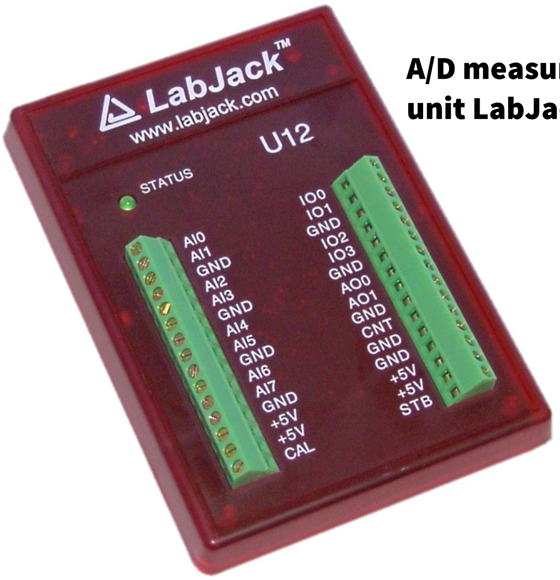
AUTOSPY

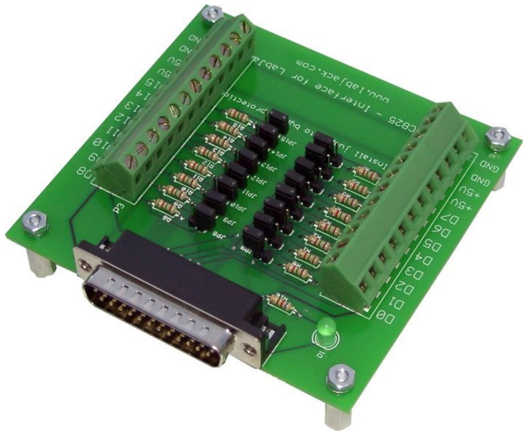
Quick Guide to A/D Measuring Device LabJack U12

With the A/D measuring device LabJack U12 you can record up to 8 analog and 20 digital electric signals in AutoSPY, for instance from switches, light barriers, temperature or pressure sensors. That allows trouble shooting and optimization to cover electrical signals that are not available in a PLC directly or that shall be double-checked by independent measurements.

The LabJack can easily be attached to the USB port of the analysis PC and does not require any additional power supply. Windows comes with the required drivers preinstalled, such that AutoSPY can instantly access the LabJack. Multiple LabJacks can be operated at different USB ports and recorded at the same time in AutoSPY, if you need to measure more signals than a single unit can handle.



A/D measurement unit LabJack U12



Digital extension module CB25

Specification of Measurement Inputs

Analog inputs AI0 through AI7

The LabJack has eight screw terminals AI0 through AI7 for analog input signals. These can measure voltages up to ± 10 V with respect to ground (GND) with a resolution of 12 bit / 4.88 mV. To do so, at first the ground and *afterwards* the signal line need to be connected to the corresponding terminals.

Beside this so called single-ended measurement, the LabJack is capable of measuring the input pairs AI0/1, AI2/3, AI4/5 and AI6/7 in differential mode. As stated in the following table, each of these four differential channels can provide a gain of up to 20 to achieve a higher effective measurement resolution for smaller voltage ranges.

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Gain G	Maximum voltage between AI and GND	Maximum differential voltage	Measurement resolution
1	± 10 V	± 20 V	4,88 mV
2	± 5 V	± 10 V	2,44 mV
4	± 2,5 V	± 5 V	1,22 mV
5	± 2 V	± 4 V	0,98 mV
8	± 1,25 V	± 2,5 V	0,61 mV
10	± 1 V	± 2 V	0,49 mV
16	± 0,625 V	± 1,25 V	0,31 mV
20	± 0,5 V	± 1 V	0,24 mV

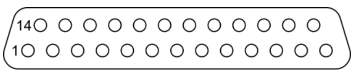
As in single-ended mode, the ground terminal (GND) should be connected with the ground of the circuit to be tested. The voltage of each AI with respect to ground must not exceed the values stated in the table, in order to achieve correct measurement results. The maximum differential voltage (with a gain of G = 1 this is 20 V for instance) occurs, when one input carries the maximum (+10 V with G = 1) and the other input carries the minimum voltage (-10 V with G = 1).

Note: Both measurement modes can be combined. Regardless of the configured measurement mode or gain, voltages beyond ± 40 V must not be attached to any of the LabJack's analog inputs, in order to avoid physical damage to the device. However, this is solely a rule to prevent damage. Voltages that exceed the limits stated in the table will be capped to the minimal or maximal limit, respectively.

Digital inputs IO0 through IO3 and D0 through D15

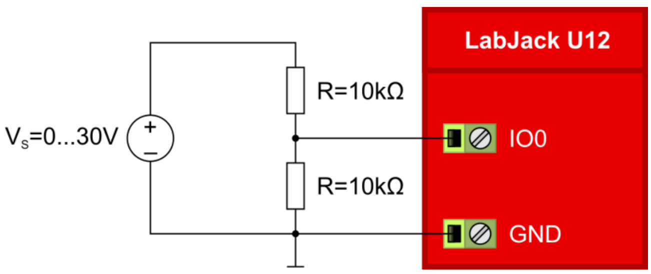
The LabJack provides 20 digital inputs in total (LOW < 0.8 V; HIGH > 4 V). Four of these, referred to as IO0 through IO3, can be connected at the right terminal block. The remaining ones, referred to as D0 through D15, can be accessed via the DB25 connector at the narrow side of the LabJack or the CB25 extension module that can be attached there.

Pinout of the DB25 extension D-sub connector:



1	D0	**6**	D5	**11**	+5V	**16**	GND	**21**	D11
2	D1	**7**	D6	**12**	+5V	**17**	GND	**22**	D12
3	D2	**8**	D7	**13**	+5V	**18**	D8	**23**	D13
4	D3	**9**	(NC)	**14**	GND	**19**	D9	**24**	D14
5	D4	**10**	+5V	**15**	GND	**20**	D10	**25**	D15

Important: The four inputs IO0 through IO3 can be fed with voltages up to 15 V. Signals exceeding this range (e. g. typical PLC signals) *necessarily* require an adequate protective circuit, like the following voltage divider:



The 16 inputs D0 through D15, as they are accessible through the extension connector, are designed for TTL signals only, and do not provide any overvoltage or short-circuit protection. The CB25 extension module, however, provides additional protection, such that voltages between -20 V and +25 V can be connected. In this case you *must not* install the jumpers that bypass the protection resistors on the CB25 board!

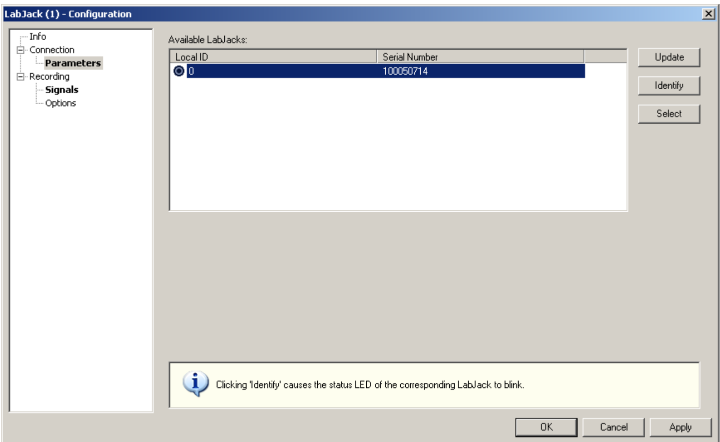
Note: The three inputs D13 through D15 are Schmitt trigger inputs. They transit from LOW to HIGH on an input voltage of about 2.7 V and transit back from HIGH to LOW on an input voltage of 1.5 V. If one of these input lines carries a voltage above 9.5 V, all three inputs transit to HIGH, caused by the LabJack's internal wiring.

Counter Input CNT

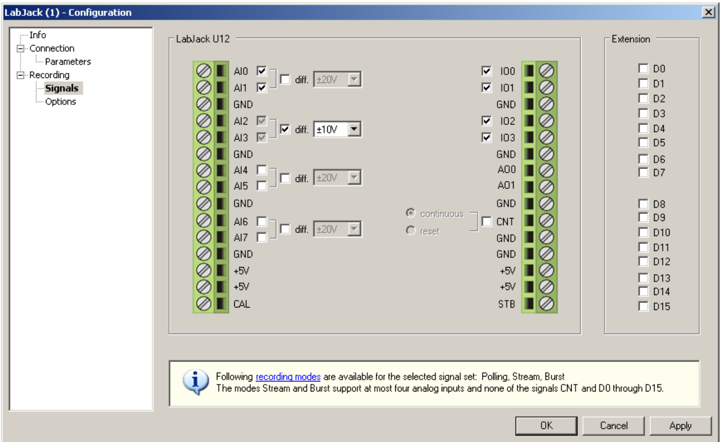
The LabJack provides a 32-bit counter that can be connected at screw terminal CNT. The counter is incremented when it detects a falling edge (from >4 V to <1 V) followed by a rising edge. Thus, resetting the counter while the attached signal is LOW will cause the first rising edge not to be counted. The connected voltage must not exceed +15 V in order to avoid damage to the LabJack. If necessary, use the voltage divider circuit suggested above to protect the input. The counter can be configured to operate in continuous mode to count piece numbers and the like, or it can be configured to reset after each measurement to count revolutions, for instance.

Recording Data with AutoSPY

In order to record data from a LabJack in AutoSPY, a data source of that type must be inserted into the document. Afterwards, the LabJack to be used for recording must be selected in the configuration dialog of the newly created data source. The button "Identify" causes the status LED of the selected LabJack to blink, which is useful when multiple LabJacks are attached to the same PC.

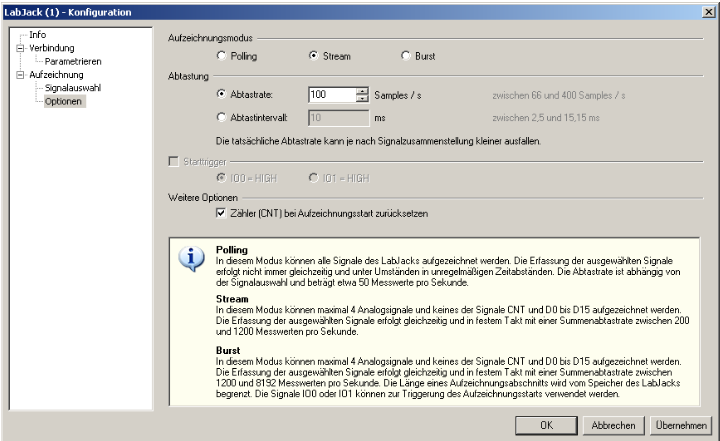


The tab "Signals" provides a graphical representation of the LabJack's screw terminals, where the inputs to be recorded can intuitively be checked. Furthermore, the option "diff." enables differential measurement for analog inputs, which additionally allows for specifying a voltage range (which translates into the appropriate gain, internally) for higher measurement resolution.



This is all mandatory configuration work that is required for simple use cases. You can now connect to your LabJack and start recording.

The tab “Options” allows further configuration to achieve higher sampling rates or enable special features like triggering. The most important setting is the choice between one of the three recording modes described below.



Recording Modes of the LabJack

By default, the recording mode **Polling** is preset. This mode allows for recording all of the LabJack’s signals, but they are not necessarily sampled simultaneously or in constant intervals. The sampling rate depends on the particular mix of selected signals. Some benchmarks are given in the following table:

Signals to record	Sampling rate [samples / s]	Sampling interval [ms]
4 x AI, 4 x IO	62	16
4 x IO, CNT, 16 x D	62	16
4 x AI, 4 x IO, CNT, 16 x D	31	32
8 x AI, 4 x IO, CNT, 16 x D (all)	19	52

The mode **Stream** suits well for continuous recordings with maximum sampling rates. It supports recording of up to four analog inputs together with the four digital inputs IO0 through IO3, but **none** of the signals CNT and D0 through D15. Measurements of the analog inputs are taken with a constant overall sampling rate between 200 and 1200 samples / s (which corresponds to sampling intervals between 0.8 and 5.0 ms). **Overall sampling rate** means the count of analog measurements carried out per second. Recording two analog inputs, for instance, is possible with up to 600 samples / s in stream mode. The count of selected digital signals IO0 through IO3 has no impact on the sampling rate.

The mode **Burst** is subject to the same limitations as the Stream mode in terms of supported signals, which means it supports up to four analog signals and the digital inputs IO0 through I03, but *none* of the signals CNT or D0 through D15. However, the Burst mode can reach much higher overall sampling rates between 1200 and 8192 samples / s (which corresponds to sampling intervals between 0.1 and 0.8 ms), but limits the length of continuous recording to 4096 analog samples. Afterwards, the trace file will contain a small gap before recording is restarted automatically. Despite that limitation, precise recording can be controlled by defining one of the digital inputs IO0 or IO1 as a trigger, which causes the recording not to start until the trigger signal carries HIGH.