

# DAQFlex

## Software User's Guide

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# Table of Contents

## Preface

<b>About this User's Guide .....</b>	<b>5</b>
What you will learn from this user's guide.....	5
Conventions in this user's guide .....	5
Where to find more information .....	5

## Chapter 1

<b>Introducing DAQFlex Software .....</b>	<b>6</b>
Platform support.....	6
Hardware requirements .....	7
Installing the DAQFlex software library .....	7
Windows 8, Windows 7, Windows Vista, and Windows XP.....	7
Windows CE .....	8
Mac OS X.....	8
Linux.....	8

## Chapter 2

<b>Using DAQFlex Software.....</b>	<b>9</b>
Reading and writing software-paced I/O .....	11
Reading an analog input channel.....	12
Writing to an analog output channel .....	13
Reading a digital bit .....	14
Writing to a digital bit.....	15
Reading a digital port .....	16
Writing to a digital port.....	17
Reading a counter input channel .....	18
Reading hardware-paced I/O.....	19
ReadScanData() parameters .....	20
Internal buffer .....	20
CallbackType .....	20
Writing hardware-paced I/O.....	22
WriteScanData() parameters .....	23
Internal buffer .....	23

## Chapter 3

<b>DAQFlex Software Reference .....</b>	<b>24</b>
DaqDeviceManager class .....	24
DaqDeviceManager.GetDeviceNames() .....	24
DaqDeviceManager.CreateDevice() .....	25
DaqDeviceManager.ReleaseDevice() .....	26
DaqDevice class .....	26
DaqDevice.SendMessage() .....	26
DaqDevice.ReadScanData().....	27
DaqDevice.WriteScanData() .....	28
DaqDevice.EnableCallback() .....	28
InputScanCallback Delegate .....	29
DaqDevice.DisableCallback() .....	29
DaqDevice.GetErrorMessage() .....	29
DaqDevice.GetSupportedMessages() .....	30

## Chapter 4

<b>DAQFlex Message Reference .....</b>	<b>31</b>
DAQFlex components .....	31
Programming messages.....	32
AI .....	32

AICAL .....	39
AIQUEUE .....	39
AISCAN .....	42
AITRIG .....	50
AO .....	52
AOCAL.....	55
AOSCAN .....	55
AOTRIG .....	60
CTR.....	60
DEV .....	61
DIO.....	65
TMR .....	68
Reflection messages.....	72
AI .....	72
AISCAN .....	76
AITRIG .....	80
AO .....	81
AOSCAN .....	83
CTR.....	86
DIO.....	88
TMR .....	89
<b>Chapter 5</b>	
<b>FlexTest Utility.....</b>	<b>92</b>
FlexTest user interface .....	93
Messagelog window.....	93
Using FlexTest.....	93
Read and display scan data .....	93
Calibrate a device .....	94
DAQFlex message reference.....	95
<b>Chapter 6</b>	
<b>C# and VB Example Programs .....</b>	<b>96</b>
Default installation path.....	96
Building the DAQFlex example programs.....	96
<b>Chapter 7</b>	
<b>Hardware Reference .....</b>	<b>98</b>
USB-200 Series .....	99
USB-1208FS-Plus .....	102
USB-1408FS-Plus .....	105
USB-1608FS-Plus .....	108
USB-1608G Series .....	111
USB-2001-TC .....	115
USB-2408 Series .....	116
USB-7202.....	120
USB-7204.....	122

## About this User's Guide

### What you will learn from this user's guide

This user's guide explains how to install, configure, and use the DAQFlex Framework communication protocol.

### Conventions in this user's guide

#### For more information

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

**Caution!** Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

**bold text**      **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes.

*italic text*      *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

### Where to find more information

Additional information about DAQFlex software is available on our website at [www.mccdaq.com](http://www.mccdaq.com). You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: [kb.mccdaq.com](http://kb.mccdaq.com)
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support
- Fax: 508-946-9500 to the attention of Tech Support
- Email: [techsupport@mccdaq.com](mailto:techsupport@mccdaq.com)

# Introducing DAQFlex Software

DAQFlex is a framework that combines a small footprint driver with a message-based command protocol. It is used to develop data acquisition applications that can be deployed across multiple operating systems and custom embedded systems. The DAQFlex protocol greatly simplifies driver and application development. All DAQ operations are programmed through a common command interface composed of a cross-platform *application programming interface* (API) and open-source driver.

The DAQFlex framework consists of a software API, DAQFlex device driver, and the DAQ device message engine. The message engine parses and converts the DAQFlex message-based command set into DAQ-specific commands that control the device and process data.

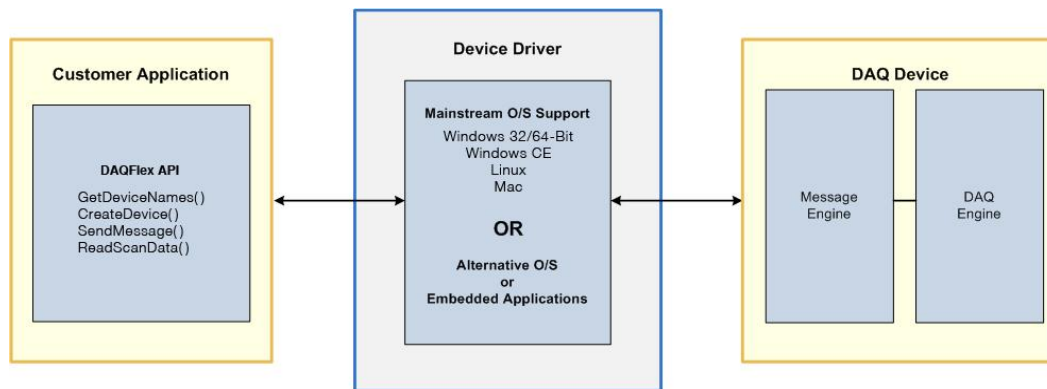


Figure 1. DAQFlex Framework

A DAQFlex program sends DAQFlex methods to the driver. The driver sends the encapsulated messages to the data acquisition device. The device interprets the message using the message engine, and sets its corresponding attributes using the DAQ engine. The data acquisition device then returns the requested data to the DAQFlex driver, which returns the data in an array (ScanData) to the program.

DAQFlex software includes the software API, device driver, FlexTest utility, and example programs.

- [Platform Support and Hardware Requirements](#)
- [Installing the DAQFlex Software Library](#)
- [Using DAQFlex Software](#)
- [DAQFlex Software Reference](#)
- [DAQFlex Message Reference](#)
- [FlexTest Utility](#)
- [C# and VB .NET Example programs](#)
- [DAQFlex Hardware Reference](#)

## Platform support

You can run the DAQFlex communication protocol on a computer running one of the following operating systems and software:

- Microsoft Windows (32-bit or 64-bit)
  - Windows 8
  - Windows 7
  - Windows Vista
  - Windows XP
  - Microsoft .NET® Framework 2.0 or later

- Microsoft Windows CE
  - Development* requirements:
    - Microsoft Windows XP/Vista operating system
    - Microsoft Visual Studio 2008 or later
    - Microsoft .NET Compact Framework 3.5
    - Microsoft ActiveSync
  - Deployment* requirements:
    - Windows CE 5.0
    - X86 or ARM CPU
    - Microsoft .NET Compact Framework 3.5
    - DaqFlex.dll
    - Mcusb.dll
    - Mcwinceusb.dll
- Macintosh (32-bit or 64-bit)
  - MAC OS X
  - Leopard 10.5 or later
  - Mono Framework 2.0 or later
  - libusb user-mode driver version 1.0.0.0
- Linux (32-bit or 64-bit)
  - Linux (2.4 kernel or later)
  - Mono Framework 2.0 or later
  - libusb user-mode driver version 1.0.0.0

## Hardware requirements

- Intel Pentium 4, 1 GHz or higher
- Minimum of 512 MG of RAM (1 GB or higher recommended)
- Video card with 128 MB memory
- Video display with 800 x 600 resolution or greater, and 256 colors or greater
- Microsoft-compatible mouse

## Installing the DAQFlex software library

DAQFlex software operates with standard drivers for Windows, Mac, and Linux. Follow the procedure below specific to your operating system to install the DAQFlex software.

### Windows 8, Windows 7, Windows Vista, and Windows XP

1. Go to the DAQFlex download page at [www.mccdaq.com/DAQFlexDL](http://www.mccdaq.com/DAQFlexDL) and select the **Windows 32/64-bit** option.
2. Run the Windows **DAQFlex.exe** installer file.
3. Follow the installer instructions.

Connect your DAQFlex device after installing the software. You can run the **FlexTest.exe** test application, or build and run the C# or VB .NET example programs included in the installation using ExampleBuilder or Visual Studio (version 2005 or later).

Refer to the *C# and VB Example Programs* chapter on page 96 for instructions on running the DAQFlex example programs, and to the *Hardware Reference* chapter on page 98 for the API components and messages supported by DAQFlex supported hardware.

## Windows CE

1. Go to the DAQFlex download page at [www.mccdaq.com/DAQFlexDL](http://www.mccdaq.com/DAQFlexDL) and select the **Windows CE** option.
2. Run the **DAQFlex for Windows CE.msi** installer file.
3. Follow the installer instructions.
4. After the DAQFlex software is installed, copy the Windows CE device drivers (mccusb.dll and mcccwinusb.dll) from the DAQFlex for Windows CE\Drivers\ directory (\X86 or \XScale folder) to the device's Windows directory.

Connect your DAQFlex device after installing the software. You can run the **FlexTest.exe**, or build and run the C# or VB .NET example programs included in the installation using Visual Studio (version 2008 or later).

Refer to the *C# and VB Example Programs* chapter on page 96 for instructions on running the DAQFlex example programs, and to the *Hardware Reference* chapter on page 98 for the API components and messages supported by DAQFlex supported hardware.

## Mac OS X

1. Go to the DAQFlex download page at [www.mccdaq.com/DAQFlexDL](http://www.mccdaq.com/DAQFlexDL) and select the **Mac OS** option.
2. Run the DAQFlex installer package (**DAQFlex.pkg**).
3. Follow the installer instructions.

Connect your DAQFlex device after installing the software. You can run the FlexTest application located in the /Applications/Mechatronics Computing/DAQFlex folder. Additionally, you can build and run the example programs included in the installation using ExampleBuilder.

Refer to the *C# and VB Example Programs* chapter on page 96 for instructions on running the DAQFlex example programs, and to the *Hardware Reference* chapter on page 98 for the API components and messages supported by DAQFlex supported hardware.

## Linux

1. Using your Software/Package manager, verify that the **Mono framework** (version 2.4 or later) and the **libusb** user-mode driver are installed on your Linux system.  
If these versions aren't listed, information on installing, updating, or adding software repositories to your Software/Package manager can be found at the following links. Click [here](#) to go to the Mono web site. Click [here](#) to go to the libusb web site.
2. As a root user, create a symbolic link to the libusb-1.0 shared object file. For example:  

```
o ln -s /usr/lib/libusb-1.0.so.0/usr/lib/libusb-1.0.so
```

  
The actual file location may vary.
3. Extract the files from the **DAQFlex-2.0.tar.gz** archive file on the DAQFlex software CD using an archive manager.
4. In a terminal window, set the current directory to DAQFlex/Source/DAQFlexAPI.
5. As a root user, run the following commands:  

```
o make
o make install
```
6. Restart the system.

Connect your DAQFlex device after installing the software. You can run the FlexTest application by running the command `$ flextest` from a terminal window. Additionally, you can build and run the C# example programs included in the installation using MonoDevelop or the Mono command line interpreter.

Refer to the *C# and VB Example Programs* chapter on page 96 for instructions on running the DAQFlex example programs, and to the *Hardware Reference* chapter on page 98 for the API components and messages supported by DAQFlex supported hardware.



## Using DAQFlex Software

The following procedure describes how to program a DAQFlex-supported device with DAQFlex software.

1. Add a reference to the DAQFlex assembly to your project.
  - o In Visual Studio and MonoDevelop, this assembly is listed under the .NET tab of the Add Reference dialog as **DAQFlex API**.  
If your project is a C# project, add the following statement to your source file:  
`using MeasurementComputing.DAQFlex;`
2. Get a list of device names using the static method **GetDeviceNames()**:

### C#

```
string[] deviceNames;

deviceNames = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);
```

### VB

```
Dim deviceNames As String()

deviceNames = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)
```

GetDeviceNames gets the names of DAQFlex devices detected by the DAQFlex API. **DeviceNameFormat** is an enumeration that specifies the format of the returned values. This enumeration defines four different formats:

Member Name	Description
NameOnly	The returned values contain only the device name.
NameAndSerno	The return values contain the device name with the device serial number formatted as "DeviceName::SerialNumber".
NameAndID	The return values contains the device name with the device's user-defined ID formatted as "DeviceName::DeviceID".
NameSernoAndID	The return values contains the device name, the device serial number and the device's user-defined ID formatted as "DeviceName::SerialNumber::DeviceID".

**Note:** Each DAQFlex API method will throw an exception if an error occurs, and should be enclosed within a **Try/Catch** block.

3. Get a device object using the static method **CreateDevice()**:

### C#

```
int deviceNumber = 0;

DaqDevice device;

string deviceName = deviceNames[deviceNumber];

device = DaqDeviceManager.CreateDevice(deviceName);
```

**VB**

```
Dim deviceNumber As Integer

Dim device As DaqDevice

Dim deviceName As String

deviceNumber = 0

deviceName = deviceNames(deviceNumber)

device = DaqDeviceManager.CreateDevice(deviceName)
```

4. Once you have a **DaqDevice** object, use the **SendMessage()** method to program your DAQFlex-supported device.

**C#**

```
DaqResponse response;
response = device.SendMessage("AI{0}:RANGE=BIP10V"); // set the input range for channel 0
response = device.SendMessage("?AI{0}:VALUE"); // read a single value from channel 0
```

**VB**

```
Dim response As DaqResponse
response = device.SendMessage("AI{0}:RANGE=BIP10V") ' set the input range for channel 0
response = device.SendMessage("?AI{0}:VALUE") ' read a single value from channel 0
```

- The **DaqResponse** object contains a method for getting the response as a string and a method for getting the response as a numeric.

To get the response as a string, use the **ToString()** method:

**C#**

```
string value = response.ToString();
```

**VB**

```
Dim value As String

value = response.ToString()
```

To get the response as a numeric, use the **ToValue()** method:

**C#**

```
double value = response.ToValue();
```

**VB**

```
Dim value As Double
value = response.ToValue()
```

If the response does not contain a numeric value, **ToValue()** returns **Double.NaN**.

When you no longer need the **DaqDevice** object, you can release it by calling the **ReleaseDevice()** method:

**C#**

```
DaqDeviceManager.ReleaseDevice(device);
```

**VB**

```
DaqDeviceManager.ReleaseDevice(device)
```

## Reading and writing software-paced I/O

The following examples demonstrate how to perform asynchronous single-point I/O using DAQFlex software:

- [Reading an analog input channel](#)
- [Writing to an analog output channel](#)
- [Reading a digital bit](#)
- [Writing to a digital bit](#)
- [Reading a digital port](#)
- [Writing to a digital port](#)
- [Reading a counter input channel](#)

## Reading an analog input channel

### C#

```
// Read the value of analog input channel 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Send device messages using the DaqDevice object
    MyDevice.SendMessage("AI{0}:RANGE=BIP10V");
    MyDevice.SendMessage("AI:CAL=ENABLE");
    MyDevice.SendMessage("AI:SCALE=ENABLE");

    // Read and display the daq response
    Response = MyDevice.SendMessage("?AI{0}:VALUE");
    label1.Text = Response.ToString();
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Read the value of analog input channel 0
Dim Devices As String ()
Dim MyDevice As DaqDevice
Dim Response As DaqResponse

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Send device messages using the DaqDevice object
    MyDevice.SendMessage("AI{0}:RANGE=BIP10V")
    MyDevice.SendMessage("AI:CAL=ENABLE")
    MyDevice.SendMessage("AI:SCALE=ENABLE")

    ' Read and display the daq response
    Response = MyDevice.SendMessage("?AI{0}:VALUE")
    Label1.Text = Response.ToString()
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message()
End Try
```

## Writing to an analog output channel

### C#

```
// Write a value to analog output channel 0
String[] Devices;
DaqDevice MyDevice;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Send device messages
    MyDevice.SendMessage("AO{0}:RANGE=BIP10V");
    MyDevice.SendMessage("AO:CAL=ENABLE");
    MyDevice.SendMessage("AO:SCALE=ENABLE");
    MyDevice.SendMessage("AO{0}:VALUE=2.53");
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Write a value to analog output channel 0
Dim Devices As String()
Dim MyDevice As DaqDevice

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Send device messages
    MyDevice.SendMessage("AO{0}:RANGE=BIP10V")
    MyDevice.SendMessage("AO:CAL=ENABLE")
    MyDevice.SendMessage("AO:SCALE=ENABLE")
    MyDevice.SendMessage("AO{0}:VALUE=2.53")
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try
```

## Reading a digital bit

### C#

```
// Read the value of digital port 0, bit 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Read and display the daq response
    MyDevice.SendMessage("DIO{0/0}:DIR=IN");
    Response = MyDevice.SendMessage("?DIO{0/0}:VALUE");
    label1.Text = Response.ToString();
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Read the value of digital port 0, bit 0
Dim MyDevice As DaqDevice
Dim Response As DaqResponse
Dim Devices As String ()

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Read and display the daq response
    MyDevice.SendMessage("DIO{0/0}:DIR=IN")
    Response = MyDevice.SendMessage("?DIO{0/0}:VALUE")
    Label1.Text = Response.ToString()
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try
```

## Writing to a digital bit

### C#

```
// Write a value to digital port 0, bit 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Send device messages
    MyDevice.SendMessage("DIO{0/0}:DIR=
    MyDevice.SendMessage("DIO{0/0}:VALUE=
    label1.Text = response.ToString();
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Write a value to digital port 0, bit 0
Dim MyDevice As DaqDevice
Dim Response As DaqResponse
Dim Devices As String ()

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Send device messages
    MyDevice.SendMessage("DIO{0/0}:DIR=
    Response = MyDevice.SendMessage("DIO{0/0}:VALUE=
    Label1.Text = Response.ToString
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try
```

## Reading a digital port

### C#

```
// Read the value of digital port 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Send device messages
    MyDevice.SendMessage("DIO{0}:DIR=IN");

    // Read and display the daq response
    Response = MyDevice.SendMessage("?DIO{0}:VALUE");
    Label1.Text = Response.ToString();
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Read the value of digital port 0
Dim MyDevice As DaqDevice
Dim Response As DaqResponse
Dim Devices As String ()

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Send device messages
    MyDevice.SendMessage("DIO{0}:DIR=IN")

    ' Read and display the daq response
    Response = MyDevice.SendMessage("?DIO{0}:VALUE")
    Label1.Text = Response.ToString()
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try
```



## Writing to a digital port

### C#

```
// Write a value to digital port 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices[0]);

    // Send device messages
    MyDevice.SendMessage("DIO{0}:DIR=OUT");
    MyDevice.SendMessage("DIO{0}:VALUE=128");
    label1.Text = response.ToString();
}
catch (Exception ex)
{
    // handle error
    label1.Text = ex.Message;
}
```

### VB

```
' Write a value to digital port 0
Dim MyDevice As DaqDevice
Dim Response As DaqResponse
Dim Devices As String ()

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    ' Send device messages
    MyDevice.SendMessage("DIO{0}:DIR=OUT")
    Response = MyDevice.SendMessage("DIO{0}:VALUE=128")
    Label1.Text = Response.ToString
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try
```

## Reading a counter input channel

### C#

```
// Read counter channel 0
String[] Devices;
DaqDevice MyDevice;
DaqResponse Response;

try
{
    // Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);

    // Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0));

    // Start the counter
    MyDevice.SendMessage("CTR{0}:VALUE=0");
    MyDevice.SendMessage("CTR{0}:START");

    // Read and display the daq response
    for(int i = 1;i<=10;i++)
    {
        System.Threading.Thread.Sleep(750);
        Response = MyDevice.SendMessage("?CTR{0}:VALUE");
        labell.Text = Response.ToString();
        Application.DoEvents();
    }

    // Stop the counter
    MyDevice.SendMessage("CTR{0}:STOP");
}
catch (Exception ex)
{
    // handle error
    labell.Text = ex.Message;
}
```

### VB

```
' Read counter channel 0
Dim MyDevice As DaqDevice
Dim Response As DaqResponse
Dim Devices As String ()

Try
    ' Get a list of message-based DAQ devices
    Devices = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)

    ' Get a DaqDevice object for device 0
    MyDevice = DaqDeviceManager.CreateDevice(Devices(0))

    Dim I As Integer

    ' Start the counter
    MyDevice.SendMessage("CTR{0}:VALUE=0")
    MyDevice.SendMessage("CTR{0}:START")

    ' Read and display the daq response
    For I = 1 To 10
        System.Threading.Thread.Sleep(750)
        Response = MyDevice.SendMessage("?CTR{0}:VALUE")
        Labell.Text = Response.ToString()
        Application.DoEvents()
    Next
```

```

    ' Stop the counter
    MyDevice.SendMessage("CTR{0}:STOP")
Catch Ex As Exception
    ' handle error
    Label1.Text = Ex.Message
End Try

```

## Reading hardware-paced I/O

The basic approach to programming analog input scans is to set the device's scan properties, send the **START** command, and call the **ReadScanData()** method. The following examples show how to program a basic input scan.

### C#

```

try
{
    double[,] scanData;
    string[] names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);
    DaqDevice device = DaqDeviceManager.CreateDevice(names[0]);

    device.SendMessage("AISCAN:LOWCHAN=0");
    device.SendMessage("AISCAN:HIGHCHAN=0");
    device.SendMessage("AISCAN:RATE=1000");
    device.SendMessage("AISCAN:SAMPLES=5000");
    device.SendMessage("AISCAN:START");

    scanData = device.ReadScanData(5000, 0);
}
catch (Exception ex)
{
    Console.WriteLine(ex.Message);
}

```

### VB

```

Try
    Dim ScanData As Double(,)
    Dim Names As String()
    Dim Device As DaqDevice

    Names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)
    Device = DaqDeviceManager.CreateDevice(Names(0))

    Device.SendMessage("AISCAN:LOWCHAN=0")
    Device.SendMessage("AISCAN:HIGHCHAN=0")
    Device.SendMessage("AISCAN:RATE=1000")
    Device.SendMessage("AISCAN:SAMPLES=5000")
    Device.SendMessage("AISCAN:START")

    ScanData = Device.ReadScanData(5000, 0)
Catch ex As Exception
    Console.WriteLine(ex.Message)
End Try

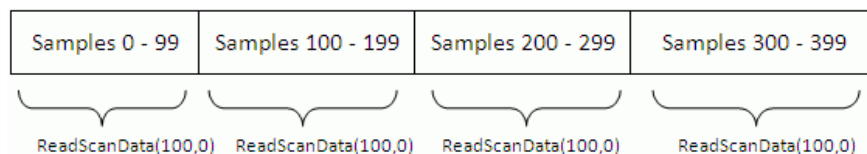
```

## ReadScanData() parameters

- The first parameter to the **ReadScanData** method is the number of samples to read.
- The second parameter is a time out value in milli-seconds. A value of 0 indicates no timeout specified.

The ReadScanData method is synchronous, and will return when the number of requested samples are available for reading. When the number of requested samples are available, the DAQFlex software copies the requested number of samples from an internal buffer to a new array of data. The DAQFlex software keeps track of the buffer index so that multiple calls to ReadScanData always return contiguous data.

## Internal buffer



An alternative method for reading scan data is to enable a **user-defined callback method**. When you enable a callback method, the DAQFlex software invokes your user-defined method when a specified number of samples are available for reading, when a scan completes, or if a scan error occurs. This is done using the **EnableCallback** method as shown below:

### C#

```
Device.EnableCallback(callbackMethod, callbackType, callbackCount);
```

### VB

```
Device.EnableCallback(Addressof CallbackMethod, CallbackType, CallbackCount)
```

The callbackMethod is the name of the method that will be invoked by the DAQFlex software. The callbackMethod is a class method that must have the following form:

### C#

```
void CallbackMethod(ErrorCodes errorCode, CallbackType callbackType, object callbackData)
```

### VB

```
Sub CallbackMethod(ByVal errorCode As ErrorCodes, ByVal callbackType As CallbackType, _  
_ ByVal callbackData As Object)
```

The callbackType is an enumeration that defines when the callback method will be invoked.

## CallbackType

Member Name	Description
OnDataAvailable	Specifies that the callback method will be invoked when a specified number of samples becomes available for reading.
OnInputScanComplete	Specifies that the callback method will be invoked when a finite scan has complete or when a continuous scan is stopped.
OnInputScanError	Specifies that the callback method will be invoked when an input scan error occurs.

Only one callback method can be specified for each callback type. When the callback type is set to OnDataAvailable, set the callbackData parameter to the number of samples you wish to receive in the callback method. When the callback type is set to OnInputScanComplete or OnInputScanError, set the callbackData parameter to null or Nothing.

The following are examples of reading scan data using a callback method:

**C#**

```
try
{
    double[,] scanData;

    string[] names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);
    DaqDevice device = DaqDeviceManager.CreateDevice(names[0]);

    device.EnableCallback(OnReadScanData, CallbackType.OnDataAvailable, 1000);
    device.EnableCallback(OnReadScanData, CallbackType.OnScanComplete, null);

    device.SendMessage("AISCAN:LOWCHAN=0");
    device.SendMessage("AISCAN:HIGHCAN=0");
    device.SendMessage("AISCAN:RATE=1000");
    device.SendMessage("AISCAN:SAMPLES=5000");
    device.SendMessage("AISCAN:START");
}
catch (Exception ex)
{
    Console.WriteLine(ex.Message);
}

protected void OnReadScanData(ErrorCodes errorCode, CallbackType callbackType,
object callbackData)
{
    try
    {
        int availableSamples = (int)callbackData;
        double[,] scanData = device.ReadScanData(availableSamples, 0);
    }
    catch (Exception ex)
    {
        Console.WriteLine(ex.Message);
    }
}
```

**VB**

```

Try
    Dim ScanData As Double(,)
    Dim Names As String()
    Dim Device As DaqDevice

    Names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)
    Device = DaqDeviceManager.CreateDevice(Names(0))

    Device.EnableCallback(AddressOf OnReadScanData, CallbackType.OnDataAvailable,
    1000)
    Device.EnableCallback(AddressOf OnReadScanData, CallbackType.OnScanComplete,
    Nothing)

    Device.SendMessage("AISCAN:LOWCHAN=0")
    Device.SendMessage("AISCAN:HIGHCAN=0")
    Device.SendMessage("AISCAN:RATE=1000")
    Device.SendMessage("AISCAN:SAMPLES=5000")
    Device.SendMessage("AISCAN:START")
Catch ex As Exception
    Console.WriteLine(ex.Message)
End Try

Protected Sub ReadScanData(ByVal errorCode As ErrorCodes, ByVal callbackType As
CallbackType, _ ByVal callbackData As Object)

Try
    Dim AvailableSamples As Integer
    Dim ScanData As Double(,)

    AvailableSamples = DirectCast(callbackData, Integer)
    ScanData = Device.ReadScanData(AvailableSamples, 0)
Catch ex As Exception
    Console.WriteLine(ex.Message)
End Try

```

**Writing hardware-paced I/O**

The basic approach to programming analog output scans is to set the device's output scan properties, call the **WriteScanData()** method, and send the **START** command. The following examples show how to program a basic output scan.

**C#**

```

try
{
    double[,] scanData = new double[1, 5000];
    string[] names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno);
    DaqDevice device = DaqDeviceManager.CreateDevice(names[0]);

    // fill scanData with data

    device.SendMessage("AOSCAN:LOWCHAN=0");
    device.SendMessage("AOSCAN:HIGHCAN=0");
    device.SendMessage("AOSCAN:RATE=1000");
    device.SendMessage("AOSCAN:SAMPLES=5000");
    device.SendMessage("AOSCAN:BUFSIZE=5000");

    int timeOut = 0;
    device.WriteScanData(scanData, 5000, timeOut);
    device.SendMessage("AOSCAN:START");
}

```

```

catch (Exception ex)
{
    Console.WriteLine(ex.Message);
}

```

## VB

```

Try
    Dim ScanData As Double(,)
    Dim Names As String()
    Dim Device As DaqDevice
    Dim TimeOut As Integer

    Names = DaqDeviceManager.GetDeviceNames(DeviceNameFormat.NameAndSerno)
    Device = DaqDeviceManager.CreateDevice(Names(0))

    Device.SendMessage("AOSCAN:LOWCHAN=0")
    Device.SendMessage("AOSCAN:HIGHCAN=0")
    Device.SendMessage("AOSCAN:RATE=1000")
    Device.SendMessage("AOSCAN:SAMPLES=5000")
    Device.SendMessage("AOSCAN:BUFSIZE=5000")

    int TimeOut = 0
    Device.WriteScanData(ScanData, 5000, TimeOut)

    Device.SendMessage("AOSCAN:START")
Catch ex As Exception
    Console.WriteLine(ex.Message)
End Try

```

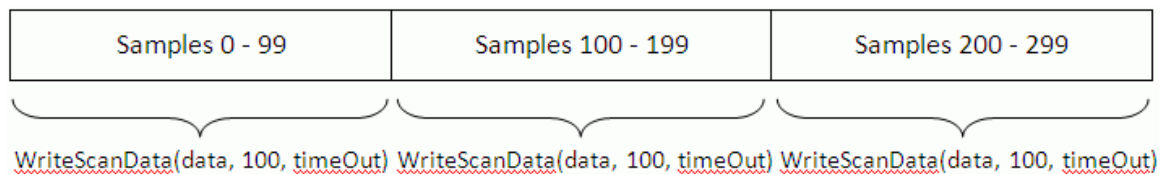
## WriteScanData() parameters

- The first parameter to the **WriteScanData** method is the array containing the output scan data.
- The second parameter is the number of samples to write.
- The last parameter is a timeout value in milliseconds.

The WriteScanData method is synchronous, and will return when the number of samples specified have been written to the device's output buffer.

Each time the WriteScanData method is called, the data is written to an internal buffer starting at the point after the last sample was written. When an output scan completes or is stopped, the write index is reset to the beginning of the buffer.

## Internal buffer



## DAQFlex Software Reference

The DAQFlex Software API is an open source library that implements a simple message-based protocol consisting of text-based commands, or messages. The API is written in C#, is designed for cross platform portability, and does not require a separate configuration utility or a configuration file.

DAQFlex Software API contains two classes:

- [DagDeviceManager class](#)
- [DagDevice class](#)

### DaqDeviceManager class

The **DaqDeviceManager** class includes the following methods:

- [GetDeviceNames\(\)](#) – gets a list of devices that support the message-based protocol.
- [CreateDevice\(\)](#) – creates a DaqDevice object, which contains the methods used to communicate with a DAQ device.
- [ReleaseDevice\(\)](#) – frees the resources associated with a DaqDevice object.

#### DaqDeviceManager.GetDeviceNames()

Gets a list of DAQ devices that support the message-based protocol.

```
C#:      static string[] GetDeviceNames(DeviceNameFormat format);

VB:      Shared Function GetDeviceNames(ByVal format As DeviceNameFormat) As
          String()
```

#### Parameter

*format*

The format to use for a device name. This parameter is a DeviceNameFormat enumeration. The enumeration values and the format of the return strings are listed below:

Value	Return string format
NameOnly	"Device name"
NameAndSerno	"Device name::Device serial number"
NameAndID	"Device name::Device ID"
NameSernoAndID	"Device name::Device serial number::Device ID"

#### Return value

An array of strings containing the device names of all DAQ devices that support the message-based protocol.

#### Remarks

- The values contained in the array can be used to create a **DaqDevice object** for the device that you want to program.  
The DaqDevice object is created using the DaqDeviceManager **CreateDevice** static method. With the DaqDevice object, all DAQ operations are configured using one API method called **SendMessage()** rather than using multiple operation-specific methods.
- The **NameOnly** format is not useful if multiple devices of the same type are connected, since the application won't be able to differentiate between one device and the other. If you are using multiple devices of the same type, then use one of the other formats.



If using a device that does not have an ID assigned, you must use the **NameOnly** or **NameAndSerno** format with the `DaqDeviceManager.CreateDevice()` method in order to create the device. A device with no ID will not be created when using the **NameAndID** and **NameSernoAndID** format with `CreateDevice()`.

## DaqDeviceManager.CreateDevice()

Creates a `DaqDevice` object. The `DaqDevice` object contains the methods used to configure, read data from, or write data to a device. With the `DaqDevice` object, all DAQ operations are configured using one API method called [DaqDevice.SendMessage\(\)](#) rather than using multiple operation-specific methods. `SendMessage()` takes a single parameter called *message*. This parameter is a text-based command that the DAQ device parses to configure a particular operation.

**C#:**        `static CreateDevice(string deviceName);`

**VB:**        `Shared Function CreateDevice(ByVal deviceName As String) As DaqDevice`

### Parameter

#### *deviceName*

One of the device names returned by the `DaqDeviceManager.GetDevicenames()` method.

### Return value

An instance of a **DaqDevice object**.

### Remarks

- Depending on the `DeviceNameFormat`, the `CreateDevice()` method creates a `DaqDevice` object for the device whose name, name and serial number, name and id, or name, serial number and id are contained in the `deviceName` parameter.
- The resources associated with the `DaqDevice` object can be freed by calling the [ReleaseDevice\(\)](#) method.
- The `CreateDevice()` method can only be called once for a specific device, unless the `ReleaseDevice()` method is called.
- If `CreateDevice()` is called more than once for a specific device without calling `ReleaseDevice()`, the `DaqDevice` object **throws an exception**, indicating that a driver handle has already been created for the device.

Refer to the following sample code:

#### **C#**

```
try
{
    MyDevice = DaqDeviceManager.CreateDevice(deviceName);
}
catch (Exception ex)
{
    // handle exception
}
```

#### **VB**

```
Try
    MyDevice = DaqDeviceManager.CreateDevice(deviceName)
Catch Ex As Exception
    ' handle exception
End Try
```

## DaqDeviceManager.ReleaseDevice()

Frees the resources associated with a DaqDevice object.

```
C#:      static void ReleaseDevice(DaqDevice device);

VB:      Shared Sub ReleaseDevice(ByVal device As DaqDevice)
```

### Parameter

#### Device

A DaqDevice object created by the CreateDevice() method.

## DaqDevice class

The **DaqDevice** class includes the following methods:

- [SendMessage\(\)](#) – takes a single text-based command that the DAQ device parses to configure a particular operation.
- [ReadScanData\(\)](#) – reads scan data.
- [WriteScanData\(\)](#) – outputs scan data.
- [EnableCallback\(\)](#) – enables a user-defined callback method to be invoked when a certain condition is met. This method is used in conjunction with input scan operations.
- [DisableCallback\(\)](#) – the condition that invokes the callback method.
- [GetErrorMessage\(\)](#) – gets the error message associated with the error code that is passed to the user-defined callback.
- [GetSupportedMessages\(\)](#) – returns a list of messages supported by a DAQ component.

## DaqDevice.SendMessage()

Configures DAQ operations. This method takes a single text-based command that the DAQ device parses to configure a particular operation.

```
C#:      DaqResponse SendMessage (string message);

VB:      Function SendMessage (ByVal Message as String) As DaqResponse
```

### Parameter

#### Message

The text-based message to send to the device.

### Return value

The device response as an instance of a **DaqResponse object**.

### Remarks

- *Message* is a string containing a text-based command supported by the device, and *Response* is a DaqResponse object containing the device's response.
- The DaqResponse object includes two methods:
- **ToString()**: gets the response as a string, for example "AI{0}:VALUE=139".
- **ToValue()**: gets the response as a numeric value, for example "139.0000".
- All messages provide a string response, but not all messages provide a numeric response. For those messages that do not provide a numeric response, the numeric value is set to NaN (not a number).

- The ToString method has additional overloads that accept formatting parameters. The overloads are ToString(string format), ToString(IFormatProvider provider) and ToString(string format, IFormatProvider provider). The overloads can be used to format the numeric part of a response, if present. If the response does not contain a numeric, these overloads are ignored.
- If an error occurs while sending a message to a device, the SendMessage method will **throw an exception** rather than returning an error code. This means the application should encapsulate calls to SendMessage within a try/catch block.

Refer to the following sample code.

#### C#

```
try
{
    DaqResponse response = MyDevice.SendMessage(message);
    label1.Text = response.ToString();
}
Catch (Exception ex)
{
    // handle exception
    label1.Text = ex.Message;
}
```

#### VB

```
Try
    DaqResponse Response = MyDevice.SendMessage(Message)
    Label1.Text = Response.ToString()
Catch Ex As Exception
    ' handle exception
    Label1.Text = Ex.Message;
End Try
```

## DaqDevice.ReadScanData()

Reads data for a scan operation.

C#:      double[,] ReadScanData(int samplesRequested, int timeOut);

VB:      Function ReadScanData(ByVal samplesRequested As Integer, ByVal timeOut As Integer) As Double(,)

#### Parameter

##### *samplesRequested*

The number of samples per channel to read.

##### *timeOut*

The number of milliseconds to wait for the samples requested to become available.

#### Return value

An array of data samples read from the device.

#### Remarks

- The DAQFlex library always performs scan operations in the background, but ReadScanData() always runs in the foreground. When called, ReadScanData() returns control to the application that called it when the number of samples requested has been read. When timeOut is non-zero, if the number of samples requested isn't available within the time specified by timeOut, an exception is thrown. The DAQFlex library manages all memory allocation and array indexing so the application doesn't have to.

## DaqDevice.WriteScanData()

Outputs scan data.

**C#:**      `void WriteScanData(double[,] scanData, int numberOfSamplesPerChannel, int timeout);`

**VB:**      `Sub WriteScanData(ByVal ScanData(,) As Double, ByVal NumberOfSamplesPerChannel As Integer, ByVal TimeOut As Integer)`

### Parameter

#### *scanData*

Array of data samples to output.

#### *numberOfSamplesPerChannel*

The number of data samples per channel to transfer from the scanData array to the device's output buffer.

#### *timeOut*

The number of milliseconds to wait for available space in the buffer to write to. This only takes effect when an output scan is running.

### Remarks

- WriteScanData may be called while a scan is running. However, the maximum number of total samples must be less than or equal to half the number of samples for which the buffer is allocated. Set the buffer size with the "AOSCAN:BUFSIZE" message.

## DaqDevice.EnableCallback()

Enables a user-defined callback method to be invoked when a certain condition is met.

**C#:**      `void EnableCallback(ErrorCodes errorCode, InputScanCallbackDelegate callback, CallbackType callbackType, Object callbackData)`

**VB:**      `Sub EnableCallback(ByVal errorCode as ErrorCodes, ByVal callback as InputScanCallbackDelegate, ByVal callbackType As CallbackType, ByVal callbackData As Object)`

### Parameter

#### *callback*

The method to be invoked when the condition specified by callbackType is met. Refer to [InputScanCallback Delegate](#) on page 29 for the format of the method.

#### *callbackType*

The condition that invokes the callback method. Callback types are defined by the CallbackType enumeration. The supported types are:

- CallbackType.OnDataAvailable – Invokes the callback method when the number of samples available for reading data is  $\geq$  the number of samples specified by the callbackData parameter.
- CallbackType.OnInputScanComplete – Invokes the callback method when an input scan completes or is stopped.
- CallbackType.OnInputScanError – Invokes the callback method when an input scan error occurs.

#### *callbackData*

When callbackType is set to OnDataAvailable, set callbackData to the number of samples per channel to acquire before invoking the user-defined callback method. When callbackType is set to OnInputScanComplete or OnInputScanError, set callbackData to null or Nothing.

**Return value**

The value of callbackType.

**Remarks**

- This method is used in conjunction with input scan operations.
- EnableCallback may be called once for each callback type. If it is called more than once for the sample callback type, a DaqException is thrown.

**InputScanCallback Delegate**

A delegate is a data structure that refers either to a static method, or to a class instance and an instance method of that class. You call the delegate by passing either its address or a pointer to the delegate to the callback parameter of the [EnableCallback\(\)](#) method.

```
C#:    public delegate void
        InputScanCallbackDelegate(MeasurementComputing.DAQFlex.ErrorCodes
        errorCode, MeasurementComputing.DAQFlex.CallbackType callbackType,
        object callbackData)

VB:    Public Delegate Sub InputScanCallbackDelegate(ByVal errorCode As
        MeasurementComputing.DAQFlex.ErrorCodes, ByVal callbackType As
        MeasurementComputing.DAQFlex.CallbackType, ByVal callbackData As
        Object)
```

**DaqDevice.DisableCallback()**

Disables the invocation of the user-defined callback method associated with the callback type.

```
C#:    void DisableCallback(CallbackType callbackType)

VB:    Sub DisableCallback(ByVal callbackType As CallbackType)
```

**Parameter**

callbackType

The callback type to disable.

**DaqDevice.GetErrorMessage()**

Gets the error message associated with the error code that is passed to the user-defined callback.

```
C#:    string GetErrorMessage(ErrorCodes errorCode)

VB:    Function GetErrorMessage(ByVal errorCode As ErrorCodes)
```

**Parameter**

errorCode

The error code that was passed to the user-defined callback method.

**Return value**

The error message associated with the error code passed to the user-defined callback method.

## DaqDevice.GetSupportedMessages()

Gets the messages supported by a DAQ component.

```
C#:    public List<string> GetSupportedMessages(string daqComponent);  
  
VB:    Function GetSupportedMessages(ByVal daqComponent As String) As List(Of  
        String)
```

### Parameter

*daqComponent*

A DAQ component, such as AISCAN, DEV, TMR, and so on.

### Return value

A list of messages supported by the *daqComponent* parameter.

---

## DAQFlex Message Reference

The software messages that you send to a DAQFlex supported device are text-based commands. Each message pertains to a specific *DAQ component*. A DAQ component is a device element that encapsulates a DAQ subsystem which has multiple properties or commands associated with it.

### DAQFlex components

A DAQ component is a device element that encapsulates a DAQ subsystem which has multiple properties or commands associated with it. The DAQFlex API defines the following DAQ components:

- DEV — encapsulates device-level operations
- AI — encapsulates single-point analog input operations
- AICAL — encapsulates analog input self-calibration
- AIQUEUE — encapsulates analog input gain queue operations
- AISCAN — encapsulates analog input scanning operations
- AITRIG — encapsulates analog input triggering operations
- AO — encapsulates single-point analog output operations
- AOCAL — encapsulates analog output self-calibration
- AOSCAN — encapsulates analog output scanning operations
- AOTRIG — encapsulates analog output triggering operations
- DIO — encapsulates digital I/O operations
- CTR — encapsulates counter input operations
- TMR — encapsulates timer output operations

Each component has one or more properties associated with it. Each property supports one or more text-based commands, or *messages*. These messages are used to communicate with DAQFlex-supported hardware.

DAQFlex supports two types of messages:

- [Device programming messages](#) configure or retrieve a device property value.
- [Device reflection messages](#) retrieve information about a device capability, such as the maximum scan rate or support for an external clock.

## Programming messages

Device programming messages are used to get and set device properties. Programming messages that query a device property always start with the ? character.

Click on a component name below for the string messages, device responses, and property values supported by the component.

Components for programming a device	Description
<a href="#">AI</a>	Sets and gets property values for analog input channels.
<a href="#">AICAL</a>	Sets and gets property values for calibrating analog inputs.
<a href="#">AIQUEUE</a>	Sets and gets property values for the analog input gain queue.
<a href="#">AISCAN</a>	Sets and gets property values when scanning analog input channels.
<a href="#">AITRIG</a>	Sets and gets analog input trigger property values.
<a href="#">AO</a>	Sets and gets property values for analog output channels
<a href="#">AOCAL</a>	Sets and gets property values for calibrating analog outputs.
<a href="#">AOSCAN</a>	Sets and gets property values when scanning analog output channels.
<a href="#">DEV</a>	Sets and gets device property values.
<a href="#">DIO</a>	Sets and gets property values for digital I/O channels.
<a href="#">CTR</a>	Sets and gets property values for counter channels.
<a href="#">TMR</a>	Sets and gets property values for timer output channels.

### AI

Sets and gets property values for analog input channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

#### Properties

ADCAL, CAL, CHMODE, CJC, DATARATE, OFFSET, RANGE, RES, SCALE, SENSOR, SLOPE, STATUS, VALIDCHANS, VALUE

#### (Component only)

- Get the number of analog input channels on a device.

Message "?AI"

Response "AI=*value*"

*value* The number of A/D channels on the device.

#### ADCAL

- Start the A/D internal calibration.

Message "AI:ADCAL/START"

Response "AI:ADCAL/START"



- Get the status of the A/D internal calibration.

Message    "?AI:ADCAL/STATUS"

Response    "AI:ADCAL/STATUS=*value*"

*value*        RUNNING, IDLE

#### CAL

- Enable or disable calibration of all A/D channels.

Message    "AI:CAL=*value*"

Response    "AI:CAL"

*value*        ENABLE, DISABLE

Example    "AI:CAL=ENABLE"

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether the calibration coefficients will be applied to the raw A/D data.

Message    "?AI:CAL"

Response    "AI:CAL=*value*"

*value*        ENABLE, DISABLE

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

#### CJC

- Get the CJC value in the specified format.

Message    "?AI{*ch*}:CJC/*format*"

Response    "AI{*ch*}:CJC/*format*=*value*"

*format*    DEGC, DEGF, KELVIN

*value*        The measured temperature.

Example    "?AI{0}:CJC/DEGC"

#### CHMODE

- Set the analog input mode to single-ended or differential for all channels.

Message    "AI:CHMODE=*value*"

Response    "AI:CHMODE"

*value*        SE, DIFF

Example    "AI:CHMODE=SE"

- Set the analog input mode single-ended or differential for a specified channel.

Message "AI{ch}:CHMODE=value"

Response "AI{ch}:CHMODE"

*ch* The channel number.

*value* SE, DIFF, TC/OTD, TC/NOOTD

Example "AI{0}:CHMODE=SE"

- Get the input mode that is set for all analog inputs.

Message "?AI:CHMODE"

Response "AI:CHMODE=value"

*value* SE, DIFF, MIXED

- Get the input mode that is set for a specified channel.

Message "?AI{ch}:CHMODE"

Response "AI{ch}:CHMODE=value"

*ch* The channel number.

*value* SE, DIFF, TC/OTD, TC/NOOTD

## DATARATE

- Set the A/D data rate in samples per channel for all channels.

Message "AI:DATARATE=value"

Response "AI:DATARATE"

*value* The data rate in S/s.

Example "AI:DATARATE=100"

- Set the A/D data rate in samples per channel for a specified channel.

Message "AI{ch}:DATARATE=value"

Response "AI{ch}:DATARATE"

*ch* The channel number.

*value* The data rate in S/s.

Example "AI{0}:DATARATE=10"

- Get the A/D data rate in samples per channel for all channels.

Message "?AI:DATARATE"

Response "AI:DATARATE=value"

*value* The data rate in S/s.

- Get the A/D data rate in samples per channel for a specified channel.

Message    "?AI{ch}:DATARATE"

Response    "AI{ch}:DATARATE=value"

*ch*            The channel number.

*value*        The data rate in S/s.

#### OFFSET

- Get the calibration offset coefficient for the specified channel.

Message    "?AI{ch}:OFFSET"

Response    "AI{ch}:OFFSET=value"

*ch*            The channel number.

*value*        The calibration offset.

Example    "?AI{0}:OFFSET"

#### RANGE

- Set the range value for a specified channel.

Message    "AI{ch}:RANGE=value"

Response    "AI{ch}:RANGE"

*ch*            The channel number.

*value*        The range value.

Example    "AI{0}RANGE= value"

Note        Call an AI:RANGES Reflection message to get the supported ranges. If the message returned does not include PROG%, then the message does not apply to the device.

If *ch* is not specified, all channels are set to the range value.

If RANGE is not specified, the device power up default value is used.

- Get the range value for a specified channel.

Message    "?AI{ch}:RANGE"

Response    "AI{ch}:RANGE=value"

*ch*            The channel number.

*value*        The range value.

Example    "?AI{0}:RANGE"

Note        Call an AI:RANGES Reflection message to get the supported ranges. If the message returned does not include PROG%, then the message does not apply to the device.

**RES**

- Get the resolution of the A/D converter.

Message    "?AI:RES"

Response    "AI:RES=*value*"

*value*       The ADC resolution, for example S24.

Note        The first character indicates if the value is signed (S) or unsigned (U). The second value indicates the resolution in bits.

**SCALE**

- Enable or disable scaling of A/D channels.

Message    "AI:SCALE=*value*"

Response    "AI:SCALE"

*value*       ENABLE, DISABLE

Example    "AI:SCALE=

Note        When SCALE is enabled, the device returns values that are converted to an appropriate unit based on the CHMODE property. For example, when CHMODE is set to DIFF, values are returned as voltage. When CHMODE is set to TC/OTD, values are returned as temperature. When SCALE is disabled, values are returned as counts.

This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether scaling will be applied to the A/D channels.

Message    "?AI:SCALE"

Response    "AI:SCALE=*value*"

*value*       ENABLE, DISABLE

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

**SENSOR**

- Set the thermocouple sensor type.

Message    "AI{ch}:SENSOR=TC/*value*"

Response    " AI:{ch}:SENSOR"

*value*       The thermocouple type.

Example    "AI{0}:SENSOR=TC/K"

Note        Thermocouple types B, E, J, K, N, R, S, and T are supported.

- Get the thermocouple sensor type.  
Message    "?AI{ch}:SENSOR"  
  
Response    " AI:{ch}:SENSOR=TC/*value*"  
  
              *value*      The thermocouple type.  
  
Example    "?AI{0}:SENSOR"  
  
Note        Thermocouple types B, E, J, K, N, R, S, and T are supported.

#### SLOPE

- Get the calibration slope coefficient for the specified channel.  
Message    "?AI{ch}:SLOPE"  
  
Response    "AI{ch}:SLOPE=*value*"  
  
              *ch*          The channel number.  
  
              *value*      The calibration slope.  
  
Example    "?AI{0}:SLOPE"

#### STATUS

- Get the current ADC status of the AI operation.  
Message    "?AI:STATUS"  
  
Response    "AI:STATUS=*value*"  
  
              *value*      BUSY, ERROR, READY

#### VALIDCHANS

- Get the number of each valid analog input channel.  
Message    "?AI:VALIDCHANS"  
  
Response    "AI:VALIDCHANS=*value*"  
  
              *value*      The valid analog input channel number(s) on the device.
- Get the channel mode for each valid analog input channel.  
Message    "?AI: VALIDCHANS/CHMODE"  
  
Response    "AI:VALIDCHANS/CHMODE={*ch*}{*mode*}"  
  
              *ch*          The channel number.  
  
              *mode*      The channel mode.

#### VALUE

- Get the value of an analog input channel.  
Message    "?AI{ch}:VALUE"  
  
Response    "AI{ch}:VALUE=*value*"  
  
              *ch*          The channel number.

*value*      The channel value.

Example    "?AI{0}:VALUE"

- Get the calibrated A/D count of a specified channel.

Message    "?AI{ch}:VALUE"

Response   "AI{ch}:VALUE=*value*"

*ch*            The channel number.

*value*        The calibrated A/D count.

Example    "?AI{0}:VALUE"

- Get the A/D value in the specified format.

Message    "?AI{ch}:VALUE/{format}"

Response   "AI{ch}:VALUE/{format}=*value*"

*ch*            The channel number.

*format*      The data format of the measurement:

- RAW: returns uncalibrated A/D counts
- VOLTS: returns a calibrated A/D voltage
- DEGC: returns a calibrated temperature value in °C
- DEGF: returns a calibrated temperature value in °F
- KELVIN: returns a calibrated temperature value in Kelvin

*value*        The A/D value.

Example    "?AI{0}:VALUE/DEGC"

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

### Working with the CAL and SCALE properties

The ENABLE/DISABLE setting of the CAL and SCALE properties affect the kind of data that is returned:

- CAL=DISABLE, SCALE=DISABLE  
If CAL and SCALE are both disabled, the data returned will be raw A/D integer values within the range of 0 to  $2^{\text{resolution}} - 1$  of the device. If the calibration factors are stored on the device and applied to the data by the application software, the data range may be limited to well within these values.
- CAL=ENABLE, SCALE=DISABLE  
When CAL is enabled and SCALE is disabled, the format of the analog data returned will depend on the type of calibration implemented. If the calibration factors are stored on the device and applied to the data by the application software, the data will be floating point values, not integer values, and may exceed the theoretical limits and include negative values and values above  $2^{\text{resolution}} - 1$ .
- SCALE=ENABLE  
When SCALE is enabled, scaled floating point values are returned. The limits of the data will depend on the implementation of calibration, as described above. Data range limits may be a small percentage less than or greater than the full scale range selected for devices for which the calibration factors are stored on the device and applied to the data by the application software.

## AICAL

Gets the manufacturer calibration date and time.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

START, STATUS

#### START

- Start the A/D internal calibration. This operation calibrates the analog inputs and writes calibration factors to the board.

Message    "?AICAL:START"

Response   "AICAL:START"

Note        Once the "AICAL:START" message is sent, no other messages other "?AICAL:STATUS" may be sent until the calibration process is complete.

#### STATUS

- Get the status of the A/D internal calibration.

Message    "?AOCAL:STATUS"

Response   "AOCAL:STATUS=*value*"

*value*       RUNNING, IDLE

## AIQUEUE

Sets and gets property values for the analog input gain queue.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

CHAN, CHMODE, CLEAR, COUNT, DATARATE, RANGE, RESET

#### CHAN

- Set the channel number for a specified queue element.

Message    "AIQUEUE{*element*}:CHAN=*value*"

Response   "AIQUEUE{*element*}:CHAN"

*element*    The number of the element in the gain queue.

*value*       The channel number.

Example    "AIQUEUE{0}:CHAN=0"

- Get the channel number for a specified queue element.

Message    "?AIQUEUE{*element*}:CHAN"

Response   "AIQUEUE{*element*}:CHAN=*value*"

*element*    The number of the element in the gain queue.

*value*       The channel number.

Example   "?AIQUEUE{0}:CHAN"

#### CHMODE

- Set the channel mode for a specified queue element.

Message   "AIQUEUE{*element*}:CHMODE=*value*"

Response   "AIQUEUE{*element*}:CHMODE"

*element*   The number of the element in the gain queue.

*value*       SE, DIFF

Example   "AIQUEUE{0}:CHMODE=DIFF"

- Get the channel mode for a specified queue element.

Message   "?AIQUEUE{*element*}:CHMODE"

Response   "AIQUEUE{*element*}:CHMODE=*value*"

*element*   The number of the element in the gain queue.

*value*       SE, DIFF

Example   "?AIQUEUE{0}:CHMODE"

#### CLEAR

- Removes the elements in the analog input gain queue.

Message   "AIQUEUE:CLEAR"

Response   "AIQUEUE:CLEAR"

#### COUNT

- Get the number of elements set in the gain queue.

Message   "?AIQUEUE:COUNT"

Response   "AIQUEUE:COUNT=*value*"

*value*       The number of elements set in the gain queue.

Example   "AIQUEUE:COUNT=15"

#### DATARATE

- Set the A/D data rate in samples per second for one or all channels.

Message   "AIQUEUE{*ch*}:DATARATE=*value*"

Response   "AIQUEUE{*ch*}:DATARATE"

*value*       The data rate in S/s.

*ch*           The channel number. If *ch* is omitted the rate is set for all channels.

Example   "AIQUEUE{0}:DATARATE=10"



- Get the A/D data rate in samples per second for a specified channel.

Message   "?AIQUEUE{ch}:DATARATE"

Response   "AIQUEUE{ch}:DATARATE=*value*"

*value*      The data rate in S/s.

*ch*          The channel number.

Note        If all channels are not set to the same range the device returns "MIXED".

#### **RANGE**

- Set the range for a specified queue element.

Message   "AIQUEUE{*element*}:RANGE=*value*"

Response   "AIQUEUE:RANGE"

*element*    The number of the element in the gain queue.

*value*       The range value.

Example   "?AIQUEUE{0}:RANGE=BIP10V"

- Get the range for a specified queue element.

Message   "?AIQUEUE{*element*}:RANGE"

Response   "AIQUEUE{*element*}:RANGE=*value*"

*element*    The number of the element in the gain queue.

*value*       The range value.

Example   "?AIQUEUE{0}:RANGE"

#### **RESET**

- Reset the analog input gain queue.

Message   "AIQUEUE:RESET"

Response   "AIQUEUE:RESET"

#### **Note**

When running the FlexTest utility, AIQUEUE messages are listed on the AISCAN tab.

## AISCAN

Sets and gets property values when scanning analog input channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

BUFOVERWRITE, BUFSIZE, BURSTMODE, CAL, COUNT, EXTPACER, HIGHCHAN, INDEX, LOWCHAN, QUEUE, RANGE, RATE, RESET, SAMPLES, SCALE, START, STATUS, STOP, TEMPUNITS, TRIG, XFRMODE

#### BUFOVERWRITE

- Enable or disable buffer monitoring to prevent overwriting unread data.

Message "AISCAN:BUFOVERWRITE=*value*"

Response "AISCAN:BUFOVERWRITE "

*value*      ENABLE, DISABLE

Example "AISCAN:BUFOVERWRITE=ENABLE"

- Note
- DISABLE (default): Do not monitor the buffer – allow overwrite.
  - ENABLE: Monitor the buffer and generate an error if unread data is being overwritten.

- Get a value indicating whether the buffer is being monitored to prevent data overwrite.

Message "?AISCAN:BUFOVERWRITE"

Response "AISCAN:BUFOVERWRITE=*value*"

*value*      ENABLE, DISABLE

- Note
- ENABLE indicates that an attempt to overwrite unread data will generate an error message.
  - DISABLE indicates that no error will be generated when data is overwritten.
- This message is processed by the DAQFlex Software library, and is not sent to the device.

#### BUFSIZE

- Set the size in bytes of the buffer to be used for AISCAN.

Message "AISCAN:BUFSIZE=*value*"

Response "AISCAN:BUFSIZE"

*value*      The size in bytes of the buffer.

Example "AISCAN:BUFSIZE=131072"

- Note
- The default buffer size 1,024,000 bytes. This should be sufficient for most applications. The actual buffer size will always be an integer multiple of the device's maximum packet size.
  - If this value is set, it should be at least (the number of bytes per sample) x (number of channels) x (sample count) for finite mode. In continuous mode, a circular buffer is used, so the size needs to be sufficient to allow reading the data before it is overwritten.

- Get the size of the buffer used for AISCAN.

Message   "?AISCAN:BUFSIZE"

Response   "AISCAN:BUFSIZE=*value*"

*value*      The size in bytes of the buffer.

#### **BURSTMODE**

- Enable or disable the Burst mode scan option.

Message   "AISCAN:BURSTMODE=*value*"

Response   "AISCAN:BURSTMODE"

*value*      ENABLE, DISABLE

Example   "AISCAN:BURSTMODE=ENABLE"

Note       If not set, BURSTMODE is set to DISABLE by default.

- Get the state of the Burst mode operation.

Message   "?AISCAN:BURSTMODE"

Response   "AISCAN:BURSTMODE=*value*"

*value*      ENABLE, DISABLE

#### **CAL**

- Enable or disable calibration of the A/D data.

Message   "AISCAN:CAL=*value*"

Response   "AISCAN:CAL"

*value*      ENABLE, DISABLE

Example   "AISCAN:CAL=ENABLE"

Note       This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether calibration coefficients will be applied to the raw A/D data.

Message   "?AISCAN:CAL"

Response   "AISCAN:CAL=*value*"

*value*      ENABLE, DISABLE

Note       This message is processed by the DAQFlex Software library, and is not sent to the device.

**COUNT**

- Get the number of samples per channel that have been acquired by the AISCAN operation.  
 Message    "?AISCAN:COUNT"  
 Response   "AISCAN:COUNT=*value*"  
               *value*      The number of samples per channel acquired.  
 Example    "AISCAN:COUNT=64"  
 Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

**EXTPACER**

- Set the configuration of the device's external pacer pin.  
 Message    "AISCAN:EXTPACER=*value*"  
 Response   "AISCAN:EXTPACER"  
               *value*      ENABLE (for most devices), DISABLE  
 Example    "AISCAN:EXTPACER= ENABLE"  
 Note
  - Some devices support ENABLE/MASTER, ENABLE/SLAVE, or ENABLE/GSLAVE.
  - For devices which do not support a master and slave configuration, the /MASTER and /SLAVE designation is ignored.
  - For devices which do not support disabling of the pacer or SYNC input (for example, the terminal is always enabled as either input or output), the DISABLE designation is invalid.
  - Set to *ENABLE* if the device is paced using a continuous clock source, such as a generator. In this mode, the first clock pulse after setting up the scan is ignored in order to ensure adequate setup time for the first conversion.
  - Set to *ENABLE/GSLAVE* if the device is paced from a DAQFlex supported device. In this mode, the first clock pulse after setting up the scan is held off to ensure adequate setup time for the first conversion. No pulses are ignored.
  - When the external pacer is enabled, the AISCAN:RATE property should be set to approximately what the external pacer rate will be, because internal transfer sizes are calculated using the rate and channel count.
  - When not specified, the default is DISABLE.
- Get the configuration of the device's external pacer pin.  
 Message    "?AISCAN:EXTPACER"  
 Response   "AISCAN:EXTPACER=*value*"  
               *ch*            The channel number.  
               *value*      ENABLE (for most devices).  
 Note        Some devices support ENABLE/MASTER, ENABLE/SLAVE, ENABLE/GSLAVE, DISABLE/MASTER, or DISABLE/SLAVE.

**HIGHCHAN**

- Set the last channel to include in the hardware-paced scan operation.

Message "AISCAN:HIGHCHAN=*value*"

Response "AISCAN:HIGHCHAN"

*value*      The channel number.

Example "AISCAN:HIGHCHAN=3"

- Get the last channel to include in the hardware-paced scan operation.

Message "?AISCAN:HIGHCHAN"

Response "AISCAN:HIGHCHAN=*value*"

*value*      The channel number.

**INDEX**

- Get the current location of the pointer in the buffer.

Message "AISCAN:INDEX="

Response "AISCAN:INDEX"

*value*      The current location of the pointer in the buffer.

Example "AISCAN:COUNT=765"

Note      INDEX tracks COUNT in finite mode, and recycles at BUFSIZE in continuous mode; this accounts for sample size, number of channels, and so on.

**LOWCHAN**

- Set the first channel to include in the hardware-paced scan operation.

Message "AISCAN:LOWCHAN=*value*"

Response "AISCAN:LOWCHAN"

*value*      The channel number.

Example "AISCAN:LOWCHAN=0"

- Get the first channel to include in the hardware-paced scan operation.

Message "?AISCAN:LOWCHAN"

Response "AISCAN:LOWCHAN=*value*"

*value*      The channel number.

**QUEUE**

- Enable or disable the analog input gain queue.

Message "AISCAN:QUEUE=*value*"

Response "AISCAN:QUEUE"

*value*      ENABLE, DISABLE, or RESET

Example "AISCAN:QUEUE=ENABLE"

Note RESET resets the queue count to 0, and disables the gain queue.

- Read whether the gain queue is used in the scanning operation.

Message "?AISCAN:QUEUE"

Response "AISCAN:QUEUE=*value*"

*value* ENABLE, DISABLE

## RANGE

- Set the range for all analog input channels to be scanned.

Message "AISCAN:RANGE=*value*"

Response "AISCAN:RANGE"

*value* The range value.

Note Call an AI:RANGES Reflection message to get the supported ranges. If the message returned does not include PROG%, then the message does not apply to the device.

- Get the range that is set for the analog input channels to be scanned.

Message "?AISCAN:RANGE"

Response "AISCAN:RANGE=*value*"

*value* The range value.

Note If all channels are not set to the same range the device returns "MIXED".

- Add the range value as the next element in the gain queue, or set the range value for a specified channel (depending on the queue setting).

Message "AISCAN:RANGE{*ch*}=*value*"

Response "AISCAN:RANGE{*qcnt/ch*}" (when QUEUE is enabled)  
"AISCAN:RANGE{*ch*}" (when QUEUE is disabled.)

The response behavior is dependent on the QUEUE setting:

- When QUEUE is enabled, an element is added to the queue and the specified channel is set to the range specified.
- When QUEUE is disabled, the specified channel is set to the range specified.

*qcnt* The position of the element in the gain queue. This number increments by 1 for each successive message sent.

*ch* The channel number.

*value* The range value (see values listed above).

Example "AISCAN:RANGE{2}=BIP20V"

- Set a specified element in the queue to a specified range (*value*) and channel (*ch*).

Message "AISCAN:RANGE{*element/ch*}=*value*"

Response "AISCAN:RANGE{*element/ch*}"

*element* The position of the element in the gain queue.

*ch* The channel number.

*value* The range value.

Example "AISCAN:RANGE{0/1}=BIP20V"

Note If *element* is greater than the size of the queue, the size of the queue is expanded to *element* + 1.

- Get the range value for a specified element or channel.

Message "?AISCAN:RANGE{x}"

Response "AISCAN:RANGE{*element/ch*}=*value*" when QUEUE is enabled, or  
"AISCAN:RANGE{*ch*}=*value*" when QUEUE is disabled.

*x* When QUEUE is disabled, *x* denotes the channel for which the range is returned.  
When QUEUE is enabled, *x* denotes the element in the queue for which the range is returned.

*element* The position of the element in the gain queue.

*ch* The channel number.

*value* The range value.  
If all channels are not set to the same range, *value* returns MIXED.

## RATE

- Set the A/D pacer rate in Hz.

Message "AISCAN:RATE=*value*"

Response "AISCAN:RATE"

*value* 0 to N

Example "AISCAN:RATE=1000"

Note If *value* is set is less than the device's minimum sampling rate, the minimum rate is used. If *value* is set is greater than the device's maximum sampling rate, the maximum rate is used.  
Check the actual scan rate set using the "?AISCAN:RATE" query after setting the RATE.

- Get the A/D pacer rate in Hz.

Message "?AISCAN:RATE"

Response "AISCAN:RATE=*value*"

*value* A value between the device's minimum and maximum rate.

Note The *value* returned may not match the value requested using the "AISCAN:RATE=*value*" message due to device limitations.  
If the *value* returned is at or near the device's maximum sampling rate, you should keep to a minimum other messages sent to the device. Otherwise, a data overrun may occur. A data overrun occurs when the device fills its buffer with data faster than it is read back.

**RESET**

- Reset the status of the AISCAN operation.

Message "AISCAN:RESET"

Response "AISCAN:RESET"

**SAMPLES**

- Set the number of samples/channel to acquire in the scan.

Message "AISCAN:SAMPLES=*value*"

Response "AISCAN:SAMPLES"

*value* 0 to N

Example "AISCAN:SAMPLES=1000"

Note A value of 0 results in a continuous scan.

- Get the number of samples/channel acquired.

Message "?AISCAN:SAMPLES"

Response "AISCAN:SAMPLES=*value*"

*value* 0 to N

Note A value of 0 indicates a continuous scan.

**SCALE**

- Enable or disable scaling of the A/D data.

Message "AISCAN:SCALE=*value*"

Response "AISCAN:SCALE"

*value* ENABLE, DISABLE

Example "AISCAN:SCALE=ENABLE"

Note When SCALE is enabled, the device returns values that are converted to an appropriate unit based on the CHMODE property. For example, when CHMODE is set to DIFF, values are returned as voltage. When CHMODE is set to TC/OTD, values are returned as temperature. When SCALE is disabled, values are returned as counts.

This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether scaling will be applied to the A/D data.

Message "?AISCAN:SCALE"

Response "AISCAN:SCALE=*value*"

*value* ENABLE, DISABLE

Note This message is processed by the DAQFlex Software library, and is not sent to the device.



**START**

- Start an analog input scan.  
Message "AISCAN:START"  
Response "AISCAN:START"

**STATUS**

- Get the status of the analog input scan operation.  
Message "?AISCAN:STATUS"  
Response "AISCAN:STATUS=*value*"  
*value* IDLE, RUNNING, or OVERRUN

**STOP**

- Stop an analog input scan operation.  
Message "AISCAN:STOP"  
Response "AISCAN:STOP"

**TEMPUNITS**

- Set the unit used for temperature measurements.  
Message "AISCAN:TEMPUNITS=*value*"  
Response "AISCAN:TEMPUNITS"  
*value* DEGC, DEGF, KELVIN  
Example "AISCAN:TEMPUNITS=DEGC"
- Get the unit used for temperature measurements.  
Message "?AISCAN:TEMPUNITS"  
Response "AISCAN:TEMPUNITS=*value*"  
*value* DEGC, DEGF, KELVIN

**TRIG**

- Enable or disable the external trigger option.  
Message "AISCAN:TRIG=*value*"  
Response "AISCAN:TRIG"  
*value* ENABLE, DISABLE  
Example "AISCAN:TRIG=ENABLE"  
Note If not set, TRIG is set to DISABLE by default.
- Get the trigger status.  
Message "?AISCAN:TRIG"  
Response "AISCAN:TRIG=*value*"

*value*      ENABLE, DISABLE

#### XFRMODE

- Set the transfer mode for analog input scan data.

Message    "AISCAN:XFRMODE=*value*"

Response   "AISCAN:XFRMODE"

*value*      SINGLEIO, BLOCKIO, BURSTIO

Example    "AISCAN:XFRMODE=BURSTIO"

Note        For SINGLEIO, the device transfers data after one sample per channel is acquired.  
For BURSTIO, the number of samples is limited to the size of the device FIFO.

- Get the transfer mode that is set for the scan.

Message    "?AISCAN:XFRMODE"

Response   "AISCAN:XFRMODE=*value*"

*value*      SINGLEIO, BLOCKIO, BURSTIO

#### Working with the CAL and SCALE properties

The ENABLE/DISABLE setting of the CAL and SCALE properties affect the kind of data that is returned:

- CAL=DISABLE, SCALE=DISABLE

If CAL and SCALE are both disabled, the data returned will be raw A/D integer values within the range of 0 to  $2^{\text{resolution}} - 1$  of the device. If the calibration factors are stored on the device and applied to the data by the application software, the data range may be limited to well within these values.

- CAL=ENABLE, SCALE=DISABLE

When CAL is enabled and SCALE is disabled, the format of the analog data returned will depend on the type of calibration implemented. If the calibration factors are stored on the device and applied to the data by the application software, the data will be floating point values, not integer values, and may exceed the theoretical limits and include negative values and values above  $2^{\text{resolution}} - 1$ .

- SCALE=ENABLE

When SCALE is enabled, scaled floating point values are returned. The limits of the data will depend on the implementation of calibration, as described above. Data range limits may be a small percentage less than or greater than the full scale range selected for devices for which the calibration factors are stored on the device and applied to the data by the application software.

## AITRIG

Sets and gets analog input trigger property values.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

#### Properties

REARM, SRC, TYPE

#### REARM

- Set the state of the retrigger mode.

Message    "AITRIG:REARM=*value*"

Response   "AITRIG:REARM"

*value*      ENABLE, DISABLE

Example "AITRIG:REARM=ENABLE"

- Get the state of the retrigger mode.

Message "?AITRIG:REARM"

Response "AITRIG:REARM=*value*"

*value*      ENABLE, DISABLE

## SRC

- Set the trigger source.

Message "AITRIG:SRC=*value*"

Response "AITRIG:SRC"

*value*      HWSTART/trig

*trig*        DIG

Example "AITRIG:SRC=DIG"

- Get the trigger source.

Message "?AITRIG:SRC"

Response "AITRIG:SRC=*value*"

*value*      HWSTART/*trig*

*trig*        DIG

## TYPE

- Set the edge trigger type and condition.

Message "AITRIG:TYPE=*value*"

Response "AITRIG:TYPE"

*value*        *type/condition*

*type*        EDGE, LEVEL

*condition*    RISING, FALLING when *type* is EDGE  
HIGH, LOW when *type* is LEVEL

Example "AITRIG:TYPE=EDGE/RISING"

- Get the trigger type and condition.

Message "?AITRIG:TYPE"

Response "AITRIG:TYPE=*value*"

*value*        EDGE/RISING, EDGE/FALLING

## Note

When running the FlexTest utility, AITRIG messages are listed on the AISCAN tab.

## AO

Sets and gets property values for analog output channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

CAL, OFFSET, RANGE, REG, RES, SCALE, SLOPE, UPDATE, VALUE

#### (Component only)

- Get the number of analog output channels on the device.

Message    "?AO"

Response    "AO=*value*"

*value*       The number of D/A channels on the device.

## CAL

- Enable or disable calibration of all D/A channels.

Message    "AO:CAL=*value*"

Response    " AO:CAL"

*value*       ENABLE, DISABLE

Example    " AO:CAL=ENABLE"

Note       This message is processed by the DAQFlex Software library, and is not sent to the device.

## OFFSET

- Get the calibration offset for a specified channel, currently set range and channel mode.

Message    "?AO{*ch*}:OFFSET"

Response    "AO{*ch*}:OFFSET=*value*"

*ch*           The D/A channel number.

*value*       The value of the calibration offset.

Example    "?AO{0}:OFFSET"

## RANGE

- Get the range value for a specified channel.

Message    "?AO{*ch*}:RANGE"

Response    "AO{*ch*}RANGE=*value*"

*ch*           The D/A channel number.

*value*       The range value.

Example    "?AO{0}:RANGE"

**REG**

- Set the value of a DAC channel that supports simultaneous output without updating the output.

Message "AO{ch}:REG=*value*"

Response "AO{ch}:REG"

*ch* 0, 1

*value* 0 to 65535

Example "AO{0}:REG=1455"

Note This message is only supported by devices with simultaneous DAC output capability. Use with AO:UPDATE to simultaneously update the DAC outputs.

Use AO:VALUE to set the DAC value on devices with non-simultaneous output.

- Get the value of a DAC channel that supports simultaneous output.

Message "?AO{ch}:REG "

Response "AO{ch}:REG=*value* "

*ch* 0, 1

*value* 0 to 65535

Example "?AO{1}:REG"

**RES**

- Get the resolution of the D/A converter.

Message "?AO:RES"

Response "AO:RES=*value*"

*value* U16

Note The first character indicates if the value is signed (S) or unsigned (U). The second value indicates the resolution in bits.

**SCALE**

- Enable or disable scaling of all D/A channels.

Message "AO:SCALE=*value*"

Response "AO:SCALE"

*value* ENABLE, DISABLE

Example "AO:SCALE=ENABLE"

Note When enabled, the device accepts voltage values. When disabled, the device accepts count values.

This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether scaling will be applied to the D/A channels.

Message    "?AO:SCALE"

Response    "AO:SCALE=*value*"

*ch*            The channel number.

*value*        ENABLE, DISABLE

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

### **SLOPE**

- Get the calibration slope for a specified channel, currently set range and channel mode.

Message    "?AO{*ch*}:SLOPE"

Response    "AO{*ch*}:SLOPE=*value*"

*ch*            The D/A channel number.

*value*        The value of the calibration slope.

Example    "?AO{0}:SLOPE"

### **UPDATE**

- Simultaneously update DAC channels.

Message    "AO:UPDATE"

Response    "AO:UPDATE"

Note        Use AO{*ch*}:REG to set the value of each DAC channel.

### **VALUE**

- Set the value of an analog output channel.

Message    "AO{*ch*}:VALUE=*value*"

Response    "AO{*ch*}:VALUE"

*ch*            The D/A channel number.

*value*        The channel value.

Example    "AO{0}:VALUE=1455"

## AOCAL

Gets the manufacturer calibration date and time.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

START, STATUS

#### START

- Start the D/A internal calibration. This operation calibrates the analog outputs and writes calibration factors to the board.

Message    "?AOCAL:START"

Response   "AOCAL:START"

Note        Once the "AOCAL:START" message is sent, no other messages other than "?AOCAL:STATUS" may be sent until the calibration process is complete.

#### STATUS

- Get the status of the D/A internal calibration.

Message    "?AOCAL:STATUS"

Response   "AOCAL:STATUS=*value*"

*value*      RUNNING, IDLE

## AOSCAN

Sets and gets property values when scanning analog output channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

BUFSIZE, CAL, COUNT, EXTPACER, HIGHCHAN, INDEX, LOWCHAN, RANGE, RATE, SAMPLES, SCALE, START, STATUS, STOP

#### BUFSIZE

- Set the size in bytes of the buffer used for analog output scanning operations.

Message    "AOSCAN:BUFSIZE=*value*"

Response   "AOSCAN:BUFSIZE"

*value*      The size in bytes of the output buffer.

Example    "AOSCAN:BUFSIZE=65536"

Notes       The default buffer size is 65536 bytes. This should be sufficient for most applications. The actual buffer size will always be an integer multiple of the device's maximum packet size.

- Get the size of the buffer used for AOSCAN.

Message    "?AOSCAN:BUFSIZE"

Response   "AOSCAN:BUFSIZE=*value*"

*value*      The size in bytes of the output buffer.

Example    "?AOSCAN:BUFSIZE"

#### **CAL**

- Enable or disable calibration of the D/A data.

Message    "AOSCAN:CAL=*value*"

Response   "AOSCAN:CAL"

*value*      ENABLE, DISABLE

Example    "AOSCAN:CAL=ENABLE"

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether calibration coefficients will be applied to the raw D/A data.

Message    "?AOSCAN:CAL"

Response   "AOSCAN:CAL=*value*"

*value*      ENABLE, DISABLE

Note        This message is processed by the DAQFlex Software library, and is not sent to the device.

#### **COUNT**

- Get the number of samples per channel that have been sent to the device by the AOSCAN operation.

Message    "?AOSCAN:COUNT"

Response   "AOSCAN:COUNT=*value*"

*value*      The number of samples per channel sent to the device buffer.

Example    "AOSCAN:COUNT=64"

Note        This message is processed by DAQFlex Software library, and is not sent to the device.

#### **EXTPACER**

- Set the state of the D/A clock.

Message    "AOSCAN:EXTPACER=*value*"

Response   "AOSCAN:EXTPACER"

*value*      ENABLE, DISABLE

Example    "AOSCAN:EXTPACER=ENABLE"

- Get the state of the D/A clock.

Message    "?AOSCAN:EXTPACER"

Response   "AOSCAN:EXTPACER=*value*"

*value*      ENABLE, DISABLE



**HIGHCHAN**

- Set the last D/A channel to include in the analog output scan operation.

Message "AOSCAN:HIGHCAN=*value*"

Response "AOSCAN:HIGHCAN"

*value*      The channel number.

Example "AOSCAN:HIGHCAN=1"

- Get the last D/A channel to include in the analog output scan operation.

Message "?AOSCAN:HIGHCAN"

Response "AOSCAN:HIGHCAN=*value*"

*value*      The channel number.

**INDEX**

- Get the current location of the output pointer in the buffer.

Message "?AOSCAN:INDEX"

Response "AOSCAN:INDEX=*value*"

*value*      The current location of the pointer in the buffer.

Example "AOSCAN:COUNT=765"

Note      This message is processed by the DAQFlex Software library, and is not sent to the device.

**LOWCHAN**

- Set the first D/A channel to include in the analog output scan operation.

Message "AOSCAN:LOWCHAN=*value*"

Response "AOSCAN:LOWCHAN"

*value*      The channel number.

Example "AOSCAN:LOWCHAN=0"

- Get the first D/A channel to include in the analog output scan operation.

Message "?AOSCAN:LOWCHAN"

Response "AOSCAN:LOWCHAN=*value*"

*value*      The channel number.

**RANGE**

- Get the analog output range set for the D/A channels.

Message "?AOSCAN:RANGE{*ch*}"

Response "AOSCAN:RANGE{*ch*}=*value*"

*ch*          The D/A channel number.

*value*      The range value.  
If the D/A channels are not set to the same range *value* returns MIXED.

Example    "AOSCAN:RANGE{0}=BIP10V"

#### **RATE**

- Set the D/A pacer rate in Hz.

Message    "AOSCAN:RATE=*value*"

Response   "AOSCAN:RATE"

*value*      >0 (float)

Example    "AOSCAN:RATE=1000"

- Get the D/A pacer rate in Hz.

Message    "?AOSCAN:RATE"

Response   "?AOSCAN:RATE=*value*"

*value*      1 to the maximum rate of the device.

Example    "?AOSCAN:RATE"

#### **RESET**

- Reset the status of the AOSCAN operation.

Message    "AOSCAN:RESET"

Response   "AOSCAN:RESET"

#### **SAMPLES**

- Set the number of samples per channel to output.

Message    "AOSCAN:SAMPLES=*value*"

Response   "AOSCAN:SAMPLES"

*value*      0 to N

Example    "AOSCAN:SAMPLES=1000"

Note       Set *value* to 0 for a continuous scan.

- Get the number of samples per channel to output.

Message    "?AOSCAN:SAMPLES"

Response   "AOSCAN:SAMPLES=*value*"

*value*      A numeric value.

Example    "?AOSCAN:SAMPLES"

**SCALE**

- Enable or disable scaling of the D/A data.

Message "AOSCAN:SCALE=*value*"

Response "AOSCAN:SCALE"

*value*      ENABLE, DISABLE

Example "AOSCAN:SCALE=ENABLE"

Note      When enabled, the device accepts voltage values. When disabled, the device accepts count values.

This message is processed by the DAQFlex Software library, and is not sent to the device.

- Get a value indicating whether scaling will be applied to the D/A data.

Message "?AOSCAN:SCALE"

Response "AOSCAN:SCALE=*value*"

*value*      ENABLE, DISABLE

Note      This message is processed by the DAQFlex Software library, and is not sent to the device.

**START**

- Start an analog output scan.

Message "AOSCAN:START"

Response "AOSCAN:START"

**STATUS**

- Get the status of the AOSCAN operation.

Message "?AOSCAN:STATUS"

Response "AOSCAN:STATUS=*value*"

*value*      IDLE, RUNNING, or UNDERRUN

Example "AOSCAN:STATUS=RUNNING"

**STOP**

- Stop an analog output scan.

Message "AOSCAN:STOP"

Response "AOSCAN:STOP"

## AOTRIG

Sets and gets analog output trigger property values.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

TYPE

#### TYPE

- Set the trigger edge.  
Message "AOTRIG:TYPE=*value*"  
Response "AOTRIG:TYPE"  
*value* EDGE/RISING, EDGE/FALLING  
Example "AOTRIG:TYPE=EDGE/RISING"
- Get the trigger edge.  
Message "?AOTRIG:TYPE"  
Response "AOTRIG:TYPE=*value*"  
*value* EDGE/RISING, EDGE/FALLING

## CTR

Sets and gets property values for counter channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

START, STOP, VALUE

#### (Component only)

- Get the number of counter channels on a device.  
Message "?CTR"  
Response "CTR=*value*"  
*value* The number of counter channels on a device.

#### START

- Start a specified counter channel.  
Message "CTR{*ch*}:START"  
Response "CTR{*ch*}:START"  
*ch* The number of the counter channel.  
Example "CTR{0}:START"

**STOP**

- Stop a specified counter channel.

Message "CTR{ch}:STOP"

Response "CTR{ch}:STOP"

*ch* The number of the counter channel.

Example "CTR{0}:STOP"

**VALUE**

- Load the specified counter channel with a value.

Message "CTR{ch}:VALUE=*value*"

Response "CTR{ch}:VALUE"

*ch* The number of the counter channel.

*value* The value to load onto the counter channel (0 to  $2^{32} - 1$ ).

Example "CTR{0}:VALUE=0"

Note Setting a value of 0 resets the counter to 0.

- Get the value of the specified counter channel.

Message "?CTR{ch}:VALUE"

Response "CTR{ch}:VALUE=*value*"

*ch* The number of the counter channel.

*value* The value of the counter channel.

Example "?CTR{0}:VALUE"

**DEV**

Sets and gets device property values.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

**Properties**

FLASHLED, FPGACFG, FPGAV, FWV, ID, MFGCAL, MFGSER, RESET, STATUS/ISO, TEMP, VEXT

**FLASHLED**

- Flash the device LED.

Message "DEV:FLASHLED/{*n*}"

Response "DEV:FLASHLED"

*n* A number indicating how many times to flash the device LED.

Example "DEV:FLASHLED/5"

**FPGACFG**

- Put the device into FPGA configuration mode.

Message "DEV:FPGACFG/<unlock code>"

Response "DEV:FPGACFG"

*unlock code* Device-specific hex value.

Example "DEV:FPGACFG/0xAD"

Note The device must be in FPGA configuration mode in order to update the device's FPGA configuration.

- Get the status of the device's FPGA.

Message "?DEV:FPGACFG"

Response "DEV:FPGACFG=*value*"

*value* CONFIGURED, CONFIGMODE

Note *CONFIGURED* indicates that the device's FPGA is currently configured. *CONFIGMODE* indicates that the device's FPGA is not currently configured.

**FPGAV**

- Get the firmware version of the device FPGA.

Message "?DEV:FPGAV"

Response "DEV:FPGAV=*value*"

*value* The firmware version of the device FPGA.

Example "DEV:FPGAV=2.05"

**FWV**

- Get the firmware version on the device.

Message "?DEV:FWV"

Response "DEV:FWV=*value*"

*value* The firmware version on the device.

Example "DEV:FWV=01.02" or "DEV:FWV=01.01.00f00"

**ID**

- Set the device ID.

Message "DEV:ID=*value*"

Response "DEV:ID"

*value* The ID set for the device. ID is set to MYDEVICE by default.

Example "DEV:ID=MYDEVICE"

Note The number of characters supported by *value* is device-dependent.

- Get the device ID.

Message    "?DEV:ID"

Response    "DEV:ID=*value*"

*value*        The ID set for the device.

#### **MFGCAL**

- Get the date and time in which the device was last calibrated.

Message    "?DEV:MFGCAL"

Response    "DEV:MFGCAL=*value*"

*value*        The calibration date and time.

Example    "DEV:MFGCAL=2009-04-13 11:56:27"

- Get the year in which the device was last calibrated.

Message    "?DEV:MFGCAL{YEAR}"

Response    "DEV:MFGCAL{YEAR}=*value*"

*YEAR*        The calibration year.

Example    "DEV:MFGCAL{YEAR}=2013"

- Get the month in which the device was last calibrated.

Message    "?DEV:MFGCAL{MONTH}"

Response    "DEV:MFGCAL{MONTH}=*value*"

*MONTH*       The calibration month.

Example    "DEV:MFGCAL{MONTH}=04"

- Get the day in which the device was last calibrated.

Message    "?DEV:MFGCAL{DAY}"

Response    "DEV:MFGCAL{DAY}=*value*"

*DAY*         The calibration day.

Example    "DEV:MFGCAL{DAY}=13"

- Get the hour in which the device was last calibrated.

Message    "?DEV:MFGCAL{HOUR}"

Response    "DEV:MFGCAL{HOUR}=*value*"

*HOUR*        The calibration hour.

Example    "DEV:MFGCAL{HOUR}=11"

- Get the minute in which the device was last calibrated.

Message    "?DEV:MFGCAL{MINUTE}"

Response    "DEV:MFGCAL{MINUTE}=value"

*MINUTE*    The calibration minute.

Example    "DEV:MFGCAL{MINUTE}=56"

- Get the second in which the device was last calibrated.

Message    "?DEV:MFGCAL{SECOND}"

Response    "DEV:MFGCAL{SECOND}=value"

*SECOND*    The calibration second.

Example    "DEV:MFGCAL{SECOND}=27"

### MFGSER

- Get the manufacturer serial number of the device.

Message    "?DEV:MFGSER"

Response    "DEV:MFGSER=value"

*value*        The serial number of the device.

Example    "DEV:MFGSER=00000001"

### RESET

- Reset the device or the default parameters.

Message    "DEV:RESET/value"

Response    "The device is not responding" when *value* is set to SYSTEM.  
(*SYSTEM* resets the USB interface to the device, and the device cannot send a response; this value is not recommended for use through the software).

"DEV:RESET" when *value* is set to DEFAULT.  
(*DEFAULT* resets all device parameters to the default value.)

*value*        SYSTEM, DEFAULT

Example    "DEV:RESET/DEFAULT"

### STATUS/ISO

- Get the status of the isolated microcontroller.

Message    "?AI:STATUS/ISO"

Response    "AI:STATUS=value"

*value*        READY, NOTREADY



**TEMP**

- Get the device internal temperature in °C.

Message    "?DEV:TEMP{tempnum}"

Response    "DEV:TEMP{tempnum}=value"

*tempnum*    The number of the temperature sensor on the device.

*value*        The internal temperature in °C.

Example    "DEV:TEMP{0}=21"

**VEXT**

- Get a value indicating whether external power is supplied to the device.

Message    "?DEV:VEXT"

Response    "DEV: VEXT =value"

*value*        True, False

**DIO**

Sets and gets property values for digital I/O channels.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

**Properties**

DIR, LATCH, VALUE

**(Component only)**

- Get the number of digital ports on a device.

Message    "?DIO"

Response    "DIO=value"

*value*        The number of digital ports.

- Get the number of bits on a port.

Message    "?DIO{port}"

Response    "DIO{port}=value"

*value*        The number of bits on the port.

Example    "?DIO{0}"

**DIR**

- Set the direction of a port.

Message    "DIO{port}:DIR=value"

Response    "DIO{port}:DIR"

*port*        The port number.

*value* IN, OUT

Example "DIO{0}:DIR=IN"

Note For devices that support this message, the default power up value is "IN".

- Get the direction of a port.

Message "?DIO{port}:DIR"

Response "DIO{port}:DIR=*value*"

*port* The port number.

*value* IN, OUT, or a number between 0 and  $2^n - 1$ , where  $n$  is the number of bits in the port.

Note If the digital bits are not individually configurable, the value returned is either "IN" or "OUT."  
If each digital bit is individually configurable, *value* is a bit mask, in which 1 indicates that the bit is configured for input, and 0 indicates that the bit is configured for output.

- Set the direction of a bit.

Message "DIO{port/bit}:DIR=*value*"

Response "DIO{port/bit}:DIR"

*port* The port number.

*bit* The bit number.

*value* IN, OUT

Example "DIO{0/1}:DIR=IN"

Note For devices that support this message, the default power up value is "IN".

- Get the direction of a bit.

Message "?DIO{port/bit}:DIR"

Response "DIO{port/bit}:DIR=*value*"

*port* The port number.

*bit* The bit number.

*value* IN, OUT

Example "?DIO{0/1}:DIR"

## LATCH

LATCH applies to programmable ports. This property lets you set a digital output value while in input mode. When programmed for output mode the latch value will be at the output.

- Set the latch value of a port.

Message "DIO{port}:LATCH=*value*"

Response "DIO{port}:LATCH"

*port*      The port number (0).  
*value*      The port value (0 to 255).

Example    "DIO{0}:LATCH=128"

- Get the latch value of a port.

Message    "?DIO{port}:LATCH"

Response   "DIO{port}:LATCH=*value*"

*port*      The port number.  
*value*      The port value.

Example    "?DIO{0}:LATCH"

- Set the latch value of a bit.

Message    "DIO{port/bit}:LATCH=*value*"

Response   "DIO{port/bit}:LATCH"

*port*      The port number.  
*bit*       The bit number.  
*value*      The bit value.

Example    "DIO{0/1}:LATCH=1"

- Get the latch value of a bit.

Message    "?DIO{port/bit}:LATCH"

Response   "DIO{port/bit}:LATCH=*value*"

*port*      The port value.  
*bit*       The bit number.  
*value*      The bit value.

Example    "?DIO{0/1}:LATCH"

## VALUE

- Set the value of a port.

Message    "DIO{port}:VALUE=*value*"

Response   "DIO{port}:VALUE"

*port*      The port number.  
*value*      The value of the port.

Example    "DIO{0}:VALUE=128"

Note        Performing an output operation on a programmable port that has not been configured for output will generate an error.

- Get the value of a port.

Message   "?DIO{port}:VALUE"

Response   "DIO{port}:VALUE=*value*"

*port*       The port number.

*value*       The value of the port.

Example   "?DIO{0}:VALUE"

- Set the value of a bit.

Message   "DIO{port/bit}:VALUE=*value*"

Response   "DIO{port/bit}:VALUE"

*port*       The port number.

*bit*        The bit number.

*value*       The value of the bit.

Example   "DIO{0/1}:VALUE=1"

Note       Performing an output operation on a programmable port that has not been configured for output will generate an error.

- Get the value of a bit.

Message   "?DIO{port/bit}:VALUE"

Response   "DIO{port/bit}:VALUE=*value*"

*port*       The port number.

*bit*        The bit number.

*value*       The value of the bit.

Example   "?DIO{0/1}:VALUE"

## TMR

Sets and gets property values for a timer output channel.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

### Properties

DELAY, DUTYCYCLE, IDLESTATE, PERIOD, PULSE, PULSECOUNT, START, STOP

### (Component only)

- Get the number of timer output channels on the device.

Message   "?TMR"

Response   "TMR=*value*"

*value*       The number of timer output channels.

**DELAY**

- Set the amount of time in mS to delay before starting the output.

Message "TMR{*ch*}:DELAY=*value*"

Response "TMR{*ch*}:DELAY"

*ch*            The channel number.

*value*        The time in milliseconds (mS).

Example "TMR{0}:DELAY=100"

- Get the amount of time in mS to delay before starting the output.

Message "?TMR{*ch*}:DELAY"

Response "TMR{*ch*}:DELAY=*value*"

*ch*            The channel number.

*value*        The time in milliseconds (mS).

Example "?TMR{0}:DELAY"

**DUTYCYCLE**

- Set the value in percent of the duty cycle for a specified channel.

Message "TMR{*ch*}:DUTYCYCLE=*value*"

Response "TMR{*ch*}:DUTYCYCLE"

*ch*            The channel number.

*value*        The duty cycle in percent (%).  
When not specified *value* is set to 50%.

Example "TMR{0}:DUTYCYCLE=100"

- Get the value of the duty cycle in percent for a specified channel.

Message "?TMR{*ch*}:DUTYCYCLE"

Response "TMR{*ch*}:DUTYCYCLE=*value*"

*ch*            The channel number.

*value*        The duty cycle in percent (%).

Example "?TMR{0}:DUTYCYCLE"

**IDLESTATE**

- Set the state of the timer channel.

Message "TMR{*ch*}:IDLESTATE=*value*"

Response "TMR{*ch*}:IDLESTATE"

*ch*            The channel number.

*value*        LOW, HIGH

Example "TMR{0}:IDLESTATE=HIGH"

Note When *value* is High the timer output is inverted.

- Get the state of the timer channel.

Message "?TMR{ch}:IDLESTATE"

Response "TMR{ch}:IDLESTATE=*value*"

*ch* The channel number.

*value* LOW, HIGH

Example "?TMR{0}:IDLESTATE"

#### PERIOD

- Set the period in milliseconds (mS) of the specified timer output.

Message "TMR{ch}:PERIOD=*value*"

Response "TMR{ch}:PERIOD"

*ch* The channel number.

*value* The period in mS.

Example "TMR{0}:PERIOD=100"

Note The PERIOD is required for timer output operations.

- Get the period in milliseconds (mS) of the specified timer output.

Message "?TMR{ch}:PERIOD"

Response "TMR{ch}:PERIOD=*value*"

*ch* The channel number.

*value* The period in mS.

Example "?TMR{0}:PERIOD"

#### PULSE

- Set the value in Hz of the pulse frequency for a specified channel.

Message "TMR{ch}:PULSE=*value*"

Response "TMR{ch}:PULSE"

*ch* The channel number.

*value* The pulse frequency in Hz.

Example "TMR{0}:PULSE=1000"

- Get the value in Hz of the pulse frequency for a specified channel.

Message    "?TMR{*ch*}:PULSE"

Response    "TMR{*ch*}:PULSE=*value*"

*ch*            The channel number.

*value*        The pulse frequency in Hz.

Example    "?TMR{0}:PULSE"

#### PULSECOUNT

- Set the number of pulses to generate.

Message    "TMR{*ch*}:PULSECOUNT=*value*"

Response    "TMR{*ch*}:PULSECOUNT"

*ch*            The channel number.

*value*        The number of pulses to generate.  
A value of 0 generates pulses continuously until the "TMR{*ch*}:STOP"  
message is sent.

Example    "TMR{0}:PULSE=100"

- Get the number of pulses to generate.

Message    "?TMR{*ch*}:PULSECOUNT"

Response    "TMR{*ch*}:PULSECOUNT=*value*"

*ch*            The channel number.

*value*        The number of pulses to generate.  
A value of 0 indicates continuous pulse generation.

Example    "?TMR{0}:PULSECOUNT"

#### START

- Start the timer output.

Message    "TMR{*ch*}:START"

Response    "TMR{*ch*}:START"

*ch*            The channel number.

Example    "TMR{0}:START"

#### STOP

- Stop the timer output.

Message    "TMR{*ch*}:STOP"

Response    "TMR{*ch*}:STOP"

*ch*            The channel number.

Example    "TMR{0}:STOP"

## Reflection messages

Device reflection messages get information about the capabilities of a device, such as the maximum scan rate or support for an external clock. Device reflection messages always start with the @ character.

Device features are stored on the device in EEPROM.

Click on a component below for the string messages, device responses, and property values supported by the component.

Components for retrieving device information	Description
<a href="#">AI</a>	Gets the analog input properties of a device.
<a href="#">AISCAN</a>	Gets the analog input scanning properties of a device.
<a href="#">AITRIG</a>	Gets the analog input triggering properties of a device.
<a href="#">AO</a>	Gets the analog output properties of a device.
<a href="#">AOSCAN</a>	Gets the analog output scanning properties of a device.
<a href="#">CTR</a>	Gets the counter input properties of a device.
<a href="#">DIO</a>	Gets the digital I/O properties of a device.
<a href="#">TMR</a>	Gets the timer output properties of a device.

### AI

Gets the analog input properties of a device.

#### Properties

CJC, CHANNELS, CHMODES, FACCAL, INPUTS, MAXCOUNT, MAXRATE, RANGES, SELF CAL, SENSORS, SENSORCONFIG, TCTYPES

#### CJC

- Get the CJC channel number associated with an analog input channel.

Message "@AI{ch}:CJC"

Response "AI{ch}:CJC=*implementation*>*value*"

*ch* Channel number.

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* Channel number for the CJC associated with the specified channel, or returns NOT\_SUPPORTED if the device doesn't support CJC's or the value of {ch} is not valid for the device.

Example "AI{0}:CJC=FIXED%0"



**CHANNELS**

- Get the number of analog input channels on a device.

Message "@AI:CHANNELS"

Response

*implementation* FIXED%, PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value* The number of A/D channels on a device, or returns NOT\_SUPPORTED if the device doesn't support analog input.

Example "AI:CHANNELS=FIXED%8"

Note On some devices, the values returned may be dependent on channel configuration settings.

**CHMODES**

- Get the analog input channel modes that are supported by the device.

Message "@AI:CHMODES"

Response "AI:CHMODES=*implementation*>*value*<*dependent properties*>"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* SE or DIFF, or returns NOT\_SUPPORTED if the device doesn't support analog input.

*dependent properties* One or more property that is dependent on the value of another property. For example, the CHANNELS property is dependent on whether the CHMODES *value* property is set to SE or DIFF.

Example "AI:CHMODES=PROG%SE,DIFF<CHANNELS, RANGES>"

**FACCAL**

- Get a value indicating if the device supports factory calibration for analog inputs.

Message "@AI:FACCAL"

Response "AI:FACCAL=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* SUPPORTED, NOT\_SUPPORTED

Example "AI:FACCAL=FIXED%SUPPORTED"

**INPUTS**

- Get the analog input signal types that are supported by the device or specified channel.

Message "@AI:INPUTS"

"@AI{ch}:INPUTS"

Response "AI{ch}:INPUTS=*implementation*>*value*"

*ch* Channel number (if {ch} format is used).

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* VOLTS, TEMP, CUR (current), or RES (resistance), or returns NOT\_SUPPORTED if the device doesn't support analog input or if the value of {ch} is not valid for the device.

Example "AI{0}:INPUTS=PROG%VOLTS,TEMP"

**MAXCOUNT**

- Get the maximum count of the device's A/D converter.

Message "@AI:MAXCOUNT"

Response

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum count of the A/D converter, or returns NOT\_SUPPORTED if the device doesn't support analog input.

Example "AI:MAXCOUNT=FIXED%65535"

**MAXRATE**

- Get the maximum rate for software paced analog input operations.

Message "@AI:MAXRATE"

Response "AI:MAXRATE=*implementation*>*value*"

**RANGES**

- Get the analog input ranges that are supported by the device.

Message "@AI:RANGES"

"@AI{ch}:RANGES"

Response "AI{ch}:RANGES=*implementation*>*value*"

*ch* Channel number (if {ch} format is used).

*implementation* FIXED%, PROG% (programmable), or HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* A list of all valid ranges for the specified channel (using the {ch} format) or device, or returns NOT\_SUPPORTED if the device doesn't support analog input, or the value of {ch} is not valid for the device.

Example "AI{0}:RANGES=PROG%BIP10V,BIP5V"

- Note            On some devices, the values returned may be dependent on channel configuration settings.  
Some devices require the {ch} format.

**SELF CAL**

- Get a value indicating if the device supports self-calibration for analog inputs.

Message    "@AI:SELF CAL"

Response    "AI:SELF CAL=<implementation>value"

*implementation*    PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value*                SUPPORTED, NOT\_SUPPORTED

Example    "AI:SELF CAL=PROG%SUPPORTED"

**SENSORS**

- Get the analog input sensor types that are supported by the device or specified channel.

Message    "@AI:SENSORS"

"@AI{ch}:SENSORS"

Response    "AI{ch}:SENSORS=implementation>value"

*ch*                    Channel number (if {ch} format is used).

*implementation*    FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value*                TC, RTD, THERM (thermistor), or SEMI (semiconductor), or returns NOT\_SUPPORTED if the device doesn't support analog input sensors or the value of {ch} is not valid for the device.

Example    "AI{0}:SENSORS=FIXED%TC"

**SENSORCONFIG**

- Get the analog sensor configurations that are supported by the specified channel.

Message    "@AI{ch}:SENSORCONFIG"

Response    "AI{ch}:SENSORCONFIG=implementation>value"

*ch*                    Channel number.

*implementation*    FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value*                2WIRE, 3WIRE, 4WIRE, FULLBRG, HALFBRG, QTRBRG, or returns NOT\_SUPPORTED if the device doesn't support configuration of sensors or the value of {ch} is not valid for the device.

Example    "AI{0}:SENSORCONFIG=PROG%2WIRE,3WIRE,4WIRE"

**TCTYPES**

- Get the thermocouple sensor types that are supported by the device or specified channel.

Message "@AI:TCTYPES"

"@AI{ch}:TCTYPES"

Response "AI{ch}:TCTYPES=*implementation*>*value*"

*ch* Channel number (if {ch} format is used).

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* B, E, J, K, N, R, S, T, or returns NOT\_SUPPORTED if the device doesn't support thermocouples or the value of {ch} is not valid for the device.

Example "AI{0}:TCTYPES=PROG%B,E,J,K,N,R,S,T"

**AISCAN**

Get the analog input scan properties of a device.

**Properties**

EXTPACER, FIFOSIZE, MAXBURSTRATE, MAXBURSTTHRUPUT, MAXSCANRATE, MAXSCANTHRUPUT, MINSCANRATE, MINBURSTRATE, QUEUECONFIG, QUEUELEN, QUEUESEQ, TRIG, XFRMODES, XFRSIZE

**EXTPACER**

- Get a value indicating which A/D pacing sources are supported by the device.

Message "@AISCAN:EXTPACER"

Response "AISCAN:EXTPACER=*implementation*>*value*"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED.

*value* DISABLE, ENABLE/MASTER, ENABLE/SLAVE, ENABLE/GSLAVE, or returns NOT\_SUPPORTED if the device doesn't support pacing analog input externally.

Example "AISCAN:EXTPACER=PROG%DISABLE, ENABLE/MASTER, ENABLE/SLAVE"

**FIFOSIZE**

- Get the size in bytes of the device's FIFO.

Message "@AISCAN:FIFOSIZE"

Response "AISCAN:FIFOSIZE=*implementation*>*value*"

*implementation* FIXED%

*value* The size, in bytes, of the device's analog input FIFO or returns NOT\_SUPPORTED if the device doesn't support analog input scan.

Example "AISCAN:FIFOSIZE=FIXED%4096"

**MAXBURSTRATE**

- Get the maximum hardware-paced input scan rate for BURSTIO mode operations.

Message "@AISCAN:MAXBURSTRATE"

Response "AISCAN:MAXBURSTRATE=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum scan rate for BURSTIO mode operations or returns NOT\_SUPPORTED if the device doesn't support analog input BURSTIO operations.

Example "AISCAN:MAXBURSTRATE=FIXED%200000"

**MAXBURSTTHRUPUT**

- Get the maximum analog input throughput for BURSTIO mode operations.

Message "@AISCAN:MAXBURSTTHRUPUT"

Response "AISCAN:MAXBURSTTHRUPUT=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum analog input throughput for BURSTIO operations, or returns NOT\_SUPPORTED if the device doesn't support analog input BURSTIO operations.

Example "AISCAN:MAXBURSTTHRUPUT=FIXED%2000"

**MAXSCANRATE**

- Get the maximum hardware-paced input scan rate in samples per second.

Message "@AISCAN:MAXSCANRATE"

Response "AISCAN:MAXSCANRATE=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum input scan rate, or returns NOT\_SUPPORTED if the device doesn't support analog input scan.

Example "AISCAN:MAXSCANRATE=FIXED%1000"

**MAXSCANTHRUPUT**

- Get the maximum analog input throughput in samples per second.

Message "@AISCAN:MAXSCANTHRUPUT"

Response "AISCAN:MAXSCANTHRUPUT=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum throughput rate, or returns NOT\_SUPPORTED if the device doesn't support analog input scan

Example "AISCAN:MAXSCANTHRUPUT=FIXED%200000"

**MINBURSTRATE**

- Get the minimum hardware-paced input scan rate for BURSTIO mode operations.

Message "@AISCAN:MINBURSTRATE"

Response "AISCAN:MINBURSTRATE=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The minimum scan rate for BURSTIO mode operations, or returns NOT\_SUPPORTED if the device doesn't support analog input BURSTIO operations.

Example "AISCAN:MINBURSTRATE=FIXED%20"

**MINSKANRATE**

- Get the minimum hardware-paced input scan rate in samples per second.

Message "@AISCAN:MINSKANRATE"

Response "AISCAN:MINSKANRATE=*implementation*>*value*"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The minimum input scan rate, or returns NOT\_SUPPORTED if the device doesn't support analog input scan.

Example "AISCAN:MINSKANRATE=FIXED%0.569"

**QUEUECONFIG**

- Get a value indicating which properties can be programmed using the AIQUEUE component.

Message "@AISCAN:QUEUECONFIG"

Response "AISCAN:QUEUECONFIG=<*implementation*>*value*"

*implementation* PROG%, or not specified if value is NOT\_SUPPORTED

*value* CHAN, CHMODE, RANGE, DATARATE, or NOT\_SUPPORTED.

Example "AISCAN:QUEUECONFIG=PROG% CHAN, CHMODE, RANGE"

**QUEUELEN**

- Get the maximum number of elements that can be stored in the analog input queue.

Message "@AISCAN:QUEUELEN"

Response "AISCAN:QUEUELEN=*implementation*>*value*"

*implementation* FIXED%, PROG%, or not specified if value is NOT\_SUPPORTED

*value* The maximum number of elements that can be stored in the queue, or returns NOT\_SUPPORTED if the device doesn't support an analog input queue.

Example "AISCAN:QUEUELEN=8"

**QUEUESEQ**

- Get the channel sequence format of the analog input channel queue.

Message "@AISCAN:QUEUESEQ"

Response "AISCAN:PROG%QUEUESEQ=*implementation*>*value*"

*implementation* FIXED%, PROG%, or not specified if value is NOT\_SUPPORTED

*value* The channel format capability for the channel queue. This value can be one or more of the following: ADJACENT, ASCENDING, ANYORDER, DUPLICATE, or returns NOT\_SUPPORTED if the device doesn't support an analog input queue.

Example "AISCAN: QUEUESEQ=FIXED%DUPLICATE,ANYORDER "

Note Queue sequence format:

- *ADJACENT* – only adjacent channels can appear in the sequence. Example: 2,3,4.
- *ASCENDING* – channels must appear in ascending order in the sequence. Example: 0,3,5.
- *ANYORDER* – channels may appear in any order in the sequence. Example: 6,3,7,0.
- *DUPLICATE* – a channel may appear more than once in the sequence. Example: 0,2,2,3.

**TRIG**

- Get a value indicating whether the device supports external triggering of analog input channels.

Message "@AISCAN:TRIG"

Response "AISCAN:TRIG=*implementation*>*value*"

*implementation* PROG%, HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED.

*value* ENABLE, DISABLE, or returns NOT\_SUPPORTED if the device doesn't support triggering analog input externally.

Example "AISCAN:EXTTRIG=PROG%ENABLE, DISABLE"

**XFRMODES**

- Get the input transfer modes supported by a device.

Message "@AISCAN:XFRMODES"

Response "AISCAN:XFRMODES=*implementation*>*value*"

*implementation* FIXED%, PROG% (programmable), or not specified if value is NOT\_SUPPORTED.

*value* BLOCKIO, SINGLEIO, BURSTAD, BURSTIO, or returns NOT\_SUPPORTED if the device doesn't support transfer modes.

Example "AISCAN:XFRMODES=PROG%BLOCKIO,SINGLEIO,BURSTIO"

**XFRSIZE**

- Get the number of bytes used in the transfer of each data sample.

Message "@AISCAN:XFRSIZE"

Response "AISCAN:XFRSIZE=<implementation>value"

*implementation* FIXED%, or not specified if *value* is NOT\_SUPPORTED

*value* The number of bytes, or NOT\_SUPPORTED

Example "AISCAN:XFRSIZE=FIXED%2"

**AITRIG**

Get the analog input trigger properties of a device.

**Properties**

RANGES, REARM, SRCS, TYPES

**RANGES**

- Get the supported ranges for a device's analog input trigger circuit.

Message "@AITRIG:RANGES"

Response "AITRIG:RANGES=<implementation>value"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if *value* is NOT\_SUPPORTED

*value* A list of all valid ranges for the specified analog trigger source or device, or returns NOT\_SUPPORTED if the device doesn't support analog triggering of analog input or the trigger source is not valid for the device.

Example "AITRIG:RANGES=PROG%BIP10V,BIP5V"

Note On some devices, the values returned may be dependent on channel configuration settings.

**REARM**

- Get a value indicating whether the device supports continuous triggering of the analog input.

Message "@AITRIG:REARM"

Response "AITRIG:REARM=<implementation>value"

*implementation* FIXED%, PROG%, or not specified if *value* is NOT\_SUPPORTED

*value* ENABLE, DISABLE, or returns NOT\_SUPPORTED if the device doesn't support continuous triggering of analog input.

Example "AITRIG:REARM=PROG%ENABLE,DISABLE"



**SRCS**

- Set the edge trigger type.

Message "@AITRIG:SRCS"

Response "AITRIG:SRCS=*implementation*>*value*"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* HW/DIG, HW/ANLG, or returns NOT\_SUPPORTED if the device doesn't support triggering analog input scans.

Example "AITRIG:SRCS=PROG%HW/DIG,HW/ANLG"

**TYPES**

- Get the types of trigger sensing that are supported by the device.

Message "@AITRIG:TYPES"

Response "AITRIG:TYPES=*implementation*>*value*"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* <type>/<condition> or returns NOT\_SUPPORTED if the device doesn't support triggering analog input scans.

*type* EDGE, LEVEL

*condition* RISING, FALLING, if type is EDGE.  
HIGH, LOW if type is LEVEL.

Example "AITRIG:TYPES=PROG%EDGE/RISING,EDGE/FALLING"

**AO**

Gets the analog output properties of a device.

**Properties**

CHANNELS, FACCAL, MAXCOUNT, MAXRATE, OUTPUTS, RANGES, SELFAL

**CHANNELS**

- Get the number of analog output channels on a device.

Message "@AO:CHANNELS"

Response "AO:CHANNELS=<*implementation*>*value*"

*implementation* FIXED%, PROG%, or not specified if value is NOT\_SUPPORTED

*value* The number of D/A channels on a device, or returns NOT\_SUPPORTED if the device doesn't support analog output.

Example "AO:CHANNELS=FIXED%4"

**FACCAL**

- Get a value indicating if the device supports factory calibration for analog outputs.

Message "@AO:FACCAL"

Response "AO:FACCAL=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* NOT\_SUPPORTED or SUPPORTED

Example "AO:FACCAL=FIXED%SUPPORTED"

**MAXCOUNT**

- Get the maximum count of the device's D/A converter.

Message "@AO:MAXCOUNT"

Response "AO:MAXCOUNT=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum count of the D/A converter or returns NOT\_SUPPORTED if the device doesn't support analog output.

Example "AO:MAXCOUNT=FIXED%65535"

**MAXRATE**

- Get the maximum rate for software paced analog output operations.

Message "@AO:MAXRATE"

Response "AO:MAXRATE=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum output rate of the device, or returns NOT\_SUPPORTED if the device doesn't support analog output.

Example "AO:MAXRATE=FIXED%100"

Note The maximum rate is based on the device's ability to perform single-point I/O.

**OUTPUTS**

- Get the analog output signal types that are supported by the device or specified channel.

Message "@AO:OUTPUTS"

"@AO{ch}:OUTPUTS"

Response "AO{ch}:OUTPUTS=<implementation>value"

*ch* Channel number (if {ch} format is used).

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* VOLTS, CUR, or returns NOT\_SUPPORTED if the device doesn't support analog output or the value of {ch} is not valid for the device.

Example "AO{0}:OUTPUTS=PROG%VOLTS,CUR"

## RANGES

- Get the analog output ranges supported by a device.

Message "@AO:RANGES"

"@AO{ch}:RANGES"

Response " AO{ch}: RANGES=<implementation>value "

*implementation* FIXED%, PROG%, or not specified if value is NOT\_SUPPORTED

*value* The AO ranges supported by a device, or returns NOT\_SUPPORTED if the device doesn't support analog output or the value of {ch} isn't valid for the device.

Example " AO:RANGES=FIXED%BIP10V"

## SELFCAL

- Get a value indicating if the device supports self-calibration for analog outputs.

Message "@AO:SELFCAL"

Response "AO:SELFCAL=<implementation>value"

*implementation* PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value* SUPPORTED, NOT\_SUPPORTED

Example "AO:SELFCAL=PROG%SUPPORTED"

## AOSCAN

Gets the analog output scan properties of a device.

### Properties

ADCLKTRIG, EXTPACER, FIFOSIZE, MAXSCANRATE, MAXSCANTHRUPUT, MINSCANRATE, SIMUL, TRIG, XFRSIZE

### ADCLKTRIG

- Get a value indicating whether analog output channels can be triggered by the device's A/D clock.

Message "@AOSCAN:ADCLKTRIG"

Response "AOSCAN:ADCLKTRIG=<implementation>value"

*implementation* FIXED%, PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value* ENABLE , DISABLE or returns NOT\_SUPPORTED if the device doesn't support pacing analog output scan from the A/D pacer.

Example "AOSCAN:ADCLKTRIG=PROG%ENABLE, DISABLE"

**EXTPACER**

- Get a value indicating which D/A pacing sources are supported by the device.

Message "@AOSCAN:EXTPACER"

Response "AOSCAN: EXTPACER=<implementation>value"

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED

*value* DISABLE, ENABLE/MASTER, ENABLE/SLAVE, ENABLE/GSLAVE or returns NOT\_SUPPORTED if the device doesn't support pacing analog input externally.

Example "AOSCAN: EXTPACER=PROG%ENABLE/MASTER"

**FIFOSIZE**

- Get the size in bytes of the device's analog output FIFO.

Message "@AOSCAN:FIFOSIZE"

Response "AOSCAN: FIFOSIZE=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The size, in bytes, of the device's analog output FIFO, or returns NOT\_SUPPORTED if the device doesn't support buffering of the analog output.

Example "AOSCAN:FIFOSIZE=FIXED%4096"

**MAXSCANRATE**

- Get the maximum hardware-paced output scan rate in samples per second.

Message "@AOSCAN:MAXSCANRATE"

Response "AOSCAN:MAXSCANRATE=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum output scan rate, or returns NOT\_SUPPORTED if the device doesn't support analog output scan.

Example "AOSCAN:MAXSCANRATE=FIXED%1000"

**MAXSCANTHRUPUT**

- Get the maximum analog output throughput in samples per second.

Message "@AOSCAN:MAXSCANTHRUPUT"

Response "AOSCAN: MAXSCANTHRUPUT=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum throughput rate, or returns NOT\_SUPPORTED if the device doesn't support analog output scan.

Example "AOSCAN: MAXSCANTHRUPUT=FIXED%200000"

**MINSKANRATE**

- Get the minimum hardware-paced output scan rate in samples per second.

Message "@AOSCAN:MINSKANRATE"

Response "AOSCAN:MINSKANRATE=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The minimum output scan rate, or returns NOT\_SUPPORTED if the device doesn't support analog output scan.

Example "AOSCAN:MINSKANRATE=FIXED%1"

**SIMUL**

- Get a value indicating whether analog output channels can be updated simultaneously.

Message "@AOSCAN:SIMUL"

Response "AOSCAN:SIMUL=<implementation>value"

*implementation* FIXED%, PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value* PROG%ENABLE, DISABLE or returns NOT\_SUPPORTED if the device doesn't support simultaneous update of the analog output.

Example "AOSCAN:SIMUL=PROG%ENABLE, DISABLE"

**TRIG**

- Get a value indicating whether analog output channels can be externally triggered.

Message "@AOSCAN: TRIG"

Response "AOSCAN: TRIG=<implementation>value"

*implementation* FIXED%, PROG% (programmable), or not specified if value is NOT\_SUPPORTED

*value* ENABLE, DISABLE, or returns NOT\_SUPPORTED if the device doesn't support triggering analog output scan.

Example "AOSCAN: TRIG=PROG%ENABLE,DISABLE"

**XFRSIZE**

- Get the number of bytes used in the transfer of each data sample.

Message "@AOSCAN:XFRSIZE"

Response " AOSCAN:XFRSIZE=<implementation>value"

*implementation* FIXED%, or not specified if *value* is NOT\_SUPPORTED

*value* The number of bytes, or NOT\_SUPPORTED

Example " AOSCAN:XFRSIZE=FIXED%2"

## CTR

Gets the counter channel properties of a device.

### Properties

CHANNELS, EDGE, LDMAX, LDMIN, MAXCOUNT, TYPE

### CHANNELS

- Get the number of counter channels on a device.

Message "@CTR:CHANNELS"

Response "CTR:CHANNELS=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*Value* The number of counter channels on a device, or returns NOT\_SUPPORTED if the device has no counters.

Example "CTR:CHANNELS=FIXED%3"

### EDGE

- Get a value indicating whether a counter's edge detection is programmable.

Message "@CTR{ch}:EDGE"

Response "CTR{ch}:EDGE=<implementation><value>"

*ch* The counter number.

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable) , or not specified if value is NOT\_SUPPORTED.

*value* RISING, FALLING, or returns NOT\_SUPPORTED if the device has no counters.

Example "CTR{0}:EDGE=PROG%RISING,FALLING"

### LDMAX

- Get the maximum count value that can be set using the "CTR{ch}:VALUE=" message.

Message "@CTR{ch}:LDMAX"

Response "CTR{ch}:LDMAX=<implementation>value"

*ch* The number of the counter channel.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum count that can be used for the VALUE property, or NOT\_SUPPORTED.

Example "CTR{0}:LDMAX=FIXED%65535"

**LDMIN**

- Get the minimum count value that can be set using the "CTR{ch}:VALUE=" message.

Message "@CTR{ch}:LDMIN"

Response "CTR{ch}:LDMIN=<implementation>value"

*ch* The number of the counter channel.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The minimum count that can be used for the VALUE property, or NOT\_SUPPORTED.

Example "CTR{0}:LDMIN=FIXED%0"

**MAXCOUNT**

- Get the maximum count of the specified counter.

Message "@CTR{ch}:MAXCOUNT"

Response "CTR{ch}:MAXCOUNT=<implementation>value"

*ch* The number of the counter channel.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* The maximum count of the counter, or returns NOT\_SUPPORTED if the device has no counters.

Example "CTR{0}:MAXCOUNT=FIXED%65535"

**TYPE**

- Get the counter type.

Message "@CTR{ch}:TYPE"

Response "CTR{ch}:TYPE=<implementation>value"

*ch* The counter number.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED

*value* 8254, 9513, EVENT, or returns NOT\_SUPPORTED if the device has no counters.

Example "CTR{0}:TYPE=FIXED%EVENT"

## DIO

Gets the digital I/O properties of a device.

### Properties

CHANNELS, CONFIG, LATCH, MAXCOUNT

### CHANNELS

- Get the number of digital channels (ports) on a device.

Message "@DIO:CHANNELS"

Response "DIO:CHANNELS=<implementation>value"

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED.

*value* The number of digital channels (ports) on a device, or returns NOT\_SUPPORTED if the device has no digital channels.

Example "DIO:CHANNELS=FIXED%3"

### CONFIG

- Get the options supported by a specified port in which no configuration is required.

Message "@DIO{ch}:CONFIG"

Response "DIO{ch}:CONFIG=<implementation>value"

*ch* The digital port number.

*implementation* PROG% (programmable), AUTO%, or not specified if *value* is NOT\_SUPPORTED.

*value* BITIN, BITOUT, PORTIN, PORTOUT, or returns NOT\_SUPPORTED if the device has no digital channels.

Example "DIO{0}: CONFIG= AUTO%BITIN,BITOUT,PORTIN,PORTOUT"

### LATCH

- Get a value indicating whether the latch associated with a specified port has read and/or write access.

Message "@DIO{ch}:LATCH"

Response "DIO{ch}:LATCH=<implementation>value"

*ch* The digital port number.

*implementation* PROG% (programmable), or not specified if *value* is NOT\_SUPPORTED.

*value* READ, WRITE, or returns NOT\_SUPPORTED if the device has no digital channels.

Example "DIO{0}:LATCH=PROG%READ,WRITE"



**MAXCOUNT**

- Get the maximum count of the specified port.

Message "@DIO{ch}:MAXCOUNT"

Response "DIO{ch}:MAXCOUNT=<implementation>value"

*ch* The digital port number.

*implementation* FIXED%, or not specified if *value* is NOT\_SUPPORTED.

*value* The maximum count of the digital port, or returns NOT\_SUPPORTED if the device has no digital channels.

Example "DIO{0}:MAXCOUNT=FIXED%65535"

**TMR**

Gets the timer output properties of a device.

Refer to the device-specific information in the *Hardware Reference* section for the component properties and commands supported by each DAQ device.

**Properties**

BASEFREQ, CHANNELS, CLKSRC, DELAY, DUTYCYCLE, MAXCOUNT, TYPE

**BASEFREQ**

- Get the specified timer's internal base frequency in Hertz.

Message "@TMR{ch}:BASEFREQ"

Response "TMR{ch}:BASEFREQ=<implementation>value"

*ch* The number of the timer channel.

*implementation* FIXED%, or not specified if *value* is NOT\_SUPPORTED.

*value* The internal clock's base frequency, or returns NOT\_SUPPORTED if the device has no timer channels.

Example "TMR{0}:BASEFREQ=FIXED%64000000"

**CHANNELS**

- Get the number of timer output channels on a device.

Message "@TMR:CHANNELS"

Response "TMR:CHANNELS=<implementation>value"

*implementation* FIXED%, or not specified if *value* is NOT\_SUPPORTED.

*value* The number of timer output channels, or returns NOT\_SUPPORTED if the device has no timer outputs.

Example "TMR:CHANNELS=FIXED%2"

**CLKSRC**

- Get the clock source for the specified timer channel.

Message "@TMR{ch}:CLKSRC"

Response "TMR:CLKSRC=<implementation>value"

*ch* The number of the timer channel, or returns NOT\_SUPPORTED if the device has no timer channels.

*implementation* FIXED%, PROG% (programmable), HWSEL% (hardware selectable), or not specified if value is NOT\_SUPPORTED.

*value* INT, EXT, or returns NOT\_SUPPORTED if the device has no timer channels.

Example "TMR{0}:CLKSRC=PROG%INT,EXT"

**DELAY**

- Get a value indicating how the specified timer's delay option is implemented.

Message "@TMR{ch}:DELAY"

Response "TMR{ch}:DELAY=<implementation>value"

*ch* The number of the timer channel.

*implementation* PROG% (programmable), or not specified if value is NOT\_SUPPORTED.

*value* PULSES, or returns NOT\_SUPPORTED if the device has no timer channels.

Example "TMR{0}:DELAY=PROG%PULSES"

**DUTYCYCLE**

- Get a value indicating how the duty cycle is supported for the specified counter.

Message "@TMR{ch}:DUTYCYCLE"

Response "TMR{ch}:DUTYCYCLE=<implementation>value"

*ch* The number of the timer channel.

*implementation* PROG% (programmable), or not specified if value is NOT\_SUPPORTED.

*value* PRCNTHIGH, PRCNTLOW, or returns NOT\_SUPPORTED if the device has no timer channels.

Example "TMR{0}:DUTYCYCLE=PROG%PRCNTHIGH"

**MAXCOUNT**

- Get the maximum count for the specified timer channel.

Message "@TMR{ch}:MAXCOUNT"

Response "TMR{ch}:MAXCOUNT=<implementation>value"

*ch* The number of the timer channel.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED.

*value* The maximum count of the timer, or returns NOT\_SUPPORTED if the device has no timer channels.

Example "TMR{0}:MAXCOUNT=FIXED%4294967295"

**TYPE**

- Get the type of timer for the specified timer channel.

Message "@TMR{ch}:TYPE"

Response "TMR{ch}:TYPE=<implementation>value"

*ch* The number of the timer channel.

*implementation* FIXED%, or not specified if value is NOT\_SUPPORTED.

*value* PULSE, NOT\_SUPPORTED

Example "TMR{0}:TYPE=FIXRD%PULSE"

## FlexTest Utility

FlexTest is an interactive GUI-based test utility that demonstrates how to communicate with a device using the DAQFlex communication protocol and software.

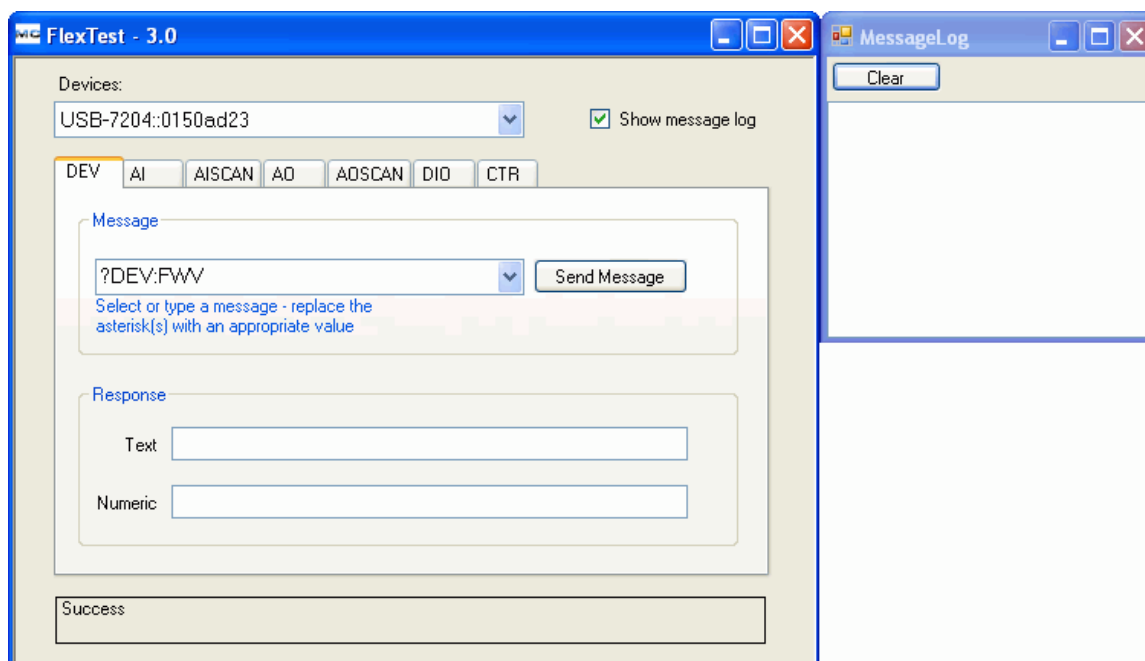
This utility automatically recognizes an available DAQFlex device, shows all commands available for this device, and allows users to interact with the device one command at a time. During this interaction, the commands are captured in a log, allowing the user to cut and paste them directly into a program.

FlexTest is included on the driver CD, and is installed to the following location:

- Windows 8, Windows 7, and Windows Vista — C:\Users\Public Documents\Measurement Computing\DAQFlex For Windows\FlexTest.exe.
- Windows XP, FlexTest — C:\Program Files\Measurement Computing\DAQFlex For Windows\FlexTest.exe.
- Windows CE — C:/Program Files/Measurement Computing/DAQFlex For Windows CE/FlexTest.exe.
- MAC OS X — FlexTest is installed to the /Applications folder.
- Linux — FlexTest is extracted to the directory in which the compressed files were extracted.  
To run FlexTest on Linux, do the following:
  - In a terminal window, set the current directory to DAQFlex/Source/DAQFlexTest.
  - As a root user, run the commands \$ make and \$ make install.
  - From a terminal window, run the FlexTest application using the command \$ flextest

**Note:** Connect a device that supports the DAQFlex protocol before running FlexTest.

When you run FlexTest, the main **FlexTest** window and a **MessageLog** window open:



## FlexTest user interface

The FlexTest window features the following controls:

- **Devices** drop-down list: displays the name and serial number of each connected DAQFlex-supported device.
- **Show message log** check box: When checked, the text of each message sent to the device appears in the **MessageLog** window.
- **Component** tabs: the DAQ components that are supported by the DAQFlex-supported device.
- **Message** field and drop down list: displays the text messages that can be sent to the device. The messages are specific to the component selected. An asterisk in the message indicates a variable whose property value must be entered.  
Refer to the DAQFlex Message Reference chapter for more information about the API messages.
- **Send Message** button: click this button to send the selected message to the device.
- **Response** field: Displays the response to the message that is returned from the device.
  - Text messages display in a *Text* field.
  - When a number is returned from the device, for example when reading the value of an analog input channel, the value displays in a *Numeric* field.
  - When multiple values are returned, such as when scanning data, the values display below the message that is returned.
- **Show message log** check box: When checked, the text of each message sent to the device appears in the MessageLog window.
- **Status area**: The bottom of the window displays either a status message or scan count:
  - *Message status*: When a message is successfully sent to a device, "Success" appears in the status area. If a message cannot be sent, such as when a variable is either not set or is set to an unsupported value, an error message appears in the status area.
  - *Scan count*: during a scan operation, the status area updates with the number of samples that are read.

### MessageLog window

The **MessageLog** window lists each message that is sent to the device. Note that the **Show message log** checkbox on the FlexTest window must be checked in order to display messages on the MessageLog window.

Click the **Clear** button to remove the messages.

## Using FlexTest

The procedures below demonstrate how to read/display scan data, and how to calibrate a device with FlexTest.

### Read and display scan data

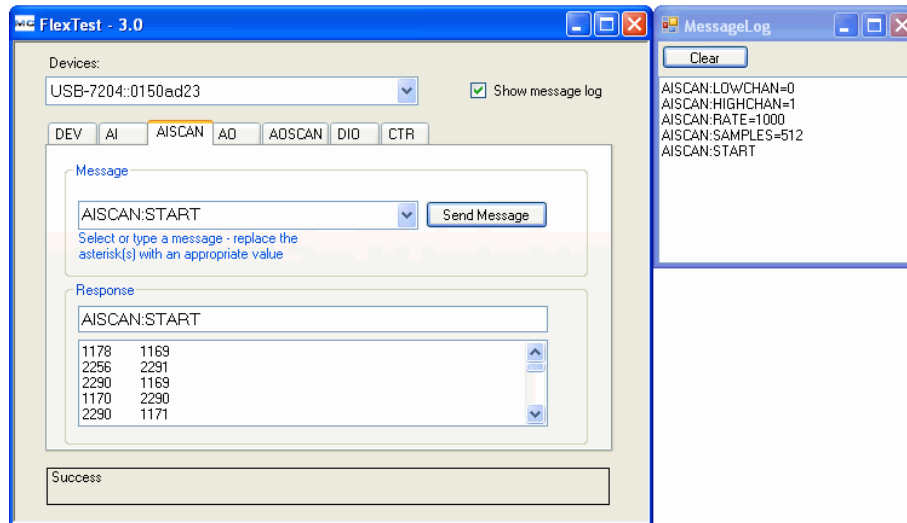
The following exercise demonstrates how to read and display multiple channel scan data using FlexTest. For this exercise, you set the range of analog channels to scan (1 to 3), set the channel range to  $\pm 10$  volts, the sample rate to 1000 Hz, and the number of samples to 256. After configuring the scan parameters, you run the operation and view the resulting scan data.

Do the following:

1. Connect a device that supports the DAQFlex protocol to your system and run FlexTest.
2. Click on the **AISCAN** tab.
3. Configure the scan parameters using the text strings in the **Message** drop down list:
  - Select **AISCAN:LOWCHAN=\***. Highlight the asterisk and enter "0", then click **Send Message**.
  - Select **AISCAN:HIGCHAN=\***. Highlight the asterisk and enter "1", then click **Send Message**.

- Select **AISCAN:RANGE=\***. Highlight the asterisk and enter "BIP10V", then click **Send Message**. This field is *not* case-sensitive.
  - Select **AISCAN:RATE=\***. Highlight the asterisk and enter "1000", then click **Send Message**.
  - Select **AISCAN:SAMPLES=\***. Highlight the asterisk and enter "512", then click **Send Message**.
4. Start the scan operation: Select **AISCAN:START** and click **Send Message**.

The FlexTest window displays the scan data in the Response area, and the MessageLog window lists the messages sent to the device.



#### Notes

- String data entered into the Message field is not case sensitive.
- Messages that begin with "?" are query messages. Select a query to read a value.

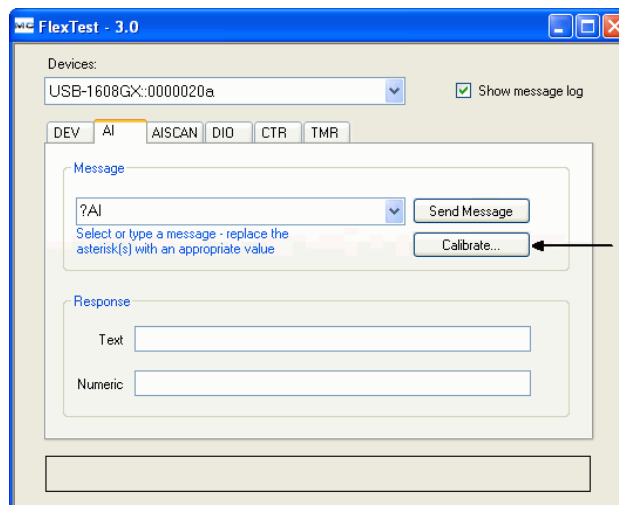
### Calibrate a device

For devices that support self-calibration, FlexText displays a **Calibrate** button on the AI tab to calibrate analog inputs. For devices with analog outputs FlexText displays a Calibrate button on the AO tab.

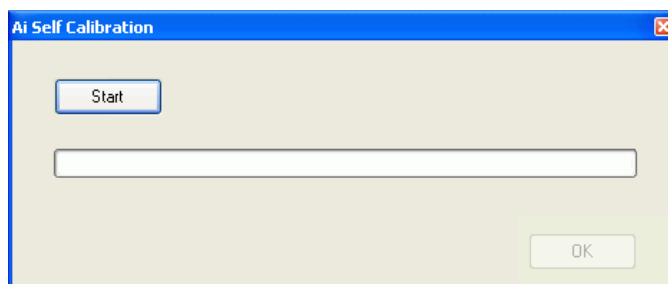
#### Calibrating analog inputs

To calibrate a device's analog inputs, do the following:

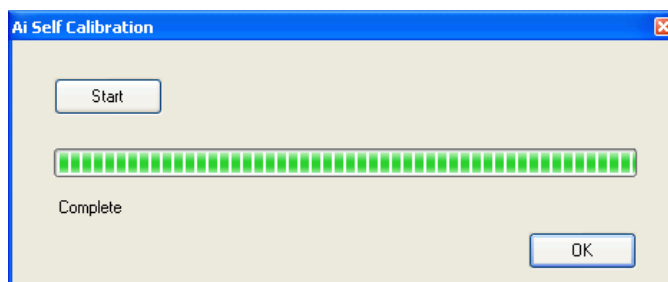
1. Select the **AI** tab.
2. Click the **Calibrate** button.



The **Ai Self Calibration** window opens.



3. Click the **Start** button to start calibrating the analog inputs. The progress bar updates as the operation progresses. When calibration is done the window displays **Complete**.



4. Click **OK** to close the window.

#### Calibrating analog outputs

To calibrate a device's analog outputs, do the following:

1. Select the **AO tab**.
2. Click the **Calibrate** button.  
The **Ao Self Calibration** window opens.
3. Click the **Start** button to start calibrating the analog outputs. The progress bar updates as the operation progresses. When calibration is done the window displays **Complete**.
4. Click **OK** to close the window.

## DAQFlex message reference

Refer to the *DAQFlex Message Reference* chapter on page 31 for the supported DAQFlex API messages.

**Note:** FlexTest cannot be run at the same time as the DAQFlex Firmware Loader utility (DAQFlexFWLoader.exe).

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## C# and VB Example Programs

Complete C# and VB example programs are installed with DAQFlex that demonstrate how to configure DAQFlex-supported devices and perform DAQ operations with the DAQFlex Software API.

### Default installation path

- On Windows, the example programs are installed by default to CSharp and VB subfolders:
  - Windows 8, Windows 7, and Windows Vista — C:\Users\Public Documents\Measurement Computing\DAQFlex For Windows\Examples.
  - Windows XP — C:\Program Files\Measurement Computing\DAQFlex For Windows\Examples.
  - Windows CE — C:\Program Files\Measurement Computing\DAQFlex For Windows CE\Examples.
- On Mac OS X, example programs are installed to Users/Shared/Measurement Computing/DAQFlex/Examples.
- On Linux, C# example programs are extracted to DAQFlex/Examples/CSharp.

### Building the DAQFlex example programs

#### Windows 8/7/Vista/XP

Complete the following steps to run the DAQFlex example programs:

1. Go to Measurement Computing\DAQFlex\Examples\ExampleBuilder.
2. Run the ExampleBuilder script to build all CSharp and Visual Basic examples.
3. Go to Measurement Computing\DAQFlex\Examples\Go To Examples.  
The example program directory opens. The example programs are installed by default to CSharp and VB subfolders.
4. Double-click on a \*.csproj or \*.vbproj file to run the DAQFlex example program.

#### Windows CE

Complete the following steps to run the DAQFlex example programs:

1. Go to Measurement Computing\DAQFlex for Windows CE\Examples\Go to Examples.  
The example program directory opens. The example programs are installed by default to CSharp and VB subfolders.
2. Double-click on a \*.csproj or \*.vbproj file to run the DAQFlex example program.

#### Mac OS X

Complete the following steps to run the DAQFlex example programs:

1. Go to Users/Shared/Measurement Computing/DAQFlex/Examples.
2. Run the ExampleBuilder script to build all CSharp and Visual Basic examples.
3. From a terminal window, go to either CSharp/<application name>/bin/Debug or VB/<application name>/bin/Debug, and run the following command:
  - mono <application name>.exe

#### Linux

You run the DAQFlex C# example programs using MonoDevelop or the Mono command line interpreter. Do the following:

1. In a terminal window, set the current directory to DAQFlex/Examples.
2. Run the following commands as a root user:
  - make
  - make install
3. Exit the root user shell.



4. From a terminal window, run the example programs as a non-root user by entering the application name as a command, for example:
  - o ainscan

Refer to the readme.txt file for additional information about running the DAQFlex example programs.

## Hardware Reference

Select your DAQFlex-supported device below for the components and programming messages supported by the device.

**Note:** You can use any of the device reflection messages to retrieve information about the device's capabilities.

- [USB-200 Series](#)
- [USB-1208FS-Plus](#)
- [USB-1408FS-Plus](#)
- [USB-1608FS-Plus](#)
- [USB-1608G Series](#)
- [USB-2001-TC](#)
- [USB-2408 Series](#)
- [USB-7202](#)
- [USB-7204](#)

## USB-200 Series

The USB-200 Series includes the following devices:

- USB-201, USB-201-OEM
- USB-202, USB-202-OEM
- USB-204, USB-204-OEM
- USB-205, USB-205-OEM

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	8
	CAL	Set/Get	ENABLE, DISABLE
	CHMODE	Get	SE
	RANGE	Get	BIP10V
	RES	Get	U12
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Get	BIP10V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AIQUEUE</a>	CLEAR	Set	
	COUNT	Get	0 to 7 elements
<a href="#">AIQUEUE(element)</a>	CHAN	Set/Get	element: 0 to 7 value: 0 to 7
	CHMODE	Get	element: 0 to 7 value: SE
	RANGE	Get	element: 0 to 7 value: BIP10V
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	EXTPACER	Set/Get	ENABLE, DISABLE
	HIGHCHAN	Set/Get	0 to 7
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 7
	QUEUE	Set/Get	ENABLE, DISABLE
	RANGE	Get	BIP10V
	RANGE{ch}	Get	channel: 0 to 7 value: BIP10V
	RATE	Set/Get	USB-204/USB-204-OEM and USB-205/ USB-205-OEM: 500,000 Hz  USB-201/USB-201-OEM and USB-202/USB-202-OEM: 100,000 Hz

Component	Supported Property/Command	Set/Get	Supported Values
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit FIFO)
	SCALE	Set/Get	ENABLE, DISABLE
	START	Set	
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP	Set	
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AITRIG</a>	SRC	Set/Get	HWSTART/DIG
	Type	Set/Get	EDGE/RISING, EDGE/FALLING LEVEL/HIGH, LEVEL/LOW
<a href="#">AO<sup>1</sup></a>		Get	2
	RES	Get	U12 (unsigned 12-bit integer)
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AO{ch}<sup>1</sup></a>	RANGE	Get	UNI5V
	VALUE	Set	0 to 4,095 0 to 4.99838 when SCALE is enabled
<a href="#">CTR</a>		Get	1
<a href="#">CTR{ch}</a>	START	Set	
	STOP	Set	
	VALUE	Get	0 to 4,294,967,295
		Set	0 (resets the counter to 0)
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET/{value}	Set	DEFAULT
<a href="#">DIO</a>		Get	1
<a href="#">DIO{port}</a>		Get	8
	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">DIO{port/bit}</a>	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	0 to 1
	VALUE	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
<sup>1</sup> Analog output is supported on the USB-202/USB-202-OEM and USB-205/USB-205-OEM only.			

- Eight 12-bit single-ended analog inputs, numbered 0 to 7
  - Analog input range is fixed at  $\pm 10$  V.
- Two 12-bit analog outputs, numbered 0 to 1 (USB-202/USB-202-OEM and USB-205/USB-205-OEM only).
  - Analog input range is fixed at 0 V to 5 V
- 8-bit digital port. Each bit is individually configurable as input or output.
- Timer output channel
- External digital trigger input
- External pacer input/output.  
This feature allows multiple devices to acquire synchronized samples.
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.
- *RATE* takes a float value.  
An error is generated if *value* is set is less than the device's minimum sampling rate or greater than the device's maximum sampling rate.

## USB-1208FS-Plus

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#"><u>AI</u></a>		Get	8 (single-ended), 4 (differential)
	CAL	Set/Get	ENABLE, DISABLE
	CHMODE	Set/Get	SE, DIFF
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
	RES	Get	U12
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#"><u>AI{ch}</u></a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#"><u>AIQUEUE</u></a>	CLEAR	Set	
	COUNT	Get	0 to 8 elements
<a href="#"><u>AIQUEUE{element}</u></a>	CHAN	Set/Get	element: 0 to 7 single-ended; 0 to 3 differential  value: 0 to 7 single-ended; 0 to 3 differential
	RANGE	Set/Get	element: 0 to 7 single-ended; 0 to 3 differential  value: BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
<a href="#"><u>AISCAN</u></a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE, DISABLE
	HIGHCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential (must be $\leq$ HIGHCHAN)
	QUEUE	Set/Get	ENABLE, DISABLE
	RATE	Set/Get	0.014 S/s to 50 kS/s

Component	Supported Property/Command	Set/Get	Supported Values
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
	RANGE{ch}		
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP		
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AITRIG</a>	REARM	Set/Get	ENABLE/DISABLE
	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING LEVEL/HIGH, LEVEL/LOW
<a href="#">AO</a>		Get	2 (number of analog output channels)
	RES	Get	U12
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AO{ch}</a>	RANGE	Get	UNI5V
	VALUE	Set	0 to 4095 0 to 4.99878 when SCALE is enabled
<a href="#">AOSCAN</a>	BUFSIZE	Set/Get	
	COUNT	Get	
	HIGHCHAN	Set/Get	0 to 1
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 1
	RATE	Set/Get	0.01 S/s to 50 kS/s
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START	Set	
	STATUS	Get	IDLE, RUNNING, UNDERRUN
	STOP	Set	
<a href="#">CTR</a>		Get	1 (number of counter channels)
<a href="#">CTR{ch}</a>	START	Set	
	STOP	Set	
	VALUE	Get	0 to 4,294,967,295
		Set	0 (resets the counter to 0)

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET/{value}	Set	DEFAULT
<a href="#">DIO</a>		Get	2 (number of digital ports)
<a href="#">DIO{port}</a>		Get	8 (number of bits on the port)
	DIR	Set/Get	IN, OUT (port-configurable)
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255
<a href="#">DIO{port/bit}</a>	LATCH	Set/Get	port number: 0, 1 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
	VALUE	Set/Get	port number: 0, 1 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1

#### Hardware features

- 8 single-ended (0 to 7), 4 differential (0 to 3) analog input channels
  - Analog input ranges:
    - Single-ended mode:  $\pm 10V$
    - Differential mode:  $\pm 20V$ ,  $\pm 10V$ ,  $\pm 5V$ ,  $\pm 4V$ ,  $\pm 2.5V$ ,  $\pm 1.25V$ ,  $\pm 1V$ ,  $\pm 1.25V$
  - Sampling rate: 50 kS/s max rate
  - Channel-gain queue: Up to eight unique, ascending elements; one gain element per channel.
  - Resolution: 12-bit differential mode, 11-bit single-ended mode.
- 2 analog output channels. The analog output range is 0 V to 5 V.
- 16 DIO configured as two 8-bit ports. Each port is configurable for input or output.
- External digital trigger
- Bidirectional external clock
- 32-bit event counter



## USB-1408FS-Plus

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#"><u>AI</u></a>		Get	8 (single-ended), 4 (differential)
	CAL	Set/Get	ENABLE, DISABLE
	CHMODE	Set/Get	SE, DIFF
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
	RES	Get	U14
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#"><u>AI{ch}</u></a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#"><u>AIQUEUE</u></a>	CLEAR	Set	
	COUNT	Get	0 to 8 elements
<a href="#"><u>AIQUEUE{element}</u></a>	CHAN	Set/Get	element: 0 to 7 single-ended; 0 to 3 differential  value: 0 to 7 single-ended; 0 to 3 differential
	RANGE	Set/Get	element: 0 to 7 single-ended; 0 to 3 differential  value: BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode) BIP10V (single-ended mode)
<a href="#"><u>AISCAN</u></a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE, DISABLE
	HIGHCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential (must be $\leq$ HIGHCHAN)
	QUEUE	Set/Get	ENABLE, DISABLE
	RATE	Set/Get	0.014 S/s to 48 kS/s

Component	Supported Property/Command	Set/Get	Supported Values
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V (differential mode)
	RANGE{ch}		BIP10V (single-ended mode)
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP		
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AITRIG</a>	REARM	Set/Get	ENABLE/DISABLE
	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING LEVEL/HIGH, LEVEL/LOW
<a href="#">AO</a>		Get	2 (number of analog output channels)
	RES	Get	U12
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AO{ch}</a>	RANGE	Get	UNI5V
	VALUE	Set	0 to 4095 0 to 4.99878 when SCALE is enabled
<a href="#">AOSCAN</a>	BUFSIZE	Set/Get	
	COUNT	Get	
	HIGHCHAN	Set/Get	0 to 1
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 1
	RATE	Set/Get	0.01 S/s to 50 kS/s
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START	Set	
	STATUS	Get	IDLE, RUNNING, UNDERRUN
	STOP	Set	
<a href="#">CTR</a>		Get	1 (number of counter channels)
<a href="#">CTR{ch}</a>	START	Set	
	STOP	Set	
	VALUE	Get	0 to 4,294,967,295
		Set	0 (resets the counter to 0)

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#"><u>DEV</u></a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET/{value}	Set	DEFAULT
<a href="#"><u>DIO</u></a>		Get	2 (number of digital ports)
<a href="#"><u>DIO{port}</u></a>		Get	8 (number of bits on the port)
	DIR	Set/Get	IN, OUT (port-configurable)
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255
<a href="#"><u>DIO{port/bit}</u></a>	LATCH	Set/Get	port number: 0, 1 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
	VALUE	Set/Get	port number: 0, 1 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1

#### Hardware features

- 8 single-ended (0 to 7), 4 differential (0 to 3) analog input channels
  - Analog input ranges:
    - Single-ended mode:  $\pm 10V$
    - Differential mode:  $\pm 20V$ ,  $\pm 10V$ ,  $\pm 5V$ ,  $\pm 4V$ ,  $\pm 2.5V$ ,  $\pm 1.25V$ ,  $\pm 1V$ ,  $\pm 1.25V$
  - Sampling rate: 48 kS/s max rate
  - Channel-gain queue: Up to eight unique, ascending elements; one gain element per channel.
  - Resolution: 14-bit differential mode, 13-bit single-ended mode.
- 2 analog output channels. The analog output range is 0 V to 5 V.
- 16 DIO configured as two 8-bit ports. Each port is configurable for input or output.
- External digital trigger
- Bidirectional external clock
- 32-bit event counter

## USB-1608FS-Plus

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	8
	CAL	Set/Get	ENABLE, DISABLE
	RES	Get	U16
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AIQUEUE</a>	CLEAR	Set	
	COUNT	Get	0 to 7 elements
<a href="#">AIQUEUE{element}</a>	CHAN	Set/Get	element: 0 to 7 value: 0 to 7
	RANGE	Set/Get	element: 0 to 7 value: BIP10V, BIP5V, BIP2V, BIP1V
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE/MASTER, ENABLE/SLAVE, DISABLE
	HIGHCHAN	Set/Get	0 to 7 single-ended
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 7 single-ended
	QUEUE	Set/Get	ENABLE, DISABLE
	RATE	Set/Get	0.009 S/s to 100 kS/s
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	Range{ch}		
	RESET	Set	
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit FIFO)
	SCALE	Set/Get	ENABLE, DISABLE
	START	Set	
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP	Set	
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO, BURSTIO
<a href="#">AITRIG</a>	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING LEVEL/HIGH, LEVEL/LOW

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">CTR</a>		Get	Number of counter channels
<a href="#">CTR{ch}</a>	VALUE	Get	0 to 4,294,967,295
		Set	0
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	Firmware version of the device MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET/{value}	Set	DEFAULT
<a href="#">DIO</a>		Get	Number of digital ports
<a href="#">DIO{port}</a>		Get	1
	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255
<a href="#">DIO{port/bit}</a>	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
	VALUE	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1

#### Hardware features

- 8 single-ended 16-bit simultaneous analog input channels, numbered 0 to 7.
  - Analog voltage input ranges:
    - ±10V
    - ±5V
    - ±2V
    - ±1V
    - ±0.625V
    - ±0.3125V
  - Sampling rate:
    - 100 kS/s max rate for one channel
    - 400 kS/s max aggregate rate, streaming. Limited by USB transfer speed; 800 kS/s max to 32K sample FIFO
  - Channel-gain queue– eight elements; one gain element per channel.
- 8 DIO, individually configurable

- External digital trigger
- Bidirectional external clock
- 32-bit event counter
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.

## USB-1608G Series

The USB-1608G Series includes the following devices:

- USB-1608G
- USB-1608GX
- USB-1608GX-2AO

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	Number of analog input channels
	CAL	Set/Get	ENABLE, DISABLE
	RES	Get	S24 (24-bit signed integer)
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	CHMODE	Set/Get	SE, DIFF
	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AICAL</a>	START	Set	
	STATUS	Get	RUNNING, IDLE
<a href="#">AIQUEUE</a>	CLEAR	Set	
	COUNT	Get	0 to 16 elements
<a href="#">AIQUEUE(element)</a>	CHAN	Set/Get	0 to 15 single-ended, 0 to 7 differential
	CHMODE	Set/Get	SE, DIFF
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	BURSTMODE	Set/Get	ENABLE, DISABLE
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE, DISABLE
	HIGHCHAN	Set/Get	0 to 15 single-ended, 0 to 7 differential
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 15 single-ended, 0 to 7 differential
	QUEUE	Set/Get	ENABLE, DISABLE, RESET
	RATE	Set/Get	USB-1608G: 0.01 to 250,000 Hz (1 channel) USB-1608GX: 0.01 to 500,000 Hz (1 channel) USB-1608GX-2AO: 0.01 to 500,000 Hz (1 channel)
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	RANGE{ch}		

Component	Supported Property/Command	Set/Get	Supported Values
	RESET	Set	
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP		
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AITRIG</a>	REARM	Set/Get	ENABLE, DISABLE
	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING LEVEL/HIGH, LEVEL/LOW
<a href="#">AO</a> <sup>1</sup>		Get	Number of analog output channels
	CAL	Set/Get	ENABLE, DISABLE
	RES	Get	U16 (unsigned 16-bit integer)
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AO{ch}</a> <sup>1</sup>	OFFSET	Get	4-byte floating point numeric
	RANGE	Get	BIP10V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Set	BIP10V
<a href="#">AOCAL</a>	START		
	STATUS	Get	
<a href="#">AOSCAN</a> <sup>1</sup>	BUFSIZE	Set/Get	
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE, DISABLE
	HIGHCHAN	Set/Get	0 to 1
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 1
	RANGE	Get	BIP10V
	RATE	Set/Get	1 to 500 kHz (1 channel)
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	START		
	STATUS	Get	IDLE, RUNNING, UNDERRUN
	STOP		
<a href="#">AOTRIG</a>	REARM	Set/Get	ENABLE, DISABLE
	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING



Component	Supported Property/Command	Set/Get	Supported Values
<a href="#"><u>CTR</u></a>		Get	Number of counter channels
<a href="#"><u>CTR{ch}</u></a>	START		
	STOP		
	VALUE	Get	0 to 4,294,967,295
		Set	0
<a href="#"><u>DEV</u></a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET	Set	DEFAULT
	TEMP	Get	Floating point numeric in °C
<a href="#"><u>DIO</u></a>		Get	Number of digital ports
<a href="#"><u>DIO{port}</u></a>		Get	8
	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255
<a href="#"><u>DIO{port/bit}</u></a>	DIR	Set/Get	IN, OUT
	LATCH	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
	VALUE	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
<a href="#"><u>TMR</u></a>		Get	Number of timer channels
<a href="#"><u>TMR{ch}</u></a>	DELAY	Set/Get	0 to 67.11 s
	DUTYCYCLE	Set/Get	0 to 100%
	IDLESTATE	Set/Get	LOW, HIGH
	PERIOD	Set/Get	31.25 ns to 67.11 s
	PULSECOUNT	Set/Get	0 to 4,294,967,295 (a value of 0 indicates continuous pulse generation)
	START		
	STOP		
<sup>1</sup> Analog output is supported on the USB-1608GX-2AO only.			

**Hardware features**

- 16 analog input channels, numbered 0 to 15.
- Analog input mode is configurable for single-ended (16 channels) or differential (8 channels).
  - Analog input ranges:
  - $\pm 10V$
  - $\pm 5V$
  - $\pm 2V$
  - $\pm 1V$
- 2 analog output channels, numbered 0 to 1 (USB-1608GX-2AO only)  
The analog output range is fixed at  $\pm 10V$ .
- 1 digital port (8 bits)  
Each bit is individually configurable as input or output.
- 1 timer output channel
- 1 external trigger input
- External pacer input/output  
This feature allows multiple devices to acquire synchronized samples.
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.
- *RATE* takes a float value  
An error is generated if *value* is set is less than the device's minimum sampling rate or greater than the device's maximum sampling rate.

## USB-2001-TC

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>	CJC/format	Get	CJC/DEGC, CJC/DEGF, CJC/KELVIN
	OFFSET	Get	Floating point numeric
	RANGE{ch}	Set/Get	BIP73.125E-3V ( $\pm 0.073125$ volts) BIP146.25E-3V ( $\pm 0.14625$ volts)
	SCALE	Set/Get	
	SENSOR	Set/Get	TC/B, TC/E, TC/J, TC/K, TC/N, TC/R, TC/S, TC/T
	SLOPE	Get	Floating point numeric
	STATUS	Get	BUSY, ERROR, READY
	VALUE	Get	Unsigned integer numeric
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	Firmware version
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits

### Hardware features

- One analog input channel, numbered 0
- Supports thermocouple types B, E, J, K, N, R, S, and T
- Possible gain ranges:
  - $\pm 146.25$  mV
  - $\pm 73.125$  mV
- 512 bytes of nonvolatile FLASH program memory; used for storing configuration information, calibration data, and user data.

## USB-2408 Series

The USB-2408 Series includes the following devices:

- USB-2408
- USB-2408-2AO

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	Number of analog input channels
	CAL	Set/Get	ENABLE, DISABLE
	DATARATE	Set/Get	3750, 2000, 1000, 500, 100, 60, 50, 25, 10, 5, 2.5 (S/s)
	ADCAL/START	Set	
	ADCAL/STATUS	Get	
	RES	Get	S24 (24-bit signed integer)
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	CHMODE	Set/Get	SE, DIFF, TC/OTD, TC/NOOTD SE is always returned for channel 8 to 15.
	CJC	Get	DEGC, DEGF, KELVIN
	DATARATE	Set/Get	3750, 2000, 1000, 500, 100, 60, 50, 25, 10, 5, 2.5 (S/s)
	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP10V, BIP5V, BIP2.5V, BIP1.25V, BIP625.0E-3V, BIP312.5E-3V, BIP156.25E-3V, BIP78.125E-3V
	SENSOR	Set/Get	TC/B, TC/E, TC/J, TC/K, TC/N, TC/R, TC/S, TC/T
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AICAL</a>	START	Set	
	STATUS	Get	
<a href="#">AIQUEUE</a>	CLEAR	Set	
	COUNT	Get	0 to 64 elements
<a href="#">AIQUEUE{element}</a>	CHAN	Set/Get	element: 0 to 63 value: 0 to 15
	CHMODE	Set/Get	element: 0 to 63 value: SE, DIFF, TC/OTD, TC/NOOTD
	DATARATE	Set/Get	3750, 2000, 1000, 500, 100, 60, 50, 25, 10, 5, 2.5 (S/s)
	RANGE	Set/Get	element: 0 to 63 value: BIP10V, BIP5V, BIP2.5V, BIP1.25V, BIP625.0E-3V, BIP312.5E-3V, BIP156.25E-3V, BIP78.125E-3V

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	HIGHCHAN	Set/Get	0 to 15 single-ended, 0 to 7 differential
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 15 single-ended, 0 to 7 differential
	QUEUE	Set/Get	ENABLE, DISABLE
	RATE	Set/Get	2.5 Hz to 1102.94 Hz (1 channel)
	RANGE	Set/Get	BIP10V, BIP5V, BIP2.5V, BIP1.25V, BIP625.0E-3V, BIP312.5E-3V, BIP156.25E-3V, BIP78.125E-3V
	RANGE{ch}		
	RESET	Set	
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START	Set	
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP	Set	
	TEMPUNITS	Set/Get	DEGC, DEGF, KELVIN
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AO</a> <sup>1</sup>		Get	Number of analog output channels
	CAL	Set/Get	ENABLE, DISABLE
	RES	Get	U16 (unsigned 16-bit integer)
	SCALE	Set/Get	ENABLE, DISABLE
	UPDATE	Set	
<a href="#">AO{ch}</a> <sup>1</sup>	OFFSET	Get	4-byte floating point numeric
	RANGE	Get	BIP10V
	REG	Set/Get	0 to 65535
	SLOPE	Get	4-byte floating point numeric
	VALUE	Set	0 to 65535
<a href="#">AOCAL</a>	START	Set	
	STATUS	Get	
<a href="#">AOSCAN</a> <sup>1</sup>	BUFSIZE	Set/Get	
	COUNT	Get	
	HIGHCHAN	Set/Get	0 to 1
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 1
	RESET	Set	
	RATE	Set/Get	1 Hz to 1000 Hz (1 channel)

Component	Supported Property/Command	Set/Get	Supported Values
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	START	Set	
	STATUS	Get	IDLE, RUNNING, UNDERRUN
	STOP	Set	
<a href="#">CTR</a>		Get	Number of counter channels
<a href="#">CTR{ch}</a>	START	Set	
	STOP	Set	
	VALUE	Get	0 to 4,294,967,295
		Set	0
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	Firmware version of the device MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
	RESET/{value}	Set	DEFAULT
	STATUS/ISO	Get	READY, NOTREADY
<a href="#">DIO</a>		Get	Number of digital ports
<a href="#">DIO{port}</a>		Get	8 (number of bits on the port)
	LATCH	Set/Get	0 to 255
	VALUE	Set/Get	0 to 255
<a href="#">DIO{port/bit}</a>	LATCH	Set/Get	0 to 1
	VALUE	Set/Get	port number: 0 bit number: 0 to 7 port value: 0 to 255 bit value: 0, 1
<sup>1</sup> Analog output is supported on the USB-2408-2AO only.			

#### Hardware features

- 16 analog input channels, numbered 0 to 15.
  - Analog input mode is configurable for single-ended (16 channels) or differential (8 channels).
  - Thermocouple mode requires a differential configuration.

Analog voltage input ranges:

- $\pm 10V$
- $\pm 5V$
- $\pm 2.5V$
- $\pm 1.25V$

- $\pm 0.625V$
- $\pm 0.3125V$
- $\pm 0.15625V$
- $\pm 0.078125V$

The analog thermocouple input range is fixed at  $\pm 0.078125V$ .

- 2 analog output channels, numbered 0 to 1 (USB-2408-2AO only).  
The analog output range is fixed at  $\pm 10V$
- 1 digital input/output port (8 bits).
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.
- RATE takes a float value. An error is generated if value set is less than the device's minimum sampling rate or greater than the device's maximum sampling rate.

## USB-7202

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	Number of analog input channels
	CAL	Set/Get	ENABLE, DISABLE
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set/Get	
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE/MASTER, ENABLE/SLAVE, DISABLE
	INDEX	Get	
	HIGHCHAN	Set/Get	0 to 7
	LOWCHAN	Set/Get	0 to 7
	RANGE	Set/Get	BIP10V, BIP5V, BIP2V, BIP1V
	RANGE{ch}		
	RATE	Set/Get	0.596 Hz to 50 kHz throughput rate for 1 channel. Aggregate throughput: <ul style="list-style-type: none"> <li>BLOCKIO mode: 100 kHz</li> <li>BURSTIO mode: 200 kHz</li> </ul>
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP		
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	SINGLEIO, BLOCKIO, BURSTIO
<a href="#">AITRIG</a>	TYPE	Set/Get	EDGE/RISING, EDGE/FALLING
<a href="#">CTR</a>		Get	Number of counter channels
<a href="#">CTR{ch}</a>	START	Set	Arms the counter channel
	STOP	Set	Disarms the counter channel
	VALUE	Set/Get	0 (Set) 0 to 4,294,967,295 (Get)



Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">DEV</a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
<a href="#">DIO</a>		Get	Number of digital ports
<a href="#">DIO{port}</a>	DIR	Set	IN, OUT
		Get	0 or 255 (bit field: 0 = all output, 255 = all input)
	VALUE	Get	0 to 255 (port) 0 to 1 (bit)
<a href="#">DIO{port/bit}</a>	DIR	Set/Get	IN, OUT
	VALUE	Set/Get	0 or 1 (bit)

#### Hardware features

- One digital port. All bits are individually configurable as input or output.
- Eight analog input channels, numbered 0 to 7. Possible gain ranges:
  - $\pm 10V$
  - $\pm 5V$
  - $\pm 2V$
  - $\pm 1V$
- External trigger input
- External pacer input / output. This feature allows multiple devices on a single USB to acquire synchronized samples. One master device is used to drive the signal. Additional devices must be configured as slave devices using the "AISCAN:EXTPACER=*value*" message. Value may be "ENABLE[/MASTER]", "ENABLE[/SLAVE]" or "DISABLE".
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.
- *RATE* takes a float value. If the input scan rate requested is less than the slowest rate supported by the device, the device is set to the slowest rate supported by the device. If the input scan rate requested is greater than the fastest rate supported by the device, the device is set to the fastest rate supported by the device.
- BURSTIO mode: the maximum sampling rate is an aggregate rate. The total acquisition rate is 200 kS/s divided by the number of channels. The maximum rate is 50 kS/s per channel for one, two, or four channels, and 25 kS/s per channel for 8 channels.  
When performing a finite BURSTIO scan, the maximum count is  $\leq 32,768$ .  
If a CONTROL IN message is sent or a CONTROL OUT message is received during a BURSTIO scan, AISCAN:STATUS=INTERRUPTED is returned. This property is not returned with BLOCKIO or SINGLEIO scans.

## USB-7204

Use the components below to set or get device properties.

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#">AI</a>		Get	Number of analog input channels
	CAL	Set/Get	ENABLE, DISABLE
	CHMODE	Set/Get	SE, DIFF
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#">AI{ch}</a>	OFFSET	Get	4-byte floating point numeric
	RANGE	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V
	SLOPE	Get	4-byte floating point numeric
	VALUE	Get	Unsigned integer numeric
	VALUE/{format}	Get	RAW, VOLTS
<a href="#">AISCAN</a>	BUFOVERWRITE	Set/Get	ENABLE, DISABLE
	BUFSIZE	Set	Set/Get
	CAL	Set/Get	ENABLE, DISABLE
	COUNT	Get	
	EXTPACER	Set/Get	ENABLE/MASTER, ENABLE/SLAVE, ENABLE/GSLAVE
	HIGHCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 7 single-ended, 0 to 3 differential (must be $\leq$ HIGHCHAN)
	QUEUE	Set/Get	ENABLE, DISABLE, RESET
	RANGE{ch}	Set/Get	BIP20V, BIP10V, BIP5V, BIP4V, BIP2PT5V, BIP2V, BIP1PT25V, BIP1V
	RANGE{element/ch}	Set	Element: 0 to 15 Channel: 0 to 7 single-ended, 0 to 3 differential Range: see the range values above.
	RATE	Set/Get	0.596 Hz to 50,000 Hz (1 channel)
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, OVERRUN
	STOP		
	TRIG	Set/Get	ENABLE, DISABLE
	XFRMODE	Set/Get	BLOCKIO, SINGLEIO
<a href="#">AITRIG</a>	Type	Set/Get	EDGE/RISING, EDGE/FALLING
	REARM	Set/Get	ENABLE, DISABLE

Component	Supported Property/Command	Set/Get	Supported Values
<a href="#"><u>AO</u></a>		Get	Number of analog output channels
	CAL	Set/Get	ENABLE, DISABLE
	SCALE	Set/Get	ENABLE, DISABLE
<a href="#"><u>AO{ch}</u></a>	RANGE	Get	UNI4.096V
	VALUE	Set	0 to 4095
<a href="#"><u>AOSCAN</u></a>	BUFSIZE	Set/Get	
	COUNT	Get	
	HIGHCHAN	Set/Get	0 to 1
	INDEX	Get	
	LOWCHAN	Set/Get	0 to 1
	RANGE	Get	UNI4.096V
	RATE	Set/Get	1 kHz to 10 kHz (1 channel)
	SAMPLES	Set/Get	0 to N (0 = continuous scan; N = 32-bit)
	SCALE	Set/Get	ENABLE, DISABLE
	START		
	STATUS	Get	IDLE, RUNNING, UNDERRUN
	STOP		
<a href="#"><u>CTR</u></a>		Get	Number of counter channels
<a href="#"><u>CTR{ch}</u></a>	START		
	STOP		
	VALUE	Get	0 to 4,294,967,295
		Set	0
<a href="#"><u>DEV</u></a>	FLASHLED/{n}	Set	0 to 255
	FWV	Get	MM.mm (M = major; m = minor)
	ID	Set/Get	Up to 56 characters
	MFGCAL	Get	yyyy-mm-dd HH:MM:SS
	MFGCAL{item}	Get	YEAR as yyyy; 20xx MONTH as mm; 01 to 12 DAY as dd; 01 to 31 HOUR as HH; 01 to 23 MINUTE as MM; 01 to 59 SECOND as SS; 01 to 59
	MFGSER	Get	Up to 8 hexadecimal digits
<a href="#"><u>DIO</u></a>		Get	Number of digital ports
<a href="#"><u>DIO{port}</u></a>	DIR	Set/Get	IN, OUT (port-configurable)
	VALUE	Set/Get	0 to 255
<a href="#"><u>DIO{port/bit}</u></a>	VALUE	Set/Get	0 or 1

**Hardware features**

- Two digital ports. Each port is individually configurable as input or output.
- Eight analog input channels, numbered 0 to 7.
- Analog input mode is configurable for single-ended (eight channels) or differential (four channels). Possible gain ranges:
  - $\pm 20\text{V}$  (differential mode)
  - $\pm 10\text{V}$  (differential or single-ended mode)
  - $\pm 5\text{V}$  (differential mode)
  - $\pm 4\text{V}$  (differential mode)
  - $\pm 2.5\text{V}$  (differential mode)
  - $\pm 2\text{V}$  (differential mode)
  - $\pm 1.25\text{V}$  (differential mode)
  - $\pm 1\text{V}$  (differential mode)
- External trigger input
- External pacer input / output. This feature allows multiple devices to acquire synchronized samples. One master device is used to drive the signal. Additional devices must be configured as slave devices using the "AISCAN:EXTPACER=*value*" message. Value may be "ENABLE/MASTER," "ENABLE/SLAVE," or "ENABLE/GSLAVE."
  - When set to *ENABLE/SLAVE*, the first clock pulse after setting up the scan is ignored to ensure adequate setup time for the first conversion. Use this mode when the device is paced from a continuous clock source.
  - When set to *ENABLE/GSLAVE*, the first clock pulse after setting up the scan is held off to ensure adequate setup time for the first conversion. No pulses are ignored. Use this mode when the device is paced from another USB-7204.
- 1,024 bytes of nonvolatile EEPROM memory; used for storing configuration information, calibration data, and user data.
- *RATE* takes a float value. If the input scan rate requested is less than the slowest rate supported by the device, the device is set to the slowest rate supported by the device. If the input scan rate requested is greater than the fastest rate supported by the device, the device is set to the maximum rate supported by the device.

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