CEBO-STICK

The pocket-sized CEBO-STICK is ideally suited for mobile applications. Four calibrated 12bit analog inputs (input range: 0 - 3,3V), two general purpose digital inputs/outputs, one multi-function digital input/output and one 5V power supply output are all available at a well-known 9pin D-Sub connector of female type. The multi-function digital I/O either serves as general purpose I/O, 32bit counter input or trigger input/output.

Get started right away without having to write a single line of program code. Free downloads are available, including applications for Windows (multi-channel voltmeter, chart recorder, data logger, and others) and support for ProfiLab Expert (driver DLL).

The GUI application CeboLab is available via free download in the download area. It runs under Windows, Linux and OS X.

Also available are programming interfaces (API) for many common programming languages and operating systems, including C++, Java, .NET, Python. The CEBO-STICK is usable not only on Windows platforms, but also supports Linux or MAC OS X. Even the Raspberry Pi is supported with drivers and API.

Applications

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

General information				
Parameter	**Min.**	**Typ.**	**Max.**	**Unit**
Dimensions (L x Wx H)		85 x 21 x 12,4		mm
Cable Length		75		mm
Weight		65		g
Operating temperature range	0	25	70	C

Features

Analog inputs

- Four single-ended
- 12bit resolution
- Analog input range: 0 - 3,3V
- Operational amplifier inputs
- Up to 188.000 Samples/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 (12Mbit)
- USB-A connector

Supported operating systems

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

Supported programming languages/interfaces

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

Hardware description

DB9 connector

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

- Four single-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

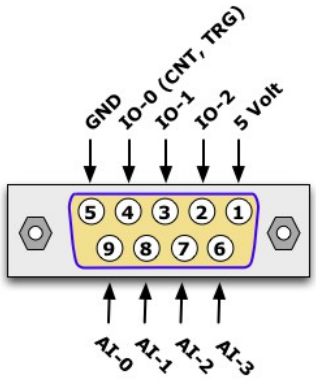

Figure 1: DB9 connector - pin assignment

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 0 Alternate: Trigger input / output or counter input
5	**GND**	GND power terminal

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.

Pin	Signal	Description
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

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

- Four single-ended analog inputs
- 12bit resolution
- Analog input measurement range: 0 - 3,3V
- Maximum allowed input voltage: 5V
- 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.

Over-voltage 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 over-voltage 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.

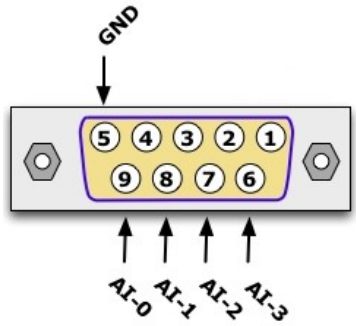

Figure 2: Analog input pin assignment

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

Analog inputs				
Parameter	**Min.[3]**	**Typ.**	**Max.[2]**	**Unit**
Typical input range	0,0		3,3	Volts
Maximum input voltage range[4]	-0,2		5,0	Volts
Input bias current		15,0	500,0	nAmperes
Input impedance		tbd		MOhms
Total unadjusted error		+/- 1,5		LSB
Offset error		+/- 1		LSB
Gain error		+/- 0,5	+/- 1,5	LSB
Differential linearity error		+/- 0,7	+/- 1,0	LSB

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

Analog inputs				
Parameter	**Min.**	**Typ.**	**Max.[2]**	**Unit**
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

Important: All specifications refer to a current of 0mA at the 5V output (DSUB connector Pin 1). Currents below 5mA will typically affect the measurement accuracy by less than 1.5 mV. Drawing 100mA from the 5 Volt output will typically affect measurement accuracy by 35mV due to voltage drop on the GND wire.

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

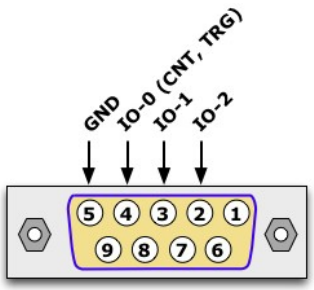

Figure 3: Digital IO pin assignment

Pin	Signal	Description
4	IO-0	Multifunction IO: Default: Digital input / output 0 Alternate: 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

Digital inputs **Parameter**	**Min.[2]**	**Typ.**	**Max.[2]**	**Unit**
Low level input voltage	0,0		0,8	Volts
High level input voltage	2,0		5,0	Volts
Maximum input voltage range[3,5]	-1,0		6,5	Volts

Digital outputs **Parameter**	**Min.[2]**	**Typ.**	**Max.[2]**	**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

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.

5 Negative voltages might disturb analog performance.

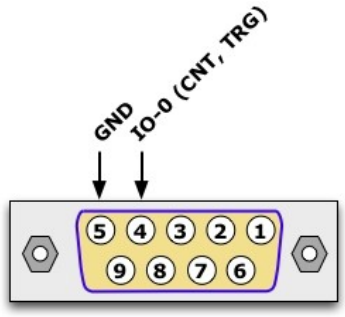

Figure 4: Trigger IO pin assignment

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

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 from low to high level on IO-0 is a trigger event.

Falling edge mode

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

Alternating mode

In alternating mode, both edges on terminal IO-0 are considered as trigger events.

Trigger input Parameter	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage	0,0		0,8	Volts
High level input voltage	2,0		5,0	Volts
Maximum input voltage range[3,4]	-1,0		6,5	Volts
Input total edge rate		tbd		Edges/s
Latency[6,7]		tbd		us
Latency[5,8]		tbd		us

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 acquisition frame rate, but duty cycle depends on frame rate and will be less than 50%.

Trigger output Parameter	Min.[2]	Typ.	Max.[2]	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
Output impedance		180		Ohms
Latency[9]		tbd		us

6 Time interval from edge of trigger signal to conversion start of the first analog input in the InputFrame.
7 External timed data acquisition.
8 Hardware timed data acquisition with trigger set to rising edge input mode.
9 Time interval from edge of trigger signal to conversion start of the first analog input in the InputFrame.

Counter

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.

Mode	Comment
Rising edge mode	In rising edge mode, every transition from low to high level on terminal IO-0 increments the counter value.
Falling edge mode	In falling edge mode, every transition from high to low level on terminal IO-0 increments the counter value.
Alternating mode	In alternating mode, both edges increment the counter value.

Parameter	Condition	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage		0,0		0,8	Volts
High level input voltage		2,0		5,0	Volts
Maximum input voltage range[3,,4]		-1,0		6,5	Volts
Input total edge rate	Read after counting[10]			tbd	Edges/s
	Polling			tbd	Edges/s
	Multi frame DAQ[11]			tbd	Edges/s

10 Counter value is checked only after counter is disabled.
11 Input frame includes analog input 0 and counter value.

5 Volt power supply output

CEBO-STICK features a 5V power output on terminal one of the DB9 connector. This voltage output is sourced by USB power. The absolute maximum current is 100mA.
Important: Keep current below 5mA for accurate measurements on analog inputs.

The 5 Volt power output can be used to source external switches connected to the digital inputs or to provide constant current for PT1000 sensors. It should not be used to draw extensive power when accurate measurements are required.

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

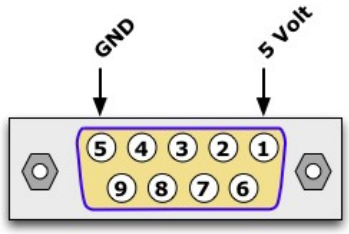

Figure 5: Power pin assignment

Pin	Signal	Description
1	**5V**	5 Volt power supply output[12]
5	**GND**	GND power terminal

Parameter	Min.	Typ.	Max.	Unit
Typical output voltage[11,13]	4,75	5,0	5,25	Volts
Voltage drop due to cable impedance[14]		0,150		Volts

12 Based on USB specification.
13 No external load.
14 100 mA 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.

DAQ 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).

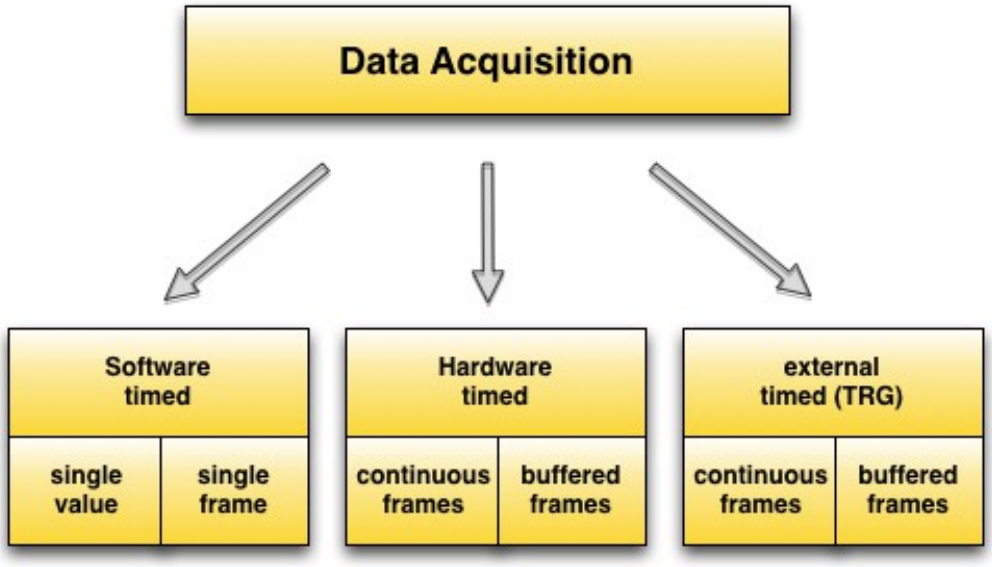

Figure 6: Data acquisition modes

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 system minimum time frames are between one and four milliseconds, hence the maximum sample rate will be about 250 up to 1.000 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 CEBO-STICK and the host system. With a fast host system total sample rates up to 188.000 Samples per second 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/buffered frames
These acquisition modes are like the hardware-timed modes but 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 IO-0, configured as trigger input, start 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 signal 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.

InputFrame

Setting up an InputFrame is a two-step process: First, build a list of inputs that should be sampled. This can be any analog input, digital port or counter. Any input can be selected only once. CEBO-STICK uses a fixed sequence for the processing of selected inputs, therefore the order of elements within the list does not matter.
Second, set up the InputFrame using the aforementioned list calling setupInputFrame of the class instance.

OutputFrame

Similarly to the process for InputFrames, the first step for defining an OutputFrame is to set up a list of all outputs that should be modified 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 to set up the OutputFrame.

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.[15]

Single value command and response times	Min.[2,16]	Typ.[2,15]	Max.[2,15]	Unit
Analog input[17]	0,80	0,93	6,00	ms
Digital input[16]	0,70	0,86	4,00	ms
Digital output[18]	0,32	0,38	2,00	ms

Single frame IO

As using single value IO transfer is easy, there are also some drawbacks. For example, if you want to read more than one analog input at a time, some 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 behavior, 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.

15 Actually, the method returns earlier than the output will show the result, as some latency from host system to the device's peripheral exist.
16 Timing depends on host computer and USB peripheral.
17 Interval between subsequent readings.
18 Pulse-length when writing high and low levels subsequently.

Read single InputFrame

Use single frame reading if you want to read more than one input at once. Specify a list of all inputs to read and call the method setupInputFrame of the device in use. Note, that list type varies between different programming languages. Please 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 input direction, start with defining a list of outputs. After this call the method setupOutputFrame() using this list.
To access the outputs, 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.

Single frame command and response times	Min.[2,15]	Typ.[2,15]	Max.[2,15]	Unit
Analog inputs only[16,19]	0,72	0,90	4,00	ms
Digital inputs only[16,20]	0,72	0,90	4,00	ms
Analog and digital inputs[21]	0,72	0,90	4,00	ms

19 InputFrame contains analog input 0 through analog input 3.
20 InputFrame contains digital port.
21 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 all at once, 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 up to 1.000 frames per second. Besides, latency of most host systems 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 digital input IO-0, which has to be configured as trigger input, then. 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 data 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 setup. With only one analog input enabled, you can sample up to 4.095 frames. See the table at the end of this section for further details.

Frame setup	Maximum number of frames for buffered modes
1x analog input	4.095
4x analog input	1.023
Digital port	4.095
4x analog input + digital port + counter	585

Maximum sample rate - continuous DAQ			
Frame setup	**Typ.**	**Max.[2,15]**	**Unit**
1 analog input		100.000	Frames/s
2 analog inputs	50.000	76.000	Frames/s
3 analog inputs	33.500	59.000	Frames/s
4 analog inputs	24.000	49.000	Frames/s
Digital port		100.000	Frames/s
4 analog inputs + digital port	20.000	42.500	Frames/s

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.

Calibration data

CEBO-STICK devices are tested and calibrated before delivery. All corrections to measurement data based upon the calibration data are done automatically within API.

Firmware and software update

For latest information on firmware and software releases, please visit the download section at www.cesys.com. There you will find release notes, drivers and newest software and firmware available for CEBO compatible devices. Additionally CeboMsr-API developer packages for Microsoft Windows, Mac OS X, Linux and others are available, supporting various programming languages, including C++, Java, .NET and Python, for example.

Specifications

General

Parameter	Min.	Typ.	Max.	Unit
Dimensions (L x Wx H)		85 x 21 x 12,4		mm
Cable Length		75		mm
Weigth		65		g
Operating temperature range	0	25	70	C

Analog inputs

Parameter	Min.[2]	Typ.	Max.[2]	Unit
Typical input range	0,0		3,3	Volts
Maximum input voltage range[3]	-0,2		5,0	Volts
Input bias current		15,0	500,0	nAmperes
Input impedance		tbd		MOhms
Total unadjusted error		+/- 1,5		LSB
Offset error		+/- 1		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

Important: All specifications refer to a current of 0mA at the 5V output (DB9, Pin 1). Currents below 5mA will typically affect the measurement accuracy by less than 1,5 mV. Drawing 100mA from the 5 Volt output will typically affect measurement accuracy by 35mV due to voltage drop on the GND wire.

Digital inputs/outputs

Input Parameter	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage	0,0		0,8	Volts
High level input voltage	2,0		5,0	Volts
Maximum input voltage range[3,,4]	-1,0		6,5	Volts

Output Parameter	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage	0,0		0,8	Volts
High level input voltage	2,0		5,0	Volts
Maximum input voltage range[3,,4]	-1,0		6,5	Volts
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 input/output

Input Parameter	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage	0,0		0,8	Volts
High level input voltage	2,0		5,0	Volts
Maximum input voltage range[3,,4]	-1,0		6,5	Volts
Input total edge rate		tbd		Edges/s
Latency[5,6]		tbd		us
Latency[5,7]		tbd		us

Output Parameter	Min.[2]	Typ.	Max.[2]	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
Output impedance		180		Ohms
Latency[8]		tbd		us

Counter input

Parameter	Condition	Min.[2]	Typ.	Max.[2]	Unit
Low level input voltage		0,0		0,8	Volts
High level input voltage		2,0		5,0	Volts
Maximum input voltage range[3,,4]		-1,0		6,5	Volts
Input total edge rate	Read after counting[9]			tbd	Edges/s
	Polling			tbd	Edges/s
	Multi frame DAQ[10]			tbd	Edges/s

5 Volt power output

Parameter	Min.	Typ.	Max.	Unit
Typical output voltage[11,12]	4,75	5,0	5,25	Volts
Voltage drop due to cable impedance[13]		0,150		Volts

Command and response times

Single value	Min.[2,15]	Typ.[2,15]	Max.[2,15]	Unit
Analog input[16]	0,80	0,93	6,00	ms
Digital input[16]	0,70	0,86	4,00	ms
Digital output[17]	0,32	0,38	2,00	ms

Single frame	Min.[2,15]	Typ.[2,15]	Max.[2,15]	Unit
Analog inputs only[16,18]	0,72	0,90	4,00	ms
Digital inputs only[16,19]	0,72	0,90	4,00	ms
Analog and digital inputs[20]	0,72	0,90	4,00	ms

Maximum number of frames for buffered mode

Frame setup	Maximum number of frames
1x analog input	4.095
4x analog input	1.023
Digital port	4.095
5x analog input + digital port + counter	585

Maximum sample rate - continuous DAQ

Frame setup	Typ.	Max.[2,15]	Unit
1 analog input		100.000	Frames/s
2 analog inputs	50.000	76.000	Frames/s
3 analog inputs	33.500	59.000	Frames/s
4 analog inputs	24.000	49.000	Frames/s
Digital port		100.000	Frames/s
4 analog inputs + digital port	20.000	42.500	Frames/s

Ordering information

Order Number	Device	Comment
C028210	CEBO-STICK	4-channel 12-bit ADC Stick with USB interface.

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CESYS Gesellschaft für angewandte Mikroelektronik mbH
Zeppelinstrasse 6a
D - 91074 Herzogenaurach
Germany

Revision history

V1.0		Initial online release.
V1.1		Provided as offline document. Minor updates and corrections.
V1.2	April, 07 2014	Header added, Footer Modified, Layout modified. (jk)
V1.3	June, 17 2015	Corrected typo on page 14 (mra)

Table of contents