PicoScope® 6000E Series

(ps6000a API)

Programmer's Guide

ps6000apg-5

Contents

1 Introduction

The PicoScope 6000E Series of oscilloscopes from Pico Technology is a range of compact high-performance units designed to replace traditional benchtop oscilloscopes.

This manual explains how to use the ps6000a API (application programming interface) for the PicoScope 6000E Series scopes.

For more information on the hardware, see the *PicoScope 6000E Series Data Sheet.*

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ps6000apg-5 (Available online and as a PDF)

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2 Programming overview

The ps6000a.dll dynamic link library in the lib subdirectory of your Pico Technology SDK installation directory allows you to program a PicoScope 6000E Series oscilloscope using standard C function calls.

A typical program for capturing data consists of the following steps:
- Open the scope unit.
- Set up the input channels with the required voltage ranges and coupling type.
- Set up triggering.
- Start capturing data. (See Sampling modes, where programming is discussed in more detail.)
- Wait until the scope unit is ready.
- Stop capturing data.
- Copy data to a buffer.
- Close the scope unit.

Numerous sample programs are available on the *picotech* channel of GitHub. These demonstrate how to use the functions of the driver software in each of the modes available.

2.1 System requirements

Using with PicoScope for Windows
To ensure that your PicoScope 6000E Series PC Oscilloscope operates correctly, you must have a computer with at least the minimum system requirements to run one of the supported operating systems, as shown in the following table. The performance of the oscilloscope will be better with a more powerful PC, and will benefit from a multi-core processor.

Item	Specification
Operating system	All desktop versions of Windows with mainstream support. 32-bit and 64-bit versions.
Processor, memory, free disk space	As required by the operating system.
Ports	USB 2.0 or 3.0 port

Using with Linux
Drivers are available for various Linux distributions. Instructions are available on our website.

Using with macOS
A software development kit (SDK) for macOS can be downloaded from our website.

Using with custom applications
32-bit and 64-bit drivers are available for Windows. The 32-bit drivers will also run in 32-bit mode on 64-bit operating systems.

USB
The ps6000a driver offers three different methods of recording data, all of which support USB 2.0 and USB 3.0. A USB 3.0 port will offer the best performance especially in streaming mode or when retrieving large amounts of data from the oscilloscope.

2.2 Driver

Your application will communicate with a PicoScope 6000 library called `ps6000a.dll`, which is supplied in 32-bit and 64-bit versions. The driver exports the PicoScope 6000 function definitions in standard C format, but this does not limit you to programming in C. You can use the API with any programming language that supports standard C calls.

The API depends on another library, `picoipp.dll`, which is supplied in 32-bit and 64-bit versions, and on a low-level driver, `WinUsb.sys`. These drivers are installed by the SDK and configured when you plug the oscilloscope into each USB port for the first time. Your application does not call these drivers directly.

2.3 Voltage ranges

You can set a device input channel to any available voltage range with the ps6000aSetChannelOn() function. Each sample is scaled to 16 bits. The minimum and maximum values returned to your application depend on the sampling resolution in use and can be queried by ps6000aGetAdcLimits(). This function replies with the following values:

Resolution	8 bits	10 bits	12 bits
Voltage	**Value returned**		
maximum	+32 512 (0x7F00)	+32 704 (0x7FC0)	+32 736 (0x7FE0)
zero	0	0	0
minimum	−32 512 (0x8100)	−32 704 (0x8040)	−32 736 (0x8020)

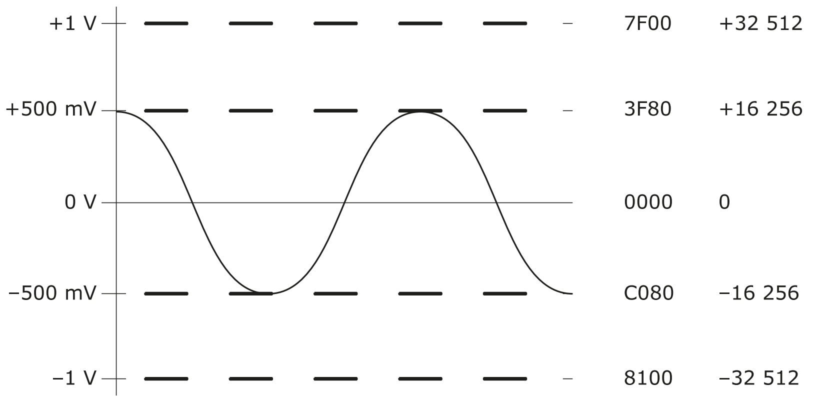
Example at 8-bit resolution

1. Call ps6000aSetChannelOn() with `range` set to `PICO_1V`.

2. Apply a sine wave input of 500 mV amplitude to the oscilloscope.

3. Capture some data using the desired sampling mode.

4. The data will be encoded as shown opposite.



Digital inputs (with optional MSO pods)

See ps6000aSetDigitalPort().

2.4 MSO digital data

Applicability
Any device with MSO pods attached. MSO pods are automatically recognized by the driver when connected.

A PicoScope MSO has two 8-bit digital ports—**Digital 1** and **Digital 2**—making a total of 16 digital channels.

Use the `ps6000aSetDataBuffer()` and `ps6000aSetDataBuffers()` functions to set up buffers into which the driver will write data from each port individually. For compatibility with the analog channels, each buffer is an array of 16-bit words. The 8-bit port data occupies the lower 8 bits of the word. The upper 8 bits of the word are undefined.

	Digital 2 buffer	Digital 1 buffer
Sample_0	[XXXXXXXX,2D7...2D0]$_0$	[XXXXXXXX,1D7...1D0]$_0$
...	...	...
Sample_{n-1}	[XXXXXXXX,2D7...2D0]$_{n-1}$	[XXXXXXXX,1D7...1D0]$_{n-1}$

Retrieving stored digital data
The following C code snippet shows how to combine data from the two 8-bit ports into a single 16-bit word, and then how to extract individual bits from the 16-bit word.

```
// Mask Digital 2 values to get lower 8 bits
portValue = 0x00ff & appDigiBuffers[2][i];

// Shift by 8 bits to place in upper 8 bits of 16-bit word
portValue <<= 8;

// Mask Digital 1 values to get lower 8 bits,
// then OR with shifted Digital 2 bits to get 16-bit word
portValue |= 0x00ff & appDigiBuffers[0][i];

for (bit = 0; bit < 16; bit++)
{
  // Shift value 32768 (binary 1000 0000 0000 0000).
  // AND with value to get 1 or 0 for channel.
  // Order will be 2D7 to 2D0, then 1D7 to 1D0.

  bitValue = (0x8000 >> bit) & portValue? 1 : 0;
}
```

2.5 Triggering

PicoScope 6000E Series PC Oscilloscopes can either start collecting data immediately or be programmed to wait for a **trigger** event to occur. In both cases you need to use the trigger functions:

- ps6000aSetTriggerChannelConditions()
- ps6000aSetTriggerChannelDirections()
- ps6000aSetTriggerChannelProperties()
- ps6000aSetTriggerDelay() (optional)

These can be run collectively by calling ps6000aSetSimpleTrigger(), or singly.

A trigger event can occur when one of the input channels crosses a threshold voltage on either a rising or a falling edge. It is also possible to combine up to four inputs using the logic trigger function.

The driver supports these triggering methods:

- Simple edge
- Advanced edge
- Windowing
- Pulse width
- Logic
- Delay
- Drop-out
- Runt

The pulse width, delay and drop-out triggering methods additionally require the use of the pulse width qualifier functions:

- ps6000aSetPulseWidthQualifierProperties()
- ps6000aSetPulseWidthQualifierConditions()
- ps6000aSetPulseWidthQualifierDirections()

2.6 Sampling modes

PicoScope 6000E Series oscilloscopes can run in various **sampling modes**.

- **Block mode**. In this mode, the scope stores data in its buffer memory and then transfers it to the PC. When the data has been collected it is possible to examine the data, with an optional downsampling factor. The data is lost when a new run is started in the same segment, the settings are changed or the scope is powered down

  The driver can return data asynchronously using a callback, which is a call to one of the functions in your own application. When you request data from the scope, you pass to the driver a pointer to your callback function. When the driver has written the data to your buffer, it makes a callback (calls your function) to signal that the data is ready. The callback function then signals to the application that the data is available.

  Because the callback is called asynchronously from the rest of your application, in a separate thread, you must ensure that it does not corrupt any global variables while it runs.

  If you do not wish to use a callback, you can poll the driver instead.

Rapid block mode. This is a variant of block mode that allows you to capture more than one waveform at a time with a minimum of delay between captures. You can use downsampling in this mode if you wish.

- **Streaming mode**. This mode enables long periods of data collection. In raw mode (no downsampling) it provides fast data transfer of unlimited amounts of data at up to 312 MB/s (3.2 ns per sample) in 8-bit mode with USB 3.0.

  If downsampling is enabled, raw data can be sampled at up to 1.25 GS/s for a single channel in 8-bit mode. Downsampled data is returned while capturing is in progress, at up to 312 MB/s. The raw data can then be retrieved after the capture is complete. The number of raw samples is limited by the memory available on the device, the selected resolution and the number of channels enabled.

  Triggering is supported in this mode.

Note: The oversampling feature of older PicoScope oscilloscopes has been replaced by PICO_RATIO_MODE_AVERAGE.

2.6.1 Block mode

In **block mode**, the computer prompts a PicoScope 6000E series oscilloscope to collect a block of data into its internal memory. When the oscilloscope has collected the whole block, it signals that it is ready and then transfers the whole block to the computer's memory through the USB port.

- **Block size.** The maximum number of values depends upon the size of the oscilloscope's memory. The memory buffer is shared between the enabled channels, so if two channels are enabled, each receives half the memory. These features are handled transparently by the driver. The block size also depends on the number of memory segments in use (see `ps6000aMemorySegments()`) and the sampling resolution.

- **Sampling rate.** A PicoScope 6000E Series oscilloscope can sample at a number of different rates according to the selected timebase and the combination of channels that are enabled. See the *PicoScope 6000E Series Data Sheet* for the specifications that apply to your scope model.

- **Setup time.** The driver normally performs a number of setup operations, which can take up to 50 milliseconds, before collecting each block of data. If you need to collect data with the minimum time interval between blocks, use rapid block mode and avoid calling setup functions between calls to `ps6000aRunBlock()`, `ps6000aStop()` and `ps6000aGetValues()`.

- **Downsampling.** When the data has been collected, you can set an optional downsampling factor and examine the data. Downsampling is a process that reduces the amount of data by combining adjacent samples. It is useful for zooming in and out of the data without having to repeatedly transfer the entire contents of the scope's buffer to the PC.

- **Memory segmentation.** The scope's internal memory can be divided into segments so that you can capture several waveforms in succession. Configure this using `ps6000aMemorySegments()` or `ps6000aMemorySegmentsBySamples()`.

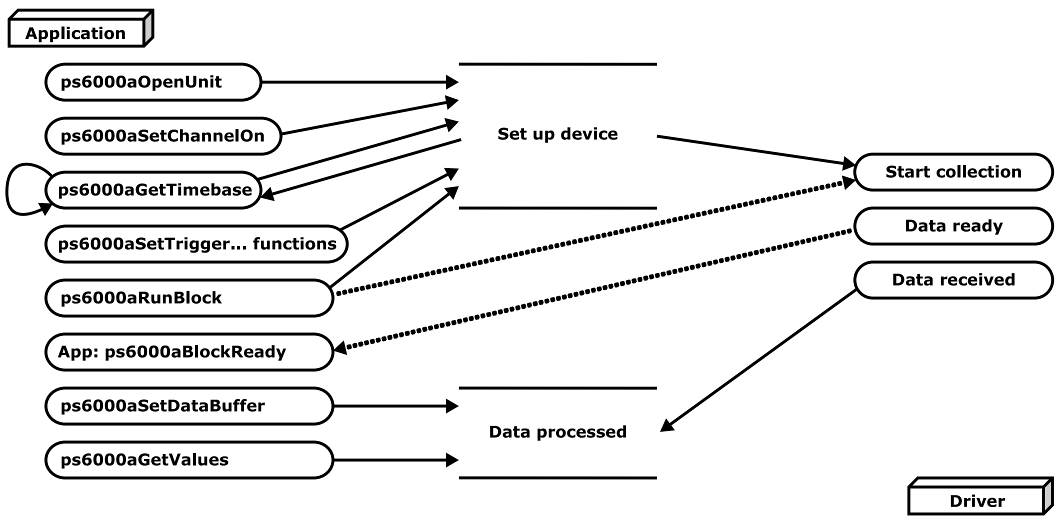
- **Data retention.** The data is lost when a new run is started in the same segment, the settings are changed, or the scope is powered down.

See Using block mode for programming details.

2.6.1.1 Using block mode

This is the general procedure for reading and displaying data in block mode using a single memory segment:

1. Open the oscilloscope using `ps6000aOpenUnit()`.
2. Select channel ranges and AC/DC/50 Ω coupling using `ps6000aSetChannelOn()` and `ps6000aSetChannelOff()`.
3. Using `ps6000aGetTimebase()`, select timebases until the required nanoseconds per sample is located.
4. Use the trigger setup functions `ps6000aSetTriggerChannelConditions()`, `ps6000aSetTriggerChannelDirections()` and `ps6000aSetTriggerChannelProperties()` to set up the trigger if required.
5. Start the oscilloscope running using `ps6000aRunBlock()`.
6. Wait until the oscilloscope is ready using the `ps6000aBlockReady()` callback (or poll using `ps6000aIsReady()`).
7. Use `ps6000aSetDataBuffer()` to tell the driver where your memory buffer is. For greater efficiency with multiple captures, you can do this outside the loop after step 4.
8. Transfer the block of data from the oscilloscope using `ps6000aGetValues()`.
9. Display the data.
10. Repeat steps 5 to 9.
11. Stop the oscilloscope using `ps6000aStop()`.
12. Request new views of stored data using different downsampling parameters: see Retrieving stored data.
13. Close the device using `ps6000aCloseUnit()`.



2.6.1.2 Asynchronous calls in block mode

`ps6000aGetValues()` may take a long time to complete if a large amount of data is being collected. To avoid hanging the calling thread, it is possible to call `ps6000aGetValuesAsync()` instead. This immediately returns control to the calling thread, which then has the option of waiting for the data or calling `ps6000aStop()` to abort the operation.

2.6.2 Rapid block mode

In normal block mode, the PicoScope 6000E Series scopes collect one waveform at a time. You start the device running, wait until all samples are collected by the device, and then download the data to the PC or start another run. There is a time overhead of tens of milliseconds associated with starting a run, causing a gap between waveforms. When you collect data from the device, there is another minimum time overhead which is most noticeable when using a small number of samples.

Rapid block mode allows you to sample several waveforms at a time with the minimum time between waveforms. It reduces the gap from milliseconds to less than 1 microsecond.

See Using rapid block mode for details.

2.6.2.1 Using rapid block mode

You can use **rapid block mode** with or without aggregation. With aggregation, you need to set up two buffers for each channel, to receive the minimum and maximum values.

Without aggregation

1. Open the oscilloscope using `ps6000aOpenUnit()`.
2. Select channel ranges and AC/DC coupling using `ps6000aSetChannelOn()` and `ps6000aSetChannelOff()`.
3. Set the number of memory segments equal to or greater than the number of captures required using `ps6000aMemorySegments()`. Use `ps6000aSetNoOfCaptures()` before each run to specify the number of waveforms to capture.
4. Using `ps6000aGetTimebase()`, select timebases until the required nanoseconds per sample is located.
5. Use the trigger setup functions `ps6000aSetTriggerChannelConditions()`, `ps6000aSetTriggerChannelDirections()` and `ps6000aSetTriggerChannelProperties()` to set up the trigger if required.
6. Start the oscilloscope running using `ps6000aRunBlock()`.
7. Wait until the oscilloscope is ready using the `ps6000aBlockReady()` callback.
8. Use `ps6000aSetDataBuffer()` to tell the driver where your memory buffers are. Call the function once for each channel/segment combination for which you require data. For greater efficiency with multiple captures, you could do this outside the loop after step 5.
9. Transfer the blocks of data from the oscilloscope using `ps6000aGetValuesBulk()`.
10. Retrieve the time offset for each data segment using `ps6000aGetValuesTriggerTimeOffsetBulk()`.
11. Display the data.
12. Repeat steps 6 to 11 if necessary.
13. Stop the oscilloscope using `ps6000aStop()`.
14. Close the device using `ps6000aCloseUnit()`.

With aggregation

To use rapid block mode with aggregation, follow steps 1 to 7 above and then proceed as follows:

8a. Call `ps6000aSetDataBuffers()` to set up one pair of buffers for every waveform segment required.
9a. Call `ps6000aGetValuesBulk()` for each pair of buffers.
10a. Retrieve the time offset for each data segment using `ps6000aGetValuesTriggerTimeOffsetBulk()`.

Continue from step 11 above.

2.6.2.2 Rapid block mode example 1: no aggregation

```
#define MAX_WAVEFORMS 100
#define MAX_SAMPLES 1000
```

Set up the device up as usual.

- Open the device
- Channels
- Trigger
- Number of memory segments (this should be equal or more than the no of captures required)

```
// set the number of waveforms to MAX_WAVEFORMS
ps6000aSetNoOfCaptures(handle, MAX_WAVEFORMS);

pParameter = false;
ps6000aRunBlock
(
  handle,
  0,                    // noOfPreTriggerSamples
  10000,                // noOfPostTriggerSamples
  1,                    // timebase to be used
  &timeIndisposedMs,
  0,                    // segment index
  lpReady,
  &pParameter
);
```

Comment: these variables have been set as an example and can be any valid value. `pParameter` will be set true by your callback function `lpReady`.

```
while (!pParameter) Sleep (0);

PICO_ACTION action = PICO_CLEAR_ALL | PICO_ADD;
int32_t first_segment_to_read = 10;

for (int32_t i = 0; i < 10; i++)
{
  for (int32_t c = PICO_CHANNEL_A; c <= PICO_CHANNEL_D; c++)
  {
    ps6000aSetDataBuffer
    (
      handle,
      c,
      buffer[c][i],
      MAX_SAMPLES,
      PICO_INT16_T,
      first_segment_to_read + i,
      PICO_RATIO_MODE_RAW,
      action
    );
    action = PICO_ADD;
  }
```



```
}
```

Comments: buffer has been created as a two-dimensional array of pointers to `int16_t`, which will contain 1000 samples as defined by `MAX_SAMPLES`. Only 10 buffers are set, but it is possible to set up to the number of captures you have requested.

```
ps6000aGetValuesBulk
(
  handle,
  0,                       // startIndex
  &noOfSamples,            // set to MAX_SAMPLES on entering the function
  10,                      // fromSegmentIndex
  19,                      // toSegmentIndex
  1,                       // downsampling ratio
  PICO_RATIO_MODE_RAW,     // downsampling ratio mode
  overflow                 // indices 0 to 9 will be populated (index always
    starts from 0)
)
```

Comments: the number of samples could be up to `noOfPreTriggerSamples + noOfPostTriggerSamples`, the values set in `ps6000aRunBlock()`. The samples are returned starting from the sample index. This function does not support aggregation. The above segments start at 10 and finish at 19 inclusive. It is possible for `fromSegmentIndex` to wrap around to `toSegmentIndex`, for example by setting `fromSegmentIndex` to 98 and `toSegmentIndex` to 7.

```
ps6000aGetValuesTriggerTimeOffsetBulk
(
  handle,
  times,
  timeUnits,
  10,
  19
)
```

Comments: the above segments start at 10 and finish at 19 inclusive. It is possible for the `fromSegmentIndex` to wrap around to the `toSegmentIndex`, for example if `fromSegmentIndex` is set to 98 and `toSegmentIndex` to 7.

2.6.2.3 Rapid block mode example 2: using aggregation

```
#define MAX_WAVEFORMS 100
#define MAX_SAMPLES 1000
```

Set up the device up as usual.

- Open the device
- Channels
- Trigger
- Number of memory segments (this should be equal or more than the number of captures required)

```
// set the number of waveforms to MAX_WAVEFORMS
ps6000aSetNoOfCaptures(handle, MAX_WAVEFORMS);

pParameter = false;
ps6000aRunBlock
(
  handle,
  0,                    // noOfPreTriggerSamples,
  1000000,              // noOfPostTriggerSamples,
  1,                    // timebase to be used,
  &timeIndisposedMs,
  0,                    // segmentIndex
  lpReady,
  &pParameter
);
```

Comments: the set-up for running the device is exactly the same whether or not aggregation will be used when you retrieve the samples.

```
PICO_ACTION action = PICO_CLEAR_ALL | PICO_ADD;

for (int32_t c = PICO_CHANNEL_A; c <= PICO_CHANNEL_D; c++)
{
  ps6000aSetDataBuffers
  (
    handle,
    c,
    bufferMax[c],
    bufferMin[c]
    MAX_SAMPLES,
    PICO_INT16_T,
    0,
    PICO_RATIO_MODE_AGGREGATE,
    action
  );
  action = PICO_ADD;
}
```

Comments: since only one waveform will be retrieved at a time, you only need to set up one pair of buffers; one for the maximum samples and one for the minimum samples. Again, the buffer sizes are 1000 samples.

```
for (int32_t segment = 10; segment < 20; segment++)
```

```
{
  ps6000aGetValues
  (
    handle,
    0,
    &noOfSamples,         // set to MAX_SAMPLES on entering
    1000,
    &downSampleRatioMode, // set to RATIO_MODE_AGGREGATE
    index,
    overflow
  );

  ps6000aGetTriggerTimeOffset
  (
    handle,
    &time,
    &timeUnits,
    index
  )
}
```

Comments: each waveform is retrieved one at a time from the driver with an aggregation of 1000.

2.6.3 Streaming mode

Streaming mode can capture data without the gaps that occur between blocks when using block mode. This makes it suitable for **high-speed data acquisition**, allowing you to capture long data sets limited only by the computer's memory. (At the highest sampling rates, the size of the device's capture buffer may limit the capture size.)

The device can return either raw or downsampled data to your application while streaming is in progress. When downsampled data is returned, the raw samples remain stored on the device.

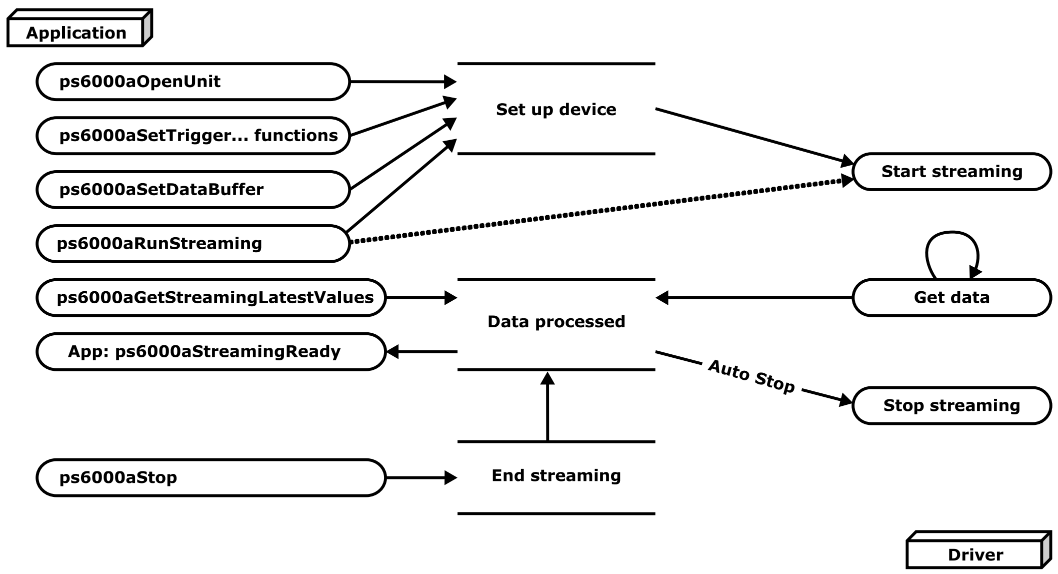
- **Downsampling.** The driver can return either raw or downsampled data. You should set up the number of buffers needed to accept the requested data. Aggregation requires two buffers, one for the minimum values and one for the maximum values. Other downsampling modes require only a single buffer.

See Using streaming mode for programming details.

2.6.3.1 Using streaming mode

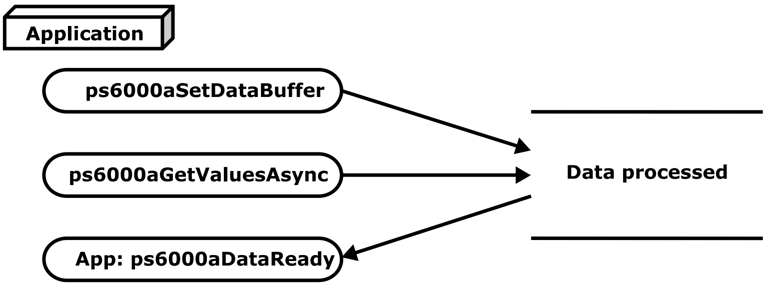
This is the general procedure for reading and displaying data in streaming mode using a single memory segment:

1. Open the oscilloscope using `ps6000aOpenUnit()`.
2. Select channels, ranges and AC/DC/50 Ω coupling using `ps6000aSetChannelOn()` and `ps6000aSetChannelOff()`.
3. Use the trigger setup functions `ps6000aSetTriggerChannelConditions()`, `ps6000aSetTriggerChannelDirections()` and `ps6000aSetTriggerChannelProperties()` to set up the trigger if required.
4. Call `ps6000aSetDataBuffer()` to tell the driver where your data buffer is.
5. Set up aggregation and start the oscilloscope running using `ps6000aRunStreaming()`.
6. Call `ps6000aGetStreamingLatestValues()` to get data. If the function runs out of buffer space, return to step 4.
7. Process data returned to your application's function. This example is using `autoStop`, so after the driver has received all the data points requested by the application, it stops the device streaming.
8. Call `ps6000aStop()`, even if `autoStop` is enabled.
9. Request new views of stored data using different downsampling parameters: see Retrieving stored data.
10. Close the device using `ps6000aCloseUnit()`.



2.6.4 Retrieving stored data

You can retrieve data from the `ps6000a` driver with a different downsampling factor when `ps6000aRunBlock()` or `ps6000aRunStreaming()` has already been called and has successfully captured all the data. Use `ps6000aGetValuesAsync()`.



2.7 Timebases

The API allows you to select any of 2^{32} different timebases based on a maximum sampling rate of 5 GHz. The timebases allow slow enough sampling in block mode to overlap the streaming sample intervals, so that you can make a smooth transition between block mode and streaming mode.

For the PicoScope 6000E Series except the PicoScope 6428E-D:

timebase	sample interval formula	sample interval examples
0 to 4	2^{timebase} / 5 000 000 000	0 => 200 ps 1 => 400 ps 2 => 800 ps 3 => 1.6 ns 4 => 3.2 ns
5 to $2^{32}-1$	(timebase−4) / 156 250 000	5 => 6.4 ns ... $2^{32}-1$ => ~ 27.49 s

For the PicoScope 6428E-D:

timebase	sample interval formula	sample interval examples
0 to 5	2^{timebase} / 10 000 000 000	0 => 100 ps 1 => 200 ps 2 => 400 ps 3 => 800 ps 4 => 1.6 ns 5 => 3.2 ns
6 to $2^{32}-1$	(timebase−5) / 156 250 000	6 => 6.4 ns ... $2^{32}-1$ => ~ 27.49 s

Applicability	Calls to `ps6000aGetTimebase()`

Notes
1. The maximum possible sampling rate may depend on the number of enabled channels and on the sampling mode. Please refer to the data sheet for details.
2. In streaming mode, the speed of the USB port may affect the rate of data transfer.

2.8 Combining several oscilloscopes

It is possible to collect data using up to 64 PicoScope 6000E Series oscilloscopes at the same time, depending on the capabilities of the PC. Each oscilloscope must be connected to a separate USB port. The `ps6000aOpenUnit()` function returns a handle to an oscilloscope. All the other functions require this handle for oscilloscope identification. For example, to collect data from two oscilloscopes at the same time:

```
CALLBACK ps6000aBlockReady(...)
// define callback function specific to application

handle1 = ps6000aOpenUnit()
handle2 = ps6000aOpenUnit()

ps6000aSetChannelOn(handle1)
// set up unit 1
ps6000aRunBlock(handle1)

ps6000aSetChannelOn(handle2)
// set up unit 2
ps6000aRunBlock(handle2)

// data will be stored in buffers
// and application will be notified using callback

ready = FALSE
while not ready
   ready = handle1_ready
   ready &= handle2_ready
```

Note: an external clock may be fed into the **10 MHz** clock reference input or a trigger into the **Aux Trig** input to provide some degree of synchronization between multiple oscilloscopes.

2.9 Handling intelligent probe interactions

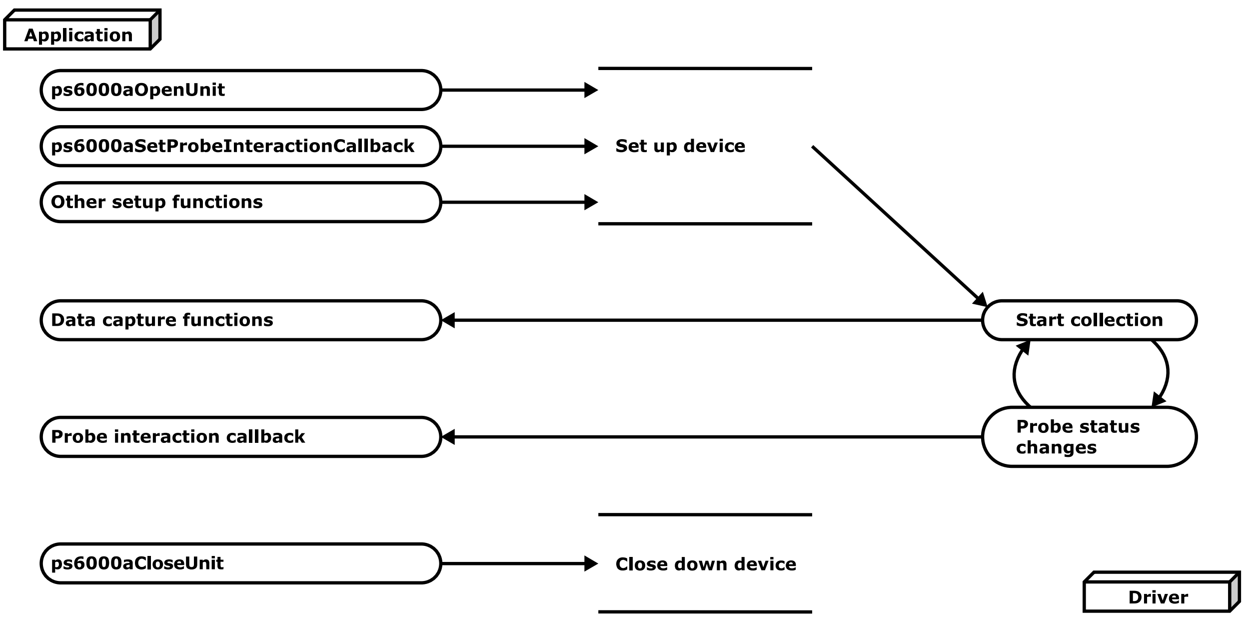
The PicoScope 6000E Series has an intelligent probe interface, which supplies power to the probe as well as allowing the scope to configure and interrogate the probe. Your application can choose to be alerted whenever a probe is connected or disconnected, or when its status changes.

Probe interactions use a callback mechanism, available in C and similar languages.

Applicability	All models
Note	In addition to `ps6000aApi.h`, you must also include `PicoDeviceEnums.h`. This file contains definitions of enumerated types that describe the intelligent probes.

Procedure

1. Define your own function to receive probe interaction callbacks.
2. Call `ps6000aOpenUnit()` to obtain a device handle.
3. Call `ps6000aSetProbeInteractionCallback()` to register your probe interaction callback function.
4. Capture data using the desired sampling mode. See Sampling modes for details.
5. Call `ps6000aCloseUnit()` to release the device handle. The makes the scope device available to other applications.



3 API functions

The PicoScope 6000E Series API exports the following functions for you to use in your own applications for Microsoft Windows. Similar APIs are available for other platforms: see www.picotech.com > Downloads for details. All functions are C functions using the standard call naming convention (`__stdcall`). They are all exported with both decorated and undecorated names.

3.1 ps6000aChannelCombinationsStateless - get possible channel combinations

```
PICO_STATUS ps6000aChannelCombinationsStateless
(
  int16_t                  handle,
  PICO_CHANNEL_FLAGS     * channelFlagsCombinations,
  uint32_t               * nChannelCombinations,
  PICO_DEVICE_RESOLUTION   resolution,
  uint32_t                 timebase
)
```

This function returns a list of the possible channel combinations given a proposed configuration (resolution and timebase) of the oscilloscope. It does not change the configuration of the oscilloscope.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* channelFlagsCombinations`, on exit, a list of possible channel combinations. See `PicoDeviceEnums.h`.

`* nChannelCombinations`, on exit, the length of the `channelFlagsCombinations` list.

`resolution`, the proposed vertical resolution of the oscilloscope.

`timebase`, the proposed timebase number.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_NULL_PARAMETER`
`PICO_INVALID_PARAMETER`

3.2 ps6000aCheckForUpdate - is firmware update available?

```
PICO_STATUS ps6000aCheckForUpdate
(
  int16_t               handle,
  PICO_FIRMWARE_INFO * firmwareInfos,
  int16_t             * nFirmwareInfos,
  uint16_t            * updatesRequired
)
```

This function checks whether a firmware update for the device is available.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`firmwareInfos`, a pointer to a buffer of `PICO_FIRMWARE_INFO` structs which, on exit, will be populated with detailed information about the available updates. Information about firmware which is already up to date will also be provided. You may pass NULL if you do not require the detailed information.

`nFirmwareInfos`, on entry, a pointer to a value which is the length of the `firmwareInfos` buffer, if `firmwareInfos` is not NULL. On exit, the number of populated entries in `firmwareInfos` (or the available number of `PICO_FIRMWARE_INFOs` if `firmwareInfos` is NULL). May be NULL if the caller does not need detailed firmware information (in which case `firmwareInfos` must also be NULL).

`* updatesRequired`, on entry, a pointer to a flag which will be set by the function to indicate if updates are required. On exit, 1 if updates are required and 0 otherwise.

Returns

`PICO_OK`
`PICO_HANDLE_INVALID`
`PICO_USER_CALLBACK`
`PICO_DRIVER_FUNCTION`

3.3 ps6000aCloseUnit - close a scope device

```
PICO_STATUS ps6000aCloseUnit
(
  int16_t    handle
)
```

This function shuts down a PicoScope 6000E Series oscilloscope.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

Returns

`PICO_OK`
`PICO_HANDLE_INVALID`
`PICO_USER_CALLBACK`
`PICO_DRIVER_FUNCTION`

3.4 ps6000aEnumerateUnits - get a list of unopened units

```
PICO_STATUS ps6000aEnumerateUnits
(
  int16_t   * count,
  int8_t    * serials,
  int16_t   * serialLth
)
```

This function counts the number of PicoScope 6000 (A API) units connected to the computer, and returns a list of serial numbers and other optional information as a string. Note that this function can only detect devices that are not yet being controlled by an application. To query opened devices, use `ps6000aGetUnitInfo()`.

Applicability

All modes

Arguments

`* count,` on exit, the number of PicoScope 6000 (A API) units found.

`* serials,` if an empty string on entry, `serials` is populated on exit with a list of serial numbers separated by commas and terminated by a final null. Example:

`AQ005/139,VDR61/356,ZOR14/107`

On entry, `serials` can optionally contain the following parameter(s) to request information:

`-v` : model number
`-c` : calibration date
`-h` : hardware version
`-u` : USB version
`-f` : firmware version

Example (any separator character can be used):

`-v:-c:-h:-u:-f`

On exit, with all the above parameters specified, each serial number has the requested information appended in the following format:

`AQ005/139[6425E,01Jan21,769,2.0,1.7.16.0]`

`serials` can be NULL if device information or serial numbers are not required.

`* serialLth,` on entry, the length of the `int8_t` buffer pointed to by `serials;` on exit, the length of the string written to `serials`

Returns

`PICO_OK`
`PICO_BUSY`
`PICO_NULL_PARAMETER`
`PICO_FW_FAIL`
`PICO_CONFIG_FAIL`
`PICO_MEMORY_FAIL`
`PICO_ANALOG_BOARD`
`PICO_CONFIG_FAIL_AWG`
`PICO_INITIALISE_FPGA`

3.5 ps6000aFlashLed - flash the front-panel LED

```
PICO_STATUS ps6000aFlashLed
(
  int16_t    handle,
  int16_t    start
)
```

This function flashes the status/trigger LED on the front of the scope without blocking the calling thread. Calls to `ps6000aRunStreaming()` and `ps6000aRunBlock()` cancel any flashing started by this function. It is not possible to set the LED to be constantly illuminated, as this state is used to indicate that the scope has not been initialized.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`start`, the action required:

- < 0 : flash the LED indefinitely.
- 0 : stop the LED flashing.
- > 0 : flash the LED `start` times. If the LED is already flashing on entry to this function, the flash count will be reset to `start`.

Returns

`PICO_OK`
`PICO_HANDLE_INVALID`
`PICO_BUSY`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`

3.6 ps6000aGetAccessoryInfo - get information about a connected accessory

```
PICO_STATUS ps6000aGetAccessoryInfo
(
  int16_t          handle,
  PICO_CHANNEL     channel,
  int8_t         * string,
  int16_t          stringLength,
  int16_t        * requiredSize,
  PICO_INFO        info
)
```

This function gets information about an accessory connected to the specified channel on the oscilloscope.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`channel`, the oscilloscope channel to which the accessory is connected.

`string`, on exit: a buffer to which the information will be written.

`stringLength`, the length of the `string` buffer.

`requiredSize`, on exit: the length of the information before being stored in the `string` buffer; if it's longer than `stringLength`, it will be truncated to fit the buffer. If truncation occurs and you need the full information, you can call the function again with the buffer extended to `requiredSize`.

`info`, the type of information you require. See `ps6000aGetUnitInfo()` for a list of `info` types.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DRIVER_FUNCTION`
`PICO_NULL_PARAMETER`
`PICO_INTERNAL_ERROR`
`PICO_FIRMWARE_UPDATE_REQUIRED_TO_USE_DEVICE_WITH_THIS_DRIVER`

3.7 ps6000aGetAdcLimits - get min and max sample values

```
PICO_STATUS ps6000aGetAdcLimits
(
  int16_t                   handle,
  PICO_DEVICE_RESOLUTION    resolution,
  int16_t                 * minValue,
  int16_t                 * maxValue
)
```

This function gets the maximum and minimum sample values that the ADC can produce at a given resolution.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

resolution, the vertical resolution about which you require information.

* minValue, the minimum sample value.

* maxValue, the maximum sample value.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_NULL_PARAMETER (if both maxValue and minValue are NULL)

3.8 ps6000aGetAnalogueOffsetLimits - get analog offset information

```
PICO_STATUS ps6000aGetAnalogueOffsetLimits
(
  int16_t                     handle,
  PICO_CONNECT_PROBE_RANGE    range
  PICO_COUPLING               coupling
  double                    * maximumVoltage,
  double                    * minimumVoltage
)
```

This function is used to get the maximum and minimum allowable analog offset for a specific voltage range.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

range, the voltage range for which minimum and maximum voltages are required

coupling, the type of AC/DC/50 Ω coupling used

* maximumVoltage, on output, the maximum analog offset voltage allowed for the range. Set to NULL if not required.

* minimumVoltage, on output, the minimum analog offset voltage allowed for the range. Set to NULL if not required.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_INVALID_VOLTAGE_RANGE
PICO_NULL_PARAMETER (if both maximumVoltage and minimumVoltage are NULL)
PICO_INVALID_COUPLING

3.9 ps6000aGetDeviceResolution – retrieve the device resolution

```
PICO_STATUS ps6000aGetDeviceResolution
(
  int16_t                  handle,
  PICO_DEVICE_RESOLUTION * resolution
)
```

This function retrieves the vertical resolution of the oscilloscope.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* resolution`, on exit, the resolution of the device.

Returns

`PICO_OK` or other code from `PicoStatus.h`

3.10 ps6000aGetMaximumAvailableMemory - depending on hardware resolution

```
PICO_STATUS ps6000aGetMaximumAvailableMemory
(
  int16_t                 handle,
  uint64_t              * nMaxSamples,
  PICO_DEVICE_RESOLUTION  resolution
)
```

This function returns the maximum number of samples that can be stored at a given hardware resolution.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* nMaxSamples`, on exit, the number of samples.

`resolution`, the resolution in bits.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NO_SAMPLES_AVAILABLE
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_TOO_MANY_SAMPLES

3.11 ps6000aGetMinimumTimebaseStateless - find fastest available timebase

```
PICO_STATUS ps6000aGetMinimumTimebaseStateless
(
  int16_t                     handle,
  PICO_CHANNEL_FLAGS          enabledChannelFlags,
  uint32_t                  * timebase,
  double                    * timeInterval,
  PICO_DEVICE_RESOLUTION      resolution
)
```

This function returns the shortest timebase that could be selected with a proposed configuration of the oscilloscope. It does not set the oscilloscope to the proposed configuration.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

enabledChannelFlags, a bit field indicating which channels are enabled in the proposed configuration. Channel A is bit 0 and so on.

* timebase, on exit, the number of the shortest timebase possible with the proposed configuration.

* timeInterval, on exit, the sample period in seconds corresponding to .timebase.

resolution, the vertical resolution in the proposed configuration.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NO_SAMPLES_AVAILABLE
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_TOO_MANY_SAMPLES

3.12 ps6000aGetNoOfCaptures - query how many captures made

```
PICO_STATUS ps6000aGetNoOfCaptures
(
  int16_t     handle,
  uint64_t  * nCaptures
)
```

This function returns the number of captures collected in one run of rapid block mode. You can call this function during device capture, after collection has completed or after interrupting waveform collection by calling `ps6000aStop()`.

The returned value (`nCaptures`) can then be used to iterate through the number of segments using `ps6000aGetValues()`, or in a single call to `ps6000aGetValuesBulk()` where it is used to calculate the `toSegmentIndex` parameter.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`nCaptures`, on output, the number of available captures that has been collected from calling `ps6000aRunBlock()`.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_NO_SAMPLES_AVAILABLE`
`PICO_NULL_PARAMETER`
`PICO_INVALID_PARAMETER`
`PICO_SEGMENT_OUT_OF_RANGE`
`PICO_TOO_MANY_SAMPLES`

3.13 ps6000aGetNoOfProcessedCaptures - query how many captures processed

```
PICO_STATUS ps6000aGetNoOfProcessedCaptures
(
  int16_t    handle,
  uint64_t  * nProcessedCaptures
)
```

This function gets the number of captures collected and processed in one run of rapid block mode. It enables your application to start processing captured data while the driver is still transferring later captures from the device to the computer.

The function returns the number of captures the driver has processed since you called `ps6000aRunBlock()`. It is for use in rapid block mode, alongside the `ps6000aGetValuesOverlapped()` function, when the driver is set to transfer data from the device automatically as soon as the `ps6000aRunBlock()` function is called. You can call `ps6000aGetNoOfProcessedCaptures()` during device capture, after collection has completed or after interrupting waveform collection by calling `ps6000aStop()`.

The returned value (`nProcessedCaptures`) can then be used to iterate through the number of segments using `ps6000aGetValues()`, or in a single call to `ps6000aGetValuesBulk()`, where it is used to calculate the `toSegmentIndex` parameter.

When capture is stopped
If `nProcessedCaptures` = 0, you will also need to call `ps6000aGetNoOfCaptures()`, in order to determine how many waveform segments were captured, before calling `ps6000aGetValues()` or `ps6000aGetValuesBulk()`.

Applicability

Rapid block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* nProcessedCaptures`, on exit, the number of waveforms captured and processed.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_PARAMETER`

3.14 ps6000aGetStreamingLatestValues - read streaming data

```
PICO_STATUS ps6000aGetStreamingLatestValues
(
  int16_t                             handle,
  PICO_STREAMING_DATA_INFO          * streamingDataInfo,
  uint64_t                            nStreamingDataInfos,
  PICO_STREAMING_DATA_TRIGGER_INFO  * triggerInfo
)
```

This function populates the `streamingDataInfo` structure with a description of the samples available and the `triggerInfo` structure to indicate that a trigger has occurred and at what location.

Applicability
Streaming mode only

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* streamingDataInfo`, a list of structures. See `PICO_STREAMING_DATA_INFO`.

`nStreamingDataInfos`, the number of structures in the `streamingDataInfo` list.

`* triggerInfo`, a list of structures containing trigger information. See `PICO_STREAMING_DATA_TRIGGER_INFO`.

Returns	`PICO_OK` `PICO_WAITING_FOR_DATA_BUFFERS` - indicates that you need to call `ps6000aSetDataBuffer()` again

3.14.1 PICO_STREAMING_DATA_INFO

A list of structures of this type is passed to `ps6000aGetStreamingLatestValues()` in the `streamingDataInfo` argument to specify parameters for streaming mode data capture. It is defined as follows:

```
typedef struct tPicoStreamingDataInfo
{
  PICO_CHANNEL    channel_;
  PICO_RATIO_MODE mode_;
  PICO_DATA_TYPE  type_;
  int32_t         noOfSamples_;
  uint64_t        bufferIndex_;
  int32_t         startIndex_;
  int16_t         overflow_;
} PICO_STREAMING_DATA_INFO;
```

The structure is byte-aligned. In C++, for example, you should specify this using the `#pragma pack()` instruction.

Elements

`channel_`, the oscilloscope channel that the parameters apply to.

`mode_`, the downsampling mode to use.

`type_`, the data type to use for the sample data.

`noOfSamples_`, the number of samples made available by the driver.

`bufferIndex_`, an index to the starting sample within the specified waveform buffer.

`startIndex_`, an index to the waveform buffer within the capture buffer.

`overflow_`, a flag indicating whether a sample value overflowed (1) or not (0).

3.14.2 PICO_STREAMING_DATA_TRIGGER_INFO

A structure of this type is returned by ps6000aGetStreamingLatestValues() in the triggerInfo argument to return information about trigger events.

```
typedef struct tPicoStreamingDataTriggerInfo
{
  uint64_t  triggerAt_;
  int16_t   triggered_;
  int16_t   autoStop_;
} PICO_STREAMING_DATA_TRIGGER_INFO;
```

The structure is byte-aligned. In C++, for example, you should specify this using the #pragma pack() instruction.

Elements

triggerAt_, an index to the sample on which the trigger occurred.

triggered_, a flag indicating whether a trigger occurred (1) or did not occur (0).

autoStop_, a flag indicating whether the oscilloscope was in autoStop mode (1) or not (0).

3.15 ps6000aGetTimebase - get available timebases

```
PICO_STATUS ps6000aGetTimebase
(
  int16_t      handle,
  uint32_t     timebase,
  uint64_t     noSamples,
  double     * timeIntervalNanoseconds,
  uint64_t   * maxSamples
  uint64_t     segmentIndex
)
```

This function calculates the sampling rate and maximum number of samples for a given timebase under the specified conditions. The result will depend on the number of channels enabled by the last call to ps6000aSetChannelOn() or ps6000aSetChannelOff().

The easiest way to find a suitable timebase is to call ps6000aNearestSampleIntervalStateless(). Alternatively, you can estimate the timebase number that you require using the information in the timebase guide, then pass this timebase to ps6000aGetTimebase() and check the returned timeIntervalNanoseconds argument. Repeat until you obtain the time interval that you need.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

timebase, see timebase guide.

noSamples, the number of samples required. This value is used to calculate the most suitable time interval.

timeIntervalNanoseconds, on exit, the time interval between readings at the selected timebase. Use NULL if not required.

maxSamples, on exit, the maximum number of samples available. The scope allocates a certain amount of memory for internal overheads and this may vary depending on the number of segments, number of channels enabled, and the timebase chosen. Use NULL if not required.

segmentIndex, the index of the memory segment to use.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_TOO_MANY_SAMPLES
PICO_INVALID_CHANNEL
PICO_INVALID_TIMEBASE
PICO_INVALID_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_DRIVER_FUNCTION

3.16 ps6000aGetTriggerInfo - get trigger timing information

```
PICO_STATUS ps6000aGetTriggerInfo
(
  int16_t               handle
  PICO_TRIGGER_INFO   * triggerInfo,
  uint64_t              firstSegmentIndex,
  uint64_t              segmentCount
)
```

This function gets trigger timing information from one or more buffer segments.

Call this function after data has been captured or when data has been retrieved from a previous capture.

Applicability

Block mode, rapid block mode

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

* triggerInfo, a list of structures, one for each buffer segment, containing trigger information.

firstSegmentIndex, the index of the first segment of interest.

segmentCount, the number of segments of interest.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DEVICE_SAMPLING
PICO_SEGMENT_OUT_OF_RANGE
PICO_NULL_PARAMETER
PICO_NO_SAMPLES_AVAILABLE
PICO_DRIVER_FUNCTION

3.16.1 PICO_TRIGGER_INFO

A list of structures of this type containing trigger information is written by ps6000aGetTriggerInfo() to the triggerInfo location. The structure is defined as follows:

```
typedef struct tPicoTriggerInfo
{
  PICO_STATUS       status;
  uint64_t          segmentIndex;
  uint64_t          triggerIndex;
  double            triggerTime;
  PICO_TIME_UNITS   timeUnits;
  uint64_t          missedTriggers;
  uint64_t          timeStampCounter;
} PICO_TRIGGER_INFO;
```

The structure is byte-aligned. In C++, for example, you should specify this using the #pragma pack() instruction.

Elements

status, indicates success or failure.

segmentIndex, the number of the segment.

triggerIndex, the index of the sample at which the trigger ocurred.

triggerTime, the time at which the trigger occurred.

timeUnits, the unit multiplier to use with triggerTime.

missedTriggers, the number of trigger events, if any, detected since the start of previous segment.

timeStampCounter, the time in samples from the first capture to the current capture. The status PICO_DEVICE_TIME_STAMP_RESET indicates that the trigger time has started over.

3.17 ps6000aGetTriggerTimeOffset - get timing corrections

```
PICO_STATUS ps6000aGetTriggerTimeOffset
(
  int16_t                   handle
  int64_t                 * time,
  PICO_TIME_UNITS         * timeUnits,
  uint64_t                  segmentIndex
)
```

This function gets the trigger time offset for waveforms obtained in block mode or rapid block mode. The trigger time offset is an adjustment value used for correcting jitter in the waveform, and is intended mainly for applications that wish to display the waveform with reduced jitter. The offset is zero if the waveform crosses the threshold at the trigger sampling instant, or a positive or negative value if jitter correction is required. The value should be added to the nominal trigger time to get the corrected trigger time.

Call this function after data has been captured or when data has been retrieved from a previous capture.

Applicability

Block mode, rapid block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`time`, on exit, the time at which the trigger point occurred

`timeUnits`, on exit, the time units in which `time` is measured. The possible values are:
- `PICO_FS`
- `PICO_PS`
- `PICO_NS`
- `PICO_US`
- `PICO_MS`
- `PICO_S`

`segmentIndex`, the number of the memory segment for which the information is required.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DEVICE_SAMPLING`
`PICO_SEGMENT_OUT_OF_RANGE`
`PICO_NULL_PARAMETER`
`PICO_NO_SAMPLES_AVAILABLE`
`PICO_DRIVER_FUNCTION`

3.18 ps6000aGetUnitInfo - get information about device

```
PICO_STATUS ps6000aGetUnitInfo
(
  int16_t        handle,
  int8_t       * string,
  int16_t        stringLength,
  int16_t      * requiredSize
  PICO_INFO      info
)
```

This function retrieves information about the specified oscilloscope. If the device fails to open, only the driver version and error code are available to explain why the last open unit call failed. To find out about unopened devices, call `ps6000aEnumerateUnits()`.

Applicability

All modes

Arguments

`handle`, identifies the device from which information is required. If an invalid handle is passed, the error code from the last unit that failed to open is returned.

`string`, on exit, the unit information string selected specified by the `info` argument. If `string` is `NULL`, only `requiredSize` is returned.

`stringLength`, the maximum number of `int8_t` values that may be written to `string`.

`requiredSize`, on exit, the required length of the `string` array.

`info`, a number specifying what information is required. The possible values are listed in the table below.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_NULL_PARAMETER`
`PICO_INVALID_INFO`
`PICO_INFO_UNAVAILABLE`
`PICO_DRIVER_FUNCTION`

info		Example
0x00	PICO_DRIVER_VERSION – Version number of ps6000a DLL	1,0,0,1
0x01	PICO_USB_VERSION – Type of USB connection to device: 1.1, 2.0 or 3.0	3.0
0x02	PICO_HARDWARE_VERSION – Hardware version of device	1
0x03	PICO_VARIANT_INFO – Model number of device	6403
0x04	PICO_BATCH_AND_SERIAL – Batch and serial number of device	KJL87/6
0x05	PICO_CAL_DATE – Calibration date of device	30Sep09
0x06	PICO_KERNEL_VERSION – Version of kernel driver	1,1,2,4
0x07	PICO_DIGITAL_HARDWARE_VERSION – Hardware version of the digital section	1
0x08	PICO_ANALOGUE_HARDWARE_VERSION – Hardware version of the analog section	1
0x09	PICO_FIRMWARE_VERSION_1 – Version information of Firmware 1	1,0,0,1
0x0A	PICO_FIRMWARE_VERSION_2 – Version information of Firmware 2	1,0,0,1
0x0F	PICO_FIRMWARE_VERSION_3 – Version information of Firmware 3	1,0,0,1
0x10	PICO_FRONT_PANEL_FIRMWARE_VERSION – Version of front-panel microcontroller firmware	1,0,0,1

3.19 ps6000aGetValues - get block mode data

```
PICO_STATUS ps6000aGetValues
(
  int16_t                handle,
  uint64_t               startIndex,
  uint64_t             * noOfSamples,
  uint64_t               downSampleRatio,
  PICO_RATIO_MODE        downSampleRatioMode,
  uint64_t               segmentIndex,
  int16_t              * overflow
)
```

This function retrieves block-mode data, either with or without downsampling, starting at the specified sample number. It is used to get the stored data from the scope after data collection has stopped, and store it in a user buffer previously passed to `ps6000aSetDataBuffer()` or `ps6000aSetDataBuffers()`. It blocks the calling function while retrieving data.

Applicability

All modes.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`startIndex`, a zero-based index that indicates the start point for data collection. It is measured in sample intervals from the start of the buffer.

`noOfSamples`, on entry, the number of raw samples to be processed. On exit, the actual number retrieved. The number of samples retrieved will not be more than the number requested, and the data retrieved always starts with the first sample captured.

`downSampleRatio`, the downsampling factor that will be applied to the raw data. Must be greater than zero.

`downSampleRatioMode`, which downsampling mode to use. The available values are:
`PICO_RATIO_MODE_AGGREGATE`
`PICO_RATIO_MODE_DECIMATE`
`PICO_RATIO_MODE_AVERAGE`
`PICO_RATIO_MODE_TRIGGER` - cannot be combined with any other ratio mode
`PICO_RATIO_MODE_RAW`

`segmentIndex`, the zero-based number of the memory segment where the data is stored.

`overflow`, on exit, a set of flags that indicate whether an overvoltage has occurred on any of the channels. It is a bit field with bit 0 denoting Channel A.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NO_SAMPLES_AVAILABLE
PICO_DEVICE_SAMPLING
PICO_NULL_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_INVALID_PARAMETER
PICO_TOO_MANY_SAMPLES
PICO_DATA_NOT_AVAILABLE
PICO_STARTINDEX_INVALID
PICO_INVALID_SAMPLERATIO
PICO_INVALID_CALL
PICO_NOT_RESPONDING
PICO_MEMORY
PICO_RATIO_MODE_NOT_SUPPORTED
PICO_DRIVER_FUNCTION

3.19.1 Downsampling modes

Various methods of data reduction, or **downsampling**, are possible with the PicoScope 6000E Series oscilloscopes. The downsampling is done at high speed by dedicated hardware inside the scope, making your application faster and more responsive than if you had to do all the data processing in software.

You specify the downsampling mode when you call one of the data collection functions, such as ps6000aGetValues(). The following modes are available:

PICO_RATIO_MODE_AGGREGATE	Reduces every block of *n* values to just two values: a minimum and a maximum. The minimum and maximum values are returned in two separate buffers.
PICO_RATIO_MODE_AVERAGE	Reduces every block of *n* values to a single value representing the average (arithmetic mean) of all the values.
PICO_RATIO_MODE_DECIMATE	Reduces every block of *n* values to just the first value in the block, discarding all the other values.
PICO_RATIO_MODE_DISTRIBUTION	Not implemented.
PICO_RATIO_MODE_TRIGGER	Gets 20 samples either side of the trigger point.
PICO_RATIO_MODE_RAW	No downsampling. Returns raw data values.

3.20 ps6000aGetValuesAsync - read data without blocking

```
PICO_STATUS ps6000aGetValuesAsync
(
  int16_t           handle,
  uint64_t          startIndex,
  uint64_t          noOfSamples,
  uint64_t          downSampleRatio,
  PICO_RATIO_MODE   downSampleRatioMode,
  uint64_t          segmentIndex,
  PICO_POINTER      lpDataReady,
  PICO_POINTER      pParameter
)
```

This function obtains data from the oscilloscope, with downsampling if requested, starting at the specified sample number. It delivers the data using a callback.

Applicability

Streaming mode and block mode

Arguments

`handle`,
`startIndex`,
`noOfSamples`,
`downSampleRatio`,
`downSampleRatioMode`,
`segmentIndex`: see `ps6000aGetValues()`

`lpDataReady`, a pointer to the user-supplied function that will be called when the data is ready. For compatibility with older applications the driver also supports a `ps6000aDataReady()` function.

`pParameter`, a void pointer that will be passed to the callback function. The data type is determined by the application.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_NO_SAMPLES_AVAILABLE`
`PICO_DEVICE_SAMPLING`
`PICO_NULL_PARAMETER`
`PICO_STARTINDEX_INVALID`
`PICO_SEGMENT_OUT_OF_RANGE`
`PICO_INVALID_PARAMETER`
`PICO_DATA_NOT_AVAILABLE`
`PICO_INVALID_SAMPLERATIO`
`PICO_INVALID_CALL`
`PICO_DRIVER_FUNCTION`

3.21 ps6000aGetValuesBulk - read multiple segments

```
PICO_STATUS ps6000aGetValuesBulk
(
  int16_t           handle,
  uint64_t          startIndex,
  uint64_t        * noOfSamples,
  uint64_t          fromSegmentIndex,
  uint64_t          toSegmentIndex,
  uint64_t          downSampleRatio,
  PICO_RATIO_MODE   downSampleRatioMode,
  int16_t         * overflow
)
```

This function retrieves waveforms captured using rapid block mode. The waveforms must have been collected sequentially and in the same run.

Applicability

Rapid block mode

Arguments

`handle`, `startIndex`, `noOfSamples`, `downSampleRatio`, `downSampleRatioMode`, `overflow`: see `ps6000aGetValues()`

`fromSegmentIndex`, `toSegmentIndex`: zero-based numbers of the first and last memory segments where the data is stored.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_PARAMETER`
`PICO_SEGMENT_OUT_OF_RANGE`
`PICO_NO_SAMPLES_AVAILABLE`
`PICO_STARTINDEX_INVALID`
`PICO_NOT_RESPONDING`
`PICO_DRIVER_FUNCTION`
`PICO_INVALID_SAMPLERATIO`

3.22 ps6000aGetValuesBulkAsync - read multiple segments without blocking

```
PICO_STATUS ps6000aGetValuesBulkAsync
(
  int16_t             handle,
  uint64_t            startIndex,
  uint64_t            noOfSamples,
  uint64_t            fromSegmentIndex,
  uint64_t            toSegmentIndex,
  uint64_t            downSampleRatio,
  PICO_RATIO_MODE     downSampleRatioMode,
  PICO_POINTER        lpDataReady,
  PICO_POINTER        pParameter
)
```

This function retrieves more than one waveform at a time from the driver in rapid block mode after data collection has stopped. The waveforms must have been collected sequentially and in the same run. The data is returned using a callback.

Applicability

Rapid block mode

Arguments

`handle`,
`startIndex`,
`noOfSamples`,
`downSampleRatio`,
`downSampleRatioMode`: see ps6000aGetValues()

`fromSegmentIndex`,
`toSegmentIndex`: see ps6000aGetValuesBulk()

`lpDataReady`,
`pParameter`

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_PARAMETER`
`PICO_SEGMENT_OUT_OF_RANGE`
`PICO_NO_SAMPLES_AVAILABLE`
`PICO_STARTINDEX_INVALID`
`PICO_NOT_RESPONDING`
`PICO_DRIVER_FUNCTION`

3.23 ps6000aGetValuesOverlapped - get rapid block data

```
PICO_STATUS ps6000aGetValuesOverlapped
(
  int16_t             handle,
  uint64_t            startIndex,
  uint64_t          * noOfSamples,
  uint64_t            downSampleRatio,
  PICO_RATIO_MODE     downSampleRatioMode,
  uint64_t            fromSegmentIndex,
  uint64_t            toSegmentIndex,
  int16_t           * overflow
)
```

This function allows you to make a deferred data-collection request in rapid block mode. The request will be executed, and the arguments validated, when you call ps6000aRunBlock(). The advantage of this method is that the driver makes contact with the scope only once, when you call ps6000aRunBlock(), compared with the two contacts that occur when you use the conventional ps6000aRunBlock(), ps6000aGetValues() calling sequence. This slightly reduces the dead time between successive captures in rapid block mode.

After calling ps6000aRunBlock(), you can optionally use ps6000aGetValues() to request further copies of the data. This might be required if you wish to display the data with different data reduction settings.

To stop collecting data, call ps6000aStopUsingGetValuesOverlapped().

Applicability

Rapid block mode

Arguments

handle,
startIndex,
* noOfSamples,
downSampleRatio,
downSampleRatioMode: see ps6000aGetValues()

fromSegmentIndex,
toSegmentIndex,
* overflow, see ps6000aGetValuesBulk().

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_INVALID_PARAMETER
PICO_DRIVER_FUNCTION

3.23.1 Using GetValuesOverlapped()

1. Open the oscilloscope using `ps6000aOpenUnit()`.
2. Select channel ranges and AC/DC coupling using `ps6000aSetChannelOn()`.
3. Using `ps6000aGetTimebase()`, select timebases until the required nanoseconds per sample is located.
4. Use the trigger setup functions `ps6000aSetTriggerChannelConditions()`, `ps6000aSetTriggerChannelDirections()` and `ps6000aSetTriggerChannelProperties()` to set up the trigger if required.
5. Use `ps6000aSetDataBuffer()` to tell the driver where your memory buffer is.
6. Set up the transfer of the block of data from the oscilloscope using `ps6000aGetValuesOverlapped()`.
7. Start the oscilloscope running using `ps6000aRunBlock()`.
8. Wait until the oscilloscope is ready using the `ps6000aBlockReady()` callback (or poll using `ps6000aIsReady()`).
9. Display the data.
10. Repeat steps 7 to 9 if needed.
11. Stop the oscilloscope by calling `ps6000aStop()`.

A similar procedure can be used with rapid block mode.

3.24 ps6000aGetValuesTriggerTimeOffsetBulk - get trigger time offsets for multiple segments

```
PICO_STATUS ps6000aGetValuesTriggerTimeOffsetBulk
(
int16_t              handle,
int64_t            * times,
PICO_TIME_UNITS    * timeUnits,
uint64_t             fromSegmentIndex,
uint64_t             toSegmentIndex
)
```

This function retrieves the trigger time offset for multiple waveforms obtained in block mode or rapid block mode. It is a more efficient alternative to calling ps6000aGetTriggerTimeOffset() once for each waveform required. See ps6000aGetTriggerTimeOffset() for an explanation of trigger time offsets.

Applicability

Rapid block mode

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

* times, an array of integers. On exit, the time offset for each requested segment index. times[0] will hold the fromSegmentIndex time offset and the last times[] index will hold the toSegmentIndex time offset. The array must be long enough to hold the number of requested times.

* timeUnits, an array of integers. The array must be long enough to hold the number of requested times. On exit, timeUnits[0] will contain the time unit for fromSegmentIndex and the last element will contain the time unit for toSegmentIndex. PICO_TIME_UNITS values are listed under ps6000aGetTriggerTimeOffset().

fromSegmentIndex, the first segment for which the time offset is required

toSegmentIndex, the last segment for which the time offset is required. If toSegmentIndex is less than fromSegmentIndex then the driver will wrap around from the last segment to the first.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_DEVICE_SAMPLING
PICO_SEGMENT_OUT_OF_RANGE
PICO_NO_SAMPLES_AVAILABLE
PICO_DRIVER_FUNCTION

3.25 ps6000aIsReady - get status of block capture

```
PICO_STATUS ps6000aIsReady
(
  int16_t      handle,
  int16_t    * ready
)
```

This function may be used instead of a callback function to receive data from `ps6000aRunBlock()`. To use this method, pass a NULL pointer as the `lpReady` argument to `ps6000aRunBlock()`. You must then poll the driver to see if it has finished collecting the requested samples.

Applicability

Block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`ready`, output: indicates the state of the collection. If zero, the device is still collecting. If non-zero, the device has finished collecting and `ps6000aGetValues()` can be used to retrieve the data.

Returns

3.26 ps6000aMemorySegments - set number of memory segments

```
PICO_STATUS ps6000aMemorySegments
(
  int16_t     handle
  uint64_t    nSegments,
  uint64_t  * nMaxSamples
)
```

This function sets the number of memory segments that the scope will use.

When the scope is opened, the number of segments defaults to 1, meaning that each capture fills the scope's available memory. This function allows you to divide the memory into a number of segments so that the scope can store several waveforms sequentially.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`nSegments`, the number of segments required. See data sheet for capacity of each model.

`* nMaxSamples`, on exit, the number of samples available in each segment. This is the total number over all channels, so if more than one channel is in use then the number of samples available to each channel is `nMaxSamples` divided by the number of channels.

Returns

`PICO_OK`
`PICO_USER_CALLBACK`
`PICO_INVALID_HANDLE`
`PICO_TOO_MANY_SEGMENTS`
`PICO_MEMORY`
`PICO_DRIVER_FUNCTION`

3.27 ps6000aMemorySegmentsBySamples - set size of memory segments

```
PICO_STATUS ps6000aMemorySegmentsBySamples
(
  int16_t     handle
  uint64_t    nSamples,
  uint64_t  * nMaxSegments
)
```

This function sets the number of samples per memory segment. Like `ps6000aMemorySegments()` it controls the segmentation of the capture memory, but in this case you specify the number of samples rather than the number of segments.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`nSamples`, the number of samples required in each segment. See data sheet for capacity of each model. This is the total number over *n* channels, where *n* is the number of enabled channels or MSO ports rounded up to the next power of 2. For example, with 5 channels or ports enabled, *n* is 8. If *n* > 1, the number of segments available will be reduced accordingly.

`* nMaxSegments`, on exit, the number of segments into which the capture memory has been divided.

Returns

`PICO_OK`
`PICO_USER_CALLBACK`
`PICO_INVALID_HANDLE`
`PICO_TOO_MANY_SEGMENTS`
`PICO_MEMORY`
`PICO_DRIVER_FUNCTION`

3.28 ps6000aNearestSampleIntervalStateless - get nearest sampling interval

```
PICO_STATUS ps6000aNearestSampleIntervalStateless
(
  int16_t                  handle,
  PICO_CHANNEL_FLAGS       enabledChannelFlags,
  double                   timeIntervalRequested,
  PICO_DEVICE_RESOLUTION   resolution,
  uint32_t               * timebase,
  double                 * timeIntervalAvailable
)
```

This function returns the nearest possible sample interval to the requested sample interval. It does not change the configuration of the oscilloscope.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

enabledChannelFlags, see ps6000aGetMinimumTimebaseStateless().

timeIntervalRequested, the time interval, in seconds, that you would like to obtain.

resolution, the vertical resolution (number of bits) for which the oscilloscope will be configured.

* timebase, on exit, the number of the nearest available timebase.

* timeIntervalAvailable, on exit, the nearest available time interval, in seconds.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NO_SAMPLES_AVAILABLE
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_TOO_MANY_SAMPLES

3.29 ps6000aNoOfStreamingValues - get number of captured samples

```
PICO_STATUS ps6000aNoOfStreamingValues
(
  int16_t     handle,
  uint64_t  * noOfValues
)
```

This function returns the number of samples available after data collection in streaming mode. Call it after calling `ps6000aStop()`.

Applicability

Streaming mode

Arguments

`handle,` the device identifier returned by `ps6000aOpenUnit()`.

`* noOfValues,` on exit, the number of samples.

Returns

```
PICO_OK
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_NO_SAMPLES_AVAILABLE
PICO_NOT_USED
PICO_BUSY
PICO_DRIVER_FUNCTION
```

3.30 ps6000aOpenUnit - open a scope device

```
PICO_STATUS ps6000aOpenUnit
(
  int16_t                  * handle,
  int8_t                   * serial,
  PICO_DEVICE_RESOLUTION     resolution
)
```

This function opens a PicoScope 6000E Series scope attached to the computer. The maximum number of units that can be opened depends on the operating system, the kernel driver and the computer.

If the function returns PICO_FIRMWARE_UPDATE_REQUIRED_TO_USE_DEVICE_WITH_THIS_DRIVER, all other API calls that perform operations with the same device will fail with the same return value until ps6000aStartFirmwareUpdate() is called. Users should avoid unplugging the device during this operation, otherwise there is a small chance that the firmware could be corrupted.

Applicability

All modes

Arguments

* handle, on exit, the result of the attempt to open a scope:
  −1 : if the scope fails to open
  0 : if no scope is found
  > 0 : a number that uniquely identifies the scope

If a valid handle is returned, it must be used in all subsequent calls to API functions to identify this scope.

serial, on entry, a null-terminated string containing the serial number of the scope to be opened. If serial is NULL then the function opens the first scope found; otherwise, it tries to open the scope that matches the string.

resolution, the required vertical resolution (in bits).

Returns

PICO_OK
PICO_OS_NOT_SUPPORTED
PICO_OPEN_OPERATION_IN_PROGRESS
PICO_EEPROM_CORRUPT
PICO_KERNEL_DRIVER_TOO_OLD
PICO_FW_FAIL
PICO_MAX_UNITS_OPENED
PICO_NOT_FOUND (if the specified unit was not found)
PICO_NOT_RESPONDING
PICO_MEMORY_FAIL
PICO_ANALOG_BOARD
PICO_CONFIG_FAIL_AWG
PICO_INITIALISE_FPGA
PICO_FIRMWARE_UPDATE_REQUIRED_TO_USE_DEVICE_WITH_THIS_DRIVER - call ps6000aCheckForUpdate() and then ps6000aStartFirmwareUpdate()

3.31 ps6000aOpenUnitAsync - open unit without blocking

```
PICO_STATUS ps6000aOpenUnitAsync
(
  int16_t                 * status,
  int8_t                  * serial,
  PICO_DEVICE_RESOLUTION    resolution
)
```

This function opens a scope without blocking the calling thread. You can find out when it has finished by periodically calling `ps6000aOpenUnitProgress()` until that function sets the `complete` flag to a non-zero value.

Applicability

All modes

Arguments

`* status`, a status code:
  `0` if the open operation was disallowed because another open operation is in progress
  `1` if the open operation was successfully started

`* serial,` see `ps6000aOpenUnit()`.

`resolution,` the vertical resolution required.

Returns

`PICO_OK`
`PICO_OPEN_OPERATION_IN_PROGRESS`
`PICO_OPERATION_FAILED`

3.32 ps6000aOpenUnitProgress - get status of opening a unit

```
PICO_STATUS ps6000aOpenUnitProgress
(
  int16_t  * handle,
  int16_t  * progressPercent,
  int16_t  * complete
)
```

This function checks on the progress of a request made to ps6000aOpenUnitAsync() to open a scope.

Applicability

Use after ps6000aOpenUnitAsync()

Arguments

`* handle,` see ps6000aOpenUnit(). This handle is valid only if the function returns `PICO_OK`.

`* progressPercent,` on exit, `0` while the operation is in progress, `100` when the operation is complete.

`* complete,` set to 1 when the open operation has finished.

Returns

`PICO_OK`
`PICO_NULL_PARAMETER`
`PICO_OPERATION_FAILED`

3.33 ps6000aPingUnit - check if device is still connected

```
PICO_STATUS ps6000aPingUnit
(
  int16_t    handle
)
```

This function can be used to check that the already opened device is still connected to the USB port and communication is successful.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_BUSY
PICO_NOT_RESPONDING

3.34 ps6000aQueryMaxSegmentsBySamples - get number of segments

```
PICO_STATUS ps6000aQueryMaxSegmentsBySamples
(
  int16_t                  handle,
  uint64_t                 nSamples,
  uint32_t                 nChannelEnabled,
  uint64_t               * nMaxSegments,
  PICO_DEVICE_RESOLUTION   resolution
)
```

This function returns the maximum number of memory segments available given the number of samples per segment.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`nSamples`, the number of samples per segment.

`nChannelEnabled`, the number of channels enabled.

`* nMaxSegments`, on exit, the maximum number of segments that can be requested.

`resolution`, an enumerated type representing the hardware resolution.

Returns

```
PICO_OK
PICO_INVALID_HANDLE
PICO_NO_SAMPLES_AVAILABLE
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_SEGMENT_OUT_OF_RANGE
PICO_TOO_MANY_SAMPLES
```


3.35 ps6000aQueryOutputEdgeDetect – check if output edge detection is enabled

```
PICO_STATUS ps6000aQueryOutputEdgeDetect
(
  int16_t   handle,
  int16_t * state
)
```

This function reports whether output edge detection mode is currently enabled. The default state is enabled.

To switch output edge detection mode on or off, use ps6000aSetOutputEdgeDetect. See that function description for more details.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

* state, on exit, the state of output edge detection:
  0 = off
  1 = on

Returns

PICO_OK or other code from PicoStatus.h

3.36 ps6000aResetChannelsAndReportAllChannelsOvervoltageTripStatus

```
PICO_STATUS ps6000aResetChannelsAndReportAllChannelsOvervoltageTripStatus
(
  int16_t                             handle,
  PICO_CHANNEL_OVERVOLTAGE_TRIPPED  * allChannelsTrippedStatus,
  uint8_t                             nChannelTrippedStatus
)
```

This function resets all oscilloscope channels and then reports the overvoltage trip status for all channels. Use this to find out which channels caused an overvoltage trip event.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

allChannelsTrippedStatus, a pointer to an array of PICO_CHANNEL_OVERVOLTAGE_TRIPPED structs. On exit, the overvoltage trip status of each channel will be written to this array.

nChannelTrippedStatus, the number of PICO_CHANNEL_OVERVOLTAGE_TRIPPED structs in the above array..

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_HARDWARE_CAPTURING_CALL_STOP
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_NOT_SUPPORTED_BY_THIS_DEVICE

3.37 ps6000aReportAllChannelsOvervoltageTripStatus

```
PICO_STATUS ps6000aReportAllChannelsOvervoltageTripStatus
(
  int16_t                             handle,
  PICO_CHANNEL_OVERVOLTAGE_TRIPPED  * allChannelsTrippedStatus,
  uint8_t                             nChannelTrippedStatus
)
```

This function reports the overvoltage trip status for all channels without resetting their status. Use it to find out which channels caused an overvoltage trip event.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

allChannelsTrippedStatus, a pointer to an array of PICO_CHANNEL_OVERVOLTAGE_TRIPPED channel status flags. On exit, the overvoltage trip status of each channel will be written to this array.

nChannelTrippedStatus, the number of PICO_CHANNEL_OVERVOLTAGE_TRIPPED structs in the above array..

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_NOT_SUPPORTED_BY_THIS_DEVICE

3.37.1 PICO_CHANNEL_OVERVOLTAGE_TRIPPED structure

```
typedef struct tPicoChannelOvervoltageTripped
{
  PICO_CHANNEL   channel_;
  uint8_t        tripped_;
} PICO_CHANNEL_OVERVOLTAGE_TRIPPED;
```

This structure contains information about the overvoltage trip on a given channel. An overvoltage trip occurs when an oscilloscope channel in 50 Ω coupling mode detects an excessive voltage on its input.

Applicability

Analog input channels

Elements

channel_, the oscilloscope channel to which the information applies.

tripped_, a flag indicating whether the overvoltage trip occurred (non-zero) or did not occur (zero).

3.38 ps6000aRunBlock - start block mode capture

```
PICO_STATUS ps6000aRunBlock
(
  int16_t                 handle,
  uint64_t                noOfPreTriggerSamples,
  uint64_t                noOfPostTriggerSamples,
  uint32_t                timebase,
  double                * timeIndisposedMs,
  uint64_t                segmentIndex,
  ps6000aBlockReady       lpReady,
  PICO_POINTER            pParameter
)
```

This function starts collecting data in block mode. For a step-by-step guide to this process, see Using block mode.

The number of samples is determined by `noOfPreTriggerSamples` and `noOfPostTriggerSamples` (see below for details). The total number of samples must not be more than the size of the segment referred to by `segmentIndex`.

Applicability

Block mode, rapid block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`noOfPreTriggerSamples`, the number of samples to return before the trigger event. If no trigger has been set, then this argument is added to `noOfPostTriggerSamples` to give the maximum number of data points (samples) to collect.

`noOfPostTriggerSamples`, the number of samples to return after the trigger event. If no trigger event has been set, then this argument is added to `noOfPreTriggerSamples` to give the maximum number of data points to collect. If a trigger condition has been set, this specifies the number of data points to collect after a trigger has fired, and the number of samples to be collected is:

`noOfPreTriggerSamples + noOfPostTriggerSamples`

`timebase`, a number in the range 0 to $2^{32}-1$. See the guide to calculating timebase values.

`* timeIndisposedMs`, on exit, the time in milliseconds that the scope will spend collecting samples. This does not include any auto trigger timeout. If this pointer is null, nothing will be written here.

`segmentIndex`, zero-based, specifies which memory segment to use.

`lpReady`, a pointer to the `ps6000aBlockReady()` callback function that the driver will call when the data has been collected. To use the `ps6000aIsReady()` polling method instead of a callback function, set this pointer to `NULL`.

`pParameter`, a void pointer that is passed to the `ps6000aBlockReady()` callback function. The callback can use this pointer to return arbitrary data to the application.

Returns

`PICO_OK`

PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_SEGMENT_OUT_OF_RANGE
PICO_INVALID_CHANNEL
PICO_INVALID_TRIGGER_CHANNEL
PICO_INVALID_CONDITION_CHANNEL
PICO_TOO_MANY_SAMPLES
PICO_INVALID_TIMEBASE
PICO_NOT_RESPONDING
PICO_CONFIG_FAIL
PICO_INVALID_PARAMETER
PICO_NOT_RESPONDING
PICO_TRIGGER_ERROR
PICO_DRIVER_FUNCTION
PICO_EXTERNAL_FREQUENCY_INVALID
PICO_FW_FAIL
PICO_NOT_ENOUGH_SEGMENTS (in Bulk mode)
PICO_TRIGGER_AND_EXTERNAL_CLOCK_CLASH
PICO_PWQ_AND_EXTERNAL_CLOCK_CLASH
PICO_PULSE_WIDTH_QUALIFIER
PICO_SEGMENT_OUT_OF_RANGE (in Overlapped mode)
PICO_STARTINDEX_INVALID (in Overlapped mode)
PICO_INVALID_SAMPLERATIO (in Overlapped mode)
PICO_CONFIG_FAIL
PICO_SIGGEN_GATING_AUXIO_ENABLED (signal generator is set to trigger on AUX input with incompatible trigger type)

3.39 ps6000aRunStreaming - start streaming mode capture

```
PICO_STATUS ps6000aRunStreaming
(
  int16_t               handle,
  double              * sampleInterval,
  PICO_TIME_UNITS       sampleIntervalTimeUnits
  uint64_t              maxPreTriggerSamples,
  uint64_t              maxPostTriggerSamples,
  int16_t               autoStop,
  uint64_t              downSampleRatio,
  PICO_RATIO_MODE       downSampleRatioMode
)
```

This function tells the oscilloscope to start collecting data in streaming mode. The device can return either raw or downsampled data to your application while streaming is in progress. Call `ps6000aGetStreamingLatestValues()` to retrieve the data. See Using streaming mode for a step-by-step guide to this process.

When a trigger is set, the total number of samples is the sum of `maxPreTriggerSamples` and `maxPostTriggerSamples`. If `autoStop` is false then this will become the maximum number of samples without downsampling.

When downsampled data is returned, the raw samples remain stored on the device. The maximum number of raw samples that can be retrieved after streaming has stopped is **(scope's memory size) / (resolution data size * channels)**, where **channels** is the number of active channels rounded up to a power of 2.

Applicability

Streaming mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* sampleInterval`, on entry, the requested time interval between samples; on exit, the actual time interval used

`sampleIntervalTimeUnits`, the unit of time used for `sampleInterval`. Use one of these values:
  PICO_FS
  PICO_PS
  PICO_NS
  PICO_US
  PICO_MS
  PICO_S

`maxPreTriggerSamples`, the maximum number of raw samples before a trigger event for each enabled channel. If no trigger condition is set this argument is ignored.

`maxPostTriggerSamples`, the maximum number of raw samples after a trigger event for each enabled channel. If no trigger condition is set, this argument states the maximum number of samples to be stored.

autoStop, a flag that specifies if the streaming should stop when all of maxSamples have been captured.

downSampleRatio, downSampleRatioMode: see ps6000aGetValues().

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_NULL_PARAMETER
PICO_INVALID_PARAMETER
PICO_STREAMING_FAILED
PICO_NOT_RESPONDING
PICO_TRIGGER_ERROR
PICO_INVALID_SAMPLE_INTERVAL
PICO_INVALID_BUFFER
PICO_DRIVER_FUNCTION
PICO_EXTERNAL_FREQUENCY_INVALID
PICO_FW_FAIL
PICO_TRIGGER_AND_EXTERNAL_CLOCK_CLASH
PICO_PWQ_AND_EXTERNAL_CLOCK_CLASH
PICO_MEMORY
PICO_SIGGEN_GATING_AUXIO_ENABLED (signal generator is set to trigger on AUX input with incompatible trigger type)

3.40 ps6000aSetChannelOff - disable one channel

```
PICO_STATUS ps6000aSetChannelOff
(
  int16_t        handle,
  PICO_CHANNEL   channel
)
```

This function switches an analog input channel off. It has the opposite function to `ps6000aSetChannelOn()`.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`channel`, see `ps6000aSetChannelOn()`.

Returns

`PICO_OK`
`PICO_USER_CALLBACK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_CHANNEL`
`PICO_DRIVER_FUNCTION`

3.41 ps6000aSetChannelOn - enable and set options for one channel

```
PICO_STATUS ps6000aSetChannelOn
(
  int16_t                    handle,
  PICO_CHANNEL               channel,
  PICO_COUPLING              coupling,
  PICO_CONNECT_PROBE_RANGE   range,
  double                     analogueOffset,
  PICO_BANDWIDTH_LIMITER     bandwidth
)
```

This function switches an analog input channel on and specifies its input coupling type, voltage range, analog offset and bandwidth limit. Some of the arguments within this function have model-specific values. Consult the relevant section below according to the model you have.

To switch off, use `ps6000aSetChannelOff()`.

For digital ports, see `ps6000aSetDigitalPortOn()`.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`channel`, the channel to be configured. The values (subject to the number of channels on your oscilloscope model) are:

`PICO_CHANNEL_A`, `PICO_CHANNEL_B`, `PICO_CHANNEL_C`, `PICO_CHANNEL_D`,
`PICO_CHANNEL_E`, `PICO_CHANNEL_F`, `PICO_CHANNEL_G`, `PICO_CHANNEL_H`

`coupling`, the impedance and coupling type. The values supported are:

`PICO_AC`, 1 MΩ impedance, AC coupling. The channel accepts input frequencies from about 1 hertz up to its maximum -3 dB analog bandwidth.*

`PICO_DC`, 1 MΩ impedance, DC coupling. The scope accepts all input frequencies from zero (DC) up to its maximum -3 dB analog bandwidth.*

`PICO_DC_50OHM`, 50 Ω impedance, DC coupling. The higher-voltage input ranges may not be available in this mode - consult data sheet.

`range`, the input voltage range (not applicable to intelligent probes – see below):

`PICO_10MV`: ±10 mV*
`PICO_20MV`: ±20 mV*
`PICO_50MV`: ±50 mV
`PICO_100MV`: ±100 mV
`PICO_200MV`: ±200 mV
`PICO_500MV`: ±500 mV
`PICO_1V`: ±1 V*
`PICO_2V`: ±2 V*
`PICO_5V`: ±5 V*
`PICO_10V`: ±10 V**

PICO_20V: ±20 V**
* not available for the PicoScope 6428E-D
** not available when coupling = PICO_DC_50R

For an intelligent probe (one with internal electronics to identify the probe and set ranges automatically), you cannot set the oscilloscope range directly. If you try to, the function will return PICO_WARNING_PROBE_CHANNEL_OUT_OF_SYNC. Instead, use the PICO_CONNECT_PROBE_RANGE values which are applicable to the connected probe. The available range values for the currently-connected probe are passed to your PicoProbeInteractions() callback when a probe is detected by the oscilloscope.

analogueOffset, a voltage to add to the input channel before digitization.

bandwidth, the bandwidth limiter setting:
PICO_BW_FULL: the scope's full specified bandwidth
PICO_BW_20MHZ: –3 dB bandwidth limited to 20 MHz
PICO_BW_200MHZ: –3 dB bandwidth limited to 200 MHz (for scopes with 750 MHz bandwidth and above)

Returns

PICO_OK
PICO_USER_CALLBACK
PICO_INVALID_HANDLE
PICO_INVALID_CHANNEL
PICO_INVALID_VOLTAGE_RANGE
PICO_INVALID_COUPLING
PICO_COUPLING_NOT_SUPPORTED
PICO_INVALID_ANALOGUE_OFFSET
PICO_INVALID_BANDWIDTH
PICO_BANDWIDTH_NOT_SUPPORTED
PICO_DRIVER_FUNCTION
PICO_WARNING_PROBE_CHANNEL_OUT_OF_SYNC

3.42 ps6000aSetDataBuffer - provide location of data buffer

```
PICO_STATUS ps6000aSetDataBuffer
(
  int16_t              handle,
  PICO_CHANNEL         channel,
  PICO_POINTER         buffer,
  int32_t              nSamples,
  PICO_DATA_TYPE       dataType,
  uint64_t             waveform,
  PICO_RATIO_MODE      downSampleRatioMode,
  PICO_ACTION          action
)
```

This function tells the driver where to store the data, either unprocessed or downsampled, that will be returned after the next call to one of the `GetValues` functions. The function allows you to specify only a single buffer, so for aggregation mode, which requires two buffers, you must call `ps6000aSetDataBuffers()` instead.

The buffer persists between captures until it is replaced with another buffer or `buffer` is set to NULL. The buffer can be replaced at any time between calls to `ps6000aGetValues()`.

You must allocate memory for the buffer before calling this function.

Applicability

Block, rapid block and streaming modes. All downsampling modes except aggregation.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`channel`, the channel you want to use with the buffer.

`buffer`, the location of the buffer.

`nSamples`, the length of the `buffer` array.

`dataType`, the data type that you wish to use for the sample values:
- `PICO_INT8_T`, 8-bit signed integer
- `PICO_INT16_T`, 16-bit signed integer
- `PICO_INT32_T`, 32-bit signed integer
- `PICO_UINT32_T`, 32-bit unsigned integer
- `PICO_INT64_T`, 64-bit signed integer

`waveform`, the segment index.

`downSampleRatioMode`, the downsampling mode. See `ps6000aGetValues()` for the available modes, but note that a single call to `ps6000aSetDataBuffer()` can only associate one buffer with one downsampling mode. If you intend to call `ps6000aGetValues()` with more than one downsampling mode activated, then you must call `ps6000aSetDataBuffer()` several times to associate a separate buffer with each downsampling mode.

action, the method to use when creating the buffer. The buffers are added to a unique list for the channel, data type and segment. Therefore you must use PICO_CLEAR_ALL to remove all buffers already written. PICO_ACTION values can be ORed together to allow clearing and adding in one call.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_INVALID_CHANNEL
PICO_RATIO_MODE_NOT_SUPPORTED
PICO_DRIVER_FUNCTION
PICO_INVALID_PARAMETER

3.43 ps6000aSetDataBuffers - provide locations of both data buffers

```
PICO_STATUS ps6000aSetDataBuffers
(
  int16_t             handle,
  PICO_CHANNEL        channel,
  PICO_POINTER        bufferMax,
  PICO_POINTER        bufferMin,
  int32_t             nSamples,
  PICO_DATA_TYPE      dataType,
  uint64_t            waveform,
  PICO_RATIO_MODE     downSampleRatioMode,
  PICO_ACTION         action
)
```

This function tells the driver the location of one or two buffers for receiving data. You need to allocate memory for the buffers before calling this function. If you do not need two buffers, because you are not using aggregate mode, then you can optionally use `ps6000aSetDataBuffer()` instead.

Applicability

Block and streaming modes with aggregation.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`channel`, the channel for which you want to set the buffers.

`* bufferMax`, a buffer to receive the maximum data values in aggregation mode, or the non-aggregated values otherwise.

`* bufferMin`, a buffer to receive the minimum aggregated data values. Not used in other downsampling modes.

`nSamples`,
`dataType`,
`waveform`, see `ps6000aSetDataBuffer()`.

`downSampleRatioMode`, the downsampling mode. See `ps6000aGetValues()` for the available modes, but note that a single call to `ps6000aSetDataBuffer()` can only associate one buffer with one downsampling mode. If you intend to call `ps6000aGetValues()` with more than one downsampling mode activated, then you must call `ps6000aSetDataBuffer()` several times to associate a separate buffer with each downsampling mode.

`action`, see `ps6000aSetDataBuffer()`

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_CHANNEL`
`PICO_RATIO_MODE_NOT_SUPPORTED`
`PICO_DRIVER_FUNCTION`
`PICO_INVALID_PARAMETER`

3.44 ps6000aSetDeviceResolution – set the hardware resolution

```
PICO_STATUS ps6000aSetDeviceResolution
(
  int16_t                  handle,
  PICO_DEVICE_RESOLUTION   resolution
)
```

This function sets the sampling resolution of the device. At 10-bit and higher resolutions, the maximum capture buffer length is half that of 8-bit mode. When using 12-bit resolution only 2 channels can be enabled to capture data.

When you change the device resolution, the driver discards all previously captured data.

After changing the resolution and before calling ps6000aRunBlock() or ps6000aRunStreaming(), call ps6000aSetChannelOn() to set up the input channels.

Applicability

All modes.

Arguments

`handle`, the device identifier returned by ps6000aOpenUnit().

`resolution`, determines the resolution of the device when opened, the available values are one of the PICO_DEVICE_RESOLUTION.

Returns

`PICO_INVALID_DEVICE_RESOLUTION` if resolution is out of range.

3.44.1 PICO_DEVICE_RESOLUTION enumerated type

```
typedef enum enPicoDeviceResolution
{
  PICO_DR_8BIT  = 0,
  PICO_DR_12BIT = 1,
  PICO_DR_10BIT = 10,
} PICO_DEVICE_RESOLUTION;
```

These values specify the resolution of the sampling hardware in the oscilloscope. Each mode divides the input voltage range into a number of levels as listed below.

Applicability

Calls to ps6000aSetDeviceResolution() etc.

Values

`PICO_DR_8BIT` – 8-bit resolution (256 levels)
`PICO_DR_10BIT` – 10-bit resolution (1024 levels)
`PICO_DR_12BIT` – 12-bit resolution (4096 levels)

3.45 ps6000aSetDigitalPortOff – switch off digital inputs

```
PICO_STATUS ps6000aSetDigitalPortOff
(
  int16_t                         handle,
  PICO_CHANNEL                    port
)
```

This function switches off one or more digital ports.

Applicability

Block and streaming modes with aggregation.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`port`, see `ps6000aSetDigitalPortOn()`.

Returns

3.46 ps6000aSetDigitalPortOn – set up and enable digital inputs

```
PICO_STATUS ps6000aSetDigitalPortOn
(
  int16_t                          handle,
  PICO_CHANNEL                     port,
  int16_t                        * logicThresholdLevel,
  int16_t                          logicThresholdLevelLength,
  PICO_DIGITAL_PORT_HYSTERESIS     hysteresis
)
```

This function switches on one or more digital ports and sets the logic thresholds.

Refer to the data sheet for the fastest sampling rates available with different combinations of analog and digital inputs. In most cases the fastest rates will be obtained by disabling all analog channels. When all analog channels are disabled you must also select 8-bit resolution to allow the digital inputs to operate alone.

Applicability

Block and streaming modes with aggregation.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`port`, identifies the MSO port:
  `PICO_DIGITAL_PORT0 = 128` (**Digital 1** port: digital channels 1D0–1D7)
  `PICO_DIGITAL_PORT1 = 129` (**Digital 2** port: digital channels 2D0–2D7)

`* logicThresholdLevel`, on entry, a list of threshold voltages, one for each port pin, used to distinguish the 0 and 1 states. Range: –32 767 (–5 V) to 32 767 (+5 V).

`logicThresholdLevelLength`, the number of items in the `logicThresholdLevel` list.

`hysteresis`, the hysteresis to apply to all channels in the port:
  `PICO_VERY_HIGH_400MV`
  `PICO_HIGH_200MV`
  `PICO_NORMAL_100MV`
  `PICO_LOW_50MV`

Returns

3.47 ps6000aSetExternalReferenceInteractionCallback - register callback function for external reference clock events

```
PICO_STATUS ps6000aSetExternalReferenceInteractionCallback
(
  int16_t                            handle,
  PicoExternalReferenceInteractions  callback
)
```

This function registers your PicoExternalReferenceInteractions() callback function with the ps6000a driver. Passing a null pointer clears any previous callback.

The PicoScope 6000 (A API) device automatically selects the external reference clock when a signal is applied to the external reference input, and reverts to the internal clock if the signal is removed. The driver will call your callback function whenever the external reference clock status changes.

Applicability

All models

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

callback, a pointer to your callback function.

Returns

PICO_OK or a code from PicoStatus.h

3.48 ps6000aSetNoOfCaptures - modify rapid block mode

```
PICO_STATUS ps6000aSetNoOfCaptures
(
  int16_t     handle,
  uint64_t    nCaptures
)
```

This function sets the number of captures to be collected in one run of rapid block mode. If you do not call this function before a run, the driver will capture only one waveform.

Applicability

Rapid block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`nCaptures`, the number of waveforms to capture in one run.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_INVALID_PARAMETER`
`PICO_DRIVER_FUNCTION`

3.49 ps6000aSetOutputEdgeDetect – change triggering behavior

```
PICO_STATUS ps6000aSetOutputEdgeDetect
(
  int16_t   handle,
  int16_t   state
)
```

This function enables or disables output edge detection mode for the logic trigger. Output edge detection is enabled by default and should be left enabled for normal operation.

The oscilloscope normally triggers only when the output of the trigger logic function changes state. For example, if the function is "A high AND B high", the oscilloscope triggers when A is high and B changes from low to high, but does not repeatedly trigger when A and B remain high. Calling `ps6000aSetOutputEdgeDetect()` with `state = 0` changes this behavior so that the oscilloscope triggers continually while the logic trigger function evaluates to TRUE.

To find out whether output edge detection is enabled, use `ps6000aQueryOutputEdgeDetect()`.

Applicability

Rapid block mode

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`state`, the desired state of output edge detection:
`0 = off`
`1 = on`

Returns

`PICO_OK` or other code from `PicoStatus.h`

3.50 ps6000aSetProbeInteractionCallback – register callback function for probe events

```
PICO_STATUS ps6000aSetProbeInteractionCallback
(
  int16_t                   handle,
  PicoProbeInteractions     callback
)
```

This function registers your PicoProbeInteractions() callback function with the ps6000a driver. The driver will then call your function whenever a Pico intelligent probe is plugged into, or unplugged from, a PicoScope 6000 (A API) device, or if the power consumption of the connected probes exceeds the power available. See Handling PicoConnect probe interactions for more information on this process.

You should call this function as soon as the device has been successfully opened and before any call to ps6000aSetChannelOn().

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

callback, a pointer to your callback function.

Returns

PICO_OK

3.51 ps6000aSetPulseWidthDigitalPortProperties – set digital port pulse width

```
PICO_STATUS ps6000aSetPulseWidthDigitalPortProperties
(
  int16_t                   handle,
  PICO_CHANNEL              port,
  PICO_DIGITAL_DIRECTION *  directions,
  int16_t                   nDirections
)
```

This function sets the individual digital channels' pulse-width trigger directions. Each trigger direction consists of a channel name and a direction. If the channel is not included in the array of PICO_DIGITAL_DIRECTION, the driver assumes the digital channel's pulse-width trigger direction is PICO_DIGITAL_DONT_CARE.

Applicability

All modes.
Any model with MSO pod(s) fitted.

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

* directions, a pointer to an array of PICO_DIGITAL_DIRECTION structures describing the requested properties. The array can contain a single element describing the properties of one channel, or a number of elements describing several digital channels. If directions is NULL, digital pulse-width triggering is switched off. A digital channel that is not included in the array is set to PICO_DIGITAL_DONT_CARE.

nDirections, the number of digital channel directions being passed to the driver.

Returns

PICO_OK or other code from PicoStatus.h

3.52 ps6000aSetPulseWidthQualifierConditions - specify how to combine channels

```
PICO_STATUS ps6000aSetPulseWidthQualifierConditions
(
  int16_t                  handle,
  PICO_CONDITION         * conditions,
  int16_t                  nConditions,
  PICO_ACTION              action
)
```

This function is used to set conditions for the pulse width qualifier, which is an optional input to the triggering condition.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* conditions`, on entry, an array of structures specifiying the pulse width qualifier conditions. See `PICO_CONDITION`.

`nConditions`, the number of structures in the `conditions` array.

`action`, how to combine the array of conditions with existing pulse width qualifier conditions. See `ps6000aSetTriggerChannelConditions()` for the list of actions.

Returns

`PICO_OK`

3.53 ps6000aSetPulseWidthQualifierDirections - specify threshold directions

```
PICO_STATUS ps6000aSetPulseWidthQualifierDirections
(
  int16_t          handle,
  PICO_DIRECTION * directions,
  int16_t          nDirections
)
```

This function is used to set directions for the pulse width qualifier, which is an optional input to the triggering condition.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`* directions`, an array of structures specifying the pulse width qualifier directions. See `PICO_DIRECTION`.

`nDirections`, the number of structures in the `directions` array.

Returns

`PICO_OK`

3.54 ps6000aSetPulseWidthQualifierProperties - specify threshold logic

```
PICO_STATUS ps6000aSetPulseWidthQualifierProperties
(
  int16_t                 handle,
  uint32_t                lower,
  uint32_t                upper,
  PICO_PULSE_WIDTH_TYPE   type
)
```

This function is used to set parameters for the pulse width qualifier, which is an optional input to the triggering condition.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`lower`, the lower pulse width threshold.

`upper`, the upper pulse width threshold.

`type`, the pulse width qualifier type:
- `PICO_PW_TYPE_NONE = 0`, no pulse width qualifier required
- `PICO_PW_TYPE_LESS_THAN = 1`, pulse width must be less than threshold
- `PICO_PW_TYPE_GREATER_THAN = 2`, pulse width must be greater than threshold
- `PICO_PW_TYPE_IN_RANGE = 3`, pulse width must be between two thresholds
- `PICO_PW_TYPE_OUT_OF_RANGE = 4`, pulse width must not be between two thresholds

Returns

`PICO_OK`

3.55 ps6000aSetSimpleTrigger - set up triggering

```
PICO_STATUS ps6000aSetSimpleTrigger
(
  int16_t                    handle,
  int16_t                    enable,
  PICO_CHANNEL               source,
  int16_t                    threshold,
  PICO_THRESHOLD_DIRECTION   direction,
  uint64_t                   delay,
  uint32_t                   autoTriggerMicroSeconds
)
```

This function simplifies arming the trigger. It supports only the LEVEL trigger types and does not allow more than one channel to have a trigger applied to it. Any previous pulse width qualifier is canceled.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

enable:disable (0) or enable (1) the trigger.

source: the channel on which to trigger. This can be any of the input channels listed under ps6000aSetChannelOn().

threshold: the ADC count at which the trigger will fire.

direction: the direction in which the signal must move to cause a trigger. The following directions are supported: ABOVE, BELOW, RISING, FALLING and RISING_OR_FALLING.

delay: the time between the trigger occurring and the first sample being taken.

autoTriggerMicroSeconds: the number of microseconds the device will wait if no trigger occurs.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_DRIVER_FUNCTION

3.56 ps6000aSetTriggerChannelConditions - set triggering logic

```
PICO_STATUS ps6000aSetTriggerChannelConditions
(
  int16_t              handle,
  PICO_CONDITION     * conditions,
  int16_t              nConditions,
  PICO_ACTION          action
)
```

This function sets up trigger conditions on the scope's inputs. The trigger is defined by one or more PICO_CONDITION structures that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

If complex triggering is not required, use ps6000aSetSimpleTrigger().

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

conditions, an array of PICO_CONDITION structures specifying the conditions that should be applied to each channel. In the simplest case, the array consists of a single element. When there is more than one element, the overall trigger condition is the logical OR of all the elements.

nConditions, the number of elements in the conditions array. If nConditions is zero then triggering is switched off.

action, specifies how to apply the PICO_CONDITION array to any existing trigger conditions:
  PICO_CLEAR_ALL = 0x00000001
  PICO_ADD = 0x00000002

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_CONDITIONS
PICO_MEMORY_FAIL
PICO_DRIVER_FUNCTION

3.56.1 PICO_CONDITION structure

A structure of this type is passed to `ps6000aSetTriggerChannelConditions()` in the `conditions` argument to specify the trigger conditions, and is defined as follows:

```
typedef struct tPicoCondition
{
  PICO_CHANNEL       source;
  PICO_TRIGGER_STATE condition;
} PICO_CONDITION
```

Each structure is the logical AND of the states of the scope's inputs. The `ps6000aSetTriggerChannelConditions()` function can OR together a number of these structures to produce the final trigger condition, which can be any possible Boolean function of the scope's inputs.

The structure is byte-aligned. In C++, for example, you should specify this using the `#pragma pack()` instruction.

Elements

`source`, the signal that forms an input to the trigger condition:
`PICO_CHANNEL_A`, `PICO_CHANNEL_B`, `PICO_CHANNEL_C`, `PICO_CHANNEL_D`, `PICO_CHANNEL_E`, `PICO_CHANNEL_F`, `PICO_CHANNEL_G`, `PICO_CHANNEL_H`, one of the analog input channels
`PICO_PORT0`, MSO port **Digital 1** (channels 1D0–1D7)
`PICO_PORT1`, MSO port **Digital 2** (channels 2D0–2D7)
`PICO_TRIGGER_AUX`, the **AUX** input
`PICO_PULSE_WIDTH_SOURCE`, the output of the pulse width qualifier

`condition`, the type of condition that should be applied to each channel. Use these constants:
`PICO_CONDITION_DONT_CARE`
`PICO_CONDITION_TRUE`
`PICO_CONDITION_FALSE`

The channels that are set to `PICO_CONDITION_TRUE` or `PICO_CONDITION_FALSE` must all meet their conditions simultaneously to produce a trigger. Channels set to `PICO_CONDITION_DONT_CARE` are ignored.

3.57 ps6000aSetTriggerChannelDirections - set trigger directions

```
PICO_STATUS ps6000aSetTriggerChannelDirections
(
  int16_t            handle,
  PICO_DIRECTION   * directions,
  int16_t            nDirections
)
```

This function sets the direction of the trigger for one or more channels.

Applicability

All modes

Arguments

`handle,` the device identifier returned by `ps6000aOpenUnit()`.

`* directions,` an array of structures specifying the trigger direction for each channel. See `PICO_DIRECTION`.

`nDirections,` the number of structures in the `directions` array.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_USER_CALLBACK`
`PICO_INVALID_PARAMETER`

3.57.1 PICO_DIRECTION structure

A structure of this type is passed to ps6000aSetTriggerChannelDirections() in the directions argument to specify the trigger directions, and is defined as follows:

```
typedef struct tPicoDirection
{
  PICO_CHANNEL              channel;
  PICO_THRESHOLD_DIRECTION direction;
  PICO_THRESHOLD_MODE      thresholdMode;
} PICO_DIRECTION
```

The structure is byte-aligned. In C++, for example, you should specify this using the #pragma pack() instruction.

Elements

channel, the channel whose direction you want to set.

direction, the direction required for the channel.

thresholdMode, the type of threshold to use.

PICO_THRESHOLD_DIRECTION values:

Constant	Trigger type	Threshold	Polarity
PICO_ABOVE = 0	Gated	Upper	Above
PICO_ABOVE_LOWER = 5	Gated	Lower	Above
PICO_BELOW = 1	Gated	Upper	Below
PICO_BELOW_LOWER = 6	Gated	Lower	Below
PICO_RISING = 2	Threshold	Upper	Rising
PICO_RISING_LOWER = 7	Threshold	Lower	Rising
PICO_FALLING = 3	Threshold	Upper	Falling
PICO_FALLING_LOWER = 8	Threshold	Lower	Falling
PICO_RISING_OR_FALLING = 4	Threshold	Lower (for rising edge) Upper (for falling edge)	
PICO_INSIDE = 0	Window-qualified	Both	Inside
PICO_OUTSIDE = 1	Window-qualified	Both	Outside
PICO_ENTER = 2	Window	Both	Entering
PICO_EXIT = 3	Window	Both	Leaving
PICO_ENTER_OR_EXIT = 4	Window	Both	Either entering or leaving
PICO_POSITIVE_RUNT = 9	Window-qualified	Both	Entering from below
PICO_NEGATIVE_RUNT	Window-qualified	Both	Entering from above
PICO_LOGIC_LOWER = 1000	Logic	Lower	
PICO_LOGIC_UPPER = 1001	Logic	Upper	
PICO_NONE = 2	None	None	None

PICO_THRESHOLD_MODE values:

Constant	Mode
PICO_LEVEL = 0	Active when input is above or below a single threshold
PICO_WINDOW = 1	Active when input is between two thresholds

3.58 ps6000aSetTriggerChannelProperties - set up triggering

```
PICO_STATUS ps6000aSetTriggerChannelProperties
(
  int16_t                              handle,
  PICO_TRIGGER_CHANNEL_PROPERTIES    * channelProperties
  int16_t                              nChannelProperties
  int16_t                              auxOutputEnable,
  uint32_t                             autoTriggerMicroSeconds
)
```

This function is used to enable or disable triggering and set its parameters.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

channelProperties, a pointer to an array of TRIGGER_CHANNEL_PROPERTIES structures describing the requested properties. The array can contain a single element describing the properties of one channel, or a number of elements describing several channels. If NULL is passed, triggering is switched off.

nChannelProperties, the size of the channelProperties array. If zero, triggering is switched off.

auxOutputEnable: not used

autoTriggerMicroSeconds, the time in microseconds for which the scope device will wait before collecting data if no trigger event occurs. If this is set to zero, the scope device will wait indefinitely for a trigger.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_TRIGGER_ERROR
PICO_MEMORY_FAIL
PICO_INVALID_TRIGGER_PROPERTY
PICO_DRIVER_FUNCTION
PICO_INVALID_PARAMETER

3.58.1 TRIGGER_CHANNEL_PROPERTIES structure

A structure of this type is passed to ps6000aSetTriggerChannelProperties() in the channelProperties argument to specify the trigger mechanism, and is defined as follows:

```
typedef struct tTriggerChannelProperties
{
  int16_t        thresholdUpper;
  uint16_t       thresholdUpperHysteresis;
  int16_t        thresholdLower;
  uint16_t       thresholdLowerHysteresis;
  PICO_CHANNEL   channel;
} PICO_TRIGGER_CHANNEL_PROPERTIES
```

The structure is byte-aligned. In C++, for example, you should specify this using the #pragma pack() instruction.

There are two trigger thresholds called Upper and Lower. Each trigger type uses one or other of these thresholds, or both, as specified in ps6000aSetTriggerChannelDirections(). Each trigger threshold has its own hysteresis setting.

Elements

thresholdUpper, the upper threshold at which the trigger fires. It is scaled in 16-bit ADC counts at the currently selected range for that channel. Use when "Upper" or "Both" is specified in ps6000aSetTriggerChannelDirections().

hysteresisUpper, the distance by which the signal must fall below the upper threshold (for rising edge triggers) or rise above the upper threshold (for falling edge triggers) in order to rearm the trigger for the next event. It is scaled in 16-bit counts.

thresholdLower, lower threshold (see thresholdUpper). Use when "Lower" or "Both" is specified in ps6000aSetTriggerChannelDirections().

hysteresisLower, lower threshold hysteresis (see hysteresisUpper).

channel, the channel to which the properties apply. This can be one of the input channels listed under ps6000aSetChannelOn().

3.59 ps6000aSetTriggerDelay - set post-trigger delay

```
PICO_STATUS ps6000aSetTriggerDelay
(
  int16_t     handle,
  uint64_t    delay
)
```

This function sets the post-trigger delay, which causes capture to start a defined time after the trigger event.

Applicability

Block and rapid block modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`delay`, the time between the trigger occurring and the first sample. For example, if `delay=100`, the scope would wait 100 sample periods before sampling. At a timebase of 5 GS/s, or 200 ps per sample (`timebase=0`), the total delay would then be 100 x 200 ps = 20 ns.
Range: 0 to `MAX_DELAY_COUNT`.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_USER_CALLBACK`
`PICO_DRIVER_FUNCTION`

3.60 ps6000aSetTriggerDigitalPortProperties - set port directions

```
PICO_STATUS ps6000aSetTriggerDigitalPortProperties
(
  int16_t                            handle,
  PICO_CHANNEL                       port,
  PICO_DIGITAL_CHANNEL_DIRECTIONS *  directions,
  int16_t                            nDirections
)
```

This function is used to enable or disable triggering and set its parameters.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`port`, identifies the digital port on the oscilloscope:
  `PICO_PORT0`: **Digital 1** port (channels 1D0–1D7)
  `PICO_PORT1`: **Digital 2** port (channels 2D0–2D7)

`* directions`, an array of structures specifying the channel directions.

`nDirections`, the number of items in the `directions` array.

Returns

`PICO_OK`

3.60.1 PICO_DIGITAL_CHANNEL_DIRECTIONS structure

A list of structures of this type is passed to ps6000aSetTriggerDigitalPortProperties() in the directions argument to specify the digital channel trigger directions, and is defined as follows:

```
typedef struct tDigitalChannelDirections
{
  PICO_PORT_DIGITAL_CHANNEL         channel;
  PICO_DIGITAL_DIRECTION            direction;
} PICO_DIGITAL_CHANNEL_DIRECTIONS
```

The structure is byte-aligned. In C++, for example, you should specify this using the #pragma pack() instruction.

Elements

channel, identifies the digital channel from PICO_PORT_DIGITAL_CHANNEL0 up to PICO_PORT_DIGITAL_CHANNEL7.

direction, the trigger direction from the following list:

PICO_DIGITAL_DONT_CARE:	channel has no effect on trigger
PICO_DIGITAL_DIRECTION_LOW:	channel must be low to trigger
PICO_DIGITAL_DIRECTION_HIGH:	channel must be high to trigger
PICO_DIGITAL_DIRECTION_RISING:	channel must transition from low to high to trigger
PICO_DIGITAL_DIRECTION_FALLING:	channel must transition from high to low to trigger
PICO_DIGITAL_DIRECTION_RISING_OR_FALLING:	any transition on channel causes a trigger

3.61 ps6000aSigGenApply - set output parameters

```
PICO_STATUS ps6000aSigGenApply
(
  int16_t             handle,
  int16_t             sigGenEnabled,
  int16_t             sweepEnabled,
  int16_t             triggerEnabled,
  int16_t             automaticClockOptimisationEnabled,
  int16_t             overrideAutomaticClockAndPrescale,
  double            * frequency,
  double            * stopFrequency,
  double            * frequencyIncrement,
  double            * dwellTime
)
```

This function sets the signal generator running using parameters previously configured by the other ps6000aSigGen... functions.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`sigGenEnabled`, switches the signal generator on (1) or off (0).

`sweepEnabled`, switches sweep mode on (1) or off (0).

`triggerEnabled`, switches triggering on (1) or off (0).

`automaticClockOptimisationEnabled`, switches clock optimization on (1) or off (0).

> In automatic clock optimization mode, the DAC clock and prescaler are automatically adjusted by the driver to generate the user-requested output frequency as precisely as possible. This is recommended for most applications. When automatic clock optimization is turned off, the DAC clock remains fixed at its maximum frequency (or a user-specified frequency if using overrideAutomaticClockAndPrescale).

`overrideAutomaticClockAndPrescale`, switches automatic clock and prescale override on or off:

`0` = override off: ignore parameters set by `ps6000aSigGenClockManual()` and allow the driver to choose the DAC clock and prescaler. This mode is recommended for most applications.

`1` = override on: use parameters set by `ps6000aSigGenClockManual()` to manually specify a user-defined DAC clock frequency and prescaler.

`* frequency`, on exit, the actual achieved signal generator frequency (or start frequency in sweep mode).

`* stopFrequency`, on exit, the actual achieved signal generator frequency at the end of the sweep.

`* frequencyIncrement`, on exit, the actual achieved frequency step size in sweep mode.

`* dwellTime`, on exit, the actual achieved time in seconds between frequency steps in sweep mode.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_NOT_RESPONDING

3.62 ps6000aSigGenClockManual - control signal generator clock

```
PICO_STATUS ps6000aSigGenClockManual
(
  int16_t                  handle,
  double                   dacClockFrequency,
  uint64_t                 prescaleRatio
)
```

This function allows direct control of the signal generator clock.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`dacClockFrequency`, the clock frequency of the DAC (digital-to-analog converter) in hertz.
Range: 100e6 to 200e6

`prescaleRatio`, the ratio to program into the prescaler. The prescaler allows the precise generation of low frequencies:
Sample frequency = `dacClockFrequency / prescaleRatio`

Range: 1 to 16384

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`
`PICO_SIGGEN_FREQUENCY_OUT_OF_RANGE`
`PICO_SIGGEN_PRESCALE_OUT_OF_RANGE`

3.63 ps6000aSigGenFilter - switch output filter on or off

```
PICO_STATUS ps6000aSigGenFilter
(
  int16_t                   handle,
  PICO_SIGGEN_FILTER_STATE  filterState
)
```

This function controls the filter on the output of the signal generator. The filter can be used to remove unwanted high-frequency synthesizer noise.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`filterState`, can be set on or off, or put in automatic mode.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`

3.64 ps6000aSigGenFrequency - set output frequency

```
PICO_STATUS ps6000aSigGenFrequency
(
  int16_t                    handle,
  double                     frequencyHz
)
```

This function sets the frequency of the signal generator.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`frequencyHz`, the desired frequency in hertz.

Returns

`PICO_OK` or a code from `PicoStatus.h`

3.65 ps6000aSigGenFrequencyLimits - get limits in sweep mode

```
PICO_STATUS ps6000aSigGenFrequencyLimits
(
  int16_t                   handle,
  PICO_WAVE_TYPE            waveType,
  uint64_t                * numSamples,
  double                  * startFrequency,
  int16_t                   sweepEnabled,
  double                  * manualDacClockFrequency,
  uint64_t                * manualPrescaleRatio,
  double                  * maxStopFrequencyOut,
  double                  * minFrequencyStepOut,
  double                  * maxFrequencyStepOut,
  double                  * minDwellTimeOut,
  double                  * maxDwellTimeOut
)
```

This function queries the maximum and minimum values for the signal generator in frequency sweep mode.

Applicability

All models

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`waveType`, the waveform that you intend to use.

`* numSamples`, for arbitrary waveforms only, the number of samples in the AWG buffer.

`* startFrequency`, for fixed-frequency mode, the desired frequency; for frequency sweep mode, the desired start frequency.

`sweepEnabled`, whether sweep mode is required (1) or not required (0).

`* manualDacClockFrequency` and `* manualPrescaleRatio`, if using manual signal generator clock parameters, provide the clock frequency and prescaler you intend to set using `ps6000aSigGenClockManual()`. If not using manual clock parameters, set both to null.

`* maxStopFrequencyOut`, on exit, the highest possible stop frequency for frequency sweep mode.

`* minFrequencyStepOut`, on exit, the smallest possible frequency step for frequency sweep mode.

`* maxFrequencyStepOut`, on exit, the largest possible frequency step for frequency sweep mode.

`* minDwellTimeOut`, on exit, the smallest possible dwell time for frequency sweep mode.

`* maxDwellTimeOut`, on exit, the largest possible dwell time for frequency sweep mode.

Returns

`PICO_OK`

3.66 ps6000aSigGenFrequencySweep - set signal generator to frequency sweep mode

```
PICO_STATUS ps6000aSigGenFrequencySweep
(
  int16_t                    handle,
  double                     stopFrequencyHz,
  double                     frequencyIncrement,
  double                     dwellTimeSeconds,
  PICO_SWEEP_TYPE            sweepType
)
```

This function sets frequency sweep parameters for the signal generator. It assumes that you have previously called `ps6000aSigGenFrequency()` to set the start frequency.

Applicability

Signal generator.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`stopFrequencyHz`, the frequency in hertz at which the sweep should stop.

`frequencyIncrement`, the amount by which the frequency should change, in hertz, at each step of the sweep.

`dwellTimeSeconds`, the time for which the generator should wait between frequency steps.

sweepType, the direction of the sweep, from the following list:
- `PICO_UP = 0`, to sweep from `startFrequency` up to `stopFrequency` and then repeat.
- `PICO_DOWN = 1`, to sweep from `startFrequency` down to `stopFrequency` and then repeat.
- `PICO_UPDOWN = 2`, to sweep from `startFrequency` up to `stopFrequency`, then down to `startFrequency`, and then repeat.
- `PICO_DOWNUP = 3`, to sweep from `startFrequency` down to `stopFrequency`, then up to `startFrequency`, and then repeat.

Returns

`PICO_OK` or a code from `PicoStatus.h`

3.67 ps6000aSigGenLimits - get signal generator parameters

```
PICO_STATUS ps6000aSigGenLimits
(
  int16_t                    handle,
  PICO_SIGGEN_PARAMETER      parameter,
  double                   * minimumPermissibleValue,
  double                   * maximumPermissibleValue,
  double                   * step
)
```

This function queries the maximum and minimum allowable values for a given signal generator parameter.

Applicability

All models

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`parameter`, one of the following enumerated values:
`PICO_SIGGEN_PARAM_OUTPUT_VOLTS = 0`, the signal generator output voltage
`PICO_SIGGEN_PARAM_SAMPLE = 1`, the value of a sample in the arbitrary waveform buffer
`PICO_SIGGEN_PARAM_BUFFER_LENGTH = 2`, the length of the arbitrary waveform buffer ,in samples

`* minimumPermissibleValue`, on exit, the minimum value

`* maximumPermissibleValue`, on exit, the maximum value

`* step`, on exit, the smallest increment in the parameter that will cause a change in the signal generator output.

Returns

`PICO_OK`

3.68 ps6000aSigGenPause - stop the signal generator

```
PICO_STATUS ps6000aSigGenPause
(
  int16_t                    handle
)
```

This function stops the signal generator. The output will remain at a constant voltage until the generator is restarted with ps6000aSigGenRestart().

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

Returns

PICO_OK or a code from PicoStatus.h

3.69 ps6000aSigGenPhase - set signal generator using delta-phase

```
PICO_STATUS ps6000aSigGenPhase
(
  int16_t                   handle,
  uint64_t                  deltaPhase
)
```

This function sets the signal generator output frequency (or the starting frequency, in the case of a frequency sweep) using a delta-phase value instead of a frequency. See Calculating deltaPhase for more information on how to calculate this value.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`deltaPhase`, the desired delta phase.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DRIVER_FUNCTION`
`PICO_SIGGEN_FREQUENCY_OUT_OF_RANGE`

3.69.1 Calculating deltaPhase

The signal generator uses direct digital synthesis (DDS) with a 32-bit phase accumulator that indicates the present location in the waveform. The top bits of the phase accumulator are used as an index into a buffer containing the arbitrary waveform. The remaining bits act as the fractional part of the index, enabling high-resolution control of output frequency and allowing the generation of lower frequencies.

The signal generator steps through the waveform by adding a *deltaPhase* value between 1 and *phaseAccumulatorSize*-1 to the phase accumulator every *dacPeriod* (= 1/*dacFrequency*). The generator produces a waveform at a frequency that can be calculated as follows:

$$outputFrequency = \frac{dacFrequency}{arbitraryWaveformSize} \times \frac{deltaPhase}{2^{(phaseAccumulatorSize - bufferAddressWidth)}}$$

where:

outputFrequency	= repetition rate of the complete arbitrary waveform
dacFrequency	= update rate of AWG DAC (see table below)
deltaPhase	= delta-phase value supplied to this function
phaseAccumulatorSize	= width in bits of phase accumulator (see table below)
bufferAddressWidth	= width in bits of AWG buffer address (see table below)
arbitraryWaveformSize	= length in samples of the user-defined waveform

Parameter	Value
dacFrequency	Default: 200 MHz. Can be changed by ps6000aSigGenClockManual()
dacPeriod	1/*dacFrequency*. Default: 5 ns.
phaseAccumulatorSize	32
bufferAddressWidth	16

3.70 ps6000aSigGenPhaseSweep - set signal generator to sweep using delta-phase

```
PICO_STATUS ps6000aSigGenPhaseSweep
(
  int16_t                    handle,
  uint64_t                   stopDeltaPhase,
  uint64_t                   deltaPhaseIncrement,
  uint64_t                   dwellCount,
  PICO_SWEEP_TYPE            sweepType
)
```

This function sets frequency sweep parameters for the signal generator using delta-phase values instead of frequency values. It assumes that you have previously called ps6000aSigGenPhase() to set the starting delta-phase.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

stopDeltaPhase, the delta-phase at which the sweep should stop. You must set the starting delta-phase, deltaPhase, beforehand by calling ps6000aSigGenPhase().

deltaPhaseIncrement, the amount by which the delta-phase should change at each step of the sweep.

dwellCount, the number of samples for which the generator should wait between sweep steps.

sweepType, the direction of the sweep, from the following list:
- PICO_UP = 0, to sweep from deltaPhase up to stopDeltaPhase and then repeat.
- PICO_DOWN = 1, to sweep from deltaPhase down to stopDeltaPhase and then repeat.
- PICO_UPDOWN = 2, to sweep from deltaPhase up to stopDeltaPhase, then down to deltaPhase, and then repeat.
- PICO_DOWNUP = 3, to sweep from deltaPhase down to stopDeltaPhase, then up to deltaPhase, and then repeat.

Returns

PICO_OK or a code from PicoStatus.h

3.71 ps6000aSigGenRange - set signal generator output voltages

```
PICO_STATUS ps6000aSigGenRange
(
  int16_t   handle,
  double    peakToPeakVolts,
  double    offsetVolts
)
```

This function sets the amplitude (peak to peak measurement) and offset (voltage corresponding to data value of zero) of the signal generator.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`peakToPeakVolts`, the signal generator's peak-to-peak output range in volts.

`offsetVolts`, the signal generator's output offset in volts.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`
`PICO_SIGGEN_PK_TO_PK`
`PICO_SIGGEN_OFFSET_VOLTAGE`
`PICO_SIGGEN_OUTPUT_OVER_VOLTAGE` (if `peakToPeak` and `offset` are within their individual ranges but the combination is out of range)

3.72 ps6000aSigGenRestart - continue after pause

```
PICO_STATUS ps6000aSigGenRestart
(
  int16_t                    handle
)
```

This function restarts the signal generator after it was paused with ps6000aSigGenPause().

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

Returns

PICO_OK or a code from PicoStatus.h

3.73 ps6000aSigGenSoftwareTriggerControl - set software triggering

```
PICO_STATUS ps6000aSigGenSoftwareTriggerControl
(
  int16_t                    handle,
  PICO_SIGGEN_TRIG_TYPE      triggerState
)
```

This function sets the trigger type (edge or level) and polarity for software triggering of the signal generator.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`triggerState`,

`PICO_SIGGEN_RISING = 0,`	rising edge trigger
`PICO_SIGGEN_FALLING = 1,`	falling edge trigger
`PICO_SIGGEN_GATE_HIGH = 2,`	trigger when high
`PICO_SIGGEN_GATE_LOW = 3,`	trigger when low

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_SIGGEN_TRIGGER_SOURCE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`

3.74 ps6000aSigGenTrigger - choose the trigger event

```
PICO_STATUS ps6000aSigGenTrigger
(
  int16_t                     handle,
  PICO_SIGGEN_TRIG_TYPE       triggerType,
  PICO_SIGGEN_TRIG_SOURCE     triggerSource,
  uint64_t                    cycles,
  uint64_t                    autoTriggerPicoSeconds
)
```

This function sets up triggering for the signal generator. This feature causes the signal generator to start and stop under the control of a signal or event.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`triggerType`, whether an edge trigger (starts on a specified edge) or a gated trigger (runs while trigger is in the specified state).

`triggerSource`, the signal used as a trigger.

`cycles`, the number of waveform cycles to generate after the trigger edge or after entering the active trigger state. Set to zero to make the signal generator run indefinitely.

`autoTriggerPicoSeconds`, the length of time in picoseconds (ps) to wait for a trigger before starting the signal generator. Set to zero to make the signal generator wait indefinitely for a trigger.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_SIGGEN_TRIGGER_SOURCE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`

3.75 ps6000aSigGenWaveform - choose signal generator waveform

```
PICO_STATUS ps6000aSigGenWaveform
(
  int16_t           handle,
  PICO_WAVE_TYPE    waveType,
  int16_t         * buffer,
  uint64_t          bufferLength
)
```

This function specifies which waveform the signal generator will produce.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`waveType`, specifies the type of waveform to generate.

`* buffer`, an array of sample values to be used by the arbitrary waveform generator (AWG). Used only when `waveType = PICO_ARBITRARY`.

`bufferLength`, the number of samples in the `buffer` array. Used only when `waveType = PICO_ARBITRARY`.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_SIGGEN_TRIGGER_SOURCE`
`PICO_DRIVER_FUNCTION`
`PICO_NOT_RESPONDING`

3.76 ps6000aSigGenWaveformDutyCycle - set duty cycle

```
PICO_STATUS ps6000aSigGenWaveformDutyCycle
(
  int16_t   handle,
  double    dutyCyclePercent
)
```

This function sets the duty cycle of the signal generator waveform in square wave and triangle wave modes.

The duty cycle of a pulse waveform is defined as the time spent in the high state divided by the period. Set to 50% to obtain a square wave.

Applicability

Square wave and triangle wave outputs only.

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`dutyCyclePercent`, the percentage duty cycle of the waveform from 0.0 to 100.0.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_SIGGEN_TRIGGER_SOURCE
PICO_DRIVER_FUNCTION
PICO_NOT_RESPONDING

3.77 ps6000aStartFirmwareUpdate - update the device firmware

```
PICO_STATUS ps6000aStartFirmwareUpdate
(
  int16_t                      handle,
  PicoUpdateFirmwareProgress   progress
)
```

This function updates the device's firmware (the embedded instructions stored in nonvolatile memory in the device). Updates may fix bugs or add new features.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`progress`, a user-supplied function that receives callbacks when the status of the update changes. See `PicoUpdateFirmwareProgress()`. May be NULL if not required.

Returns

`PICO_FIRMWARE_UP_TO_DATE` - the firmware update was performed successfully or firmware was already up to date
`PICO_INVALID_HANDLE` - invalid handle parameter
`PICO_DRIVER_FUNCTION` - another driver call is in progress

3.78 ps6000aStop - stop sampling

```
PICO_STATUS ps6000aStop
(
  int16_t    handle
)
```

This function stops the scope device from sampling data.

When running the device in streaming mode, always call this function after the end of a capture to ensure that the scope is ready for the next capture.

When running the device in block mode or rapid block mode, you can call this function to interrupt data capture.

If this function is called before a trigger event occurs, the oscilloscope may not contain valid data.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_USER_CALLBACK`
`PICO_DRIVER_FUNCTION`

3.79 ps6000aStopUsingGetValuesOverlapped - complements ps6000aGetValuesOverlapped

```
PICO_STATUS ps6000aStopUsingGetValuesOverlapped
(
  int16_t          handle
)
```

This function stops deferred data-collection that was started by calling ps6000aGetValuesOverlapped().

Applicability

Rapid block mode

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_FIRMWARE_UPDATE_REQUIRED_TO_USE_DEVICE_WITH_THIS_DRIVER

3.80 ps6000aTriggerWithinPreTriggerSamples - switch feature on or off

```
PICO_STATUS ps6000aTriggerWithinPreTriggerSamples
(
  int16_t                              handle,
  PICO_TRIGGER_WITHIN_PRE_TRIGGER      state
)
```

This function controls a special triggering feature.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`state`, 0 to enable, 1 to disable.

Returns

`PICO_OK`
`PICO_INVALID_HANDLE`
`PICO_USER_CALLBACK`
`PICO_DRIVER_FUNCTION`

4 Callbacks

4.1 ps6000aBlockReady - indicate when block-mode data ready

```
typedef void (CALLBACK *ps6000aBlockReady)
(
  int16_t        handle,
  PICO_STATUS    status,
  PICO_POINTER   pParameter
)
```

This callback function is part of your application. You register it with the PicoScope 6000E Series driver using `ps6000aRunBlock()` and the driver calls it back when block-mode data is ready. You can then download the data using the `ps6000aGetValues()` function.

Applicability

Block mode only

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`status`, indicates whether an error occurred during collection of the data.

`pParameter`, a pointer passed from `ps6000aRunBlock()`. Your callback function can write to this location to send any data, such as a status flag, back to your application.

Returns

nothing

4.2 ps6000aDataReady - indicate when post-collection data ready

```
typedef void *ps6000aDataReady
(
  int16_t          handle,
  PICO_STATUS      status,
  uint64_t         noOfSamples,
  int16_t          overflow,
  PICO_POINTER     pParameter
)
```

This is a callback function that you write to collect data from the driver. You supply a pointer to the function when you call `ps6000aGetValuesAsync()` and the driver calls your function back when the data is ready.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`status`, a `PICO_STATUS` code returned by the driver.

`noOfSamples`, the number of samples collected.

`overflow`, a set of flags that indicates whether an overvoltage has occurred and on which channels. It is a bit field with bit 0 representing Channel A.

`pParameter`, a void pointer passed from `ps6000aGetValuesAsync()`. The callback function can write to this location to send any data, such as a status flag, back to the application. The data type is defined by the application programmer.

Returns

nothing

4.3 PicoUpdateFirmwareProgress - get status of firmware update

```
typedef void (CALLBACK * PicoUpdateFirmwareProgress)
(
  int16_t        handle,
  uint16_t       progress
)
```

You should write this callback function and register it with the driver using `ps6000aStartFirmwareUpdate()`. The driver calls it back when the firmware update status changes.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`progress`, a progress indicator.

Returns

nothing

4.4 PicoProbeInteractions() – callback for PicoConnect probe events

```
typedef void (PREF4 *PicoProbeInteractions)
(
  int16_t                            handle,
  PICO_STATUS                        status,
  PICO_USER_PROBE_INTERACTIONS     * probes,
  uint32_t                           nProbes
)
```

This callback function handles notifications of probe changes on scope devices that support Pico intelligent probes.

If you wish to use this feature, you must create this function as part of your application. You register it with the `ps6000a` driver using `ps6000aSetProbeInteractionCallback()` and the driver calls it back whenever a probe generates an error. See Handling PicoConnect probe interactions for more information on this process.

Applicability

All modes

Arguments

`handle`, the device identifier returned by `ps6000aOpenUnit()`.

`status`, indicates success or failure. If multiple errors have occurred, the most general error is returned here. Probe-specific errors are returned in the `status` field of the relevant elements of the probes array.

`probes`, on entry, pointer to an array of `PICO_USER_PROBE_INTERACTIONS` structures.

`nProbes`, the number of elements in the `probes` array.

Returns

nothing

4.4.1 PICO_USER_PROBE_INTERACTIONS structure

A structure of this type is passed to the PicoProbeInteractions() callback function. It is defined as follows:

```
typedef struct tPicoUserProbeInteractions
{
  uint16_t                      connected_;

  PICO_CHANNEL                  channel_;
  uint16_t                      enabled_;

  PicoConnectProbe              probeName_;

  uint8_t                       requiresPower_;
  uint8_t                       isPowered_;

  PICO_STATUS                   status_;

  PICO_CONNECT_PROBE_RANGE      probeOff_;

  PICO_CONNECT_PROBE_RANGE      rangeFirst_;
  PICO_CONNECT_PROBE_RANGE      rangeLast_;
  PICO_CONNECT_PROBE_RANGE      rangeCurrent_;

  PICO_COUPLING                 couplingFirst_;
  PICO_COUPLING                 couplingLast_;
  PICO_COUPLING                 couplingCurrent_;

  PICO_BANDWIDTH_LIMITER_FLAGS filterFlags_;
  PICO_BANDWIDTH_LIMITER_FLAGS filterCurrent_;

  PICO_BANDWIDTH_LIMITER        defaultFilter_;
} PICO_USER_PROBE_INTERACTIONS;
```

Elements

connected_, indicates whether the probe is connected or not. The driver saves information on disconnected probes in case they are reconnected, in which case it reapplies the previous settings.

channel_, the scope channel to which the probe is connected.

enabled_, indicates whether the probe is switched on or off.

probeName_, identifies the type of probe from the PICO_CONNECT_PROBE enumerated list defined in PicoConnectProbes.h.

For intelligent probes (those with circuitry enabling them to identify themselves to the driver and to apply signal scaling under the control of the driver) the following special values are defined:
PICO_CONNECT_PROBE_NONE = 0, if no probe is connected to the channel
PICO_CONNECT_PROBE_INTELLIGENT = -3, if a correctly functioning intelligent probe is connected to the channel
PICO_CONNECT_PROBE_UNKNOWN_PROBE = -2, if an intelligent probe is connected but cannot be identified

PICO_CONNECT_PROBE_FAULT_PROBE = -1, if an intelligent probe is connected but has suffered an internal error

requiresPower_, indicates whether the probe draws power from the scope.

isPowered_, indicates whether the probe is receiving power.

status_, a status code indicating success or failure. See PicoStatus.h for definitions.

probeOff_, the range in use when the probe was last switched off.

rangeFirst_, the first applicable range in the PICO_CONNECT_PROBE_RANGE enumerated list.

rangeLast_, the last applicable range in the PICO_CONNECT_PROBE_RANGE enumerated list.

rangeCurrent_, the range currently in use.

couplingFirst_, the first applicable coupling type in the PS4000A_COUPLING list.

couplingLast_, the last applicable coupling type in the PS4000A_COUPLING list.

couplingCurrent_, the coupling type currently in use.

filterFlags_, a bit field indicating which bandwidth limiter options are available.

filterCurrent_, the bandwidth limiter option currently selected.

defaultFilter_, the default bandwidth limiter option for this type of probe.

4.5 PicoExternalReferenceInteractions () - callback for external reference clock events

```
typedef void (CALLBACK * PicoExternalReferenceInterations)
(
  int16_t                               handle,
  PICO_STATUS                           status,
  PICO_CLOCK_REFERENCE                  reference
)
```

This callback function handles notifications when the status of the external 10 MHz reference clock changes. The PicoScope 6000 (A API) device automatically selects the external reference clock when a signal is applied to the external reference input, and uses this callback function to inform your application of the change (and whether the external reference signal is valid).

Register your callback function with the driver using
ps6000aSetExternalReferenceInterationCallback ()

Applicability

All models

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

status, indicates success or failure. Status codes can be:

PICO_OK: the device is synchronized to the clock source indicated by the reference parameter

PICO_NOT_LOCKED_TO_REFERENCE_FREQUENCY: the device is unable to synchronize to the clock source, for example because its frequency is out of range. The timebase accuracy is out of specification in this situation.

Another status from PicoStatus.h may be returned, for example if the device has been disconnected.

reference, indicates whether the internal or external clock source is in use. The available values are one of the PICO_CLOCK_REFERENCE enumerated type.

Returns

Nothing

4.5.1 PICO_CLOCK_REFERENCE enumerated type

An enum of this type is passed to the PicoExternalReferenceInteractions() callback function. It is defined as follows:

```
typedef enum enPicoClockReference
{
        PICO_INTERNAL_REF,
        PICO_EXTERNAL_REF
}       PICO_CLOCK_REFERENCE;
```

Applicability

Calls to PicoExternalReferenceInteractions () - callback for external reference clock events

Values

PICO_INTERNAL_REF, indicates that the internal clock is being used by the device.

PICO_EXTERNAL_REF, indicates that the external clock is being used by the device.

5 Reference

5.1 Numeric data types

Here is a list of the numeric data types used in the ps6000a API:

Type	Bits	Signed or unsigned?
`int16_t`	16	signed
`uint16_t`	16	unsigned
`enum`	32	enumerated
`int32_t`	32	signed
`uint32_t`	32	unsigned
`float`	32	signed (IEEE 754)
`double`	64	signed (IEEE 754)
`int64_t`	64	signed
`uint64_t`	64	unsigned

5.2 Enumerated types and constants

The enumerated types and constants used in the PicoScope 6000E Series API driver are defined in the file `ps6000aApi.h`, which is included in the SDK. We recommend that you refer to these constants by name unless your programming language allows only numerical values.

5.3 Driver status codes

Every function in the ps6000a driver returns a **driver status code** from the list of `PICO_STATUS` values in the file `PicoStatus.h`, which is included in the Pico Technology SDK. Not all codes in `PicoStatus.h` apply to the PicoScope 6000E Series.

5.4 Glossary

Callback. A mechanism that the PicoScope 6000 driver uses to communicate asynchronously with your application. At design time, you add a function (a *callback* function) to your application to deal with captured data. At run time, when you request captured data from the driver, you also pass it a pointer to your function. The driver then returns control to your application, allowing it to perform other tasks until the data is ready. When this happens, the driver calls your function in a new thread to signal that the data is ready. It is then up to your function to communicate this fact to the rest of your application.

Driver. A program that controls a piece of hardware. The driver for the PicoScope 6000E Series oscilloscopes is supplied in the form of 32-bit and 64-bit Windows DLLs called `ps6000a.dll`. These are used by your application to control the oscilloscope.

PicoScope 6000E Series. A range of PC Oscilloscopes from Pico Technology, with a maximum sampling rate of up to 10 GS/s. Sampling resolutions range from 8 to 12 bits and capture memory sizes from 1 to 4 GS.

PRBS (pseudo-random binary sequence). A fixed, repeating sequence of binary digits that appears random when analyzed over a time shorter than the repeat period. The waveform swings between two values: logic high (binary 1) and logic low (binary 0).

USB 2.0. The second generation of USB (universal serial bus) interface. The port supports a data transfer rate of up to 480 megabits per second.

USB 3.0. A USB 3.0 port uses signaling speeds of up to 5 gigabits per second and is backwards-compatible with USB 2.0.

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