PicoScope® 6000E Series

(ps6000a API)

Programmer's Guide

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-6 (Available online and as a PDF)

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2 Programming overview

The ps6000a library 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

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	Microsoft Windows 10 or 11, 32-bit and 64-bit Linux: Ubuntu or openSUSE, 64-bit only macOS, 64-bit only
Processor, memory, free disk space	As required by the operating system.
Ports	USB 2.0 or 3.0 port

The software development kit or driver libraries for all supported operating systems can be found at picotech.com/downloads.

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. 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 OS-specific low-level drivers. This driver is installed by the SDK and configured when you plug the oscilloscope into each USB port for the first time. Your application does not call this driver directly.

If you want to deploy your application which uses the ps6000a driver on other computer systems, you'll need to include these dependencies in your package / installer or, in the case of Linux systems, list ps6000a as a dependency of your package and ensure the Pico package repository is available on the target system.

The driver names for each supported operating system are listed in the following table:

Windows:	`ps6000a.dll`
mac:	`libps6000a.dylib`
Linux:	`libps6000a.so`

2.3 Voltage ranges

You can set a device input channel to any available voltage range with the ps6000aSetChannelOn() function. By default, 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)

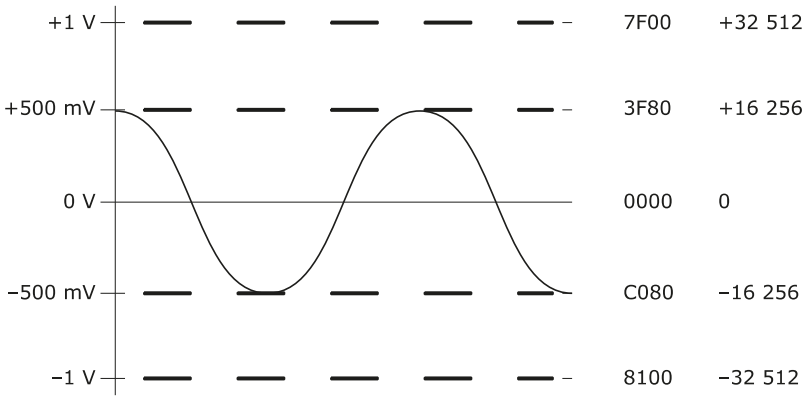
Example at 8-bit resolution

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 & sampleFromDigitalPort2Buffer

// 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 & sampleFromDigitalPort1Buffer

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)
- ps6000aSetTriggerHoldoffCounterBySamples() (optional)
- ps6000aSetTriggerDigitalPortProperties() (for MSO triggering)

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 triggering methods, including:

- 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()
- ps6000aSetPulseWidthDigitalPortProperties() (for MSO triggering)

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()`.

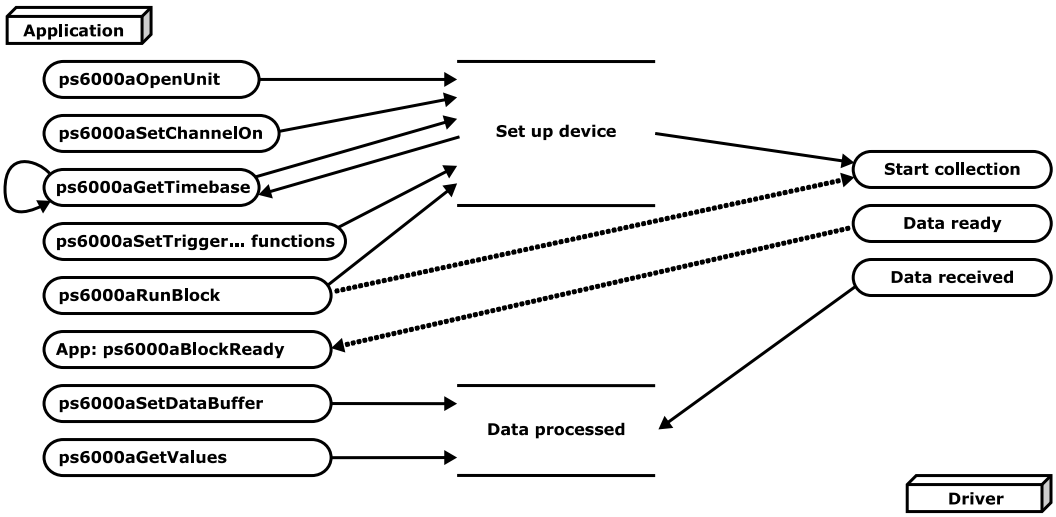
- **Data retention.** The data is lost when a new run is started in the same segment, the settings are changed, or the scope is powered down.

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 or process 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 blocking 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. Display or process the data.
11. Repeat steps 6 to 10 if necessary.
12. Stop the oscilloscope using `ps6000aStop()`.
13. 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.

Continue from step 10 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,                  // first segment index to be captured
  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.

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,                // first segment index to be captured
  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
    );
```

Comments: each waveform is retrieved one at a time from the driver with an aggregation of 1000. Alternatively, it would be equally valid to use ps6000aGetValuesBulk() to retrieve multiple waveforms at once as shown in the previous example.

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 and can be read after streaming is completed.

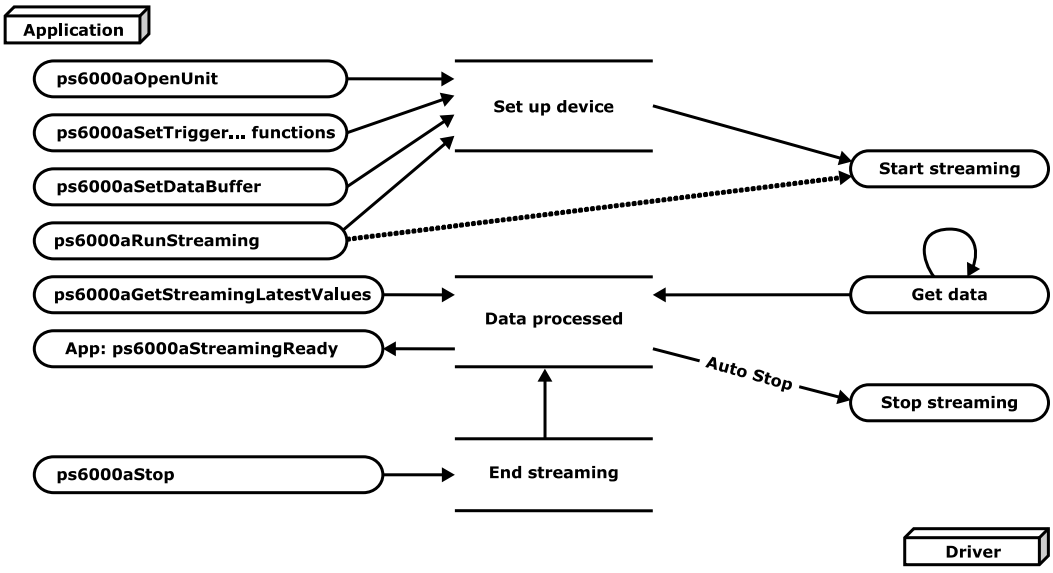
- **Downsampling.** The driver can return either raw or downsampled data. You should set up the number of buffers needed to accept the requested data. Aggregation requires two buffers, one for the minimum values and one for the maximum values. Other downsampling modes require only a single buffer.

See Using streaming mode for programming details.

2.6.3.1 Using streaming mode

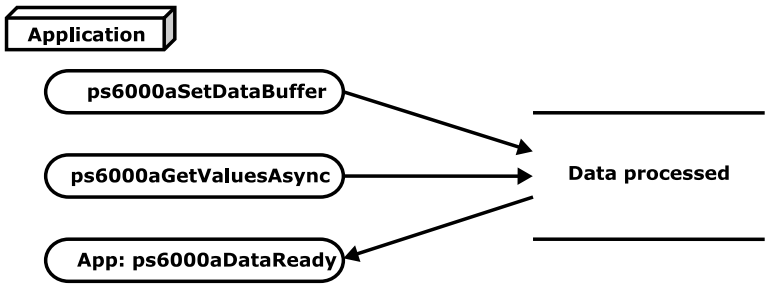
This is the general procedure for reading and displaying data in streaming mode using a single memory segment:

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, call `ps6000aSetDataBuffer()` again to provide more buffers. You can provide the same buffer repeatedly, if you have finished processing the data already in the buffer before resubmitting it for further samples.
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

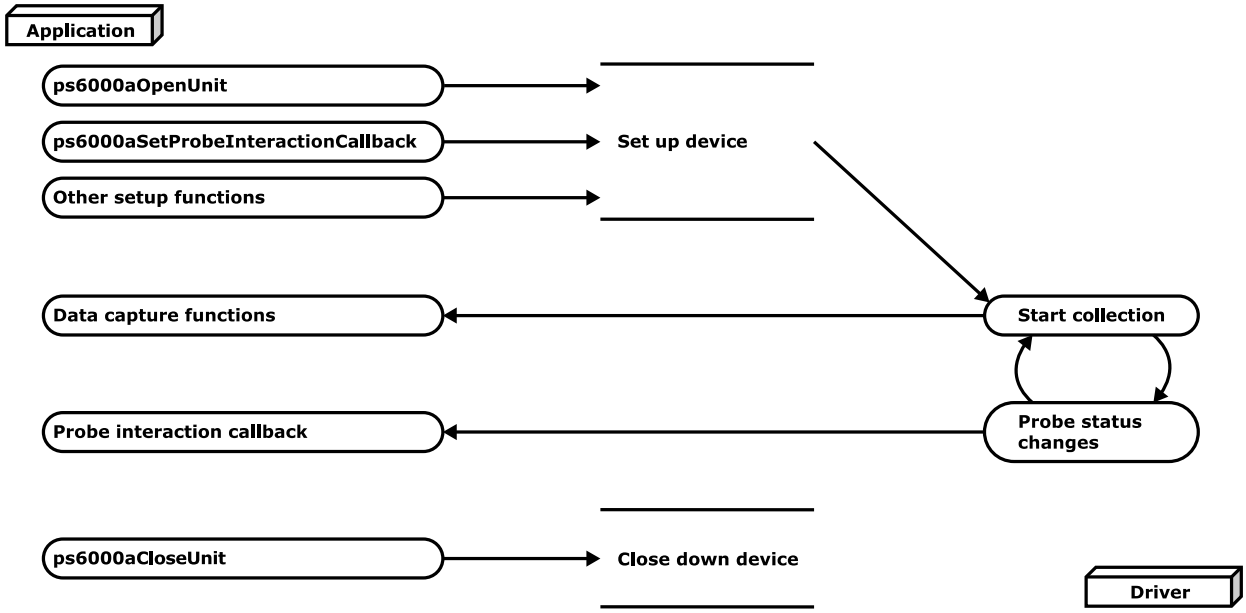
The PicoScope 6000E Series has an intelligent probe interface, which supplies power to the probe as well as allowing the scope to configure and interrogate the probe. Your application can choose to be alerted whenever a probe is connected or disconnected, or when its status changes.

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. 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 - check if firmware update is 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. Firmware updates, when required, are distributed as part of the driver library and this function checks whether the currently-running driver contains more up-to-date firmware than that on the connected device.

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, `updatesRequired` is set to `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. Closing the unit correctly after use returns it to a low-power state, turns off the fan and leaves it in a known state ready to be re-opened when required.

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. These values can be used to scale the returned sample values from the driver into voltages, using the full-scale voltage of the current input range.

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 (most positive) analog offset voltage allowed for the range. Set to `NULL` if not required.

`* minimumVoltage`, on output, the minimum (most negative) 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 currently selected 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`
`PICO_INVALID_HANDLE`
`PICO_NULL_PARAMETER`

3.10 ps6000aGetMaximumAvailableMemory - find max memory at a given 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 as one of the `PICO_DEVICE_RESOLUTION` enum values

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 have 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` structures with a description of the samples available and the `triggerInfo` structure to indicate that a trigger has occurred and at what location.

`streamingDataInfo` should point to an array of structures, one per combination of enabled channel, downsampling mode and data type, to determine how many samples are available for that combination. For example, if you have enable two channels with both raw data and min-max aggregation, the array should contain four structures. The number of available samples at a given instant may not be the same for each channel due to the way samples are processed in blocks. If your application requires the same number of samples on each channel, process the minimum number of samples reported by any channel. The later samples remain in the buffer and can be processed on the next call.

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 structure 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 as the previously supplied buffers have been filled. Note this return status does not mean the call has failed: if the `streamingDataInfo` structures indicate a non-zero number of samples (completing the previous buffer) then these are still valid data which should be read by the user.

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. Set by user.

mode_, the downsampling mode to use. Set by user.

type_, the data type to use for the sample data. Set by user.

noOfSamples_, the number of samples made available by the driver. Set by driver when the function returns.

bufferIndex_, an index to the waveform buffer within the capture buffer. Set by driver when the function returns.

startIndex_, an index to the starting sample within the specified waveform buffer. Set by driver when the function returns

overflow_, a flag indicating whether a sample value overflowed (1) or not (0). Set by driver when the function returns.

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 has stopped capturing due to autoStop being set and the requested number of samples having been collected (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. Must be equal to (or less than) the number of structures in `*triggerInfo`

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. This value may be the logical OR of multiple status values:

PICO_DEVICE_TIME_STAMP_RESET, the time stamp per waveform segment has been reset.

PICO_TRIGGER_TIME_NOT_REQUESTED, when requesting the ps6000aGetTriggerTimeOffset the trigger time has not been set as described under triggerTime below.

PICO_TRIGGER_TIME_BUFFER_NOT_SET, trigger time buffer not set (see below).

PICO_TRIGGER_TIME_FAILED_TO_CALCULATE, the trigger time failed to be calculated.

For example the value 0x03000001 is a combination of:

PICO_DEVICE_TIME_STAMP_RESET bit or'ed with PICO_TRIGGER_TIME_NOT_REQUESTED

segmentIndex, the number of the segment.

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

triggerTime, the time at which the trigger occurred. This is interpolated to greater precision than one sample interval, using adjacent sample values. triggerTime is only available when trigger data has been requested from the oscilloscope either by using PICO_RATIO_MODE_TRIGGER with ps6000aGetValues() or its comparable bulk or async versions, or by using PICO_RATIO_MODE_TRIGGER_DATA_FOR_TIME_CALCULATION with ps6000aGetValuesOverlapped(). See Downsampling modes for more information. Otherwise, status includes the value PICO_TRIGGER_TIME_NOT_REQUESTED and the triggerTime is zero.

timeUnits, the unit multiplier to use with triggerTime.

`missedTriggers`, the number of trigger events, if any, detected since the trigger point of the of previous segment. The trigger circuit is constantly counting events, regardless of whether the trigger is armed, so this includes events which may have occurred during the post-trigger time of the previous capture, or the pre-trigger time of the current capture, or in the "dead time" between captures (trigger re-arm time). By dividing `missedTriggers` by the `timeStamp` difference between the previous and current capture, you can calculate the input signal frequency even if this is faster than the scope's trigger re-arm time.

`timeStampCounter`, the time in samples from the first capture to the current capture. See Time stamping. The status `PICO_DEVICE_TIME_STAMP_RESET` indicates that the trigger time has started over, for example due to a change in settings.

3.16.2 Time stamping

The `timeStampCounter` parameter in the `PICO_TRIGGER_INFO` structure allows you to determine the time interval between the trigger points of consecutive captures with the same settings, in block or rapid block mode. Only events causing the scope to trigger are timestamped. Additional trigger events occurring within a capture or in the trigger rearm time between captures cannot be timestamped.

To get the offset between the respective segment trigger points, in sample intervals at the current timebase, subtract the `timeStampCounter` for each segment from the previous segment's timestamp. The timestamps are accurate to one sample interval at the current timebase.

The timestamp of the first segment captured after changing any scope settings is arbitrary, and is only provided to allow you to calculate the offset of subsequent segments. The timestamp counter may either maintain or reset its value when scope settings are changed, and your code must not rely on particular behavior in this respect but should instead check the status code.

The status code returned for each segment indicates whether the timestamp is valid. For example, if you set up 10 segments in memory and then carry out two rapid block runs of 5 captures each, the status codes for segments 0 and 5 may have the bit-flag `PICO_DEVICE_TIME_STAMP_RESET` set, if you changed any settings since the previous run, indicating that the timestamp for that segment is arbitrary. The other segments will not have this flag set, indicating that the timestamp is valid and can be used to determine the time offset from the previous segment. `PICO_DEVICE_TIME_STAMP_RESET` is a bit-flag so may be masked with any other status flag that relates to that segment.

You can convert the intervals between segments from sample counts to time intervals if required. The current sample interval can be found by using the timebase that was passed to `ps6000aRunBlock` in conjunction with `ps6000aGetTimebase`.

`timeStampCounter` is a 56-bit unsigned value and will eventually wrap around. Your code must handle this correctly, for example by masking the results of any arithmetic to the lower 56 bits. If the timestamp wraps around more than once between two adjacent segments, this cannot be detected. This will only happen if the interval between two adjacent trigger events exceeds 100 days (at the fastest timebase, or longer for slower timebases), so is unlikely to be a concern in practical applications. Note that calculating the time offset between adjacent segments, rather than to the first segment, reduces the complexity of dealing with wraparounds.

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. This is the same as the `triggerTime` value obtained from `ps6000aGetTriggerInfo()`, which also provides additional information. There is no need to call both functions.

Call this function after data has been captured or when data has been retrieved from a previous capture. The trigger time offset is only available when trigger data has been requested from the oscilloscope either by using `PICO_RATIO_MODE_TRIGGER` with `ps6000aGetValues()` or its comparable bulk or async versions, or by using `PICO_RATIO_MODE_TRIGGER_DATA_FOR_TIME_CALCULATION` with `ps6000aGetValuesOverlapped()`. See Downsampling modes for more information. Otherwise, `PICO_TRIGGER_TIME_NOT_REQUESTED` is returned.

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`
`PICO_TRIGGER_TIME_NOT_REQUESTED`

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 - an initial call like this allows you to determine the required length of the string before allocating it.

`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	KJL87/66 or 10001/0001
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 data after a capture has completed

```
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 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. When using trigger delay, this is the original event causing the trigger and not the delayed point. This data is available even when the original trigger point falls outside the main preTrigger + postTrigger data. Trigger data must be retrieved before attempting to get the trigger time using ps6000aGetTriggerInfo(), ps6000aGetTriggerTimeOffset() or ps6000aGetValuesTriggerTimeOffsetBulk()
PICO_RATIO_MODE_RAW	No downsampling. Returns raw data values.

PICO_RATIO_MODE_TRIGGER_DATA_FOR_TIME_CALCULATION	In overlapped mode only, causes trigger data to be retrieved from the scope to calculate the trigger time for ps6000aGetTriggerInfo(), ps6000aGetTriggerTimeOffset() or ps6000aGetValuesTriggerTimeOffsetBulk(), without requiring a user buffer to be set for this data. See ps6000aGetValuesOverlapped().

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 `ps6000aDataReady()` callback function that will be called when the data is ready.

`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: see ps6000aGetValuesAsync()

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 - make a deferred request for data before running the scope

```
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 block or 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.

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,
overflow, see ps6000aGetValues()

fromSegmentIndex,
toSegmentIndex, 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 or process 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`
`PICO_TRIGGER_TIME_NOT_REQUESTED`

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

PICO_OK
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER

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 can use up to 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.

See also ps6000aMemorySegmentsBySamples() which sets up the memory segments to each fit a required number of samples.

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 of raw data, per enabled channel, available for retrieval after the end of the capture.

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. It does not change the current segment configuration of the scope.

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
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION

3.36 ps6000aResetChannelsAndReportAllChannelsOvervoltageTripStatus - reset 50Ω input protection

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

On oscilloscopes with selectable input coupling, when in 50 Ω coupling mode, the oscilloscope hardware includes an overvoltage protection circuit which disconnects the input to prevent damage.

This function resets all oscilloscope channels and then reports the overvoltage trip status for all channels. Use this function to reset after an overvoltage trip event and check that the channels haven't immediately tripped again due to a continuing overvoltage.

Applicability

All modes. Not PicoScope 6428E-D.

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 - check if 50Ω input protection has tripped

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

On oscilloscopes with selectable input coupling, when in 50 Ω coupling mode the oscilloscope hardware includes an overvoltage protection circuit which disconnects the input to prevent damage.

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. Not PicoScope 6428E-D.

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 and disconnects the scope input to prevent damage.

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 ps6000aSetAuxIoMode - configure the AUX IO connector

```
PICO_STATUS ps6000aSetAuxIoMode
(
  int16_t             handle
  PICO_AUXIO_MODE     auxIoMode
)
```

Configures the AuxIO mode/function using the PICO_AUXIO_MODE enum values.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

auxIoMode, required AuxIO mode:

- PICO_AUXIO_INPUT, high-impedance input for use triggering the scope or AWG if configured.
- PICO_AUXIO_HIGH_OUT, constant logic high output.
- PICO_AUXIO_LOW_OUT, constant logic low output.
- PICO_AUXIO_TRIGGER_OUT, logic high pulse during the post-trigger acquisition time.

Returns

PICO_OK

PICO_OPERATION_FAILED, failed to change AuxIO mode

PICO_WARNING_AUX_OUTPUT_CONFLICT, the AuxIO mode has been set to an output mode while the scope or AWG is set to trigger on it. This is allowed but will result in the scope or AWG triggering on the output value of the AuxIO.

3.40 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)

3.41 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

3.42 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. The allowable analog offset for a given input voltage range can be read from `ps6000aGetAnalogueOffsetLimits()`

`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`

3.43 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. You must call this function for each channel for which you want to retrieve data.

`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 (valid data types vary by resolution and downsample ratio mode):

- `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

3.44 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 ps6000aSetDataBuffers() can only associate buffers with one downsampling mode. If you intend to call ps6000aGetValues() with more than one downsampling mode activated, then you must call ps6000aSetDataBuffers() several times to associate separate buffers 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

3.45 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.

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.

3.45.1 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)

3.46 ps6000aSetDigitalPortOff – switch off a digital port

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

This function switches off a given digital port.

Applicability

All modes.

Arguments

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

`port`, see `ps6000aSetDigitalPortOn()`.

Returns

3.47 ps6000aSetDigitalPortOn – set up and enable a digital port

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

This function switches on a digital port 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

All modes, when MSO pods are attached.

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

3.48 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

3.49 ps6000aSetNoOfCaptures - configure 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`

3.50 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
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
```

3.51 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

3.52 ps6000aSetPulseWidthDigitalPortProperties – set digital port pulse-width trigger settings

```
PICO_STATUS ps6000aSetPulseWidthDigitalPortProperties
(
  int16_t                           handle,
  PICO_CHANNEL                      port,
  PICO_DIGITAL_CHANNEL_DIRECTIONS   * 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_CHANNEL_DIRECTIONS, 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().

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, a pointer to an array of PICO_DIGITAL_CHANNEL_DIRECTIONS 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. See PICO_DIGITAL_CHANNEL_DIRECTIONS structure.

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

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_DRIVER_FUNCTION

3.53 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 time qualifier, which is an optional input to the triggering condition.

Multiple conditions can be combined as described in ps6000aSetTriggerChannelConditions() . When the pulse width condition is met, the pulse width timer is reset and this signifies the start of a "pulse". The main trigger condition signifies the end of the "pulse" and if the pulse width qualifier is enabled and the time between these events meets the time condition set with ps6000aSetPulseWidthQualifierProperties(), the scope will trigger.

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
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_INVALID_ACTION

3.54 ps6000aSetPulseWidthQualifierDirections - specify threshold directions

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

This function is used to set the trigger direction for each channel used in the pulse width qualifier, which is an optional input to the triggering condition.

This function works in the same way as ps6000aSetTriggerChannelDirections(). Each channel has two trigger threshold comparators, so when using simple level triggers you can use one for the pulse width direction (for example, RISING), and the other for the main trigger direction (for example, FALLING_LOWER) signifying a positive pulse.

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
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_DRIVER_FUNCTION

3.55 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 time qualifier, which is an optional input to the triggering condition.

The pulse width timer is reset when an event occurs matching the user's conditions set using ps6000aSetPulseWidthQualifierConditions(), this represents the start of a "pulse". The qualifier is true when the time since the most recent start-of-pulse event meets the conditions set by this function (for example, less than 100 sample intervals ago).

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

lower, the lower pulse width threshold in sample intervals.

upper, the upper pulse width threshold in sample intervals.

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
PICO_INVALID_HANDLE
PICO_NULL_PARAMETER
PICO_DRIVER_FUNCTION

3.56 ps6000aSetSimpleTrigger - set up basic 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 post-trigger sample being taken, in sample intervals.

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_DRIVER_FUNCTION

3.57 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 ANDed together. By calling the function multiple times, additional sets of trigger conditions can be defined which are then ORed together. This AND-OR logic allows you to create any possible Boolean function of up to four of the scope's inputs. On 8-channel models, more than four inputs may be included in a simple "AND" or "OR" function only.

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 AND 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, resets any previous conditions

PICO_ADD, adds this condition to any previous conditions

To apply only the conditions passed in the current call, specify both PICO_CLEAR_ALL | PICO_ADD together.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_USER_CALLBACK
PICO_CONDITIONS
PICO_MEMORY_FAIL
PICO_DRIVER_FUNCTION

3.57.1 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 specifies a condition for just one of the scope's inputs. The ps6000aSetTriggerChannelConditions() function can AND together a number of these structures to produce the final trigger condition.

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.

3.58 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`

3.58.1 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. Each channel has two threshold comparators, designated as "upper" and "lower" below. These can be used independently, for example to set different directions or thresholds for the start and end of a time-qualified trigger using ps6000aSetPulseWidthQualifierDirections(), or used both together to set up a window or runt trigger as described below.

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_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

3.59 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`

3.59.1 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().

3.60 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 event occurring and the first post-trigger sample being captured. For example, if `delay=100`, the post-trigger samples will be counted starting 100 sample periods after the trigger event. At a timebase of 5 GS/s, or 200 ps per sample, the delay would be 100 x 200 ps = 20 ns. If pre-trigger samples are requested, these are immediately preceding the post-trigger samples, i.e. overlapping with the trigger delay time.

Returns

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

3.61 ps6000aSetTriggerDigitalPortProperties - set digital port trigger 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`

3.61.1 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 within the selected port from PICO_PORT_DIGITAL_CHANNEL0 up to PICO_PORT_DIGITAL_CHANNEL7. For example, if you have selected PICO_PORT_1 then PICO_PORT_DIGITAL_CHANNEL0 represents 2D0 and PICO_PORT_DIGITAL_CHANNEL7 represents 2D7.

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:	channel must transition (in either direction) to trigger

3.62 ps6000aSetTriggerHoldoffCounterBySamples - set the trigger holdoff time in sample intervals

```
PICO_STATUS ps6000aSetTriggerHoldoffCounterBySamples
(
  int16_t       handle,
  uint64_t      samples,
)
```

This function sets the trigger holdoff time in sample intervals. Trigger holdoff allows you to set a period when the scope won't look for further trigger events after each triggered acquisition.

Applicability

All modes

Arguments

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

`samples`, the time in sample intervals to disable looking for further triggers after the trigger event of each acquisition.

Returns

`PICO_OK`
`PICO_ARGUMENT_OUT_OF_RANGE`

3.63 ps6000aSigGenApply - set the signal generator running

```
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 of the signal generator (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

3.64 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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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

3.65 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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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

3.66 ps6000aSigGenFrequency - set output frequency

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

This function sets the frequency of the signal generator. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

Applicability

All modes

Arguments

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

`frequencyHz`, the desired frequency in hertz.

Returns

PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_SIGGEN_FREQUENCY_OUT_OF_RANGE

3.67 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`

3.68 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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_SIGGEN_FREQUENCY_OUT_OF_RANGE
PICO_SIGGEN_SWEEPTYPE_INVALID
PICO_SIGGEN_INVALID_SWEEP_PARAMETERS

3.69 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`

3.70 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
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_SIGGEN_SETTINGS_CHANGED_CALL_APPLY

3.71 ps6000aSigGenPhase - set signal generator using delta-phase value instead of a frequency

```
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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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

3.71.1 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

3.72 ps6000aSigGenPhaseSweep - set signal generator to sweep using delta-phase values instead of frequency values

```
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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_SIGGEN_FREQUENCY_OUT_OF_RANGE
PICO_SIGGEN_INVALID_SWEEP_PARAMETERS
PICO_SIGGEN_SWEEPTYPE_INVALID

3.73 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. After configuring all required signal generator settings, call `ps6000aSigGenApply()` to apply them to the device.

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.

The total output voltage accounting for both peak-to-peak and offset must fall within the signal generator's output voltage range described in the data sheet or returned by `ps6000aSigGenLimits()`

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)

3.74 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
PICO_INVALID_HANDLE
PICO_DRIVER_FUNCTION
PICO_SIGGEN_SETTINGS_CHANGED_CALL_APPLY

3.75 ps6000aSigGenSoftwareTriggerControl - set software triggering

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

This function causes the signal generator trigger to fire, if a software trigger has been set up using ps6000aSigGenTrigger() and the signal generator is waiting for a trigger event.

If the trigger type set using ps6000aSigGenTrigger() is PICO_SIGGEN_RISING or PICO_SIGGEN_FALLING, calling this function will trigger the defined number of waveform cycles or sweeps and the triggerState parameter is not used.

If the trigger type set using ps6000aSigGenTrigger() is PICO_SIGGEN_GATE_HIGH or PICO_SIGGEN_GATE_LOW, calling this function will start the signal generator running when triggerState = PICO_SIGGEN_GATE_HIGH , or pause it when any other value.

Applicability

All modes

Arguments

handle, the device identifier returned by ps6000aOpenUnit().

triggerState, when the trigger type is set to gating, runs the signal generator if triggerState = PICO_SIGGEN_GATE_HIGH or pauses it otherwise.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_SIGGEN_TRIGGER_SOURCE
PICO_DRIVER_FUNCTION
PICO_NOT_RESPONDING

3.76 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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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).

```
PICO_SIGGEN_RISING = 0,
PICO_SIGGEN_FALLING = 1,
PICO_SIGGEN_GATE_HIGH = 2,
PICO_SIGGEN_GATE_LOW = 3
```

`triggerSource,` the signal used as a trigger.

```
PICO_SIGGEN_NONE = 0,
PICO_SIGGEN_SCOPE_TRIG = 1,
PICO_SIGGEN_AUX_IN = 2,
PICO_SIGGEN_SOFT_TRIG = 4,
```

`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,` reserved for future use, set to zero.

Returns

PICO_OK
PICO_INVALID_HANDLE
PICO_SIGGEN_TRIGGER_SOURCE
PICO_DRIVER_FUNCTION
PICO_NOT_RESPONDING

3.77 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. After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

Applicability

All modes

Arguments

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

`waveType`, specifies the type of waveform to generate, for example `PICO_SINE`.

`* 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`. Each sample value should be in the range (–32767 to 32767) as returned by ps6000aSigGenLimits(), representing the full output voltage span of the waveform generator.

Returns

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

3.78 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. The default duty cycle is 50% (representing a square wave with equal high and low times, or a triangle wave with equal rise and fall times) and it is only necessary to call this function if a different duty cycle is required.

After configuring all required signal generator settings, call ps6000aSigGenApply() to apply them to the device.

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

3.79 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. The function applies any firmware update to the device which is included in the current driver. It does not check online for updates or require internet access.

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

3.80 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`

3.81 ps6000aStopUsingGetValuesOverlapped - complements ps6000aGetValuesOverlapped

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

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

Applicability

Block and 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

3.82 ps6000aTriggerWithinPreTriggerSamples - switch feature on or off

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

When this feature is enabled, the scope will trigger if a trigger event is detected during the pre-trigger samples. Effectively, the user-specified pre-trigger count becomes a maximum pre-trigger count and the actual number of pre-trigger samples returned will be between zero and that number depending on when the trigger occurs. You can find the actual trigger point by calling ps6000aGetTriggerInfo() after the capture has completed.

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?
int8_t	8	signed
uint8_t	8	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 header files 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.

In addition to the function-specific error codes described in this guide, functions may also return a generic error code such as one of the following:

PICO_INVALID_HANDLE - the handle passed does not refer to an open PicoScope unit

PICO_MEMORY_FAIL - could not allocate sufficient memory on the host PC to complete the operation

PICO_NOT_RESPONDING - the PicoScope did not respond to a command, for example if it has been disconnected

PICO_INTERNAL_ERROR - an unexpected error has occurred in the driver. Contact Pico technical support for assistance.

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 and mac and Linux libraries called libps6000a. 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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