unused</td>
</tr>
<tr>
<td>- Port 1: Unused</td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>A pointer to where the readout value should be stored. Each bit corresponds to an I/O pin of the port.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also ReadGPIO()

8.3.14 SDCardBackupDaisyChainGetTriggerInformation()

virtual int SDCardBackupDaisyChainGetTriggerInformation ( 
unsigned int source,
unsigned int edge,
int level,
unsigned int channel,
unsigned int nof_records,
unsigned int record_length,
struct ADQDaisyChainDeviceInformation ∗ device_info,
unsigned int nof_devices,
struct ADQDaisyChainTriggerInformation ∗ trig_info)

Get the daisy chain trigger information from SD card.
See DaisyChainGetTriggerInformation for documentation.
Note that the input parameters must be read from the SD card using SDCardBackupGetConfiguration.

Parameters

source
See DaisyChainGetTriggerInformation()
edge
See DaisyChainGetTriggerInformation()
level
See DaisyChainGetTriggerInformation()
channel
See DaisyChainGetTriggerInformation()
nof_records
See DaisyChainGetTriggerInformation()
record_length
See DaisyChainGetTriggerInformation()
device_info
See DaisyChainGetTriggerInformation()
nof_devices
See DaisyChainGetTriggerInformation()
trig_info
See DaisyChainGetTriggerInformation()

Returns 1 for success, 0 otherwise
Valid for ADQ8
8.3.15 SDCardBackupEnable()

virtual int SDCardBackupEnable ( int enable )

Enables the backup of data to microSD card.
This function must be called between MultiRecordSetup and ArmTrigger

Parameters

enable
0: Disables the backup 1: Enables the backup

Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.16 SDCardBackupGetConfiguration()

virtual int SDCardBackupGetConfiguration ( struct SDCardConfiguration ∗ sdc_config )

Read the device configuration uses for data stored on SD card.
See ADQAPI.h for struct fields.

Parameters

sdc_config
Pointer to SDCardConfiguration struct

Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.17 SDCardBackupGetData()

virtual int SDCardBackupGetData ( void ∗ ∗ targetBuffers, void ∗ targetHeaders, unsigned int targetBufferSize, unsigned char targetBytesPerSample, unsigned int startRecordNumber, unsigned int numberOfRecords, unsigned char channelMask, unsigned int startSample, unsigned int nofSamples )
Read data from SD card. See GetDataWHTS()

The length of the target_buffers and target_headers parameters must match the available data on the SDCard. Use SDCardBackupGetConfiguration to read the configuration used when the data was stored to the SD card.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>target_buffers</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>target_headers</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>target_buffer_size</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>target_bytes_per_sample</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>start_record_number</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>number_of_records</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>channel_mask</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>start_sample</td>
<td>See GetDataWHTS()</td>
</tr>
<tr>
<td>nof_samples</td>
<td>See GetDataWHTS()</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ8

8.3.18 SDCardBackupGetProgress()

virtual int SDCardBackupGetProgress (  
    unsigned int * percent )  

Get the progress of the backup process in percent.

Note that the percent value is ceil, and may report 100 without being finished. Use SDCardBackupGetStatus to check if the write process is finished.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>percent</td>
<td>The completion progress in percent.</td>
</tr>
</tbody>
</table>
Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.19  SDCardBackupGetStatus()

virtual int SDCardBackupGetStatus ( 
    unsigned int * status )

Get the status of the SD card backup procedure.

Parameters

status

- Bit 0: Backup read completed
- Bit 1: Backup read in progress
- Bit 2: Backup FIFO underflow (error)
- Bit 3: Backup FIFO overflow (error)
- Bit 4: Backup FIFO almost full
- Bit 5: Backup FIFO full (error)
- Bit 6: Backup FIFO empty
- Bit 16: Backup write process busy (writing data)
- Bit 17: Backup write process busy (writing configuration)
- Bit 18: Backup write error

Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.20  SDCardBackupResetWriterProcess()

virtual int SDCardBackupResetWriterProcess ( )

Reset the SD card backup process.

The reset will abort an ongoing write process to the SD card. Can be used to reset the process if an error has occurred, i.e. if bit 18 from SDCardBackupGetStatus is set.

Calling this function while the process is busy (if bit 16 or bit 17 is set) will result in loss of data.

Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.21  SDCardBackupSetAdditionalData()

virtual int SDCardBackupSetAdditionalData ( 


unsigned int daisy_chain_position

Set addition information required to parse data from SD card.

Parameters

<table>
<thead>
<tr>
<th>daisy_chain_position</th>
</tr>
</thead>
<tbody>
<tr>
<td>The position of the device in the daisy chain. Setting this parameter is only required if the daisy chain trigger mode is used.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise
Valid for ADQ8

8.3.22 SDCardErase()

virtual int SDCardErase (  
  unsigned int start_block,  
  unsigned int stop_block )

Commands the SDCard to erase blocks from start_block to stop_block (inclusive). start_block - stop_block must be larger than one. A block has a fixed size of 512B.

Parameters

<table>
<thead>
<tr>
<th>start_block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block from where to start erasing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>stop_block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block where to stop erasing</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ8

8.3.23 SDCardGetNofSectors()

virtual unsigned int SDCardGetNofSectors ( )

Get the number of sectors required to store data.

This function should be used to determine the number of sectors that has to be erased.

Note that this function will only return a valid result if called after MultiRecordSetup.

Returns The number of SD card sectors which will be used.
Valid for ADQ8
8.3.24 SDCardInit()

virtual int SDCardInit()

Attempts to bring the compatible high capacity SD-Card through initialization. This should be done before erasing, writing or reading from/to the SD-Card.

Returns 1 for successful operation and 0 for failure

Valid for ADQ8

8.3.25 SDCardIsInserted()

virtual int SDCardIsInserted(int *is_inserted)

Check if the micro SD card is inserted.

Parameters

<table>
<thead>
<tr>
<th>is_inserted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inserted status for the SD card (1 if inserted, 0 otherwise)</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ8

8.3.26 SDCardRead()

virtual int SDCardRead(unsigned int *dst, unsigned int start_block, unsigned int number_of_blocks)

Reads the specified number_of_blocks starting from start_block params. A block has a fixed size of 512B.

Parameters

<table>
<thead>
<tr>
<th>dst</th>
</tr>
</thead>
<tbody>
<tr>
<td>destination buffer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>start_block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block to start reading from</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>number_of_blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of blocks to read</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ8
8.3.27 SDCardWriterStatus()

virtual int SDCardWriterStatus ( 
    unsigned int * status )

Retrieves the status of the microblaze mem Writer process.

Parameters

status
status, 2 internal error, 1 busy, 0 idle

Returns 1 for successful operation and 0 for failure
Valid for ADQ8

8.3.28 SetConfigurationTrig()

virtual unsigned int SetConfigurationTrig ( 
    unsigned int mode, 
    unsigned int pulselength, 
    unsigned int invertoutput )

Sets the configuration of the trig connector.
This command will overwrite any previous calls to SetDirectionTrig().

Parameters

mode
For ADQ7 / ADQ12 / ADQ14 / ADQ8 digitizers, the following mode values are allowed:
- 0 : Trigger set to input (default)
- 1 : Reserved
- 2 : Internal trigger
- 3 : Record acquisition trigger event, uses pulselength argument
- 4 : Level trigger event, uses pulselength argument
- 5 : Internal trigger rising edge, uses pulselength argument
- 6 : Internal trigger falling edge, uses pulselength argument
- 7 : Internal trigger both edges, uses pulselength argument

For V5/V6 digitizers:
- 0x00: Trigger set to input (default)
- 0x01: WriteTrig() data
- 0x05: Trigger state (See app note)
- 0x11: Trigger event, use pulselength to set the length. Wired OR between units, set WriteTrig(1)
- 0x19: Level trigger, use **pulselength** to set the length. Wired OR between units, set WriteTrig(1)
- 0x41: Internal trigger 50% duty cycle
- 0x45: Internal trigger, use **pulselength** to set the length. If mode is OR:ed with bit 5 (mode | 0x20) the special GPIO trigger block will be activated. Triggers are then blocked with an active high input on GPIO connector pin 5.

Some V6 digitizers support up to 2 selectable trigger out ports. Trigger out 1 is configured by mode bits \{20, 2, 6\} Trigger out 2 is configured by mode bits \{23, 22, 21\}

- Bit pattern: Trigger choice
  - 000 writetrig data
  - 001 internal trigger signal (50% duty cycle)
  - 010 use trig_selector from MultiRecord trigger
  - 011 use configurable pulse from internal trigger
  - 100 use ext_trig_vector_i directly
  - 101 use pxie_trig_vector_i[0] (not available for all devices)
  - 110 use pxie_trig_vector_i[1] (not available for all devices)
  - 111 use PrecisePeriodTrig trig event

**Parameters**

<table>
<thead>
<tr>
<th>pulselength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets the length of the output pulse in nanoseconds when trigger connector is used as output. Minimum is 20ns (14.4ns for ADQ112 and ADQ212) and maximum is 5100 ns (3672ns for ADQ112 and ADQ212)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>invertoutput</th>
</tr>
</thead>
<tbody>
<tr>
<td>If set to 1, the output will be inverted</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for: ADQ212, ADQ112, ADQ114, ADQ214, ADQ1600, ADQ412, ADQ12, ADQ14, ADQ7, ADQ8

See also: WriteTrig(), SetDirectionTrig(), SetupTriggerOutput()

### 8.3.29 SetDACOffsetVoltage()

```cpp
def SetDACOffsetVoltage(channel: int, v: float) -> bool:
    pass
```

Sets the common-mode voltage for the DAC outputs of SDR14.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output channel to set the voltage for (1 or 2)</td>
</tr>
</tbody>
</table>
The common mode voltage to set, from -1.0 to 1.0

Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also AWGArm()

8.3.30 SetDirectionGPIO()

virtual int SetDirectionGPIO(
    unsigned int direction,
    unsigned int mask
)

Sets the direction of the GPIO pins.

Parameters

direction
The configuration as a bit mask:
- bit 0: Sets pin 1 to input if 0 and output as 1
- bit 1: Sets pin 2 to input if 0 and output as 1
- bit 2: Sets pin 3 to input if 0 and output as 1
- bit 3: Sets pin 4 to input if 0 and output as 1
- bit 4: Sets pin 5 to input if 0 and output as 1

mask
A negative bit mask. If a bit here is 1, then the same bit in direction will be ignored.

Returns The state as a bit field, where bit 0 corresponds to the value of GPIO pin 1, bit 1 to pin 2, and so on.

Example If direction is 3 (2^1+2^0) and mask is 1, pin 1 will retain its old configuration (because of the mask), pin 2 will be set to output, and all other pins configured to be input.

Note For firmware older than revision 3991, only pin 5 may be configured.

For SDR14 bits 8-12 are used for muxing GPIO output between API control and AWG control, for example setting bit 8 will give control to the AWG data embedded for GPIO pin 1. Pins still need to be configured as output to enable this feature. Bit 16-20 will decide if GPIO is fed from channel A embedded GPIO data or from channel B embedded GPIO data. Setting a bit will enable taking data from channel B embedded GPIO data.

Valid for ADQ214, ADQ112, ADQ114, ADQ214, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14

See also WriteGPIO(), ReadGPIO()
8.3.31 SetDirectionGPIOPort()  

virtual int SetDirectionGPIOPort(
    
    unsigned int port,
    unsigned int direction,
    unsigned int mask)

Sets the input/output state of the GPIO pins for a specified GPIO port.

Parameters

| **port** | Port number. |
|---------------------------------------------|
| • ADQ7:                                      |
|   - Port 0: GPIO (6 bits. Each bit set direction for two GPIO. Bit 0 is for GPIO0 and GPIO1 and so on) |
|   - Port 1: Not used (GPDI and GPDO has fixed direction) |
|   - Port 2: External trigger (1 bit) |
|   - Port 3: SYNC (1 bit) |
| • ADQ12/ADQ14:                                |
|   - Port 0: GPIO (16 bits) |
|   - Port 1: GPIOCTRL (5 bits) |
|   - Port 2: External trigger (1 bit) |
|   - Port 3: SYNC (1 bit) |
| • ADQ8:                                       |
|   - Port 0: Unused |
|   - Port 1: Unused |
|   - Port 2: External trigger (1 bit) |
|   - Port 3: SYNC (1 bit) |

<table>
<thead>
<tr>
<th><strong>direction</strong></th>
<th>Each bit corresponds to an I/O pin of the port, set to 0 for input, 1 for output.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>mask</strong></th>
<th>Only bits which are zero-valued in the mask will be changed</th>
</tr>
</thead>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8
See also SetDirectionGPIO()

8.3.32 SetDirectionTrig()  

virtual int SetDirectionTrig(
    
    int direction)

Sets the direction of the trig connector.

Parameters
The specified direction. These values are valid:

- 0: Input
- 1: Output, data from WriteTrig calls
- 5: Output, a positive pulse for each trigger accepted (ignores WriteTrig() calls). Not available for ADQ108 and ADQ208

Returns 1 for successful operation and 0 for failure
Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, ADQ1600
See also SetConfigurationTrig(), WriteTrig()

### 8.3.33 SetFanControl()

```cpp
def SetFanControl(fan_control):
    # Sets the fan control of the device.
    # Parameters:
    # fan_control: Bit field that control the fans:
    #   - bit 31: Set to 0 for automatic mode and 1 for manual override (not valid for ADQ12 / ADQ14)
    #   - bit 30: Set to 0 to keep fan failure monitoring and 1 to disable (not valid for ADQ12 / ADQ14)
    #   - bit 29: Set to 0 to restart the fan and 1 to shutdown (not valid for ADQ12 / ADQ14)
    #   - bits 0 to 3: Set the fan speed from 0-15

    # Returns 1 for successful operation and 0 for failure
    # Valid for ADQ214, ADQ212, ADQ112, ADQ114, SDR14, ADQ412, ADQ1600, ADQ108, ADQ208, ADQ12, ADQ14
```

### 8.3.34 SetFunctionGPIOPort()

```cpp
def SetFunctionGPIOPort(port, function_id, gpio_id):
    # Control the GPIO output functions.
    # The function is controlled for each pin. Enable the function by setting function_id to 1. The available functions for each pin are listed below.
    # - GPIO 0 (out):
```
- Function id 0: Disabled.
- Function id 1: Data in user range. The pin is high when the data is within a specified range. The range must be specified with SetupUserRangeGPIO().

- **GPIO 1 (out):**
  - Function id 0: Disabled.
  - Function id 1: Trigger blocking window. High when triggers are accepted.

- **GPIO 2 (out):**
  - Function id 0: Disabled.
  - Function id 1: Trigger blocking armed. High when armed, low otherwise.

- **GPIO 3 (out):**
  - Function id 0: Disabled.
  - Function id 1: Data path overflow.

- **GPIO 4 (out):**
  - Function id 0: Disabled.
  - Function id 1: Trigger out. Must be configured with SetupTriggerOutput().

- **GPIO 5 (out):**
  - Function id 0: Disabled.
  - Function id 1: ATD: Ongoing accumulation. DAQ: Acquiring record.

- **GPIO 6 (out):**
  - Function id 0: Disabled.
  - Function id 1: Frame sync signal. See SetupFrameSync()

- **GPIO 7 (out):**
  - Function id 0: Disabled.
  - Function id 1: 10 MHz clock reference

- **GPIO 8 (out):**
  - Function id 0: Disabled.
  - Function id 1: Data acquisition armed

- **GPIO 9 (out):**
  - Function id 0: Disabled.
  - Function id 1: N/A

- **GPIO 10 (in):**
  - Function id 0: Disabled.
  - Function id 1: Trigger 0 in

- **GPIO 11 (in):**
  - Function id 0: Disabled.
- Function id 1: Trigger 1 in

Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>port</td>
<td>Port number. Must be 0 (single-ended GPIO)</td>
</tr>
<tr>
<td>function_id</td>
<td>See table above</td>
</tr>
<tr>
<td>gpio_id</td>
<td>GPIO pin ID</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ7-PCIe/PXle

See also WriteGPIO()

8.3.35 SetupTriggerOutput()

```cpp
virtual unsigned int SetupTriggerOutput(
    int outputnum,
    unsigned int mode,
    unsigned int pulselength,
    unsigned int invertoutput
)
```

Sets the configuration of the trig connector.

Parameters

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>outputnum</td>
<td>Selects the trigger output port:</td>
</tr>
<tr>
<td></td>
<td>• 0 : The TRIG connector</td>
</tr>
<tr>
<td></td>
<td>• 1 : MLVDS RX17 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 2 : MLVDS TX17 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 3 : MLVDS RX18 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 4 : MLVDS TX18 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 5 : MLVDS RX19 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 6 : MLVDS TX19 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 7 : MLVDS RX20 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 8 : MLVDS TX20 (MTCA only)</td>
</tr>
<tr>
<td></td>
<td>• 9 : PXle STARC (PXle only)</td>
</tr>
<tr>
<td></td>
<td>• 10: PXI TRIG0 (PXle only)</td>
</tr>
<tr>
<td></td>
<td>• 11: PXI TRIG1 (PXle only)</td>
</tr>
<tr>
<td></td>
<td>• 12: The SYNC connector</td>
</tr>
<tr>
<td></td>
<td>• 13: GPIO trigout pin (ADQ7-PCIe/PXle only).</td>
</tr>
</tbody>
</table>

GPIO pin function must be set for output to be active, see SetFunctionGPIOPort(). Uses the same logic internally as TRIG connector (mode 0), and can not be configured independently of TRIG connector.
mode
Selects a source signal for the trigger output, as follows:
- 0: Trigger output disabled (default)
- 1: Reserved
- 2: Internal trigger
- 3: Record acquisition trigger event, uses pulselength argument
- 4: Level trigger event, uses pulselength argument
- 5: Internal trigger rising edge, uses pulselength argument
- 6: Internal trigger falling edge, uses pulselength argument
- 7: Internal trigger both edges, uses pulselength argument
- 8: External trigger (TRIG connector)
- 9: Trigger blocking status event, uses pulselength argument (ADQ14 only)
- 10: Enable WR PPS output (SYNC connector on ADQ7 only)
- 11: Sync trigger input, rising edge, uses pulselength argument (ADQ7 only)

pulselength
Sets the length of the output pulse in nanoseconds.

invertoutput
If set to 1, the output will be inverted

Returns 1 for successful operation and 0 for failure

Note TRIG/SYNC share the same trigger output source, pulser and inversion circuitry (cannot be independently set). All MLVDS/PXI/PXIe share the same trigger output source, pulser and inversions circuitry (cannot be independently set)

On ADQ14/ADQ12 mode 2 requires both edges of the internal trigger to be generated (set with SetTriggerEdge)

Valid for ADQ12, ADQ14, ADQ7

8.3.36 SetupUserRangeGPIO()

virtual int SetupUserRangeGPIO (
    unsigned int channel,
    int threshold_high,
    int threshold_low )

Configure User Range GPIO function.

The user range bit is high when the input signal is below the high threshold and above the low threshold (including the threshold values). Only one channel may be used.

User range GPIO function pin must also be enabled with SetFunctionGPIOPort()

Parameters

channel
Channel index, starting at 1
threshold_high
High threshold in ADC codes.

threshold_low
Low threshold in ADC codes

Returns 1 for success, 0 otherwise
Valid for ADQ7
See also SetFunctionGPIOPort

8.3.37 TrigoutEnable()

virtual unsigned int TrigoutEnable ( unsigned int bitflags )

Selects which trigout connectors to send a trigger output to.
Parameters

bitflags
A bit field where the two first bits do this:
• bit 0: If this bit is asserted the signal will be output on trigout1
• bit 1: If this bit is asserted the signal will be output on trigout2

Returns 1 for successful operation and 0 for failure
Valid for ADQ1600

8.3.38 WriteEEPROM()

virtual unsigned int WriteEEPROM ( unsigned int addr,
                                unsigned int data,
                                unsigned int accesscode )

Writes one byte to the on-board EEPROM.

Lower addresses are reserved for internal use and are protected by an access code, while higher addresses are free to use for storage of customer data.
• ADQ12/ADQ14/ADQ7/ADQ8: Addresses 0x000000 to 0x00FFFF are write protected, highest address is 0x03FFFF
• Other digitizers: Addresses 0x000000 to 0x003FFF are write protected, highest address is 0x00FFFF

Parameters
```cpp
virtual unsigned int WriteEEPROMDB ( unsigned int addr, unsigned int data, unsigned int accesscode )
```

Writes one byte to the daughterboard EEPROM.

The daughterboard EEPROM is completely reserved for internal use only.

**Parameters**

- **addr**
  The byte address to write.

- **data**
  The data to write (8 bits)

- **accesscode**
  Internal use only, set to 0 for normal operation

**Returns**

1 for successful operation and 0 for failure

**Valid for**

ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

**See also**

ReadEEPROMDB(), WriteEEPROM(), ReadEEPROM()

---

```cpp
virtual int WriteGPIO ( unsigned int data, unsigned int mask )
```

**Parameters**

- **data**
  The data to write (8 bits)

- **accesscode**
  Internal use only, set to 0 for normal operation

**Returns**

1 for successful operation and 0 for failure

**Valid for**

ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14, ADQ8

**See also**

ReadEEPROMDB(), WriteEEPROM(), ReadEEPROM()
Sets the state of the GPIO pins.

Only the bits that are configured as output will be written. To select these bits, use SetDirectionGPIO().

**Parameters**

| **data** | The values to write. Bit 0 sets GPIO pin 1, bit 1 pin 2 and so forth |
| **mask** | A negative bit mask. If a bit here is 1, then the same bit in data will be ignored. |

**Returns** The state as a bit field, where bit 0 corresponds to the value of GPIO pin 1, bit 1 to pin 2, and so on.

**Example** If `data` is 3 \((2^1 + 2^3)\) and `mask` is 1, pin 1 will retain its old value (because of the mask), pin 2 will be set to 1, and all other pins will be 0.

**Note** For firmware older than revision 3991, bit 2 corresponds to pin 2, bit 3 to pin 1, and bit 5 to pin 5.

**Valid for** ADQ214, ADQ112, ADQ114, ADQ214, ADQ412, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14

**See also** SetDirectionGPIO(), ReadGPIO()

### 8.3.41 WriteGPIOPort()

```cpp
virtual int WriteGPIOPort (
    unsigned int port,
    unsigned int data,
    unsigned int mask )
```

Sets the output value of the GPIO pins for a specified GPIO port.

**Parameters**

<table>
<thead>
<tr>
<th><strong>port</strong></th>
<th>Port number.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>• ADQ7:</strong></td>
<td></td>
</tr>
<tr>
<td>- Port 0: GPIO (12 bits)</td>
<td></td>
</tr>
<tr>
<td>- Port 1: GPDO (3 bits)</td>
<td></td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
<td></td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
<td></td>
</tr>
<tr>
<td><strong>• ADQ8:</strong></td>
<td></td>
</tr>
<tr>
<td>- Port 0: Unused</td>
<td></td>
</tr>
<tr>
<td>- Port 1: Unused</td>
<td></td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
<td></td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
<td></td>
</tr>
<tr>
<td><strong>• ADQ12/ADQ14:</strong></td>
<td></td>
</tr>
<tr>
<td>- Port 0: GPIO (16 bits)</td>
<td></td>
</tr>
<tr>
<td>- Port 1: GPIOCTRL (5 bits)</td>
<td></td>
</tr>
<tr>
<td>- Port 2: External trigger (1 bit)</td>
<td></td>
</tr>
<tr>
<td>- Port 3: SYNC (1 bit)</td>
<td></td>
</tr>
</tbody>
</table>
data
Each bit corresponds to an I/O pin of the port, set desired output value.

mask
Only bits which are zero-valued in the mask will be changed

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8
See also WriteGPIO()

8.3.42 WriteTrig()

virtual int WriteTrig (
    int  data
)

Sets the output level for the trig output.

Parameters

data
Specifies the level. Set to 0 for low output and 1 for high output.

Returns 1 for successful operation and 0 for failure
Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ1600, ADQ412, ADQ108, ADQ208
See also SetDirectionTrig()

9 Trigger Options

Functions

- int ArmTimestampSync ()
  Arm the timestamp synchronization (disarm must be done prior to arm)
- int ArmTriggerBlocking ()
  Arm the trigger blocking engine (disarm must be done prior to arm)
- int DisarmTimestampSync ()
  Disarm the timestamp synchronization.
- int DisarmTriggerBlocking ()
  Disarm the trigger blocking engine.
- int EnableFrameSync (unsigned int enable)
  Enables frame sync output.
- int EnableLevelTriggerLogicOr (int channel, int enable)
Enable the level trigger OR functionality.

- int GetExternalTimestamp (unsigned long long *value, unsigned int *valid, unsigned int *status_bits)
  
  Gets the saved external timestamp.

- unsigned int GetExternTrigEdge (unsigned int *edge)
  
  Gets the current external trigger edge.

- int GetLvlTrigChannel ()
  
  Gets the channels for which the level trigger is active.

- int GetLvlTrigEdge ()
  
  Gets the current level trigger edge.

- int GetLvlTrigLevel ()
  
  Gets the current level trigger level.

- int GetTimestampSyncCount (unsigned int *count)
  
  Gets the number of timestamp synchronizations.

- int GetTimestampSyncState (unsigned int *state)
  
  Gets the state of the timestamp sync.

- int GetTimestampValue (unsigned long long *value)
  
  Retrieve the current timestamp value.

- unsigned int GetTriggerBlockingGateCount ()
  
  Returns the current number of detected gates. DisarmTriggerBlocking() resets the counter.

- int GetTriggerEdge (unsigned int trigger, unsigned int *edge)
  
  Read the edge selection for a specified trigger source.

- int GetTriggerInputImpedance (unsigned int input_num, unsigned int *mode)
  
  Get the trigger connector input impedance.

- int GetTriggerMode ()
  
  Gets the current clock source.

- int ResetTimestamp (void)
  
  Reset the timestamp.

- int SetAuxTriggerMode (int trig_mode)
  
  Sets the trigger source for the auxiliary trigger path (only usable in the DevKit)

- unsigned int SetExternalTriggerDelay (unsigned char delaycycles)
  
  Sets the delay of the external trigger to match the data path.

- unsigned int SetExternTrigEdge (unsigned int edge)
  
  Selects which edge the external trigger input shall trigger on.

- unsigned int SetExtTrigThreshold (unsigned int trignum, double vthresh)
  
  Sets the threshold voltage of the specified external trigger input.

- unsigned int SetInternalTriggerFrequency (unsigned int Int_Trig_Freq)
  
  Sets the internal trigger frequency in Hertz.

- int SetInternalTriggerHighLow (unsigned int HighSamples, unsigned int LowSamples)
  
  Sets the high and low length of the internal trigger.
- unsigned int SetInternalTriggerPeriod (unsigned int TriggerPeriodClockCycles)
  Sets the period of the internal trigger.
- int SetLevelTriggerSequenceLength (unsigned int channel, unsigned int sequence_length)
  Set the level trigger sequence length.
- int SetLvlTrigChannel (int channel)
  Sets the channels to level trig from.
- int SetLvlTrigEdge (int edge)
  Sets the level trigger edge.
- int SetLvlTrigLevel (int level)
  Sets the level trigger code level.
- unsigned int SetSTARBTrigEdge (unsigned int edge)
  Selects which edge the STARB trigger input shall trigger on.
- unsigned int SetSyncTriggerDelay (unsigned char delaycycles)
  Sets the delay of the sync trigger to match the data path.
- int SetTriggerEdge (unsigned int trigger, unsigned int edge)
  Enables generation of trigger events on rising and/or falling trigger edges for a specified trigger source.
- int SetTriggerInputImpedance (unsigned int input_num, unsigned int mode)
  Sets the trigger connector input impedance.
- int SetTriggerMode (int trig_mode)
  Sets how the ADQ should be trigged.
- int SetTriggerThresholdVoltage (unsigned int trigger, double vthresh)
  Sets the threshold voltage of the specified trigger input.
- int SetTrigLevelResetValue (int OffsetValue)
  Sets the level trigger reset value.
- int SetupFrameSync (unsigned int frame_len, unsigned int frame_factor, unsigned int edge)
  Setup frame sync.
- unsigned int SetupLevelTrigger (const int *level, const int *edge, const int *reset_level, unsigned int channel_mask, unsigned int individual_mode)
  Sets up the level trigger.
- int SetupTimestampSync (unsigned int mode, unsigned int trig_source)
  Set up a synchronization of the timestamp counter to a trigger source.
- int SetupTriggerBlocking (unsigned int mode, unsigned int trig_source, uint64_t window_length, unsigned int tcount_limit)
  Set up trigger blocking from another trigger source.
- int SWTrig ()
  Triggers the digitizer via a register write.

9.1 Detailed Description

Multiple trigger modes are available for the devices. The most frequently used ones are documented here.
9.2 Function Documentation

9.2.1 ArmTimestampSync()

virtual int ArmTimestampSync ( )

Arm the timestamp synchronization (disarm must be done prior to arm)

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also DisarmTimestampSync()

9.2.2 ArmTriggerBlocking()

virtual int ArmTriggerBlocking ( )

Arm the trigger blocking engine (disarm must be done prior to arm)

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also DisarmTriggerBlocking()

9.2.3 DisarmTimestampSync()

virtual int DisarmTimestampSync ( )

Disarm the timestamp synchronization.

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also ArmTimestampSync()

9.2.4 DisarmTriggerBlocking()

virtual int DisarmTriggerBlocking ( )

Disarm the trigger blocking engine.

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also ArmTriggerBlocking()
9.2.5 EnableFrameSync()

virtual int EnableFrameSync (
    unsigned int enable )

Enables frame sync output.

Enables frame sync output on the SYNC connector

Parameters

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 1 to enable frame sync output, 0 to disable.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ12, ADQ14, ADQ7

See also SetupFrameSync()

9.2.6 EnableLevelTriggerLogicOr()

virtual int EnableLevelTriggerLogicOr (
    int channel,
    int enable )

Enable the level trigger OR functionality.

This function enables or disables logic OR between level trigger events and events from the channel's trigger source specified through either SetTriggerMode() or SetParameters().

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The target channel, indexed from 1 and upwards.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to a nonzero value to enable, zero to disable.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ8

9.2.7 GetExternalTimestamp()

virtual int GetExternalTimestamp (
    unsigned long long *value,
    unsigned int *valid,
    unsigned int *status_bits )

Gets the saved external timestamp.
Parameters

<table>
<thead>
<tr>
<th>value</th>
<th>Pointer to timestamp value</th>
</tr>
</thead>
<tbody>
<tr>
<td>valid</td>
<td>Status for the returned timestamp</td>
</tr>
<tr>
<td>status_bits</td>
<td>Extra status bits, see White Rabbit App Note for more information</td>
</tr>
</tbody>
</table>

Returns 1
Valid for ADQ7
See also SetupTimestampSync() ArmTimestampSync()

9.2.8 GetExternTrigEdge()

virtual unsigned int GetExternTrigEdge ( unsigned int * edge )

Gets the current external trigger edge.

Parameters

<table>
<thead>
<tr>
<th>edge</th>
<th>Pointer to where the result is returned. One of these values are returned:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• 0: Falling edge</td>
</tr>
<tr>
<td></td>
<td>• 1: Rising edge</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, SDR14, ADQ1600, ADQ12, ADQ14
See also SetExternTrigEdge()

9.2.9 GetLvlTrigChannel()

virtual int GetLvlTrigChannel ( )

Gets the channels for which the level trigger is active.

The value returned from this function is a bitmask that indicates which channels that are active.
Return value = 0: None
Return value = 1: Channel A  
Return value = 2: Channel B  
Return value = 4: Channel C  
Return value = 8: Channel D  
Return value = 10 => Both Channel B and D  
Return value = 15 => All Channels

Returns A bitmask with the active channels  
Valid for ADQ208, ADQ212, ADQ214, ADQ412, SDR14, ADQ12, ADQ14  
See also SetLvlTrigChannel()

9.2.10 GetLvlTrigEdge()  

virtual int GetLvlTrigEdge ( )  
Gets the current level trigger edge.  
Returns 1 for rising edge and 0 for falling edge  
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14  
See also SetLvlTrigEdge()

9.2.11 GetLvlTrigLevel()  

virtual int GetLvlTrigLevel ( )  
Gets the current level trigger level.  
Please see SetLvlTrigLevel for more information.  
Returns The current set level  
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14  
See also SetLvlTrigLevel()

9.2.12 GetTimestampSyncCount()  

virtual int GetTimestampSyncCount (  
    unsigned int * count )  
Gets the number of timestamp synchronizations.  
The counter is reset by DisarmTimestampSync().  
Parameters
count
Pointer to an unsigned int where the result is stored.

Returns 1 for successful operation and 0 for failure
Valid for ADQ7

9.2.13 GetTimestampSyncState()

virtual int GetTimestampSyncState ( 
  unsigned int * state )

Gets the state of the timestamp sync.

Parameters

state
Pointer to unsigned int for the result (0 is not synchronized, 1 is synchronized)

Returns 1 for successful operation and 0 for failure
Valid for ADQ7, ADQ12, ADQ14, ADQ8
See also ArmTimestampSync()

9.2.14 GetTimestampValue()

virtual int GetTimestampValue ( 
  unsigned long * value )

Retrieve the current timestamp value.

Capture and read out the digitizer's monotonically increasing timestamp. This function has no guarantees on timing.

Parameters

value
Pointer to timestamp value

Returns 1 for successful operation and 0 for failure
Valid for ADQ7, ADQ14, ADQ12
9.2.15 GetTriggerBlockingGateCount()

virtual unsigned int GetTriggerBlockingGateCount ( )

Returns the current number of detected gates. DisarmTriggerBlocking() resets the counter.

Deprecated from firmware revision 43153 for ADQ7, please use GetTimestampSyncCount() instead.

Returns The number of detected gates.

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also GetTimestampSyncCount()

9.2.16 GetTriggerEdge()

virtual int GetTriggerEdge ( unsigned int trigger, unsigned int * edge )

Read the edge selection for a specified trigger source.

Parameters

| trigger | The selected trigger source, see SetTriggerEdge for numbering |
| edge    | Pointer to an unsigned int where the value should be stored |

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also SetTriggerEdge()

9.2.17 GetTriggerInputImpedance()

virtual int GetTriggerInputImpedance ( unsigned int input_num, unsigned int * mode )

Get the trigger connector input impedance.

Parameters

| input_num | Set to 1 for external trigger input connector and 2 for sync connector |
| mode      | Return argument, 0 means 50 ohms input, 1 means high impedance mode |
Returns 1 for successful operation and 0 for failure.

Note When SYNC is enabled as GPIO, the API SetTriggerInputImpedance will not have any effect for SYNC pin.

Valid for ADQ12, ADQ14, ADQ7, ADQ8
See also EnableGPIOPort()

9.2.18 GetTriggerMode()

virtual int GetTriggerMode ( )

Gets the current clock source.

Please see SetTriggerMode() for an explanation of the values.

Returns The clock source

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7
See also SetTriggerMode()

9.2.19 ResetTimestamp()

virtual int ResetTimestamp ( )

Reset the timestamp.

Reset the digitizer's monotonically increasing timestamp to zero. This function has no guarantees on timing.

Returns 1 for successful operation and 0 for failure

Valid for ADQ7, ADQ14, ADQ12

9.2.20 SetAuxTriggerMode()

virtual int SetAuxTriggerMode ( int trig_mode )

Sets the trigger source for the auxiliary trigger path (only usable in the DevKit)

Parameters
trig_mode
The selected trigger mode:
- 1: Software trigger
- 2: External trigger
- 3: Level trigger (ADQ12/ADQ14 only)
- 4: Internal trigger
- 6: PXIe STARB trigger (ADQ12/ADQ14 only)
- 7: OCT trigger (only available on ADQ14OCT)
- 9: SYNC trigger
- 10: MLVDS trigger
- 12: External trigger, resynchronized to reference clock
- 14: PXI triggers
- 16: PXIe STARB trigger, resynchronized to reference clock (ADQ12/ADQ14 only)

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7
See also SetTriggerMode()

9.2.21 SetExternalTriggerDelay()

virtual unsigned int SetExternalTriggerDelay ( unsigned char delaycycles )

Sets the delay of the external trigger to match the data path.
In default configurations this is setup correctly by the API. If there is additional delay in user configured logic, this API call may be used to compensate correctly.

Parameters

delaycycles
The number of data path clock cycles to delay the external trigger. For ADQ7 and ADQ8, valid values are 1-127. For ADQ12 / ADQ14 the only valid values are 0 and 37.

Returns 1 for successful operation and 0 for failure
Note
- Data path clock cycle is 4 samples on ADQ12, ADQ14, ADQ112 and ADQ114 and 2 samples on ADQ214 and ADQ212.
- Data path clock cycle is 32 samples on ADQ7-10GSPS mode and 16 samples on ADQ7-5GSPS mode (each step is 3.2ns)
- Data path clock cycle is 4 ns on ADQ8.
Valid for ADQ214, ADQ114, ADQ212, ADQ112, ADQ7, ADQ12, ADQ14, ADQ8
See also SetTriggerMode()
9.2.22 SetExternTrigEdge()

virtual unsigned int SetExternTrigEdge ( unsigned int edge )

Selects which edge the external trigger input shall trigger on.

Parameters:

edge
Specifies which edge to use:
- 0: Falling edge
- 1: Rising edge
- 2: Both edges (ADQ12 / ADQ14 only)

Returns 1 for successful operation and 0 for failure.

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, SDR14, ADQ1600, ADQ12, ADQ14

See also SetTriggerMode()

9.2.23 SetExtTrigThreshold()

virtual unsigned int SetExtTrigThreshold ( unsigned int trignum, double vthresh )

Sets the threshold voltage of the specified external trigger input.

Parameters:

trignum
The trigger number. Allowed numbers are hardware dependent (some boards only have trig1, others have 1,2,3, etc.).

vthresh
The Threshold voltage. 0.5V is default.

Returns 1 for successful operation and 0 for failure.

Note Not all hardware supports threshold adjustment, see HasVariableTrigThreshold()

Valid for ADQ1600, ADQ12, ADQ14

See also HasVariableTrigThreshold(), SetTriggerMode()

9.2.24 SetInternalTriggerFrequency()

virtual unsigned int SetInternalTriggerFrequency ( )
unsigned int Int_Trig_Freq )

Sets the internal trigger frequency in Hertz.

The actual frequency set by the ADQ is an approximation of the desired frequency. It is also dependent on the sampling frequency. Thus, if the sampling frequency is changed, please set the trigger period manually using SetInternalTriggerPeriod().

Parameters

<table>
<thead>
<tr>
<th>Int_Trig_Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>The frequency in Hertz</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ214, ADQ208, ADQ1600, ADQ412, SDR14

See also SetInternalTriggerPeriod(), SetTriggerMode()

9.2.25 SetInternalTriggerHighLow()

virtual int SetInternalTriggerHighLow (  
    unsigned int HighSamples,  
    unsigned int LowSamples )

Sets the high and low length of the internal trigger.

Parameters

<table>
<thead>
<tr>
<th>HighSamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of time the internal trigger should remain high, in ADC-sample units</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LowSamples</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of time the internal trigger should remain low, in ADC-sample units</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also SetInternalTriggerPeriod()

9.2.26 SetInternalTriggerPeriod()

virtual unsigned int SetInternalTriggerPeriod (  
    unsigned int TriggerPeriodClockCycles )

Sets the period of the internal trigger.

Parameters
TriggerPeriodClockCycles
The trigger period given as a number of internal clock cycles. The internal clock cycle length is related to the 
sample clock frequency according to the below:

- **ADQ112, ADQ114 & SDR14**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (4 / F_s) \)
- **ADQ212 & ADQ214**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (2 / F_s) \)
- **ADQ108 & ADQ208**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (32 / F_s) \)
- **ADQ1600**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (8 / F_s) \)
- **ADQ412**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (8 / F_s) \), where \( F_s \) is the four-channel mode sampling frequency
- **ADQ12, ADQ14, ADQ7, ADQ8**: \( \text{Period} = \text{TriggerPeriodClockCycles} \times (1 / F_s) \)

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ12, 
ADQ14, ADQ7, ADQ8

See also SetInternalTriggerFrequency()

### 9.2.27 SetLevelTriggerSequenceLength()

```cpp
virtual int SetLevelTriggerSequenceLength ( 
    unsigned int channel, 
    unsigned int sequence_length )
```

Set the level trigger sequence length.

The **sequence length** is the minimum number of samples required to be above or below the level trigger threshold in order for a trigger event to be generated.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The target channel, indexed from 1 and upwards.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>sequence_length</th>
</tr>
</thead>
<tbody>
<tr>
<td>The length of the trigger sequence, i.e. the minimum number of samples required to have crossed the level trigger threshold. A sequence length of 1 sample is the default value. The value has to fall in the range:</td>
</tr>
</tbody>
</table>

- **ADQ7**: \([1, 4]\)

Returns 1 for successful operation and 0 for failure

Valid for ADQ7

See also SetupLevelTrigger()
### 9.2.28 SetLvlTrigChannel()

```cpp
def virtual int SetLvlTrigChannel (int channel):
    # Sets the channels to level trig from.

    # Parameters
    channel
    A mask that tells the ADQ which channels that are active
    - channels = 0 => None
    - channels = 1 => Channel A
    - channels = 2 => Channel B
    - channels = 4 => Channel C
    - channels = 8 => Channel D
    To trig on multiple channels add the channel code for each individual channel. Examples:
    - channels = 10 => Any of Channel B and D
    - channels = 15 => Any Channel Values given for any non-existing channel is simply ignored

    # Returns
    1 for successful operation and 0 for failure

    # Note
    When interleaving on ADQ412 or ADQ208, enable level trigger for both channels that are interleaved
    (that is, use ChannelCode = 0, 3, 12 or 15). This is because channel A&B and C&D are interleaved.
    For V6 digitizers, the function SetupLevelTrigger may be used to set up all level trigger parameters in
    one call.
    On ADQ7 only a single bit in the mask can be set, only one channel is allowed to at once generate
    the trigger. On ADQ12 and ADQ14 only masks 1,2,4,8 (single bit) and masks 3 (A+B), 12 (C+D), 15
    (A+B+C+D) are allowed.

    # Valid for
    ADQ108, ADQ1600, ADQ208, ADQ212, ADQ214, ADQ412, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

    # See also
    SetupLevelTrigger(), GetLvlTrigChannel(), SetLvlTrigEdge()
```

### 9.2.29 SetLvlTrigEdge()

```cpp
def virtual int SetLvlTrigEdge (int edge):
    # Sets the level trigger edge.

    # Parameters
    edge
    Trigger edge

    # Returns
    1 for successful operation and 0 for failure

    # Valid for
    ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ12,
ADQ14, ADQ7, ADQ8
See also SetLvlTrigLevel(), SetTriggerMode()

9.2.30 SetLvlTrigLevel()

virtual int SetLvlTrigLevel (  
  int level )  

Sets the level trigger code level.

Parameters

level  
Trigger level in codes

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8
See also SetLvlTrigEdge(), SetTriggerMode()

9.2.31 SetSTARBTrigEdge()

virtual unsigned int SetSTARBTrigEdge (  
  unsigned int edge )  

Selects which edge the STARB trigger input shall trigger on.

Parameters

edge  
Specifies which edge to use:
  - 0: Falling edge
  - 1: Rising edge
  - 2: Both edges

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14
See also SetTriggerMode()

9.2.32 SetSyncTriggerDelay()

virtual unsigned int SetSyncTriggerDelay (  

unsigned char delaycycles )

Sets the delay of the sync trigger to match the data path.
In default configurations this is setup correctly by the API. If there is additional delay in user configured logic, this API call may be used to compensate correctly.

Parameters

| delaycycles |
The number of data path clock cycles to delay the external trigger. For ADQ7, valid values are 1-63

Returns 1 for successful operation and 0 for failure

Note 1 data path clock cycle is 32 samples on ADQ7-10GSPS mode and 16 samples on ADQ7-5GSPS mode

Valid for ADQ7

See also SetTriggerMode()

9.2.33 SetTriggerEdge()

virtual int SetTriggerEdge ( unsigned int trigger, unsigned int edge )

Enables generation of trigger events on rising and/or falling trigger edges for a specified trigger source.

Parameters

| trigger |
The selected trigger source:
- 1: Software trigger
- 2: External trigger 1
- 3: Level trigger
- 4: Internal trigger
- 6: PXI triggers
- 9: SYNC connector
- 10: MTCA MLVDS triggers
- 25: GPIO Trig 0 (ADQ7-PCIe/PXIe only)
- 26: GPIO Trig 1 (ADQ7-PCIe/PXIe only)

| edge |
Specifies which edge should generate a trigger event:
- 0: Falling edge
- 1: Rising edge
- 2: Both edges

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8
See also SetTriggerMode()

9.2.34 SetTriggerInputImpedance()

virtual int SetTriggerInputImpedance (    
    unsigned int input_num,    
    unsigned int mode )

Sets the trigger connector input impedance.

Parameters

<table>
<thead>
<tr>
<th>input_num</th>
<th>Set to 1 for external trigger input connector and 2 for sync connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode</td>
<td>Set to 0 for 50 ohm input, set to 1 for high impedance mode</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note When SYNC is enabled as GPIO, the API SetTriggerInputImpedance will not have any effect for SYNC pin.

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also EnableGPIOPort()

9.2.35 SetTriggerMode()

virtual int SetTriggerMode (    
    int trig_mode )

Sets how the ADQ should be trigged.

Parameters
### trig_mode

The selected trigger mode:

- 1: Software trigger only
- 2: External trigger 1
- 3: Level trigger
- 4: Internal trigger
- 6: PXIe STARB trigger
- 7: External trigger 2
- 8: External trigger 3
- 9: SYNC connector
- 10: MLVDS (MTCA backplane) (ADQ12 / ADQ14 / ADQ7 / ADQ8 only)
- 11: External trigger 1, gated with sync input (ADQ7 / ADQ8 only)
- 12: External trigger 1, resynchronized to clock reference (ADQ12 / ADQ14 / ADQ8 only)
- 13: MLVDS (MTCA backplane), resynchronized to clock reference (ADQ12 / ADQ14 / ADQ7 / ADQ8 only)
- 14: PXI Trig (PXI_TRIG0, PXI_TRIG1, PXI_STARA) (ADQ12 / ADQ14 / ADQ7 / ADQ8 only)
- 16: PXIe STARB trigger, resynchronized to clock reference (ADQ12 / ADQ14)
- 19: SYNC connector, resynchronized to clock reference
- 20: Reserved for internal use (ADQ12 / ADQ14 only)
- 21: Reserved for internal use (ADQ12 / ADQ14 only)
- 23: Daisy chain trigger (ADQ8 only)
- 24: Software trigger, resynchronized to clock reference (ADQ8 only)
- 25: GPIO Trig 0 (ADQ7-PCIe/PXIe only)
- 26: GPIO Trig 1 (ADQ7-PCIe/PXIe only)
- 920: Reserved for internal use (ADQ12 / ADQ14 only)
- 921: Reserved for internal use (ADQ12 / ADQ14 only)

**Returns** 1 for successful operation and 0 for failure

**Note** The software trigger is always enabled regardless of mode

External triggers 2 and 3 are not available on all ADQs. SYNC connector is only available on ADQ12 / ADQ14.

MLVDS triggers to listen for is configured with SetTriggerMaskMLVDS (also needs to be configured as inputs with SetDirectionMLVDS)

**Valid for** ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

**See also** SWTrig(), SetTriggerMaskMLVDS(), SetDirectionMLVDS(), SetTriggerMaskPXI()

#### 9.2.36 SetTriggerThresholdVoltage()

```c
virtual int SetTriggerThresholdVoltage ( 
    unsigned int trigger, 
    double vthresh )
```

Sets the threshold voltage of the specified trigger input.

**Parameters**
The trigger number, see SetTriggerMode() for numbering

\[ vthresh \]

The Threshold voltage. 0.5V is default.

Returns 1 for successful operation and 0 for failure

Valid for ADQ7, ADQ8

See also SetTriggerMode()

### 9.2.37 SetTrigLevelResetValue()

\[ \text{virtual int SetTrigLevelResetValue (} \]
\[ \quad \text{int OffsetValue}) \]

Sets the level trigger reset value.

**Parameters**

- \[ \text{OffsetValue} \]
  - The offset from the trigger level for which the level trigger shall arm the trigger for detecting rising or falling edges

Returns 1 for successful operation and 0 for failure

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also SetLvlTrigLevel(), SetupLevelTrigger()

### 9.2.38 SetupFrameSync()

\[ \text{virtual int SetupFrameSync (} \]
\[ \quad \text{unsigned int frame_len,} \]
\[ \quad \text{unsigned int frame_factor,} \]
\[ \quad \text{unsigned int edge}) \]

Setup frame sync.

Frame sync generates a 'frame_length' long pulse on every 'frame_factor' trigger. E.g., for frame_length = 128 and reduction_factor = 7, on every 7th trigger edge a 128 samples long pulse will be generated on the SYNC connector.

If the length is larger than the trigger period, a constant high signal will be outputted.

**Parameters**
frame_len
The length of the frame, in samples. The length will be truncated to the nearest multiple of parallel samples.

frame_factor
Every 'frame_factor' trigger will generate a sync pulse

detail
Specify trigger edges:
- 0: Falling edge
- 1: Rising edge
- 2: Both edges

Returns 1 for success, 0 otherwise

Note Frame sync output also has to be enabled by calling the EnableFrameSync() function.

Valid for ADQ12, ADQ14, ADQ7

See also EnableFrameSync()

9.2.39 SetupLevelTrigger()

virtual unsigned int SetupLevelTrigger (  
    const int * level,  
    const int * edge,  
    const int * reset_level,  
    unsigned int channel_mask,  
    unsigned int individual_mode )

Sets up the level trigger.

This function may be used to set up all level trigger options in one call. It also has the option to set individual values for different channels. When using individual mode, care must be taken to provide the correct amount of values at the inputs.

Parameters

level
A pointer to the values that the level trigger should trigger on. In individual mode, level[0] will be used for channel A, and level[1] for channel B etc. In non-individual the code value at level[0] will be used for all channels.

detail
A pointer to the edge that the level trigger should trigger on. Set to 1 for rising edge and 0 for falling. In individual mode, edge[0] will be used for channel A, and edge[1] for channel B etc. In non-individual the value at edge[0] will be used for all channels.
reset_level
A pointer to the code values should be used as reset values for the level trigger. The reset level is the offset from the trigger level which the signal must pass in order to arm the level trigger. A low level results in a more sensitive but less noise-resistant trigger. By setting the value to -1, the default value for the device will be used. In individual mode, reset_level[0] will be used for channel A, and reset_level[1] for channel B etc. In non-individual the value at reset_level[0] will be used for all channels.

channel_mask
A bit field that specifies which channels that are active:
- bit 0: Set to 1 to activate channel 1/A level trigger and 0 to deactivate
- bit 1: Set to 1 to activate channel 2/B level trigger and 0 to deactivate
- bit 2: Set to 1 to activate channel 3/C level trigger and 0 to deactivate
- bit 3: Set to 1 to activate channel 4/D level trigger and 0 to deactivate
- bit 4: Set to 1 to activate channel 5 level trigger and 0 to deactivate
- bit 5: Set to 1 to activate channel 6 level trigger and 0 to deactivate
- bit 6: Set to 1 to activate channel 7 level trigger and 0 to deactivate
- bit 7: Set to 1 to activate channel 8 level trigger and 0 to deactivate For example, a value of 15 ($2^3+2^2+2^1+2^0$) will activate all 4 channels. Note: On ADQ12 / ADQ14, only one single bit is supported (1,2,4,8) or the special combinations 3=A+B, 12=C+D, 15=A+B+C+D. Setting other masks will generate an error.

individual_mode
Specifies whether the level trigger should be set up with different values for different channels (individual_mode = 1) or not (individual_mode = 0). If individual mode is not active, the first value of each input array is used for all available channels.

Returns 1 for successful operation and 0 for failure

Example On ADQ412, the code below sets the level trigger to trigger on the rising edge at level 1024 for channel A and the falling edge at level 87 for channel D. The other channels are deactivated.

```c
int level[4] = [1024, 0, 0, 87];
int edges[4] = [1 0 0 0];
int reset_level = [7 7 7 7];
channel_mask = 0x9; // 2^3 + 2^0
individual_mode = 1;
ADQ_SetupLevelTrigger(adq_cu_ptr, adq_num, level, edges, reset_level, channel_mask, individual_mode);
```

Note When interleaving ADQ412 or ADQ208, all channels must still be specified if SetupLevelTrigger() is used in individual mode. For example, on ADQ412 channel A and B should have the same values, and C and D should have the same values.

Valid for ADQ412, ADQ208, SDR14, ADQ1600, ADQ108, ADQ12, ADQ14, ADQ7, ADQ8

See also SetLvlTrigLevel(), SetLvlTrigEdge(), SetTrigLevelResetValue(), SetTriggerMode()

9.2.40 SetupTimestampSync()

```c
virtual int SetupTimestampSync ( 
    unsigned int mode, 
    unsigned int trig_source )
```

Set up a synchronization of the timestamp counter to a trigger source.
Parameters

**mode**
The synchronization mode, as follows: 0: Synchronize only on the first trigger event 1: Synchronize on all trigger events (until disarmed)

**trig_source**
See SetTriggerMode() for trigger source numbering
- Level trigger cannot be used for timestamp synchronization.

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8

### 9.2.41 SetupTriggerBlocking()

```cpp
virtual int SetupTriggerBlocking ( 
    unsigned int mode, 
    unsigned int trig_source, 
    uint64_t window_length, 
    unsigned int tcount_limit )
```

Set up trigger blocking from another trigger source.
After SetupTriggerBlocking() the functions DisarmTriggerBlocking() and ArmTriggerBlocking() should be called to enable the trigger blocking functionality.
All triggers are blocked after setup. To disable the trigger blocking logic use mode DISABLE.

Parameters

**mode**
Set trigger blocking mode.
- 0 (ONCE): Block until the first trigger is detected.
- 1 (WINDOW): Unblock for window_length samples after the trigger.
- 2 (GATE): Unblock while the trigger is high.
- 3 (INVERSE WINDOW): Block for window_length samples after the trigger.
- 4 (DISABLE) Disable trigger blocking (ADQ7, ADQ14, ADQ12, ADQ8).
trig_source

- Bits 0 to 7: The trigger blocking source. See SetTriggerMode() for source numbering. The accepted values change depending on the tcount mode.
- Bits 8 to 11: The tcount mode
  - 0: Disabled. Valid trigger blocking sources are
    - External trigger
    - SYNC connector
    - External trigger, gated with sync input (ADQ7 only)
    - GPIO Trig 0/1 (ADQ7-PCIe/PXIe only)
  - 1: One trigger blocking event will be passed on once tcount_limit triggers have been observed on the specified trigger blocking source. Any trigger source supported by SetTriggerMode() is valid as a trigger blocking source. The mode GATE is not supported in this mode.
  - 2: As mode 1, but the trigger blocking event is delayed until an edge on the signal input on the SYNC connector has been detected.
- Bits 12 to 31: Reserved

window_length

Set the trigger blocking window length (in samples). Only applicable in mode 1 (WINDOW) and 3 (INVERSE WINDOW). ADQ7 and ADQ8 support a 64-bit window length. Other products are restricted to a 32-bit window length chosen as the low part of the input argument.

tcount_limit

Specifies the number of triggers on the trigger blocking source to wait for before passing on a trigger blocking event. Only used when tcount mode is non-zero.

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also SetTriggerMode() SetTriggerEdge() ArmTriggerBlocking() DisarmTriggerBlocking()
10 Advanced Trigger Options

Functions

- unsigned int AWGSetTriggerEnable (unsigned int dacId, unsigned int bitflags)
  
  Selects which trigger signals that may trigger the AWG.

- unsigned int AWGTrigoutDisarm (unsigned int dacId)
  
  Disarms the trigger output of the specified AWG.

- unsigned int ClearInternalTriggerCounts ()
  
  Resets the count of internal triggers issued.

- int DaisyChainEnable (unsigned int enable)
  
  Enable the digitizer’s local daisy chain trigger mechanism.

- int DaisyChainEnableOutput (unsigned int enable)
  
  Enable/disable the output buffer and select the daisy chain output as the source.

- int DaisyChainGetInputState (unsigned int *state)
  
  Get the state of the daisy chain input.

- int DaisyChainGetNoFPretriggerSamples (int position, int64_t sample_rate, int *nof_pretrigger_samples)
  
  Get the number of extra pretrigger samples needed due to the daisy chain.

- int DaisyChainGetStatus (unsigned int *status)
  
  Get the digitizer’s daisy chain status.

- int DaisyChainGetTriggerInformation (unsigned int source, unsigned int edge, int level, unsigned int channel, unsigned int start_record_number, unsigned int nof_records, unsigned int record_length, struct ADQDaisyChainDeviceInformation *device_info, unsigned int nof_devices, struct ADQDaisyChainTriggerInformation *trig_info)
  
  Get the trigger information from the daisy chain master device.

- int DaisyChainReset (void)
  
  Resets the digitizer’s daisy chain mechanism.

- int DaisyChainSetMode (unsigned int mode)
  
  Set the daisy chain mode.

- int DaisyChainSetOutputState (unsigned int state)
  
  Set the state of the daisy chain output.

- int DaisyChainSetTriggerSource (unsigned int trig_source)
  
  Set the trigger source for the daisy chain master.

- int DaisyChainSetupLevelTrigger (unsigned int channel, int level, int arm_hysteresis, unsigned int edge)
  
  Set up the daisy chain level trigger.

- int DaisyChainSetupOutput (unsigned int sync_polarity, unsigned int sync_immediate, unsigned int sync_length)
  
  Set up the shape of the daisy chain output pulse.

- unsigned int DisableInternalTriggerCounts ()
  
  Disables the internal trigger counter.

- unsigned int EnableInternalTriggerCounts ()
Enables the internal trigger counter.

- unsigned int EnablePXleTriggers (unsigned int port, unsigned int bitflags)
  
  Selects which PXle triggers to trigger on.
- unsigned int EnablePXleTrigout (unsigned int port, unsigned int bitflags)
  
  Selects which PXle triggers outputs to use.
- unsigned int GetPPTStatus ()
  
  Gets the status register of the Precise Period Trigger function.
- unsigned int InitPPT ()
  
  Initializes the Precise Period Trigger.
- unsigned int PXleSoftwareTrigger ()
  
  Sends a trigger signal on all enabled trigger outputs.
- unsigned int SetInternalTriggerCounts (unsigned int trigger_counts)
  
  Sets the number of triggers that will be issued by the internal trigger.
- unsigned int SetInternalTriggerSyncMode (unsigned int mode)
  
  Sets up and activates the internal trigger synchronization.
- unsigned int SetPPTActive (unsigned int active)
  
  Activates or deactivates Precise Period Trigger.
- unsigned int SetPPTBurstMode (unsigned int burst_mode)
  
  Activates or deactivates the Precise Period Trigger burst mode.
- unsigned int SetPPTInitOffset (unsigned int init_offset)
  
  Sets the Precise Period Trigger initial offset.
- unsigned int SetPPTPeriod (unsigned int period)
  
  Sets the Precise Period Trigger period.
- unsigned int SetPXleTrigDirection (unsigned int trig0output, unsigned int trig1output)
  
  Sets the direction of the two PXI_TRIG I/O pins.
- unsigned int SetTriggerGate (unsigned int enabled, unsigned int mode, unsigned int gate_mux)
  
  Sets up and activates the trigger gating functionality.
- int SetTriggerMaskPXI (unsigned char mask)
  
  Sets the mask for accepting triggers from PXI.
- unsigned int WriteSTARBDelay (unsigned int starbdelay, unsigned int writetoeeprom)
  
  Writes a delay value for the PXIe DSTARB trigger input.

10.1 Detailed Description

This section documents the non-standard trigger modes and options.

10.2 Function Documentation
10.2.1 AWGSetTriggerEnable()

virtual unsigned int AWGSetTriggerEnable (  
    unsigned int dacId,  
    unsigned int bitflags  
)

Selects which trigger signals that may trigger the AWG.

Parameters

<table>
<thead>
<tr>
<th>dacId</th>
<th>Selects the AWG/DAC (1 or 2)</th>
</tr>
</thead>
</table>
| bitflags | A bit field where each bit enables a trigger if asserted, according to:  
  • bit 0: Host trigger/software trigger from the data acquisition logic.  
  • bit 1: External trigger  
  • bit 2: PXIe port1 trigger  
  • bit 3: Internal trigger  
  • bit 4 AWG Software trigger (AWGTrig) |

Returns 1 for successful operation and 0 for failure  
Valid for SDR14  
See also SetTriggerMode()

10.2.2 AWGTrigoutDisarm()

virtual unsigned int AWGTrigoutDisarm (  
    unsigned int dacId  
)

Disarms the trigger output of the specified AWG.

Parameters

| dacId  | Selects the AWG/DAC (1 or 2) |

Returns 1 for successful operation and 0 for failure  
Valid for SDR14  
See also AWGTrigoutArm()

10.2.3 ClearInternalTriggerCounts()

virtual unsigned int ClearInternalTriggerCounts ( )

Resets the count of internal triggers issued.
Every time the function is called the counting will restart from zero.

**Returns** 1 for successful operation and 0 for failure

**Valid for** ADQ214

**See also** SetInternalTriggerCounts()

### 10.2.4 DaisyChainEnable()

```cpp
class ADQ214 {
public:
    int DaisyChainEnable(unsigned int enable);
}
```

Enable the digitizer's local daisy chain trigger mechanism.

This function enables the digitizer's local daisy chain mechanism allowing triggers to propagate to the acquisition engine and trigger records. Calling this function does *not* enable the SYNC connector's output buffer. Refer to DaisyChainEnableOutput() for that functionality.

**Parameters**

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: disable</td>
</tr>
<tr>
<td>1: enable</td>
</tr>
</tbody>
</table>

**Returns** 1 for success, 0 otherwise

**Valid for** ADQ8

**See also** DaisyChainEnableOutput

### 10.2.5 DaisyChainEnableOutput()

```cpp
class ADQ214 {
public:
    int DaisyChainEnableOutput(unsigned int enable);
}
```

Enable/disable the output buffer and select the daisy chain output as the source.

This function activates the buffer for the connector associated with the daisy chain output signal. The connector is often shared between several digitizer functions (e.g. GPIO) but only one function can be activated at a time.

**Parameters**

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Disable</td>
</tr>
<tr>
<td>1: Enable</td>
</tr>
</tbody>
</table>
Returns 1 for success, 0 otherwise
Valid for ADQ8

10.2.6 DaisyChainGetInputState()

```cpp
virtual int DaisyChainGetInputState(
    unsigned int * state )
```

Get the state of the daisy chain input.

**Parameters**

<table>
<thead>
<tr>
<th>state</th>
</tr>
</thead>
</table>
| **state**
| Reference to memory where the state should be written to.
| • 0: The daisy chain input is logic low.
| • 1: The daisy chain input is logic high. |

Returns 1 for success, 0 otherwise
Valid for ADQ8

10.2.7 DaisyChainGetNofPretriggerSamples()

```cpp
virtual int DaisyChainGetNofPretriggerSamples(
    int position,
    int64_t sample_rate,
    int * nof_pretrigger_samples )
```

Get the number of extra pretrigger samples needed due to the daisy chain.

Using the daisy chain trigger mechanism comes with a requirement that each slave device increases its pretrigger length. This is needed to capture the data at the true trigger point which occurs earlier in time for each slave (relative to its daisy chain trigger). The true trigger position is reconstructed from the timing information read from the master device.

**Parameters**

<table>
<thead>
<tr>
<th>position</th>
</tr>
</thead>
</table>
| **position**
| The digitizer’s position in the daisy chain.
| • 0: The master device.
| • 1: The first slave device.
| • 2: The second slave device.
| • N: The Nth slave device. |

An important note is that if a number of slave devices are grouped together with the sync_immediate setting in DaisyChainSetupOutput() they will identify as the same position.

<table>
<thead>
<tr>
<th>sample_rate</th>
</tr>
</thead>
</table>
| **sample_rate**
| The sample rate of the device in hertz, including sample skip if used. |
### nof_pretrigger_samples

Reference to memory where the number of pretrigger samples should be written to.

Returns 1 for success, 0 otherwise

Valid for ADQ8

#### 10.2.8 DaisyChainGetStatus()

```cpp
virtual int DaisyChainGetStatus ( 
    unsigned int * status )
```

Get the digitizer's daisy chain status.

**Parameters**

- **status**
  
  Reference to memory where the status should be written to. The status value is a 32-bit unsigned number interpreted as
  
  - Bit 3: Output synchronizer proximity error.
  - Bit 2: Input synchronizer proximity error.
  - Bit 1: Input synchronizer delay error.
  - Bit 0: State of the daisy chain input.
    
    - 1: Logic high
    - 0: Logic low

Returns 1 for success, 0 otherwise

Valid for ADQ8

#### 10.2.9 DaisyChainGetTriggerInformation()

```cpp
virtual int DaisyChainGetTriggerInformation ( 
    unsigned int source, 
    unsigned int edge, 
    int level, 
    unsigned int channel, 
    unsigned int start_record_number, 
    unsigned int nof_records, 
    unsigned int record_length, 
    struct ADQDaisyChainDeviceInformation * device_info, 
    unsigned int nof_devices, 
    struct ADQDaisyChainTriggerInformation * trig_info )
```
Get the trigger information from the daisy chain master device.

This function reads out the trigger information from the daisy chain master device and returns the data in the trig_info parameter. Currently only supports the multirecord data collection mode.

**Parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>source</td>
<td>The trigger source used by the daisy chain mechanism. Has to be the same value used in the call to Daisy-ChainSetTriggerSource().</td>
</tr>
<tr>
<td>edge</td>
<td>The edge selection. Only used when the level trigger is specified as the trigger source. This value is expected to match the value provided in the call to DaisyChainSetupLevelTrigger().</td>
</tr>
<tr>
<td></td>
<td>- 0: Falling edge</td>
</tr>
<tr>
<td></td>
<td>- 1: Rising edge</td>
</tr>
<tr>
<td>level</td>
<td>The level trigger threshold value. This parameter is only used when the level trigger is specified as the trigger source and is expected to match the value provided to DaisyChainSetupLevelTrigger().</td>
</tr>
<tr>
<td>channel</td>
<td>The target channel. If the level trigger is used as the trigger source, then the value is expected to point to the channel sampling the trigger signal. Otherwise, any active channel index will suffice. Channels are indexed from 1 and upwards.</td>
</tr>
<tr>
<td>start_record_number</td>
<td>Similar to GetData(), this parameter instructs the API for which record to begin constructing the trigger information, skipping any records up until this point. The trigger information at index zero in the array trig_info will represent the trigger information for the record corresponding to start_record_number.</td>
</tr>
<tr>
<td>nof_records</td>
<td>The number of records to collect timing information from. This value is used to define the length of the array starting at trig_info.</td>
</tr>
<tr>
<td>record_length</td>
<td>The record length in samples. This value is expected to be the same as the value provided to the acquisition setup function, e.g. MultiRecordSetup().</td>
</tr>
<tr>
<td>device_info</td>
<td>A pointer to the first element in an array of ADQDaisyChainDeviceInformation structs. Each device in the daisy chain is represented by an entry in the array and the array length is provided as nof_devices. The entry is of type ADQDaisyChainDeviceInformation and lists the position, the number of pretrigger samples, the trigger delay in samples, and the sample rate in hertz. The sample rate should include the sample skip if used. No restrictions on the order of the elements are imposed by the API but the order will be reflected in the array pointed to by RecordStart in trig_info. The struct is defined in the ADQAPI header as struct ADQDaisyChainDeviceInformation</td>
</tr>
</tbody>
</table>

```c
{
    int64_t SampleRate;
    int64_t Position;
    int64_t PretriggerSamples;
    int64_t TriggerDelaySamples;
};
```
**nof_devices**

The length of the array pointed to by `device_info`.

**trig_info**

A pointer to the first element in an array of `ADQDaisyChainTriggerInformation` structs. This array is allocated by the user and filled in by the API. Each entry represents the trigger information for one record across all channels and devices. Hence, the expected length of the array is `nof_records`. The struct is defined in the `ADQAPI` header as:

```c
struct ADQDaisyChainTriggerInformation
{
    uint64_t Timestamp;
    int64_t *RecordStart;
    double *ExtendedPrecision;
};
```

- The `Timestamp` field indicates the time of the trigger point and is measured in 25 ps steps on ADQ8.
- The `RecordStart` field is a pointer to an array of 64-bit integers representing the `RecordStart` values of all devices in the daisy chain and thus is expected to have the same length as the `device_info` array, i.e. `nof_devices`. A `RecordStart` value indicates the relation between the first sample in the record and the timestamp. The timestamp of the first sample is calculated as `Timestamp + RecordStart`. Thus, negative values indicates that the trigger point occurs after the first sample in the record and vice versa for positive values. The elements are ordered according to the `device_info` array, i.e. the `RecordStart` value at index 3 will be the new value for the device at index 3 in the `device_info` array for that record.
- The `ExtendedPrecision` field holds a non-zero value if the selected trigger method can yield a higher resolution than what the `Timestamp` and `RecordStart` fields can represent. Currently, this field is only non-zero when the level trigger is used as the daisy chain source since the data is subjected to interpolation. The value will be in the range [0,1) and should be subtracted from `Timestamp` and added to `RecordStart`. The `Timestamp` and the `RecordStart` values provided by this function is intended to overwrite the values reported in the headers returned by any data collection call, e.g. `GetDataWHTS()`.

Note: To obtain proper daisy chain timing information, both master and slaves of a chain must be set to trigger mode "Daisy chain trigger". The master is then configured with which trigger to use for the chain by using API call `DaisyChainSetTriggerSource`

Returns 1 for success, 0 otherwise

See also `DaisyChainSetTriggerSource()`

Valid for ADQ8

### 10.2.10 DaisyChainReset()

```c
virtual int DaisyChainReset ( )
    void
```

Resets the digitizer's daisy chain mechanism.

Returns 1 for success, 0 otherwise

Valid for ADQ8
10.2.11 DaisyChainSetMode()

```cpp
virtual int DaisyChainSetMode ( unsigned int mode )
```

Set the daisy chain mode.

**Parameters**

`mode`

The target mode

- 0: Slave
- 1: Master

**Returns** 1 for success, 0 otherwise

Valid for ADQ8

10.2.12 DaisyChainSetOutputState()

```cpp
virtual int DaisyChainSetOutputState ( unsigned int state )
```

Set the state of the daisy chain output.

This function is used to set the state of the daisy chain output for the purpose of identifying the device order. Forcing a logic high level will supersede any normal operation of the output port. Calling this function does not activate the output buffer. Refer to DaisyChainEnableOutput() for that functionality.

**Parameters**

`state`

- 0: Default behavior
- 1: Force a logic high level

**Returns** 1 for success, 0 otherwise

Valid for ADQ8

See also DaisyChainEnableOutput

10.2.13 DaisyChainSetTriggerSource()

```cpp
virtual int DaisyChainSetTriggerSource ( unsigned int trig_source )
```

Set the trigger source for the daisy chain master.
The default behavior of the daisy chain master is to use a level trigger applied to one of the data channels as the trigger source. This function is used to specify an alternate trigger source. A slave device always selects the daisy chain input as the trigger source.

Parameters

<table>
<thead>
<tr>
<th>trig_source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to SetTriggerMode() for a source selection table.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ8

See also SetTriggerMode

10.2.14 DaisyChainSetupLevelTrigger()

virtual int DaisyChainSetupLevelTrigger ( 
  unsigned int channel,
  int level,
  int arm_hysteresis,
  unsigned int edge )

Set up the daisy chain level trigger.

The level trigger only needs to be configured on the master device.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The target channel, indexed from 1 and upwards.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>level</th>
</tr>
</thead>
<tbody>
<tr>
<td>The trigger level specified in ADC codes. A trigger will be generated at the first sample crossing this threshold.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>arm_hysteresis</th>
</tr>
</thead>
<tbody>
<tr>
<td>The trigger arm hysteresis protects against false trigger events, e.g. generated due to signal noise a the threshold crossing. The arm hysteresis is involved in computing the trigger arm level as</td>
</tr>
<tr>
<td>• arm level = trigger level + trigger arm hysteresis (for polarity 0)</td>
</tr>
<tr>
<td>• arm level = trigger level - trigger arm hysteresis (for polarity 1)</td>
</tr>
<tr>
<td>In order for the level trigger to be ready to generate a trigger event, the signal has to visit ADC codes</td>
</tr>
<tr>
<td>• above the trigger arm level (for polarity 0)</td>
</tr>
<tr>
<td>• below the trigger arm level (for polarity 1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0: Falling edge</td>
</tr>
<tr>
<td>• 1: Rising edge</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise
10.2.15 `DaisyChainSetupOutput()`

```cpp
def DaisyChainSetupOutput(
    sync_polarity: int,
    sync_immediate: int,
    sync_length: int
): int
```

Set up the shape of the daisy chain output pulse.

**Parameters**

- **sync_polarity**
  - The sync polarity determines the overall shape of the daisy chain output signal. Additionally, the setting also selects the edge of the input signal at which to detect an event.
  - 0: Negative pulse (idle at logic high), falling edge detection
  - 1: Positive pulse (idle at logic low), rising edge detection

- **sync_immediate**
  - The immediate mode is only applicable for daisy chain slave devices. The mode accelerates the passthrough of the trigger signal by not resynchronizing the output pulse to the reference clock. The trigger event used to trigger the record remains unaffected and is still synchronized to the reference grid.
  - 0: Disable
  - 1: Enable

- **sync_length**
  - The length of the output pulse, specified in samples.

**Returns**

1 for success, 0 otherwise

Valid for ADQ8

10.2.16 `DisableInternalTriggerCounts()`

```cpp
def DisableInternalTriggerCounts(): int
```

Disables the internal trigger counter.

This will let the internal trigger block to run freely and all the triggers generated by the internal trigger block will propagate forward as normal.

**Returns**

1 for successful operation and 0 for failure

Valid for ADQ214

See also `SetInternalTriggerCounts()`
10.2.17 EnableInternalTriggerCounts()

virtual unsigned int EnableInternalTriggerCounts()

Enables the internal trigger counter.

Allows the user to control the number of internal triggers that will be generated. A number of triggers must
be specified with the function call SetInternalTriggerCounts() enabling alone will not pass through any triggers
if you have not specified how many triggers that will be allowed to pass through.

Returns 1 for successful operation and 0 for failure

Valid for ADQ214
See also SetInternalTriggerCounts()

10.2.18 EnablePXIETriggers()

virtual unsigned int EnablePXIETriggers(
    unsigned int port,
    unsigned int bitflags
)

Selects which PXIE triggers to trigger on.

All the various PXIE trigger inputs are summed together into a single PXIE trigger signal. This function allows
specific inclusion/exclusion of these inputs.

Parameters

<table>
<thead>
<tr>
<th>port</th>
</tr>
</thead>
</table>
| The PXIE trigger block has two ports which can be configured independently, and which are connected to
| separate parts of the digitizer logic, according to:
| • 0: Data acquisition logic
| • 1: AWG

<table>
<thead>
<tr>
<th>bitflags</th>
</tr>
</thead>
</table>
| Is a bit field where each bit enables a specific trigger input for the selected port
| • bit 0: DSTARA
| • bit 1: DSTARB
| • bit 2: PXI_TRIG[0]
| • bit 3: PXI_TRIG[1]

Returns 1 for successful operation and 0 for failure

Note PXI_TRIG[2 to7] are not routed on the digitizer PCB and cannot be used

Valid for SDR14
See also EnablePXIETrigout(), PXIESoftwareTrigger()
10.2.19 EnablePXIETrigout()

virtual unsigned int EnablePXIETrigout (  
    unsigned int port,  
    unsigned int bitflags )

Selects which PXIe triggers outputs to use.

The trigger output of each port may be connected to any/all the available PXIe trigger outputs via this function.

Parameters

<table>
<thead>
<tr>
<th>port</th>
<th>Selects where from to take the trigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:</td>
<td>Data acquisition logic</td>
</tr>
<tr>
<td>1:</td>
<td>AWG</td>
</tr>
<tr>
<td>2:</td>
<td>Software (PXIe Software trigger)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bitflags</th>
<th>Is a bit field where each bit enables output of the port trigout signal to a specific PXIe trigger output</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit 0:</td>
<td>DSTARC</td>
</tr>
<tr>
<td>bit 1:</td>
<td>PXI_TRIG[0]</td>
</tr>
<tr>
<td>bit 2:</td>
<td>PXI_TRIG[1]</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also EnablePXIETriggers(), PXIESoftwareTrigger()

10.2.20 GetPPTStatus()

virtual unsigned int GetPPTStatus ( )

Gets the status register of the Precise Period Trigger function.

Returns 1 for successful operation and 0 for failure

Valid for ADQ108, ADQ208

See also SetPPTActive()

10.2.21 InitPPT()

virtual unsigned int InitPPT ( )

Initializes the Precise Period Trigger.

Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208
See also SetPPTActive()

10.2.22 PXleSoftwareTrigger()

virtual unsigned int PXleSoftwareTrigger ( )
Sends a trigger signal on all enabled trigger outputs.
The trigger outputs enabled are specified using EnablePXleTrigout()

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also EnablePXleTriggers()

10.2.23 SetInternalTriggerCounts()

virtual unsigned int SetInternalTriggerCounts ( unsigned int trigger_counts )
Sets the number of triggers that will be issued by the internal trigger.
This can be used to create a finite burst of triggers.

Parameters

<table>
<thead>
<tr>
<th>trigger_counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of triggers that will be issued</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ214
See also EnableInternalTriggerCounts()

10.2.24 SetInternalTriggerSyncMode()

virtual unsigned int SetInternalTriggerSyncMode ( unsigned int mode )
Sets up and activates the internal trigger synchronization.
Allows the user to synchronize several boards with a synchronization signal (can for instance be a PPS input).
For slaves for instance, using trigger source 11 resets the internal trigger on an external trigger gated with the sync input provided by the master.

Parameters
### mode

- **0**: Do not use any synchronization scheme
- **1**: Master: External trigger input as synchronization input, will provide gate on trigout
- **2**: Slave: Selected trigger (selected with SetupTimeStampSync) is also used for resetting the internal trigger (ADQ7 only)

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, ADQ108, SDR14, ADQ7, ADQ8
See also SetupTimestampSync()

#### 10.2.25 SetPPTActive()

```
virtual unsigned int SetPPTActive (    
    unsigned int active )
```

Activates or deactivates Precise Period Trigger.

The Precise Period Trigger (PPT) synchronizes the external trigger to precise period. Please refer to the PPT user guide and example for more detailed information on how to use the Precise Period Trigger.

**Parameters**

| active | Set to 1 to activate and 0 to deactivate PPT |

Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208
See also InitPPT()

#### 10.2.26 SetPPTBurstMode()

```
virtual unsigned int SetPPTBurstMode (     
    unsigned int burst_mode )
```

Activates or deactivates the Precise Period Trigger burst mode.

In burst mode, the device will continue to trigger at each PPT period after the first external trigger event, without the need for more external triggers

**Parameters**

| burst_mode | Set to 1 to activate and 0 to deactivate burst mode |
Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208
See also SetPPTActive()

10.2.27 SetPPTInitOffset()  

virtual unsigned int SetPPTInitOffset(
    unsigned int init_offset)

Sets the Precise Period Trigger initial offset.
The offset is applied to the period on the first trig after initialization of the Precise Period Trigger

Parameters

<table>
<thead>
<tr>
<th>init_offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>A number of samples from 32 to $2^{27}-1$</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208
See also SetPPTActive()

10.2.28 SetPPTPeriod()  

virtual unsigned int SetPPTPeriod(
    unsigned int period)

Sets the Precise Period Trigger period.

Parameters

<table>
<thead>
<tr>
<th>period</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of sample per period, from 32 to $2^{27}-1$</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208
See also SetPPTActive()

10.2.29 SetPXIETrigDirection()  

virtual unsigned int SetPXIETrigDirection(
    unsigned int trig0output,
    unsigned int trig1output)
Sets the direction of the two PXI_TRIG I/O pins.

Parameters

<table>
<thead>
<tr>
<th>trig0output</th>
<th>I/O selection for PXI_TRIG[0]</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0: Input (default)</td>
<td></td>
</tr>
<tr>
<td>• 1: Output</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>trig1output</th>
<th>I/O selection for PXI_TRIG[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0: Input (default)</td>
<td></td>
</tr>
<tr>
<td>• 1: Output</td>
<td></td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Warning Make sure that no other drivers are connected to the PXI_TRIG bus before setting the trigger pins to outputs, or you may risk damaging the digitizer.

Valid for SDR14

See also EnablePXleTriggers(), EnablePXleTrigout()

10.2.30 SetTriggerGate()

```c
virtual unsigned int SetTriggerGate ( 
    unsigned int enabled, 
    unsigned int mode, 
    unsigned int gate_mux )
```

Sets up and activates the trigger gating functionality.

Allows the user to apply trigger gating. i.e. block triggers until a condition is fulfilled. A closed trigger gate means triggers are blocked and not accepted.

Parameters

<table>
<thead>
<tr>
<th>enabled</th>
<th>If set to 1, trigger gating logic is activated (activates on arm)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>mode</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0 : Use level on gate control input to decide whether trigger gate is open or closed</td>
<td></td>
</tr>
<tr>
<td>• 1 : Arm closes the trigger gate initially, then first rising edge on gate_control_input open the trigger gate</td>
<td></td>
</tr>
</tbody>
</table>
gate_mux

- 0: Use external trigger input as gate control input
- 1: Use GPIO pin #5 as gate control input

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, ADQ108, SDR14
See also SetConfigurationTrig()

10.2.31 SetTriggerMaskPXI()

virtual int SetTriggerMaskPXI ( unsigned char mask )

Sets the mask for accepting triggers from PXI.

Parameters

mask
Select which PXI TRIG inputs to trigger from (inputs are ORed together if several bits are set) The bits and PXI TRIG signales are connected according to the list below:
- bit 0: PXI TRIG 0
- bit 1: PXI TRIG 1
- bit 2: PXIe STARA
- bit 3: PXIe STARB (ADQ7 / ADQ8 only)

Returns 1 for successful operation and 0 for failure
Valid for ADQ14, ADQ7, ADQ8

10.2.32 WriteSTARBDelay()

virtual unsigned int WriteSTARBDelay ( unsigned int starbdelay, unsigned int writetoeeprom )

Writes a delay value for the PXIe DSTARB trigger input.
The value may also be stored in the onboard EEPROM to be loaded upon each restart of the digitizer.

Parameters

starbdelay
The delay value. The allowed range is 0 to 31, where each unit corresponds to a 78 ps delay.
writetoeeprom
Specifies whether to write the value to the onboard EEPROM:
- 0: Do not update the EEPROM value
- 1: Update the EEPROM value so that the new value is loaded by default on power-up.

Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also EnablePXLeTriggers()

11 Clock Setup

Functions
- int AdjustClockReferenceDelay (float delayadjust_ps)
  Adjust the reference clock delay relative to the factory calibrated delay.
- int GetClockSource ()
  Gets the current clock source.
- unsigned int GetExternalClockReferenceStatus (unsigned int *extrefstatus)
  Gets the status of the external clock reference.
- int GetPllFreqDivider ()
  Gets the current PLL-divider.
- int SetClockFrequencyMode (int clockmode)
  Sets the clock frequency mode.
- int SetClockInputImpedance (unsigned int input_num, unsigned int mode)
  Sets the clock connector input impedance.
- int SetClockSource (int source)
  Sets the clock source.
- int SetExternalReferenceFrequency (float ref_freq)
  Sets the external clock reference frequency.
- int SetPll (int n_divider, int r_divider, int vco_divider, int channel_divider)
  Performs setup of the clock PLL.
- int SetPllFreqDivider (int divider)
  Sets the clock PLL divider.
- int SetTargetSampleRate (int mode, double value)
  Sets the desired target sample rate.

11.1 Detailed Description

Functions used for selecting clock source and speed.
11.2 Function Documentation

11.2.1 AdjustClockReferenceDelay()

```c
int AdjustClockReferenceDelay ( 
    float delayadjust_ps )
```

Adjust the reference clock delay relative to the factory calibrated delay.

On boards which support programmable clock reference delay, this function can be used to adjust the clock reference delay in order to compensate for inter-digitizer skew caused by wiring or backplane routing. Make sure that the clock source is set to a mode which includes the delay circuitry in order for the function to have any effect.

**Parameters**

| delayadjust_ps | An adjustment amount in units of picoseconds, relative to the factory calibrated delay |

**Returns** 1 for success, 0 otherwise

**Valid for** ADQ8, (ADQ7 produced post 2021-04-01)

**See also** SetClockSource

11.2.2 GetClockSource()

```c
virtual int GetClockSource ( )
```

Gets the current clock source.

Please see SetClockSource() for an explanation of the values.

**Returns** The clock source

**Valid for** ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14

**See also** SetClockSource()

11.2.3 GetExternalClockReferenceStatus()

```c
virtual unsigned int GetExternalClockReferenceStatus ( 
    unsigned int * extrefstatus )
```

Gets the status of the external clock reference.

When using an external clock reference, this API returns the status of this reference.

**Parameters**
extrefstatus
Pointer to where to return the status. These values may be returned:
- 1: External reference available
- 0: External reference not detected

Returns 1 for successful operation and 0 for failure
Valid for ADQ214, ADQ114, ADQ212, ADQ112, ADQ7

11.2.4 GetPllFreqDivider()

virtual int GetPllFreqDivider ( )
Gets the current PLL-divider.
Please see SetPllFreqDivider() for an explanation of the values.
Returns The PLL divider
Valid for ADQ212, ADQ112, ADQ114, ADQ214
See also SetPllFreqDivider()

11.2.5 SetClockFrequencyMode()

virtual int SetClockFrequencyMode ( 
    int       clockmode )
Sets the clock frequency mode.
If internal clock and reference is used, this is handled automatically. If external clock or external reference is used, the board must be manually set to the correct mode by the user.

Parameters

  clockmode
  Selects the clock frequency mode according to this list:
- 0: Low frequency mode (external clock range 35-240MHz)
- 1: High frequency mode (default, external clock range 240-550MHz)

Returns 1 for successful operation and 0 for failure
Valid for ADQ212, ADQ112, ADQ114, ADQ214
See also SetClockSource()
11.2.6 SetClockInputImpedance()

virtual int SetClockInputImpedance ( 
  unsigned int input_num, 
  unsigned int mode )

Sets the clock connector input impedance.

Parameters

<table>
<thead>
<tr>
<th>input_num</th>
<th>Set to 1 for standard clock / clock reference input connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode</td>
<td>Set to 0 for 50 ohm input, set to 1 for high impedance mode</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7

11.2.7 SetClockSource()

virtual int SetClockSource ( 
  int source )

Sets the clock source.

Parameters

<table>
<thead>
<tr>
<th>source</th>
</tr>
</thead>
</table>

Selects the source according to this list:
- 0: Internal clock source, internal 10 MHz reference
- 1: Internal clock source, external 10 MHz reference
- 2: External clock source
- 3: Internal clock source, external 10 MHz reference from PXIsync
- 4: Internal clock source, external TCLKA backplane reference (MTCA units only)
- 5: Internal clock source, external TCLKB backplane reference (MTCA units only)
- 6: Internal clock source, external 100 MHz reference from PXIe 100 MHz clock
- 7: Internal clock source, external 10 MHz reference plus jitter cleaning (ADQ7, ADQ8 only)
- 8: Internal clock source, external 10 MHz reference plus delay adjustment (ADQ8 only)
- 9: Internal clock source, external reference, free target sample rate (ADQ14/ADQ12 only)

Returns 1 for successful operation and 0 for failure

Note When using external reference, make sure that an existing reference signal is connected to the correct clock reference input port. Otherwise this command will fail. See data sheet for requirements on external clock reference.

For ADQ112, ADQ114, ADQ212 and ADQ214: When setting external clock source, do not follow with the command to set the pll frequency divider because it will reset the source to internal.
For ADQ412, ADQ108, ADQ208, ADQ1600, SDR14: Please note that selecting clock source also resets the timestamp counter.

Mode 9 with free target sample rate is still very limited as it has to comply with PLL configuration possibilities. Use SetTargetSampleRate for setting the target sample rate.

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also SetClockFrequencyMode(), SetTargetSampleRate()

11.2.8 SetExternalReferenceFrequency()

virtual int SetExternalReferenceFrequency ( 
  float ref_freq )

Sets the external clock reference frequency.

By default, the digitizer is configured to use a 10 MHz external reference, when an external reference clock source is set up via SetClockSource. This function can be used to specify a reference frequency that differs from the default. The function must be called prior to SetClockSource in order to be taken into account during the clocking setup.

Parameters

ref_freq
Reference clock frequency in MHz
- ADQ12 / ADQ14: In the range 10 - 500 MHz (needs to fulfill PLL requirements),
- ADQ7: In the range of 1 - 500 MHz (needs to fulfill PLL requirements)

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7

See also SetClockSource(), SetTargetSampleRate()

11.2.9 SetPll()

virtual int SetPll ( 
  int n_divider,
  int r_divider,
  int vco_divider,
  int channel_divider )

Performs setup of the clock PLL.

Not all parameters can be changed on all ADQs. Please look under the specific card below to see how the sample frequency is set.
- ADQ214 & ADQ212:

$$F_s = \frac{F_{ref} \cdot n\text{ divider}}{r\text{ divider} \cdot vco\text{ divider} \cdot channel\text{ divider}}$$
• ADQ114 & ADQ112:
  \[ F_s = \frac{2 F_{ref} \cdot \text{n Divider}}{r \cdot \text{VCO Divider} \cdot \text{Channel Divider}} \]

• ADQ108 & ADQ208:
  \[ F_s = \frac{4 F_{ref} \cdot \text{n Divider}}{r \cdot \text{Divider}} \]

• ADQ1600:
  \[ F_s = \frac{4 F_{ref} \cdot \text{n Divider}}{r \cdot \text{Divider}} \]

• SDR14:
  \[ F_s = \frac{2 F_{ref} \cdot \text{n Divider}}{r \cdot \text{Divider}} \]

• ADQ412-1G:
  \[ F_s = \frac{F_{ref} \cdot \text{n Divider}}{2r \cdot \text{Divider}} \]

• ADQ412-3G and -4G:
  \[ F_s = \frac{F_{ref} \cdot \text{n Divider}}{r \cdot \text{Divider}} \]

  \[ F_{ref} \] is either the internal 10 MHz reference, or an external reference.

Parameters

<table>
<thead>
<tr>
<th>n_divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ214 and ADQ114: Default is 220, 1 to 262175 are valid values</td>
</tr>
<tr>
<td>ADQ212, and ADQ112: Default is 160, 1 to 262175 are valid values</td>
</tr>
<tr>
<td>ADQ1600 and SDR14: Default is 160</td>
</tr>
<tr>
<td>ADQ108: Default is 350</td>
</tr>
<tr>
<td>ADQ208: Default is 400</td>
</tr>
<tr>
<td>ADQ1600: Default is 160</td>
</tr>
<tr>
<td>ADQ412-1G: Default is 400 (only multiples of 16 is allowed)</td>
</tr>
<tr>
<td>ADQ412-3G: Default is 360 (only multiples of 8 is allowed)</td>
</tr>
<tr>
<td>ADQ412-4G: Default is 400 (only multiples of 8 is allowed)</td>
</tr>
<tr>
<td>SDR14: Default is 160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>r_divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ214, ADQ212, ADQ114, and ADQ112: Default is 1, 1 to 16383 are valid values</td>
</tr>
<tr>
<td>ADQ1600, SDR14, ADQ108, ADQ208, ADQ1600 and ADQ412: Default is 2, 1 to 16383 are valid values</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>vco_divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ214, ADQ212, ADQ114, and ADQ112: Default is 2, 2 to 6 are valid values</td>
</tr>
<tr>
<td>Not used for other units</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>channel_divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADQ214, ADQ212, ADQ114, and ADQ112: Default is 2, 1 to 32 are valid values</td>
</tr>
<tr>
<td>Not used for other units</td>
</tr>
</tbody>
</table>
Returns 1 for successful operation and 0 for failure

Note  For ADQ212, ADQ112, ADQ114 and ADQ214: Frequencies lower than 100 MHz may sometimes fail to get the PLL locked as this renders a clock out of specification for the clocking circuitry in the FPGA. If you require lower sampling rates, please consider using the sample skip function.

For ADQ212, ADQ112, ADQ114 and ADQ214: This function will call SetClockFrequencyMode if the clock source is internal reference.

For ADQ108 and ADQ208: Frequencies lower than 6000 MHz may sometimes fail to get the PLL locked as this renders a clock out of specification for the clocking circuitry in the FPGA.

For ADQ412 and ADQ1600 VCO Frequencies lower than 1400 MHz may sometimes fail to get the PLL locked as this renders a clock out of specification for the clocking circuitry in the FPGA.

For SDR14 VCO Frequencies lower than 1550 MHz or higher than 1600MHz may fail due to design restrictions.

For ADQ412, ADQ108, ADQ208, ADQ1600, SDR14: Please note that selecting a new frequency also resets the timestamp counter.

Valid for  ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14

See also  SetClockSource()

### 11.2.10  SetPllFreqDivider()

virtual int SetPllFreqDivider (  
    int divider  )

Sets the clock PLL divider.

After setting the divider value, the PLL is restarted. The software will also check that the PLL locks properly. The sampling rate is calculated differently for the different units:

- **ADQ214**:  \( F_s = \frac{F_{ref} \times 80}{\text{divider}} \)
- **ADQ114**:  \( F_s = \frac{F_{ref} \times 160}{\text{divider}} \)
- **ADQ212**:  \( F_s = \frac{F_{ref} \times 110}{\text{divider}} \)
- **ADQ112**:  \( F_s = \frac{F_{ref} \times 220}{\text{divider}} \)

Parameters

<table>
<thead>
<tr>
<th>divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects the divider. 2 to 20 are valid values (2 is default).</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note  Dividers 18 to 20 may sometimes fail to get the PLL locked for ADQ114/ADQ214 devices as this renders a clock out of specification for the clocking circuitry in the FPGA. If you require lower sampling rates, please consider using the sample skip function. The function will then return failure.

Valid for  ADQ212, ADQ112, ADQ114, ADQ214

See also  SetClockSource()
11.2.11 SetTargetSampleRate()

```c
int SetTargetSampleRate (  
    int  mode,  
    double  value )
```

Sets the desired target sample rate.
This function can be called prior to SetClockSource in order to specify a target sample rate that differs from
the default. The allowed range of sample rates is limited by the clocking hardware of the unit.

**Parameters**

<table>
<thead>
<tr>
<th><strong>mode</strong></th>
<th>Reserved, set to 0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>value</strong></td>
<td>Target sample rate in MHz / MSPS</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for (ADQ7 produced post 2021-04-01)

See also SetClockSource(), SetExternalReferenceFrequency()

12 MultiRecord Mode

**Functions**

- int ArmTrigger ()
  
  *Arms the trigger block.*
- int DisArmTrigger ()
  
  *Disarms the ADQ device.*
- int GetAcquired ()
  
  *Checks if one or more record has been collected.*
- unsigned int GetAcquiredAll ()
  
  *Checks if all record have been collected.*
- unsigned int GetAcquiredRecords ()
  
  *Gets the number of records collected.*
- int GetData (void **target_buffers, unsigned int target_buffer_size, unsigned char target_bytes_per_sample,
unsigned int StartRecordNumber, unsigned int NumberOfRecords, unsigned char ChannelsMask, unsigned int StartSample, unsigned int nSamples, unsigned char TransferMode)
  
  *Transfers data from ADQ to host in MultiRecord mode.*
- int GetDataWH (void **target_buffers, void *target_headers, unsigned int target_buffer_size, unsigned char target_bytes_per_sample, unsigned int StartRecordNumber, unsigned int NumberOfRecords, unsigned char ChannelsMask, unsigned int StartSample, unsigned int nSamples, unsigned char TransferMode)

  Transfers from ADQ to host in MultiRecord mode. Also saves headers.

- int GetDataWHTS (void **target_buffers, void *target_headers, void *target_timestamps, unsigned int target_buffer_size, unsigned char target_bytes_per_sample, unsigned int StartRecordNumber, unsigned int NumberOfRecords, unsigned char ChannelsMask, unsigned int StartSample, unsigned int nSamples, unsigned char TransferMode)

  Transfers from ADQ to host in MultiRecord mode. Also saves headers and timestamps.

- int GetTriggedCh ()

  Gets the channel that the level trigger triggered on.

- int GetWaitingForTrigger ()

  Polls the MultiRecord collection to see if it is waiting for a trigger.

- unsigned int MultiRecordClose ()

  Closes MultiRecord mode.

- unsigned int MultiRecordSetChannelMask (unsigned int channelmask)

  Enables/disables channels for a multirecord acquisition.

- unsigned int MultiRecordSetup (unsigned int NumberOfRecords, unsigned int SamplesPerRecord)

- int SetPreTrigSamples (unsigned int PreTrigSamples)

  Selects the number of pre-trigger samples for MultiRecord.

- int SetTriggerDelay (unsigned int triggerdelay_samples)

  Sets the delay between the trigger and the start of the record acquisition.

### 12.1 Detailed Description

MultiRecord is the standard collection mode for the ADQ digitizers. It uses the on-board memory to store multiple records of data. This section documents the functions used for setting up and transferring collections in with MultiRecord.

### 12.2 Function Documentation

#### 12.2.1 ArmTrigger() 

```cpp
virtual int ArmTrigger ()
```

Arms the trigger block.

This command must be sent before the ADQ device is allowed to be trigged. In MultiRecord mode, the ADQ will collect a record of data for each trigger that is acquired after this command is sent.

Returns 1 for successful operation and 0 for failure.
Note While the ADQ device is busy recording a record of data, the device will ignore triggers until the collection logic has finished.

To rearm the device, you must first call DisarmTrigger(), then ArmTrigger().

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also DisarmTrigger(), MultiRecordSetup(), SetTriggerMode()

### 12.2.2 DisarmTrigger()

virtual int DisarmTrigger ( )

Disarms the the ADQ device.

The ADQ device cannot be triggered when the trigger is disarmed. Disarming and then arming the trigger will cause any old data collected to be overwritten.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also ArmTrigger(), MultiRecordSetup(), SetTriggerMode()

### 12.2.3 GetAcquired()

virtual int GetAcquired ( )

Checks if one or more record has been collected.

Returns 1 if the ADQ has been triggered and at least one record has been acquired

Note To see if all records have been acquired, use GetAcquiredAll(). To get the number of records that have been acquired, use GetAcquiredRecords()

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14

See also GetAcquiredAll(), GetAcquiredRecords()

### 12.2.4 GetAcquiredAll()

virtual unsigned int GetAcquiredAll ( )

Checks if all record have been collected.

Returns 1 if all records have been collected and 0 otherwise

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also GetAcquired(), GetAcquiredRecords()
12.2.5 GetAcquiredRecords()

virtual unsigned int GetAcquiredRecords ( )

Gets the number of records collected.

Returns The number of records collected

Note For some units, the number of records collected is not updated until all records are completed.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

12.2.6 GetData()

virtual int GetData ( void **target_buffers,
unsigned int target_buffer_size,
unsigned char target_bytes_per_sample,
unsigned int StartRecordNumber,
unsigned int NumberOfRecords,
unsigned char ChannelsMask,
unsigned int StartSample,
unsigned int nSamples,
unsigned char TransferMode )

Transfers data from ADQ to host in MultiRecord mode.

Transfers data from the internal memory buffers in the ADQ device directly to user-assigned buffers. This function is meant to be used together with the function MultiRecordSetup().

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>target_buffer_size</td>
<td>The size of each buffer for the data that you want to transfer from each channel. This parameter should always be set to NumberOfRecords×nSamples.</td>
</tr>
<tr>
<td>target_buffers</td>
<td>Pointer to the buffers where the data should be stored, one buffer buffer for each channel of data. This parameter may therefore be an array of pointers, depending on how many channels the ADQ device has.</td>
</tr>
<tr>
<td>target_bytes_per_sample</td>
<td>The size of each element in bytes</td>
</tr>
<tr>
<td>StartRecordNumber</td>
<td>The record number to start collecting data from. This value can be set between 0 and up to NumberOfRecords - 1. For example, if you have set up the ADQ device to collect 20 records but you are only interested in collecting the last 5, StartRecordNumber should be set to 14 (record index starts from 0).</td>
</tr>
</tbody>
</table>
**NumberOfRecords**

The number of records to collect from the unit. Please note that the sum `NumberOfRecords + StartRecordNumber` must always be smaller than the amount of records that were collected by the ADQ.

**ChannelsMask**

A bit-mask providing a set bit for each channel to be fetched. For a unit with two channels, this parameter can be set to 0x1 to fetch data from channel A, 0x2 to fetch data from channel B, and 0x3 to fetch data from both channels. Note: For ADQ12 / ADQ14, the same channel mask should also be set using the `MultiRecordSetChannelMask` command.

**StartSample**

The starting sample of each record to fetch. This can be used to transfer only a part of a record. The first sample is indexed 0.

**nSamples**

The number of samples to collect from each record. The starting point is set by `StartSample`.

**TransferMode**

The transfer mode. Please set to 0x00 for normal data fetch operations.

- **Returns**: 1 for successful operation and 0 for failure.
- **Note**: The buffers pointed to by `target_buffers` must be allocated correctly by the user.

  This is the recommended function for fast record data transfers.

  Partial record read-out using `StartSample` and `nSamples` is not supported for ADQ14, ADQ12, ADQ7 or ADQ8. A full record - in same sequence and with no gaps as acquired - must be read on each call.

- **Valid for**: ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

- **See also**: `MultiRecordSetup()`, `MultiRecordSetChannelMask()`

### 12.2.7 GetDataWH()

```c
virtual int GetDataWH ( 
    void ** target_buffers, 
    void * target_headers, 
    unsigned int target_buffer_size, 
    unsigned char target_bytes_per_sample, 
    unsigned int StartRecordNumber, 
    unsigned int NumberOfRecords, 
    unsigned char ChannelsMask, 
    unsigned int StartSample, 
    unsigned int nSamples, 
    unsigned char TransferMode )
```

Transfers from ADQ to host in MultiRecord mode. Also saves headers.

Collects data from the device with headers. See documentation for `GetData()`. The difference is only one added argument, the target destination for header data.
Parameters

- **target_buffers**
  See GetData()

- **target_headers**
  The memory location where headers will be written. The total amount of data that will be written is the header size times the number of records to fetch specified in NumberOfRecords. If set to NULL, no headers will be fetched. The header size is:
  - 40 bytes for ADQ8, ADQ7, ADQ12 and ADQ14.
  - 32 bytes for all other products.

- **target_buffer_size**
  See GetData()

- **target_bytes_per_sample**
  See GetData()

- **StartRecordNumber**
  See GetData()

- **NumberOfRecords**
  See GetData()

- **ChannelsMask**
  See GetData()

- **StartSample**
  See GetData()

- **nSamples**
  See GetData()

- **TransferMode**
  See GetData()

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also MultiRecordSetup(), GetData()

### 12.2.8 GetDataWHTS()

```c
virtual int GetDataWHTS()
```
void ** target_buffers,
void * target_headers,
void * target_timestamps,
unsigned int target_buffer_size,
unsigned char target_bytes_per_sample,
unsigned int StartRecordNumber,
unsigned int NumberOfRecords,
unsigned char ChannelsMask,
unsigned int StartSample,
unsigned int nSamples,
unsigned char TransferMode )

Transfers from ADQ to host in MultiRecord mode. Also saves headers and timestamps.
Collects data from the device with headers and timestamps. See documentation for GetData(). The difference is only two added arguments, the target destination for header data and timestamp data.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>target_buffers</td>
<td>See GetData()</td>
</tr>
</tbody>
</table>
| target_headers     | The memory location where headers will be written. The total amount of data that will be written is the header sizes times the number of records to fetch specified in NumberOfRecords. If set to NULL no headers will be fetched. The header size is:
  - 40 bytes for ADQ8, ADQ7, ADQ12 and ADQ14.
  - 32 bytes for all other products. |
| target_timestamps  | The memory location where timestamps will be written. The total amount of data that will be written is 8 bytes (one int64) times the number of records to fetch specified in NumberOfRecords. If set to NULL no timestamps will be fetched. |
| target_buffer_size | See GetData() |
| target_bytes_per_sample | See GetData() |
| StartRecordNumber  | See GetData() |
| NumberOfRecords    | See GetData() |
| ChannelsMask       | See GetData() |
| StartSample        | See GetData() |
| nSamples           | See GetData() |
TransferMode
See GetData()

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
See also MultiRecordSetup(), GetData()

12.2.9 GetTriggedCh()

virtual int GetTriggedCh ( )

Gets the channel that the level trigger triggered on.
- Return value = 0: None (may happen if the device was triggered in software trigger mode)
- Return value = 1: Channel A
- Return value = 2: Channel B
- Return value = 4: Channel C
- Return value = 8: Channel D

The trigged channel value is updated each time a new record is collected.

Returns The channel that which the device was trigged by
Valid for ADQ208, ADQ212, ADQ214, ADQ412, SDR14, ADQ8

12.2.10 GetWaitingForTrigger()

virtual int GetWaitingForTrigger ( )

Polls the MultiRecord collection to see if it is waiting for a trigger.

Returns 1 if the device is waiting for a trigger, and 0 otherwise
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14
See also MultiRecordSetup()

12.2.11 MultiRecordClose()

virtual unsigned int MultiRecordClose ( )

Closes MultiRecord mode.

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also MultiRecordSetup()

### 12.2.12 MultiRecordSetChannelMask()

```cpp
class virtual unsigned int MultiRecordSetChannelMask(
    unsigned int channelmask)
```

Enables/disables channels for a multirecord acquisition. Selects which channels should be active for a multirecord acquisition. By disabling unused channels, the remaining channels will have more memory area available for data storage, allowing larger maximum records. This command should be run prior to MultiRecordSetup.

**Parameters**

<table>
<thead>
<tr>
<th>channelmask</th>
</tr>
</thead>
<tbody>
<tr>
<td>A bit field, where bit 0 corresponds to channel A, bit 1 to channel B, etc. A bit value of 1 means the channel will be enabled.</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also MultiRecordSetup()

### 12.2.13 MultiRecordSetup()

```cpp
class virtual unsigned int MultiRecordSetup(
    unsigned int NumberOfRecords,
    unsigned int SamplesPerRecord)
```

The MultiRecord mode may be used to trigger multiple records in successive order. The data is stored in the on-board DRAM and may then be read using GetData().

**Parameters**

<table>
<thead>
<tr>
<th>NumberOfRecords</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of records to collect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SamplesPerRecord</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of samples per record</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

**Note** The same values are set for all channels

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
12.2.14 SetPreTrigSamples()

#define virtual int SetPreTrigSamples ( 
  unsigned int PreTrigSamples )

Selects the number of pre-trigger samples for MultiRecord.

The granularity of the pre-trigger buffer depends on the product type:

- ADQ412: 8 samples in non-interleaved mode and 16 samples in interleaved mode
- ADQ1600: 8 samples
- ADQ108: 32 samples
- ADQ208: 16 samples in non-interleaved mode and 32 samples in interleaved mode
- SDR14: 4 samples
- ADQ214 & ADQ212: 2 samples
- ADQ114 & ADQ112: 4 samples
- ADQ12-4C/2C: 4 samples (value must match granularity)
- ADQ14-2X/1X & ADQ14OCT: 8 samples (value must match granularity)
- ADQ14-4C/2C: 4 samples (value must match granularity)
- ADQ14-4A/2A: 2 samples (value must match granularity)
- ADQ7: 32 samples in 1ch@10GSPS mode and 16 samples in 2ch@5GSPS mode
- ADQ8-8A/8C: 4 samples Any pre-trigger size will be rounded UP by the granularity (except for ADQ12 and ADQ14).

For example on ADQ412 in non-interleaved mode; if you set pretrigsamples to 5, it will automatically be rounded up to 8 samples and if you instead set it to 9, it will be rounded up to 16 samples.

Parameters

**PreTrigSamples**
The number of pre-trigger samples. Must be less than the MultiRecord record size.

Returns 1 for successful operation and 0 for failure.

**Note** When using this function, the trigger hold-off is automatically reset to zero.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also ArmTrigger(), MultiRecordSetupGP(), MultiRecordClose(), GetMaxNofSamplesFromNofRecords(), GetMaxNofRecordsFromNofSamples()
12.2.15 SetTriggerDelay()

```c
virtual int SetTriggerDelay(
    unsigned int triggerdelay_samples)
```

Sets the delay between the trigger and the start of the record acquisition.

The granularity of the delay setting depends on the product type:

- ADQ412: 8 samples in non-interleaved mode and 16 samples in interleaved mode
- ADQ1600: 8 samples
- ADQ108: 32 samples
- ADQ208: 16 samples in non-interleaved mode and 32 samples in interleaved mode
- SDR14: 4 samples
- ADQ214 & ADQ212: 2 samples
- ADQ114 & ADQ112: 4 samples
- ADQ12-4C/2C: 4 samples
- ADQ14-2X/1X & ADQ14OCT: 8 samples
- ADQ14-4C/2C: 4 samples
- ADQ14-4A/2A: 2 samples
- ADQ7: 32 samples in 1ch@10GSPS mode and 16 samples in 2ch@5GSPS mode
- ADQ8-8A: 4 samples

Any delay entered will be rounded up to the closest multiple of the granularity.

Parameters

<table>
<thead>
<tr>
<th>triggerdelay_samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>The trigger delay in units of samples.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Note When using this function, the pre-trigger setting is automatically reset to zero.

This function supersedes the deprecated SetTriggerHoldOffSamples

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ214, ADQ114, ADQ214, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also SetPreTrigSamples(), SetTriggerHoldOffSamples(), MultiRecordSetup()

13 Advanced MultiRecord

Functions

- unsigned int GetAcquiredRecordsAndLoopCounter(unsigned int *acquired_records, unsigned int *loop_counter)

  Gets the number of records collected and one which loop the MultiRecord engine is acquiring.
- unsigned int GetMaxNofRecordsFromNofSamples(unsigned int NofSamples, unsigned int *MaxNofRecords)
  
  Gets the maximum number of records given a number of samples per record.

- unsigned int GetMaxNofSamplesFromNofRecords(unsigned int NofRecords, unsigned int *MaxNofSamples)
  
  Gets the maximum number of samples per record given a number of records.

- unsigned int GetNofRecords()
  
  Gets the number of MultiRecord records set in the ADQ device.

- int GetOverflow()
  
  Checks if an overflow has occurred.

- unsigned int GetRecordSize()
  
  Gets the current MultiRecord record size.

- int GetTriggerInformation()
  
  Gets the enhanced trigger accuracy information.

- int GetTrigPoint()
  
  Gets the position in the data where the trig occurred.

- unsigned long long GetTrigTime()
  
  Gets the timestamp counter value.

- unsigned long long GetTrigTimeCycles()
  
  Gets the cycle counter value of the time stamp.

- unsigned int GetTrigTimeStart()
  
  Gets the start pulse value of the time stamp.

- unsigned int GetTrigTimeSyncs()
  
  Gets the sync counter value of the time stamp.

- unsigned int MultiRecordSetupGP(unsigned int NumberOfRecords, unsigned int SamplesPerRecord, unsigned int *mrinfo)
  
  Performs an advanced setup of MultiRecord.

- int ResetTrigTimer(int TrigTimeRestart)
  
  Resets the trig timer.

- int SetCacheSize(unsigned int newSizeInBytes)
  
  Sets the cache size of transfer of data for MultiRecord mode.

- int SetTrigTimeMode(int TrigTimeMode)
  
  Selects the trig timer mode.

13.1 Detailed Description

These functions are implements advanced use cases for MultiRecord mode.

13.2 Function Documentation
13.2.1 GetAcquiredRecordsAndLoopCounter()

virtual unsigned int GetAcquiredRecordsAndLoopCounter (  
    unsigned int  * acquired_records,  
    unsigned int  * loop_counter )

Gets the number of records collected and one which loop the MultiRecord engine is acquiring.  
This is only intended to be used for the acquisition mode called Continuous MultiRecord.

Parameters

acquired_records  
Pointer to where the number of acquired records should be returned

loop_counter  
Pointer to where the loop iteration of the MultiRecord engine should be returned

Returns  
The number of records collected

Valid for  
ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14

See also  
MultiRecordSetupGP()

13.2.2 GetMaxNofRecordsFromNofSamples()

virtual unsigned int GetMaxNofRecordsFromNofSamples (  
    unsigned int NofSamples,  
    unsigned int  * MaxNofRecords )

Gets the maximum number of records given a number of samples per record.

Parameters

NofSamples  
The number of sample for each record

MaxNofRecords  
A pointer to where the resulting maximum number of MultiRecord records will be stored

Returns  
1 for successful operation and 0 for failure

Valid for  
ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14

See also  
MultiRecordSetup(), GetMaxNofSamplesFromNofRecords()  

13.2.3 GetMaxNofSamplesFromNofRecords()

virtual unsigned int GetMaxNofSamplesFromNofRecords (  
    unsigned int  NofRecords,  

unsigned int * MaxNofSamples )

Gets the maximum number of samples per record given a number of records.

**Parameters**

| NofRecords | The number of records |
| MaxNofSamples | A pointer to where the resulting maximum number of samples per MultiRecord record |

**Returns**

1 for successful operation and 0 for failure

**Valid for**

ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14

**See also** MultiRecordSetup(), GetMaxNofRecordsFromNofSamples()

### 13.2.4 GetNofRecords()

**virtual unsigned int GetNofRecords ()**

Gets the number of MultiRecord records set in the ADQ device.

**Returns**

The number of records set

**Valid for**

ADQ214, ADQ114, ADQ212, ADQ112, ADQ12, ADQ14, ADQ8

### 13.2.5 GetOverflow()

**virtual int GetOverflow ()**

Checks if an overflow has occurred.

**Returns**

1 if an overflow has occurred in the most recent collected record. 0 if not

**Valid for**

ADQ214, ADQ114, ADQ212, ADQ112

### 13.2.6 GetRecordSize()

**virtual unsigned int GetRecordSize ()**

Gets the current MultiRecord record size.

The value is given per channel.

**Returns**

The record size in number of samples

**Valid for**

ADQ214, ADQ114, ADQ212, ADQ112
13.2.7 GetTriggerInformation()

virtual int GetTriggerInformation ( )

Gets the enhanced trigger accuracy information.

The bits in the returned value holds the information and is decoded as:

- output[0:9]: Reserved for future use
- output[10:11]: Enhanced trigger accuracy vector
- output[12:31]: Reserved for future use

Where output is the returned value.

Returns The enhanced trigger information

Note This information is only valid if the ADQ device is set to External trigger mode.

Valid for ADQ214, ADQ114, ADQ212, ADQ112

13.2.8 GetTrigPoint()

virtual int GetTrigPoint ( )

Gets the position in the data where the trig occurred.

The point returned is the trigger point in the latest MultiRecord record transferred.

Returns The position in the data array

Valid for ADQ214, ADQ114, ADQ212, ADQ112

13.2.9 GetTrigTime()

virtual unsigned long long GetTrigTime ( )

Gets the timestamp counter value.

The result depends on the Trig Time Mode.

- SYNC_ON=cycles\(2^2\)+start_val+trig_val
- SYNC_OFF=syncs\(2^4\)+cycles\(2^2\)+start_val+trig_val

Returns The cycle counter value of the time stamp

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14

See also SetTrigTimeMode()
13.2.10 GetTrigTimeCycles()

virtual unsigned long long GetTrigTimeCycles ( )

Gets the cycle counter value of the time stamp.

Returns The cycle counter value of the time stamp

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14
See also SetTrigTimeMode(), GetTrigTimeSyncs()

13.2.11 GetTrigTimeStart()

virtual unsigned int GetTrigTimeStart ( )

Gets the start pulse value of the time stamp.

Returns A two bit value of the start pulse

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14
See also SetTrigTimeMode()

13.2.12 GetTrigTimeSyncs()

virtual unsigned int GetTrigTimeSyncs ( )

Gets the sync counter value of the time stamp.

Returns The sync counter value of the time stamp

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14
See also SetTrigTimeMode(), GetTrigTimeCycles()

13.2.13 MultiRecordSetupGP()

virtual unsigned int MultiRecordSetupGP ( unsigned int NumberOfRecords, unsigned int SamplesPerRecord, unsigned int * mrinfo )

Performs an advanced setup of MultiRecord.

Performs setup of MultiRecord in a similar way as MultiRecordSetup, but as an extra parameter for advanced setup.

Parameters
### NumberOfRecords
The number of records to collect (On ADQ12 and ADQ14 NumberOfRecords == 0 indicates infinite number of records in continuous mode)

<table>
<thead>
<tr>
<th>SamplesPerRecord</th>
<th>The number of samples per record</th>
</tr>
</thead>
</table>

| mrinfo |
Both an input and output. When calling this function, the contents at mrinfo used as below:
- mrinfo[0]: (mrinfo[0] can only be used on ADQV6 devices.)
- Set to 2 to enable MultiRecordModeAuto
- Set to 4 to enable MultiRecordModeDisablePretrigger. May be used to disable pretrigger buffering. (Note: disable pretrigger buffering cannot be used in conjunction with sample-skip or other data reduction methods) This will improve data readout performance while reading a record before all are completed.
- Set to 7 to enable both MultiRecordModeAuto and MultiRecordModeDisablePretrigger
- Set to 0 to disable both MultiRecordModeAuto and MultiRecordModeDisablePretrigger
- mrinfo[1] to mrinfo[9]: Reserved

When this function returns, it outputs data in these fields, according to:
- mrinfo[0]: dram_start_addr
- mrinfo[1]: dram_end_addr
- mrinfo[2]: dram_addr_per_record
- mrinfo[3]: dram_bytes_per_addr
- mrinfo[4]: setup_records
- mrinfo[5]: setup_samples
- mrinfo[6]: setup_padded_samples
- mrinfo[7]: max_number_of_records
- mrinfo[8]: shadow_size
- mrinfo[9]: reserved

These values are useful if the data is dumped using MemoryDump() for later parsing.

**Returns** 1 for successful operation and 0 for failure

**Valid for** ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14

**See also** MultiRecordSetup(), MemoryDump()

### 13.2.14 ResetTrigTimer()

```c
virtual int ResetTrigTimer (  
      int  TrigTimeRestart )
```

Resets the trig timer.
Parameters

**TrigTimeRestart**

Restart mode. These values are valid:

- 0: Timer waits for start pulse to start
- 1: Timer restarts immediately

Returns 1 for successful operation and 0 for failure

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14

See also SetTrigTimeMode()

### 13.2.15 SetCacheSize()

```
virtual int SetCacheSize (
    unsigned int newSizeInBytes )
```

Sets the cache size of transfer of data for MultiRecord mode.

Can be used to optimize transfer performance for a specific application.

**Parameters**

- **newSizeInBytes**
  - The new cache size. Must be given in multiples of 1024 bytes.

Returns 1 for successful operation and 0 for failure

**Note** When transferring small records one at the time, use a small value.

This function should rarely be used, the default setting is the best for most applications.

This function allocates memory in the kernel space.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU

See also SetTransferBuffers()

### 13.2.16 SetTrigTimeMode()

```
virtual int SetTrigTimeMode (
    int TrigTimeMode )
```

Selects the trig timer mode.

**Parameters**
**TrigTimeMode**

Trig timer mode. These values are valid:
- 0: Continuous count
- 1: Activate sync mode, count sync pulses and reset counter

Returns 1 for successful operation and 0 for failure

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14

See also ResetTrigTimer()

### 14 Data Streaming

**Data Structures**

- struct ADQRecordHeader

  Header structure returned when streaming data.
  For each record returned when streaming data a corresponding header structure is also returned. More...

**Macros**

- #define ADQ14_STREAM_CHUNK_BYTES (1024)
  Chunk size used when streaming, in bytes
  If a buffer of raw data parsed by GetDataStreaming() or ADQData_ParsePacketStream() the buffer size needs to be a multiple of this value.

- #define ADQ14_STREAM_RECORD_MIN_BYTES (128)
  Minimum record size in raw data stream
  Minimum raw record size before parsing data. If a buffer of raw data of size N bytes is parsed by GetDataStreaming() or ADQData_ParsePacketStream() it can generate at most N/ADQ14_STREAM_RECORD_MIN_BYTES number of records.

- #define ADQ7_STREAM_CHUNK_BYTES (1024)
  Chunk size used when streaming, in bytes
  If a buffer of raw data parsed by GetDataStreaming() or ADQData_ParsePacketStream() the buffer size needs to be a multiple of this value.

- #define ADQ7_STREAM_RECORD_MIN_BYTES (128)
  Minimum record size in raw data stream
  Minimum raw record size before parsing data. If a buffer of raw data of size N bytes is parsed by GetDataStreaming() or ADQData_ParsePacketStream() it can generate at most N/ADQ7_STREAM_RECORD_MIN_BYTES number of records.

**Functions**

- int CollectDataNextPage()
  Transfers streamed data from the DMA buffers.
- unsigned int ContinuousStreamingSetup (unsigned char ChannelsMask)
  
  **Sets up a continuous streaming data acquisition.**

- unsigned int FlushDMA (void)
  
  **Flushes DMA buffer.**

- int FlushPacketOnRecordStop (unsigned int enable)
  
  **Enables or disables the forced flush of a packet on record stop.**

- int GetDataStreaming (void **target_buffers, void **target_headers, unsigned char channels_mask, unsigned int *samples_added, unsigned int *headers_added, unsigned int *header_status)
  
  **Transfers data and record headers from the ADQ in streaming mode.**

- int GetGPVectorMode (unsigned int channel, unsigned int *mode)
  
  **Retrieves the configuration of the general purpose vector fields in the triggered streaming user header.**

- void * GetPtrStream ()
  
  **Gets a pointer to the array of streamed data.**

- unsigned int GetSamplesPerPage ()
  
  **Gets the number of samples per transfer buffer for the ADQ.**

- int GetStreamConfig (unsigned int option, unsigned int *value)
  
  **Gets the streaming configuration.**

- int GetStreamOverflow ()
  
  **Returns whether there has been an overflow of the internal FPGA data buffers.**

- int GetStreamStatus ()
  
  **Gets the streaming status.**

- unsigned int GetTransferBufferStatus (unsigned int *filled)
  
  **Gets the number of DMA buffers available.**

- int InitializeStreaming ()
  
  **Initialize and set up a streaming data acquisition.**

- int SetChannelLevelTriggerMask (unsigned int channel, unsigned int level_trig_mask)
  
  **Sets the level trigger mask (which level triggers are used by a channel) for a specific channel.**

- int SetChannelNumberOfRecords (unsigned int channel, unsigned int nofrecords, int infinite_records)
  
  **Sets the number of records for a specific channel.**

- int SetChannelPretrigger (unsigned int channel, unsigned int pretrigger)
  
  **Sets the amount of pre-trigger for a specific channel.**

- int SetChannelRecordLength (unsigned int channel, unsigned int length, int infinite_length)
  
  **Sets the record length for a specific channel.**

- int SetChannelSampleSkip (unsigned int channel, unsigned int skipfactor)
  
  **Sets the sample skip factor for a specific channel.**

- int SetChannelTriggerDelay (unsigned int channel, unsigned int triggerdelay)
  
  **Sets the amount of trigger delay for a specific channel.**

- int SetChannelTriggerMode (unsigned int channel, int trig_mode)
  
  **Sets the trigger mode for a specific channel.**
• unsigned int SetFlushDMASize (unsigned int flush_size)
  
  Set DMA flush size.
• int SetGPVectorMode (unsigned int channel, unsigned int mode)

  Configures the behavior of the general purpose vector fields in the triggered streaming user header.
• int SetStreamConfig (unsigned int option, unsigned int value)
  
  Sets the streaming configuration.
• int SetStreamingChannelMask (unsigned int channelmask)

  Select which channels will transmit data to the host system during streaming.
• int SetStreamStatus (int status)
  
  Controls streaming mode.
• int SetTransferBuffers (unsigned int nOfBuffers, unsigned int bufferSize)

  Sets the number and size of the data transfer buffers.
• int StartStreaming ()
  
  Sets up the software for streaming from the ADQ.
• int StopStreaming ()
  
  Stops streaming in the software.
• unsigned int TriggeredStreamingSetupV5 (unsigned int SamplePerRecord, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples, unsigned int TriggeredStreamingFlags)

  Sets the parameters for multi channels Triggered Streaming on V5 ADQs.
• unsigned int TriggeredStreamingShutdownV5 ()
  
  Issues shutdown for Triggered Streaming on V5 product.
• unsigned int WaitForTransferBuffer (unsigned int *filled, unsigned int timeout_setting)

  Wait for DMA buffers to be available (not working for USB2 interface units)

14.1 Detailed Description

These functions are used for setting up streaming mode and transferring data.

14.2 Data Structure Documentation

14.2.1 struct ADQRecordHeader

Header structure returned when streaming data.

For each record returned when streaming data a corresponding header structure is also returned.
14.3 Function Documentation

14.3.1 CollectDataNextPage()

virtual int CollectDataNextPage ( )

Transfers streamed data from the DMA buffers.
The data is stored at the location pointed to by GetPtrStream(). The number of samples retrieved is given by GetSamplesPerPage().

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also GetPtrStream(), GetSamplesPerPage()

14.3.2 ContinuousStreamingSetup()

virtual unsigned int ContinuousStreamingSetup ( unsigned char ChannelsMask )

Sets up a continuous streaming data acquisition.
At the first incoming trigger event, the digitizer will start streaming continuous data from the ADCs. Some form of data reduction will likely be required in order for the data transfer to not bottleneck the acquisition and cause data overflow. Some examples of data reduction are the sample skip feature, and using the channel mask argument to disable channels.
Parameters

<table>
<thead>
<tr>
<th>ChannelsMask</th>
</tr>
</thead>
<tbody>
<tr>
<td>A bit field specifying which channels to enable streaming for. Bit 0 enables channel A, bit 1 channel B and so forth.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7

14.3.3 FlushDMA()

virtual unsigned int FlushDMA ( )

Flushes DMA buffer.
Flushes the current DMA buffer so data can be read out if the buffer is only partly filled.

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7

14.3.4 FlushPacketOnRecordStop()

virtual int FlushPacketOnRecordStop ( unsigned int enable )

Enables or disables the forced flush of a packet on record stop.
This function may be used to control whether the capture of the last data in a record also forces a flush of the packet. This is particularly useful when configuring low latency data transfers. This is an advanced feature and should only be used in the approved contexts, i.e. another document should point you to this function.

Parameters

| enable |

Returns 1 for successful operation and 0 for failure
Note This function must be called after TriggeredStreamingSetup()
Valid for ADQ12, ADQ14, ADQ7

14.3.5 GetDataStreaming()

virtual int GetDataStreaming ( )
void ** target_buffers,
void ** target_headers,
unsigned char channels_mask,
unsigned int * samples_added,
unsigned int * headers_added,
unsigned int * header_status )

Transfers data and record headers from the ADQ in streaming mode.

This function is not recommended for new designs, refer to document 20-2465 for information about the updated flow.

This function fetches and parses the data from the ADQ when the device is configured in streaming mode. The data and metadata is delivered to the user buffers: target_buffers and target_headers, respectively. The channels_mask is used to suppress data collection from specific channels. The parameter samples_added contains information on how many samples that were added to the user data buffers. This allows the user to increment the data buffer pointers accordingly before the next call to the GetDataStreaming() function. The parameters headers_added and header_status provide the user with information to determine if the header buffer pointers should be incremented. The parameter headers_added contains the number of initialized headers as a result of this call to GetDataStreaming(). The header_status parameter is used to denote if the last header is complete or not. E.g. a return value of headers_added = 4 and header_status = 1 signifies 4 complete headers, while headers_added = 4 and header_status = 0 would signify 3 complete headers and one incomplete header. In this case, it is important that the header buffers are incremented such that the buffer for that channel points at the incomplete header in the next call to GetDataStreaming().

Parameters

<table>
<thead>
<tr>
<th><strong>target_buffers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to the user-allocated buffers where the data is to be placed. One buffer for each channel of data.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>target_headers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to the user-allocated buffers where the headers are to be placed. One buffer for each channel of data.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>channels_mask</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Channels mask to enable/disable data parsing from specific channels. Expecting a 4-bit bitmask.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>samples_added</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains the number of samples added to the target buffers (per channel) when the function returns successfully.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>headers_added</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains the number of initialized headers from this function call.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>header_status</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains the last header status. See description above.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ12, ADQ14, ADQ7

14.3.6 GetGPVectorMode()

virtual int GetGPVectorMode (  
          unsigned int channel,
unsigned int * mode 

Retrieves the configuration of the general purpose vector fields in the triggered streaming user header.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
<th>The target channel, indexed from 1 and upwards.</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode</td>
<td>Pointer to memory where the value is placed.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Valid for ADQ7

See also SetGPVectorMode()

### 14.3.7 GetPtrStream()

virtual void* GetPtrStream ()

Gets a pointer to the array of streamed data.

The size of the data array may be acquired using GetSamplesPerPage() after calling SetStreamStatus().

Returns A pointer to the data array of the stream.

Valid for ADQ212, ADQ214, ADQ112, ADQ114, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also SetStreamStatus(), GetSamplesPerPage(), CollectDataNextPage()

### 14.3.8 GetSamplesPerPage()

virtual unsigned int GetSamplesPerPage ()

Gets the number of samples per transfer buffer for the ADQ.

Used with CollectDataNextPage/CollectRecord to get information on number of samples per call.

Returns The number of samples per page

Note per channel if applicable. This figure may change when altering the acquisition settings.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

See also SetTransferBuffers()
14.3.9 GetStreamConfig()

virtual int GetStreamConfig (  
   unsigned int  option,  
   unsigned int * value )

Gets the streaming configuration.  
Please see SetStreamConfig() for information on the meaning of the values.  

Parameters

<table>
<thead>
<tr>
<th>option</th>
<th>Selected option</th>
</tr>
</thead>
<tbody>
<tr>
<td>value</td>
<td>Retuned configuration value</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure  
Valid for ADQ7, ADQ12, ADQ14

14.3.10 GetStreamOverflow()

virtual int GetStreamOverflow ( )  

Returns whether there has been an overflow of the internal FPGA data buffers.  
When overflow occurs, data will be missing from the stream.  
Returns 1 for overflow condition detected, 0 for no overflow condition detected and negative numbers for any errors.  
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8  
See also GetStreamStatus(), SetStreamStatus(), StartStreaming(), StopStreaming(), GetStatus()

14.3.11 GetStreamStatus()

virtual int GetStreamStatus ( )  

Gets the streaming status.  
Please see SetStreamStatus() for information on the meaning of the values.  
Returns The current stream status of the device  
Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ412, ADQ108, ADQ208, ADQ1600, SDR14
14.3.12 GetTransferBufferStatus()

virtual unsigned int GetTransferBufferStatus(
    unsigned int *filled)

Gets the number of DMA buffers available.

This function enables the host application to balance the streaming read-out to avoid overflows. If the answer is 0, no buffer is ready to be read. If the answer is the same as the total number of buffers set by SetTransferBuffers(), all buffers are full, and an overflow will likely occur soon (if it have not already).

Parameters

filled
Pointer to where the number of filled buffers will be written

Returns 1 for successful operation and 0 for failure

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ412, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7

See also SetTransferBuffers()

14.3.13 InitializeStreaming()

virtual int InitializeStreaming()

Initialize and set up a streaming data acquisition.

This function is an alternative to ContinuousStreamingSetup() and TriggeredStreamingSetup(). It allows a streaming acquisition with channel-specific settings to be set up, after first using functions such as SetChannelRecordLength() and SetChannelNumberOfRecords() to configure the channels.

Returns 1 for successful operation and 0 for failure

Valid for ADQ14, ADQ7

See also InitializeStreaming(), SetChannelRecordLength(), SetChannelNumberOfRecords(), SetChannelPre-trigger(), SetChannelTriggerDelay(), SetChannelSampleSkip(), SetStreamingChannelMask()

14.3.14 SetChannelLevelTriggerMask()

virtual int SetChannelLevelTriggerMask(
    unsigned int channel,
    unsigned int level_trig_mask)

Sets the level trigger mask (which level triggers are used by a channel) for a specific channel.

This function allows channel-specific level trigger selection, of the level triggers setup by SetupLevelTrigger API

Parameters
channel
Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.

level_trig_mask
An OR is performed for events for all 1's in this mask, to define the used trigger for the channel. Bit 0 corresponds to channel 1 and so forth.

Returns 1 for successful operation and 0 for failure
Valid for ADQ14, ADQ7
Note Not all combinations of masks are allowed, see SetupLevelTrigger API documentation for limitations
This API must be called, for all channels, after setting up the level trigger with SetupLevelTrigger, as that call overrides the individual trigger masks
Trigger mode must be set to level trigger (at least for this channel), for these settings to have any effect
See also InitializeStreaming(), SetupLevelTrigger()

14.3.15 SetChannelNumberOfRecords()

virtual int SetChannelNumberOfRecords(
    unsigned int channel,
    unsigned int nofrecords,
    int infinite_records )

Sets the number of records for a specific channel.
This function allows channel-specific amounts of records per data acquisition, when used prior to calling InitializeStreaming()

Parameters

channel
Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.

nofrecords
The number of records.

infinite_records
Set to 1 to enable an infinite number of records.

Returns 1 for successful operation and 0 for failure
Valid for ADQ14, ADQ7
See also InitializeStreaming()
14.3.16 SetChannelPretrigger()

virtual int SetChannelPretrigger(
    unsigned int channel,
    unsigned int pretrigger
)

Sets the amount of pre-trigger for a specific channel.

This function allows channel-specific pretrigger settings, when used prior to calling InitializeStreaming().

The granularity of the pretrigger setting depends on the product type:

- ADQ14-2X/1X & ADQ14OCT: 8 samples
- ADQ14-4C/2C: 4 samples
- ADQ14-4A/2A: 2 samples
- ADQ7: 32 samples in 1ch@10GSPS mode and 16 samples in 2ch@5GSPS mode

The requested pre-trigger value must match this granularity.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pretrigger</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of pretrigger (in units of samples).</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14, ADQ7

See also InitializeStreaming()

14.3.17 SetChannelRecordLength()

virtual int SetChannelRecordLength(
    unsigned int channel,
    unsigned int length,
    int infinite_length
)

Sets the record length for a specific channel.

This function allows channel-specific record length settings, when used prior to calling InitializeStreaming().

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>length</th>
</tr>
</thead>
<tbody>
<tr>
<td>The record length (in units of samples).</td>
</tr>
</tbody>
</table>
### infinite_length
Set to 1 to enable infinite record length (continuous streaming).

Returns 1 for successful operation and 0 for failure.

Valid for ADQ14, ADQ7

See also InitializeStreaming()

#### 14.3.18 SetChannelSampleSkip()

```cpp
virtual int SetChannelSampleSkip (  
  unsigned int channel,  
  unsigned int skipfactor  
)
```

Sets the sample skip factor for a specific channel.

This function allows channel-specific sample skip settings, when used prior to calling InitializeStreaming().

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>skipfactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample skip factor (see SetSampleSkip() for valid factors per product)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Valid for ADQ14, ADQ7

See also InitializeStreaming()

#### 14.3.19 SetChannelTriggerDelay()

```cpp
virtual int SetChannelTriggerDelay (  
  unsigned int channel,  
  unsigned int triggerdelay  
)
```

Sets the amount of trigger delay for a specific channel.

This function allows channel-specific trigger delay settings, when used prior to calling InitializeStreaming().

The granularity of the trigger delay setting depends on the product type:

- ADQ14-2X/1X & ADQ14OCT: 8 samples
- ADQ14-4C/2C: 4 samples
- ADQ14-4A/2A: 2 samples
- ADQ7: 32 samples in 1ch@10GSPS mode and 16 samples in 2ch@5GSPS mode
The requested trigger delay value will be rounded up to the nearest multiple of the granularity.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>triggerdelay</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of trigger delay (in units of samples).</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14, ADQ7

See also InitializeStreaming()

14.3.20 SetChannelTriggerMode()

virtual int SetChannelTriggerMode ( unsigned int channel, int trig_mode )

Sets the trigger mode for a specific channel.
This function allows channel-specific trigger selection.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel number, indexed from 1 and upwards, or set to 0xFFFFFFFF to apply to all channels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>trig_mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>See SetTriggerMode() for options.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14, ADQ7

Note This API must be called, for all channels, after setting up any generic trigger mode with SetTriggerMode, as that call overrides the individual trigger masks

See also InitializeStreaming(), SetTriggerMode()

14.3.21 SetFlushDMASize()

virtual unsigned int SetFlushDMASize ( unsigned int flush_size )

Set DMA flush size.
Set the flush block size for FlushDMA()
Parameters
flush_size
Flush block size, must be a multiple of 16.

Returns 1 for successful operation and 0 for failure
Valid for ADQ14
See also FlushDMA()

14.3.22 SetGPVectorMode()

virtual int SetGPVectorMode (  
    unsigned int channel,  
    unsigned int mode )  

Configures the behavior of the general purpose vector fields in the triggered streaming user header.

Parameters

channel
The target channel, indexed from 1 and upwards.

mode
Valid values are
• 0: GPVector0: General purpose vector sampled at record start GPVector1: General purpose vector sampled at record end
• 1: GPVector0: General purpose vector sampled at record start GPVector1: Gate counter value
• 2: GPVector0: General purpose vector sampled at record end GPVector1: Gate counter value

Returns 1 for successful operation and 0 for failure
Valid for ADQ7
See also GetGPVectorMode()

14.3.23 SetStreamConfig()

virtual int SetStreamConfig (  
    unsigned int option,  
    unsigned int value )  

Sets the streaming configuration.

• Option = 0x1 Bypass DRAM Fifo
  – value = 0 => Using DRAM as fifo
  – value = 1 => DRAM fifo is disabled (only small fifo is used)
• Option = 0x2 Streaming mode
– value = 0 => Packet headers are enabled
– value = 1 => Raw without headers data order is deterministic

• Option = 0x3 Stream channel mask bit field
  – value = 0 => None
  – value = 1 => Channel A
  – value = 2 => Channel B
  – value = 4 => Channel C
  – value = 8 => Channel D

• Option = 0x5 Streaming mode (ADQ7 & ADQ14 only)
  – value = 0 => Records with headers (default)
  – value = 1 => Records without headers, data order is deterministic

Parameters

<table>
<thead>
<tr>
<th>option</th>
<th>Selected option</th>
</tr>
</thead>
<tbody>
<tr>
<td>value</td>
<td>Configuration value</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ7, ADQ12, ADQ14

14.3.24 SetStreamingChannelMask()

virtual int SetStreamingChannelMask ( 
  unsigned int channelmask )

Select which channels will transmit data to the host system during streaming.

This function allows enabling/disabling the transfer of data to host for specific channels, when used prior to calling InitializeStreaming()

Parameters

| channelmask | Each bit corresponds to one data channel (bit 0 for channel 1, bit 1 for channel 2 and so on). Set a bit to 1 to enable data transfer for that channel |

Returns 1 for successful operation and 0 for failure

Valid for ADQ14, ADQ7

See also InitializeStreaming()
14.3.25 SetStreamStatus()

virtual int SetStreamStatus (  
    int status  )  

Controls streaming mode.

Parameters

status

The streaming mode to be selected. Use one of the following macros:

- **ADQ214 & ADQ212:**
  - ADQ214_STREAM_DISABLED
  - ADQ214_STREAM_ENABLED_BOTH
  - ADQ214_STREAM_ENABLED_A
  - ADQ214_STREAM_ENABLED_B

- **ADQ114 & ADQ112:**
  - ADQ214_STREAM_DISABLED
  - ADQ214_STREAM_ENABLED

- **ADQ108, ADQ208, ADQ1600, SDR14**
  - 0x0 (stream disabled)
  - 0x1 (stream enabled)
  - 0x9 (redirect data to DRAM)

- **SDR14**
  - 0x100 (Sort data linear)

- **ADQ7/ADQ12/ADQ14:** Use SetStreamConfig API instead

Returns 1 for successful operation and 0 for failure.

Note For ADQ214, ADQ114, ADQ212 and ADQ112: The start of the streaming may wait for a trigger after arming. To do this, make a bitwise 'or' between the selected macro and the macro ADQxxx_STREAM_WAIT_FOR_TRIGGER.

When stream status is set to 0x1 and StartStreaming() is executed, data will be streamed immediately and the user application must start emptying with the API command CollectDataNextPage.

When stream status is set to 0x9, the DRAM may be emptied using the MemoryDump function after setting stream status to 0x0. Stream mode 0x9 Requires firmware revision 12920 or newer.

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7

See also  StartStreaming()

14.3.26 SetTransferBuffers()

virtual int SetTransferBuffers (  
    unsigned int nOfBuffers,  
    unsigned int bufferSize  )  

Sets the number and size of the data transfer buffers.

Parameters
### nOfBuffers

The number of buffers

### bufferSize

The transfer buffer size in bytes. The value is required to be a multiple of
- 1024 on ADQ14, ADQ7 and ADQ8
- 512 on other products

If MultiRecord mode is to be used, SetCacheSize() must be called to set a cache size that is less than or equal to the transfer buffer size.

Returns 1 for successful operation and 0 for failure

**Note** This function could be used for MultiRecord mode, but this is rarely recommended.

This function allocates memory in the kernel space.

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

### 14.3.27 StartStreaming()

```cpp
virtual int StartStreaming ()
```

Sets up the software for streaming from the ADQ.

Calling this function will set the software to expect streamed data from the ADQ. To enable streamed data from the ADQ, SetStreamStatus() must be called.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, DSU, ADQDSP, ADQ12, ADQ14, ADQ7

See also StopStreaming(), SetStreamStatus()

### 14.3.28 StopStreaming()

```cpp
virtual int StopStreaming ()
```

Stops streaming in the software.

To stop streaming on the ADQ, call SetStreamStatus().

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, DSU, ADQDSP, ADQ12, ADQ14, ADQ7

See also StartStreaming(), SetStreamStatus()
14.3.29 TriggeredStreamingSetupV5()

```cpp
virtual unsigned int TriggeredStreamingSetupV5(
    unsigned int SamplePerRecord,
    unsigned int NofPreTrigSamples,
    unsigned int NofTriggerDelaySamples,
    unsigned int TriggeredStreamingFlags )
```

Sets the parameters for multi channels Triggered Streaming on V5 ADQs.

Please consult the Triggered Streaming example for V5 product for details on the execution flow.

**Parameters**

<table>
<thead>
<tr>
<th><strong>SamplePerRecord</strong></th>
<th>The number of samples per waveform</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NofPreTrigSamples</strong></td>
<td>The number of pretrigger samples for each waveform</td>
</tr>
<tr>
<td><strong>NofTriggerDelaySamples</strong></td>
<td>The number of samples to hold off after the trigger event</td>
</tr>
<tr>
<td><strong>TriggeredStreamingFlags</strong></td>
<td>A bit mask that specifies different behaviors, (similar to Waveform Averaging)</td>
</tr>
</tbody>
</table>

- 0x0001 (bit 0) Compensate data path for external trigger
- 0x0002 (bit 1) Compensate data path for level trigger
- 0x0004 (bit 2) Enable fastest readout
- 0x0008 (bit 3) Enable medium paced readout
- 0x0010 (bit 4) Enable slow readout
- 0x0020 (bit 5) Enable data path for using level trigger
- 0x0040 (bit 6) Enable the "get waveform" function. Cannot be used together with automatic readout and arm
- 0x0080 (bit 7) Enable automatic readout and arm (Used for streaming continuously). Cannot be used together "get waveform" function
- 0x0100 (bit 8) Choose to only read out data for channel A (ADQ214).
- 0x0200 (bit 9) Choose to only read out data for channel B (ADQ214).
- 0x0400 (bit 10) Immediate readout mode The different bits may be combined with the exception for bit 6 and 7.

**Returns** 1 for successful operation and 0 for failure.

**Note** If streaming over USB is used, one should preferably choose a sample size of the waveform that equals a packet size of 512 bytes. Each sample is 2 bytes but data is arriving in groups of 4 samples (2 samples for each channel), therefore sample sizes should be chosen as 128 samples increments (128*2*2 =512).

Enabling the "get waveform" function will change the transfer settings of the device.

Triggered Streaming cannot be used together with Packet Streaming, Waveform Averaging or MultiRecord

Immediate readout is only available on ADQ214

On ADQ214 the maximum length waveform is 64k samples. Pretrigger, trigger delay and sample length is chosen by 2 sample increments.
Valid for ADQ214
See also TriggeredStreamingArmV5(), TriggeredStreamingGetWaveformV5(), TriggeredStreamingShutdownV5()

14.3.30 TriggeredStreamingShutdownV5()

virtual unsigned int TriggeredStreamingShutdownV5 ( )
Issues shutdown for Triggered Streaming on V5 product.

Used to gracefully stop the automatic readout and rearm mode. After issuing shutdown, please monitor and wait for the in_idle signal of the TriggeredStreamingGetStatusV5() command to go high before starting again.

Returns 1 for successful operation and 0 for failure
Valid for ADQ214
See also TriggeredStreamingDisarmV5(), TriggeredStreamingSetupV5()

14.3.31 WaitForTransferBuffer()

virtual unsigned int WaitForTransferBuffer ( 
    unsigned int * filled,
    unsigned int timeout_setting )

Wait for DMA buffers to be available (not working for USB2 interface units)

This function enables the host application to idle-wait for data to be available during streaming read-out. This call is blocking until data are available or a timeout has occurred. If filled is 0, no buffer is ready to be read. If filled is the same as the total number of buffers set by SetTransferBuffers(), all buffers are full, and an overflow will likely occur soon (if it have not already).

Parameters

<table>
<thead>
<tr>
<th>filled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where the number of filled buffers will be written</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>timeout_setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time out in ms</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7
See also SetTransferBuffers(), GetTransferBufferStatus()
15 Offline data parsing

Functions

- int ADQData_Create (void **pref)
- int ADQData_Destroy (void *ref)
- int ADQData_EnableErrorTrace (void *ref, int trace_level, const char *filename, unsigned int append)
- int ADQData_GetDeviceStructPID (void *device_struct, const char *filename, unsigned int *pid)
- int ADQData_InitPacketStream (void *ref, void *device_struct, const char *filename)
- int ADQData_ParsePacketStream (void *ref, void *raw_data_buffer, unsigned int raw_data_size, void **target_buffers, void **target_headers, unsigned int *samples_added, unsigned int *headers_added, unsigned int *header_status, unsigned char channels_mask)
- int GetADQDataDeviceStruct (void *buffer)

Get ADQData device structure.

- int GetADQDataDeviceStructSize (unsigned int *size)

Get size of ADQData device structure.

15.1 Detailed Description

Functions related to parsing stored data from the digitizer offline

15.2 Function Documentation

15.2.1 ADQData_Create()

int ADQData_Create ( void **pref )

Create ADQData reference

This function creates a reference used in succeeding ADQData calls.

Parameters

<table>
<thead>
<tr>
<th>pref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to a void pointer where the reference will be returned by this call.</td>
</tr>
</tbody>
</table>

Note: This function uses the prefix ADQData__ instead of ADQ__ and does not have ADQControlUnit and ADQ number parameters.

Returns 1 if successful, otherwise 0

See also ADQData_Destroy()
15.2.2  ADQData_Destroy()

```c
int ADQData_Destroy ( void * ref )
```

Destroy ADQData reference

This function performs any cleanup related to the ADQData reference created by ADQData_Create().

**Parameters**

| ref | ADQData reference from ADQData_Create(). |

**Note** This function uses the prefix ADQData_ instead of ADQ_ and does not have ADQControlUnit and ADQ number parameters.

**Returns** 1 if successful, otherwise 0

**See also** ADQData_Create()

**Valid for** ADQ7

15.2.3  ADQData_EnableErrorTrace()

```c
int ADQData_EnableErrorTrace ( void * ref, int trace_level, const char * filename, unsigned int append )
```

Enable trace log from ADQData functions

This function enables logging of errors and warnings to file from ADQData functions.

**Parameters**

| ref | ADQData reference from ADQData_Create(). |

<table>
<thead>
<tr>
<th>trace_level</th>
<th>Trace level</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>trace_level = 0</code></td>
<td>No error logging</td>
</tr>
<tr>
<td><code>trace_level = 1</code></td>
<td>Error logging</td>
</tr>
<tr>
<td><code>trace_level = 2</code></td>
<td>Error and warnings logging</td>
</tr>
<tr>
<td><code>trace_level = 3</code></td>
<td>Error, warning, info logging</td>
</tr>
</tbody>
</table>

Additionally if bit 11 is set (e.g. by ORing 2048 with the trace_level), timestamping will be enabled in the log.

| filename | Path and filename of log file. |
append
If set zero the log file will be truncated before new messages are added.

Note This function uses the prefix ADQData_ instead of ADQ_ and does not have ADQControlUnit and ADQ number parameters.
Returns 1 if successful, otherwise 0
See also ADQData_Create()
Valid for ADQ7

15.2.4 ADQData_GetDeviceStructPID()

int ADQData_GetDeviceStructPID (  
void * device_struct,  
const char * filename,  
unsigned int * pid )
Get ADQData device structure PID

Parameters

<table>
<thead>
<tr>
<th>parameter</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>device_struct</td>
<td>ADQ device structure from GetADQDataDeviceStruct().</td>
</tr>
<tr>
<td>filename</td>
<td>Filename for stored ADQ device structure. If set to NULL device_struct parameter is used instead, if set to a filename the device_struct parameter is ignored.</td>
</tr>
<tr>
<td>pid</td>
<td>Return argument for PID from given device struct.</td>
</tr>
</tbody>
</table>

Note This function uses the prefix ADQData_ instead of ADQ_ and does not have ADQControlUnit and ADQ number parameters.
Returns 1 if successful, otherwise 0
See also GetADQDataDeviceStruct()
Valid for ADQ7

15.2.5 ADQData_InitPacketStream()

int ADQData_InitPacketStream (  
void * ref,  
void * device_struct,  
const char * filename )
Initialize ADQData packet stream
This function needs to be called before calling ADQData_ParsePacketStream()

Parameters

ref
ADQData reference from ADQData_Create().

device_struct
ADQ device structure from GetADQDataDeviceStruct().

filename
Filename for stored ADQ device structure. If set to NULL device_struct parameter is used instead, if set to a filename the device_struct parameter is ignored.

Note: This function uses the prefix ADQData_ instead of ADQ_ and does not have ADQControlUnit and ADQ number parameters.

Returns 1 if successful, otherwise 0

See also GetADQDataDeviceStruct()

Valid for ADQ7

15.2.6 ADQData_ParsePacketStream()

int ADQData_ParsePacketStream (  
    void * ref,  
    void * raw_data_buffer,  
    unsigned int raw_data_size,  
    void ** target_buffers,  
    void ** target_headers,  
    unsigned int * samples_added,  
    unsigned int * headers_added,  
    unsigned int * header_status,  
    unsigned char channels_mask  )

Parse out data and headers from raw packet stream

Parse raw packet stream from an earlier data collection.

Parameters

ref
ADQData reference from ADQData_Create().

raw_data_buffer
Pointer to raw packet stream from earlier collection.

raw_data_size
Size of raw_data_buffer.

target_buffers
Pointer to the user-allocated buffers where the data is to be placed. One buffer for each channel of data.
**target_headers**  
Pointer to the user-allocated buffers where the headers are to be placed. One buffer for each channel of data.

**samples_added**  
Number of samples parsed

**channels_mask**  
Channels mask to enable/disable data parsing from specific channels. Expecting a 4-bit bitmask.

**headers_added**  
Contains the number of initialized headers from this function call.

**header_status**  
Contains the last header status. See description above.

Note  
This function uses the prefix ADQData_ instead of ADQ_ and does not have ADQControlUnit and ADQ number parameters.

Returns  
1 if successful, otherwise 0

See also  
GetADQDataDeviceStruct()  
Valid for  
ADQ7

### 15.2.7 GetADQDataDeviceStruct()

```c
int GetADQDataDeviceStruct (  
    void *buffer )
```

Get ADQData device structure.  
Returns the ADQData device structure. When storing data for later parsing this structure needs to be stored as well. This structure needs to be passed to ADQData_InitPacketStream() before stored data can be parsed using ADQData_ParsePacketStream(). All setup related to the transfer needs to be performed before calling this function and getting the relevant ADQData device structure.

**Parameters**

**buffer**  
Pointer to allocated buffer where the device structure will be stored

Returns  
1 for success, 0 otherwise

Valid for  
ADQ7

See also  
GetADQDataDeviceStruct

### 15.2.8 GetADQDataDeviceStructSize()

```c
int GetADQDataDeviceStructSize (  
```
unsigned int * size )

Get size of ADQData device structure.
Returns the size of the ADQData device structure so that memory can be allocated beforehand.

Parameters

size
Pointer to integer where size will be stored

Returns 1 for success, 0 otherwise
Valid for ADQ7
See also GetADQDataDeviceStruct

16  Data Decimation and Sample Skip

Functions

- int GetChannelDecimation (unsigned int channel, unsigned int *decfactor)
  
  Get the current decimation factor for a specific channel.
- unsigned int GetSampleDecimation ()
  
  Gets the current decimation factor.
- unsigned int GetSampleSkip ()
  
  Gets the current sample skip factor.
- int SetChannelDecimation (unsigned int channel, unsigned int decfactor)
  
  Enables decimation with filtering and downsampling for a specific channel.
- unsigned int SetSampleDecimation (unsigned int SampleDecimation)
  
  Enables decimation with filtering and downsampling.
- unsigned int SetSampleSkip (unsigned int DecimationFactor)
  
  Enable sample skip of input data.

16.1 Detailed Description

Especially for streaming applications it may be desired to reduce the rate of data. For this, data decimation or sample skip may be used depending on the unit type.

16.2 Function Documentation
16.2.1 GetChannelDecimation()

virtual int GetChannelDecimation ( 
    unsigned int channel, 
    unsigned int * decfactor )

Get the current decimation factor for a specific channel.

Parameters

channel
The channel for which the decimation factor will be read

decfactor
A pointer to an unsigned int where the read value will be stored. A value of N here indicates a decimation factor of $2^N$.

Returns 1 for successful operation and 0 for failure

Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

See also SetChannelDecimation

16.2.2 GetSampleDecimation()

virtual unsigned int GetSampleDecimation ( )

Gets the current decimation factor.

Returns The current value of the sample decimation unit. SetSampleDecimation() an explanation of the values

Note For ADQ7, ADQ12 and ADQ14, decimation is only supported by firmware option FWSDR or FW4DDC

Valid for ADQ214, ADQ212, SDR14, ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

See also SetSampleDecimation()

16.2.3 GetSampleSkip()

virtual unsigned int GetSampleSkip ( )

Gets the current sample skip factor.

Returns the current value of the sample-skip unit. See SetSampleSkip() for explanations of the values.

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also SetSampleSkip(), SetStreamStatus()
16.2.4 SetChannelDecimation()

virtual int SetChannelDecimation (  
    unsigned int channel,  
    unsigned int decfactor )

Enables decimation with filtering and downsampling for a specific channel.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The channel for which the decimation factor will be set</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>defactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A value of N here results in a decimation factor of $2^N$.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

See also GetChannelDecimation

16.2.5 SetSampleDecimation()

virtual unsigned int SetSampleDecimation (  
    unsigned int SampleDecimation )

Enables decimation with filtering and downsampling.

Parameters
SampleDecimation

The decimation factor. Examples:
- ADQ214 / ADQ114-FWSDR:
  - SampleDecimation = 0 => No decimation
  - SampleDecimation = 1 => Decimation by $2^1=2$
  - SampleDecimation = 2 => Decimation by $2^2=4$
  - etc...
  - SampleDecimation = 34 => Decimation by $2^{34}$
- SDR14:
  - SampleDecimation = 1 => No decimation
  - SampleDecimation = 2 => Decimation by 2
  - SampleDecimation = 4 => Decimation by 4
  - SampleDecimation = 8 => Decimation by 8
  - SampleDecimation = 16 => Decimation by 16
  - SampleDecimation = 32 => Decimation by 32
- ADQ7-FW2DDC:
  - SampleDecimation = 0 => No decimation
  - SampleDecimation = 1 => Decimation by $2^1=2$
  - SampleDecimation = 2 => Decimation by $2^2=4$
  - etc...
  - SampleDecimation = 34 => Decimation by $2^{34}$

Returns 1 for successful operation and 0 for failure

Note For ADQ7, ADQ12 and ADQ14, decimation is only supported by firmware option FWSDR or FW4DDC

Valid for ADQ214, ADQ212, SDR14, ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

See also GetSampleDecimation(), SetSampleSkip()

16.2.6 SetSampleSkip()

virtual unsigned int SetSampleSkip ( unsigned int DecimationFactor )

Enable sample skip of input data.

The sample skip factors available differs for different units:
- ADQ214, ADQ212: 2, 4, 6, 8, ..., 131072
- ADQ112, ADQ114: 2, 4, 8, 12, ..., 262140
- ADQ1600, ADQ412, SDR14, ADQ208, ADQ108: 2, 4, 8, 16, 32, 64, 128
- ADQ12-2X/-1X: 2, 4, 8, 9, 10, ..., 65536
- ADQ12-4C/-2C: 2, 4, 5, 6, 7, ..., 65536
- ADQ12-4A/-2A: 2, 3, 4, 5, 6, ..., 65536
- ADQ14-2X/-1X: 2, 4, 8, 9, 10, ..., 65536
- ADQ14-4C/-2C: 2, 4, 5, 6, 7, ..., 65536
- ADQ14-4A/-2A: 2, 3, 4, 5, 6, ..., 65536
- ADQ7-1CH: 2, 4, 8, 16, 32, 33, 34 ..., 65536
- ADQ7-2CH: 2, 4, 8, 16, 17, 18 ..., 65536
Parameters

**DecimationFactor**
The factor with which to skip samples
- skipsamples = 1: No samples skipped
- skipsamples = N: Every N:th sample kept

Returns 1 for successful operation and 0 for failure

**Note** For FWSDR/FW4DDC firmware options, Sample Skip is not available, instead use SetChannelDecimation.

Valid for ADQ212, ADQ112, ADQ114, ADQ214, ADQ108, ADQ208, ADQ412, SDR14, ADQ1600, ADQ12, ADQ14, ADQ7, ADQ8

See also GetSampleSkip(), SetChannelDecimation()

## 17 ADX Interleaving IP

### Functions

- `unsigned int GetInterleavingIPBypassMode(unsigned char IPInstanceAddr, unsigned int *bypassflag)`
  
  *Gets the current ADX bypass selection.*

- `unsigned int GetInterleavingIPCalibration(unsigned char IPInstanceAddr, unsigned int *calibration)`
  
  *Gets the current calibration state of the ADX interleaving IP.*

- `unsigned int GetInterleavingIPEstimationMode(unsigned char IPInstanceAddr, unsigned int *updatetype)`
  
  *Gets the ADX parameter update mode.*

- `int InterleavingIPTemperatureAutoUpdate(unsigned int enable)`
  
  *Enabled update of ADC temperature to the ADX IP.*

- `unsigned int ResetInterleavingIP(unsigned char IPInstanceAddr)`
  
  *Resets the ADX interleaving IP.*

- `unsigned int SendIPCommand(unsigned int IPInstanceAddr, unsigned int cmd, unsigned int arg1, unsigned int arg2, unsigned int *answer)`
  
  *Gets the user direct access to the ADX command interface.*

- `unsigned int SetInterleavingIPBypassMode(unsigned char IPInstanceAddr, unsigned int bypassflag)`
  
  *Selects whether to bypass the ADX interleaving IP or not.*

- `unsigned int SetInterleavingIPCalibration(unsigned char IPInstanceAddr, unsigned int *calibration)`
  
  *Loads a calibration state into the ADX interleaving IP.*

- `unsigned int SetInterleavingIPEstimationMode(unsigned char IPInstanceAddr, unsigned int updatetype)`
  
  *Selects the ADX parameter update mode.*
17.1 Detailed Description

The ADX Interleaving IP significantly increases performance when interleaving multiple channels. In most cases, no special configuration needs to be made.

17.2 Function Documentation

17.2.1 GetInterleavingIPBypassMode()

```cpp
virtual unsigned int GetInterleavingIPBypassMode (
    unsigned char IPInstanceAddr,
    unsigned int * bypassflag )
```

Gets the current ADX bypass selection.

**Parameters**

<table>
<thead>
<tr>
<th>IPInstanceAddr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADX instance to get the current value from. ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bypassflag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where to return the value. Please see SetInterleavingIPBypassMode() for the meaning of the different values.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also SetInterleavingIPBypassMode()

17.2.2 GetInterleavingIPCConfiguration()

```cpp
virtual unsigned int GetInterleavingIPCConfiguration ( 
    unsigned char IPInstanceAddr,  
    unsigned int * calibration )
```

Gets the current calibration state of the ADX interleaving IP.

**Parameters**

<table>
<thead>
<tr>
<th>IPInstanceAddr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADX instance to get the current value from. ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where to store the output. This area must be allocated by the user, and at least 8kB (2048 32-bit integers) large.</td>
</tr>
</tbody>
</table>
17.2.3 GetInterleavingIPEstimationMode()

```cpp
virtual unsigned int GetInterleavingIPEstimationMode ( 
    unsigned char IPInstanceAddr, 
    unsigned int * updatetype )
```

Gets the ADX parameter update mode.

The ADX interleaving IP may be configured to not update its internal parameters. This function gets the current value.

**Parameters**

<table>
<thead>
<tr>
<th>IPInstanceAddr</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ADX instance to get the current value from. ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>updatetype</th>
</tr>
</thead>
<tbody>
<tr>
<td>A pointer to where to return the value. Please see SetInterleavingIPEstimationMode() for the meaning of the different values.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note This function is for advanced use cases. Please contact SP Devices support for more information on the different modes.

Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also SetInterleavingIPEstimationMode()

17.2.4 InterleavingIPTemperatureAutoUpdate()

```cpp
virtual int InterleavingIPTemperatureAutoUpdate ( 
    unsigned int enable )
```

Enabled update of ADC temperature to the ADX IP.

**Parameters**

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 1 to enable, 0 to disable.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14
17.2.5 ResetInterleavingIP()

virtual unsigned int ResetInterleavingIP ( 
    unsigned char IPInstanceAddr )

Resets the ADX interleaving IP.

Parameters

- **IPInstanceAddr**
  The ADX instance to reset.

Returns 1 for successful operation and 0 for failure.

Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14, ADQ14, ADQ7

See also SetInterleavingIPBypassMode()

17.2.6 SendIPCommand()

virtual unsigned int SendIPCommand ( 
    unsigned int IPInstanceAddr, 
    unsigned int cmd, 
    unsigned int arg1, 
    unsigned int arg2, 
    unsigned int * answer )

Gets the user direct access to the ADX command interface.

This is an advanced user function, which should rarely be used. Please refer to the ADX or DBS IP User's Guide for information regarding the commands available.

Parameters

- **IPInstanceAddr**
  The ADX instance to get the current value from ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0) To instead communicate with DBS IPs, set bit 16-23 to 1.

- **cmd**
  Selects the command

- **arg1**
  First argument

- **arg2**
  Second argument

- **answer**
  Pointer to the answer returned from the function
Returns 1 for successful operation and 0 for failure
Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7
See also SetInterleavingIPBypassMode(), ResetInterleavingIP(), SetInterleavingIPEstimationMode()

17.2.7 SetInterleavingIPBypassMode()

virtual unsigned int SetInterleavingIPBypassMode (
    unsigned char IPInstanceAddr,
    unsigned int bypassflag )

Selects whether to bypass the ADX interleaving IP or not.
While the ADX IP is bypassed, it will still update its current parameters.

Parameters

<table>
<thead>
<tr>
<th>IPInstanceAddr</th>
<th>The ADX instance to update setting for. ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0)</th>
</tr>
</thead>
</table>
| bypassflag     | The bypass selection:
|                | • 0: use correction
|                | • 1: bypass correction (default)                                                                                  |

Returns 1 for successful operation and 0 for failure
Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14
See also GetInterleavingIPBypassMode(), SetInterleavingIPEstimationMode()

17.2.8 SetInterleavingIPCALibration()

virtual unsigned int SetInterleavingIPCALibration (
    unsigned char IPInstanceAddr,
    unsigned int * calibration )

Loads a calibration state into the ADX interleaving IP.

Parameters

<table>
<thead>
<tr>
<th>IPInstanceAddr</th>
<th>The ADX instance to update setting for. ADQ412 and SDR14 contain two ADX IP instances (addressed by 0 and 1) and the other ADQs contain one (addressed by 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>calibration</td>
<td>Pointer to where to read the calibration state from. The memory contents must be fetched by GetInterleavingIPCALibration().</td>
</tr>
</tbody>
</table>
Returns 1 for successful operation and 0 for failure

Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also GetInterleavingIPCalibration()

### 17.2.9 SetInterleavingIPEstimationMode()

```cpp
class Datalogger {
    virtual unsigned int SetInterleavingIPEstimationMode(unsigned char IPInstanceAddr,
                                                           unsigned int updatetype);
}
```

Selects the ADX parameter update mode.

The ADX interleaving IP may be configured to not update its internal parameters. It is typically not desired to change the default setting.

**Parameters**

**IPInstanceAddr**
The ADX instance to update setting for.

**updatetype**
The setting. These options are available:

- 0: No updates allowed
- 1: Normal mode, with continuous updates (default)
- 2: Time-domain mode

Returns 1 for successful operation and 0 for failure

Note: This function is for advanced use cases. Please contact SP Devices support for more information on the different modes.

Valid for ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also GetInterleavingIPEstimationMode(), SetInterleavingPBPProtocol()

### 18 Digital Baseline Stabilization

**Functions**

- unsigned int GetNoDBSInstances (unsigned int *nof_dbs_instances)
  
  *Gets the number of verified DBS instances.*

- unsigned int SetupDBS (unsigned char DBS_instance, unsigned int bypass, int dc_target, int lower_saturation_level, int upper_saturation_level)

  *Performs setup of Digital Baseline Stabilization (DBS)*
18.1 Detailed Description

Digital Baseline Stabilization (DBS) is used to provide a stable baseline by active digital compensation.

18.2 Function Documentation

18.2.1 GetNofDBSInstances()

```c
virtual unsigned int GetNofDBSInstances ( unsigned int * nof_dbs_instances )
```

Gets the number of verified DBS instances.

Parameters

- `nof_dbs_instances`: Pointer to where the number of verified DBS cores is to be returned.

Returns

1 for successful operation and 0 for failure.

Valid for ADQ1600, ADQ412, ADQ12, ADQ14, ADQ7, ADQ8.

See also SetupDBS().

18.2.2 SetupDBS()

```c
virtual unsigned int SetupDBS ( unsigned char DBS_instance, unsigned int bypass, int dc_target, int lower_saturation_level, int upper_saturation_level )
```

Performs setup of Digital Baseline Stabilization (DBS).

Initializes the DBS algorithm, sets a number of user-specified settings, and enables or bypasses the DBS block.

Parameters

- `DBS_instance`: The instance of DBS to setup. Only 0 is valid for ADQ1600. 0 or 1 is valid for ADQ412. 0 to 3 are valid for ADQ7/ADQ12/ADQ14. Addressing with 0xFF sets up all 4 cores (if 4 is available) to same settings. Addressing with 0xFE sets up core 0 and 1 to same settings. Addressing with 0xFD sets up core 2 and 3 to same settings.

- `bypass`: Selects whether the DBS instance should be active (`bypass = 0`) or bypassed (`bypass = 1`).
**dc_target**
Sets the DC target in ADC codes. The data format is 16-bit MSB aligned for ADQ1600.

**lower_saturation_level**
Advanced parameter that selects how many codes below the baseline the signal may be before it is ignored in the DC estimation. The value is given as a negative number. Set this parameter to 0 to use the default level.

**upper_saturation_level**
Advanced parameter that selects how many codes above the baseline the signal may be before it is ignored in the DC estimation. Set this parameter to 0 to use the default level.

Returns 1 for successful operation and 0 for failure.

**Note** The analog baseline must be stable when starting DBS. If the adjustable bias level is changed (on a unit were this is possible), a pause of around two seconds should be made before starting DBS.

**Valid for** ADQ1600, ADQ412, ADQ12, ADQ14, ADQ7, ADQ8

**See also** GetNofDBSInstances()

## 19 Waveform Averaging

### Functions

- `unsigned int WaveformAveragingArm ()`
  *Arms the Waveform Averaging.*

- `unsigned int WaveformAveragingDisarm ()`
  *Disarms the Waveform Averaging and puts it in bypass mode.*

- `unsigned int WaveformAveragingGetStatus (unsigned char *ready, unsigned int *nofrecordscompleted, unsigned char *in_idle)`
  *Gets the status of the averaging block.*

- `unsigned int WaveformAveragingGetWaveform (int *waveform_data)`
  *Collects a waveform from the Waveform Averaging block.*

- `unsigned int WaveformAveragingParseDataStream (unsigned int samples_per_record, int *data_stream, int **data_target)`
  *Parses a buffer filled with a single record of WFA data.*

- `unsigned int WaveformAveragingSetup (unsigned int NofWaveforms, unsigned int NofSamples, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples, unsigned int WaveformAveragingFlags)`
  *Sets up the Waveform Averaging block.*

- `unsigned int WaveformAveragingShutdown ()`
  *Issues shutdown for Waveform Averaging.*

- `unsigned int WaveformAveragingSoftwareTrigger ()`
  *Issues a software trigger to the WFA module.*

- `unsigned int WfaArm ()`
Arms the Waveform Averaging on SDR14.

- unsigned int WfaDisarm()
  
  Disarms the Waveform Averaging and puts it in bypass mode.

- unsigned int WfaGetStatus(unsigned int *data_available, unsigned int *in_idle, unsigned int *overflow, unsigned int *transfer_in_progress, unsigned int *channel_sync_error, unsigned int *waveforms_accumulated)
  
  Gets the status of the averaging block.

- unsigned int WfaGetWaveform()
  
  Send a readout signal to the Waveform Averaging block when using manual re-arm mode.

- unsigned int WfaSetup(unsigned int NofWaveforms, unsigned int NofSamples, unsigned int NofPreTriggerSamples, unsigned int NofTriggerDelaySamples, unsigned int NofReadoutWaitCycles, unsigned int trigger_mode, unsigned int trigger_edge, unsigned int triggers_limit, unsigned int ArmMode, unsigned int ReadoutMode, unsigned int AccMode)
  
  Sets up the Waveform Averaging block on SDR14 from firmware version 25118.

- unsigned int WfaShutdown()
  
  Issues shutdown for Waveform Averaging.

19.1 Detailed Description

Waveform Averaging (WFA) is used to average multiple collections together on the devices. These are then typically transferred to host using the streaming mode.

19.2 Function Documentation

19.2.1 WaveformAveragingArm()

virtual unsigned int WaveformAveragingArm()

Arms the Waveform Averaging.

Triggers will be accepted by the Waveform Averaging block only after this call. If automatic readout and arm is active, readout will occur once average is done and a new average will restart when readout is completed.

Returns 1 for successful operation and 0 for failure

Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also WaveformAveragingDisarm(), WaveformAveragingSetup()

19.2.2 WaveformAveragingDisarm()

virtual unsigned int WaveformAveragingDisarm()

Disarms the Waveform Averaging and puts it in bypass mode.

After this call, the ADQ may again be used in e.g. MultiRecord mode
Returns 1 for successful operation and 0 for failure

Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also WaveformAveragingArm(), WaveformAveragingShutdown(), WaveformAveragingSetup()

19.2.3 WaveformAveragingGetStatus()

virtual unsigned int WaveformAveragingGetStatus (  
    unsigned char * ready,  
    unsigned int * norecordscompleted,  
    unsigned char * in_idle )

Gets the status of the averaging block.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>ready</td>
<td>Pointer to where to store whether data is available for readout. If this pointer is NULL, the value will not be written. If value stored at pointer is 3 this means that all data is available for readout. If this value is non-zero but lower than 3, then it means that some data is available but not all. User should wait until all data is ready before readout.</td>
<td>ready</td>
</tr>
<tr>
<td>norecordscompleted</td>
<td>Pointer to where to store the number of acquired records. If this pointer is NULL, the value will not be written</td>
<td>norecordscompleted</td>
</tr>
<tr>
<td>in_idle</td>
<td>Pointer to where to store whether the collection logic is idle. If this pointer is NULL, the value will not be written</td>
<td>in_idle</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14

See also WaveformAveragingGetWaveform(), WaveformAveragingSetup()

19.2.4 WaveformAveragingGetWaveform()

virtual unsigned int WaveformAveragingGetWaveform (  
    int * waveform_data )

Collects a waveform from the Waveform Averaging block.

Readout will only succeed if data has been collected by the device. In manual rearm mode, WaveformAveragingGetStatus() can be called to verify that data is available.

Parameters
waveform_data
Pointer to where the output is to be stored. The data is stored as signed 32-bit integers, and the user is responsible that enough memory is allocated at this pointer.

Returns 1 for successful operation and 0 for failure
Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14
See also WaveformAveragingArm(), WaveformAveragingGetStatus(), WaveformAveragingSetup()

19.2.5 WaveformAveragingParseDataStream()

virtual unsigned int WaveformAveragingParseDataStream (  
    unsigned int samples_per_record,  
    int * data_stream,  
    int ** data_target )

Parses a buffer filled with a single record of WFA data.
The parsed data is stored in buffers provided by the user.

Parameters

samples_per_record
The number of samples per channel in the buffer data_stream

data_stream
Pointer to the buffer containing the data that will be parsed

data_target
Pointer table to buffers where the outputs will be stored, one buffer per channel. For example, data_target[0] is a pointer to the channel A output buffer, and data_target[1] is a pointer to the channel B output buffer.

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, SDR14, ADQ214, ADQ212, ADQ114, ADQ112
See also WaveformAveragingGetWaveform()

19.2.6 WaveformAveragingSetup()

virtual unsigned int WaveformAveragingSetup (  
    unsigned int NofWaveforms,  
    unsigned int NofSamples,  
    unsigned int NofPreTrigSamples,  
    unsigned int NofTriggerDelaySamples,  
    unsigned int WaveformAveragingFlags )

Sets up the Waveform Averaging block.
Please consult the Waveform Averaging example for details on the execution flow.

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NofWaveforms</td>
<td>The number of waveforms to average</td>
</tr>
<tr>
<td>NofSamples</td>
<td>The number of samples per waveform</td>
</tr>
<tr>
<td>NofPreTrigSamples</td>
<td>The number of pretrigger samples for each waveform</td>
</tr>
<tr>
<td>NofTriggerDelaySamples</td>
<td>The number of samples to hold off after the trigger event</td>
</tr>
<tr>
<td>WaveformAveragingFlags</td>
<td>A bit mask that specifies different behaviors</td>
</tr>
<tr>
<td></td>
<td>• 0x0001 (bit 0) Compensate data path for external trigger</td>
</tr>
<tr>
<td></td>
<td>• 0x0002 (bit 1) Compensate data path for level trigger</td>
</tr>
<tr>
<td></td>
<td>• 0x0004 (bit 2) Enable fastest readout</td>
</tr>
<tr>
<td></td>
<td>• 0x0008 (bit 3) Enable medium paced readout</td>
</tr>
<tr>
<td></td>
<td>• 0x0010 (bit 4) Enable slow readout</td>
</tr>
<tr>
<td></td>
<td>• 0x0020 (bit 5) Enable data path for using level trigger</td>
</tr>
<tr>
<td></td>
<td>• 0x0040 (bit 6) Enable the waveform get function</td>
</tr>
<tr>
<td></td>
<td>• 0x0080 (bit 7) Enable automatic readout and arm (Used for streaming continuously)</td>
</tr>
<tr>
<td></td>
<td>• 0x0400 (bit 10) Immediate readout mode</td>
</tr>
<tr>
<td></td>
<td>• 0x1000 (bit 12) Choose channel A as input when running WFA in one channel mode (ADQ214)</td>
</tr>
<tr>
<td></td>
<td>• 0x2000 (bit 13) Choose channel B as input when running WFA in one channel mode (ADQ214)</td>
</tr>
</tbody>
</table>

### Returns

1 for successful operation and 0 for failure

### Note

It is important to use the correct size for the waveform depending on which interface (USB or P+le) and which product is being used. Waveform Averaging is running via streaming mode and the minimum packet size for this mode is different for different interface. On USB the streaming packet size is 512 bytes and on P+le it is 128 bytes. Different ADQ products can have different number of channels and also different number of samples per clock cycle. It is therefore required by the user to set the appropriate waveform size to match the product in use. The following formula can be used to calculate the smallest waveform size for different product that respects the streaming packet size on different interface. Any other waveform size that the user wishes to use should be in multiples of this smallest size:

$$\text{min\_waveform\_size} = \frac{\text{interface\_packet\_size}}{\text{number\_of\_channels} \times 4}$$

Since different waveform size for individual channel is not supported, this number is the smallest waveform size possible, no matter how many channels the product has.

### Note

Enabling the waveform get function will change the transfer settings of the device.

Waveform Averaging cannot be used together with Packet Streaming, Triggered Streaming or MultiRecord. Immediate readout is only available on ADQ214, ADQ212, ADQ114, ADQ112 and SDR14.

When running in one channel input mode (to gain longer record length) only one channel can be chosen. Special custom firmware is required to use this mode. If both channels have been set OR no channel has been set when using such a firmware, default channel will be A. On standard firmware without support for this one channel input mode, these two flags will have no meaning.
On ADQ114 and ADQ112 the maximum length waveform is 32k samples and maximum waveform count is 64k. Pretrigger, trigger delay and sample length is chosen by 4 sample increments.

Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14
See also WaveformAveragingArm(), WaveformAveragingGetWaveform(), WaveformAveragingShutdown()

19.2.7 WaveformAveragingShutdown()

virtual unsigned int WaveformAveragingShutdown ( )

Issues shutdown for Waveform Averaging.

Used to gracefully stop the automatic readout and rearm mode. After issuing shutdown, please monitor and wait for the in_idle signal of the WaveformAveragingGetStatus() command to go high before starting again.

Returns 1 for successful operation and 0 for failure
Valid for ADQ214, ADQ212, ADQ112, ADQ114, ADQ412, ADQ1600, SDR14
See also WaveformAveragingDisarm(), WaveformAveragingSetup()

19.2.8 WaveformAveragingSoftwareTrigger()

virtual unsigned int WaveformAveragingSoftwareTrigger ( )

Issues a software trigger to the WFA module.

Only valid for V6 digitizers. For V5 digitizers (ADQ214, ADQ114, ADQ212 & ADQ112), SWTrig() should be used instead.

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, SDR14
See also SWTrig()

19.2.9 WfaArm()

virtual unsigned int WfaArm ( )

Arms the Waveform Averaging on SDR14.

Triggers will be accepted by the Waveform Averaging block only after this call. If auto-rearm and readout is active, readout will occur once average is done and a new average will restart when readout is completed.

Returns 1 for successful operation and 0 for failure 1 for success, 0 otherwise. Check the errorlog or ADQ Monitor in ADQUpdater for further details on failed return.
Valid for SDR14 firmware revision 25118 or greater.
See also WfaDisarm(), WfaSetup()
19.2.10 WfaDisarm()  

virtual unsigned int WfaDisarm( )  
Disarms the Waveform Averaging and puts it in bypass mode.  
After this call, the ADQ may again be used in e.g. MultiRecord mode  
Returns 1 for successful operation and 0 for failure  
Note This function will call ResetDevice(3) if streaming overflow is detected to restore the streaming interface 
and make it possible to switch back to multi-record mode.  
Valid for SDR14 firmware revision 25118 or greater.  
See also WfaArm(), WfaShutdown(), WfaSetup()  

19.2.11 WfaGetStatus()  

virtual unsigned int WfaGetStatus(  
    unsigned int * data_available,  
    unsigned int * in_idle,  
    unsigned int * overflow,  
    unsigned int * transfer_in_progress,  
    unsigned int * channel_sync_error,  
    unsigned int * waveforms_accumulated )  

Gets the status of the averaging block.  

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>data_available</td>
<td>Pointer to store the data available flag when using manual re-arm mode.</td>
</tr>
<tr>
<td>in_idle</td>
<td>Pointer to store the idle flag which indicates whether WFA has entered the idle state. Used to in manual re-arm mode.</td>
</tr>
</tbody>
</table>
| overflow            | Pointer to store the overflow flag. There are different kinds of overflow. The bit field below defines the overflow type: Overflow Bit position meaning:  
  - 0 = Global Device Streaming Overflow Flag  
  - 1 = Waveform Average Output Fifo Overflow Channel A  
  - 2 = Waveform Average Output Fifo Overflow Channel B  
  - 3 = Waveform Average Accumulation Overflow Channel A (Accumulation sum exceeds 32 bits)  
  - 4 = Waveform Average Accumulation Overflow Channel A (Accumulation sum exceeds 32 bits) |
| transfer_in_progress | Pointer to store the transfer in progress flag. Useful when collecting waveforms with long time spann (via sample skip or decimation) |
### channel_sync_error

Pointer to store the sync error signal between the channels. Useful to detect if the outputs from the different channels are in sync or not. Sync error should normally not happen unless there is something wrong with the firmware or when the setup for both channels differs in some way.

### waveforms_accumulated

Pointer to store the number of waveforms that has been accumulated so far. Useful when averaging many waveforms.

Returns 1 for success, 0 otherwise. Check the errorlog or ADQ Monitor in ADQUpdater for further details on failed return.

**Note** The flags are returned as one bit per channel. I.E if data_available = 3 (bin 11), this means that both channels have data available.

Valid for SDR14 firmware revision 25118 or greater.

See also WfaGetWaveform(), WfaSetup()

### WfaGetWaveform()

```cpp
virtual unsigned int WfaGetWaveform ()
```

Send a readout signal to the Waveform Averaging block when using manual re-arm mode.

Readout will only succeed if data has been collected by the device. It is the users responsibility to check for the status (WfaGetStatus()) and determines when it is appropriate to readout the accumulated resulting waveform. These two status flags are useful to check before reading out:

- data_available
- waveforms_accumulated

Returns 1 for success, 0 otherwise. Note that success here only indicates that the command was send successfully and not the success of readout.

Valid for SDR14 firmware revision 25118 or greater.

See also WfaArm(), WfaGetStatus(), WfaSetup()

### WfaSetup()

```cpp
virtual unsigned int WfaSetup ()
```
unsigned int NofWaveforms,
unsigned int NofSamples,
unsigned int NofPreTriggerSamples,
unsigned int NofTriggerDelaySamples,
unsigned int NofReadoutWaitCycles,
unsigned int trigger_mode,
unsigned int trigger_edge,
unsigned int triggers_limit,
unsigned int ArmMode,
unsigned int ReadoutMode,
unsigned int AccMode)

Sets up the Waveform Averaging block on SDR14 from firmware version 25118.

Please consult the SDR14 Waveform Averaging example for details on the execution flow.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NofWaveforms</td>
<td>The number of waveforms to average. (to add together sample by sample)</td>
</tr>
<tr>
<td>NofSamples</td>
<td>The number of samples per waveform</td>
</tr>
<tr>
<td>NofPreTriggerSamples</td>
<td>The number of pretrigger samples for each waveform</td>
</tr>
<tr>
<td>NofTriggerDelaySamples</td>
<td>The number of samples to hold off after the trigger event</td>
</tr>
<tr>
<td>NofReadoutWaitCycles</td>
<td>The number of clock cycles to wait between each readout pulse. Used to adjust readout speed. Only valid for readout mode 0.</td>
</tr>
<tr>
<td>trigger_mode</td>
<td>Trigger mode to collect the individual waveforms.</td>
</tr>
<tr>
<td>trigger_edge</td>
<td>Set the trigger edge to initiate waveform collection for trigger mode that has this property (i.e., external trigger).</td>
</tr>
<tr>
<td>triggers_limit</td>
<td>Should be set to zero by default. Used to set the total number of triggers that will be accepted by the accumulator. Can be used for diagnostic and debugging purpose.</td>
</tr>
</tbody>
</table>
### ArmMode
Set the arm mode after each accumulation is done.
- 0: Manual Re-arm. User must manually readout the averaged waveform and re-arm the accumulator from the PC once an accumulation is done.
- 1: Auto Re-arm. The accumulator will automatically push out the resulting waveform and re-arm itself once an accumulation is done. This will require that the software on the PC side must be fast enough to receive the data. Otherwise overflow might occur.

### ReadoutMode
Set the readout mode once an accumulation is done.
- 0: Normal Readout. The resulting waveform is first stored in memory and can be readout according the readout speed set by NofReadoutWaitCycles.
- 1: Immediate Readout. The final resulting waveform will not be stored in memory. Readout will automatically follow once NofWaveforms has been reached. This Readout mode is only available when using Auto Re-arm mode. Used in high performance application.

### AccMode
Set the accumulation mode for each individual waveform that will make up the final averaged result.
- 0: No dead time between each waveform. Only one trigger pulse is needed to produce the final average result. The first sample of one waveform will be right after the last sample of the previous waveform.
- 1: One trigger per waveform. Every individual waveform must be triggered by a trigger.

---

**Returns**: 1 for success, 0 otherwise. Check the errorlog or ADQ Monitor in ADQUpdater for further details on failed return.

**Note**: It is important to use the correct size for the waveform depending on which interface (USB or P+le) and which product is being used. Waveform Averaging is running via streaming mode and the minimum packet size for this mode is different for different interface. On USB the streaming packet size is 512 bytes and on P+le it is 128 bytes. Different ADQ products can have different number of channels and also different number of samples per clock cycle. It is therefore required by the user to set the appropriate waveform size to match the product in use. The following formula can be used to calculate the smallest waveform size for different product that respects the streaming packet size on different interface. Any other waveform size that the user wishes to use should be in multiples of this smallest size:

\[
\text{min\_waveform\_size} = \frac{\text{interface\_packet\_size}}{(\text{number\_of\_channels} \times 4)}
\]

Waveform Averaging cannot be used together with Packet Streaming, Triggered Streaming or Multi-Record.

Waveform Averaging in firmware only performs addition on the waveforms samples. No division is performed due to the hardware cost. Pretrigger, trigger delay and sample length is chosen by 4 sample increments.

**Valid for**: SDR14 firmware revision 25118 or greater.

**See also**: WfaArm(), WfaGetWaveform(), WfaShutdown()

### 19.2.14 WfaShutdown()

virtual unsigned int WfaShutdown ()
Issues shutdown for Waveform Averaging.

Used to gracefully stop the automatic readout and rearm mode. After issuing shutdown, please monitor and wait for the in_idle signal of the WfaGetStatus() command to go high before starting again.

Returns 1 for success, 0 otherwise. Check the errorlog or ADQ Monitor in ADQUpdater for further details on failed return.

Valid for SDR14 firmware revision 25118 or greater.

See also WfaDisarm(), WfaSetup()

# 20 Advanced Time Domain

## Data Structures

- struct ATDWFABufferStruct
  
  WFA buffer struct
  Data structure used in FWATD. Valid fields: More...

## Enumerations

- enum ATDWFABufferFormat {
    ATD_WFA_BUFFER_FORMAT_INT32 = 0,
    ATD_WFA_BUFFER_FORMAT_STRUCT = 1
  }

  ATD buffer format enum.
  Used in ATDSetWFABufferFormat() to switch the WFA buffer format.

## Functions

- int ATDEnableAccumulationGridSync (unsigned int enable)
  
  Enable the reset of the accumulation grid.

- int ATDFlushWFA (void)
  
  Flush ATD WFA streaming buffer.

- int ATDGetAdjustedRecordLength (unsigned int record_length, int search_direction)
  
  Receive help with selecting an appropriate record length.

- unsigned int ATDGetDeviceNofAccumulations (unsigned int nof_accumulations)
  
  Get the number of accumulations performed by the ADQ.

- int ATDGetWFAPartitionBoundaries (unsigned int *partition_lower_bound, unsigned int *partition_upper_bound)
  
  Get the upper and lower boundaries for the WFA workload partitioning.

- int ATDGetWFAStatus (unsigned int *wfa_progress_percent, unsigned int *records_collected, unsigned int *stream_status, unsigned int *wfa_status)
  
  Read out status of ATD Wave Form Averaging module.

- int ATDRegisterWFABuffer (unsigned int channel, void *buffer)
  
  Register ATD WFA buffers.
- int ATDSetThresholdFilter (unsigned int channel, unsigned int *coefficients)
  
  Setup ATD Threshold module filter.
- int ATDSetupThreshold (unsigned int channel, int threshold, int baseline, unsigned int polarity, unsigned int bypass)
  
  Setup ATD Threshold module.
- int ATDSetupWFA (unsigned int record_length, unsigned int nof_pretrig_samples, unsigned int nof_triggerdelay_samples, unsigned int nof_accumulations, unsigned int nof_repeats)
  
  Setup ATD Wave Form Averaging module.
- int ATDSetupWFAAdvanced (unsigned int segment_length, unsigned int segments_per_record, unsigned int accumulations_per_batch, unsigned int record_length, unsigned int nof_accumulations, unsigned int nof_pretrig_samples, unsigned int nof_triggerdelay_samples, unsigned int bypass)
  
  Setup ATD Wave Form Averaging module using detailed parameters.
- int ATDSetWFABufferFormat (enum ATDWFABufferFormat format)
  
  Set the format of the ATD data buffer.
- int ATDSetWFIAInternalTimeout (unsigned int timeout_ms)
  
  Set the default internal timeout setting in milliseconds.
- int ATDSetWFAPartitionBoundaries (unsigned int partition_lower_bound, unsigned int partition_upper_bound)
  
  Set the upper and lower boundaries for the WFA workload partitioning.
- int ATDSetWFAPartitionBoundariesDefault ()
  
  Set the default upper and lower boundaries for the WFA workload partitioning.
- int ATDStartWFA (void **target_buffers, unsigned char channels_mask, unsigned int blocking)
  
  Start ATD WFA.
- int ATDStopWFA (void)
  
  Stop ATD WFA.
- int ATDUpdateNofAccumulations (unsigned int nof_accumulations)
  
  Set the number of accumulations.
- int ATDWaitForWFABuffer (unsigned int channel, void **buffer, int timeout)
  
  Wait for ATD WFA buffer.
- int ATDWaitForWFACompletion (void)
  
  Wait for ATD WFA completion.

20.1 Detailed Description

These functions are used to configure devices with the -FWATD firmware option.

20.2 Data Structure Documentation

20.2.1 struct ATDWFABufferStruct

WFA buffer struct

Data structure used in FWATD. Valid fields:
• ADQ14: Timestamp, Data and Channel
• ADQ7: All

<table>
<thead>
<tr>
<th>uint8_t</th>
<th>Channel</th>
<th>Indexed from 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>int32_t*</td>
<td>Data</td>
<td>Pointer to data array. Memory is managed by user application</td>
</tr>
<tr>
<td>uint32_t</td>
<td>RecordNumber</td>
<td>Starts at 1</td>
</tr>
<tr>
<td>uint32_t</td>
<td>RecordsAccumulated</td>
<td>Number of accumulated records in current batch</td>
</tr>
<tr>
<td>uint32_t</td>
<td>Status</td>
<td></td>
</tr>
<tr>
<td>uint64_t</td>
<td>Timestamp</td>
<td>Timestamp of first trigger in accumulation</td>
</tr>
</tbody>
</table>

20.3 Enumeration Type Documentation

20.3.1 ATDWFABufferFormat

`enum ATDWFABufferFormat`

ATD buffer format enum.

Used in ATDSetWFABufferFormat() to switch the WFA buffer format.

```
ATD_WFA_BUFFER_FORMAT_INT32 int_32t (default)
ATD_WFA_BUFFER_FORMAT_STRUCT struct ATDWFABufferStruct
```

20.4 Function Documentation

20.4.1 ATDEnableAccumulationGridSync()

`virtual int ATDEnableAccumulationGridSync ( unsigned int enable )`

Enable the reset of the accumulation grid.

When enabled the accumulation grid will reset on each trigger blocking event. Unfinished accumulations may be discarded.

Parameters

```
enable
1 to enable, 0 to disable
```

Returns 1 for success, 0 otherwise
Valid for ADQ7-FWATD

20.4.2 ATDFlushWFA()

virtual int ATDFlushWFA (  
   void  
)
Flush ATD WFA streaming buffer.
Flushes streaming buffer during ATD WFA transfer.
Returns 1 for success, 0 otherwise
Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

20.4.3 ATDGetAdjustedRecordLength()

virtual int ATDGetAdjustedRecordLength (  
   unsigned int record_length,  
   int search_direction  
)
Receive help with selecting an appropriate record length.
This function will help the user select a valid record length according to the rule set imposed by FWATD. The maximum record length returned by this function is 1M samples.
Parameters

<table>
<thead>
<tr>
<th>record_length</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>search_direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>'1' to perform a descending search, returning a record length equal to or less than record_length. '1' performs an ascending search, returning a record length equal to or greater than record_length.</td>
</tr>
</tbody>
</table>

Returns The adjusted record length. Negative numbers are error codes.
Valid for ADQ12-FWATD, ADQ14-FWATD

20.4.4 ATDGetDeviceNofAccumulations()

virtual unsigned int ATDGetDeviceNofAccumulations (  
   unsigned int nof_accumulations  
)
Get the number of accumulations performed by the ADQ.
Perform the same WFA workload partitioning that will be performed by ATDSetupWFA().
Parameters
nof_accumulations
The total number of accumulations

Returns The number of accumulations performed by the device. nof_accumulations divided by the return value is the number of accumulations performed by the API.

Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

See also ATDSetWFAPartitionBoundaries() ATDSetWFAPartitionBoundariesDefault() ATDGetWFAPartitionBoundaries()

20.4.5 ATDGetWFAPartitionBoundaries()

virtual int ATDGetWFAPartitionBoundaries ( 
  unsigned int * partition_lower_bound,
  unsigned int * partition_upper_bound )

Get the upper and lower boundaries for the WFA workload partitioning.

Retrieve the values of the WFA partition boundaries.

Parameters

partition_lower_bound
The lower boundary for the WFA partitioning.

partition_upper_bound
The upper boundary for the WFA partitioning.

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWATD, ADQ14-FWATD

See also ATDSetWFAPartitionBoundaries() ATDSetWFAPartitionBoundariesDefault() ATDGetDeviceNofAccumulations()

20.4.6 ATDGetWFAStatus()

virtual int ATDGetWFAStatus ( 
  unsigned int * wfa_progress_percent,
  unsigned int * records_collected,
  unsigned int * stream_status,
  unsigned int * wfa_status )

Read out status of ATD Wave Form Averaging module.

Parameters
### ATDRegisterWFABuffer()

```c
virtual int ATDRegisterWFABuffer ( 
    unsigned int channel, 
    void * buffer )
```

Register ATD WFA buffers.

Adds a buffer where ATD WFA can write data. Size of buffers must be the length previously set using ATDSetupWFA() or ATDSetupWFAAdvanced().

**Parameters**

- `channel`  
  Channel select, 1 to 4
buffer
Pointer to buffer

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

20.4.8 ATDSetThresholdFilter()

virtual int ATDSetThresholdFilter (  
    unsigned int channel,  
    unsigned int * coefficients )

Setup ATD Threshold module filter.
Program the filter coefficients for the linear-phase FIR filter (Type-I, order 16) in the threshold module. The coefficient vector consists of the impulse response values in the following order: h(0), h(1), h(2), h(3), h(4), h(5), h(6), h(7), h(8), where h(8) is the point of symmetry. The coefficients are represented using a 16-bit 2's complement representation with 14 fractional bits, yielding a coefficient range of $[-2, 1.999938965]$. The coefficient values fed into this function are the codes $[-2^{15}, 2^{15} - 1]$. For example, a filter coefficient value of 1.5 would be input as the code 24576 (0x6000).

Parameters

channel
Target channel, 1 to 4 (ADQ12/ADQ14), 1 to 2 (ADQ7)

coefficients
Array of filter coefficients. The first 9 values are expected to be the coefficients represented using a 16-bit fix-point representation with 14 fractional bits.

Returns 1 for successful operation and 0 for failure
Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

20.4.9 ATDSetupThreshold()

virtual int ATDSetupThreshold (  
    unsigned int channel,  
    int threshold,  
    int baseline,  
    unsigned int polarity,  
    unsigned int bypass )

Setup ATD Threshold module.

Parameters
channel
Target channel, 1 to 4 (ADQ12/ADQ14), 1 to 2 (ADQ7)

threshold
Threshold level in ADC codes. [-32768, 32767]

baseline
Baseline level in ADC codes. [-32768, 32767]

polarity
Specify the threshold polarity
- 0: Positive (samples below the threshold are masked with the baseline)
- 1: Negative (samples above the threshold are masked with the baseline)

bypass
Bypass the threshold module.

Returns 1 for successful operation and 0 for failure
Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

20.4.10 ATDSsetupWFA() 
virtual int ATDSsetupWFA ( 
    unsigned int record_length, 
    unsigned int nof_pretrig_samples, 
    unsigned int nof_triggerdelay_samples, 
    unsigned int nof_accumulations, 
    unsigned int nof_repeats )

Setup ATD Wave Form Averaging module.

Parameters

record_length
Length of record in samples.

nof_pretrig_samples
The number of samples to collect from before the trigger point

nof_triggerdelay_samples
The number of samples to wait before collecting data, after the trigger arrives

nof_accumulations
Number of accumulations to perform.

nof_repeats
Number of times to repeat the accumulation, creating a new record. A value of 4294967295 (0xFFFFFFFF) indicates infinite repeats.
Returns 1 for success, 0 for failure, -1 if the settings exceed the available DRAM on the device.

Note: The record_length, nof_pretrig_samples and nof_triggerdelay_samples parameters must be a multiple of the parallel samples used:

- ADQ7: In 1ch@10GSPS mode, parallel samples are 32. In 2ch@5GSPS mode, parallel samples are 16.
- ADQ12-1X, ADQ12-2X: Parallel samples are 8
- ADQ12-2C, ADQ12-4C: Parallel samples are 4
- ADQ12-2A, ADQ12-4A: Parallel samples are 2
- ADQ14-1X, ADQ14-2X: Parallel samples are 8
- ADQ14-2C, ADQ14-4C: Parallel samples are 4
- ADQ14-2A, ADQ14-4A: Parallel samples are 2

At the successful return of ATDSetupWFA() any buffers registered with ATDRegisterWFABuffer() will be automatically unregistered.

Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

### 20.4.11 ATDSetupWFAAdvanced()

```c
virtual int ATDSetupWFAAdvanced(
    unsigned int segment_length,
    unsigned int segments_per_record,
    unsigned int accumulations_per_batch,
    unsigned int record_length,
    unsigned int nof_accumulations,
    unsigned int nof_pretrig_samples,
    unsigned int nof_triggerdelay_samples,
    unsigned int bypass )
```

Setup ATD Wave Form Averaging module using detailed parameters.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>segment_length</strong></td>
<td>Length in samples of the WFA segment, the minimum quanta of data used by the WFA module. Must be specified in multiples of 32.</td>
</tr>
<tr>
<td><strong>segments_per_record</strong></td>
<td>Number of segments used to make up a record. The record length will be segment_length x segments_per_records long.</td>
</tr>
<tr>
<td><strong>accumulations_per_batch</strong></td>
<td>Number of records that will be stored in each DRAM bank.</td>
</tr>
<tr>
<td><strong>record_length</strong></td>
<td>Record length, must be set to segment_length x segments_per_records.</td>
</tr>
</tbody>
</table>
nof_accumulations
Number of accumulations to perform before emitting the result. Must be a multiple of 2.

nof_pretrig_samples
The number of samples to collect from before the trigger point.

nof_triggerdelay_samples
The number of samples to wait before collecting data, after the trigger arrives.

bypass
Bypass the WFA module.
- 0: Bypass disabled
- 1: Bypass enabled

Returns 1 for success, 0 otherwise.

Note: At the successful return of ATDSetupWFAAdvanced() any buffers registered with ATDRegisterWFABuffer() will be automatically unregistered.

Valid for ADQ12-FWATD, ADQ14-FWATD

20.4.12 ATDSetWFABufferFormat()

```c
int ATDSetWFABufferFormat ( enum ATDWFABufferFormat format )
```

Set the format of the ATD data buffer.

Set the type of the returned buffers from ATDWaitForWFABuffer. The default is ATD_WFA_BUFFER_FORMAT_INT32 (int32_t).

Parameters

- `format`: Buffer data format. See ATDWFABufferFormat for supported formats.

Returns 1 for success, 0 otherwise.

Valid for ADQ14-FWATD

20.4.13 ATDSetWFAInternalTimeout()

```c
virtual int ATDSetWFAInternalTimeout ( unsigned int timeout_ms )
```

Set the default internal timeout setting in milliseconds.

Set the internal timeout (default is 1000ms). The internal timeout is used when the internal data collection
thread is coming to an end. This is a one-time timeout occurring when either a fixed length acquisition has collected all the raw data needed or the user has requested a stop by calling ATDStopWFA().

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>timeout_ms</td>
<td>The number of ms to use for timeout.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ7-FWATD

20.4.14 ATDSetWFAPartitionBoundaries()

virtual int ATDSetWFAPartitionBoundaries(
    unsigned int partition_lower_bound,
    unsigned int partition_upper_bound )

Set the upper and lower boundaries for the WFA workload partitioning.

This function specifies the boundaries used by the partitioning algorithm in ATDSetupWFA(). The lower bound must never be set lower than 50. The limit on the upper bound is determined by the maximum record length that the user wants to support. Constrained by the interval, the partitioning algorithm will choose the highest integer which yields the best internal goal function score. Given a maximum supported record length, the upper boundary is computed as partition_upper_bound = floor(1024^3 / (8/9 * nof_channels * max_record_length * 2)) The values set by this function is applied in all later calls to e.g. ATDGetDeviceNofAccumulations() and ATDSetupWFA().

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>partition_lower_bound</td>
<td>The lower boundary for the WFA partitioning.</td>
</tr>
<tr>
<td>partition_upper_bound</td>
<td>The upper boundary for the WFA partitioning.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWATD, ADQ14-FWATD

See also ATDGetWFAPartitionBoundaries() ATDSetWFAPartitionBoundariesDefault() ATDGetDeviceNofAccumulations()

20.4.15 ATDSetWFAPartitionBoundariesDefault()

virtual int ATDSetWFAPartitionBoundariesDefault ( )

Set the default upper and lower boundaries for the WFA workload partitioning.

Reset the WFA partition boundaries to their default values (supporting 1M samples on ADQ12-FWATD/ADQ14-FWATD).
20.4.16 **ATDStartWFA()**

```c
virtual int ATDStartWFA(
    void **targetBuffers,
    unsigned char channels_mask,
    unsigned int blocking)
```

Start ATD WFA.

**Parameters**

<table>
<thead>
<tr>
<th>target_buffers</th>
<th>Array of buffers where data will be stored or NULL if ATDRegisterWFABuffer() is used to register target buffers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>channels_mask</td>
<td>A bit field specifying which channels to enable streaming for. Bit 0 enables channel A, bit 1 channel B and so forth.</td>
</tr>
<tr>
<td>blocking</td>
<td>Selects blocking or non-blocking mode. If set to 1 the function will not return until all of the requested data has been collected, accumulated and transferred to target_buffers. If set to 0 the function will return as soon as data collection has been started. After calling ATDStartWFA in non-blocking mode no other ADQAPI functions other than ATDRegisterWFABuffer(), ATDWaitForWFABuffer(), ATDGetWFAStatus(), ATDFlushWFA() and ADQ_ATDStopWFA() may be called before ATDWaitForWFACompletion() has been called.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Note When ATDStartWFA() is called with NULL as target_buffers argument, transfer buffers need to be registered in advance using ATDRegisterWFABuffer().

Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD

See also ATDGetWFAStatus(), ATDWaitForWFACompletion(), ATDStopWFA()

20.4.17 **ATDStopWFA()**

```c
virtual int ATDStopWFA(
    void)
```

Stop ATD WFA.

Stops a data collection started by ATDStartWFA().

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD
20.4.18  ATDUpdateNofAccumulations()

virtual int ATDUpdateNofAccumulations (  
    unsigned int nof_accumulations )

Set the number of accumulations.

Update the number of accumulations. This function may only be called when the WFA is running. Refer to the ADQ7-FWATD User Guide (17-1957) for details on when the settings are updated. When an update has been requested, another change cannot occur until the incoming data reflects the requested changes.

Parameters

<table>
<thead>
<tr>
<th>nof_accumulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>The total number of accumulations</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 for error, -1 indicates an update is currently in progress

Valid for ADQ7-FWATD

See also ATDSetWFAPartitionBoundaries() ATDSetWFAPartitionBoundariesDefault() ATDGetWFAPartitionBoundaries()

20.4.19  ATDWaitForWFABuffer()

virtual int ATDWaitForWFABuffer (  
    unsigned int channel,  
    void ** buffer,  
    int timeout )

Wait for ATD WFA buffer.

Waits for filled ATD WFA buffer previously registered using ATDRegisterWFABuffer().

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel select, 1 to 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to a pointer where the returned buffer pointer will be stored. Returns -1 if a streaming overflow has occurred, -2 if WFA streaming is not running and NULL NULL on timeout. The format of the buffer is controlled with ATDSetWFABufferFormat().</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>timeout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeout in milliseconds, use 0 for infinite timeout, use -1 to return immediately if no buffer is available.</td>
</tr>
</tbody>
</table>

Returns Status code:
20.4.20 ATDWaitForWFACompletion()

virtual int ATDWaitForWFACompletion ( 
    void 
) 
Wait for ATD WFA completion.
Blocks execution until ATD WFA collection is completed.
Returns 1 for success, 0 otherwise
Valid for ADQ12-FWATD, ADQ14-FWATD, ADQ7-FWATD
See also ATDStartWFA()

21 Pulse Detection

Functions

- int PDAutoTrig (unsigned int channel, int *detected_trigger_level, unsigned int *detected_arm_hysteresis)
  
  Let the ADQ attempt to acquire settings for the level trigger.

- int PDClearHistogram (unsigned int histogram_type, unsigned int channel)
  
  Clear the histogram bins.

- int PDEnableLevelTrig (unsigned int enable)
  
  Enable the -FWPD level trigger.

- int PDEnableTriggerCoincidence (unsigned int enable)
  
  Enable the -FWPD trigger coincidence.

- int PDGetCharacterizationStatus (unsigned int channel, unsigned int *status)
  
  Get pulse characterization status.

- int PDGetGeneration (unsigned int *generation)
  
  Get the FWPD generation.

- int PDGetHistogramStatus (unsigned int *overflow_bin, unsigned int *underflow_bin, unsigned int *histogram_count, unsigned int *histogram_status, unsigned int histogram_type, unsigned int channel)
  
  Get histogram status.

- int PDGetLevelTrigStatus (unsigned int *status)
  
  Readout of the -FWPD level trigger status.

- int PDRestoreHistogram (unsigned int *data, unsigned int histogram_type, unsigned int channel)
Read histogram data.

- **int PDResetTriggerCoincidence (void)**
  
  Resets the -FWPD trigger coincidence module.

- **int PDSetDataMux (unsigned int input_channel, unsigned int output_channel)**
  
  Control the FWPD data multiplexer.

- **int PDSetMinimumFrameLength (unsigned int channel, unsigned int minimum_frame_length)**
  
  Set the minimum frame length.

- **int PDSetupCharacterization (unsigned int channel, unsigned int collection_mode, unsigned int reduction_factor, unsigned int detection_window_length, unsigned int record_length, unsigned int padding_offset, unsigned int minimum_frame_length, unsigned int trigger_polarity, unsigned int trigger_mode, unsigned int padding_trigger_mode)**
  
  Configure pulse characterization.

- **int PDSetupHistogram (unsigned int offset, unsigned int scale, unsigned int histogram_type, unsigned int channel)**
  
  Setup FWPD Histograms.

- **int PDSetupLevelTrig (unsigned int channel, int trigger_level, int reset_hysteresis, int trigger_arm_hysteresis, int reset_arm_hysteresis, unsigned int trigger_polarity, unsigned int reset_polarity)**
  
  Configure the -FWPD level trigger.

- **int PDSetupMovingAverageBypass (unsigned int bypass, int reference_level)**
  
  Enable bypass for the moving average filter.

- **int PDSetupStreaming (unsigned char channels_mask)**
  
  Configure the streaming mode for the -FWPD option.

- **int PDSetupTiming (unsigned int channel, unsigned int nof_pretrigger_samples, unsigned int nof_moving_average_samples, unsigned int moving_average_delay, unsigned int trailing_edge_window, unsigned int number_of_records, unsigned int record_variable_length)**
  
  Configure the -FWPD timing.

- **int PDSetupTriggerCoincidence (unsigned int channel, unsigned int window_length, unsigned int mask)**

- **int PDSetupTriggerCoincidence2 (unsigned int channel, unsigned int core_id, unsigned int enable)**
  
  Assign and enable -FWPD coincidence core to channel.

- **int PDSetupTriggerCoincidenceCore (unsigned int core_id, unsigned int window_length, unsigned char *expr_array, unsigned int mask)**
  
  Configure the -FWPD trigger coincidence cores.

### 21.1 Detailed Description

These functions are used to configure devices with the -FWPD firmware option.

### 21.2 Function Documentation
21.2.1 PDAutoTrig()

virtual int PDAutoTrig (  
    unsigned int channel,  
    int * detected_trigger_level,  
    unsigned int * detected_arm_hysteresis )  

Let the ADQ attempt to acquire settings for the level trigger.

This function returns the trigger level for which events are detected on channel A.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
<th>The target channel. [1, 4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>detected_trigger_level</td>
<td>Suggested level trigger value. If 0, no signal could be acquired.</td>
</tr>
<tr>
<td>detected_arm_hysteresis</td>
<td>Suggested trigger- and reset arm hysteresis levels. If 0, no signal could be acquired.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.2 PDClearHistogram()

virtual int PDClearHistogram (  
    unsigned int histogram_type,  
    unsigned int channel )  

Clear the histogram bins.

Set histogram bins to zero. The histogram overflow status bit will also be reset.

Parameters

<table>
<thead>
<tr>
<th>histogram_type</th>
<th>Specifies the histogram type:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Pulse width histogram</td>
<td></td>
</tr>
<tr>
<td>1: Peak value histogram</td>
<td></td>
</tr>
</tbody>
</table>

| channel | The channel from which the status should be read. The channel index start at 1 (channel A). |

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWPD, ADQ14-FWPD
21.2.3  **PDEnableLevelTrig()**

```cpp
virtual int PDEnableLevelTrig ( unsigned int enable )
```

Enable the -FWPD level trigger.
Enable the level trigger. Requires a valid -FWPD license key.

**Parameters**

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value 1 to enable, 0 to disable.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.4  **PDEnableTriggerCoincidence()**

```cpp
virtual int PDEnableTriggerCoincidence ( unsigned int enable )
```

Enable the -FWPD trigger coincidence.
This function enables the -FWPD trigger coincidence masking if enable is set to 1. By default the trigger coincidence masking is bypassed.

**Parameters**

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
</table>

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD

21.2.5  **PDGetCharacterizationStatus()**

```cpp
virtual int PDGetCharacterizationStatus ( unsigned int channel, unsigned int * status )
```

Get pulse characterization status.
Read the status of the pulse characterization module for the target channel.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel ID, starting at 1.</td>
</tr>
</tbody>
</table>
status
For ADQ14:
- Bit 0: Metadata FIFO overflow
- Bit 1: Pulse width histogram FIFO overflow
- Bit 2: Pulse peak histogram FIFO overflow
For ADQ7:
- Bit 0: Metadata buffer FIFO overflow
- Bit 1: Metadata packer overflow
- Bit 2: Metadata window discarded
- Bit 3: Time over threshold (arithmetic) overflow
- Bit 4: Metadata alignment error (internal error)

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.6 PDGetGeneration()

virtual int PDGetGeneration (  
    unsigned int * generation  )

Get the FWPD generation.

Parameters

    generation
Output parameter with the firmware PD generation. Only valid if the return status is 1

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.7 PDGetHistogramStatus()

virtual int PDGetHistogramStatus (  
    unsigned int * overflow_bin,  
    unsigned int * underflow_bin,  
    unsigned int * histogram_count,  
    unsigned int * histogram_status,  
    unsigned int histogram_type,  
    unsigned int channel  )

Get histogram status.

Reads the histogram status, histogram count, overflow and underflow bin. The output parameters are ignored if the pointer is NULL (0).

Parameters
<table>
<thead>
<tr>
<th><strong>overflow_bin</strong></th>
<th>Read result of the underflow bin.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>underflow_bin</strong></td>
<td>Read result of the overflow bin.</td>
</tr>
<tr>
<td><strong>histogram_count</strong></td>
<td>Read result of the histogram count.</td>
</tr>
</tbody>
</table>
| **histogram_status**  | Read result of the histogram status.  
| - Bit 0: Histogram FIFO empty  
| - Bit 1: Histogram FIFO overflow |
| **histogram_type**    | Specifies the histogram type:  
| - 0: Pulse width histogram  
| - 1: Peak value histogram   |
| **channel**           | The channel from which the status should be read. The channel index start at 1 (channel A). |

Returns 1 for success, 0 otherwise  
Valid for ADQ12-FWPD, ADQ14-FWPD

### 21.2.8 PDGetLevelTrigStatus()

```c
virtual int PDGetLevelTrigStatus ( 
    unsigned int * status )
```

Readout of the -FWPD level trigger status.

**Parameters**

<table>
<thead>
<tr>
<th><strong>status</strong></th>
</tr>
</thead>
</table>

Returns 1 for success, 0 otherwise  
Valid for ADQ12-FWPD, ADQ14-FWPD

### 21.2.9 PDReadHistogram()

```c
virtual int PDReadHistogram ( 
```
unsigned int * data,
unsigned int histogram_type,
unsigned int channel )

Read histogram data.

Read histogram data bins. The data array has to be allocated by the user, and should be sufficiently large to
fit all bins. Refer to the FWPD User Guide for the number of bins per histogram. The histogram overflow and
underflow bins are read with PDGetHistogramStatus.

Parameters

<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to the return data array. This should be large enough to hold all histogram bins.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>histogram_type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specifies the histogram type:</td>
</tr>
<tr>
<td>• 0: Pulse width histogram</td>
</tr>
<tr>
<td>• 1: Peak value histogram</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel ID. The index start at 1 (channel A)</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD

21.2.10 PDResetTriggerCoincidence()

virtual int PDResetTriggerCoincidence ( void )

Resets the -FWPD trigger coincidence module.

Returns 1 for success, 0 otherwise
Valid for ADQ14-FWPD

21.2.11 PDSetDataMux()

virtual int PDSetDataMux ( unsigned int input_channel,
                          unsigned int output_channel )

Control the FWPD data multiplexer.

Forward the data on the channel specified by input_channel to the channel specified by output_channel. The
channel indices start at 1.

Parameters
**input_channel**
Input channel ID starting at 1 (channel A).

**output_channel**
Output channel ID starting at 1 (channel A).

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD

### 21.2.12 PDSetMinimumFrameLength()  

virtual int PDSetMinimumFrameLength (    
    unsigned int channel,    
    unsigned int minimum_frame_length )

Set the minimum frame length.
Set the minimum frame length used by the padding module. The minimum frame length may be changed while the acquisition is active.

**Parameters**

**channel**
The target channel. Index start at 1.

**minimum_frame_length**
The minimum frame length in samples. This has to be a multiple of the number of parallel samples used in the hardware. Note that the number of parallel samples may differ between the data and metadata channels.

Returns 1 for success, 0 otherwise
Valid for ADQ7-FWPD

### 21.2.13 PDSetupCharacterization()  

virtual int PDSetupCharacterization (    
    unsigned int channel,    
    unsigned int collection_mode,    
    unsigned int reduction_factor,    
    unsigned int detection_window_length,    
    unsigned int record_length,    
    unsigned int padding_offset,    
    unsigned int minimum_frame_length,    
    unsigned int trigger_polarity,    
    unsigned int trigger_mode,    
    unsigned int padding_trigger_mode )

Configure pulse characterization.
Configure the Pulse Characterization module according to specified settings. This function has to be called after PDSetupTiming on ADQ14-FWPD.

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>channel</strong></td>
<td>Channel ID, starting at 1.</td>
</tr>
<tr>
<td><strong>collection_mode</strong></td>
<td>Pulse characterization collection mode</td>
</tr>
<tr>
<td><strong>reduction_factor</strong></td>
<td>Every Nth record reduction factor</td>
</tr>
<tr>
<td><strong>detection_window_length</strong></td>
<td>Detection window length in number of samples.</td>
</tr>
<tr>
<td><strong>record_length</strong></td>
<td>Record length in number of samples.</td>
</tr>
<tr>
<td><strong>padding_offset</strong></td>
<td>Padding offset in number of samples.</td>
</tr>
<tr>
<td><strong>minimum_frame_length</strong></td>
<td>Minimum frame length in number of samples.</td>
</tr>
<tr>
<td><strong>trigger_polarity</strong></td>
<td>Trigger polarity, should match the pulse polarity.</td>
</tr>
<tr>
<td></td>
<td>• 0: Negative pulses</td>
</tr>
<tr>
<td></td>
<td>• 1: Positive pulses</td>
</tr>
<tr>
<td><strong>trigger_mode</strong></td>
<td>Trigger mode used for record acquisition</td>
</tr>
<tr>
<td><strong>padding_trigger_mode</strong></td>
<td>Trigger mode used for the padding grid.</td>
</tr>
</tbody>
</table>

**Returns** 1 for success, 0 otherwise

**Valid for** ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

### 21.2.14 PDSetupHistogram()

```cpp
virtual int PDSetupHistogram ( 
    unsigned int offset, 
    unsigned int scale, 
    unsigned int histogram_type, 
    unsigned int channel )
```

Setup FWPD Histograms.

Configure the FWPD histogram.
Parameters

<table>
<thead>
<tr>
<th>offset</th>
<th>Offset used for mapping values to bins. See FWPD User Guide.</th>
</tr>
</thead>
<tbody>
<tr>
<td>scale</td>
<td>Scale factor used for mapping values to bins. See FWPD User Guide.</td>
</tr>
<tr>
<td>histogram_type</td>
<td>Specifies the histogram which the settings should be applied to</td>
</tr>
<tr>
<td>channel</td>
<td>Channel ID. The index start at 1 (channel A)</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD

21.2.15 PDSsetupLevelTrig()

virtual int PDSsetupLevelTrig (
  unsigned int channel,
  int trigger_level,
  int reset_hysteresis,
  int trigger_arm_hysteresis,
  int reset_arm_hysteresis,
  unsigned int trigger_polarity,
  unsigned int reset_polarity )

Configure the -FWPD level trigger.
Configure the data driven level trigger for a channel. The reset_polarity must have the opposite edge of the trigger_polarity.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
<th>Channel identifier. Indexed from 1 and upwards.</th>
</tr>
</thead>
<tbody>
<tr>
<td>trigger_level</td>
<td>Trigger level as a value in the range [-32768, 32767]</td>
</tr>
<tr>
<td>reset_hysteresis</td>
<td>Reset hysteresis (trigger polarity 1: negative offset from the trigger level, trigger polarity 0: positive offset from the trigger level)</td>
</tr>
<tr>
<td>trigger_arm_hysteresis</td>
<td>Trigger event rearm level (trigger polarity 1: negative offset from the trigger level, trigger polarity 0: positive offset from the trigger level)</td>
</tr>
</tbody>
</table>
reset_arm_hysteresis
Reset event rearm level (reset polarity 1: negative offset from the reset level, reset polarity 0: positive offset from the reset level)

trigger_polarity
Logic value, 1: Rising edge, 0: Falling edge.

reset_polarity
Logic value, 1: Rising edge, 0: Falling edge.

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.16 PDSetupMovingAverageBypass()

virtual int PDSetupMovingAverageBypass ( unsigned int bypass, int reference_level )

Enable bypass for the moving average filter.
The purpose of this function is to allow the user to configure the moving average filter without using the filter output as a baseline for the level trigger. Instead, the value of reference_level is used as a baseline. This function does not need to be called for normal operation, i.e. using the MA filter output as the level trigger baseline.

Parameters

bypass
Set to 1 to activate bypass and trigger relative to the fixed value of reference_level, 0 to allow a moving baseline from the MA filter output.

reference_level
Specifies the constant level to use as a reference to the level trigger instead of the output from the MA filter.

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD

21.2.17 PDSetupStreaming()

virtual int PDSetupStreaming ( unsigned char channels_mask )

Configure the streaming mode for the -FWPD option.

Parameters
channels_mask
Channels mask, four bits.

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD

21.2.18 PDSetupTiming()

virtual int PDSetupTiming ( 
    unsigned int channel,
    unsigned int nof_pretrigger_samples,
    unsigned int nof_moving_average_samples,
    unsigned int moving_average_delay,
    unsigned int trailing_edge_window,
    unsigned int number_of_records,
    unsigned int record_variable_length )

Configure the -FWPD timing.

Parameters

channel
Channel identifier. Indexed from 1 and upwards.

nof_pretrigger_samples
Set the number of pretrigger samples.

nof_moving_average_samples
Set the number of samples to be used for the moving average. Values [0, 100]

moving_average_delay
Specify the moving average delay. Range [0, 100 - nof_moving_average_samples]

trailing_edge_window
Synonymous to the record length when record_variable_length is set to 0.

number_of_records
Number of records to collect.

record_variable_length
Activate variable length mode. Logic value.

Returns 1 for success, 0 otherwise
Valid for ADQ12-FWPD, ADQ14-FWPD, ADQ7-FWPD
### 21.2.19 PDSetupTriggerCoincidence()

```cpp
virtual int PDSetupTriggerCoincidence (  
    unsigned int channel,  
    unsigned int window_length,  
    unsigned int mask )
```

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>channel</td>
<td>Channel identifier. Indexed from 1 and upwards.</td>
</tr>
<tr>
<td>window_length</td>
<td>Coincidence window length (in samples). Must be a multiple of 4 on -C devices and 8 on -X devices.</td>
</tr>
<tr>
<td>mask</td>
<td>The coincidence bitmask. It represents a logic OR expression which combines the channel triggers. E.g. a mask of 0b1010 (0xA) configured for channel 1 signifies that triggers are accepted on channel 1 if any of the channels 2 or 4 have triggered and the event on channel A occurs within the configured coincidence window.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise  
Valid for ADQ12-FWPD, ADQ14-FWPD

### 21.2.20 PDSetupTriggerCoincidence2()

```cpp
virtual int PDSetupTriggerCoincidence2 (  
    unsigned int channel,  
    unsigned int core_id,  
    unsigned int enable )
```

Assign and enable -FWPD coincidence core to channel.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>channel</td>
<td>Channel identifier. Indexed from 1 and upwards.</td>
</tr>
<tr>
<td>core_id</td>
<td>Core identifier. Indexed from 0 and upwards.</td>
</tr>
<tr>
<td>enable</td>
<td>Enables use or bypass of coincidence core</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise  
Valid for ADQ12-FWPD, ADQ14-FWPD
21.2.21 PDSetupTriggerCoincidenceCore()

virtual int PDSetupTriggerCoincidenceCore (  
    unsigned int core_id,  
    unsigned int window_length,  
    unsigned char *expr_array,  
    unsigned int mask  
)

Configure the -FWPD trigger coincidence cores.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>core_id</td>
<td>Core identifier. Indexed from 0 and upwards.</td>
</tr>
<tr>
<td>window_length</td>
<td>Coincidence window length (in samples). Must be a multiple of 4 on -C devices and 8 on -X devices.</td>
</tr>
<tr>
<td>expr_array</td>
<td>Pointer to array to use when populating expression-memory.</td>
</tr>
<tr>
<td>mask</td>
<td>The coincidence start expression bit mask. Each bit in the mask corresponds to a channel where channel A is bit 0 and so on. The start expression is logic OR between all channels where the corresponding bit is set, i.e. &quot;1&quot;.</td>
</tr>
</tbody>
</table>

Returns 1 for success, 0 otherwise

Valid for ADQ12-FWPD, ADQ14-FWPD

22 Software-defined radio

Functions

- int ForceResynchronizationSDR ()
  
  Synchronizes the phase of the mixer and decimation stages between all DDCs, as an alternative to synchronizing with respect to an external signal via SetupTimestampSync.

- int SetCrosspointSDR (unsigned int iqchannel, unsigned int mode)
  
  Selects the input data for the SDR down-converters.

- int SetEqualizerSDR (unsigned int iqchannel, float *coeffs1, float *coeffs2, unsigned int mode)
  
  Sets up the SDR channel equalizer filter, in either real-valued or complex-valued mode.

- int SetMixerFrequency (unsigned int iqchannel, double freq_hz)
  
  Sets the local oscillator frequency for the quadrature mixer of a firmware I/Q channel.

- int SetMixerPhase (unsigned int iqchannel, double radians)
  
  Sets the local oscillator phase for the quadrature mixer of a firmware I/Q channel.
22.1 Detailed Description

These functions are used to configure devices with the -FWSDR or -FW4DDC firmware options.

22.2 Function Documentation

22.2.1 ForceResynchronizationSDR()

virtual int ForceResynchronizationSDR ( )

Synchronizes the phase of the mixer and decimation stages between all DDCs, as an alternative to synchronizing with respect to an external signal via SetupTimestampSync.

Returns 1 for successful operation and 0 for failure
Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

22.2.2 SetCrosspointSDR()

virtual int SetCrosspointSDR ( 

unsigned int iqchannel, 
unsigned int mode )

Selects the input data for the SDR down-converters.

Parameters

<table>
<thead>
<tr>
<th>iqchannel</th>
<th>The desired I/Q channel number, between 1 and the total number of I/Q channels</th>
</tr>
</thead>
</table>
| mode      | - 0: Real valued data from channel A -> A + j0  
|           | 1: Real valued data from channel B -> B + j0  
|           | 2: Channel A and B as I/Q -> A/2 + j*B/2  
|           | 3: Channel A and B as differential real-valued data: (A-B)/2 + j0 |

Returns 1 for successful operation and 0 for failure
Valid for ADQ7-FW2DDC

22.2.3 SetEqualizerSDR()

virtual int SetEqualizerSDR ( 

unsigned int iqchannel, 
float * coeffs1, 
float * coeffs2, 

...
Sets up the SDR channel equalizer filter, in either real-valued or complex-valued mode.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>iqchannel</td>
<td>The desired I/Q channel number, between 1 and the total number of I/Q channels</td>
</tr>
<tr>
<td>coeffs1</td>
<td>Coefficient array 1</td>
</tr>
<tr>
<td>coeffs2</td>
<td>Coefficient array 2</td>
</tr>
</tbody>
</table>
| mode        | - 0: Bypassed (default)  
1: Real-valued equalizer, coeffs1 is applied to I data, coeffs2 is applied to Q data, with no interaction  
2: Complex-valued equalizer, the filter is \((\text{coeffs1} + i \times \text{coeffs2})\) and is applied to both I and Q data in a complex multiplication |

Returns 1 for successful operation and 0 for failure

Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

22.2.4 SetMixerFrequency()

virtual int SetMixerFrequency (  
    unsigned int iqchannel,  
    double freq_hz )

Sets the local oscillator frequency for the quadrature mixer of a firmware I/Q channel.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>iqchannel</td>
<td>The desired I/Q channel number, between 1 and the total number of I/Q channels</td>
</tr>
<tr>
<td>freq_hz</td>
<td>The desired LO frequency in Hz</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

22.2.5 SetMixerPhase()

virtual int SetMixerPhase (  
    unsigned int iqchannel,  
    double radians )
Sets the local oscillator phase for the quadrature mixer of a firmware I/Q channel.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>iqchannel</td>
<td>The desired I/Q channel number, between 1 and the total number of I/Q channels</td>
</tr>
<tr>
<td>radians</td>
<td>The desired phase offset in radians</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ14-FWSDR, ADQ14-FW4DDC, ADQ7-FW2DDC

23 FPGA DNA Readout

Functions

- int GetDNA (unsigned int *dna)
  
  * Returns FPGA DNA value. *
  
- int ResetDNA (unsigned int assert)
  
  * Reset FPGA DNA extraction. *

23.1 Detailed Description

These functions are used to read the FPGA DNA, a value used to differentiate devices from each other.

23.2 Function Documentation

23.2.1 GetDNA()

virtual int GetDNA ( 
    unsigned int * dna )

* Returns FPGA DNA value. *

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dna</td>
<td>A pointer to an array of four 32-bit unsigned integers to store the DNA / board unique ID.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8
23.2.2 ResetDNA()

virtual int ResetDNA ( unsigned int assert )

Reset FPGA DNA extraction.

Parameters

assert
Set to 1 to reset the DNA extraction.

Returns 1 for success, 0 otherwise

Valid for ADQ12, ADQ14, ADQ7, ADQ8

24 Triggered Streaming

Functions

- unsigned int GetTriggeredStreamingHeaderSizeBytes ()
  
  Gets the number of bytes for the record header.

- unsigned int GetTriggeredStreamingRecords (unsigned int NofRecordsToRead, void **data_buf, void *header_buf, unsigned int *NofRecordsRead)
  
  Collects a number of Triggered Streaming-record.

- unsigned int GetTriggeredStreamingRecordSizeBytes ()
  
  Gets the number of bytes for the samples of each record.

- unsigned int HasTriggeredStreamingFunctionality ()
  
  Polls the ADQ to see if it has the Triggered Streaming functionality.

- unsigned int ParseTriggeredStreamingHeader (void *HeaderPtr, unsigned long long *Timestamp, unsigned int *Channel, unsigned int *ExtraAccuracy, int *RegisterValue, unsigned int *SerialNumber, unsigned int *RecordCounter)
  
  Reads a Triggered Streaming header and returns the values.

- unsigned int SetTriggeredStreamingHeaderRegister (char RegValue)
  
  Puts a user-defined 8-bit value in the Triggered Streaming record header.

- unsigned int SetTriggeredStreamingHeaderSerial (unsigned int SerialNumber)
  
  Overwrites the SerialNumber field in the Triggered Streaming header.

- unsigned int SetTriggeredStreamingTotalNofRecords (unsigned int MaxNofRecordsTotal)
  
  Sets an optional total number of Triggered Streaming records for all channels combined.

- unsigned int TriggeredStreamingArm ()
  
  Arms Triggered Streaming.

- unsigned int TriggeredStreamingArmV5 ()
  
  Arms Triggered Streaming for V5 ADQs.

- unsigned int TriggeredStreamingDisarm ()
Disarms triggered streaming.

- unsigned int TriggeredStreamingDisarmV5()

Disarms Triggered Streaming for V5 ADQs.

- unsigned int TriggeredStreamingGetNofRecordsCompleted(unsigned int ChannelsMask, unsigned int *NofRecordsCompleted)

  Gets the number of records that have been collected.

- unsigned int TriggeredStreamingGetStatus(unsigned int *InIdle, unsigned int *TriggerSkipped, unsigned int *Overflow)

  Gets the status of the Triggered Streaming block.

- unsigned int TriggeredStreamingGetStatusV5(unsigned char *ready, unsigned int *nofrecordscompleted, unsigned char *in_idle)

  Gets the status of Triggered Streaming for V5 ADQs.

- unsigned int TriggeredStreamingGetWaveformV5(short *waveform_data_short)

  Collects one record for Triggered Streaming for V5 ADQs.

- unsigned int TriggeredStreamingOneChannelSetup(unsigned int SamplePerRecord, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples, unsigned int ArmMode, unsigned int ReadOutSpeed, unsigned int Channel)

  Sets the parameters for one channel Triggered Streaming on V5 ADQs. Special firmware is needed. Please contact SP Devices for more information.

- unsigned int TriggeredStreamingParseDataStream(unsigned int samples_per_record, int *data_stream, int **data_target)

  Parses a buffer filled with a single record of Triggeres Streaming data.

- unsigned int TriggeredStreamingSetup(unsigned int NofRecords, unsigned int NofSamples, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples, unsigned char ChannelsMask)

  Sets up a triggered streaming data acquisition.

### 24.1 Detailed Description

Triggered Streaming is a collection block for small collections with short rearm-time. The records are typically transferred to host using streaming mode.

### 24.2 Function Documentation

#### 24.2.1 GetTriggeredStreamingHeaderSizeBytes()

```cpp
virtual unsigned int GetTriggeredStreamingHeaderSizeBytes()
```

Gets the number of bytes for the record header.

This function may be convenient when allocating memory for storing the output.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412
24.2.2 GetTriggeredStreamingRecords()

virtual unsigned int GetTriggeredStreamingRecords ( 
    unsigned int NofRecordsToRead,
    void ** data_buf,
    void * header_buf,
    unsigned int * NofRecordsRead )

Collects a number of Triggered Streaming-record.

The data is retrieved from the ADQ and stored in user-allocated memory space. One record from one channel is transferred at a time, in the order of collection.

Parameters

<table>
<thead>
<tr>
<th>NofRecordsToRead</th>
<th>Specifies the number of records to read from the ADQ. The records arrive in the order of collection.</th>
</tr>
</thead>
<tbody>
<tr>
<td>data_buf</td>
<td>Pointer to different buffers, one for each channel of the device, where the actual data is output (without headers). If multiple records are collected from a channel, these are simply stored after each other in the buffer. The user is responsible for allocating these buffers.</td>
</tr>
<tr>
<td>header_buf</td>
<td>Pointer to a buffer where the headers are stored in order. In level trigger mode this information is needed to determine from which buffer in data_buf to read the data, as the channels collect data individually. For other modes, the channel order is always A,B,C,D for ADQ412 if all channels are enabled. The user is responsible for allocating this buffer.</td>
</tr>
<tr>
<td>NofRecordsRead</td>
<td>Pointer to an integer where the function returns the number of records that were collected</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note When streaming data to host, this function assumes that the buffer size of the transfer buffers have been set using SetTransferBuffers(). The buffers sizes must follow two rules: The first is that they must be a multiple of the size of one record (including header). The second is that the total amount of data that is to be collected must be a multiple of the transfer buffer size.

If data is directed to the DRAM instead of the streaming interface, this function may be used after calling MemoryDump() and MemoryShadow().

Valid for ADQ412

See also TriggeredStreamingSetup(), GetTriggeredStreamingRecordSizeBytes(), GetTriggeredStreamingHeaderSizeBytes()
24.2.3 GetTriggeredStreamingRecordSizeBytes()

virtual unsigned int GetTriggeredStreamingRecordSizeBytes ( )

Gets the number of bytes for the samples of each record.
The size returned will not include the header. This function may be convenient when allocating memory for
storing the output.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412

See also GetTriggeredStreamingHeaderSizeBytes()

24.2.4 HasTriggeredStreamingFunctionality()

virtual unsigned int HasTriggeredStreamingFunctionality ( )

Polls the ADQ to see if it has the Triggered Streaming functionality.

Returns 1 if Triggered Streaming is available and 0 otherwise

Valid for ADQ412, ADQ12, ADQ14, ADQ7

See also TriggeredStreamingSetup()

24.2.5 ParseTriggeredStreamingHeader()

virtual unsigned int ParseTriggeredStreamingHeader ( 
    void ∗ HeaderPtr,
    unsigned long ∗ Timestamp,
    unsigned int ∗ Channel,
    unsigned int ∗ ExtraAccuracy,
    int ∗ RegisterValue,
    unsigned int ∗ SerialNumber,
    unsigned int ∗ RecordCounter )

Reads a Triggered Streaming header and returns the values.

Parameters

<table>
<thead>
<tr>
<th>HeaderPtr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to the first byte of the header to parse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timestamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where to return the value of the internal time counter stored in the header. Useful for knowing when a record was triggered. In interleaved mode for ADQ412, an increment of the counter means that one more sample passed. In non-interleaved mode, every two increments indicates that a sample passed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where to return the channel that was read. Channel 1 = A, 2 = B, 4 = C, and 8 = D.</td>
</tr>
</tbody>
</table>
### ExtraAccuracy
Not used

### RegisterValue
Pointer to where to return the register value that was stored in the header. The value may be specified using SetTriggeredStreamingHeaderRegister().

### SerialNumber
Pointer to where to return the serial number of the board. The value may be overridden using SetTriggeredStreamingHeaderSerial().

### RecordCounter
Pointer to where to return the record number stored in the header. This value starts at 0 and is then incremented for each record. If infinite streaming is used, this value will wrap back to 0 after 131072 records have been collected for the specific channel.

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also GetTriggeredStreamingRecords()

#### 24.2.6 SetTriggeredStreamingHeaderRegister()

```cpp
template unsigned int SetTriggeredStreamingHeaderRegister ( char RegValue )
```

Puts a user-defined 8-bit value in the Triggered Streaming record header.
Useful for keeping track of different measurements and for debugging purposes.

**Parameters**

<table>
<thead>
<tr>
<th>RegValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value to set in the register</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also SetTriggeredStreamingHeaderSerial()

#### 24.2.7 SetTriggeredStreamingHeaderSerial()

```cpp
template unsigned int SetTriggeredStreamingHeaderSerial ( unsigned int SerialNumber )
```

Overwrites the SerialNumber field in the Triggered Streaming header.

**Parameters**
### SerialNumber

The value to set in the register

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also SetTriggeredStreamingHeaderRegister()

#### 24.2.8 SetTriggeredStreamingTotalNofRecords()

virtual unsigned int SetTriggeredStreamingTotalNofRecords ( unsigned int MaxNofRecordsTotal )

Sets an optional total number of Triggered Streaming records for all channels combined.

**Parameters**

**MaxNofRecordsTotal**

The maximum number of records to collect in total, regardless of from which channel the record came. If set to 0, there will be no limit. For technical reasons, one record per channel extra may be collected than the specified amount.

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also TriggeredStreamingSetup()

#### 24.2.9 TriggeredStreamingArm()

virtual unsigned int TriggeredStreamingArm ( )

Arms Triggered Streaming.
Must be called after TriggeredStreamingSetup() to start collection

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also TriggeredStreamingDisarm(), TriggeredStreamingSetup()

#### 24.2.10 TriggeredStreamingArmV5()

virtual unsigned int TriggeredStreamingArmV5 ( )

Arms Triggered Streaming for V5 ADQs.
After this command is issued, triggers will be accepted. If automatic rearm and readout is turned on, readout will occur once a record is collected and a new record will be collected when readout is done.

Returns 1 for successful operation and 0 for failure

Valid for ADQ214

See also TriggeredStreamingDisarmV5(), TriggeredStreamingSetupV5()

24.2.11 TriggeredStreamingDisarm()

virtual unsigned int TriggeredStreamingDisarm ( )
Disarms triggered streaming.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412

See also TriggeredStreamingArm()

24.2.12 TriggeredStreamingDisarmV5()

virtual unsigned int TriggeredStreamingDisarmV5 ( )
Disarms Triggered Streaming for V5 ADQs.

This function will disarm Triggered Streaming, and put the block in bypass mode so that other collection methods may be used.

Returns 1 for successful operation and 0 for failure

Valid for ADQ214

See also TriggeredStreamingArmV5(), TriggeredStreamingSetupV5()

24.2.13 TriggeredStreamingGetNofRecordsCompleted()

virtual unsigned int TriggeredStreamingGetNofRecordsCompleted ( 
    unsigned int ChannelsMask, 
    unsigned int * NofRecordsCompleted )

Gets the number of records that have been collected.
The user may specify which channel(s) to ask.

Parameters

| ChannelsMask | Bit field to select which channel(s) to read from. Bit 0 selects channel A, bit 1 selects channel B, and so forth. |
| NofRecordsCompleted | Pointer to where to store the result. All selected channels are added together. |
Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also TriggeredStreamingGetStatus()

24.2.14 TriggeredStreamingGetStatus()

virtual unsigned int TriggeredStreamingGetStatus ( 
  unsigned int * InIdle, 
  unsigned int * TriggerSkipped, 
  unsigned int * Overflow )

Gets the status of the Triggered Streaming block.

Parameters

<table>
<thead>
<tr>
<th>InIdle</th>
<th>Pointer to where to tell if the block is idle (1) or not (0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TriggerSkipped</td>
<td>Pointer to a bit field, one per channel, that tells if a trigger was skipped by the particular channel due to the module not being able to buffer an extra record.</td>
</tr>
<tr>
<td>Overflow</td>
<td>Pointer to where to tell if an data overflow have occurred (1) or not (0). An overflow may cause data loss.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ412
See also TriggeredStreamingGetNofRecordsCompleted()

24.2.15 TriggeredStreamingGetStatusV5()

virtual unsigned int TriggeredStreamingGetStatusV5 ( 
  unsigned char * ready, 
  unsigned int * norecordscompleted, 
  unsigned char * in_idle )

Gets the status of Triggered Streaming for V5 ADQs.

Parameters

<table>
<thead>
<tr>
<th>ready</th>
<th>Pointer to where to store whether data is available for readout. If this pointer is NULL, the value will not be written</th>
</tr>
</thead>
<tbody>
<tr>
<td>norecordscompleted</td>
<td>Pointer to where the to store the number of acquired records. If this pointer is NULL, the value will not be written</td>
</tr>
</tbody>
</table>
in_idle
Pointer to where to store whether the collection logic is idle. If this pointer is NULL, the value will not be written.

Returns 1 for successful operation and 0 for failure
Valid for ADQ214
See also TriggeredStreamingGetWaveformV5(), TriggeredStreamingSetupV5()

24.2.16 TriggeredStreamingGetWaveformV5()

virtual unsigned int TriggeredStreamingGetWaveformV5(
  short * waveform_data_short )

Collects one record for Triggered Streaming for V5 ADQs.
Readout will only succeed if data has been collected by the device. In manual rearm mode, TriggeredStreamingGetStatusV5() can be called to verify that data is available.

Parameters

waveform_data_short
Pointer to where the output is to be stored. The data is stored as signed 16-bit integers, and the user is responsible that enough memory is allocated at this pointer.

Returns 1 for successful operation and 0 for failure
Valid for ADQ214
See also TriggeredStreamingGetStatusV5(), TriggeredStreamingSetupV5()

24.2.17 TriggeredStreamingOneChannelSetup()

virtual unsigned int TriggeredStreamingOneChannelSetup(
  unsigned int SamplePerRecord,
  unsigned int NofPreTrigSamples,
  unsigned int NofTriggerDelaySamples,
  unsigned int ArmMode,
  unsigned int ReadOutSpeed,
  unsigned int Channel )

Sets the parameters for one channel Triggered Streaming on V5 ADQs. Special firmware is needed. Please contact SP Devices for more information.
Triggered Streaming will stream a record of fixed size when it is triggered.

Parameters
**SamplePerRecord**
The number of samples to collect per record. If streaming over USB, one should choose a number of samples per record that gives a record size that is a multiple of 512 bytes. Because each sample is 2 bytes, this means that the record sizes should be chosen with 256 sample increments.

**NofPreTrigSamples**
The number of samples to collect from before the trigger point

**NofTriggerDelaySamples**
The number of samples to wait before collecting data, after the trigger arrives

**ArmMode**
Selects the rearm strategy:
- 0: Manual rearm and readout
  - Manual mode will collect a record, signal to the user that it has been collected, and then wait for the user to read it. Readout is done using TriggeredStreamingGetWaveformV5(). After the waveform has been read, the user must rearm the Triggered Streaming block by calling the function TriggeredStreamingArmV5() before collecting a new record.
- 1: Auto rearm and readout
  - Auto mode will directly push an acquired record through the streaming interface and rearm itself to collect the next record. The user must read the data fast enough, or the streaming interface will overflow. TriggeredStreamingArmV5() must be called once, before the collection starts.

**ReadOutSpeed**
Is the readout speed from the Triggered Streaming block:
- 0: Slow readout speed (use for USB)
- 1: Medium readout speed
- 2: Fast readout speed (requires four lanes PXIe or very short records)

**Channel**
Specifies from which channel the data will be streamed:
- 0: Not supported. For multi channels Triggered Streaming please use TriggeredStreamingSetupV5 instead
- 1: Channel A.
- 2: Channel B.

Returns 1 for successful operation and 0 for failure

Note Manual rearm and readout will change the transfer settings of the device

Using Triggered Streaming excludes use of Packet Streaming, Waveform Averaging and MultiRecord

Valid for ADQ214

See also TriggeredStreamingArmV5(), TriggeredStreamingGetWaveformV5(), TriggeredStreamingDisarmV5()

24.2.18 TriggeredStreamingParseDataStream()
Parses a buffer filled with a single record of Triggeres Streaming data.

The parsed data is stored in buffers provided by the user.

**Parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>samples_per_record</td>
<td>The number of samples per channel in the buffer data_stream</td>
</tr>
<tr>
<td>data_stream</td>
<td>Pointer to the buffer containing the data that will be parsed</td>
</tr>
<tr>
<td>data_target</td>
<td>Pointer table to buffers where the outputs will be stored, one buffer per channel. For example, data_target[0] is a pointer to the channel A output buffer, and data_target[1] is a pointer to the channel B output buffer.</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

Valid for ADQ214

See also TriggeredStreamingGetWaveformV5()
### NofSamples

The number of samples to collect for each record. This value may be adjusted internally if necessary to align with the number of parallel samples per clock cycle for the product in use. This adjusted number of samples per record will also be what the record header will show. For ADQ412, which is a legacy product, triggered streaming only supports NofSamples of maximum 16384 samples in non-interleaved mode, and 32768 samples in interleaved mode. Furthermore, this record length must also be set in multiples of 32 samples, even though the number of parallel samples per clock cycle for ADQ412 is 8 in non-interleaved mode and 16 in interleaved mode.

### NofPreTrigSamples

The number of samples to collect from before the trigger arrives. When using pre-trigger, NofTriggerDelaySamples should be set to 0.

The pre-trigger value is internally rounded downwards to a multiple of a constant factor. This factor is also often called "number of parallel samples". See note below.

### NofTriggerDelaySamples

NofTriggerDelaySamples is the number of samples to ignore after the trigger arrives. When this is used, NofPreTrigSamples should be 0. Trigger delay affects the rearm time in a negative way. For fast triggering, NofTriggerDelaySamples should be set to 0.

The trigger delay value is internally rounded downwards to a multiple of a constant factor. This factor is also often called "number of parallel samples". See note below.

### ChannelsMask

Is used to specify from which channels to collect data. Bit 0 enables channel A, bit 1 channel B and so forth. For example on ADQ412, ChannelsMask = 0xF enables all channels while ChannelsMask = 0x3 enables only channel A and B.

Returns 1 for successful operation and 0 for failure

**Note** Triggered streaming is typically with the streaming interface. This is done by calling SetStreamStatus(0x7) after this function. It is also possible to redirect the data to DRAM, by instead calling SetStreamStatus(0x9). The data can then later be dumped using MemoryDump() and then read using MemoryShadow() and GetTriggeredStreamingRecords()

Number of parallel samples on supported products:

- ADQ412: In non-interleaved mode number of parallel samples is 8. In interleaved mode, number of parallel samples 16.
- ADQ7: In 1ch@10GSPS mode, number of parallel samples are 32. In 2ch@5GSPS mode, parallel samples are 16.
- ADQ12-1X, ADQ12-2X: Number of parallel samples are 8
- ADQ12-2C, ADQ12-4C: Number of parallel samples are 4
- ADQ12-2A, ADQ12-4A: Number of parallel samples are 2
- ADQ14-1X, ADQ14-2X: Number of parallel samples are 8
- ADQ14-2C, ADQ14-4C: Number of parallel samples are 4
- ADQ14-2A, ADQ14-4A: Number of parallel samples are 2

Valid for ADQ412, ADQ12, ADQ14, ADQ7

See also TriggeredStreamingArm(), GetTriggeredStreamingRecords(), SetStreamStatus()
25 Packet Streaming

Functions

- unsigned int PacketStreamingArm ()
  
  Arms Packet Streaming.

- unsigned int PacketStreamingDisarm ()

  Disarms Packet Streaming.

- unsigned int PacketStreamingSetup (unsigned int PacketSizeSamples, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples)

  Sets up the Packet Streaming block on the ADQ.

25.1 Detailed Description

Packet Streaming is a special streaming mode for ADQ214.

25.2 Function Documentation

25.2.1 PacketStreamingArm()

virtual unsigned int PacketStreamingArm ( )

Arms Packet Streaming.

Packets will be pushed on the data interface for each trigger

Returns 1 for successful operation and 0 for failure

Valid for ADQ214

See also PacketStreamingDisarm(), PacketStreamingSetup()

25.2.2 PacketStreamingDisarm()

virtual unsigned int PacketStreamingDisarm ( )

Disarms Packet Streaming.

After disarming, the Packet Streaming block is inactive and bypassed.

Returns 1 for successful operation and 0 for failure

Valid for ADQ214

See also PacketStreamingArm()
25.2.3 PacketStreamingSetup()

virtual unsigned int PacketStreamingSetup (  
    unsigned int PacketSizeSamples,  
    unsigned int NofPreTrigSamples,  
    unsigned int NofTriggerDelaySamples )

Sets up the Packet Streaming block on the ADQ.

Parameters

<table>
<thead>
<tr>
<th>PacketSizeSamples</th>
<th>The number of samples in each package</th>
</tr>
</thead>
<tbody>
<tr>
<td>NofPreTrigSamples</td>
<td>The number of samples to keep from before the trigger event</td>
</tr>
<tr>
<td>NofTriggerDelaySamples</td>
<td>The number of samples to hold off after the trigger event</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Note Packet size, pretrig and trigger delay may be chosen by 2 sample increments.

If streaming over USB is used, one should preferably choose a sample size of the waveform that equals a packet size of 512 bytes. Each averaged sample is 4 bytes, therefore sample sizes should be chosen as 128 sample increments. Also, best practice is to use SetTransferBuffers to complete each packet independently, i.e. set the transfer buffer size to the expected number of bytes of each packet.

The packet streaming block and waveform averaging block cannot be used at the same time.

Valid for ADQ214

See also PacketStreamingArm()

26 ADQDSP and DSU

Functions

- int GetDSPData ()
  
  Starts and waits for transfer of data from the device to host.

- int GetDSPDataNowait ()
  
  Starts transfer of data from the device to host.

- unsigned int GetNoftRecorderIP (unsigned int *answer)
  
  Get number of DSU disk controller instances (2×1ch has 2, all other has 1)

- unsigned int GetRecorderBytesPerAddress ()
  
  Gets the number of bytes per disk address.

- unsigned int GetSendLength ()
  
  Gets the current transfer length.

- int InitTransfer ()
Initiates and flush the data path.

- `unsigned int ReadDataFromDSU (unsigned int inst, unsigned int start_address, unsigned int nofbytes, unsigned char *data)`
  
  *Reads raw data from the DSU.*

- `unsigned int ResetFIFOPaths (unsigned int inst)`
  
  *Resets the data path for the DSU.*

- `unsigned int ResetRecorder (unsigned int inst)`
  
  *Resets the DSU.*

- `unsigned int RunRecorderSelfTest (unsigned int inst, unsigned int *inout_vector)`
  
  *Runs self-test of the DSU.*

- `int SetSendLength (unsigned int length)`
  
  *Sets the size of data transfers.*

- `unsigned int SetupDSUAcquisition (unsigned int inst, unsigned int start_address, unsigned int end_address)`
  
  *Setup data peer-to-peer recording.*

- `unsigned int StartDSUAcquisition (unsigned int inst)`
  
  *Start data peer-to-peer recording.*

- `int TrigOutEn (unsigned int en)`
  
  *Enable or disable Trigger In to Trigger Out propagation.*

- `int WaitForPCIeDMAFinish (unsigned int length)`
  
  *Waits for transfer from the device to complete.*

- `unsigned int WriteDataToDSU (unsigned int inst, unsigned int start_address, unsigned int nofbytes, unsigned char *data)`
  
  *Writes raw data to the DSU.*

- `unsigned int WriteToDataEP (unsigned int *pData, unsigned int length)`
  
  *Writes data to the device.*

### 26.1 Detailed Description

Because ADQDSP and DSU do not collect data, they have several specific functions. These are documented here.

### 26.2 Function Documentation

#### 26.2.1 GetDSPData()

```cpp
virtual int GetDSPData() {
    // Start and waits for transfer of data from the device to host.
    Data will be transferred from the internal memory buffers of the device to the host computer. This function will return when the transfer is completed.
```
Returns 1 for successful operation and 0 for failure
Valid for ADQDSP, DSU
See also GetDSPDataNowait(), SetSendLength(), InitTransfer()

26.2.2 GetDSPDataNowait()

virtual int GetDSPDataNowait ( )
Starts transfer of data from the device to host.
Data will be transferred from the internal memory buffers of the device to the host computer. This function will return before the transfer is completed. Use WaitForPCIeDMAFinish() before reading data to ensure that the transfer is complete
Returns 1 for successful operation and 0 for failure
Valid for ADQDSP, DSU
See also WaitForPCIeDMAFinish(), GetDSPData(), SetSendLength(), InitTransfer()

26.2.3 GetNofRecorderIP()

virtual unsigned int GetNofRecorderIP ( unsigned int * answer )
Get number of DSU disk controller instances (2x1ch has 2, all other has 1)
Parameters

<table>
<thead>
<tr>
<th>answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to return value</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for DSU

26.2.4 GetRecorderBytesPerAddress()

virtual unsigned int GetRecorderBytesPerAddress ( )
Gets the number of bytes per disk address.
Returns The number of bytes per disk address
Valid for DSU
26.2.5 GetSendLength()

virtual unsigned int GetSendLength()

Gets the current transfer length.

**Returns**  The current send length. This is the value that was previously set by SetSendLength()

Valid for ADQDSP, DSU

See also SetSendLength()

26.2.6 InitTransfer()

virtual int InitTransfer()

Initiates and flush the data path.

Must be issued before any transfer of data to or from the unit is made.

**Returns**  1 for successful operation and 0 for failure

Valid for ADQDSP, DSU

See also GetDSPData(), GetDSPDataNowait()

26.2.7 ReadDataFromDSU()

virtual unsigned int ReadDataFromDSU(unsigned int inst, unsigned int start_address, unsigned int nofbytes, unsigned char *data)

Reads raw data from the DSU.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>inst</strong></td>
<td>DSU controller instance number for DSU with multiple controllers, for others set to 0</td>
</tr>
<tr>
<td><strong>start_address</strong></td>
<td>Address on disc to start reading from</td>
</tr>
<tr>
<td><strong>nofbytes</strong></td>
<td>Number of bytes to be read. Must be a multiple of bytes per address returned by GetRecorderBytesPerAddress()</td>
</tr>
<tr>
<td><strong>data</strong></td>
<td>Pointer to where to store read data</td>
</tr>
</tbody>
</table>

**Returns**  1 for successful operation and 0 for failure

Valid for DSU
26.2.8  ResetFIFOPaths()

virtual unsigned int ResetFIFOPaths (  
    unsigned int inst )

Resets the data path for the DSU.

Parameters

inst
DSU controller instance number for DSU with multiple controllers, for others set to 0

Returns 1 for successful operation and 0 for failure
Valid for DSU
See also ResetRecorder()

26.2.9  ResetRecorder()

virtual unsigned int ResetRecorder (  
    unsigned int inst )

Resets the DSU.

Parameters

inst
DSU controller instance number for DSU with multiple controllers, for others set to 0

Returns 1 for successful operation and 0 for failure
Valid for DSU
See also ResetFIFOPaths()

26.2.10  RunRecorderSelfTest()

virtual unsigned int RunRecorderSelfTest (  
    unsigned int inst,  
    unsigned int * inout_vector )

Runs self-test of the DSU.

Parameters

inst
DSU controller instance number for DSU with multiple controllers, for others set to 0
### inout_vector

Test configuration and result vector. Declare as unsigned int with 16 elements.

- **Input:**
  - inout_vector[0] Start address
  - inout_vector[1] End address
  - inout_vector[other] don’t care. Set to zero

- **Output:**
  - inout_vector[1] Write speed in Mbytes/s
  - inout_vector[2] Read speed in Mbytes/s
  - inout_vector[other] Internal error indicators. Should be zero for successful test

**Returns**

1 for successful operation and 0 for failure

**Note**

This command will overwrite existing data with test pattern in the selected address range.

**Valid for** DSU

---

### 26.2.11 SetSendLength()

```cpp
virtual int SetSendLength ( 
    unsigned int length )
```

Sets the size of data transfers.

The length is used by GetDSPData() and GetDSPDataNowait()

**Parameters**

- **length**
  - The transfer length, given as the number of 32-bit words to transfer

**Returns**

1 for successful operation and 0 for failure

**Valid for** ADQDSP, DSU

**See also** GetDSPData(), GetDSPDataNowait()

### 26.2.12 SetupDSUAcquisition()

```cpp
virtual unsigned int SetupDSUAcquisition ( 
    unsigned int inst, 
    unsigned int start_address, 
    unsigned int end_address )
```

Setup data peer-to-peer recording.

**Parameters**
<table>
<thead>
<tr>
<th><strong>inst</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DSU controller instance number for DSU with multiple controllers, for others set to 0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>start_address</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address on disc to start writing at</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>end_address</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address on disc to stop writing at</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for DSU

### 26.2.13 StartDSUAcquisition()

```
virtual unsigned int StartDSUAcquisition ( unsigned int inst )
```

Start data peer-to-peer recording.

**Parameters**

<table>
<thead>
<tr>
<th><strong>inst</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DSU controller instance number for DSU with multiple controllers, for others set to 0</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for DSU

### 26.2.14 TrigOutEn()

```
vint TrigOutEn ( unsigned int en )
```

Enable or disable Trigger In to Trigger Out propagation.

**Parameters**

<table>
<thead>
<tr>
<th><strong>en</strong></th>
</tr>
</thead>
</table>
| Specifies whether the connection is enabled or not:  
  • 0: Disabled  
  • 1: Enabled |

Returns 1 for successful operation and 0 for failure
Valid for ADQDSP, DSU
26.2.15  WaitForPCIeDMAFinish()

virtual int WaitForPCIeDMAFinish( 
    unsigned int length )

Waits for transfer from the device to complete.

Parameters

<table>
<thead>
<tr>
<th>length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should be set to the same length as in SetSendLength()</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQDSP, DSU
See also GetDSPDataNowait(), SetSendLength()

26.2.16  WriteDataToDSU()

virtual unsigned int WriteDataToDSU ( 
    unsigned int inst, 
    unsigned int start_address, 
    unsigned int nofbytes, 
    unsigned char * data )

Writes raw data to the DSU.

Parameters

| inst |
|-----------------
| DSU controller instance number for DSU with multiple controllers, for others set to 0 |

| start_address |
|-----------------
| Address on disc to start writing at |

| nofbytes |
|-----------------
| Number of bytes to be written. Must be a multiple of bytes per address returned by GetRecorderBytesPerAddress() |

| data |
|-----------------
| Pointer to data that will be written |

Returns 1 for successful operation and 0 for failure
Valid for DSU

26.2.17  WriteToDataEP()

virtual unsigned int WriteToDataEP (
unsigned int * pData,
unsigned int length )

Writes data to the device.

Parameters

<table>
<thead>
<tr>
<th>pData</th>
<th>A Pointer to where the data is stored</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>the number of 32 bit words stored at pData. This length is not affected by SetSendLength()</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQDSP, DSU, SDR14

### 27 Micro-TCA Specific

#### Functions

- unsigned int SetDirectionMLVDS (unsigned char direction)
  
  *Sets the direction of the MTCA backplane LVDS pairs.*

- unsigned int SetEthernetPll (unsigned short refdiv, unsigned char useref2, unsigned char a, unsigned short b, unsigned char p, unsigned char vcooutdiv, unsigned char eth10_outdiv, unsigned char eth1_outdiv)
  
  *Sets the 10G and 1G Ethernet GTX clocks.*

- unsigned int SetEthernetPllFreq (unsigned char eth10_freq, unsigned char eth1_freq)
  
  *Sets the 10G and 1G Ethernet GTX clocks to predefined values.*

- unsigned int SetPointToPointPll (unsigned short refdiv, unsigned char useref2, unsigned char a, unsigned short b, unsigned char p, unsigned char vcooutdiv, unsigned char pp_outdiv, unsigned char pp-sync_outdiv)
  
  *Sets the point-to-point interface GTX clock.*

- unsigned int SetPointToPointPllFreq (unsigned char pp_freq)
  
  *Sets the point-to-point interface GTX clock to predefined values.*

- int SetTriggerMaskMLVDS (unsigned char mask)
  
  *Sets the mask for accepting triggers from MLVDS in MTCA.*

#### 27.1 Detailed Description

These functions are for units based on MTCA

#### 27.2 Function Documentation
27.2.1 SetDirectionMLVDS()

virtual unsigned int SetDirectionMLVDS(
    unsigned char direction )

Sets the direction of the MTCA backplane LVDS pairs.

The MTCA backplane contains eight LVDS pairs. This function may be used to set the direction of these.

Parameters

direction
A bit field where each bit that is 0 configures its pair as input and each bit that is 1 configures its pair as output. The bits and LVDS pairs are connected according to the list below:

- bit 0: R17
- bit 1: T17
- bit 2: R18
- bit 3: T18
- bit 4: R19
- bit 5: T19
- bit 6: R20
- bit 7: T20

Returns 1 for successful operation and 0 for failure

Note Only available for MTCA units

Valid for ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQ14, ADQ7, ADQ8

27.2.2 SetEthernetPll()

virtual unsigned int SetEthernetPll(
    unsigned short refdiv,
    unsigned char useref2,
    unsigned char a,
    unsigned short b,
    unsigned char p,
    unsigned char vcooutdiv,
    unsigned char eth10_outdiv,
    unsigned char eth1_outdiv )

Sets the 10G and 1G Ethernet GTX clocks.

This function provides an advanced way to set the frequencies. The function SetEthernetPllFreq() may be used to set predefined values in a more simple manner. Please refer to the AD9517-1 PLL datasheet for more info on parameters and allowed values.

Parameters

refdiv
Reference divider, 0 to 16383 are valid values
### 27.2.3 `SetEthernetPllFreq()`

```
virtual unsigned int SetEthernetPllFreq (  
    unsigned char eth10_freq,  
    unsigned char eth1_freq )
```

Sets the 10G and 1G Ethernet GTX clocks to predefined values.

This function provides a simple way to set the frequencies. For more direct control of the PLL, please refer to `SetEthernetPll()`.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>eth10_freq</code></td>
<td>Frequency value for the 10G clock. Allowed values: ETH10_FREQ_156_25MHZ (156.25 MHz), ETH10_FREQ_125MHZ (125 MHz)</td>
</tr>
<tr>
<td><code>eth1_freq</code></td>
<td>Frequency value for the 1G clock. Allowed values: ETH1_FREQ_156_25MHZ (156.25 MHz), ETH1_FREQ_125MHZ (125 MHz)</td>
</tr>
</tbody>
</table>

**Returns**

1 for successful operation and 0 for failure.

**Note**

Only available for MTCA units.

Valid for ADQ108, ADQ208, ADQ412, ADQ1600, SDR14
Returns 1 for successful operation and 0 for failure

Note Only available for MTCA units

Valid for ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQ7

See also SetEthernetPll()

27.2.4 SetPointToPointPll()

virtual unsigned int SetPointToPointPll (
    unsigned short refdiv,
    unsigned char useref2,
    unsigned char a,
    unsigned short b,
    unsigned char p,
    unsigned char vcooutdiv,
    unsigned char pp_outdiv,
    unsigned char ppsync_outdiv )

Sets the point-to-point interface GTX clock.

This function provides an advanced way to set the frequency. The function SetPointToPointPllFreq() may be used to set predefined values in a more simple manner. Please refer to the AD9517-1 PLL datasheet for more info on parameters and allowed values.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>refdiv</td>
<td>Reference divider, 0 to 16383 are valid values</td>
</tr>
<tr>
<td>useref2</td>
<td>Reference selector</td>
</tr>
<tr>
<td></td>
<td>- 0: 10MHz TCX0</td>
</tr>
<tr>
<td></td>
<td>- 1: Output from the clock reference mux</td>
</tr>
<tr>
<td>a</td>
<td>VCO feedback parameter A, 0 to 31 are valid values</td>
</tr>
<tr>
<td>b</td>
<td>VCO feedback parameter B, 0 to 4095 are valid values</td>
</tr>
<tr>
<td>p</td>
<td>VCO feedback parameter P, 2,4,8,16 and 32 are valid values</td>
</tr>
<tr>
<td>vcooutdiv</td>
<td>VCO divider, 1 to 6 are valid values</td>
</tr>
<tr>
<td>pp_outdiv</td>
<td>Point-to-point output divider, 0 to 32 are valid values</td>
</tr>
<tr>
<td>ppsync_outdiv</td>
<td>Point-to-point synched clock for 1G Ethernet output divider, 0 to 32 are valid values</td>
</tr>
</tbody>
</table>
27.2.5 SetPointToPointPllFreq()

virtual unsigned int SetPointToPointPllFreq (
    unsigned char pp_freq )

Sets the point-to-point interface GTX clock to predefined values.
This function provides a simple way to set the frequency. For more direct control of the PLL, please refer to SetPointToPointPll().

Parameters

pp_freq
Frequency value for the point-to-point interface GTX clock. Allowed values are: PP_FREQ_330MHZ (330 MHZ) PP_FREQ_250MHZ (250 MHZ) PP_FREQ_156.25MHZ (156.25 MHZ) PP_FREQ_125MHZ (125 MHZ)

Returns 1 for successful operation and 0 for failure
Note Only available for MTCA units
Valid for ADQ108, ADQ208, ADQ412, ADQ1600, SDR14, ADQ14-MTCA
See also SetPointToPointPll()
mask
Select which MLVDS inputs to trigger from (inputs are ORed together if several bits are set) The bits and LVDS pairs are connected according to the list below:

- bit 0: R17
- bit 1: T17
- bit 2: R18
- bit 3: T18
- bit 4: R19
- bit 5: T19
- bit 6: R20
- bit 7: T20

Returns 1 for successful operation and 0 for failure
Valid for ADQ7, ADQ14, ADQ8
See also SetDirectionMLVDS()

28 Peer-to-Peer Streaming

Functions

- unsigned int GetP2pSize (unsigned int channel)
  _Gets the current peer-to-peer package size._

- unsigned int GetP2pStatus (unsigned int *pending, unsigned int channel)
  _Gets the number of pending DMA transfers._

- unsigned long GetPhysicalAddress ()
  _Get the physical DMA address of the unit._

- unsigned int SendDataDev2Dev (unsigned long PhysicalAddress, unsigned int channel, unsigned int options)
  _Configures the device for transaction of one DMA package from one device to another._

- unsigned int SetP2pSize (unsigned int bytes, unsigned int channel)
  _Sets the peer-to-peer package size._

- unsigned int SetupDMADev2GPUDMA (unsigned int numBuffers, unsigned long long *physical_address_list, unsigned int *size_list)
  _Configures the device for DMA transfer to GPU using nvidia GPUDirect._

- unsigned int SetupDMADev2GPUDGMA (unsigned int numBuffers, unsigned long long *physical_address_list, unsigned int *size_list)
  _Configures the device for DMA transfer to GPU using DirectGMA._

- unsigned int SetupDMAP2p2D (unsigned long long *physical_address_list, unsigned long long *size_list, unsigned int record_len, unsigned int nof_rec_line, unsigned int nof_lines_buf, unsigned int stream_channels, unsigned int destination_type, void *options)
  _Configures the device for P2P DMA transfer with 2 dimensional addressing controlled by triggers._
- int SetUserTransferBuffers(uint32_t nofBuffers, size_t buffer_size, const uint64_t *const physical_address_list)
  Sets DMA to use user supplied transfer buffers.
- unsigned int WaitForGPUMarker(unsigned int *marker_list, unsigned int list_size, unsigned int marker, unsigned int timeout_ms)
  ADQ14: Wait for device to write the specified marker (greater or equal) when transfer data with peer-to-peer to GPU using nvidia GPUDirect.

28.1 Detailed Description

Peer-to-peer streaming may be used to stream data directly between units without intervention from the host.

28.2 Function Documentation

28.2.1 GetP2pSize()

virtual unsigned int GetP2pSize (unsigned int channel)

Gets the current peer-to-peer package size.

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The DMA channel to get the value for</td>
</tr>
</tbody>
</table>

Returns The current peer-to-peer package size, which was set by SetP2pSize()
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU
See also SetP2pSize()

28.2.2 GetP2pStatus()

virtual unsigned int GetP2pStatus (unsigned int *pending, unsigned int channel)

Gets the number of pending DMA transfers.

Parameters

<table>
<thead>
<tr>
<th>pending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointer to where the number of pending transfers is to be stored</td>
</tr>
</tbody>
</table>
### channel
The DMA channel to get the value from

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU,
See also SendDataDev2Dev()

#### 28.2.3 GetPhysicalAddress()

```c
virtual unsigned long GetPhysicalAddress ( )
```
Get the physical DMA address of the unit.
Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ1600, SDR14, ADQDSP, DSU
See also GetDSPDataNowait()

#### 28.2.4 SendDataDev2Dev()

```c
virtual unsigned int SendDataDev2Dev ( 
    unsigned long PhysicalAddress,
    unsigned int  channel,
    unsigned int  options )
```
Configures the device for transaction of one DMA package from one device to another.
This function may be called multipe times to enqueue DMA transfers before data is available in order to prepare the device.

**Parameters**

<table>
<thead>
<tr>
<th>PhysicalAddress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receivers address returned by GetPhysicalAddress()</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senders DMA channel to be used</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 1 for constant address (recommend). Set to 0 for incrementing address.</td>
</tr>
</tbody>
</table>

Returns 1 for valid parameters. Retuning 1 does not garantee that the transacation is registerd since this command does not know if the DMA queue is full. The number of pending DMA transfers must be checked with GetP2pStatus().

**Note** This command will not work on USB devices

Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU
28.2.5 SetP2pSize()

virtual unsigned int SetP2pSize (
    unsigned int bytes,
    unsigned int channel )

Sets the peer-to-peer package size.

Parameters

<table>
<thead>
<tr>
<th>param</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bytes</td>
<td>The package size to set in bytes</td>
</tr>
<tr>
<td>channel</td>
<td>The DMA channel to set the package size for</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ108, ADQ208, SDR14, ADQDSP, DSU

See also GetP2pSize()

28.2.6 SetupDMADev2GPUDDMA()

virtual unsigned int SetupDMADev2GPUDDMA ( 
    unsigned int num_buffers,
    unsigned long physical_address_list,
    unsigned int * size_list )

Configures the device for DMA transfer to GPU using nvidia GPUDirect.

Parameters

<table>
<thead>
<tr>
<th>param</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>num_buffers</td>
<td>Number of receiving buffers (including markers) setup on GPU.</td>
</tr>
<tr>
<td>physical_address_list</td>
<td>Array of physical addresses of receiving buffers, including marker buffers.</td>
</tr>
<tr>
<td>size_list</td>
<td>Array of receiving buffer sizes in bytes, including marker buffers that need to be set to 32 bytes.</td>
</tr>
</tbody>
</table>

Returns 1 on success or 0 on failure

Note This command will only work with PCIe device under Linux.

Valid for ADQ12, ADQ14-FWDT
28.2.7   SetupDMADev2GPUDGMA()

virtual unsigned int SetupDMADev2GPUDGMA ( 
    unsigned int num_buffers,
    unsigned long physical_address_list,
    unsigned int * size_list )

Configures the device for DMA transfer to GPU using DirectGMA.

Parameters

<table>
<thead>
<tr>
<th><strong>num_buffers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of receiving buffers (including markers) setup on GPU.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>physical_address_list</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Array of physical addresses of receiving buffers, including marker buffers.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>size_list</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Array of receiving buffer sizes in bytes, including marker buffers that need to be set to 32 bytes.</td>
</tr>
</tbody>
</table>

Returns 1 on success or 0 on failure

Note   This command will not work on USB devices

Valid for ADQ12, ADQ14 with PCIe gen3 option

28.2.8   SetupDMAP2p2D()

virtual unsigned int SetupDMAP2p2D ( 
    unsigned long physical_address_list,
    unsigned long size_list,
    unsigned int record_len,
    unsigned int nof_rec_line,
    unsigned int nof_lines_buf,
    unsigned int stream_channels,
    unsigned int destination_type,
    void * options )

Configures the device for P2P DMA transfer with 2 dimensional addressing controlled by triggers.

Parameters

<table>
<thead>
<tr>
<th><strong>physical_address_list</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Array of physical addresses of receiving buffers {data_0, marker_0, data_valid_0, data_1, marker_1, data_valid_1}.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>size_list</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Array of receiving buffer sizes in bytes, structured as physical_address_list, set data_valid size = 0 to disable data_valid writes. Marker size should always be 4 bytes.</td>
</tr>
</tbody>
</table>
record_len
Record length in samples.

nof_rec_line
Number of records per line (A-scans per B-scan).

nof_lines_buf
Number of lines per buffer (B-scans per buffer).

stream_channels
Number of channels to collect data from.

destination_type
Target device type, 0: Nvidia, 1: AMD.

options
Reserved for future use, set to NULL.

Returns 1 on success or 0 on failure

Note See ADQ7 GPU P2P users guide for detailed information.

Valid for ADQ7-2CH-FWDAQ

28.2.9 SetUserTransferBuffers()

virtual int SetUserTransferBuffers ( 
  uint32_t nofBuffers,
  size_t buffer_size,
  const uint64_t *const physical_address_list )

Sets DMA to use user supplied transfer buffers.

Parameters

nof_buffers
The number of buffers in physical_address_list

buffer_size
The buffer size in bytes, must be a multiple of 1024

physical_address_list
A list of physical addresses to transfer buffers

Returns 1 on success, 0 on failure

Valid for ADQ14, ADQ7
28.2.10  WaitforGPUMarker()

virtual unsigned int WaitforGPUMarker (
    unsigned int * marker_list,
    unsigned int list_size,
    unsigned int marker,
    unsigned int timeout_ms )

ADQ14: Wait for device to write the specified marker (greater or equal) when transfer data with peer-to-peer to GPU using nvidia GPUDirect.

ADQ7: Wait for device to write a marker when transfer data with peer-to-peer to GPU using nvidia GPUDirect.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>list_size</td>
<td>ADQ14: Number of marker buffers setup on GPU, ADQ7: Don't care.</td>
</tr>
<tr>
<td>marker_list</td>
<td>ADQ14: Array of marker values, ADQ7: pointer for returning marker value.</td>
</tr>
<tr>
<td>marker</td>
<td>marker value to wait for.</td>
</tr>
<tr>
<td>timeout_ms</td>
<td>Time out time in ms to for wait.</td>
</tr>
</tbody>
</table>

Returns 1 on success, 0 on failure, ADQ14: 2 on timeout

Note  This command will only work with PCIe device under Linux.

Valid for ADQ12, ADQ14-FWDT, ADQ7-2CH-FWDAQ

29  Arbitrary Waveform Generator

Functions

- unsigned int AWGArm (unsigned int dacId)
  Arms the AWG.

- unsigned int AWGAutoRearm (unsigned int dacId, unsigned int enable)
  Turns auto-rearm of the AWG on or off.

- unsigned int AWGContinuous (unsigned int dacId, unsigned int enable)
  Turns continuous mode of the AWG on or off.

- unsigned int AWGDIsarm (unsigned int dacId)
  Disarms the AWG.

- unsigned int AWGEnableSegments (unsigned int dacId, unsigned int enableSeg)

- unsigned int AWGPlaylistMode (unsigned int dacId, unsigned int mode)
  Sets the playlist mode.
- unsigned int AWGReset (unsigned int dacId)
  
  Resets the AWG controller.

- unsigned int AWGSegmentMalloc (unsigned int dacId, unsigned int segId, unsigned int length, unsigned char reallocate)
  
  Allocates segment space for an AWG segment.

- unsigned int AWGSetupTrigout (unsigned int dacId, unsigned int trigoutmode, unsigned int pulselength, unsigned int enableflags, unsigned int autorearm)
  
  Configures the way the AWG uses the PXIe trigger outputs.

- unsigned int AWGTrig (unsigned int dacId)
  
  Triggers the AWG.

- unsigned int AWGTrigMode (unsigned int dacId, unsigned int trigmode)
  
  Sets special trigger modes for the AWG.

- unsigned int AWGTrigoutArm (unsigned int dacId)
  
  Arms the trigger output of the specified AWG.

- unsigned int AWGWritePlaylist (unsigned int dacId, unsigned int NofPlaylistElements, unsigned int *index, unsigned int *write_mask, unsigned int *segId, unsigned int *NofLaps, unsigned int *nextIndex, unsigned int *triggerType, unsigned int *triggerLength, unsigned int *triggerPolarity, unsigned int *triggerSample, unsigned int *triggerULSignals)
  
  Writes one or more playlist items.

- unsigned int AWGWritePlaylistItem (unsigned int dacId, unsigned int index, unsigned int write_mask, unsigned int segId, unsigned int NofLaps, unsigned int nextIndex, unsigned int triggerType, unsigned int triggerLength, unsigned int triggerPolarity, unsigned int triggerSample, unsigned int triggerULSignals)
  
  Writes one playlist item.

- unsigned int AWGWriteSegment (unsigned int dacId, unsigned int segId, unsigned int enable, unsigned int NofLaps, unsigned int length, int *data)
  
  Writes a segment to the AWG memory.

- unsigned int AWGWriteSegments (unsigned int dacId, unsigned int NofSegs, unsigned int *segId, unsigned int *NofLaps, unsigned int *length, short int **data)
  
  Writes segments to the AWG memory.

- int SetDACNyquistBand (unsigned int dacId, unsigned int nyquistband)
  
  Allows optimization of DAC characteristics for operation in a specific nyquist band.

29.1 Detailed Description

The Arbitrary Waveform Generator (AWG) of the SDR14 is controlled using these functions.

29.2 Function Documentation
29.2.1  AWGArm()

virtual unsigned int AWGArm (   
  unsigned int  dacId )

Arms the AWG.
This preloads the first set of data from the DRAM so that the AWG is ready to output data as soon as it is triggered.

Parameters

<table>
<thead>
<tr>
<th>dacId</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also  AWGDisarm()

29.2.2  AWGAutoRearm()

virtual unsigned int AWGAutoRearm (   
  unsigned int  dacId,   
  unsigned int  enable )

Turns auto-rearm of the AWG on or off.
Auto-rearm mode will rearm the AWG immediately upon a finished readout cycle, to make it ready for a new trigger event. Allows the user to select which segments that are output before restarting.

Parameters

<table>
<thead>
<tr>
<th>dacId</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects whether the auto-rearm is enabled (enable = 1) or disabled (enable = 0)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also  AWGArm()

29.2.3  AWGContinuous()

virtual unsigned int AWGContinuous (   
  unsigned int  dacId,   
  unsigned int  enable )
Turns continuous mode of the AWG on or off.
If this mode is turned on, the AWG will start outputting data as soon as it is armed and triggered to start.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
<tr>
<td>enable</td>
<td>Selects whether the continuous mode is enabled (enable = 1) or disabled (enable = 0)</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure.

**Valid for** SDR14

**See also** AWGArm()

### 29.2.4 AWGDisarm()

**virtual unsigned int AWGDisarm ( unsigned int dacId )**

Disarms the AWG.

Turns of the AWG. A trigger event will not cause the AWG to output data once it is disarmed.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure.

**Valid for** SDR14

**See also** AWGArm()

### 29.2.5 AWGEnableSegments()

**virtual unsigned int AWGEnableSegments ( unsigned int dacId, unsigned int enableSeg )**

Allows the user to select which segments that are output before restarting.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
</tbody>
</table>
enableSeg
The highest segment number to output. All segments up to and including this number are output.

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also AWGWriteSegments()

29.2.6 AWGPlaylistMode()

virtual unsigned int AWGPlaylistMode(
    unsigned int dacId,
    unsigned int mode )

Sets the playlist mode.
Requires firmware support for the AWG Playlist mode.

Parameters

<table>
<thead>
<tr>
<th>dacId</th>
<th>Selects the AWG/DAC (1 or 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mode</td>
<td>- 0 for no playlist and 1 for playlist activation.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also AWGWritePlaylist()

29.2.7 AWGReset()

virtual unsigned int AWGReset(
    unsigned int dacId )

Resets the AWG controller.
The function resets the AWG controller to a known state

Parameters

| dacId          | Sets the AWG to reset (for DAC 1 or 2) |

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also `AWGWriteSegment()`

### 29.2.8 AWGSegmentMalloc()

```c
virtual unsigned int AWGSegmentMalloc ( 
    unsigned int dacId, 
    unsigned int segId, 
    unsigned int length, 
    unsigned char reallocate )
```

Allocates segment space for an AWG segment.

The function uses the end address of the preceding segment internally during allocation, so an allocation loop using this function should always go from segment 1 and upwards sequentially, never the other way around.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Sets the AWG/DAC to allocate for (1 or 2)</td>
</tr>
<tr>
<td>segId</td>
<td>Selects the segment number to allocate for</td>
</tr>
<tr>
<td>length</td>
<td>The number of samples to be allocated to the segment selected by segId. Must be a multiple of 16.</td>
</tr>
<tr>
<td>reallocate</td>
<td>Parameter that can be used to reallocate the memory mapping of all the segments following the one that is being modified. This is useful if only a few segments are to be reallocated and the user desires the update of the remaining segments to be done automatically. If, however, every segment in the entire AWG is to be reallocated within a loop by the user, the reallocate parameter should be set to 0 in order to avoid wasting computations.</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

Valid for SDR14

See also `AWGWriteSegment()`

### 29.2.9 AWGSetupTrigout()

```c
virtual unsigned int AWGSetupTrigout ( 
    unsigned int dacId, 
    unsigned int trigoutmode, 
    unsigned int pulselength, 
    unsigned int enableflags, 
    unsigned int autorearm )
```

Configures the way the AWG uses the PXIe trigger outputs.
The AWG may be used to output a trigger signal to the PXIe backplane, trigger output connector or similar.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
<tr>
<td>trigoutmode</td>
<td>Selects the mode:</td>
</tr>
<tr>
<td></td>
<td>• 0: Off</td>
</tr>
<tr>
<td></td>
<td>• 1: Pulse at the start of each segment</td>
</tr>
<tr>
<td></td>
<td>• 2: Pulse at the end of each segment</td>
</tr>
<tr>
<td></td>
<td>• 3 Use trigger in data (ignores pulselength and autorearm arguments)</td>
</tr>
<tr>
<td></td>
<td>• 3 Use playlist trigger data (ignores pulselength and autorearm arguments)</td>
</tr>
<tr>
<td>pulselength</td>
<td>The trigout pulse length, in 5ns increments (200 MHz clock period)</td>
</tr>
<tr>
<td>enableflags</td>
<td>A bitfield, where each bit enables output to the following:</td>
</tr>
<tr>
<td></td>
<td>• bit 0: Trigout connector</td>
</tr>
<tr>
<td></td>
<td>• bit 1: PXIe port1 trigger output</td>
</tr>
<tr>
<td>autorearm</td>
<td>Sets auto rearm on or off</td>
</tr>
<tr>
<td></td>
<td>• 0: autorearm off (requires manual rearm after every triggered trigout pulse)</td>
</tr>
<tr>
<td></td>
<td>• 1: autorearm on</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also EnablePXIeTrigout()

29.2.10 AWGTrig()

virtual unsigned int AWGTrig (  
    unsigned int dacId )  

Triggers the AWG.
This triggers the waveform sequencing for the specified channel.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2) [dacId == 3 will send a trigger to both channels]</td>
</tr>
</tbody>
</table>
Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also AWGArm(), AWGDisarm()

29.2.11 AWGTrigMode()

virtual unsigned int AWGTrigMode (  
    unsigned int dacId,  
    unsigned int trigmode )

Sets special trigger modes for the AWG.

Parameters

dacId
Selected the AWG/DAC (1 or 2)

trigmode
Trigger mode selection. These inputs are available:
- 0: Normal single-shot triggering.
- 1: Requires trigger event before starting each segment lap.
- 2: Seamless segment switching mode. This mode should be used in conjunction with infinite-laps programmed segments (see AWGWriteSegment description). Upon being triggered, the AWG will wait until the end of the current segment lap before seamlessly switching to the next segment. This allows the user to loop segments indefinitely, with the trigger acting as break for the loop, and without any junk data being output when the segment switch occurs.

Returns 1 for successful operation and 0 for failure

Note If seamless mode is enabled during the very first trigger that starts the AWG, the AWG will immediately seamlessly skip to segment 2. For this reason, always trigger the AWG without seamless mode initially, and then enable it for subsequent triggers.

Valid for SDR14

See also AWGSetTriggerEnable()

29.2.12 AWGTrigoutArm()

virtual unsigned int AWGTrigoutArm (  
    unsigned int dacId )

Arms the trigger output of the specified AWG.

If the AWG is to be rearmed after having triggered, an AWGTrigoutDisarm() command must first be issued.

Parameters
dacId
Selects the AWG/DAC (1 or 2)

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also AWGTrigoutDisarm()

29.2.13 AWGWritePlaylist()

virtual unsigned int AWGWritePlaylist ( 
    unsigned int dacId,
    unsigned int NofPlaylistElements,
    unsigned int * index,
    unsigned int * write_mask,
    unsigned int * segId,
    unsigned int * NofLaps,
    unsigned int * nextIndex,
    unsigned int * triggerType,
    unsigned int * triggerLength,
    unsigned int * triggerPolarity,
    unsigned int * triggerSample,
    unsigned int * triggerULSignals )

Writes one or more playlist items.
Requires firmware support for the AWG Playlist mode.

Parameters

daclid
Selects the AWG/DAC (1 or 2)

NofPlaylistElements
The number of playlist elements to transfer and describes the size of the pointer arguments. Failure to comply
with pointer table lengths may cause read failures in the system.

index
A pointer table to 32-bit unsigned integers that specifies playlist indices for each table entry

write_mask
A pointer table to 32-bit unsigned integers that masks what parameters are written for this specific playlist
element (15 writes all). Bit 0 = 1 to write segId information Bit 1 = 1 to write nextIndex information Bit 2 =
1 to write NofLaps information Bit 3 = 1 to write trigger information

segId
A pointer table to 32-bit unsigned integers that specifies the segment ID to play
**NofLaps**
A pointer table to 32-bit unsigned integers that specifies the number of laps for this playlist element. By setting bit 31 high in the NofLaps values, the *infinite-laps mode* is enabled. This will repeat the corresponding segment until the AWG is disarmed or a special trigger mode forces a segment switch (see AWGTrigMode()).

**nextIndex**
A pointer table to 32-bit unsigned integers that specifies which playlist index to play next.

**triggerType**
A pointer table to 32-bit unsigned integers that specifies trigger type (1 = no trigger, 2 = trigger once, 3 = trigger every lap).

**triggerLength**
A pointer table to 32-bit unsigned integers that specifies trigger duration in samples.

**triggerPolarity**
A pointer table to 32-bit unsigned integers that specifies the polarity of the trigger.

**triggerSample**
A pointer table to 32-bit unsigned integers that specifies at which sample the trigger should start.

**triggerULSignals**
A pointer table to 32-bit unsigned integers that specifies if signals should be sent to user logic or not.

Returns 1 for successful operation and 0 for failure. 
Valid for SDR14.

See also AWGPlaylistMode()

### 29.2.14 AWGWritePlaylistItem()

```cpp
template virtual unsigned int AWGWritePlaylistItem ( 
    unsigned int dacId, 
    unsigned int index, 
    unsigned int write_mask, 
    unsigned int segId, 
    unsigned int NofLaps, 
    unsigned int nextIndex, 
    unsigned int triggerType, 
    unsigned int triggerLength, 
    unsigned int triggerPolarity, 
    unsigned int triggerSample, 
    unsigned int triggerULSignals )
```

Writes one playlist item.

Requires firmware support for the AWG Playlist mode.

Parameters
**dacId**  
Selects the AWG/DAC (1 or 2)

**index**  
A 32-bit unsigned integers that specifies playlist index

**write_mask**  
A 32-bit unsigned integers that masks what parameters are written for this specific playlist element (15 writes all). Bit 0 = 1 to write segId information Bit 1 = 1 to write nextIndex information Bit 2 = 1 to write NofLaps information Bit 3 = 1 to write trigger information

**segId**  
A 32-bit unsigned integers that specifies the segment ID to play

**NofLaps**  
A 32-bit unsigned integers that specifies the number of laps for this playlist element. By setting bit 31 high in the NofLaps values, the *infinite-laps mode* is enabled. This will repeat the corresponding segment until the AWG is disarmed or a special trigger mode forces a segment switch (see AWGTrigMode()).

**nextIndex**  
A 32-bit unsigned integers that specifies which playlist index to play next

**triggerType**  
A 32-bit unsigned integers that specifies trigger type (1 = no trigger, 2 = trigger once, 3 = trigger every lap)

**triggerLength**  
A 32-bit unsigned integers that specifies trigger duration in nanoseconds (5ns steps are available)

**triggerPolarity**  
A 32-bit unsigned integers that specifies the polarity of the trigger

**triggerSample**  
A 32-bit unsigned integers that specifies at which sample the trigger should start

**triggerULSignals**  
A 32-bit unsigned integers that specifies if signals should be sent to user logic or not

---

Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also [AWGPlaylistMode()](#)

---

### 29.2.15 AWGWriteSegment()

```c
virtual unsigned int AWGWriteSegment (  
    unsigned int  dacId,  
    unsigned int  segId,  
    unsigned int  enable,  
    unsigned int  NofLaps,  
    unsigned int  length,  
```
int * data )

Writes a segment to the AWG memory.

The memory must first be allocated using AWGSegmentMalloc().

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dacId</td>
<td>Selects the AWG/DAC (1 or 2)</td>
</tr>
<tr>
<td>segId</td>
<td>Selects the segment number</td>
</tr>
<tr>
<td>enable</td>
<td>Deprecated. Use AWGEnableSegments() instead.</td>
</tr>
<tr>
<td>NofLaps</td>
<td>Sets the number of laps which the segment should be looped before the AWG continues to the next segment. By setting bit 31 high in this value, the <em>infinite-laps mode</em> is enabled. This will repeat the segment until the AWG is disarmed or a special trigger mode forces a segment switch (see AWGTrigMode()).</td>
</tr>
<tr>
<td>length</td>
<td>The number of samples to write. Must be a multiple of 16.</td>
</tr>
<tr>
<td>data</td>
<td>Pointer to the data to write. If this is a NULL pointer, all other settings will be set but no new data will be written. Data is required to be 16-bit short integers (14-bit two's complement integers with range -8192 to 8191, where the two 2 MSB bits (bits 15-14) are used for special feature encoding otherwise zeroed). Min DAC code is represented by hexadecimal 0x2000 (-8192) and max DAC code represented by hexadecimal code 0x1FFF (8191)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for SDR14

See also AWGSegmentMalloc(), AWGWriteSegments(), AWGTrigMode()
<table>
<thead>
<tr>
<th>dacId</th>
<th>Selects the AWG/DAC (1 or 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NofSegs</td>
<td>The number of segments to transfer and describes the size of the pointer arguments. Failure to comply with pointer table lengths may cause read failures in the system.</td>
</tr>
<tr>
<td>segId</td>
<td>A pointer table to 32-bit unsigned integers that specifies segment IDs for each table entry</td>
</tr>
<tr>
<td>NofLaps</td>
<td>A pointer table to 32-bit unsigned integers that sets the number of laps which the segment should be looped before the AWG continues to the next segment. By setting bit 31 high in the NofLaps values, the infinite-laps mode is enabled. This will repeat the corresponding segment until the AWG is disarmed or a special trigger mode forces a segment switch (see AWGTrigMode()).</td>
</tr>
<tr>
<td>length</td>
<td>A pointer table to 32-bit unsigned integers that specifies segment length for each table entry. The data lengths must be multiples of 16 samples.</td>
</tr>
<tr>
<td>data</td>
<td>A pointer table of memory sections of 16-bit short integers (14-bit two's complement integers with range -8192 to 8191, where the two 2 MSB bits (bits 15-14) are used for special feature encoding otherwise zeroed). Min DAC code is represented by hexadecimal 0x2000 (-8192) and max DAC code represented by hexadecimal code 0x1FFF (8191)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14
See also AWGSegmentMalloc(), AWGWriteSegment(), AWGTrigMode()

### 29.2.17 SetDACNyquistBand()

def SetDACNyquistBand(
    dacId,  # Select the DAC channel to change nyquist band for (1 or 2)
    nyquistband  # Select nyquist band to optimize for (1 or 2)
)

Allows optimization of DAC characteristics for operation in a specific nyquist band.

**Parameters**

<table>
<thead>
<tr>
<th>dacId</th>
<th>Select the DAC channel to change nyquist band for (1 or 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>nyquistband</td>
<td>Select nyquist band to optimize for (1 or 2)</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for SDR14TX
30 Digital Gain and Offset

Functions

- unsigned int GetGainAndOffset (unsigned char Channel, int *Gain, int *Offset)
  
  *Gets the current digital gain and offset for the individual ADC channel/core.*

- unsigned int SetGainAndOffset (unsigned char Channel, int Gain, int Offset)

*Sets the digital gain and offset for the individual ADC channel/core.*

30.1 Detailed Description

These functions may be used to fine-tune the digital gain and offset settings on some units.

30.2 Function Documentation

30.2.1 GetGainAndOffset()

```c
virtual unsigned int GetGainAndOffset ( 
    unsigned char Channel, 
    int * Gain, 
    int * Offset )
```

*Gets the current digital gain and offset for the individual ADC channel/core.*

**Parameters**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Channel</strong></td>
<td>The channel/ADC-core for which to get the Gain and Offset parameters. This parameter is not always equivalent to an analog input channel of an ADQ unit, depending on product model</td>
</tr>
<tr>
<td><strong>Gain</strong></td>
<td>Pointer to where to store the gain value output</td>
</tr>
<tr>
<td><strong>Offset</strong></td>
<td>Pointer to where to store the offset value output</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

**Note** On some ADQ model, an analog input channel might be governed by multiple ADC cores, thus changing gain and offset for one core alone, without proper calibration, will introduce gain/offset error into the captured data. If you don't have special reasons to change the default value, just use the factory setting instead!

The settings are relative to the factory calibration. To overrate this relativeness, set bit 7 of the channel argument to 1.

**Valid for** ADQ114, ADQ112, ADQ214, ADQ212, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

**See also** SetGainAndOffset()
30.2.2 SetGainAndOffset()

```cpp
virtual unsigned int SetGainAndOffset(
    unsigned char Channel,
    int Gain,
    int Offset )
```

Sets the digital gain and offset for the individual ADC channel/core.

The gain and offset block is located directly after the sampling circuit. This function can be used if it is desired to change factory calibrated values for this block.

**Parameters**

<table>
<thead>
<tr>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>The channel/ADC-core for which to set the Gain and Offset parameters. This parameter is not always equivalent to an analog input channel of an ADQ unit, depending on product model.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>The gain value to set, normalized to 10 bits. A value of 1024 corresponds to unity gain. The allowed range is -32768 to 32767.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>The offset value to set. An offset value of 8 will change the offset by 8 codes (multiplied by the gain setting). The allowed range is -32768 to 32767.</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

**Note** On some ADQ model, an analog input channel might be governed by multiple ADC cores, thus changing gain and offset for one core alone, without proper calibration, will introduce gain/offset error into the captured data. If you don’t have special reasons to change the default value, just use the factory setting instead!

The settings are relative to the factory calibration. To overrate this relativeness, set bit 7 of the channel argument to 1.

**Valid for** ADQ114, ADQ112, ADQ214, ADQ212, ADQ1600, SDR14, ADQ12, ADQ14, ADQ7, ADQ8

**See also** GetGainAndOffset()

31 Miscellaneous Functions

**Functions**

- int EnableTestPatternPulseGenerator (unsigned int channel, unsigned int enable)

  Enables the test pattern pulse generator.

- int EnableTestPatternPulseGeneratorOutput (unsigned int enable_bitmask)

  Enables output of the test pattern pulse generator on TRIG and/or SYNC connector.

- unsigned int GetNofBytesPerSample (unsigned int *bytes_per_sample)
Gets the number of bytes needed to store each sample.

- void *GetPtrData(unsigned int channel)
  Gives a pointer for data access.

- unsigned int GetTransferTimeout(unsigned int *timeout)
  Reads out the current timeout setting for data transfers.

- unsigned int MemoryDump(unsigned int StartAddress, unsigned int EndAddress, unsigned char *buffer, unsigned int *bufctr, unsigned int transfersize)
  Transfers data from the ADQ:s DRAM without parsing.

- unsigned int MemoryDumpRecords(unsigned int StartRecord, unsigned int NofRecords, unsigned char *buffer, unsigned int *bufctr, unsigned int transfersize)
  Transfers data from the ADQ:s DRAM without parsing, but with respect to record alignments rather than raw addresses.

- unsigned int MemoryShadow(void *MemoryArea, unsigned int ByteSize)
  Sets the API to use a DRAM shadow for parsing data.

- unsigned int SetTestPatternConstant(int value)
  Sets a constant value for some of the test pattern modes.

- unsigned int SetTestPatternMode(int mode)
  Sets a specified test pattern mode.

- unsigned int SetTransferTimeout(unsigned int value)
  Sets the timeout for data transfers.

- int SetupTestPatternPulseGenerator(unsigned int channel, int baseline, int amplitude, unsigned int pulse_period, unsigned int pulse_width, unsigned int nof_pulses_in_burst, unsigned int nof_bursts, unsigned int burst_period, int mode)
  Sets up the test pattern pulse generator.

- int SetupTestPatternPulseGeneratorPRBS(unsigned int channel, unsigned int prbs_id, unsigned int seed, int offset, unsigned int scale_bits)
  Sets up the PRBS module for the test pattern pulse generator.

### 31.1 Detailed Description

These functions contain functions that are not part of a specific function block.

### 31.2 Function Documentation

#### 31.2.1 EnableTestPatternPulseGenerator()

```c
virtual int EnableTestPatternPulseGenerator(
    unsigned int channel,
    unsigned int enable)
```

Enables the test pattern pulse generator.
Parameters

| channel | The target channel, indexed 1-4. |
| enable  | 1 to enable, 0 to disable. |

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8

31.2.2 EnableTestPatternPulseGeneratorOutput()

virtual int EnableTestPatternPulseGeneratorOutput ( unsigned int enable_bitmask )
Enables output of the test pattern pulse generator on TRIG and/or SYNC connector.
Parameters

| enable_bitmask | A bitmask specifying if the output is active or not. |
|               | • Bit 0: TRIG |
|               | • Bit 1: SYNC |

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14

31.2.3 GetNofBytesPerSample()

virtual unsigned int GetNofBytesPerSample ( unsigned int * bytes_per_sample )
Gets the number of bytes needed to store each sample.
The sample size is affected by SetDataFormat().
Parameters

| bytes_per_sample | Pointer to where the number bytes per sample is returned |

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also SetDataFormat()

### 31.2.4 GetPtrData()

```cpp
virtual void* GetPtrData ( unsigned int channel )
```

Gives a pointer for data access.

**ADQ14, ADQ7:** Gives a pointer to transfer buffer with the specified index. Others: Gives a pointer to the data array of a channel.

**Parameters**

- **channel**
  - ADQ14, ADQ7: Buffer index to get pointer to. Others: Channel to get pointer to.

**Returns** Pointer to the specified object.

**Valid for** ADQ412, ADQ1600, ADQ108, ADQ208, ADQ112, ADQ114, ADQDSP, SDR14, DSU, ADQDSP, ADQ14, ADQ7

See also CollectDataNextPage()

### 31.2.5 GetTransferTimeout()

```cpp
virtual unsigned int GetTransferTimeout ( unsigned int* timeout )
```

Reads out the current timeout setting for data transfers.

**Parameters**

- **timeout**
  - The timeout value, specified in milliseconds. 0 is infinite timeout.

**Returns** 1 for successful operation and 0 for failure

**Valid for** ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also SetTransferBuffers(), SetTransferTimeout()

### 31.2.6 MemoryDump()

```cpp
virtual unsigned int MemoryDump (  )
```
unsigned int StartAddress,
unsigned int EndAddress,
unsigned char * buffer,
unsigned int * bufctr,
unsigned int transfersize )

Transfers data from the ADQ’s DRAM without parsing.

This will simply store the raw data in the PC RAM for later parsing. May be used to improve transfer rate. For MultiRecord and Triggered Streaming, MemoryShadow() can be used to make the parsing functions use the dumped data. when data can be parsed at a later time.

Parameters

StartAddress
The first address to read. The number of bits per address is:
- ADQ214, ADQ114, ADQ212, ADQ112: 128 bits
- SDR14: 256 bits
- Other: 512 bits Must be a multiple of 32

EndAddress
The last address to read. The number of bits per address is:
- ADQ214, ADQ114, ADQ212, ADQ112: 128 bits
- SDR14: 256 bits
- Other: 512 bits Must be a multiple of 32, minus one (for example, 63 is valid)

buffer
A pointer to where the output will be stored. The user is responsible for allocating this memory.

bufctr
A pointer to where the number of bytes collected will be stored

transfersize
Is the transfer size to use. Set to NULL to use the default value.

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ212, ADQ108, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ208, ADQ12, ADQ14

See also MemoryShadow(), MultiRecordSetupGP()

31.2.7 MemoryDumpRecords()

virtual unsigned int MemoryDumpRecords ( 
    unsigned int StartRecord,
    unsigned int NofRecords,
    unsigned char * buffer,
    unsigned int * bufctr,
    unsigned int transfersize )
Transfers data from the ADQ:s DRAM without parsing, but with respect to record alignments rather than raw addresses.

This will simply store the raw data in the PC RAM for later parsing. May be used to improve transfer rate. For MultiRecord and Triggered Streaming, MemoryShadow() can be used to make the parsing functions use the dumped data. when data can be parsed at a later time. Required size of buffer (shadow RAM) is obtained by calling MultiRecordSetupGP(). This function will return an error if MultiRecordSetupGP() has not been called in advance.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StartRecord</td>
<td>The first record to include in raw read.</td>
</tr>
<tr>
<td>NofRecords</td>
<td>The number of records to read</td>
</tr>
<tr>
<td>buffer</td>
<td>A pointer to where the output will be stored. The user is responsible for allocating this memory.</td>
</tr>
<tr>
<td>bufctr</td>
<td>A pointer to where the number of bytes collected will be stored</td>
</tr>
<tr>
<td>transfersize</td>
<td>Is the transfer size to use. Set to NULL to use the default value.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure.

Valid for ADQ412, ADQ212, ADQ108, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ208

See also MemoryShadow(), MultiRecordSetupGP()
Returns 1 for successful operation and 0 for failure

Note To retrieve product/settings dependent sizes to know which DRAM addresses to read, you may use the MultiRecordSetupGP function. To parse the data at a later stage use this MemoryShadow() of the API, together with GetData().

This function is typically used for MultiRecord, but may also be used when if data from Triggered Streaming has been redirected to DRAM and dumped with MemoryDump.

Valid for ADQ412, ADQ212, ADQ108, ADQ112, ADQ114, ADQ214, SDR14, ADQ1600, ADQ208

See also MemoryDump(), GetData(), GetTriggeredStreamingRecords()

31.2.9 SetTestPatternConstant()

virtual unsigned int SetTestPatternConstant ( int value )

Sets a constant value for some of the test pattern modes.

Parameters

<table>
<thead>
<tr>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The constant value to set</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ108, ADQ112, ADQ114, ADQ1600, ADQ208, ADQ212, ADQ214, ADQ412, SDR14

See also SetTestPatternMode()

31.2.10 SetTestPatternMode()

virtual unsigned int SetTestPatternMode ( int mode )

Sets a specified test pattern mode.

Parameters

<table>
<thead>
<tr>
<th>mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>The selected mode. One of these values are available:</td>
</tr>
<tr>
<td>• 0: Normal operation mode (direct data)</td>
</tr>
<tr>
<td>• 1: Test mode with user constant output (ADQ214,ADQ114 only)</td>
</tr>
<tr>
<td>• 2: Count upwards</td>
</tr>
<tr>
<td>• 3: Count downwards</td>
</tr>
<tr>
<td>• 4: Count alternating upwards and downwards</td>
</tr>
<tr>
<td>• 5 to 6: Reserved</td>
</tr>
<tr>
<td>• 7: Mode for merging GPIO with data (unpacked 16-bit modes for ADQ214, ADQ114 only)</td>
</tr>
</tbody>
</table>
Returns 1 for successful operation and 0 for failure
Valid for ADQ108, ADQ112, ADQ114, ADQ1600, ADQ208, ADQ212, ADQ214, ADQ412, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
See also SetTestPatternConstant()

31.2.11 SetTransferTimeout()

virtual unsigned int SetTransferTimeout(
    unsigned int value
)
Sets the timeout for data transfers.
This is used in situations where certain data amounts are expected over the streaming interface at certain update rates. This value should always be significantly higher than the expected data rate, to avoid problems with the communication link.

Parameters

<table>
<thead>
<tr>
<th>value</th>
</tr>
</thead>
</table>
The timeout value, specified in milliseconds. Set to 0 for infinite timeout. Default is:
- ADQ14: 60000 ms
- ADQ12: 60000 ms
- ADQ7: Infinite
- Others: 1000 ms

Returns 1 for successful operation and 0 for failure
Valid for ADQ412, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQ1600, SDR14, ADQDSP, DSU, ADQ12, ADQ14, ADQ7, ADQ8
See also SetTransferBuffers(), GetTransferTimeout()

31.2.12 SetupTestPatternPulseGenerator()

virtual int SetupTestPatternPulseGenerator(
    unsigned int channel,
    int baseline,
    int amplitude,
    unsigned int pulse_period,
    unsigned int pulse_width,
    unsigned int nof_pulses_in_burst,
    unsigned int nof_bursts,
    unsigned int burst_period,
    unsigned int mode
)
Sets up the test pattern pulse generator.

Parameters
| **channel** | The target channel, indexed 1-4. |
| **baseline** | The pulse resting value. |
| **amplitude** | The pulse 'high' value, offset from the baseline. |
| **pulse_period** | The pulse period in samples. |
| **pulse_width** | The pulse width in samples (i.e. the area where the value is baseline+amplitude). |
| **nof_pulses_in_burst** | The number of pulses in a burst, if left zero, the burst mode is disabled. |
| **nof_bursts** | The number of bursts, if left zero, the burst pattern will keep repeating. |
| **burst_period** | The burst period in number of samples, must be greater than the pulse period. If left zero, the burst mode is disabled. |
| **mode** | The pulse generator mode. One of these values are available: |
| | • 0: Bypassed |
| | • 1: Regular pulse output. |
| | • 2: PRBS width mode. |
| | • 3: PRBS amplitude mode. |
| | • 4: PRBS width & amplitude mode. |
| | • Bit 3: Activate trigger sensing mode. |
| | • Bit 4: Activate PRBS signal noise. |

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8

### 31.2.13 SetupTestPatternPulseGeneratorPRBS()

```c
virtual int SetupTestPatternPulseGeneratorPRBS (
    unsigned int  channel,
    unsigned int  prbs_id,
    unsigned int  seed,
    int            offset,
    unsigned int  scale_bits )
```

Sets up the PRBS module for the test pattern pulse generator.
Parameters

channel
The target channel, indexing starts at 1.

prbs_id
The target PRBS within the channel. Valid ID are:
- 0: PRBS applied as the pulse width.
- 1: PRBS applied as the pulse amplitude.
- 2: PRBS applied as noise to the signal.

seed
The seed value for the PRBS. Valid range is [0,16383].

offset
The offset value, applied after the scaling. Valid range is [-32768, 32767].

scale_bits
Number of right shifts to perform. Valid range is [0, 15].

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8

32 DevKit Functions

Functions

- unsigned int BypassUserLogic (unsigned int ul_target, unsigned int bypass)
  
  Bypasses current user logic design.

- unsigned int EnableUseOfUserHeaders (unsigned int mode, unsigned int api_value)
  
  Enables connection from DevKit or API for the User ID header field in user logic.

- int EnableUserLogicFilter (unsigned int channel, unsigned int enable)
  
  Enable filter located in User Logic 1.

- const char * GetUserLogicPartNumber ()
  
  Gets the part number of the user logic block on the firmware.

- int ReadBlockUserRegister (int ul_target, uint32_t start_addr, uint32_t *data, uint32_t num_bytes, uint32_t options)
  
  Read a set of 32-bit registers from the ADQ DevKit user logic.

- int ReadUserRegister (int ul_target, uint32_t regnum, uint32_t *retval)
  
  Reads a 32-bit register in the ADQ DevKit.

- int ResetUserLogicFilter (unsigned int channel)
  
  Reset filter located in User Logic 1.

- int SetUserLogicFilter (unsigned int channel, void *coefficients, unsigned int length, unsigned int format, unsigned int rounding_method)
Set filter coefficients for the FIR filter located in User Logic 1.

- int WriteBlockUserRegister (int ul_target, uint32_t start_addr, uint32_t *data, uint32_t num_bytes, uint32_t options)

  Write a set of 32-bit registers in the ADQ DevKit user logic.

- int WriteUserRegister (int ul_target, uint32_t regnum, uint32_t mask, uint32_t data, uint32_t *retval)

  Write a 32-bit register in the ADQ DevKit.

32.1 Detailed Description

These functions are used to interface the user logic block for customers of the ADQ DevKit.

32.2 Function Documentation

32.2.1 BypassUserLogic()

virtual unsigned int BypassUserLogic (
  unsigned int ul_target,
  unsigned int bypass )

Bypasses current user logic design.

Parameters

**ul_target**
Select between different user logic blocks when there exists several on the digitizer. Different settings may be used on different units:

- V6 family (ADQ412/ADQ108/ADQ208/ADQ1600/ADQDSP/SDR14)
  - 0: Main FPGA user logic
- ADQ12 / ADQ14 / ADQ7 / ADQ8
  - 1: User logic 1
  - 2: User logic 2

**bypass**
Bypass setting

- 0: Do not bypass
- 1: Bypassed

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ108, ADQ208, ADQDSP, SDR14, ADQ12, ADQ14, ADQ7, ADQ8
### 32.2.2 EnableUseOfUserHeaders()

```c
virtual unsigned int EnableUseOfUserHeaders (
    unsigned int mode,
    unsigned int api_value )
```

Enables connection from DevKit or API for the User ID header field in user logic.

**Parameters**

<table>
<thead>
<tr>
<th>mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>User ID mode</td>
</tr>
<tr>
<td>0: Take User ID from User Logic 2</td>
</tr>
<tr>
<td>1: Take User ID from inserted api_value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>api_value</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-bit User ID value (ignored when mode == 0)</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14

### 32.2.3 EnableUserLogicFilter()

```c
virtual int EnableUserLogicFilter (
    unsigned int channel,
    unsigned int enable )
```

Enable filter located in User Logic 1.

**Parameters**

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel ID, indexed from 1 and upwards.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set to 1 to enable, 0 to bypass.</td>
</tr>
</tbody>
</table>

**Returns** 1 for successful operation and 0 for failure

Valid for ADQ7, ADQ8

### 32.2.4 GetUserLogicPartNumber()

```c
virtual const char* GetUserLogicPartNumber ( )
```

Gets the part number of the user logic block on the firmware.

This part number may be modified from inside the DevKit, using either the set_userlogicpartnumber command
while building the DevKit, or by modifying the assignment statements to the registers in the user logic module. This allows the DevKit user to keep track of different firmware types and revisions.

Returns A NULL-terminated string, consisting of three three-digit numbers followed by a revision letter. For example, 400-013-011-A.

Note Older firmware revisions do not contain part number registers and will always be read out as 000-000-000-A.

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU

See also GetNGCPartNumber()

32.2.5 ReadBlockUserRegister()

virtual int ReadBlockUserRegister ( int ul_target, uint32_t start_addr, uint32_t *data, uint32_t num_bytes, uint32_t options )

Read a set of 32-bit registers from the ADQ DevKit user logic.

Performs a read of several values at once from the 32-bit user logic input registers.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ul_target</td>
<td>Select between different user logic blocks when there exists several on the digitizer. Different settings may be used on different units:</td>
</tr>
<tr>
<td></td>
<td>• ADQ12 / ADQ14 / ADQ7</td>
</tr>
<tr>
<td></td>
<td>– 1: User logic 1</td>
</tr>
<tr>
<td></td>
<td>– 2: User logic 2</td>
</tr>
<tr>
<td>start_addr</td>
<td>Specifies which register to start reading at (from 0 and up)</td>
</tr>
<tr>
<td>data</td>
<td>Pointer for storing the read data</td>
</tr>
<tr>
<td>num_bytes</td>
<td>Data size in bytes (4 x number of registers).</td>
</tr>
<tr>
<td>options</td>
<td>• 0: Do not increment address. All values are read from start_addr. This is useful for FIFO interfaces.</td>
</tr>
<tr>
<td></td>
<td>• 1: Increment address. Used for registers and RAM interfaces.</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure
Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also WriteBlockUserRegister()

32.2.6 ReadUserRegister()

```cpp
virtual int ReadUserRegister (
    int ul_target,
    uint32_t regnum,
    uint32_t * retval )
```

Reads a 32-bit register in the ADQ DevKit.

**Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ul_target</td>
<td>Select between different user logic blocks when there exists several on the digitizer. Different settings may be used on different units:</td>
</tr>
<tr>
<td>regnum</td>
<td>Specifies which register to read (from 0 and up)</td>
</tr>
<tr>
<td>retval</td>
<td>Pointer to where the function will store the read result</td>
</tr>
</tbody>
</table>

**Returns**

1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also WriteUserRegister()

32.2.7 ResetUserLogicFilter()

```cpp
virtual int ResetUserLogicFilter ( 
    unsigned int channel )
```

Reset filter located in User Logic 1.

Resetting the filter will reload the default coefficient set.

**Parameters**
channel
Channel ID, indexed from 1 and upwards.

Returns 1 for successful operation and 0 for failure
Valid for ADQ7, ADQ8

32.2.8 SetUserLogicFilter()

virtual int SetUserLogicFilter (  
    unsigned int channel,  
    void * coefficients,  
    unsigned int length,  
    unsigned int format,  
    unsigned int rounding_method )

Set filter coefficients for the FIR filter located in User Logic 1.

Parameters

channel
Channel ID, indexed from 1 and upwards.

coefficients
Array of filter coefficients. The array is interpreted as either an array of unsigned integers or as an array of floating point numbers, according to the value of format. In the case of floating point numbers, the coefficients are subject to rounding, specified by rounding_method.

length
The length of the filter coefficient array. The value is checked against the number of coefficients.

format
The format of the coefficient array. Valid values are:
- 0: 32-bit unsigned integers. By default, the values are interpreted as fixed point numbers using a 16-bit 2's complement representation with 14 fractional bits.
- 1: Single-precision floating point numbers. The values are subject to rounding.

rounding_method
The rounding method used when the format is set to single-precision floating point numbers. Valid values are:
- 0: Round to nearest, tie away from zero.
- 1: Round to nearest, tie towards zero.
- 2: Round to nearest, tie to even.

Returns 1 for successful operation and 0 for failure
Valid for ADQ7, ADQ8
32.2.9  WriteBlockUserRegister()

virtual int WriteBlockUserRegister (  
  int ul_target,  
  uint32_t start_addr,  
  uint32_t *data,  
  uint32_t num_bytes,  
  uint32_t options )

Write a set of 32-bit registers in the ADQ DevKit user logic.

Performs a write of several values at once to the 32-bit user logic input registers.

Parameters

\begin{itemize}
  \item \textbf{ul\_target}  
  Select between different user logic blocks when there exists several on the digitizer. Different settings may be used on different units:
  \begin{itemize}
    \item ADQ12 / ADQ14 / ADQ7  
      \begin{itemize}
        \item 1: User logic 1  
        \item 2: User logic 2  
      \end{itemize}
  \end{itemize}
  \item \textbf{start\_addr}  
  Specifies which register to start writing at (from 0 and up)
  \item \textbf{data}  
  Pointer to write data.
  \item \textbf{num\_bytes}  
  Data size in bytes (4 x number of registers).
  \item \textbf{options}  
  \begin{itemize}
    \item 0: Do not increment address. All values are written to start\_addr. This is useful for FIFO interfaces.
    \item 1: Increment address. Used for registers and RAM interfaces.
  \end{itemize}
\end{itemize}

Returns 1 for successful operation and 0 for failure

Valid for ADQ12, ADQ14, ADQ7, ADQ8

See also ReadBlockUserRegister()

32.2.10  WriteUserRegister()

virtual int WriteUserRegister (  
  int ul_target,  
  uint32_t regnum,  
  uint32_t mask,  
  uint32_t data,  
  uint32_t *retval )
Write a 32-bit register in the ADQ DevKit.
Performs a masked write of a value to one of the 32-bit user logic input registers. Also re-reads the data and returns it for user validation.

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ul_target</td>
<td>Select between different user logic blocks when there exists several on the digitizer. Different settings may be used on different units:</td>
</tr>
<tr>
<td></td>
<td>• V6 family (ADQ412/ADQ108/ADQ208/ADQ1600/ADQDSP/ADQDSU/SDR14)</td>
</tr>
<tr>
<td></td>
<td>– 0: Main FPGA user logic</td>
</tr>
<tr>
<td></td>
<td>• V5 family (ADQ214/ADQ114/ADQ212/ADQ112)</td>
</tr>
<tr>
<td></td>
<td>– 0: Alg FPGA user logic</td>
</tr>
<tr>
<td></td>
<td>– 1: Comm FPGA user logic</td>
</tr>
<tr>
<td></td>
<td>• ADQ12 / ADQ14 / ADQ7 / ADQ8</td>
</tr>
<tr>
<td></td>
<td>– 1: User logic 1</td>
</tr>
<tr>
<td></td>
<td>– 2: User logic 2</td>
</tr>
<tr>
<td>regnum</td>
<td>Specifies which register to write (from 0 and up)</td>
</tr>
<tr>
<td>mask</td>
<td>Performs a negative mask, i.e. only the bits that are zero in the mask will be written. You can use a mask of 0xFFFFFFFF to simply check the current value of an input register without overwriting it.</td>
</tr>
<tr>
<td>data</td>
<td>The data to write. The data will be first be masked by the mask parameter.</td>
</tr>
<tr>
<td>retval</td>
<td>Pointer to where the function will store its re-read result from of the register</td>
</tr>
</tbody>
</table>

Returns 1 for successful operation and 0 for failure

Valid for ADQ412, ADQ1600, ADQ212, ADQ108, ADQ208, ADQ112, ADQ114, ADQ214, ADQDSP, SDR14, DSU, ADQ12, ADQ14, ADQ7, ADQ8

See also ReadUserRegister()

33 Configuration

Functions

- int GetParameters (enum ADQParameterId id, void *const parameters)
- int InitializeParameters (enum ADQParameterId id, void *const parameters)
- int SetParameters (void *const parameters)
- int ValidateParameters (const void *const parameters)
33.1 Detailed Description

These functions are used to configure the digitizer's parameters before proceeding with the data acquisition step.

33.2 Function Documentation

33.2.1 GetParameters()

```c
virtual int GetParameters ( 
    enum ADQParameterId id, 
    void *const parameters )
```

See document 20-2465

Parameters

<table>
<thead>
<tr>
<th>id</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameters</td>
</tr>
</tbody>
</table>

Returns If the operation is successful, the return value is set to the size of the retrieved parameter set. Negative values are error codes.

Valid for ADQ8

33.2.2 InitializeParameters()

```c
virtual int InitializeParameters ( 
    enum ADQParameterId id, 
    void *const parameters )
```

See document 20-2465

Parameters

<table>
<thead>
<tr>
<th>id</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameters</td>
</tr>
</tbody>
</table>

Returns If the operation is successful, the return value is set to the size of the initialized parameter set. Negative values are error codes.

Valid for ADQ8
33.2.3 SetParameters()

virtual int SetParameters ( 
  void *const parameters )

See document 20-2465

Parameters

parameters

Returns If the operation is successful, the return value is set to the size of the written parameter set. Negative values are error codes.

Valid for ADQ8

33.2.4 ValidateParameters()

virtual int ValidateParameters ( 
  const void *const parameters )

See document 20-2465

Parameters

parameters

Returns If the operation is successful, the return value is set to the size of the validated parameter set. Negative values are error codes.

Valid for ADQ8

34 Data Acquisition

Data Structures

- struct ADQRecord
  
  Structure that represents a record buffer for Gen3 digitizers. See document 20-2465. More...

Functions

- int ReturnRecordBuffer (int channel, void *buffer)
- int StartDataAcquisition (void)
• int StopDataAcquisition (void)
• int64_t WaitForRecordBuffer (int *channel, void **buffer, int timeout, struct ADQDataReadoutStatus *status)

34.1 Detailed Description

These functions are used to initiate, terminate and control the data acquisition process.

34.2 Data Structure Documentation

34.2.1 struct ADQRecord

Structure that represents a record buffer for Gen3 digitizers. See document 20-2465.

See also WaitForRecordBuffer, ReturnRecordBuffer

Valid for ADQ8

<table>
<thead>
<tr>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>header</td>
</tr>
<tr>
<td>size</td>
</tr>
</tbody>
</table>

34.3 Function Documentation

34.3.1 ReturnRecordBuffer()

virtual int ReturnRecordBuffer ( int channel, void * buffer )

See document 20-2465

Parameters

channel

buffer

Returns ADQ_EOK if successful, negative values are error codes.

Valid for ADQ8
34.3.2 StartDataAcquisition()

virtual int StartDataAcquisition ()
  
See document 20-2465

Returns ADQ_EOK if successful, negative values are error codes.

Valid for ADQ8

34.3.3 StopDataAcquisition()

virtual int StopDataAcquisition ()
  
See document 20-2465

Returns ADQ_EOK if successful, ADQ_EINTERRUPTED may be an expected return value if an unbounded acquisition is interrupted. Otherwise, negative values are error codes.

Valid for ADQ8

34.3.4 WaitForRecordBuffer()

virtual int64_t WaitForRecordBuffer ( int *channel, void **buffer, int timeout, struct ADQDataReadoutStatus *status )

See document 20-2465

Parameters

<table>
<thead>
<tr>
<th>channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>buffer</td>
</tr>
<tr>
<td>timeout</td>
</tr>
<tr>
<td>status</td>
</tr>
</tbody>
</table>

Returns If the operation is successful, the return value is the size of the record buffer's data payload in bytes. The value zero indicates a successful operation, but that only the status parameter can be read. Negative values are error codes.
Valid for ADQ8

35 Internal Use Only

Functions

- int ADCCalibrate()
- int ADCReg(unsigned char addr, unsigned char adc, unsigned int val)
- int ArmInternal001(void)
- int ATDEnableTestPattern(unsigned int enable)
- int ATDSetupTestPattern(unsigned int record_length, unsigned int number_of_records)
- unsigned int AWGSetInterpolationFilter(unsigned int dacId, unsigned char interpolation_filter)
  
  \textit{Chooses the interpolation filter to use.}
- unsigned int BootAdqFromFlash(unsigned int addr)
- unsigned int BreakRecorderCommand(unsigned int inst)
- int CollectDataNextPageWithPrefetch(unsigned int prefetch)
- int ConManSPI(unsigned char cmd, void *wr_buf, unsigned int wr_buf_len, void *rd_buf, unsigned int rd_buf_len)
- unsigned int DACSpiRead(unsigned char channel, unsigned char address, unsigned char *data)
- unsigned int DACSpiWrite(unsigned char channel, const unsigned char address, const unsigned char data)
- int DebugCmd(unsigned int cmd, unsigned int arg1, unsigned int arg2, unsigned int arg3, float arg4, unsigned int *ptr1, unsigned int *ptr2, unsigned int *ptr3)
- int DebugParsePacketDataStreaming(void *raw_data_buffer, unsigned int raw_data_size, void **target_buffers, void **target_headers, unsigned int *bytes_added, unsigned int *headers_added, unsigned int *header_status, unsigned char channels_mask)
- int DisarmInternal002(void)
- unsigned int DisconnectInputs(unsigned int channelmask)
- int EnableFixedShift(unsigned int channel, unsigned int enable)
- int EnableRecordSegmenter(unsigned int channel, unsigned int enable)
- unsigned int FX2ReadRequest(unsigned int requestcode, unsigned int value, unsigned int index, long len, char *buf)
- unsigned int FX2SetRetryLimit(unsigned int retry_limit)
- unsigned int FX2WriteRequest(unsigned int requestcode, unsigned int value, unsigned int index, long len, char *data)
- unsigned int GetBcdDevice()
- unsigned int GetComFlashEnableBit()
- int GetConManSPIVersion(unsigned int *major, unsigned int *minor)
- int GetDeviceSNConManSPI(char *device_sn)
- unsigned int GetDeviceStatus(unsigned int *status)
- unsigned int GetDRAMPhysEndAddr(unsigned int *DRAM_MAX_END_ADDRESS)
- unsigned int GetFPGAApart(unsigned int fpganum, char *partstr)
- unsigned int GetFPGASpeedGrade(unsigned int fpganum, unsigned int *sgrade)
• unsigned int GetFPGATempGrade (unsigned int fpganum, char *tgrade)
• unsigned int GetNextDSURecordingAddress (unsigned int inst, unsigned int *next_address)
• unsigned int GetNofFPGAs ()
• unsigned int GetNofHwChannels ()
• unsigned int GetPageCount ()
• unsigned int GetRecorderDiskStatus (unsigned int inst, unsigned int diskno, unsigned int *status)
• unsigned int GetRecorderStatus (unsigned int inst, unsigned int *status)
• int GetStreamErrors (unsigned int channel, unsigned int *error)
• int GetSystemManagerType ()
• unsigned int GetTrigType ()
• unsigned int GetUSB3Config (unsigned int option, unsigned int *value)
• int GetUSBFirmwareVersion (unsigned int *major, unsigned int *minor)
• int GetWriteCount (unsigned int *write_count)
• int GetWriteCountMax (unsigned int *write_count)
• int HasConManSPIFeature (const char *const feature_name)
• unsigned int InvalidateCache ()
• unsigned int IsBootloader ()
• int IsVirtualDevice ()
• unsigned int MeasureInputOffset (unsigned int channel, int *value)
• int MeasureSupplyVoltage (unsigned int sensor_num, float *value)
• int OCTDebug (unsigned int arg1, unsigned int arg2, unsigned int arg3)
• unsigned int OffsetDACspiWrite (unsigned char channel, unsigned int data)
• unsigned int ParseEEPROMBlock (char *blockname, char *map_version, unsigned int buffer_len, unsigned char *buffer, unsigned int i2c_addr)
• unsigned int PlotAssist (const char *MemoryName, void *MemoryPointer, unsigned int MemoryMaxBytesCount, unsigned int PlotSamplesCount, const char *Format)
• unsigned int ProcessorFlashControl (unsigned char cmd, unsigned int data)
• unsigned int ProcessorFlashControlData (unsigned int *data, unsigned int len)
• unsigned int ra (const char *regname)
• unsigned int ReadADCCalibration (unsigned char ADCNo, unsigned short *calibration)
• unsigned int ReadAlgoRegister (unsigned int addr)
• unsigned int ReadDBI2C (unsigned int addr, unsigned int nbytes)
• unsigned int ReadEEPROM (unsigned int addr, unsigned int i2c_addr)
• unsigned int ReadI2C (unsigned int addr, unsigned int nbytes)
• int ReadInternal000 (unsigned int *arg0)
• unsigned int ReadRegister (unsigned int addr)
• unsigned int RebootALGFPGAFromPrimaryImage ()
• unsigned int RebootCOMFPGAFromSecondaryImage (unsigned int PCIeAddress, unsigned int PromAddress)
• unsigned int RegisterNameLookup (const char *regname, unsigned int *address, unsigned int allow_assertion)
• unsigned int ReloadPCIeConfig (unsigned int *pci_space)
• unsigned int ResetCalibrationStateADQ412DC ()
- int ResetWriteCountMax()
- unsigned int RxSetDecOffsetDac(unsigned char channel, unsigned short dacValue)
- unsigned int RxSetIfGainDac(unsigned char channel, unsigned char dacValue)
- unsigned int RxSetLinearityDac(unsigned short dacValue)
- unsigned int RxSetLoFilter(unsigned char filter)
- unsigned int RxSetLoOut(unsigned char mode)
- unsigned int RxSetRfPath(unsigned char mode)
- unsigned int RxSetVcomDac(unsigned char channel, unsigned short dacValue)
- unsigned int SendLongProcessorCommand(unsigned int command, unsigned int addr, unsigned int mask, unsigned int data)
- unsigned int SendProcessorCommand(int command, int argument)
- unsigned int SendProcessorCommand(unsigned int command, unsigned int addr, unsigned int mask, unsigned int data)
- unsigned int SendRecorderCommand(unsigned int inst, unsigned char cmd, unsigned int arg1, unsigned int arg2, unsigned int *answer)
- unsigned int SetADCClockDelay(unsigned int adcnum, float delayval)
- unsigned int SetAttenuators(unsigned int channel, unsigned int attmask)
- unsigned int SetBiasDACPercentage(unsigned int channel, float percent)
- int SetClockReferenceDelayDAC(unsigned int dacvalue)
- unsigned int SetDACPercentage(unsigned int spi_addr, unsigned int output_num, float percent)
- int SetDelayLineValues(int samplerate, unsigned int linear_interpolation)
- int SetDelayLineValuesDirect(unsigned int delay1, unsigned int delay2)
- unsigned int SetDMATest(unsigned int option, unsigned int value)
- int SetFixedShiftValue(unsigned int channel, unsigned int shift)
- unsigned int SetOffsetCompensationDAC(unsigned int channel, unsigned int daccode)
- int SetPreTrigWords(unsigned int PreTrigWords)
- int SetSWTrigValue(float samples)
- unsigned int SetTimeoutFlush(unsigned int stream_timeout, unsigned int packet_timeout)
  
  Activate automatic flush after timeout.
- int SetTrigCompareMask1(unsigned int TrigCompareMask)
- int SetTrigCompareMask2(unsigned int TrigCompareMask)
- int SetTrigLevel1(int TrigLevel)
- int SetTrigLevel2(int TrigLevel)
- int SetTrigMask1(unsigned int TrigMask)
- int SetTrigMask2(unsigned int TrigMask)
- int SetTrigPreLevel1(int TrigLevel)
- int SetTrigPreLevel2(int TrigLevel)
- int SetupInternal000(unsigned int arg0, int arg1, int arg2, unsigned int arg3, unsigned int arg4, unsigned int arg5, unsigned int arg6)
- int SetupInternal004(unsigned int arg0, unsigned int arg1, unsigned int arg2, int arg3)
- int SetupInternal005(unsigned int arg0)
- int SetupInternal006(unsigned int arg0)
int SetupInternal007 (unsigned int *arg0)
int SetupInternal008 (unsigned int arg0)
int SetupInternal009 (unsigned int arg0)
int SetupInternal010 (unsigned int arg0)
unsigned int SetupInternal011 (unsigned int arg0, unsigned int arg1, unsigned int arg2, unsigned int arg3)
int SetupRecordSegmenter (unsigned int channel, unsigned int *seg_length, unsigned int *gap_length, unsigned int nof_segments)
unsigned int SetUSB3Config (unsigned int option, unsigned int value)
int SetWordsAfterTrig (unsigned int WordsAfterTrig)
int SetWordsPerPage (unsigned int WordsPerPage)
int SmTransaction (uint16_t cmd, const void *const wr_buf, size_t wr_buf_len, void *const rd_buf, size_t rd_buf_len)
int SpiSend (unsigned char addr, const char *data, unsigned char length, unsigned int negedge, unsigned int *ret)
unsigned int StorePCIeConfig (unsigned int *pci_space)
unsigned int SynthDisableAutoLevel (unsigned char channel, unsigned char mode)
unsigned int SynthGetAlcDac (unsigned char channel, unsigned int *dacValue)
unsigned int SynthSetAlcDac (unsigned char channel, unsigned int dacValue)
unsigned int SynthSetAlcMode (unsigned char channel, unsigned char mode)
unsigned int SynthSetDeviceStandby (unsigned char channel, unsigned char standbyStatus)
unsigned int SynthSetReferenceDac (unsigned int dacValue)
unsigned int TriggeredStreamingSetupGatedAcq (unsigned int NofRecords, unsigned int NofPreTrigSamples, unsigned int NofTriggerDelaySamples, unsigned int NofPostTrigSamples, unsigned char Channels-Mask)
unsigned int TxSetDcOffsetDac (unsigned char channel, unsigned short dacValue)
unsigned int TxSetFrequency (unsigned long long int frequency)
unsigned int TxSetLinearityDac (unsigned char channel, unsigned short dacValue)
unsigned int TxSetLoFilter (unsigned char filter)
unsigned int TxSetLoOut (unsigned char mode)
unsigned int TxSetRfPath (unsigned char mode)
int USBLinkupTest (unsigned int retries)
unsigned int USBReConnect ()
unsigned int WaveformAveragingStartReadout ()
unsigned int WriteADCCalibration (unsigned char ADCNo, unsigned short *calibration)
unsigned int WriteADQATTStateManual (unsigned int channel, unsigned int relay16, unsigned int relay8, unsigned int ptap8, unsigned int ptap4, unsigned int ptap2, unsigned int ptap1, unsigned int ptap05, unsigned int ptap025)
unsigned int WriteAlgoRegister (unsigned int addr, unsigned int mask, unsigned int data)
unsigned int WriteDBI2C (unsigned int addr, unsigned int nbytes, unsigned int data)
unsigned int WriteEEPROM (unsigned int addr, unsigned int data, unsigned int accesscode, unsigned int i2c_addr)
unsigned int WriteI2C (unsigned int addr, unsigned int nbytes, unsigned int data)
int WriteInternal003 (void *arg0, unsigned int arg1)
• unsigned int WriteReadI2C (unsigned int addr, unsigned int rbytes, unsigned int wbytes, unsigned int wrdata)
• unsigned int WriteRegister (unsigned int addr, unsigned int mask, unsigned int data)

35.1 Detailed Description

These functions are for internal use by SP Devices, and are listed here for completeness.

36 Deprecated Functions

Functions

• void ADQControlUnit_DeleteADQ108 (void *adq_cu_ptr, int adq108_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ112 (void *adq_cu_ptr, int adq112_num)
• void ADQControlUnit_DeleteADQ114 (void *adq_cu_ptr, int adq114_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ1600 (void *adq_cu_ptr, int adq1600_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ208 (void *adq_cu_ptr, int adq208_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ212 (void *adq_cu_ptr, int adq212_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ214 (void *adq_cu_ptr, int adq214_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQ412 (void *adq_cu_ptr, int adq412_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteADQDSP (void *adq_cu_ptr, int ADQDSP_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteDSU (void *adq_cu_ptr, int ADQDSP_num)
  Use ADQControlUnit_DeleteADQ() instead.
• void ADQControlUnit_DeleteSDR14 (void *adq_cu_ptr, int sdr14_num)
  Use ADQControlUnit_DeleteADQ() instead.
• unsigned int AWGmalloc (unsigned int dacId, unsigned int LengthSeg1, unsigned int LengthSeg2, unsigned int LengthSeg3, unsigned int LengthSeg4)
  Use AWGSegmentMalloc() instead.
• unsigned int CollectRecord (int RecordNumber)
  Use GetData() instead.
• unsigned int DisableWFATriggerCounter ()
  Do not use.
- unsigned int EnableWFATriggerCounter()
  
  Do not use.
- unsigned int GetBufferSize()
  
  No usage necessary.
- unsigned int GetBufferSizePages()
  
  No usage necessary.
- unsigned int GetDataMultiRecordSetup(unsigned int NumberOfRecords, unsigned int SamplesPerRecord)
  
  Use MultiRecordSetup() instead.
- unsigned int GetInterleavingIPFrequencyCalibrationMode(unsigned char IPInstanceAddr, unsigned int *freqcalflag)
  
  No usage necessary.
- int GetLvlTrigFlank()
  
  Use GetLvlTrigEdge instead.
- unsigned long long GetMaxBufferSize()
  
  No usage necessary.
- unsigned int GetMaxBufferSizePages()
  
  No usage necessary.
- unsigned int *GetMultiRecordHeader()
  
  Use GetDataWH instead.
- int *GetPtrDataChA()
  
  Use GetPtrData() instead.
- int *GetPtrDataChB()
  
  Use GetPtrData() instead.
- unsigned int GetRxFifoOverflow()
  
  No usage necessary.
- int GetTrigged()
  
  Use GetAcquired instead.
- unsigned int GetTriggedAll()
  
  Use GetAcquiredAll() instead.
- unsigned int MultiRecordGetRecord(int RecordNumber)
  
  Use GetData() instead.
- int SetAlgoNyquistBand(unsigned int band)
  
  No usage necessary.
- int SetAlgoStatus(int status)
  
  Use SetInterleavingIPBypassMode() instead.
- int SetBufferSize(unsigned int samples)
  
  Use MultiRecordSetup() instead.
- int SetBufferSizePages(unsigned int pages)
  
  No usage necessary.
• int SetBufferSizeWords (unsigned int words)
  
  No usage necessary.

• unsigned int SetInterleavingIPFrequencyCalibrationMode (unsigned char IPInstanceAddr, unsigned int freqcalmode)
  
  No usage necessary.

• int SetNofBits (unsigned int NofBits)
  
  Use SetDataFormat() instead.

• int SetSampleWidth (unsigned int SampleWidth)
  
  Use SetDataFormat() instead.

• int SetTriggerHoldOffSamples (unsigned int TriggerHoldOffSamples)
  
  Use SetTriggerDelay() instead.

• unsigned int SetWFANumberOfTriggers (unsigned int number_of_triggers)
  
  Do not use.

• unsigned int StartWFATriggerCounter ()
  
  Do not use.

36.1 Detailed Description

These functions are deprecated