PicoScope 5000 Series PC Oscilloscopes

Programmer's Guide

ps5000pg.en-1


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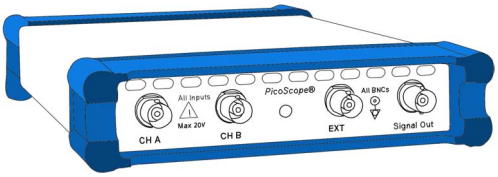
Contents

1 Introduction

1.1 Welcome

Thank you for buying a Pico Technology product!



The PicoScope 5000 Series of PC Oscilloscopes from Pico Technology is a range of compact units designed to replace traditional bench-top oscilloscopes costing many times the price.

Here are some of the benefits provided by your PicoScope 5000 Series PC Oscilloscope:

- Portability: Take the unit with you and plug it in to any Windows PC.
- Performance: Fast sampling up to 1 GS/s, probe-tip bandwidth of 250 MHz, large buffer with up to 128 M samples, fast USB 2.0 interface.
- Flexibility: Use it as an oscilloscope, spectrum analyser or high-speed data acquisition interface.
- Programmability: The PicoScope 5000 series API lets you write your own programs, in your chosen programming language, to control all the features of the scope.
- Long-term support: Software upgrades are available to download from our website. You can also call our technical specialists for support. You can continue to use both of these services free of charge for the lifetime of the product.
- Value for money: You don't have to pay twice for all the features that you already have in your PC. The PicoScope 5000 Series scope unit contains the special hardware you need and nothing more.
- Convenience: The software makes full use of the large display, storage, user interface and networking built in to your PC.

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1.4 Company details

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2 Programming with the PicoScope 5000 Series

The `ps5000.dll` dynamic link library in your PicoScope installation directory allows you to program a PicoScope 5000 Series oscilloscope [79] using standard C function calls. [18]

A typical program for capturing data consists of the following steps:

- Open [39] the scope unit.
- Set up the input channels with the required voltage ranges [5] and coupling mode [5].
- Set up triggering [5].
- Set up ETS [12], if required.
- Start capturing data. (See Sampling modes [6], 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 [72] are installed with your PicoScope software. These show how to use the functions of the driver software in each of the modes available.

2.1 Driver

Your application will communicate with a PicoScope 5000 API driver called `ps5000.dll`. The driver exports the PicoScope 5000 function definitions [18] 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 driver depends on a kernel driver, `picopp.sys`, which works with Windows XP SP2, Windows Vista and Windows 7. Your application does not need to call the kernel driver. Once you have installed the PicoScope 6 software, Windows automatically installs the kernel driver when you plug in the PicoScope 5000 Series [79] PC Oscilloscope for the first time.

2.2 System requirements

To ensure that your PicoScope 5000 Series [79] 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 software will increase with more powerful PCs, including those with multi-core processors.

Item	Absolute minimum	Recommended minimum	Recommended full specification
Operating system	Windows XP SP2, Windows Vista or Windows 7		
Processor	As required by Windows	300 MHz	1 GHz
Memory		256 MB	512 MB
Free disk space (Note 1)		1 GB	2 GB
Ports	USB 1.1 compliant port	USB 2.0 compliant port	

Note 1: The PicoScope software does not use all the disk space specified in the table. The free space is required to make Windows run efficiently.

USB

The PicoScope 5000 driver offers three different methods[6] of recording data, all of which support both USB 1.1 and USB 2.0, although the fastest transfer rates are achieved between the PC and the PicoScope 5000 using USB 2.0.

2.3 Voltage ranges

You can set a device input channel to any voltage range from ±100 mV to ±20 V with the ps5000SetChannel[46] function. Each sample is scaled from 8 bits to 16 bits, so that the values returned to your application are as follows:

Constant	Voltage	Value returned	
		decimal	hex
PS5000_LOST_DATA	N/A	-32768*	8000*
PS5000_MIN_VALUE	minimum	-32512	8100
N/A	zero	0	0000
PS5000_MAX_VALUE	maximum	32512	7F00

* In streaming mode,[13] this special value indicates a buffer overrun.

2.4 Channel selection

You can switch each channel on and off, and set its coupling mode to either AC or DC, using the ps5000SetChannel[46] function.

- DC coupling: The scope accepts all input frequencies from zero (DC) up to its maximum analogue bandwidth.
- AC coupling: The scope accepts input frequencies from a few hertz up to its maximum analogue bandwidth. The lower -3 dB cutoff frequency is about 1 hertz.

2.5 Triggering

PicoScope 5000 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 PicoScope 5000 trigger functions [1][63] [2][65] [3][66]. A trigger event can occur when one of the signal or trigger input channels crosses a threshold voltage on either a rising or a falling edge.

The driver supports these triggering methods:

	Block mode	ETS mode	Streaming mode
Simple Edge	✓	✓	✓
Advanced Edge	✓		✓
Windowing	✓		✓
Pulse width	✓		✓
Logic	✓		✓
Delay	✓		✓
Drop-out	✓		✓

2.6 Sampling modes

PicoScope 5000 Series PC Oscilloscopes 79 can run in numerous different sampling modes.

- Block mode. 6 In this mode, the scope stores data in internal RAM and then transfers it to the PC. When the data has been collected it is possible to examine the data, with an optional aggregation 78 factor. The data is lost when a new run is started in the same segment 37, the settings are changed, or the scope is powered down.

- Rapid block mode. 8 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 aggregation 78 in this mode if you wish.

- ETS. 12 This mode is similar to block mode, but allows you to achieve higher time resolution by combining data captured in different cycles of a repetitive signal. Aggregation and oversampling 14 are not possible in this mode.

- Streaming mode. 13 In this mode, data is passed directly to the PC without being stored in the scope's internal RAM. This enables long periods of slow data collection for chart recorder and data-logging applications. Streaming mode provides fast streaming at up to 13.33 MS/s (75 ns per sample). Aggregation and triggering are supported in this mode.

In all sampling modes, the driver returns data asynchronously using a *callback.* 78 This 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.

In block mode, you can also poll the driver instead of using a callback.

2.6.1 Block mode

In block mode, the computer prompts a PicoScope 5000 series 79 PC 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.

- Sampling rate. A PicoScope 5000 Series PC Oscilloscope can sample at a number of different rates according to the selected timebase. 16 If only one channel is enabled, it can use the A-to-D converter of the disabled channel to double its sampling rate.

- 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, avoid calling setup functions between calls to ps5000RunBlock 42, ps5000Stop 70 and ps5000GetValues 29.

- Aggregation. When the data has been collected, you can set an optional aggregation 78 factor and examine the data. Aggregation is a process that reduces the amount of data by combining adjacent samples using a maximum/minimum algorithm. 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 behaviour using ps5000MemorySegments 37, 37

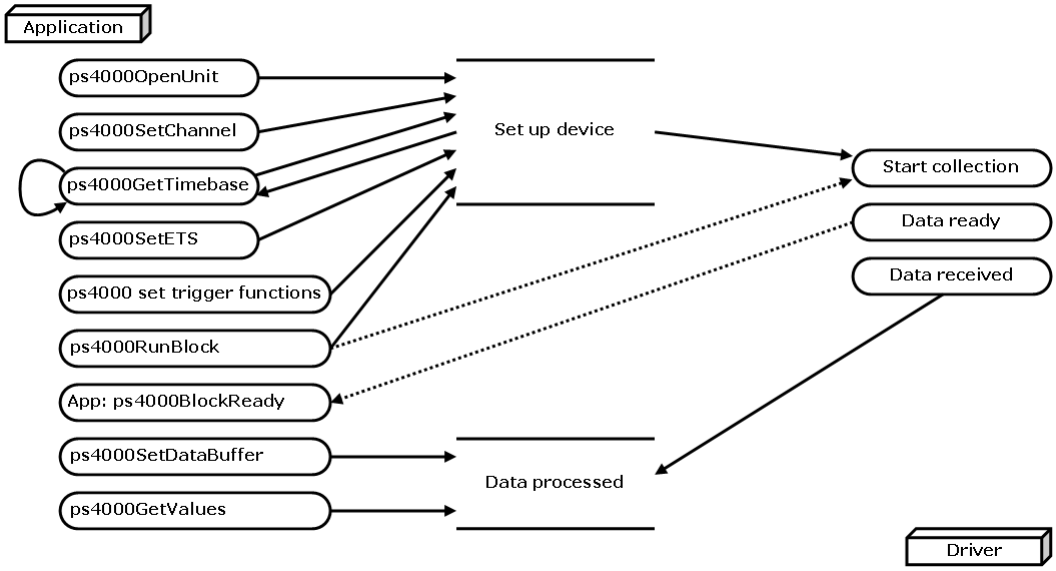
- Data retention. The data is lost when a new run is started in the same segment or the scope is powered down.

See Using block mode 7 for programming details.

2.6.1.1 Using block mode

This is the general procedure for reading and displaying data in block mode 6 (including ETS mode 12), using a single memory segment: 37

1. Open the oscilloscope using ps5000OpenUnit 39.
2. Select channel ranges and AC/DC coupling using ps5000SetChannel 46.
3. Using ps5000GetTimebase 25, select timebases until the required nanoseconds per sample is located.
4. If you require ETS mode, set it up using ps5000SetEts 50.
5. If you are using ETS mode, allocate timing information buffers and tell the driver about them using ps5000SetEtsTimeBuffer 51.
6. Use the trigger setup functions [1] 63 [2] 65 [3] 66 to set up the trigger if required.
7. If required, set the signal generator using ps5000SetSigGen 56.
8. Start the oscilloscope running using ps5000RunBlock 42.
9. Wait until the oscilloscope is ready using the ps5000BlockReady 19 callback.
10. Use ps5000SetDataBuffer 47 to tell the driver where your memory buffer is.
11. Transfer the block of data from the oscilloscope using ps5000GetValues 29.
12. Display the data.
13. Repeat steps 8 to 12.
14. Stop the oscilloscope using ps5000Stop 70.



15. Request new views of stored data using different aggregation parameters: see Retrieving stored data. 14

2.6.2 Rapid block mode

In normal block mode, 6 the PicoScope 5000 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 approximately 600 microseconds.

See Using rapid block mode 8 for details.

2.6.2.1 Using rapid block mode

You can use rapid block mode 8 with or without aggregation. 78 The following procedure shows you how to use it without aggregation.

Without aggregation

1. Open the oscilloscope using ps5000OpenUnit 39.
2. Select channel ranges and AC/DC coupling using ps5000SetChannel 46.
3. Using ps5000GetTimebase 25, select timebases until the required nanoseconds per sample is located.
4. Use the trigger setup functions [1] 63 [2] 65 [3] 66 to set up the trigger if required.
5. If required, set the signal generator using ps5000SetSigGen 56.

6a. Set the number of memory segments equal to or greater than the number of captures required, using ps5000MemorySegments 37.

6b. Call ps5000SetNoOfCaptures 53 to set the number of captures.

7. Start the oscilloscope running using ps5000RunBlock 42.
8. Wait until the oscilloscope is ready using the ps5000BlockReady 19 callback.
9. Use ps5000SetDataBufferBulk 48 to tell the driver where your memory buffers are.
10. Transfer the blocks of data from the oscilloscope using ps5000GetValuesBulk 31.

11. Retrieve the time offset for each data segment using ps5000GetValuesTriggerTimeOffsetBulk64 33.
12. Display the data.
13. Repeat steps 7 to 12 if necessary.
14. Stop the oscilloscope using ps5000Stop 70.

With aggregation

To use rapid block mode with aggregation, follow steps 1 to 10 above and then proceed as follows:

11a. Call ps5000SetDataBuffers 49 to set up one pair of buffers for every waveform segment required.
12a. Call ps5000GetValues 29 for each pair of buffers.
13a. Retrieve the time offset for each data segment using ps5000GetTriggerTimeOffset64 27.

Continue from step 14 in the procedure for capturing data without aggregation.

2.6.2.2 Rapid block mode example 1: no aggregation

```
#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 100
ps5000SetNoOfCaptures (handle,  100);

pParameter = false;
ps5000RunBlock
(
  handle,
  0,                  //noOfPreTriggerSamples,
  10000,              // noOfPostTriggerSamples,
  1,                  // timebase to be used,
  1,                  // oversample
  &timeIndisposedMs,
  1,                  // oversample
  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);

for (int i = 0; i < 10; i++)
{
  for (int c = PS5000_CHANNEL_A; c <= PS5000_CHANNEL_D; c++)
  {
    ps5000SetDataBufferBulk
    (
```



```
            handle,
            c,
            &buffer[c][i],
            MAX_SAMPLES,
            i
        );
    }
}
```

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

```
ps5000GetValuesBulk
(
  handle,
  &noOfSamples, // set to MAX_SAMPLES on entering the function
  10,           // fromSegmentIndex,
  19,           // toSegmentIndex,
  overflow      // an array of size 10 shorts
)
```

Comments: the number of samples could be up to noOfPreTriggerSamples + noOfPostTriggerSamples, the values set in ps5000RunBlock. The samples are always returned from the first sample taken, unlike the ps5000GetValues function which allows the sample index to be set. This function does not support aggregation. The above segments start at 10 and finish at 19 inclusive. It is possible for the fromSegmentIndex to wrap around to the toSegementIndex, by setting the fromSegmentIndex to 98 and the toSegmentIndex to 7.

```
ps5000GetValuesTriggerTimeOffsetBulk64
(
  handle,
  times,
  timeUnits,
  10,
  19
)
```

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

2.6.2.3 Rapid block mode example 2: using aggregation

```
#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 100
ps5000SetNoOfCaptures (handle,  100);
```

```
pParameter = false;
ps5000RunBlock
(
  handle,
  0,                  //noOfPreTriggerSamples,
  1000000,            // noOfPostTriggerSamples,
  1,                  // timebase to be used,
  1,                  // oversample
  &timeIndisposedMs,
  1,                  // oversample
  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.

```
for (int c = PS5000_CHANNEL_A; c <= PS5000_CHANNEL_D; c++)
{
  ps5000SetDataBuffers
  (
    handle,
    c,
    &bufferMax[c],
    &bufferMin[c]
    MAX_SAMPLES,
  );
}
```

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 (int segment = 10; segment < 20; segment++)
{
  ps5000GetValues
  (
    handle,
    0,
    &noOfSamples, // set to MAX_SAMPLES on entering
    1000,
    &downSampleRatioMode, //set toRATIO_MODE_AGGREGATE
    index,
    overflow
  );

  ps5000GetTriggerTimeOffset64
  (
    handle,
    &time,
    &timeUnits,
    index
  )
}
```

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

2.6.3 ETS (Equivalent Time Sampling)

ETS is a way of increasing the effective sampling rate of the scope when capturing repetitive signals. It is a modified form of block mode, [6] and is controlled by the `ps5000SetTrigger` [66] and `ps5000SetEts` [50] functions.

- Overview. ETS works by capturing several cycles of a repetitive waveform, then combining them to produce a composite waveform that has a higher effective sampling rate than the individual captures. The scope hardware adds a short, variable delay, which is a small fraction of a single sampling interval, between each trigger event and the subsequent sample. This shifts each capture slightly in time so that the samples occur at slightly different times relative to those of the previous capture. The result is a larger set of samples spaced by a small fraction of the original sampling interval. The maximum effective sampling rates that can be achieved with this method are listed in the specifications table in the User's Guide.
- Trigger source. The EXT and AUXIO inputs cannot be used as triggers in ETS mode.
- Trigger stability. Because of the high sensitivity of ETS mode to small time differences, the trigger must be set up to provide a stable waveform that varies as little as possible from one capture to the next.
- Callback. ETS mode returns data to your application using the `ps5000BlockReady` [19] callback function.

Applicability	Available in block mode [6] only. Not suitable for one-shot (non-repetitive) signals. Aggregation [78] and oversampling [14] are not supported. Edge-triggering [5] only. Auto trigger delay [66] (`autoTriggerMilliseconds`) is ignored.

2.6.3.1 Using ETS mode

Since ETS mode [12] is a type of block mode, the procedure is the same as the one described in Using block mode. [7]

2.6.4 Streaming mode

Streaming mode can capture data without the gaps that occur between blocks when using block mode. [6] It can transfer data to the PC at speeds of up to 13.33 million samples per second (75 nanoseconds per sample), depending on the computer's performance. This makes it suitable for high-speed data acquisition, allowing you to capture long data sets limited only by the computer's memory.

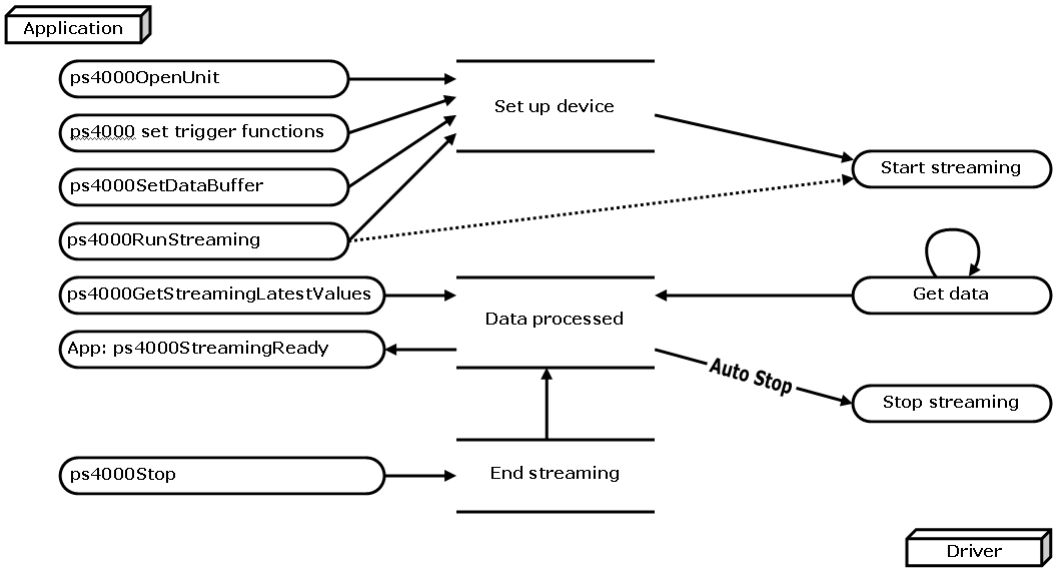
- Aggregation. The driver returns aggregated readings [78] while the device is streaming, which allows your application to zoom in and out of the data with the minimum of programming effort. If aggregation is set to 1 then only one buffer is returned per channel. When aggregation is set above 1 then two buffers (maximum and minimum) per channel are returned.
- Lost data. If there are gaps in the data values passed to your application, the lost samples are replaced by PS5000_LOST_DATA [5] constants.
- Memory segmentation. The memory can be divided into segments [37] to reduce the latency of data transfers to the PC. However, this increases the risk of losing data if the PC cannot keep up with the device's sampling rate.

See Using streaming mode [13] for programming details.

2.6.4.1 Using streaming mode

This is the general procedure for reading and displaying data in streaming mode [13] using a single memory segment: [37]

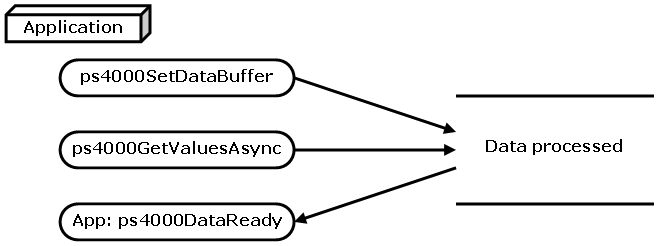
1. Open the oscilloscope using ps5000OpenUnit [39].
2. Select channels, ranges and AC/DC coupling using ps5000SetChannel [46].
3. Use the trigger setup functions [1] [63] [2] [65] [3] [66] to set up the trigger if required.
4. Call ps5000SetDataBuffer [47] to tell the driver where your data buffer is.
5. Set up aggregation and start the oscilloscope running using ps5000RunStreaming [44].
6. Call ps5000GetStreamingLatestValues [24] to get data.
7. Process data returned to your application's function. This example is using Auto Stop, so after the driver has received all the data points requested by the application, it stops the device streaming.
8. Call ps5000Stop [70], [70] even if Auto Stop is enabled.



9. Request new views of stored data using different aggregation parameters: see Retrieving stored data. 14

2.6.5 Retrieving stored data

You can collect data from the PicoScope 5000 driver with a different aggregation factor when ps5000RunBlock 42 or ps5000RunStreaming 44 has already been called and has successfully captured all the data. Use ps5000GetValuesAsync 30.



2.7 Oversampling

When the oscilloscope is operating at sampling rates less than its maximum, it is possible to oversample. Oversampling is taking more than one measurement during a time interval and returning the average as one sample. The number of measurements per sample is called the oversampling factor. If the signal contains a small amount of Gaussian noise, this technique can increase the effective vertical resolution 79 of the oscilloscope by *n* bits, where *n* is given approximately by the equation below:

$$n = log\ (\text{oversampling factor}) / log\ 4$$

Conversely, for an improvement in resolution of *n* bits, the oversampling factor you need is given approximately by:

$$\text{oversampling factor} = 4^n$$

Applicability	Available in block mode 6 only, and not in ETS 12 mode. Cannot be used at the same time as aggregation. 78

2.8 Signal generator

The PicoScope 5000 Series PC Oscilloscopes have a built-in signal generator 79. The generator's clock frequency is fixed, and a phase counter is used to index successive samples in the waveform buffer. This method is called direct digital synthesis (DDS), and is discussed in detail under ps5000SetSigGenArbitrary 56.

You can configure these parameters:

- Peak-to-peak voltage
- Frequency
- Offset voltage
- Waveform type

You can pass the signal to be generated to the device as an arbitrary pattern with up to 8,192 samples, along with the output frequency and voltage level. The signal generator can sweep the frequency up, down or up-and-down. Use ps5000SetSigGenArbitrary 56.

You can also use the predefined signals such as square, sine, triangle, ramp up and ramp down waveforms. Use ps5000SetSigGenBuiltIn 59.

Applicability	Use ps5000SetSigGenArbitrary 56, ps5000SetSigGenBuiltIn 59 and ps5000SigGenSoftwareControl 69 API calls.

2.9 Timebases

The API allows you to select any of 2^{32} different timebases based on a maximum sampling rate of 1 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.

The range of timebase values is divided into two subranges, with the subrange 0 to 2 specifying a power of 2, and the subrange greater than 2 specifying a number divided by 125,000,000. The maximum value is $2^{32}-1$.

timebase	sample interval
0 to 2	$2^{timebase}$ / 1,000,000,000 That is: - 0 => 1 ns 1 => 2 ns 2 => 4 ns
> 2	(timebase - 2) / 125,000,000 For example: - 3 => 8 ns 4 => 16 ns 5 => 24 ns ... 2^{32}-1 => ~34 s

Applicability	Use ps5000GetTimebase 25 API call.

2.10 Combining several oscilloscopes

It is possible to collect data using up to 64 PicoScope 5000 Series PC Oscilloscopes 79 at the same time, depending on the capabilities of the PC. Each oscilloscope must be connected to a separate USB port. The ps5000OpenUnit 39 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 ps5000BlockReady(...)
// define callback function specific to application

handle1 = ps5000OpenUnit()
handle2 = ps5000OpenUnit()

ps5000SetChannel(handle1)
// set up unit 1
ps5000RunBlock(handle1)

ps5000SetChannel(handle2)
// set up unit 2
ps5000RunBlock(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: It is not possible to synchronise the collection of data between oscilloscopes that are being used in combination.

2.11 API function calls

The PicoScope 5000 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.

ps5000BlockReady 19	indicate when block-mode data ready
ps5000CloseUnit 20	close a scope device
ps5000DataReady 21	indicate when post-collection data ready
ps5000FlashLed 22	flash the front-panel LED
ps5000GetMaxDownSampleRatio 23	find out aggregation ratio for data
ps5000GetStreamingLatestValues 24	get streaming data while scope is running
ps5000GetTimebase 25	find out what timebases are available
ps5000GetTriggerTimeOffset 26	find out when trigger occurred (32-bit)
ps5000GetTriggerTimeOffset64 27	find out when trigger occurred (64-bit)
ps5000GetUnitInfo 28	read information about scope device
ps5000GetValues 29	retrieve block-mode data with callback
ps5000GetValuesBulk 31	retrieve more than one waveform at a time
ps5000GetValuesTriggerTimeOffsetBulk 32	retrieve time offset for a group of waveforms
ps5000GetValuesTriggerTimeOffsetBulk64 33	set the buffers for each waveform (64-bit)
ps5000GetValuesAsync 30	retrieve streaming data with callback
ps5000IsLedFlashing 34	read status of LED
ps5000IsReady 35	poll driver in block mode
ps5000IsTriggerOrPulseWidthQualifierEnabled 36	find out whether trigger is enabled
ps5000MemorySegments 37	divide scope memory into segments
ps5000NoOfStreamingValues 38	get number of samples in streaming mode
ps5000OpenUnit 39	open a scope device
ps5000OpenUnitAsync 40	open a scope device without waiting
ps5000OpenUnitProgress 41	check progress of OpenUnit call
ps5000RunBlock 42	start block mode
ps5000RunStreaming 44	start streaming mode
ps5000SetChannel 46	set up input channels
ps5000SetDataBuffer 47	register data buffer with driver
ps5000SetDataBufferBulk 48	set the buffers for each waveform
ps5000SetDataBuffers 49	register min/max data buffers with driver
ps5000SetEts 50	set up Equivalent Time Sampling
ps5000SetEtsTimeBuffer 51	register ETS time buffer with driver (64-bit)
ps5000SetEtsTimeBuffers 52	register ETS time buffers with driver (32-bit)
ps5000SetNoOfCaptures 53	set the number of captures to be collected in one run
ps5000SetPulseWidthQualifier 54	set up pulse width triggering
ps5000SetSigGenArbitrary 56	set up arbitrary waveform generator
ps5000SetSigGenBuiltIn 59	set up signal generator with built-in waveforms
ps5000SetSimpleTrigger 62	set up level triggers only
ps5000SetTriggerChannelConditions 63	specify which channels to trigger on
ps5000SetTriggerChannelDirections 65	set up signal polarities for triggering
ps5000SetTriggerChannelProperties 66	set up trigger thresholds
ps5000SetTriggerDelay 68	set up post-trigger delay
ps5000SigGenSoftwareControl 69	trigger the signal generator
ps5000Stop 70	stop data capture
ps5000StreamingReady 71	indicate when streaming-mode data ready

2.11.1 ps5000BlockReady

```
typedef void (CALLBACK *ps5000BlockReady)
(
  short       handle,
  PICO_STATUS status,
  void        * pParameter
)
```

This callback 78 function is part of your application. You register it with the PicoScope 5000 series driver using ps5000RunBlock 42, and the driver calls it back when block-mode data is ready. You can then download the data using the ps5000GetValues 29 function.

Applicability	Block mode 6 only
Arguments	handle, the handle of the device returning the samples. status, indicates whether an error occurred during collection of the data. pParameter, a void pointer passed from ps5000RunBlock 42. The callback function can write to this location to send any data, such as a status flag, back to your application.
Returns	nothing

2.11.2 ps5000CloseUnit

```
PICO_STATUS ps5000CloseUnit
(
  short handle
)
```

This function shuts down a PicoScope 5000 scope device.

Applicability	All modes
Arguments	handle, the handle, returned by ps5000OpenUnit 39, of the scope device to be closed.
Returns 75	PICO_OK PICO_HANDLE_INVALID

2.11.3 ps5000DataReady

```
typedef void (CALLBACK *ps5000DataReady)
(
  short          handle,
  long           noOfSamples,
  short          overflow,
  unsigned long  triggerAt,
  short          triggered,
  void           * pParameter
)
```

This function handles post-collection data returned by the driver after a call to ps5000GetValuesAsync 30. It is a callback 78 function that is part of your application. You register it with the PicoScope 5000 series driver using ps5000GetValuesAsync 30, and the driver calls it back when the data is ready.

Applicability	All modes.
Arguments	`handle,` the handle of the device returning the samples. `noOfSamples,` the number of samples collected. `overflow,` returns a flag that indicates whether an overvoltage has occurred on any of the channels. It is a bit pattern with bit 0 denoting Channel A and bit 1 Channel B. `triggerAt,` an index to the buffer indicating the location of the trigger point. This parameter is valid only when `triggered` is non-zero. `triggered,` a flag indicating whether a trigger occurred. If non-zero, a trigger occurred at the location indicated by `triggerAt.` `pParameter,` a void pointer passed from ps5000GetValuesAsync 30. 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

2.11.4 ps5000FlashLed

```
PICO_STATUS ps5000FlashLed
(
  short handle,
  short start
)
```

This function flashes the LED on the front of the scope without blocking the calling thread. Calls to ps5000RunStreaming 44 and ps5000RunBlock 42 cancel any flashing started by this function.

Applicability	All modes
Arguments	handle, the handle of the scope device 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 75	PICO_OK PICO_HANDLE_INVALID PICO_BUSY

2.11.5 ps5000GetMaxDownSampleRatio

```
PICO_STATUS ps5000GetMaxDownSampleRatio
(
  short          handle,
  unsigned long  noOfUnaggregatedSamples,
  unsigned long  * maxDownSampleRatio,
  short          downSampleRatioMode,
  unsigned short segmentIndex
)
```

This function returns the maximum downsampling ratio that can be used for a given number of samples.

Applicability	All modes
Arguments	`handle`, the handle of the required device `noOfUnaggregatedSamples`, the number of unaggregated samples to be used to calculate the maximum downsampling ratio `maxDownSampleRatio`: returns the aggregation ratio `downSampleRatioMode`: see `ps5000GetValues` 29 `segmentIndex`, the memory segment 37 where the data is stored

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_NO_SAMPLES_AVAILABLE`
	`PICO_NULL_PARAMETER`
	`PICO_INVALID_PARAMETER`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_TOO_MANY_SAMPLES`

2.11.6 ps5000GetStreamingLatestValues

```
PICO_STATUS ps5000GetStreamingLatestValues
(
  short                 handle,
  ps5000StreamingReady  lpPs5000Ready,
  void                  * pParameter
)
```

This function is used to collect the next block of values while streaming [13] is running. You must call ps5000RunStreaming [44] beforehand to set up streaming.

Applicability	Streaming [13] mode only.
Arguments	handle, the handle of the required device. lpPs5000Ready, a pointer to your ps5000StreamingReady [71] callback function that will return the latest aggregated values. pParameter, a void pointer that will be passed to the ps5000StreamingReady [71] callback function.
Returns [75]	PICO_OK PICO_INVALID_HANDLE PICO_NO_SAMPLES_AVAILABLE PICO_INVALID_CALL PICO_BUSY PICO_NOT_RESPONDING

2.11.7 ps5000GetTimebase

```
PICO_STATUS ps5000GetTimebase
(
  short          handle,
  unsigned long  timebase,
  long           noSamples,
  long           * timeIntervalNanoseconds,
  short          oversample,
  long           * maxSamples
  unsigned short segmentIndex
)
```

This function discovers which timebases[79] are available on the oscilloscope. You should set up the channels using ps5000SetChannel[46] and, if required, ETS[78] mode using ps5000SetEts[50], first.

Applicability	All modes
Arguments	handle, the handle of the required device. timebase, a code between 0 and 2^{32}-1 that specifies the sampling interval (see timebase guide[16]) noSamples, the number of samples required. This value is used to calculate the most suitable time unit to use. timeIntervalNanoseconds, a pointer to the time interval between readings at the selected timebase. If a null pointer is passed, nothing will be written here. oversample, the amount of oversample required. An oversample of 4, for example, would quadruple the time interval and quarter the maximum samples, and at the same time would increase the effective resolution by one bit. See the topic on oversampling.[14] maxSamples, a pointer to the maximum number of samples available. The maximum samples may vary depending on the number of channels enabled, the timebase chosen and the oversample selected. If this pointer is null, nothing will be written here. segmentIndex, the number of the memory segment to use.
Returns[75]	PICO_OK PICO_INVALID_HANDLE PICO_TOO_MANY_SAMPLES PICO_INVALID_CHANNEL PICO_INVALID_TIMEBASE PICO_INVALID_PARAMETER

2.11.8 ps5000GetTriggerTimeOffset

```
PICO_STATUS ps5000GetTriggerTimeOffset
(
  short             handle
  unsigned long     * timeUpper
  unsigned long     * timeLower
  PS5000_TIME_UNITS * timeUnits
  unsigned short    segmentIndex
)
```

This function gets the time, as two 4-byte values, at which the trigger occurred. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture.

Applicability	Block mode 6, rapid block mode 8. Only when Channel A or Channel B is used as the trigger source.

Arguments	`handle`, the handle of the required device
	
	`timeUpper`, a pointer to the upper 32 bits of the time at which the trigger point occurred
	
	`timeLower`, a pointer to the lower 32 bits of the time at which the trigger point occurred
	
	`timeUnits`, returns the time units in which `timeUpper` and `timeLower` are measured. The allowable values include: -
	`PS5000_NS`
	`PS5000_US`
	`PS5000_MS`
	`PS5000_S`
	
	`segmentIndex`, the number of the memory segment 37 for which the information is required.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_DEVICE_SAMPLING`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_NULL_PARAMETER`
	`PICO_NO_SAMPLES_AVAILABLE`

2.11.9 ps5000GetTriggerTimeOffset64

```
PICO_STATUS ps5000GetTriggerTimeOffset64
(
  short             handle,
  __int64           * time,
  PS5000_TIME_UNITS * timeUnits,
  unsigned short    segmentIndex
)
```

This function gets the time, as a single 8-byte value, at which the trigger occurred. Call it after block-mode data has been captured or when data has been retrieved from a previous block-mode capture.

Applicability	Block mode 6, rapid block mode 8. Only when Channel A or Channel B is used as the trigger source.

Arguments	`handle`, the handle of the required device
	
	`time`, a pointer to the time at which the trigger point occurred
	
	`timeUnits`, returns the time units in which `timeUpper` and `timeLower` are measured. The allowable values include: -
	`PS5000_NS`
	`PS5000_US`
	`PS5000_MS`
	`PS5000_S`
	
	`segmentIndex`, the number of the memory segment 37 for which the information is required

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_DEVICE_SAMPLING`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_NULL_PARAMETER`
	`PICO_NO_SAMPLES_AVAILABLE`

2.11.10 ps5000GetUnitInfo

```
PICO_STATUS ps5000GetUnitInfo
(
  short     handle,
  char      * string,
  short     stringLength,
  short     * requiredSize
  PICO_INFO info
)
```

This function writes information about the specified scope device to a character string. If the device fails to open, only the driver version and error code are available to explain why the last open unit call failed.

Applicability	All modes
Arguments	`handle,` the handle of 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,` a pointer to the character string buffer in the calling function where the unit information string (selected with `info`) will be stored. If a null pointer is passed, only the `requiredSize,` pointer to a short, of the character string buffer is returned. `stringLength,` used to return the size of the character string buffer. `requiredSize,` used to return the required character string buffer size. `info,` an enumerated type specifying what information is required from the driver.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NULL_PARAMETER PICO_INVALID_INFO PICO_INFO_UNAVAILABLE

info		String returned	Example
0	PICO_DRIVER_VERSION	Version number of PicoScope 5000 DLL	1,0,0,1
1	PICO_USB_VERSION	Type of USB connection to device: 1.1 or 2.0	2.0
2	PICO_HARDWARE_VERSION	Hardware version of device	1
3	PICO_VARIANT_INFO	Variant number of device	5204
4	PICO_BATCH_AND_SERIAL	Batch and serial number of device	KJL87/6
5	PICO_CAL_DATE	Calibration date of device	07Feb07
6	PICO_KERNEL_VERSION	Version of kernel driver	1,1,2,4

2.11.11 ps5000GetValues

```
PICO_STATUS ps5000GetValues
(
  short          handle,
  unsigned long  startIndex,
  unsigned long  * noOfSamples,
  unsigned long  downSampleRatio,
  short          downSampleRatioMode,
  unsigned short segmentIndex,
  short          * overflow
)
```

This function returns block-mode data, either with or without aggregation, 78 starting at the specified sample number. It is used to get the stored data from the scope after data collection has stopped.

Applicability	Block mode, 6 rapid block mode 8
Arguments	`handle`, the handle of the required device. `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`, the number of samples to return. `downSampleRatio`, the aggregation factor that will be applied to the raw data. `downSampleRatioMode`, whether to use aggregation to reduce the amount of data. The available values are: - `RATIO_MODE_NONE` (`downSampleRatio` is ignored) `RATIO_MODE_AGGREGATE` (uses aggregation 78) `segmentIndex`, the zero-based number of the memory segment 37 where the data is stored. `overflow`, returns a set of flags that indicate whether an overvoltage has occurred on any of the channels. It is a bit pattern with bit 0 denoting Channel A and bit 1 Channel B.

Returns 75	`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`

2.11.12 ps5000GetValuesAsync

```
PICO_STATUS ps5000GetValuesAsync
(
  short          handle,
  unsigned long  startIndex,
  unsigned long  noOfSamples,
  unsigned long  downSampleRatio,
  short          downSampleRatioMode,
  unsigned short segmentIndex,
  void           * lpDataReady,
  void           * pParameter
)
```

This function returns streaming data, either with or without aggregation, 78 starting at the specified sample number. It is used to get the stored data from the scope after data collection has stopped. It returns the data using a callback. 78

Applicability	Streaming mode 13 only
Arguments	handle, the handle of the required device startIndex: see ps5000GetValues 29 noOfSamples: see ps5000GetValues 29 downSampleRatio: see ps5000GetValues 29 downSampleRatioMode: see ps5000GetValues 29 segmentIndex: see ps5000GetValues 29 lpDataReady, a pointer to the ps5000StreamingReady 71 function that is called when the data is ready pParameter, a void pointer that will be passed to the ps5000StreamingReady 71 callback function. The data type depends on the design of the callback function, which is determined by the application programmer.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NO_SAMPLES_AVAILABLE PICO_DEVICE_SAMPLING – streaming only PICO_NULL_PARAMETER PICO_STARTINDEX_INVALID PICO_SEGMENT_OUT_OF_RANGE PICO_INVALID_PARAMETER PICO_DATA_NOT_AVAILABLE PICO_INVALID_SAMPLERATIO PICO_INVALID_CALL

2.11.13 ps5000GetValuesBulk

```
PICO_STATUS ps5000GetValuesBulk
(
  short          handle,
  unsigned long  * noOfSamples,
  unsigned short fromSegmentIndex,
  unsigned short toSegmentIndex,
  short          * overflow
)
```

This function allows more than one waveform to be retrieved at a time in rapid block mode. 8 The waveforms must have been collected sequentially and in the same run. This method of collection does not support aggregation. 78

Applicability	Rapid block mode 8
Arguments	`handle`, the handle of the device `* noOfSamples`. On entering the API, the number of samples required. On exiting the API, the actual number retrieved. The number of samples retrieved will not be more than the number requested. The data retrieved always starts with the first sample captured. `fromSegmentIndex`, the first segment from which the waveform should be retrieved `toSegmentIndex`, the last segment from which the waveform should be retrieved `* overflow`, equal to or larger than the number of waveforms to be retrieved. Each segment index has a separate `overflow` element, with `overflow[0]` containing the `fromSegmentIndex` and the last index the `toSegmentIndex`.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_INVALID_PARAMETER`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_NO_SAMPLES_AVAILABLE`
	`PICO_STARTINDEX_INVALID`
	`PICO_NOT_RESPONDING`

2.11.14 ps5000GetValuesTriggerTimeOffsetBulk

```
PICO_STATUS ps5000GetValuesTriggerTimeOffsetBulk
(
  short             handle,
  unsigned long     * timesUpper,
  unsigned long     * timesLower,
  PS5000_TIME_UNITS * timeUnits,
  unsigned short    fromSegmentIndex,
  unsigned short    toSegmentIndex
)
```

This function retrieves the time offset, as lower and upper 32-bit values, for a group of waveforms obtained in rapid block mode. 8 The array size for `timesUpper` and `timesLower` must be greater than or equal to the number of waveform time offsets requested. The segment indexes are inclusive.

Applicability	Rapid block mode 8
Arguments	`handle`, the handle of the device `* timesUpper`, a pointer to 32-bit integers. This will hold the most significant 32 bits of 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. `* timesLower`, a pointer to 32-bit integers. This will hold the least-significant 32 bits of 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. `* timeUnits`, a pointer to a range of `PS5000_TIME_UNITS`. This must be equal to or larger than the number of requested times. `timeUnits[0]` will contain the time unit for `fromSegmentIndex` and the last index will contain the time unit for `toSegmentIndex`. `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 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_NULL_PARAMETER`
	`PICO_DEVICE_SAMPLING`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_NO_SAMPLES_AVAILABLE`

2.11.15 ps5000GetValuesTriggerTimeOffsetBulk64

```
PICO_STATUS ps5000GetValuesTriggerTimeOffsetBulk64
(
  short             handle,
  __int64           * times,
  PS5000_TIME_UNITS * timeUnits,
  unsigned short    fromSegmentIndex,
  unsigned short    toSegmentIndex
)
```

This function retrieves the time offset, as a 64-bit integer, for a group of waveforms captured in rapid block mode. 8 The array size of `times` must be greater than or equal to the number of waveform time offsets requested. The segment indexes are inclusive.

Applicability	Rapid block mode 8
Arguments	`handle`, the handle of the device `* times`, a pointer to 64-bit integers. This will hold the time offset for each requested segment index. `times[0]` will hold the time offset for `fromSegmentIndex`, and the last `times` index will hold the time offset for `toSegmentIndex`. `* timeUnits`, a pointer to a range of `PS5000_TIME_UNITS`. This must be equal or larger than the number of requested times. `timeUnits[0]` will contain the time unit for `fromSegmentIndex`, and the last index will contain the `toSegmentIndex`. `fromSegmentIndex`, the first segment for which the time offset is required. The result will be placed in `times[0]` and `timeUnits[0]`. `toSegmentIndex`, the last segment for which the time offset is required. The result will be placed in the last elements of the `times` and `timeUnits` arrays. If `toSegmentIndex` is less than `fromSegmentIndex` then the driver will wrap around from the last segment to the first.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_NULL_PARAMETER`
	`PICO_DEVICE_SAMPLING`
	`PICO_SEGMENT_OUT_OF_RANGE`
	`PICO_NO_SAMPLES_AVAILABLE`

2.11.16 ps5000IsLedFlashing

```
PICO_STATUS ps5000IsLedFlashing
(
  short handle,
  short * status
)
```

This function reports whether or not the LED is flashing.

Applicability	All modes
Arguments	`handle`, the handle of the scope device `status`, returns a flag indicating the status of the LED: - <> 0 : flashing 0 : not flashing
Returns 75	PICO_OK PICO_HANDLE_INVALID PICO_NULL_PARAMETER

2.11.17 ps5000IsReady

```
PICO_STATUS ps5000IsReady
(
  short handle,
  short * ready
)
```

This function may be used instead of a callback function to receive data from ps5000RunBlock 42. To use this method, pass a NULL pointer as the lpReady argument to ps5000RunBlock 42. You must then poll the driver to see if it has finished collecting the requested samples.

Applicability	Block mode 6
Arguments	handle, the handle of the required device ready: output: indicates the state of the collection. If zero, the device is still collecting. If non-zero, the device has finished collecting and ps5000GetValues 29 can be used to retrieve the data.
Returns 75	

2.11.18 ps5000IsTriggerOrPulseWidthQualifierEnabled

```
PICO_STATUS ps5000IsTriggerOrPulseWidthQualifierEnabled
(
  short handle,
  short * triggerEnabled,
  short * pulseWidthQualifierEnabled
)
```

This function discovers whether a trigger, or pulse width triggering, is enabled.

Applicability	Call after setting up the trigger and calling ps5000SetEts 50, and just before calling either ps5000RunBlock 42 or ps5000RunStreaming 44.
Arguments	handle, the handle of the required device triggerEnabled, indicates whether the trigger will successfully be set when ps5000RunBlock 42 or ps5000RunStreaming 44 is called. A non-zero value indicates that the trigger is set, otherwise the trigger is not set. pulseWidthQualifierEnabled, indicates whether the pulse width qualifier will successfully be set when ps5000RunBlock 42 or ps5000RunStreaming 44 is called. A non-zero value indicates that the pulse width qualifier is set, otherwise the pulse width qualifier is not set.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NULL_PARAMETER

2.11.19 ps5000MemorySegments

```
PICO_STATUS ps5000MemorySegments
(
  short          handle
  unsigned short nSegments,
  long           * nMaxSamples
)
```

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

By default, each capture fills the scope device's available memory. This function allows you to divide the memory into a number of segments so that the scope can store several captures sequentially. The number of segments defaults to 1 when the scope device is opened.

Applicability	All modes
Arguments	`handle`, the handle of the required device `nSegments`, the number of segments to be used. The maximum numbers are 8,192 for the PicoScope 5203 and 32,768 for the PicoScope 5204. `nMaxSamples`, returns the number of samples that are available in each segment. This is independent of the number of 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 75	`PICO_OK`
	`PICO_USER_CALLBACK`
	`PICO_INVALID_HANDLE`
	`PICO_TOO_MANY_SEGMENTS`
	`PICO_MEMORY`

2.11.20 ps5000NoOfStreamingValues

```
PICO_STATUS ps5000NoOfStreamingValues
(
  short         handle,
  unsigned long * noOfValues
)
```

This function returns the available number of samples from a streaming run.

Applicability	Streaming mode 13. Call after ps5000Stop 70.
Arguments	handle, the handle of the required device noOfValues, returns the number of samples
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NULL_PARAMETER PICO_NO_SAMPLES_AVAILABLE PICO_NOT_USED PICO_BUSY

2.11.21 ps5000OpenUnit

```
PICO_STATUS ps5000OpenUnit
(
  short * handle
)
```

This function opens a scope device. The maximum number of units that can be opened is determined by the operating system, the kernel driver and the PC's hardware.

Applicability	All modes
Arguments	handle, pointer to a short that receives the handle number: -1 : if the unit fails to open, 0 : if no unit is found or > 0 : if successful (value is handle to the device opened) The handle number must be used in all subsequent calls to API functions to identify this scope device.
Returns 75	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 PICO_NOT_RESPONDING

2.11.22 ps5000OpenUnitAsync

```
PICO_STATUS ps5000OpenUnitAsync
(
  short * status
)
```

This function opens a scope device without blocking the calling thread. You can find out when it has finished by periodically calling ps5000OpenUnitProgress 41 until that function returns a non-zero value.

Applicability	All modes
Arguments	status, pointer to a short that indicates: 0 if there is already an open operation in progress 1 if the open operation is initiated
Returns 75	PICO_OK PICO_OPEN_OPERATION_IN_PROGRESS PICO_OPERATION_FAILED

2.11.23 ps5000OpenUnitProgress

```
PICO_STATUS ps5000OpenUnitProgress
(
  short * handle,
  short * progressPercent,
  short * complete
)
```

This function checks on the progress of ps5000OpenUnitAsync 40.

Applicability	Use after ps5000OpenUnitAsync 40
Arguments	handle, pointer to a short where the unit handle is to be written. -1 if the unit fails to open, 0 if no unit is found or a non-zero handle to the device. Note: This handle is not valid unless the function returns PICO_OK. progressPercent, pointer to a short to which the percentage progress is to be written. 100% implies that the open operation is complete. complete, pointer to a short that is set to 1 when the open operation has finished
Returns 75	PICO_OK PICO_NULL_PARAMETER PICO_OPERATION_FAILED

2.11.24 ps5000RunBlock

```
PICO_STATUS ps5000RunBlock
(
  short            handle,
  long             noOfPreTriggerSamples,
  long             noOfPostTriggerSamples,
  unsigned long    timebase,
  short            oversample,
  long             * timeIndisposedMs,
  unsigned short   segmentIndex,
  ps5000BlockReady lpReady,
  void             * pParameter
)
```

This function starts a collection of data points (samples) in 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 memory depth of the segment 37 referred to by `segmentIndex`.

Applicability	Block mode, 6 rapid block mode 8
Arguments	`handle`, the handle of the required device. `noOfPreTriggerSamples`, the number of samples to return before the trigger event. If no trigger has been set then this argument is ignored and `noOfPostTriggerSamples` specifies the maximum number of data points (samples) to collect. `noOfPostTriggerSamples`, the number of samples to be taken after a trigger event. If no trigger event is set then this specifies the maximum number of samples to be taken. If a trigger condition has been set, this specifies the number of data points (samples) to be taken after a trigger has fired, and the number of data points to be collected is: - `noOfPreTriggerSamples + noOfPostTriggerSamples` `timebase`, a number in the range 0 to 2^{32}-1. See the guide to calculating timebase values. 16 `oversample`, the oversampling 14 factor, a number in the range 1 to 256. `timeIndisposedMs`, returns the time, in milliseconds, that the PicoScope5000 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 37 to use. `lpReady`, a pointer to the `ps5000BlockReady` 19 callback that the driver will call when the data has been collected. To use the `ps5000IsReady` 35 polling method instead of a callback function, set this pointer to NULL. `pParameter`, a void pointer that is passed to the `ps5000BlockReady` 19 callback function. The callback can use the pointer to return arbitrary data to your application.

Returns 75	`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_WARNING_AUX_OUTPUT_CONFLICT`
	`PICO_WARNING_EXT_THRESHOLD_CONFLICT`
	`PICO_TRIGGER_ERROR`

2.11.25 ps5000RunStreaming

```
PICO_STATUS ps5000RunStreaming
(
  short             handle,
  unsigned long     * sampleInterval,
  PS5000_TIME_UNITS sampleIntervalTimeUnits
  unsigned long     maxPreTriggerSamples,
  unsigned long     maxPostTriggerSamples,
  short             autoStop
  unsigned long     downSampleRatio,
  unsigned long     overviewBufferSize
)
```

This function tells the oscilloscope to start collecting data in streaming mode 13. When data has been collected from the device it is aggregated 78 and the values returned to the application. Call ps5000GetStreamingLatestValues 24 to retrieve the data.

When a trigger is set, the sum of `maxPreTriggerSamples` and `maxPostTriggerSamples` is the total number of samples stored in the driver. If `autoStop` is false then this will become the maximum number of unaggregated samples.

Applicability	Streaming mode 13 only.
Arguments	handle, the handle of the required device. sampleInterval, a pointer to the requested time interval between data points on entry and the actual time interval assigned on exit. sampleIntervalTimeUnits, the unit of time that the sampleInterval is set to. Use one of these values: - PS5000_NS PS5000_US PS5000_MS PS5000_S maxPreTriggerSamples, the maximum number of raw samples before a trigger condition for each enabled channel. If no trigger condition is set this argument is ignored. maxPostTriggerSamples, the maximum number of raw samples after a trigger condition for each enabled channel. If no trigger condition is set this argument states the maximum number of samples to be stored. autoStop, a flag to specify if the streaming should stop when all of maxSamples have been taken. downSampleRatio, the number of raw values to each aggregated value. overviewBufferSize, the size of the overview buffers. These are temporary buffers used for storing the data before returning it to the application. The size is the same as the bufferLth value passed to ps5000SetDataBuffer 47.
Returns 75	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

2.11.26 ps5000SetChannel

```
PICO_STATUS ps5000SetChannel
(
  short           handle,
  PS5000_CHANNEL  channel,
  short           enabled,
  short           dc,
  PS5000_RANGE    range
)
```

This function specifies whether an input channel is to be enabled, the AC/DC coupling 78 mode and the voltage range.

Applicability	All modes

Arguments	`handle`, the handle of the required device
	
	`channel`, an enumerated type. The values are: -
	`PS5000_CHANNEL_A`
	`PS5000_CHANNEL_B`
	
	`enabled`, specifies if the channel is active. The values are: -
	`TRUE` = active
	`FALSE` = inactive
	
	`dc`, specifies the AC/DC coupling 78 mode. The values are: -
	`TRUE` = DC
	`FALSE` = AC
	
	`range`, a number between 3 and 10 that specifies the voltage range. See the table 46 below.

Returns 75	`PICO_OK`
	`PICO_USER_CALLBACK`
	`PICO_INVALID_HANDLE`
	`PICO_INVALID_CHANNEL`
	`PICO_INVALID_VOLTAGE_RANGE`

range		Voltage range
3	PS5000_100MV	±100 mV
4	PS5000_200MV	±200 mV
5	PS5000_500MV	±500 mV
6	PS5000_1V	±1 V
7	PS5000_2V	±2 V
8	PS5000_5V	±5 V
9	PS5000_10V	±10 V
10	PS5000_20V	±20 V

2.11.27 ps5000SetDataBuffer

```
PICO_STATUS ps5000SetDataBuffer
(
  short          handle,
  PS5000_CHANNEL channel,
  short          * buffer,
  long           bufferLth
)
```

This function registers your data buffer, for non-aggregated 78 data, with the PicoScope 5000 driver. You need to allocate the buffer before calling this function.

Applicability	All modes. For aggregated data, use ps5000SetDataBuffers 49 instead.
Arguments	handle, the handle of the required device channel, the channel for which you want to set the buffers. Use one of these values: - PS5000_CHANNEL_A PS5000_CHANNEL_B buffer, a buffer to receive the data values bufferLth, the size of the buffer array
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_INVALID_CHANNEL

2.11.28 ps5000SetDataBufferBulk

```
PICO_STATUS ps5000SetDataBufferBulk
(
  short          handle,
  PS5000_CHANNEL channel,
  short          * buffer,
  long           bufferLth,
  unsigned short waveform
)
```

This function allows the buffers to be set for each waveform in rapid block mode. 8 The number of waveforms captured is determined by the `nCaptures` argument sent to `ps5000SetNoOfCaptures` 53. There is only one buffer for each waveform, because bulk collection does not support aggregation. 78

Applicability	Rapid block mode 8
Arguments	`handle`, the handle of the device `channel`, the scope channel with which the buffer is to be associated. The data should be retrieved from this channel by calling one of the GetValues 29 functions. `* buffer`, an array in which the captured data is stored `bufferLth`, the size of the buffer `waveform`, an index to the waveform number, between `0` and `nCaptures - 1`

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_INVALID_CHANNEL`
	`PICO_INVALID_PARAMETER`

2.11.29 ps5000SetDataBuffers

```
PICO_STATUS ps5000SetDataBuffers
(
  short          handle,
  PS5000_CHANNEL channel,
  short          * bufferMax,
  short          * bufferMin,
  long           bufferLth
)
```

This function registers your data buffers, for receiving aggregated 78 data, with the PicoScope 5000 driver. You need to allocate memory for the buffers before calling this function.

Applicability	All sampling modes. For non-aggregated data, use ps5000SetDataBuffer 47 instead.
Arguments	handle, the handle of the required device. channel, the channel for which you want to set the buffers. Use one of these constants: - PS5000_CHANNEL_A PS5000_CHANNEL_B 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 data values when downSampleRatio > 1. Not used when downSampleRatio is 1. bufferLth, specifies the size of the bufferMax and bufferMin arrays.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_INVALID_CHANNEL

2.11.30 ps5000SetEts

```
PICO_STATUS ps5000SetEts
(
  short           handle,
  PS5000_ETS_MODE mode,
  short           etsCycles,
  short           etsInterleave,
  long            * sampleTimePicoseconds
)
```

This function is used to enable or disable ETS 12 (equivalent time sampling) and to set the ETS parameters.

Applicability	Block mode 6
Arguments	`handle`, the handle of the required device `mode`, the ETS mode. Use one of these values: - `PS5000_ETS_OFF` - disables ETS `PS5000_ETS_FAST` - enables ETS and provides `ets_cycles` cycles of data, which may contain data from previously returned cycles `PS5000_ETS_SLOW` - enables ETS and provides fresh data every `ets_cycles` cycles. This mode takes longer to provide each data set, but the data sets are more stable and are guaranteed to contain only new data. `ets_cycles`, the number of cycles to store: the computer can then select `ets_interleave` cycles to give the most uniform spread of samples. `ets_cycles` should be between two and five times the value of `ets_interleave`. `ets_interleave`, the number of ETS interleaves to use. If the sample time is 20 ns and the interleave is 10, the approximate time per sample will be 2 ns. `sampleTimePicoseconds`, returns the effective sample time used by the function

Returns 75	`PICO_OK`
	`PICO_USER_CALLBACK`
	`PICO_INVALID_HANDLE`
	`PICO_INVALID_PARAMETER`

2.11.31 ps5000SetEtsTimeBuffer

```
PICO_STATUS ps5000SetEtsTimeBuffer
(
  short    handle,
  __int64 * buffer,
  long     bufferLth
)
```

This function tells the PicoScope 5000 driver where to find your application's ETS time buffers. These buffers contain the 64-bit timing information for each ETS sample after you run a block-mode ETS capture.

Applicability	ETS mode 12 only. If your programming language does not support 64-bit data, use the 32-bit version ps5000SetEtsTimeBuffers 52 instead.
Arguments	handle, the handle of the required device buffer, a pointer to a set of 8-byte words, the time in nanoseconds at which the first data point occurred bufferLth, the size of the buffer array
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NULL_PARAMETER

2.11.32 ps5000SetEtsTimeBuffers

```
PICO_STATUS ps5000SetEtsTimeBuffers
(
  short         handle,
  unsigned long * timeUpper,
  unsigned long * timeLower,
  long          bufferLth
)
```

This function tells the PicoScope 5000 driver where to find your application's ETS time buffers. These buffers contain the timing information for each ETS sample after you run a block-mode ETS capture. There are two buffers containing the upper and lower 32-bit parts of the timing information, to allow programming languages that do not support 64-bit data to retrieve the timings correctly.

Applicability	ETS mode 12 only. If your programming language supports 64-bit data, then you can use ps5000SetEtsTimeBuffer 51 instead.
Arguments	handle, the handle of the required device timeUpper, a pointer to a set of 4-byte words, the time in nanoseconds at which the first data point occurred, top 32 bits only timeLower, a pointer to a set of 4-byte words, the time in nanoseconds at which the first data point occurred, bottom 32 bits only bufferLth, the size of the timeUpper and timeLower arrays
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NULL_PARAMETER

2.11.33 ps5000SetNoOfCaptures

```
PICO_STATUS ps5000SetNoOfCaptures
(
  short          handle,
  unsigned short nCaptures
)
```

This function sets the number of captures to be collected in one run of rapid block mode. 8 If you do not call this function before a run, the driver will capture one waveform.

Applicability	Rapid block mode 8
Arguments	handle, the handle of the device nCaptures, the number of waveforms to be captured in one run
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_INVALID_PARAMETER

2.11.34 ps5000SetPulseWidthQualifier

```
PICO_STATUS ps5000SetPulseWidthQualifier
(
  short                 handle,
  struct PWQ_CONDITIONS * conditions,
  short                 nConditions,
  THRESHOLD_DIRECTION   direction,
  unsigned long         lower,
  unsigned long         upper,
  PULSE_WIDTH_TYPE      type
)
```

This function sets up pulse width qualification, which can be used on its own for pulse width triggering or combined with window triggering to produce more complex triggers. The pulse width qualifier is set by defining one or more conditions structures that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

Applicability	All modes
Arguments	`handle`, the handle of the required device `conditions`, a pointer to an array of PWQ_CONDITIONS 55 structures specifying the conditions that should be applied to each channel. In the simplest case, the array consists of a single element. When there are several elements, the overall trigger condition is the logical OR of all the elements. If `conditions` is set to `null` then the pulse width qualifier is not used. `nConditions`, the number of elements in the `conditions` array. If `nConditions` is zero then the pulse width qualifier is not used. `direction`, the direction of the signal required to indicate the start of a pulse `lower`, the lower limit of the pulse width counter `upper`, the upper limit of the pulse width counter. This parameter is used only when the type is set to `PW_TYPE_IN_RANGE` or `PW_TYPE_OUT_OF_RANGE`. `type`, the pulse width type, one of these constants: - `PW_TYPE_NONE` (do not use the pulse width qualifier) `PW_TYPE_LESS_THAN` (pulse width less than `lower`) `PW_TYPE_GREATER_THAN` (pulse width greater than `lower`) `PW_TYPE_IN_RANGE` (pulse width between `lower` and `upper`) `PW_TYPE_OUT_OF_RANGE` (pulse width not between `lower` and `upper`)

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_USER_CALLBACK`
	`PICO_CONDITIONS`
	`PICO_PULSE_WIDTH_QUALIFIER`

2.11.34.1 PWQ_CONDITIONS structure

A structure of this type is passed to ps5000SetPulseWidthQualifier 54 in the `conditions` argument to specify the trigger conditions, and is defined as follows: -

```
typedef struct tPwqConditions
{
  TRIGGER_STATE channelA;
  TRIGGER_STATE channelB;
  TRIGGER_STATE channelC;
  TRIGGER_STATE channelD;
  TRIGGER_STATE external;
  TRIGGER_STATE aux;
} PWQ_CONDITIONS
```

Each structure is the logical AND of the states of the scope's inputs. The ps5000SetPulseWidthQualifier 54 function can OR together a number of these structures to produce the final pulse width qualifier, which can be any possible Boolean function of the scope's inputs.

Elements	`channelA, channelB, channelC, channelD, external, aux:` the type of condition that should be applied to each channel. Use these constants: -
	`CONDITION_DONT_CARE`
	`CONDITION_TRUE`
	`CONDITION_FALSE`
	
	The channels that are set to `CONDITION_TRUE` or `CONDITION_FALSE` must all meet their conditions simultaneously to produce a trigger. Channels set to `CONDITION_DONT_CARE` are ignored.

2.11.35 ps5000SetSigGenArbitrary

```
PICO_STATUS ps5000SetSigGenArbitrary
(
  short               handle,
  long                offsetVoltage,
  unsigned long       pkToPk
  unsigned long       startDeltaPhase,
  unsigned long       stopDeltaPhase,
  unsigned long       deltaPhaseIncrement,
  unsigned long       dwellCount,
  short               * arbitraryWaveform,
  long                arbitraryWaveformSize,
  SWEEP_TYPE          sweepType,
  short               whiteNoise,
  INDEX_MODE          indexMode,
  unsigned long       shots,
  unsigned long       sweeps,
  SIGGEN_TRIG_TYPE    triggerType,
  SIGGEN_TRIG_SOURCE triggerSource,
  short               extInThreshold
)
```

This functions instructs the signal generator to produce an arbitrary waveform.

The arbitrary waveform generator uses direct digital synthesis (DDS). It maintains a 32-bit phase counter that indicates the present location in the waveform. The top 13 bits of the counter are used as an index into a buffer containing the arbitrary waveform.

The generator steps through the waveform by adding a "delta phase" between 1 and 2^{32}-1 to the phase counter every 8 ns. If the delta phase is constant, then the generator produces a waveform at a constant frequency. It is also possible to sweep the frequency by continually modifying the delta phase. This is done by setting up a "delta phase increment" which is added to the delta phase at specified intervals.

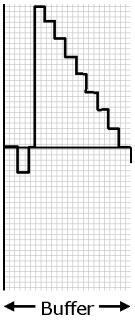
Applicability	All modes
Arguments	`handle`, the handle of the required device `offsetVoltage`, the voltage offset, in microvolts, to be applied to the waveform `pkToPk`, the peak-to-peak voltage, in microvolts, of the waveform signal `startDeltaPhase`, the initial value added to the phase counter as the generator begins to step through the waveform buffer `stopDeltaPhase`, the final value added to the phase counter before the generator restarts or reverses the sweep `deltaPhaseIncrement`, the amount added to the delta phase value every time the `dwellCount` period expires. This determines the amount by which the generator sweeps the output frequency in each dwell period.

Arguments	dwellCount, the time, in 8 ns steps, between successive additions of deltaPhaseIncrement to the delta phase counter. This determines the rate at which the generator sweeps the output frequency. arbitraryWaveform, a buffer that holds the waveform pattern as a set of samples equally spaced in time. Sample values must be between 0 and 4,095. arbitraryWaveformSize, the size of the arbitrary waveform buffer, in samples, from 10 to 8191. sweepType, determines whether the startDeltaPhase is swept up to the stopDeltaPhase, or down to it, or repeatedly swept up and down. Use one of these values: - UP DOWN UPDOWN DOWNUP whiteNoise. If TRUE, the signal generator produces white noise and ignores all settings except pkToPk and offsetVoltage. If FALSE, the generator produces the arbitrary waveform. indexMode, specifies how the signal will be formed from the arbitrary waveform data. Single, dual and quad index modes 58 are possible. Use one of these constants: SINGLE DUAL QUAD shots, see ps5000SigGenBuiltIn 59 sweeps, see ps5000SigGenBuiltIn 59 triggerType, see ps5000SigGenBuiltIn 59 triggerSource, see ps5000SigGenBuiltIn 59 extInThreshold, see ps5000SigGenBuiltIn 59
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_SIG_GEN_PARAM PICO_SHOTS_SWEEPS_WARNING PICO_NOT_RESPONDING PICO_WARNING_AUX_OUTPUT_CONFLICT PICO_WARNING_EXT_THRESHOLD_CONFLICT PICO_NO_SIGNAL_GENERATOR PICO_SIGGEN_OFFSET_VOLTAGE PICO_SIGGEN_PK_TO_PK PICO_SIGGEN_OUTPUT_OVER_VOLTAGE

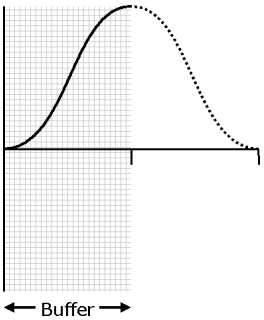
2.11.35.1 AWG index modes

The arbitrary waveform generator 56 supports single, dual and quad index modes to make the best use of the waveform buffer.

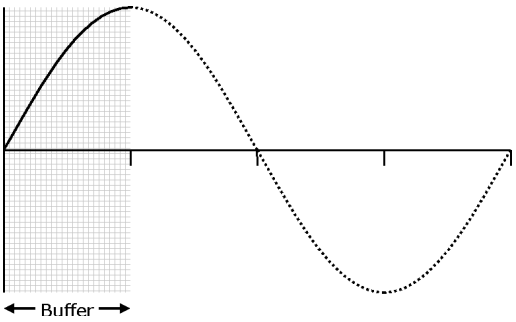
Single mode. The generator outputs the raw contents of the buffer repeatedly. This mode is the only one that can generate asymmetrical waveforms. You can also use this mode for symmetrical waveforms, but the dual and quad modes make more efficient use of the buffer memory.



Dual mode. The generator outputs the contents of the buffer from beginning to end, and then does a second pass in the reverse direction through the buffer. This allows you to specify only the first half of a waveform with twofold symmetry, such as a Gaussian function, and let the generator fill in the other half.



Quad mode. The generator outputs the contents of the buffer, then on its second pass through the buffer outputs the same data in reverse order. On the third and fourth passes it does the same but with a negative version of the data. This allows you to specify only the first quarter of a waveform with fourfold symmetry, such as a sine wave, and let the generator fill in the other three quarters.



2.11.36 ps5000SetSigGenBuiltIn

```
PICO_STATUS ps5000SetSigGenBuiltIn
(
  short               handle,
  long                offsetVoltage,
  unsigned long       pkToPk
  short               waveType
  float               startFrequency,
  float               stopFrequency,
  float               increment,
  float               dwellTime,
  SWEEP_TYPE          sweepType,
  short               whiteNoise,
  unsigned long       shots,
  unsigned long       sweeps
  SIGGEN_TRIG_TYPE    triggerType,
  SIGGEN_TRIG_SOURCE triggerSource,
  short               extInThreshold
)
```

This function sets up the signal generator to produce a signal from a list of built-in waveforms. If different start and stop frequencies are specified, the device will sweep either up, down or up and down.

Applicability	All modes
Arguments	`handle`, the handle of the required device `offsetVoltage`, the voltage offset, in microvolts, to be applied to the waveform `pkToPk`, the peak-to-peak voltage, in microvolts, of the waveform signal `waveType`, the type of waveform to be generated by the scope device. See the table 61 below. `startFrequency`, the frequency that the signal generator will initially produce. For allowable values see `ps5000api.h` - look for `PS5000_SINE_MAX_FREQUENCY` and so on. `stopFrequency`, the frequency at which the sweep reverses direction or returns to the initial frequency `increment`, the amount of frequency increase or decrease in sweep mode `dwellTime`, the time for which the sweep stays at each frequency, in seconds

	sweepType, specifies whether the frequency will sweep from startFrequency to stopFrequency, or in the opposite direction, or repeatedly reverse direction. Use one of these constants: - UP DOWN UPDOWN DOWNUP
Arguments	whiteNoise. If TRUE, the signal generator produces white noise and ignores all settings except offsetVoltage and pkTopk. If FALSE, the signal generator produces the waveform specified by waveType. shots, the number of cycles of the waveform to be produced after a trigger event. If this is set to a non-zero value (1 <= shots <= MAX_SWEEPS_SHOTS), then sweeps must be set to zero. sweeps, the number of times to sweep the frequency after a trigger event, according to sweepType. If this is set to a non-zero value (1 <= sweeps <= MAX_SWEEPS_SHOTS), then shots must be set to zero. triggerType, the type of trigger that will be applied to the signal generator. See the table of triggerType values 61 below. triggerSource, the source that will trigger the signal generator. See the table of triggerSource values 61 below. If a trigger source other than SIGGEN_NONE is specified, then either shots or sweeps, but not both, must be set to a non-zero value. extInThreshold, an ADC count for use when the trigger source is SIGGEN_EXT_IN. If the EXT input is also being used as the scope trigger then the same ADC count must be specified in both places, otherwise a warning will be issued.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_SIG_GEN_PARAM PICO_SHOTS_SWEEPS_WARNING PICO_NOT_RESPONDING PICO_WARNING_AUX_OUTPUT_CONFLICT PICO_WARNING_EXT_THRESHOLD_CONFLICT PICO_NO_SIGNAL_GENERATOR PICO_SIGGEN_OFFSET_VOLTAGE PICO_SIGGEN_PK_TO_PK PICO_SIGGEN_OUTPUT_OVER_VOLTAGE

`waveType` values

`PS5000_SINE`	sine wave
`PS5000_SQUARE`	square wave
`PS5000_TRIANGLE`	triangle wave
`PS5000_RAMP_UP`	rising sawtooth
`PS5000_RAMP_DOWN`	falling sawtooth
`PS5000_SINC`	(sin x)/x
`PS5000_GAUSSIAN`	Gaussian
`PS5000_HALF_SINE`	half (full-wave rectified) sine
`PS5000_DC_VOLTAGE`	DC voltage
`PS5000_WHITE_NOISE`	white noise

`triggerType` values

`SIGGEN_RISING`	trigger on rising edge
`SIGGEN_FALLING`	trigger on falling edge
`SIGGEN_GATE_HIGH`	run while trigger is high
`SIGGEN_GATE_LOW`	run while trigger is low

`triggerSource` values

`SIGGEN_NONE`	run without waiting for trigger
`SIGGEN_SCOPE_TRIG`	use scope trigger
`SIGGEN_AUX_IN`	use AUXIO input
`SIGGEN_EXT_IN`	use EXT input
`SIGGEN_SOFT_TRIG`	wait for software trigger provided by `ps5000SigGenSoftwareControl` 69

2.11.37 ps5000SetSimpleTrigger

```
PICO_STATUS ps5000SetSimpleTrigger
(
    short               handle,
    short               enable,
    PS5000_CHANNEL      source,
    short               threshold,
    THRESHOLD_DIRECTION direction,
    unsigned long       delay,
    short               autoTrigger_ms
)
```

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 cancelled.

Applicability	All modes
Arguments	`handle:` the handle of the required device. `enabled:` zero to disable the trigger, any non-zero value to set the trigger. `source:` the channel on which to trigger. `threshold:` the ADC count at which the trigger will fire. `direction:` the direction in which the signal must move to cause a trigger. The following directions are supported: `ABOVE`, `BELOW`, `RISING`, `FALLING` and `RISING_OR_FALLING`. `delay:` the time between the trigger occurring and the first sample being taken. `autoTrigger_ms:` the number of milliseconds the device will wait if no trigger occurs.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_USER_CALLBACK`
	`PICO_DRIVER_FUNCTION`

2.11.38 ps5000SetTriggerChannelConditions

```
PICO_STATUS ps5000SetTriggerChannelConditions
(
  short                      handle,
  struct TRIGGER_CONDITIONS * conditions,
  short                      nConditions
)
```

This function sets up trigger conditions on the scope's inputs. The trigger is set up by defining one or more TRIGGER_CONDITIONS 64 structures that are then ORed together. Each structure is itself the AND of the states of one or more of the inputs. This AND-OR logic allows you to create any possible Boolean function of the scope's inputs.

If complex triggering is not required, use ps5000SetSimpleTrigger 62.

Applicability	All modes
Arguments	handle, the handle of the required device. conditions, a pointer to an array of TRIGGER_CONDITIONS 64 structures specifying the conditions that should be applied to each channel. In the simplest case, the array consists of a single element. When there are several elements, the overall trigger condition is the logical OR of all the elements. nConditions, the number of elements in the conditions array. If nConditions is zero then triggering is switched off.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_USER_CALLBACK PICO_CONDITIONS PICO_MEMORY_FAIL

2.11.38.1 TRIGGER_CONDITIONS structure

A structure of this type is passed to ps5000SetTriggerChannelConditions 63 in the conditions argument to specify the trigger conditions, and is defined as follows: -

```
typedef struct tTriggerConditions
{
  TRIGGER_STATE channelA;
  TRIGGER_STATE channelB;
  TRIGGER_STATE channelC;
  TRIGGER_STATE channelD;
  TRIGGER_STATE external;
  TRIGGER_STATE aux;
  TRIGGER_STATE pulseWidthQualifier;
} TRIGGER_CONDITIONS
```

Each structure is the logical AND of the states of the scope's inputs. The ps5000SetTriggerChannelConditions 63 function can OR together a number of these structures to produce the final trigger condition, which can be any possible Boolean function of the scope's inputs.

Elements	channelA, channelB, channelC, channelD, external, aux, pulseWidthQualifier: the type of condition that should be applied to each channel. Use these constants: - CONDITION_DONT_CARE CONDITION_TRUE CONDITION_FALSE The channels that are set to CONDITION_TRUE or CONDITION_FALSE must all meet their conditions simultaneously to produce a trigger. Channels set to CONDITION_DONT_CARE are ignored. The EXT and AUX inputs are ignored in ETS 12 mode.

2.11.39 ps5000SetTriggerChannelDirections

```
PICO_STATUS ps5000SetTriggerChannelDirections
(
  short                handle,
  THRESHOLD_DIRECTION channelA,
  THRESHOLD_DIRECTION channelB,
  THRESHOLD_DIRECTION channelC,
  THRESHOLD_DIRECTION channelD,
  THRESHOLD_DIRECTION ext,
  THRESHOLD_DIRECTION aux
)
```

This function sets the direction of the trigger for each channel.

Applicability	All modes. When using ETS, 12 only channel A and channel B can be used as a trigger, and only level triggers are available.
Arguments	`handle`, the handle of the required device `channelA, channelB, channelC, channelD, ext, aux` all specify the direction in which the signal must pass through the threshold to activate the trigger. See the table 65 below.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_USER_CALLBACK PICO_INVALID_PARAMETER

Trigger direction constants

ABOVE	for gated triggers: above a threshold
BELOW	for gated triggers: below a threshold
RISING	for threshold triggers: rising edge
FALLING	for threshold triggers: falling edge
RISING_OR_FALLING	for threshold triggers: either edge
INSIDE	for window-qualified triggers: inside window
OUTSIDE	for window-qualified triggers: outside window
ENTER	for window triggers: entering the window
EXIT	for window triggers: leaving the window
ENTER_OR_EXIT	for window triggers: either entering or leaving the window
NONE	no trigger

2.11.40 ps5000SetTriggerChannelProperties

```
PICO_STATUS ps5000SetTriggerChannelProperties
(
  short                                handle,
  struct TRIGGER_CHANNEL_PROPERTIES * channelProperties
  short                                nChannelProperties
  short                                auxOutputEnable,
  long                                 autoTriggerMilliseconds
)
```

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

Applicability	All modes
Arguments	`handle`, the handle of the required device. `channelProperties`, a pointer to an array of TRIGGER_CHANNEL_PROPERTIES [67] 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`: Zero configures the AUXIO connector as a trigger input. Any other value configures it as a trigger output. This argument is ignored in ETS [12] mode, when the connector becomes high-impedance and is not used. When used as an output, AUXIO goes high when the trigger event occurs (after the trigger delay, if one is in use) and then goes low once the data collection has finished. The pulse width therefore depends on the timebase and number of samples. Example: you collect 5 M pre- and 5 M post-trigger samples at 1 GS/s. The AUXIO output will be high for 5 M x 1 ns = 5 ms. `autoTriggerMilliseconds`, the time in milliseconds 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. This parameter is ignored in ETS [12] mode.
Returns [75]	PICO_OK PICO_INVALID_HANDLE PICO_USER_CALLBACK PICO_TRIGGER_ERROR PICO_MEMORY_FAIL

2.11.40.1 TRIGGER_CHANNEL_PROPERTIES structure

A structure of this type is passed to ps5000SetTriggerChannelProperties 66 in the channelProperties argument to specify the trigger mechanism, and is defined as follows: -

```
typedef struct tTriggerChannelProperties
{
  short          thresholdMajor;
  short          thresholdMinor;
  unsigned short hysteresis;
  PS5000_CHANNEL channel;
  THRESHOLD_MODE thresholdMode;
} TRIGGER_CHANNEL_PROPERTIES
```

Elements	thresholdMajor, the upper threshold at which the trigger event is to take place. This is scaled in 16-bit ADC counts 5 at the currently selected range for that channel. If an external trigger is enabled, the range is fixed at ±20 V. thresholdMinor, the lower threshold at which the trigger event is to take place. This is scaled in 16-bit ADC counts 5 at the currently selected range for that channel. If an external trigger is enabled, the range is fixed at ±20 V. Used only with window triggering types. hysteresis, the hysteresis that the trigger has to exceed before it will fire. It is scaled in 16-bit counts. Only channels A and B have programmable hysteresis. AUXIO has none, and EXT has fixed 40 mV to 140 mV hysteresis. channel, the channel to which the properties apply. See ps5000SetChannel 46 for possible values. thresholdMode, either a level or window trigger. Use one of these constants: - LEVEL WINDOW

2.11.41 ps5000SetTriggerDelay

```
PICO_STATUS ps5000SetTriggerDelay
(
  short         handle,
  unsigned long delay
)
```

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

Applicability	All modes
Arguments	`handle`, the handle of the required device `delay`, the time between the trigger occurring and the first sample, in multiples of eight sample periods. For example, if `delay`=100 then the scope would wait 800 sample periods before sampling. At a timebase 16 of 500 MS/s, or 2 ns per sample (`timebase`=1), the total delay would then be 800 x 2 ns = 1.6 µs.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_USER_CALLBACK`

2.11.42 ps5000SigGenSoftwareControl

```
PICO_STATUS ps5000SigGenSoftwareControl
(
  short   handle,
  short   state
)
```

This function causes a trigger event, or starts and stops gating. It is used when the signal generator is set to SIGGEN_SOFT_TRIG. 61

Applicability	Use with ps5000SetSigGenBuiltIn 59 or ps5000SetSigGenArbitrary 56.
Arguments	handle, the handle of the required device state, sets the trigger gate high or low when the trigger type is set to either SIGGEN_GATE_HIGH or SIGGEN_GATE_LOW. Ignored for other trigger types.
Returns 75	PICO_OK PICO_INVALID_HANDLE PICO_NO_SIGNAL_GENERATOR PICO_SIGGEN_TRIGGER_SOURCE

2.11.43 ps5000Stop

```
PICO_STATUS ps5000Stop
(
  short  handle
)
```

This function stops the scope device from sampling data. If this function is called before a trigger event occurs, the oscilloscope may not contain valid data.

Always call this function after the end of a capture to ensure that the scope is ready for the next capture.

Applicability	All modes
Arguments	`handle`, the handle of the required device.

Returns 75	`PICO_OK`
	`PICO_INVALID_HANDLE`
	`PICO_USER_CALLBACK`

2.11.44 ps5000StreamingReady

```
typedef void (CALLBACK *ps5000StreamingReady)
(
  short          handle,
  long           noOfSamples,
  unsigned long  startIndex,
  short          overflow,
  unsigned long  triggerAt,
  short          triggered,
  short          autoStop,
  void           * pParameter
)
```

This callback 78 function is part of your application. You register it with the PicoScope 5000 series driver using ps5000GetStreamingLatestValues 24, and the driver calls it back when streaming-mode data is ready. You can then download the data using the ps5000GetValuesAsync 30 function.

Applicability	Streaming mode 13 only
Arguments	`handle`, the handle of the device returning the samples. `noOfSamples`, the number of samples to collect. `startIndex`, an index to the first valid sample in the buffer. This is the buffer that was previously passed to ps5000SetDataBuffer 47. `overflow`, returns a set of flags that indicate whether an overvoltage has occurred on any of the channels. It is a bit pattern with bit 0 denoting Channel A and bit 1 Channel B. `triggerAt`, an index to the buffer indicating the location of the trigger point. This parameter is valid only when `triggered` is non-zero. `triggered`, a flag indicating whether a trigger occurred. If non-zero, a trigger occurred at the location indicated by `triggerAt`. `autoStop`, the flag that was set in the call to ps5000RunStreaming 44. `pParameter`, a void pointer passed from ps5000GetStreamingLatestValues 24. The callback function can write to this location to send any data, such as a status flag, back to the application.
Returns	nothing

2.12 Programming examples

The PicoScope 5000 Series SDK (Software Development Kit) includes programming examples in a number of languages and development environments.

2.12.1 C

The C example is a comprehensive console mode program that demonstrates all of the facilities of the driver.

The console example program is a generic windows application - that is, it does not use Borland AppExpert or Microsoft AppWizard. To compile the program, create a new project for an Application containing the following files: -

- `ps5000con.c`

and:

- `ps5000bc.lib` (Borland 32-bit applications) or
- `ps5000.lib` (Microsoft Visual C 32-bit applications)

The following files must be in the compilation directory:

- `ps5000Api.h`
- `picoStatus.h`

and the following file must be in the same directory as the executable:

- `ps5000.dll`

2.12.2 Delphi

The program:

- `ps5000.dpr`

in the `Examples/ps5000/` subdirectory of your PicoScope installation demonstrates how to operate PicoScope 5000 Series PC Oscilloscopes. The file:

- `ps5000.inc`

contains procedure prototypes that you can include in your own programs. Other required files are:

- `ps5000.res`
- `ps5000fm.dfm`
- `ps5000fm.pas`

This has been tested with Delphi version 3.

2.12.3 Excel

1. Load the spreadsheet `ps5000.xls`
2. Select Tools | Macro
3. Select GetData
4. Select Run

Note: The Excel macro language is similar to Visual Basic. The functions which return a TRUE/FALSE value, return 0 for FALSE and 1 for TRUE, whereas Visual Basic expects 65 535 for TRUE. Check for >0 rather than =TRUE.

2.12.4 LabView

The SDK contains a library of VIs that can be used to control the PicoScope 5000 and some simple examples of using these VIs in streaming mode 13, block mode 6 and rapid block mode 8.

The LabVIEW library (`PicoScope5000.llb`) can be placed in the `user.lib` sub-directory to make the VIs available on the 'User Libraries' palette. You must also copy `ps5000.dll` and `ps5000wrap.dll` to the folder containing your LabView project.

The library contains the following VIs:

- `PicoErrorHandler.vi` - takes an error cluster and, if an error has occurred, displays a message box indicating the source of the error and the status code returned by the driver
- `PicoScope5000AdvancedTriggerSettings.vi` - an interface for the advanced trigger features of the oscilloscope

  This VI is not required for setting up simple triggers, which are configured using `PicoScope5000Settings.vi`.

  For further information on these trigger settings, see descriptions of the trigger functions:

  ```
  ps5000SetTriggerChannelConditions
  ps5000SetTriggerChannelDirections
  ps5000SetTriggerChannelProperties
  ps5000SetPulseWidthQualifier
  ps5000SetTriggerDelay
  ```

- `PicoScope5000AWG.vi` - controls the arbitrary waveform generator

  Standard waveforms or an arbitrary waveform can be selected under 'Wave Type'. There are three settings clusters: general settings that apply to both arbitrary and standard waveforms, settings that apply only to standard waveforms and settings that apply only to arbitrary waveforms. It is not necessary to connect all of these clusters if only using arbitrary waveforms or only using standard waveforms.

  When selecting an arbitrary waveform, it is necessary to specify a text file containing the waveform. This text file should have a single value on each line in the range -1 to 1. For further information on the settings, see descriptions of `ps5000SetSigGenBuiltIn` and `ps5000SetSigGenArbitrary`.

- `PicoScope5000Close.vi` - closes the oscilloscope

  Should be called before exiting an application.

- `PicoScope5000GetBlock.vi` - collects a block of data from the oscilloscope

  This can be called in a loop in order to continually collect blocks of data. The oscilloscope should first be set up by using `PicoScope5000Settings.vi`. The VI outputs data arrays in two clusters (max and min). If not using aggregation, 'Min Buffers' is not used.

- PicoScope5000GetRapidBlock.vi - collects a set of data blocks or captures from the oscilloscope in rapid block mode 8

  This VI is similar to PicoScope5000GetBlock.vi. It outputs two-dimensional arrays for each channel that contain data from all the requested number of captures.

- PicoScope5000GetStreamingValues.vi - used in streaming mode 13 to get the latest values from the driver

  This VI should be called in a loop after the oscilloscope has been set up using PicoScope5000Settings.vi and streaming has been started by calling PicoScope5000StartStreaming.vi. The VI outputs the number of samples available and the start index of these samples in the array output by PicoScope5000StartStreaming.vi.

- PicoScope5000Open.vi - opens a PicoScope 5000 and returns a handle to the device

- PicoScope5000Settings.vi - sets up the oscilloscope

  The inputs are clusters for setting up channels and simple triggers. Advanced triggers can be set up using PicoScope5000AdvancedTriggerSettings.vi.

- PicoScope5000StartStreaming.vi - starts the oscilloscope streaming 13

  It outputs arrays that will contain samples once PicoScope5000GetStreamingValues.vi has returned.

- PicoStatus.vi - checks the status value returned by calls to the driver

  If the driver returns an error, the status member of the error cluster is set to 'true' and the error code and source are set.

2.13 Driver error codes

This description of the driver error codes is aimed at those people who intend to write their own programs for use with the driver. Every function in the ps5000 driver returns an error code from the following list of PICO_STATUS values.

Code (hex)	Enum	Description
00	PICO_OK	The PicoScope 5000 is functioning correctly
01	PICO_MAX_UNITS_OPENED	An attempt has been made to open more than PS5000_MAX_UNITS. Reserved.
02	PICO_MEMORY_FAIL	Not enough memory could be allocated on the host machine
03	PICO_NOT_FOUND	No PicoScope 5000 could be found
04	PICO_FW_FAIL	Unable to download firmware
05	PICO_OPEN_OPERATION_IN_PROGRESS	
06	PICO_OPERATION_FAILED	
07	PICO_NOT_RESPONDING	The PicoScope 5000 is not responding to commands from the PC
08	PICO_CONFIG_FAIL	The configuration information in the PicoScope 5000 has become corrupt or is missing
09	PICO_KERNEL_DRIVER_TOO_OLD	The picopp.sys file is too old to be used with the device driver
0A	PICO_EEPROM_CORRUPT	The EEPROM has become corrupt, so the device will use a default setting
0B	PICO_OS_NOT_SUPPORTED	The operating system on the PC is not supported by this driver
0C	PICO_INVALID_HANDLE	There is no device with the handle value passed
0D	PICO_INVALID_PARAMETER	A parameter value is not valid
0E	PICO_INVALID_TIMEBASE	The time base is not supported or is invalid
0F	PICO_INVALID_VOLTAGE_RANGE	The voltage range is not supported or is invalid
10	PICO_INVALID_CHANNEL	The channel number is not valid on this device or no channels have been set
11	PICO_INVALID_TRIGGER_CHANNEL	The channel set for a trigger is not available on this device
12	PICO_INVALID_CONDITION_CHANNEL	The channel set for a condition is not available on this device
13	PICO_NO_SIGNAL_GENERATOR	The device does not have a signal generator
14	PICO_STREAMING_FAILED	Streaming has failed to start or has stopped without user request
15	PICO_BLOCK_MODE_FAILED	Block failed to start - a parameter may have been set wrongly
16	PICO_NULL_PARAMETER	A parameter that was required is NULL
17	PICO_ETS_MODE_SET	Function call failed because ETS mode is being used
18	PICO_DATA_NOT_AVAILABLE	No data is available from a run block call
19	PICO_STRING_BUFFER_TOO_SMALL	The buffer passed for the information was too small

1A	PICO_ETS_NOT_SUPPORTED	ETS is not supported on this device variant
1B	PICO_AUTO_TRIGGER_TIME_TOO_SHORT	The auto trigger time is less than the time it will take to collect the data
1C	PICO_BUFFER_STALL	The collection of data has stalled as unread data would be overwritten
1D	PICO_TOO_MANY_SAMPLES	Number of samples requested is more than available in the current memory segment
1E	PICO_TOO_MANY_SEGMENTS	Not possible to create number of segments requested
1F	PICO_PULSE_WIDTH_QUALIFIER	A null pointer has been passed in the trigger function or one of the parameters is out of range
20	PICO_DELAY	One or more of the hold-off parameters are out of range
21	PICO_SOURCE_DETAILS	One or more of the source details are incorrect
22	PICO_CONDITIONS	One or more of the conditions are incorrect
23	PICO_USER_CALLBACK	The driver's thread is currently in the ps5000...Ready 19 callback function and therefore the action cannot be carried out
24	PICO_DEVICE_SAMPLING	An attempt is being made to get stored data while streaming. Either stop streaming by calling ps5000Stop, 70 or use ps5000GetStreamingLatestValues 24
25	PICO_NO_SAMPLES_AVAILABLE	...because a run has not been completed
26	PICO_SEGMENT_OUT_OF_RANGE	The memory index is out of range
27	PICO_BUSY	Data cannot be returned yet
28	PICO_STARTINDEX_INVALID	The start time to get stored data is out of range
29	PICO_INVALID_INFO	The information number requested is not a valid number
2A	PICO_INFO_UNAVAILABLE	The handle is invalid so no information is available about the device. Only PICO_DRIVER_VERSION is available.
2B	PICO_INVALID_SAMPLE_INTERVAL	The sample interval selected for streaming is out of range
2C	PICO_TRIGGER_ERROR	ETS is set but no trigger has been set. A trigger setting is required for ETS.
2D	PICO_MEMORY	Driver cannot allocate memory.
2E	PICO_SIG_GEN_PARAM	One or more signal generator parameters are out of range
2F	PICO_SHOTS_SWEEPS_WARNING	The signal generator will output the signal required but sweeps and shots will be ignored. Only one parameter can be non-zero.
30	PICO_SIGGEN_TRIGGER_SOURCE	A software trigger has been sent but the trigger source is not a software trigger
31	PICO_AUX_OUTPUT_CONFLICT	ps5000SetTrigger 66 has found a conflict between the trigger source and the AUXIO output enable

32	PICO_AUX_OUTPUT_ETS_CONFLICT	ETS mode is being used and AUXIO is set as an input
33	PICO_WARNING_EXT_THRESHOLD_CONFLICT	The EXT threshold is being set in both a ps5000SetTrigger 66 function and in the signal generator but the threshold values differ. The last value set will be used.
34	PICO_WARNING_AUX_OUTPUT_CONFLICT	ps5000SetTrigger has set AUXIO as an output and the signal generator is using it as a trigger
35	PICO_SIGGEN_OUTPUT_OVER_VOLTAGE	The requested voltage and offset levels combine to give an overvoltage
36	PICO_DELAY_NULL	NULL pointer passed as delay parameter
37	PICO_INVALID_BUFFER	The buffers for overview data have not been set while streaming
38	PICO_SIGGEN_OFFSET_VOLTAGE	The offset is higher than allowed
39	PICO_SIGGEN_PK_TO_PK	The peak-to-peak voltage is higher than allowed
3A	PICO_CANCELLED	A block collection has been cancelled
3B	PICO_SEGMENT_NOT_USED	The segment index is not currently being used
3C	PICO_INVALID_CALL	The wrong GetValues 29 function has been called for the collection mode in use
3F	PICO_NOT_USED	
40	PICO_INVALID_SAMPLERATIO	The aggregation 78 ratio requested is out of range
41	PICO_INVALID_STATE	Device is in an invalid state
45	PICO_INVALID_COUPLING	The requested coupling mode is not allowed.
46	PICO_BUFFERS_NOT_SET	You must set up buffers before collecting data.
47	PICO_RATIO_MODE_NOT_SUPPORTED	The requested type of aggregation is not possible.
48	PICO_RAPID_NOT_SUPPORT_AGGREGATION	Aggregation cannot be used in rapid block mode 8.
49	PICO_INVALID_TRIGGER_PROPERTY	

3 Glossary

AC/DC switch. To switch from AC coupling to DC coupling, or vice versa, select AC or DC from the control on the PicoScope toolbar. The AC setting filters out very low-frequency components of the input signal, including DC, and is suitable for viewing small AC signals superimposed on a DC or slowly changing offset. In this mode you can measure the peak-to-peak amplitude of an AC signal but not its absolute value. Use the DC setting for measuring the absolute value of a signal.

Aggregation. The PicoScope 5000 79 driver can use this method to reduce the amount of data your application needs to process. This means that for every block of consecutive samples, it stores only the minimum and maximum values. You can set the number of samples in each block, called the aggregation parameter, when you call ps5000RunStreaming 44 for real-time capture, and when you call ps5000GetStreamingLatestValues 24 to obtain post-processed data.

Block mode. A sampling mode in which the computer prompts the oscilloscope to collect a block of data into its internal memory before stopping the oscilloscope and transferring the whole block into computer memory. Choose this mode of operation when the input signal being sampled contains high frequencies. Note: To avoid sampling errors, the maximum input frequency must be less than half the sampling rate.

Buffer size. The size of the oscilloscope buffer memory, measured in samples. The buffer allows the oscilloscope to sample data faster than it can transfer it to the computer.

Callback. A mechanism that the PicoScope 5000 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.

Device Manager. Device Manager is a Windows program that displays the current hardware configuration of your computer. On Windows XP or Vista, right-click on 'My Computer,' choose 'Properties', then click the 'Hardware' tab and the 'Device Manager' button.

Driver. A program that controls a piece of hardware. The driver for the PicoScope 5000 Series PC Oscilloscopes is supplied in the form of a 32-bit Windows DLL, `ps5000.dll`. This is used by the PicoScope software, and by user-designed applications, to control the oscilloscopes.

ETS. Equivalent Time Sampling. Constructs a picture of a repetitive signal by accumulating information over many similar wave cycles. This allows the oscilloscope to create a composite cycle that has more samples, and therefore better time resolution, than a single cycle. Note: cannot be used for one-shot signals.

External trigger. The BNC socket marked EXT on the PicoScope 5000 Series PC Oscilloscopes. It can be used as a trigger input.

Maximum sampling rate. A figure indicating the maximum number of samples the oscilloscope can acquire per second. The higher the sampling rate of the oscilloscope, the more accurate the representation of the high-frequency details in a fast signal. "GS/s" is an abbreviation for gigasamples (1,000,000,000 samples) per second.

Oversampling. Oversampling is taking measurements more frequently than the requested sample rate, and then combining them to produce the required number of samples. If, as is usually the case, the signal contains a small amount of noise, this technique can increase the effective vertical resolution 79 of the oscilloscope.

PC Oscilloscope. A virtual instrument formed by connecting a PicoScope 5000 Series scope unit to a computer running the PicoScope software.

PicoScope 5000 Series. Pico Technology's fifth generation of PC Oscilloscopes.

PicoScope software. A software product that accompanies all Pico PC Oscilloscopes. It turns your PC into an oscilloscope, spectrum analyser, and meter display.

Signal generator. Generates a waveform and outputs it on the BNC socket marked Signal Out on the oscilloscope. This output can be used to drive a test signal through a BNC cable into one of the scope's input channels. The PicoScope software and the API allow the generator to output regular waveforms, such as sine and square waves, or arbitrary waveforms defined by the user.

Streaming mode. A sampling mode in which the oscilloscope samples data and returns it to the computer in an unbroken stream. This mode allows the capture of data sets whose size is not limited by the size of the scope's memory buffer, at sampling rates up to 13.3 million samples per second.

Timebase. The timebase controls the time interval that each horizontal division of a scope view represents. There are ten divisions across the scope view, so the total time across the view is ten times the timebase per division.

USB 1.1. Universal Serial Bus (Full Speed). This is a standard port used to connect external devices to PCs. A typical USB 1.1 port supports a data transfer rate of 12 megabits per second, so is much faster than an RS232 COM port.

USB 2.0. Universal Serial Bus (High Speed). This is a standard port used to connect external devices to PCs. A typical USB 2.0 port supports a data transfer rate 40 times faster than USB 1.1 when used with a USB 2.0 device, but can also be used with USB 1.1 devices.

Vertical resolution. A value, in bits, indicating the precision with which the oscilloscope converts input voltages to digital values. Oversampling 14 (see above) can improve the effective vertical resolution.

Voltage range. The range of input voltages that the oscilloscope can measure. For example, a voltage range of ±100 mV means that the oscilloscope can measure voltages between -100 mV and +100 mV. Input voltages outside this range will not damage the instrument as long as they remain within the protection limits of ±100 V.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