CEBO-STICK

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CEBO-STICK at a glance

Application

- Detect sensor signals and digital states
- Automate experiments and tests
- Monitor processes
- Switch digital signals
- Count events

Features

Analog inputs

- Four single-ended
- 12 bit resolution
- Analog input range: 0 - 3,3V
- Operational amplifier inputs
- Up to 188 kSamples/s (total sampling rate)

Digital io

- Two general purpose io
- Individually configurable as input or output
- One multi-function io: configurable as digital io, trigger io or counter input
- 3,3 Volt TTL compliant signaling levels
- 5 Volt tolerant inputs
- Short-circuit proof

Additional

- One trigger input / output
- One counter input
- 5 Volt power output

USB interface

- USB1.1 and USB2.0 compatible
- Fullspeed (12 Mbit)
- USB-A connector

Supported Operating Systems

- Microsoft Windows (XP, Vista, 7, 8) (32 + 64 bit, Windows XP 32 bit only)
- Mac OS X, 10.6 or higher
- Linux (PC/Desktop), tested on Ubuntu 12.04 LTS (32 + 64 bit)
- Linux on Raspberry Pi (Wheezy)

Supported Programming Languages/Interfaces

- C++
- Java
- .NET
- Python
- LabVIEW (on Windows platforms)
- ProfiLab (on Windows platforms)

Instructions for Use and Safety Precautions

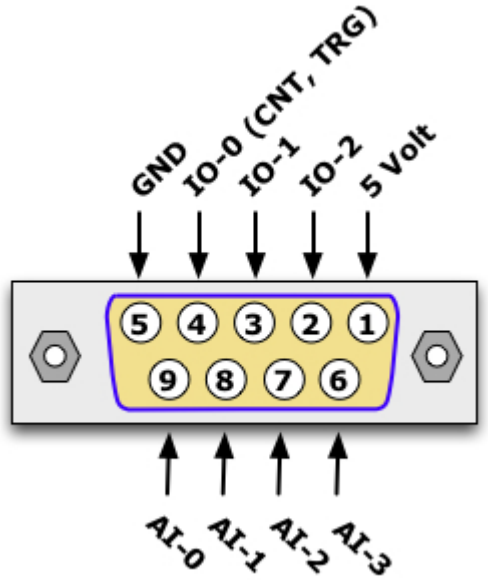
Specifications - general

Parameter	Min	Typical	Max	Units
Dimensions (L x W x H)		85 x 21 x 12,4		mm
Cable Length		75		mm
Weigth		65		g
Operating temperature range		25	70	°C

DB9 connector

All CEBO-STICK input / output signals are available on a standard 9pin D-SUB jack of female type:

- Four sinlge-ended analog inputs
- Two general purpose digital IO signals
- One multi-function IO: configurable as digital IO, trigger IO or counter input
- 5 Volt power output
- GND signal



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- Two general purpose digital IO signals
- One multi-function IO: configurable as digital IO, trigger IO or counter input
- 5 Volt power output
- GND signal

DB9 connector - pin assignment

Pin	Signal	Description
1	5V	5 Volt power output [1,2]
2	IO-2	Digital input / output 2
3	IO-1	Digital input / output 1
4	IO-0	Multifunction io:Default: Digital input / output 0Alternate: Trigger input / output or counter input

5	GND	GND power terminal
6	AI-3	Analog input terminal 3
7	AI-2	Analog input terminal 2
8	AI-1	Analog input terminal 1
9	AI-0	Analog input terminal 0
Shell		USB shield

USB interface

1. Power output. Do not connect external power supplies. CEBO-STICK is sourced from USB.
2. The 5 Volt power output is connected to USB power supply. Typically up to 450mA of current are available for your own applications.

CEBO-STICK connects to host devices through a USB2.0 full-speed compatible interface. As a bus-powered device CEBO-STICK uses USB2.0 not only for the purpose of communication with a host system but also as power supply, so no external power supply is necessary.

CEBO-STICK USB features

- USB 1.1 and USB2.0 compatible
- Full speed (12Mbit)
- Standard USB-A connector

Analog inputs

Features:

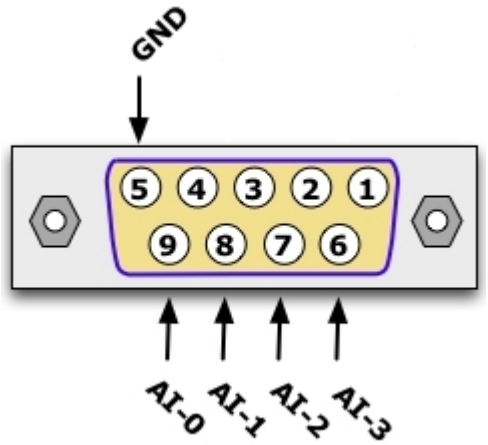
- Four single-ended
- 12bit resolution
- Analog input range: 0 - 3,3V
- Operational amplifier inputs
- Up to 188 kSamples/s (total sampling rate)

Floating inputs

To keep input resistance at a maximum, all analog inputs are left floating. The analog inputs are not pulled to GND internally. Readings from floating inputs have undefined results.

Overvoltage protection

CEBO-STICK analog inputs are rated for 0 - 3,3V with respect to GND. Keep voltages on any analog input within this range to guarantee valid readings on adjacent channels. To limit current flow in case of overvoltage an internal series resistor is added at all input channels. Make sure voltages are within the Input Voltage Range at any time to prevent CEBO-STICK from damage.



DB9 connector - analog input pin assignment

Pin	Signal	Description
9	AI-0	Analog input terminal 0
8	AI-1	Analog input terminal 1
7	AI-2	Analog input terminal 2
6	AI-3	Analog input terminal 3
5	GND	GND power terminal

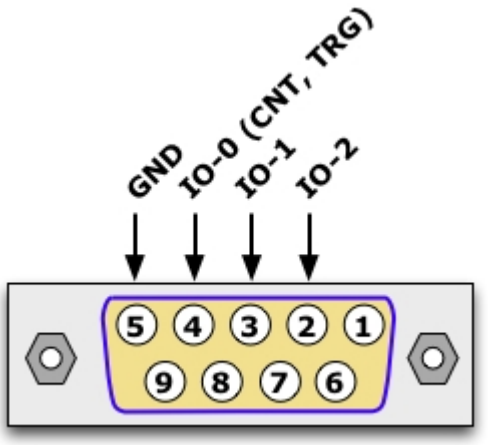
Specifications - analog inputs

Parameter	Min [1]	Typical	Max [1]	Unit
Typical Input Range	0,0		3,3	Volts
Maximum Input Voltage Range [2]	-0,2		5,0	Volts
Input Bias Current		15,0	500,0	nAmperes
Input Impedance		tbd		MOhms
Total unadjusted error		+/- 1,5	tbd	LSB
Offset Error		+/- 1	tbd	LSB
Gain Error		+/- 0,5	+/- 1,5	LSB
Differential Linearity Error		+/- 0,7	+/- 1,0	LSB
Integral Linearity Error		+/- 0,8	+/- 1,5	LSB
Noise (Peak-To-Peak)		tbd		µV
Effective Resolution		tbd		bits
Noise-Free Resolution		tbd		bits
Crosstalk		tbd		dB

1. Based on characterization, not production tested.
2. Voltages beyond the maximum input voltage range may damage CEBO-STICK.

Digital io

- Two general purpose io
- Individually configurable as input or output
- One multi-function io: configurable as digital io, trigger io or counter input
- 3,3 Volt TTL compliant signaling levels
- 5 Volt tolerant inputs
- Short-circuit proof



DB9 connector - digital io pin assignment

Pin	Signal	Description
4	IO-0	Multifunction io:Default: Digital input / output 0Alternate: Trigger input / output or counter input
3	IO-1	Digital input / output 1
2	IO-2	Digital input / output 2
5	GND	GND power terminal

Specifications - digital inputs

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Input Voltage	0,0		0,8	Volts
High Level Input Voltage	2,0		5,0	Volts
Maximum Input Voltage Range [2,3]	-1,0		6,5	Volts

Specifications - digital outputs

Parameter	Min [1]	Typical	Max [1]	Unit

Low Level Output Voltage		0,0	0,8	Volts
High Level Output Voltage	2,0	3,3		Volts
Sinking 1mA		0,2		Volts
Sourcing 1mA		3,1		Volts
Short-Circuit Current		18		mAmperes
Output Impedance		180		Ohms

Trigger

1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the maximum input voltage range may damage CEBO-STICK.
1. Based on characterization, not production tested.

After startup of CEBO-STICK, the multifunction IO-0 is configured as digital input signal. To use the trigger functionalities, output or input, the corresponding peripheral needs to be enabled first. This is done by software calls (API). While IO-0 is used as trigger input / output, digital IO functionalities or counter input are not available. With the help of the trigger output signal you can, for example, synchronize multiple CEBO-STICK devices. With the trigger as input signal, you can delay data acquisition until the occurrence of an external event.

Trigger input

In trigger input mode, you have to supply an external signal to terminal IO-0. You can use trigger events, for example, to delay the start of a buffered or continuous data acquisition until the occurrence of an external signal. In external timed data acquisition modes each trigger event trips the recording of a new frame, therefore the input signal defines the frame rate.

CEBO-STICK can be configured for three different types of trigger input signals: rising edge, falling edge or alternating.

Rising edge mode:

In rising edge mode, every transition form low to high level on terminal IO-0 is a trigger event.

Falling edge mode:

In falling edge mode, every transition from high to low level on terminal IO-0 is a trigger event.

Alternating mode:

In alternating mode, both edges are trigger events.

Specifications - trigger input

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Input Voltage	0,0		0,8	Volts
High Level Input Voltage	2,0		5,0	Volts
Maximum Input Voltage Range [2,3]	-1,0		6,5	Volts
Input Total Edge Rate		tbd		Edges/s
Latency [4,5]		tbd		us
Latency [4,6]		tbd		us

1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the maximum input voltage range may damage CEBO-STICK.
4. Time interval from edge of trigger signal to conversion of the first analog input in the InputFrame.
5. External timed data acqusition.
6. Hardware timed data acquisition with trigger set to rising edge input mode.

Trigger output

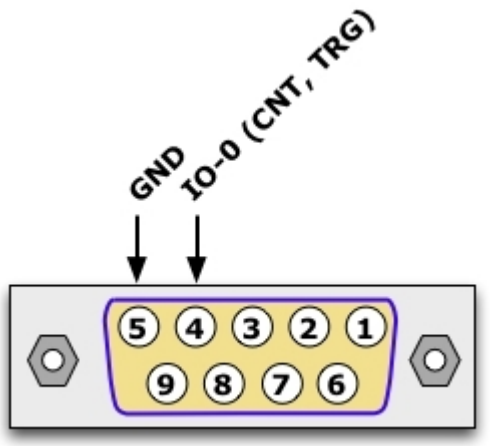
In Trigger Output mode, terminal IO-0 becomes an actively driven digital output. CEBO-STICK supports two different modes to generate Trigger Output signals: alternating and pulse output mode.

Alternating mode:

In alternating mode, every acquisition of a frame toggles the level of the signal output on IO-0. Consequently, the resulting signal is a square wave with 50% duty cycle and half the frequency of the data acquisition frame rate.

Pulse mode:

In pulse mode, every acquisition of a frame trips a short positive pulse of some 100ns on terminal IO-0. In this mode, trigger signal rate equals the data acquistion frame rate, but duty cycle depends on frame rate and will be less than 50%.



DB9 connector - trigger io pin assignment

Pin	Signal	Description
4	IO-0	Multifunction io:Default: Digital input / output 0Alternate: Trigger input / output or counter input
5	GND	GND power terminal

Specifications - trigger output

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Output Voltage			0,8	Volts
High Level Output Voltage	2,0	3,3		Volts
Sinking 1mA		0,2		Volts
Sourcing 1mA		3,1		Volts
Output Impedance		180		Ohms
Latency [2]		tbd		us

Counter

1. Based on characterization, not production tested.
2. Time interval from edge of trigger signal to conversion of the first analog input in the InputFrame.

After startup of CEBO-STICK, the multifunction IO-0 is configured as digital input signal. To use the counter functionalities, the corresponding peripheral needs to be enabled first. This is done by software calls (API). While IO-0 is used as counter input, digital IO functionalities or trigger input / output are not available.

Counter input

In counter input mode, each counter event on IO-0 causes the firmware to jump to a small interrupt routine and increment an internal 32bit register. Thus maximum input edge rate without missing counts depends on available processing resources. When IO-0 counter module is used exclusively, maximum edge rate will be in the range of **TBD** edges / s. With Multi Frame DAQ enabled at the same time, maximum input edge rate will be less. And since each counter event needs processing time, maximum Multi Frame DAQ input frame rate will be reduced, too.

CEBO-STICK can be configured for three different types of counter input signals: rising edge, falling edge or alternating.

Rising edge mode:

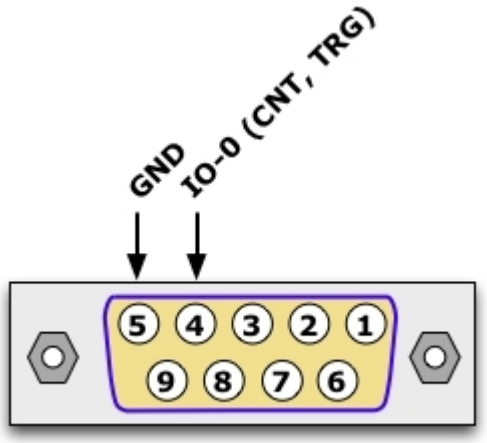
In rising edge mode, every transition form low to high level on terminal IO-0 increments the counter value.

Falling edge mode:

In falling edge mode, every transition form high to low level on terminal IO-0 increments the counter value.

Alternating mode:

In alternating mode, both edges increment the counter value.



DB9 connector - counter input pin assignment

Pin	Signal	Description
4	IO-0	Multifunction io:Default: Digital input / output 0Alternate: Trigger input / output or counter input
5	GND	GND power terminal

Specifications - counter input

Parameter	Condition	Min	Typical	Max [1]	Unit
Low Level Input Voltage		0,0		0,8	Volts
High Level Input Voltage		2,0		5,0	Volts
Maximum Input Voltage Range [2,3]		-1,0		6,5	Volts
Input Total Edge Rate	Read after counting [4]			tbd	Edges/s
	Polling			tbd	Edges/s
	Multi Frame DAQ [5]			tbd	Edges/s

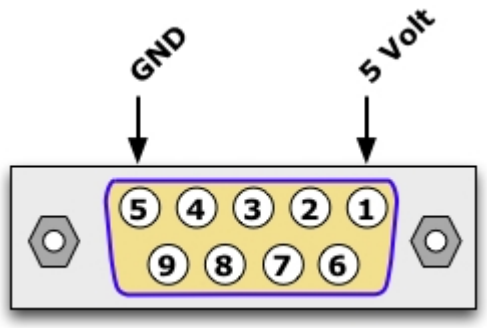
1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the input voltage range may damage CEBO-STICK.
4. Counter value is checked only after counter input is disabled.
5. Input frame includes analog input 0 and counter value.

5 Volt power supply output

CEBO-STICK includes a 5V power output on terminal 1 of the DB9 connector. This voltage output is connected to the USB power supply. Typical current drain of CEBO-STICK is about 50mA. With USB specification allowing a total current draw of 500mA, this leaves up to 450mA for your own applications.

Keep in mind, that USB specification demands current draw on 5V power supply to be limited to 100mA during enumeration process. Connect external devices with a current demand above 50mA to CEBO-STICK only after it has been plugged to the host and the driver is working properly.

Do not connect an external power source to this output. CEBO-STICK is sourced from USB and does not need an additional power supply.



DB9 connector - power pin assignment

Pin	Signal	Description
1	5V	5 Volt power output [1,2]
5	GND	GND power terminal

Specifications - 5 Volt power output

Parameter	Min	Typical	Max	Unit
Typical Output Voltage [1,2]	4,75	5,0	5,25	Volts
Voltage Drop due to cable resistance [3]		0,4		Volts

1. Based on USB specification.
2. No external load.
3. 500mA of external load.

Data acquisition

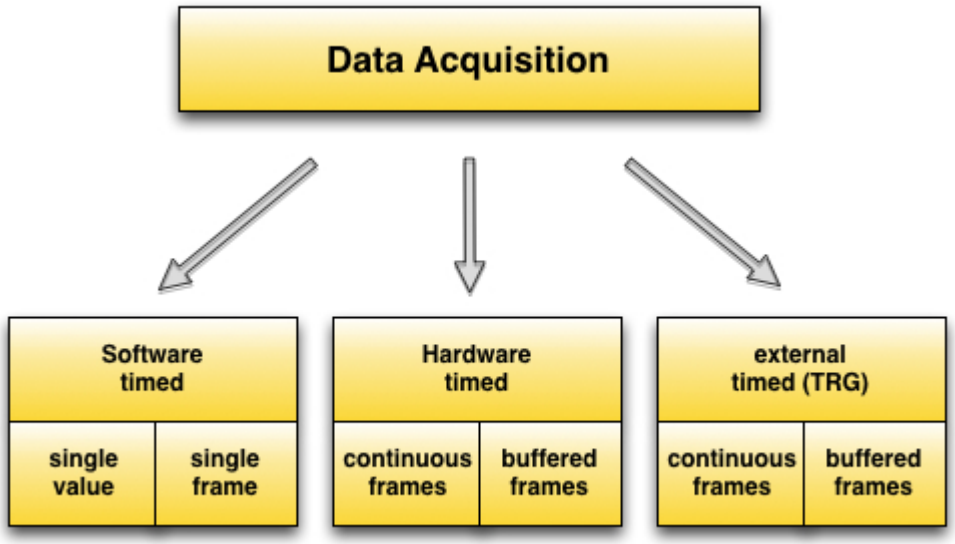
The process of measuring data is called "Data acquisition". It is abbreviated DAQ.
There are several ways to collect data with the CEBO-STICK. We call them "DAQ modes".

This section gives you guidance on how to acquire analog and digital data with CEBO-STICK.

Data acquisition modes

Some measurement problems require more effort than reading one single input.

Depending on the circumstances, a fixed number of measurements with well defined timing or an endless stream of measurements is desired. Sometimes, data acquisition should take place only when there is a trigger event (i.e. a external digital signal switches from low to high).



Software timed - single value input /output

The most basic form to sample an input or modify an output. Exact timing is not predictable, as it strongly depends on host system processing of requests targeting the usb interface.

Software timed - one single frame

Capture and return one frame, which may consist of several input or output signals. Exact frame timing is not predictable, as it strongly depends on host system processing of requests targeting the usb interface. Therefore frame to frame timing might vary. With a typical host system minimum time frames are between 1ms and 4ms, hence the maximum sample rate will be about 250 - 1000 frames per second.

Hardware timed - continuous frames

Capture and return an unlimited number of frames. The frame to frame timing is completely done by CEBO-STICK hardware and only stopped upon user request. If you need well defined sample rates at the highest data transfer levels use this mode.

The achievable maximum frame acquisition frequency is limited by the available data transfer rate between the CEBO-STICK and the host system. With a fast host system total sample rates up to 188 kSamples are possible.

Hardware timed - buffered frames

Frame data is captured to onboard memory of CEBO-STICK and stops automatically, when a given number of frames has been stored. The frame to frame timing is completely done by CEBO-STICK hardware. Use this mode, if you need a well defined sample rate at the highest data transfer levels, but your host system is not capable to sustain such high data rates. The number of acquisitions is limited by the buffer size of the CEBO-STICK.

When **external trigger** is enabled, an edge on the TRG input is required to start capturing.

External timed - continuous frames / buffered frames

These acquisition modes are like the equivalent hardware-timed modes with one difference: Timing is not done by CEBO-STICK hardware, but an adequate clock signal has to be provided on the trigger input. Edges on the input trigger the acquisition of one frame. You can configure the trigger input to trip trigger events on falling, rising or both edges.

Digital port

The three digital io signals of CEBO-STICK are grouped as one digital port. Therefore you not only can read / modify the value of one single line at a time, but also can read / modify the whole port at once. You can individually define the direction of every digital io. As default, all digital io are set to input mode, with a small pull-down resistor enabled on each line.

Frames

With CEBO-STICK various sources and sinks of data are available. Besides analog inputs there exist two general purpose digital io and a multi-function io, which can be configured as trigger input / output or 32bit counter input.

To reduce transmission overhead when accessing the peripherals, rather than assigning an individual address to each peripheral, data flow from and to CEBO-STICK is organized as blocks of data. These have known size and structures and are referred to as "frames".

Depending on the transmission direction, there are **InputFrames** and **OutputFrames**. An **InputFrame** contains the results of data acquisition, digital inputs and/or counter values, while an **OutputFrame** contains data that is sent to the digital outputs.

You can find more information about how to setup input and output frames in the Programming Reference, sections setupInputFrame or setupOutputFrame, respectively.

Data acquisition example

Data acquisition timing

Data acquisition of all channels takes place sequentially in a fixed order. Unlike with some other CEBO devices, channel to channel delay is fixed, too.

InputFrame

Setting up an InputFrame is a two step process.

First, build a list of inputs that should be measured. This can be any analog input, digital port or counter. Every input can be selected only once. The order of the elements in the list does not matter.

Second, set up the InputFrame using this list calling setupInputFrame of the class instance.

OutputFrame

Similarly to the process for an InputFrame, an OutputFrame is set up by defining a list of all outputs that should be set using a single write. With CEBO-STICK there is only one element available to be included in an OutputFrame, the digital port (do not forget to set the output enable masks for the selected digital ios).

Call setupOutputFrame using this list.

Single value io

Single value io is the most basic form to sample an input or modify an output. The call is synchronous, so invoking a method processes the request always immediately, which means:

- In case of sampling: The result of the called method is the sampled value, the method call lasts as long as sampling and data transmission from device to host is active.
- In case of modify: The method call sends the value to the peripheral directly and returns*.

*In reality, the method returns earlier than the output will show the result, there is some latency from host to the devices periphery.

Specifications - single value command/response time

	Min [1,2]	Typical [1,2]	Max [1,2]	Unit
Analog Input [3]	0,80	0,93	6,00	ms
Digital In [3]	0,70	0,86	4,00	ms
Digital Out [4]	0,32	0,38	2,00	ms

1. Timing depends on host computer and USB peripheral.
2. Based on characterization, not production tested.
3. Interval between subsequent readings.
4. Pulselength when writing high and low levels subsequently.

Single frame io

As using single value io tranfers is easy, there are also some drawbacks. For example, if you want to read more than one analog input at a time, some timing overhead will occur, reducing the maximum achievable update rate.

A better approach in this case would be to define a list of input signals to be sampled, tell the device to sample them and then get the values with only one USB reading. With the help of single frame io transfers you can achieve exactly this behaviour, reducing necessary USB transfers to a minimum.

Another benefit of doing framed readings is, that host latency no longer affects timing between sampled Analog Inputs, but only between concurrent frames, as channel to channel timing within one frame is done by hardware in CEBO-STICK.

Read single InputFrame

Use single frame reading if you want to read more than one input at once. First, specify the inputs to read. Do this by creating a list of inputs and call the method setupInputFrame of the device in use (The list type varies between the different programming languages, refer to the specific language documentation for more detail).

All subsequent calls to readFrame() will sample the specified inputs and return an instance of type InputFrame, which contains the sampled values. InputFrame has convenient methods to access these values.

Write single OutputFrame

If you want to update various outputs at once, use the method writeFrame(). Similar to the input direction, you have to define a list of outputs, first. Thereafter call the method setupOutputFrame() using this list of outputs.

To access the outputs, you need to create an instance of type OutputFrame, whose set-up fits to the respective device. This is easily done by calling the Method createOutputFrame(). Use the various methods of OutputFrame to fill the structure with the values you intent to output. Then call writeFrame() on the device instance to update all previously specified outputs.

With CEBO-STICK, only the digital port is available to be included in an OutputFrame.

Specifications - single frame command/response time

	Min [1,2]	Typical [1,2]	Max [1,2]	Unit
Analog Only [3]	0,72	0,90	4,00	ms
Digital Only [4]	0,72	0,90	4,00	ms
Analog & Digital [5]	0,72	0,90	4,00	ms

1. Timing depends on host computer and USB peripheral.
2. Based on characterization, not production tested.
3. InputFrame contains analog input 0 through analog input 3.
4. InputFrame contains digital port.
5. InputFrame contains analog input 0 through analog input 3 and digital port.

Multi frame data acquisition

While single frame accesses are a convenient way to read multiple input signals at a time, maximum achievable sample rate is limited due to timing limits of USB. With a typical host system minimum time frames are between 1ms and 4ms, hence the maximum sample rate will be about 250 - 1000 frames per second. Besides, latency of the host system cannot be guaranteed and therefore frame to frame timing might vary. If you want to do measurements with well defined sample rates or need the highest possible frame rate, use the Multi Frame DAQ methods of CEBO-STICK.

Methods

CEBO-STICK supports four methods for multi frame data acquisition:

1. startBufferedDataAcquisition()
2. startContinuousDataAcquisition()
3. startBufferedExternalTimedDataAcquisition()
4. startContinuousExternalTimedDataAcquisition()

These four modes can be classified as two groups: the hardware timed modes (1. + 2.), where timing is done by CEBO-STICK, and the external timed modes (3. + 4.), where an adequate clock signal has to be provided on trigger input. Hardware timed modes also support a triggered mode, where data acquisition is delayed until a valid trigger event has been detected.

Continuous data acquisition

Each group supports continuous as well as buffered data acquisition. In continuous modes, once you start data acquisition, data is captured continuously until you stop it. To compensate for host system timing issues, CEBO-STICK provides an onboard buffer. Make sure to read frames as fast as possible to avoid buffer overflows.

Buffered data acquisition

With buffered modes, data is captured to onboard memory of CEBO-STICK and stops automatically, when a given number of frames has been stored. Use these modes, if you need a high sample rate, but your host system is not capable to sustain such high rates. The maximum number of samples you can capture using buffered modes is limited by the amount of onboard memory and depends on frame size. Use calculateMaxBufferedInputFrames() to get the maximum number of frames that fit into onboard memory for a given frame set-up. With only one analog input enabled, you can sample up to 4k frames. See the table at the bottom of the page for further details.

Workflow

Use the the following steps to setup CEBO-STICK for multi frame data acquisition:

1. Open device.

2. Create a list of input signals.
3. Setup the InputFrame using setupInputFrame() together with this list.
4. Call one of the Multi Frame DAQ methods:
   - startBufferedDataAcquisition()
   - startContinuousDataAcquisition()
   - startBufferedExternalTimedDataAcquisition()
   - startContinuousExternalTimedDataAcquisition()
5. Read the captured frames using either readBlocking() or readNonBlocking().
6. Stop the data acquisition using stopDataAcquisition().
7. Close device.

Specifications - maximum number of frames for buffered modes

Frame set-up	Maximum number of frames
1x analog input	4096
4x analog input	1024
Digital port	4096
4x analog input + digital port + counter	585

Specifications - maximum sample rate - continuous DAQ

Frame set-up	Typical	Max [1,2]	Unit
1x analog input		100 000	Frames/s
2x analog inputs	50 000	76 000	Frames/s
3x analog inputs	33 500	59 000	Frames/s
4x analog inputs	24 000	49 000	Frames/s
Digital port		100 000	Frames/s
4x analog inputs + digital port	20 000	42 500	Frames/s

1. Timing depends on host computer and USB peripheral.
2. Based on characterization, not production tested.

Specifications - general

Parameter	Min	Typical	Max	Units
Dimensions (L x W x H)		85 x 21 x 12,4		mm
Cable Length		75		mm
Weigth		65		g
Operating temperature range		25	70	°C

Specifications - analog inputs

Parameter	Min [1]	Typical	Max [1]	Unit
Typical Input Range	0,0		3,3	Volts
Maximum Input Voltage Range [2]	-0,2		5,0	Volts
Input Bias Current		15,0	500,0	nAmperes
Input Impedance		tbd		MOhms
Total unadjusted error		+/- 1,5	tbd	LSB
Offset Error		+/- 1	tbd	LSB
Gain Error		+/- 0,5	+/- 1,5	LSB
Differential Linearity Error		+/- 0,7	+/- 1,0	LSB
Integral Linearity Error		+/- 0,8	+/- 1,5	LSB
Noise (Peak-To-Peak)		tbd		µV
Effective Resolution		tbd		bits
Noise-Free Resolution		tbd		bits
Crosstalk		tbd		dB

1. Based on characterization, not production tested.
2. Voltages beyond the maximum input voltage range may damage CEBO-STICK.

Specifications - digital inputs

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Input Voltage	0,0		0,8	Volts
High Level Input Voltage	2,0		5,0	Volts
Maximum Input Voltage Range [2,3]	-1,0		6,5	Volts

1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the maximum input voltage range may damage CEBO-STICK.

Specifications - digital outputs

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Output Voltage		0,0	0,8	Volts
High Level Output Voltage	2,0	3,3		Volts
Sinking 1mA		0,2		Volts
Sourcing 1mA		3,1		Volts
Short-Circuit Current		18		mAmperes
Output Impedance		180		Ohms

1. Based on characterization, not production tested.

Specifications - trigger input

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Input Voltage	0,0		0,8	Volts
High Level Input Voltage	2,0		5,0	Volts
Maximum Input Voltage Range [2,3]	-1,0		6,5	Volts
Input Total Edge Rate		tbd		Edges/s
Latency [4,5]		tbd		us
Latency [4,6]		tbd		us

1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the maximum input voltage range may damage CEBO-STICK.
4. Time interval from edge of trigger signal to conversion of the first analog input in the InputFrame.
5. External timed data acqusition.
6. Hardware timed data acquisition with trigger set to rising edge input mode.

Specifications - trigger output

Parameter	Min [1]	Typical	Max [1]	Unit
Low Level Output Voltage			0,8	Volts
High Level Output Voltage	2,0	3,3		Volts
Sinking 1mA		0,2		Volts
Sourcing 1mA		3,1		Volts
Output Impedance		180		Ohms
Latency [2]		tbd		us

1. Based on characterization, not production tested.
2. Time interval from edge of trigger signal to conversion of the first analog input in the InputFrame.

Specifications - counter input

Parameter	Condition	Min	Typical	Max [1]	Unit
Low Level Input Voltage		0,0		0,8	Volts
High Level Input Voltage		2,0		5,0	Volts
Maximum Input Voltage Range [2,3]		-1,0		6,5	Volts
Input Total Edge Rate	Read after counting [4]			tbd	Edges/s
	Polling			tbd	Edges/s
	Multi Frame DAQ [5]			tbd	Edges/s

1. Based on characterization, not production tested.
2. Negative voltages might disturb analog performance.
3. Voltages beyond the input voltage range may damage CEBO-STICK.
4. Counter value is checked only after counter input is disabled.
5. Input frame includes analog input 0 and counter value.

Specifications - 5 Volt power output

Parameter	Min	Typical	Max	Unit
Typical Output Voltage [1,2]	4,75	5,0	5,25	Volts
Voltage Drop due to cable resistance [3]		0,4		Volts

1. Based on USB specification.
2. No external load.
3. 500mA of external load.

Specifications - single value command/response time

	Min [1,2]	Typical [1,2]	Max [1,2]	Unit
Analog Input [3]	0,80	0,93	6,00	ms
Digital In [3]	0,70	0,86	4,00	ms
Digital Out [4]	0,32	0,38	2,00	ms

1. Timing depends on host computer and USB peripheral.
2. Based on characterization, not production tested.

3. Interval between subsequent readings.
4. Pulselength when writing high and low levels subsequently.