Content

Safety instructions

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Warranty Information

A copy of the specific warranty terms applicable to your DEWETRON product and replacement parts can be obtained from your local sales and service office.

Support

For any support please contact your local distributor first or DEWETRON directly.

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Web: http://www.dewetron.com

The telephone hotline is available
Monday to Friday between
08:00 and 17:00 CET (GMT +1:00)

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Printing History

Please refer to the page bottom for printing version.

Safety instructions

Safety symbols in the manual

Indicates hazardous voltages.

WARNING	*Calls attention to a procedure, practice, or condition that could cause bodily injury or death.*

CAUTION	*Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.*

WARNINGS

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. DEWETRON Elektronische Messgeraete Ges.m.b.H. assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as option and will not be shipped as standard parts.

Safety instructions for all DEWETRON DAQ boards

- The DEWETRON data acquisition boards may only be installed by experts.
- Read your manual before operating the board.
- Observe local laws when using the board.
- DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to a DEWETRON sales and service office for service and repair to ensure that safety features are maintained.
- Keep away from live circuits: Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.
- DO NOT try to service or adjust the board.
- DO NOT substitute parts or modify equipment.
- Before opening the instrument or computer (experts only) disconnect power!
- Don’t touch internal wiring (electrostatic damage is possible).
- Don’t use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- Safety of the operator and the unit depend on following these rules.
- Using the board for medical applications only at owner’s risk

General System Information

Environmental Considerations

Information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling a DEWETRON system:

System and Components Recycling

Production of this components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at it's end of life! Please recycle this product in an appropriate way to avoid an unnecessary pollution of the environment and to keep natural resources.

This symbol indicates that this system complies with the European Union’s requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further informations about recycling on the DEWETRON web site www.dewetron.com

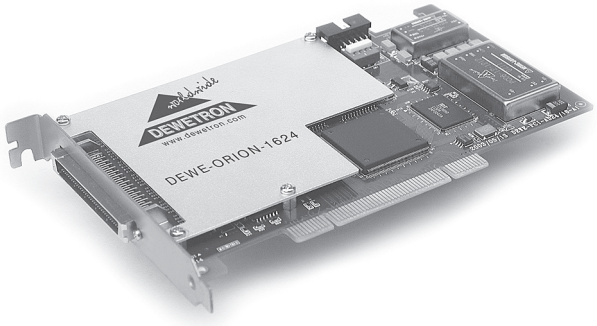
Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product is known to contain lead.

1 Introduction

1.1 Key features

- 16 simultaneous sampled channels
- Unbalanced differential inputs
- 24-bit resolution
- 3.2 MS/s data throughput
- Anti-aliasing filter
- High dynamic range 108 dB
- Channel separation 120 dB



1.2 Overview

The DEWE-ORION-1624 combines high resolution (24-bit) with high speed (3.2 MS/s total, 200 kS/s per channel) and high accuracy (0.002 dB inter channel gain mismatch). All this has been arranged on a PCI half-size board. In addition each channel also has it's own anti-aliasing filter which is automatically set to the half of the sample frequency. This can be reached with an internal oversampling of the ADC of up to 256 times. That means if the sample frequency is set to 50 kHz, the ADC converts data with 12.8 MHz! This allows the use of a digital anti-aliasing filter.

Due to the multiple board synchronisation features it is possible to install up to 8 DEWE-ORION-1624 boards in one system working absolutely synchronous. Using more than 8 boards (in an external system or connected with a PCI to PCI-Bridge to the main system) requires the usage of a SYNCH-BUS-REPEATER.

This high channel count, combined with high sample rate, requires a high speed and high capacity data storing system behind the boards. For example: 128 channels, each with 200 kHz sample rate and 24-bit resolution results in nearly 100 Mbyte of data per second (24-bit data will be transferred as a 32-bit value). To reduce this by a factor of two, a unique 16-bit data transfer mode (packed mode) is implemented. It is no simple reduction to 16-bit resolution. The technique picks the 16 bits of interest out of the whole 24-bit analog range for the data transfer.

1.3 Requirements for using the DEWE-ORION-1624

To install and use the DEWE-ORION-1624 device you need:

- PC with one free PCI slot
- WINDOWS 2000 or XP operating system
- DEWE-ORION-1624 board
- DEWE-ORION-1624 Technical Reference Manual
  (shipped with the board or available on www.dewetron.com or ftp.dewetron.com)
- Device driver (shipped with the board)

Recommended options (not shipped with the board):

- Signal connection (e.g. BNC connector box ORION-CB16-BNC)
- DEWESoft 6 (or higher) or other application software

1.4 Unpacking

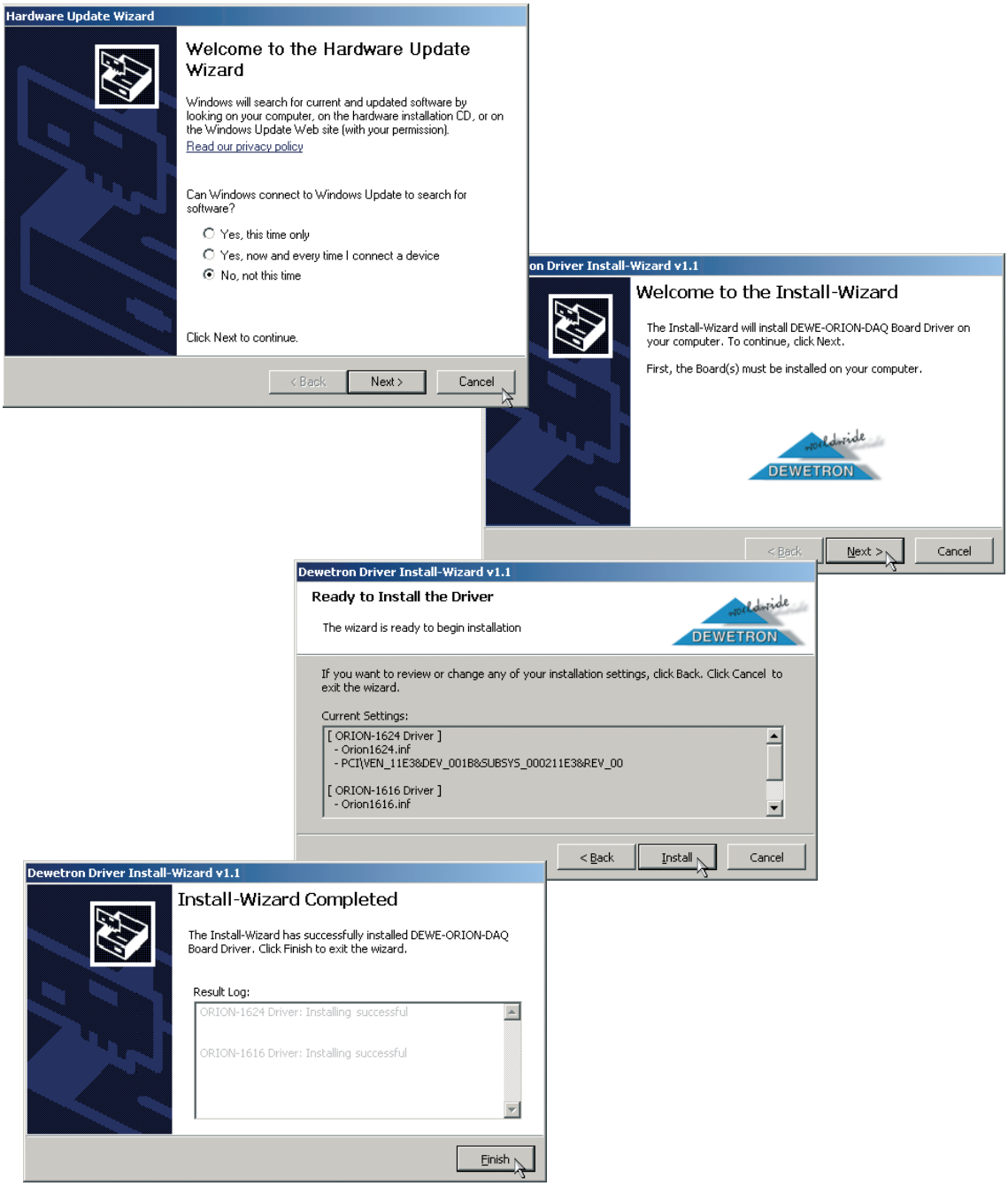
Transport and store the DEWE-ORION-1624 in the antistatic plastic package (ESD packaging), where it was originally packed in. Otherwise the device may be damaged by electrostatic discharge. The unpacking and the mounting in your computer should be done in an electrostatic protected area. Don’t touch the exposed pins of the connectors! Inspect the device for loose components or other sign of damage before mounting it. Don’t install a damaged device into your computer.

2 Using DEWE-ORION-1624

2.1 Hardware installation

Shut down your computer and remove power. Install the board into your computer in correspondence with the instructions in your PC manual. When you have finished the hardware installation and boot up your computer, the operating system will alert that it found a new hardware. Chancel the windows hardware-driver wizard.

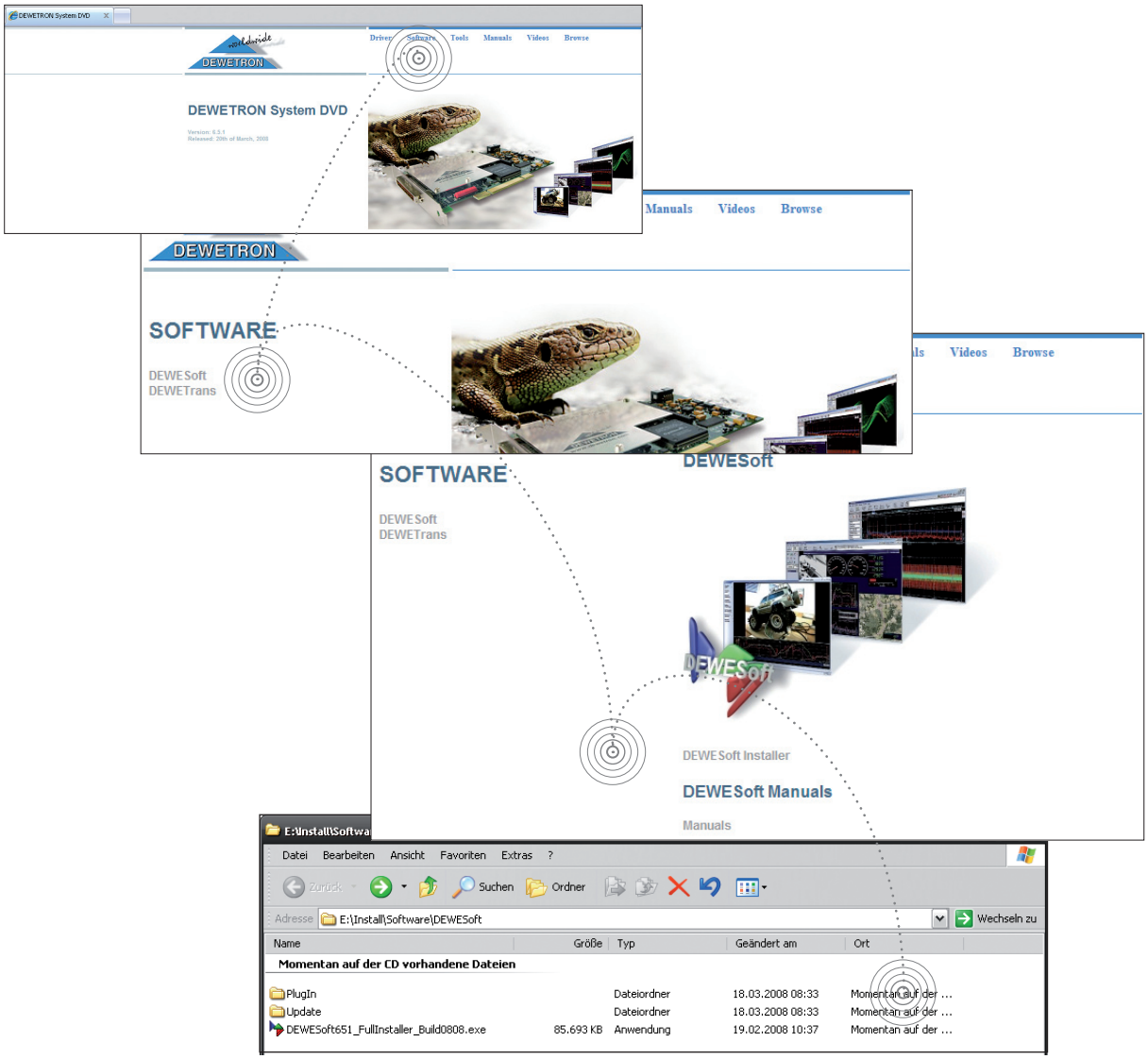
Insert the DEWE-System DVD shipped together with the board into your DVD drive (for example D:\) and start the following executable file: D:\Install\Drivers\6_DaqBoards\Dewetron\Orion-16xx\OrionSetup.exe. After the installation you have to reboot the system.



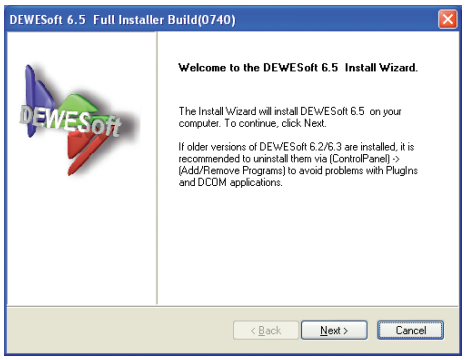
2.2 Software installation

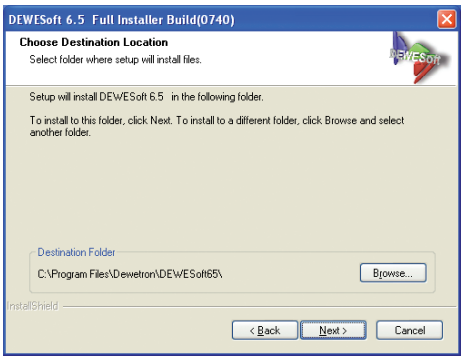
2.2.1 DEWESoft installation

If the installation software doesn't start when you insert the DEWE-System DVD into the computer, start it manually by clicking on the ***Aviplayer.exe*** file on the DVD. Follow the instructions of the installer.

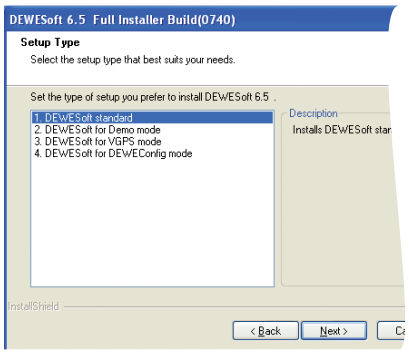


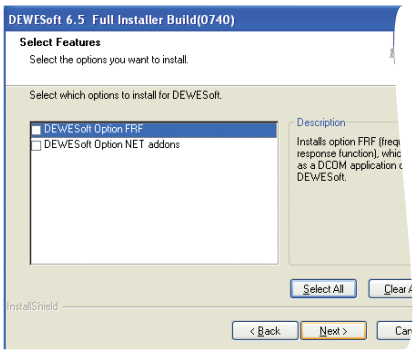
The install shield wizard will simplify the installing procedure.

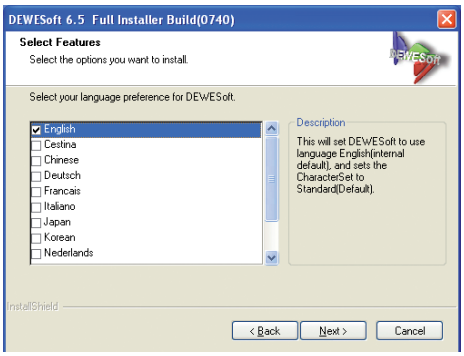




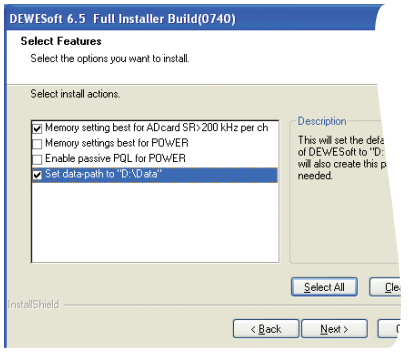
You only have to select the needed options you want to install.

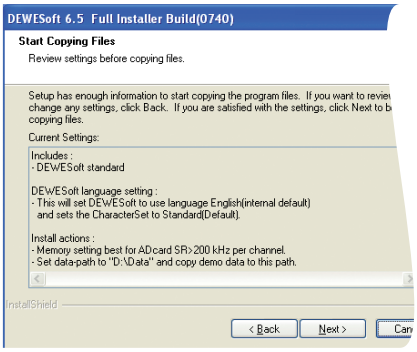


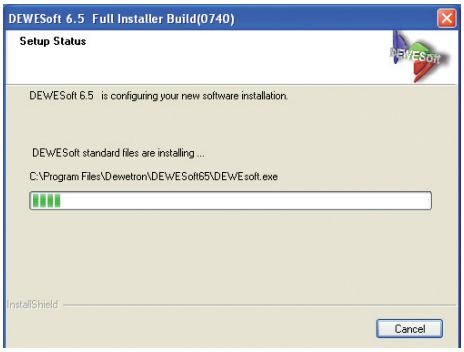




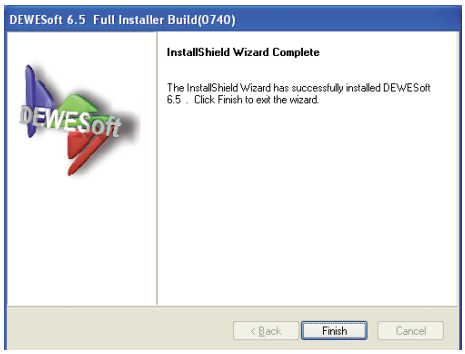
Select the feature you want to install.

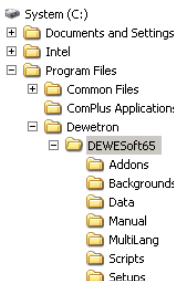


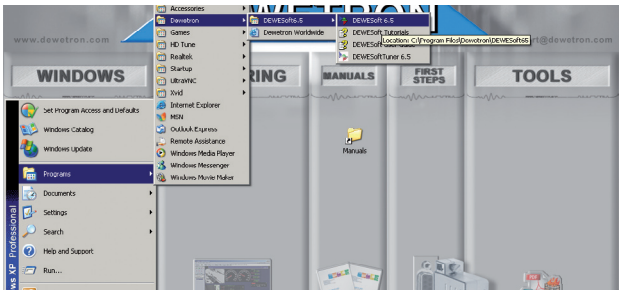




Now DEWESoft is installed on your computer. The software creates some directories on your harddisk.

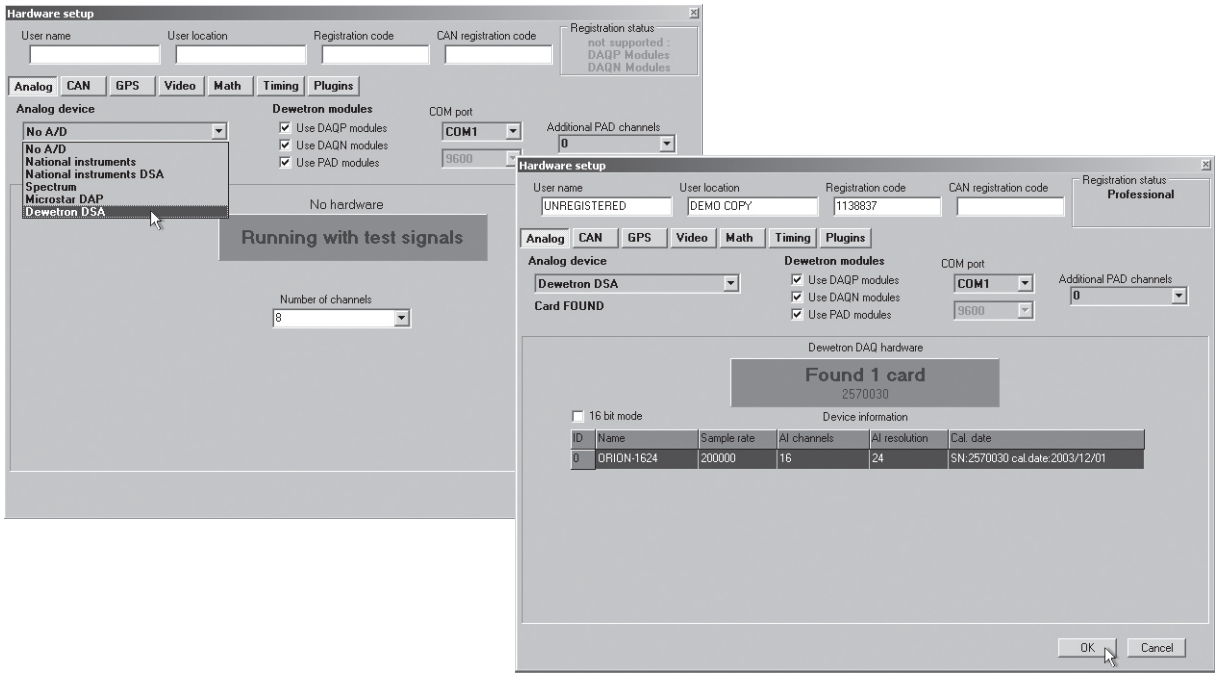






You can start the software in the Windows start menu or use the icon created on your desktop. For more information about the DEWESoft installation please refer to the *DEWESoft Software Users Manual*.

To modify the hardware settings, select ***System*** - ***Hardware setup*** in the menu. Select the ***DEWETRON DSA*** card at the analog device selection field and enter your username, user location and registration code. You can find them in your DEWESoft licence agreement. Be aware that the licence is always related to the hardware.



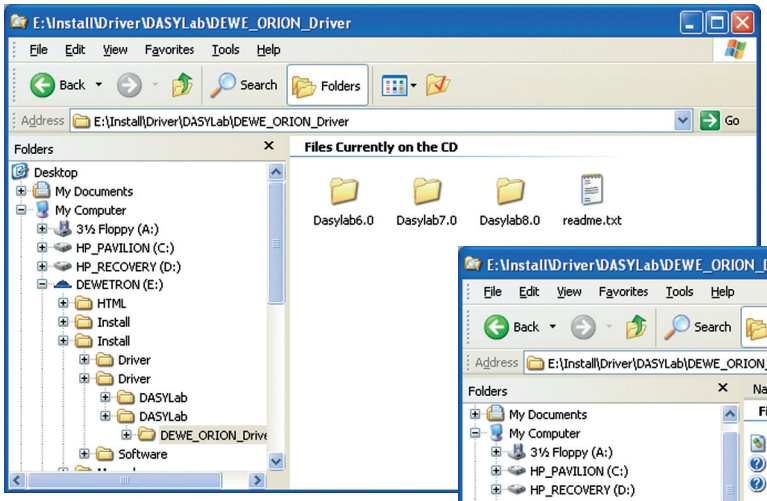
2.2.2 Installing and Configuring the DEWE-ORION-1624 card within DASYLab 6-7-8-9

First, using the DEWE-System DVD, please locate the DASYLab drivers for the same version of DASYLab that you are using. As of the date of this document, there are drivers available for DASYLab versions 6, 7, 8 and 9. This document assumes that you have already installed the DEWE-ORION-1624 card and installed the proper Windows driver for the card.

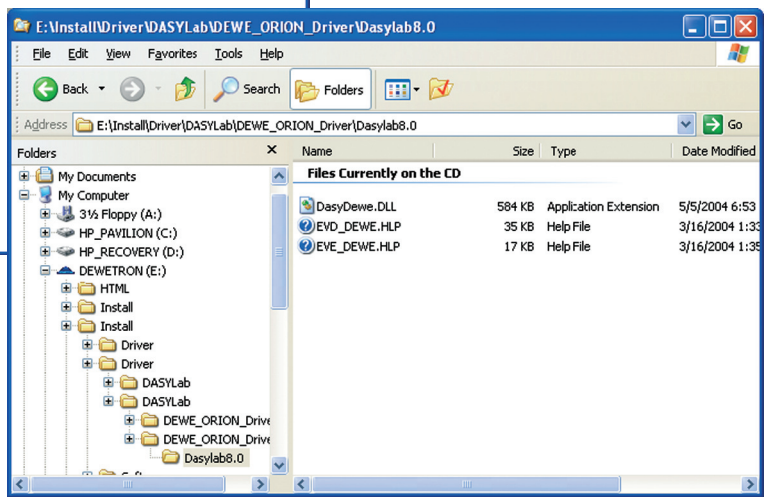
The location of the drivers On the DEWE-System DVD is:

D:\Install\Drivers\X_DASYLab\DEWE_ORION_Driver (Where D is the letter of your CD-ROM drive)

Within that directory are three versions:



Please open the directory that matches your base DASYLab version number.



Assuming your version is 8.x (the process is the same regardless of the version!), it will look like this:

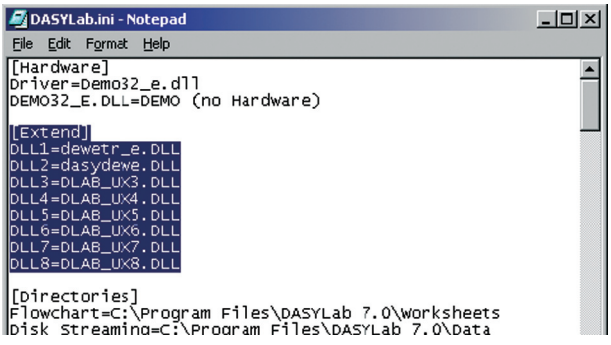
Copy the files DasyDewe.DLL and EVE_DEWE-HLP to the clipboard, then paste them into the root directory of your DASYLab program (the EVD_DEWE.HLP is a German language help file, and is only required for German installations). Assuming version 8, it will be located at c:\Program Files\DASYLab 8.0

If you have just installed DASYLab, please run it once, then close it before proceeding! If you skip this step, the rest may not work.

Now, with DASYLab NOT running, locate the dasylab.ini file located in the root DASYLab directory (the same place you just copied the driver files into), and open it using NOTEPAD.

DO NOT USE A WORD PROCESSOR! ONLY USE A TEXT EDITOR LIKE NOTEPAD.

This caution applies when editing ANY ini file. You must make an edit to the DASYLab.ini file, as shown below:



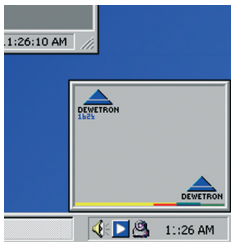
You need to change one of the [EXTEND] section defaults from DLAB_UX#.DLL to dasydewe.dll

NOTE – THE OTHER KEY YOU SEE ABOVE IS CALLED DEWETR_E.DLL. THIS IS A SEPARATE DRIVER FOR PROVIDING A DEWETRON-MODULES MENU WITHIN DASYLAB, FOR CONTROLLING DEWETRON DAQ AND PAD SERIES MODULES. THIS IS SEPARATE FROM THIS INSTALLATION! IF YOU DO NOT HAVE A FILE CALLED DEWETR_E.DLL LOCATED IN YOUR ROOT DASYLAB DIRECTORY, PLEASE DO NOT MAKE THAT EDIT TO THE INI FILE.

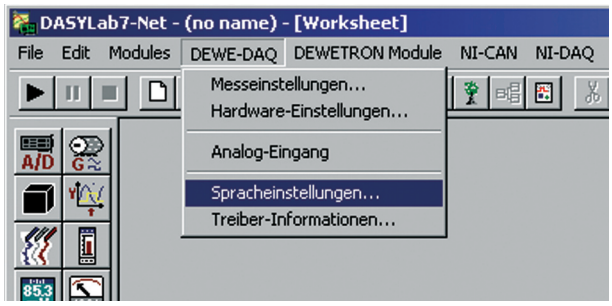
YOU ONLY NEED THE dasydewe.dll EDIT IN ORDER TO INSTALL THE DEWE-ORION-1624 CARD DRIVER.

Save your changes to the ini file and then close it. Now, launch DASYLab.

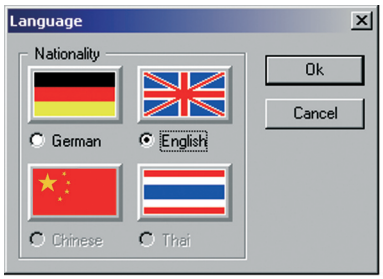
As it loads, you should see a small ORION related icon appear at the bottom right corner of your screen, then as DASYLab finishes loading, this little box will disappear:



You will have a new DASYLab menu now – please take a look:

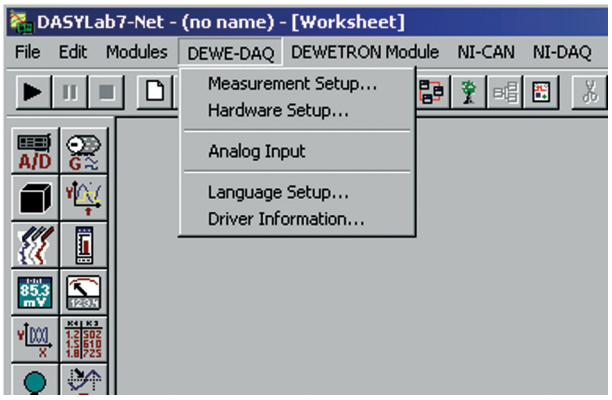


Well, unless you prefer German, you can change it to English by selecting the menu item that begins with the word “Sprach” (that means tongue, or language, in German). Then choose the English flag from the dialog, which will appear:



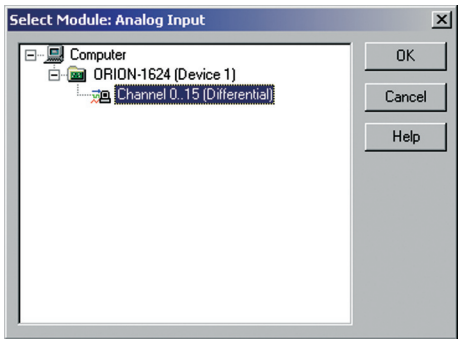
Click ***OK***. Now you must exit and then restart DASYLab in order for the menu to appear in English.

Now look at the menu. This menu provides the controls that you need in order to add an ORION card icon to your worksheet, and to configure its sample rate, etc.

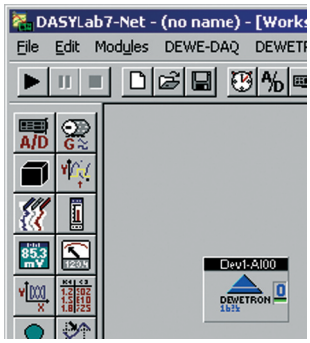


HINT: NONE OF THE OTHER SAMPLE RATE ICONS OR SELECTIONS ELSEWHERE IN DASYLAB WILL HAVE ANY EFFECT ON THE ORION CARD – YOU MUST USE THIS MENU!

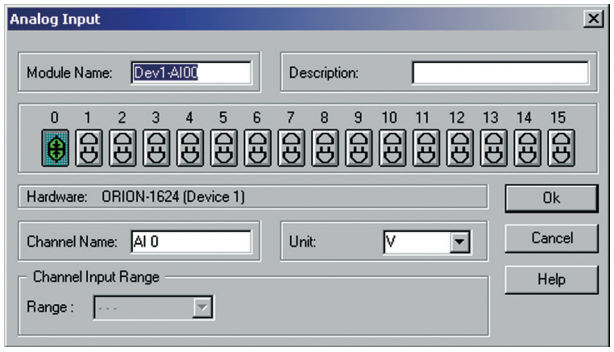
To add an ORION card icon to your worksheet, click the center selection: ANALOG INPUT. You will be presented with this dialog box. Select the ORION card that you want to use and then click OK. Most people will only have one, but it is possible to have up to 8!



When you click OK this will close and you will have a basic ORION card icon on your worksheet (you may be required to click somewhere on the worksheet to drop it there).



Now you have the basic icon, where the first channel (input 0) is active by default (this is a standard DASYLab behavior). Now double-click the icon to open it up if you want to activate additional channels:

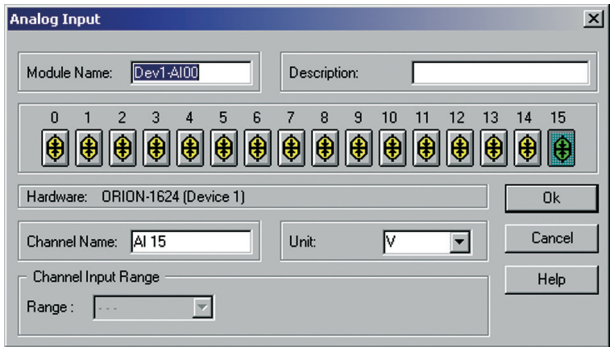


You can individually activate/deactivate channels on the card using double-clicking techniques:

DOUBLE LEFT-CLICK to activate a channel
DOUBLE RIGHT-CLICK to deactivate a channel

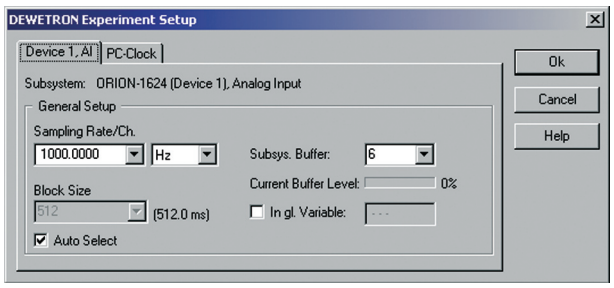
HINT: To activate a range of channels with a single left double-click, hold down the CONTROL key on your keyboard, then double left-click the LAST channel that you want to activate. When you do, all the ones in between will also activate!

Here is the result of that technique:



When the desired channels are activated, click OK to close this box.

Now you can configure the SAMPLE RATE of the ORION Card. From the Dewe-DAQ menu, select MEASUREMENT SETUP, and this box will appear:

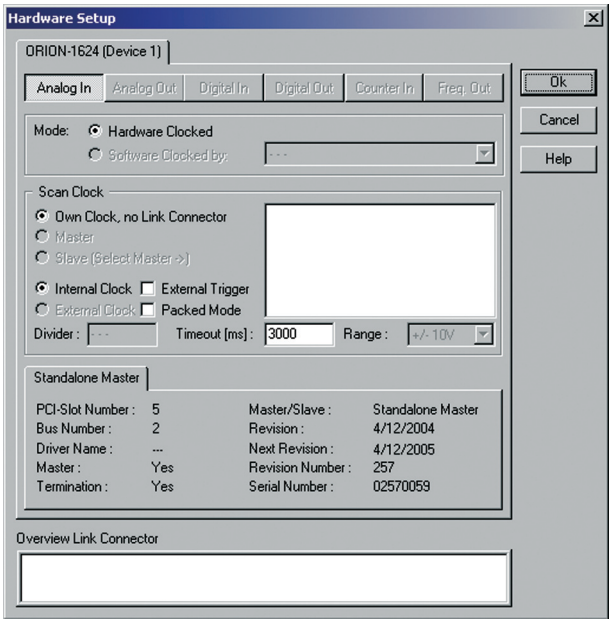


Set the sample rate desired per channel. It is best not to change the Subsys Buffer from the default settings unless you are experienced with DASYLab and A/D cards in general. Click **OK** to close this box.

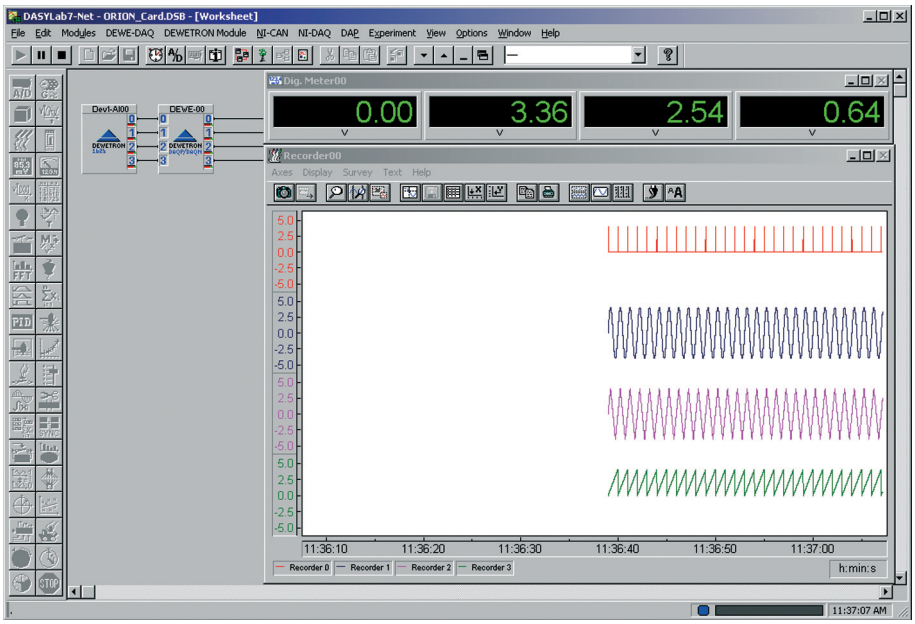
HINT: THE ORION CARD HAS SEPARATE A/D'S PER CHANNEL, SO THE RATE THAT YOU SET HERE APPLIES TO ALL ACTIVE CHANNELS ON THIS CARD!

HARDWARE SETUP Dialog

There should be no common reason to alter these settings, unless you have some additional ORION card options, or multiple cards installed. But the second menu item under the DeweDAQ menu called Hardware Setup, brings up this dialog box:



That's it – your ORION card is ready to be used. Connect it up just like any other A/D card within DASYLab and start making measurements! Here is a typical worksheet:



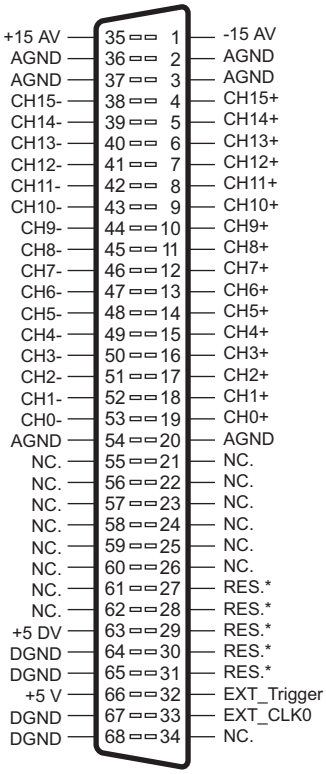
Notes:

2.3 Connecting signals (DEWE-ORION-1624 / 1624E)

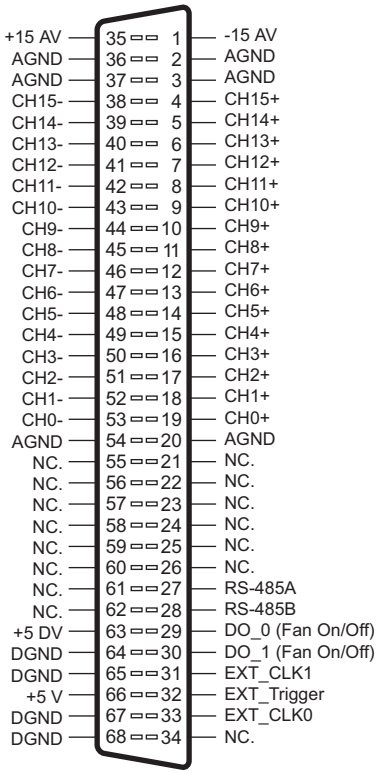
2.3.1 Input connector

The schematic below shows the pin assignment of the input connector. A standard 68-pin high density female type with 0.05 inch pin distance can be used for the signal connection.

The ±15 V output is able to supply up to 66 mA (2 W). The supply is protected against short circuits. Overloading this output may cause an overheating of the DEWE-ORION-1624 and lowers the signal quality. The +5 V output can supply up to 200 mA.

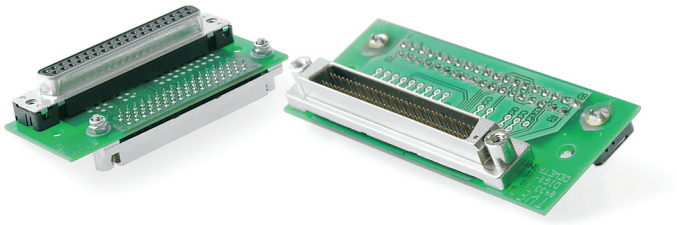


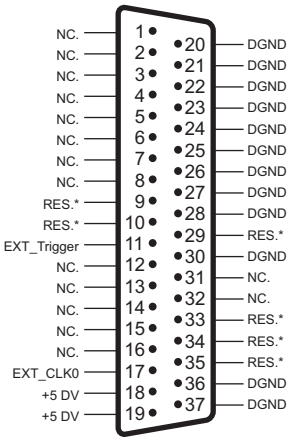
68-pin high density connector AMP: 174341-5
DEWE-ORION-1624



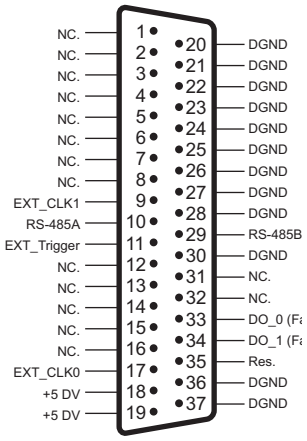
68-pin high density connector AMP: 174341-5
DEWE-ORION-1624E

Connect the optional DB37 adaptor to your DEWE-ORION-1624 card to contact the digital in- and outputs. This schematic shows the pin assignment of the 37-pin connector on the DB37-adaptor.





37-pin SUB-D connector
DEWE-ORION-1624



37-pin SUB-D connector
DEWE-ORION-1624E

Don’t connect any signals to the pins, labeled with “RES”. These pins are reserved for future use.

2.3.2 Analog signals

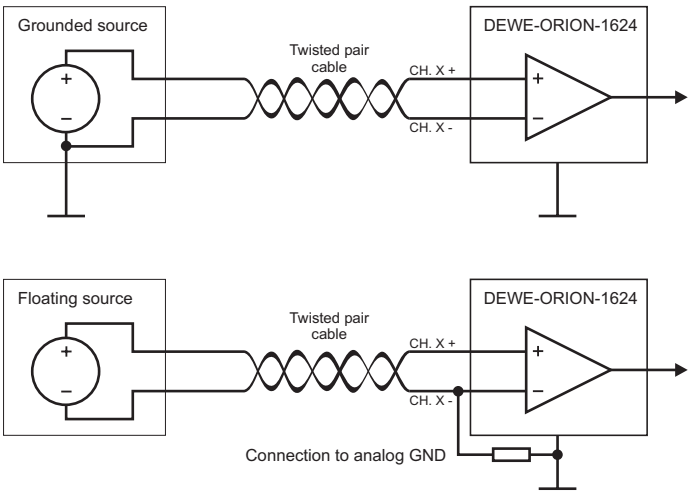
All 16 channels of the DEWE-ORION-1624 are fully differential inputs with 10 MOhm input resistance in parallel to 60 pF. The input voltage range is fixed to ±10 V. Because of the differential input structure, the difference of the input (Channel xx (+) - Channel xx (-)) will be shown as the result of the measurement. Although the input is protected for input voltages up to ±30 V, the common voltage range of each input is limited to ±11.5 V. If the input voltage exceeds this range, the result is not valid even when the difference input voltage is lower than 10 V. These voltage ranges will be clipped and introduced as large errors that can be easily identified in the frequency spectrum.

Examples:

V(+) = +10 V, V(-) = +5 V, voltage difference = 5 V, result is valid

V(+) = +15 V, V(-) = +10 V, voltage difference = 5 V, result is not valid (V+ will be clipped at +11.5 V!)

The differential input is ideal for grounded signal sources because the ground loop between signal source and input is eliminated automatically. When measuring floating input sources (batteries or isolated thermocouples) it is necessary to connect Channel xx (-) input to analog ground (AGND) pin.



If you use a customized cable for signal connection, we strongly recommend to use twisted pair cables. Each channel has to get its own twisted pair. Otherwise the high channel to channel isolation (channel cross talk) get lost. Also the high signal to noise ratio of up to 108 dB can only be guaranteed by using a shielded twisted pair cable to connect the signal sources to the DEWE-ORION-1624.

2.3.3 Trigger input

The CMOS or TTL compatible input **EXT. TRIGGER** can be used to initiate the data acquisition sequence. It is possible to start the acquisition at the positive or at the negative edge of the trigger input.

Please note: ORION-1624 does not support the external trigger function!

2.3.4 Sample rate output

The **SAMPLE CLOCK** pin offers the actual sample clock as an CMOS/TTL compatible output to synchronize external devices like special high speed cameras. To increase the flexibility of the DEWE-ORION-1624 this output can be divided in steps from 1 to 131072 (2^{17}).

Please note: ORION-1624 only supports EXT_CLK0!

2.3.5 Digital outputs

For noise measurements the fan of the system the ORION-1624 is installed can be switched of using DO_0 or DO_1 as the control signal. Please refer also to the <DEWESoft> <System> <General setup>

Please note: ORION-1624 does not support DO_0 and DO_1!

2.3.6 RS-485 interface

The DEWE-ORION-1624E is suited with an RS-485 interfaced as standard. The baud-rate is fixed to 9600, 8 Data, 1 Stop bit and no parity. This interface is used for configuration of the DAQ and MDAQ signal conditioning modules. Also the acquiring of PAD and EPAD from DEWETRON is possible with this RS-485 port.

Please note: ORION-1624 does not support the RS-485 interface!

2.4 Sample clock selection

Due to the nature of delta sigma converters they have to overclock the ADC to reach the high accuracy specification. The overclocking rate varies with the sample rate:

256 for 1kS/s <= fs <= 51.2 KS/s

128 for 51.2 kS/s < fs <= 102.4 KS/s

64 for 102.4 kS/s < fs <= 200 KS/s

That means at 50 kS/s the delta sigma converter is clocked with 12.8 Mhz (50 kHz * 256).

To set nearly each frequency a low jitter programmable PLL (phase locked loop) circuit is used for generating the clocking frequency. PLL gives the best solution for variable frequency setting with small steps between the frequency. But still not every frequency is possible to set. The formula below gives you an idea how the frequency can be set to get different sample rates.

$$Fs = \frac{12.8\,MHz * C1}{C2}$$

The constants C1 and C2 are integer values and automatically set the best performance values. To know the exact sample frequency the board driver offers a command to read back the really set sample rate.

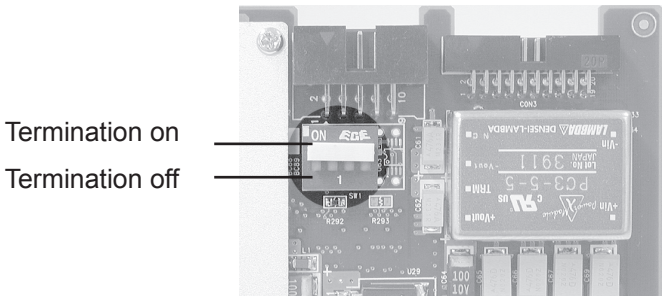
All channels have to be acquired with the same sample rate. It is not possible to set different sample rates to some channels.

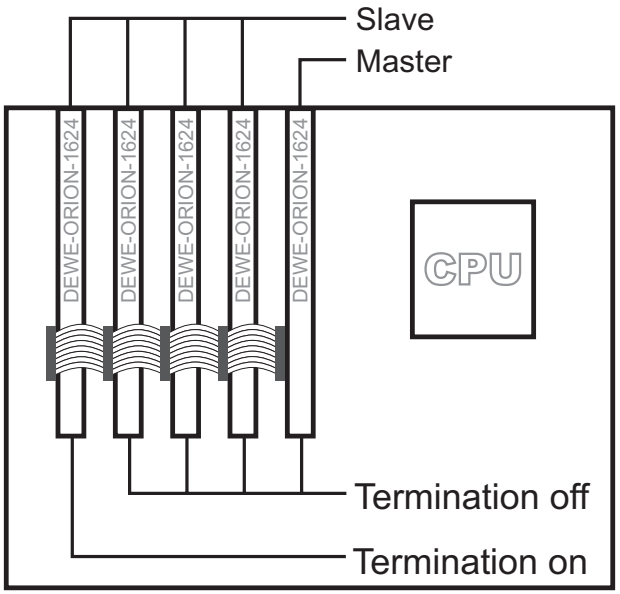
2.5 Synchronizing multiple devices

For multiple device operation the DEWE-ORION-1624 is equipped with an additional synchronization connector. A standard 10-pin connector with 1.27 mm flat ribbon cable is available for easy connection between the boards. To reduce electromagnetic influences because of the very high frequency at this synchronization bus, IEEE 1394 compatible LVDS (low voltage difference signals) where used.

The LVDS interface is current-based. Therefore the last board has to be terminated. This can be done with a switch, positioned directly below the sync connector.

If you use only one DEWE-ORION-1624 in your system, the board has to be terminated.

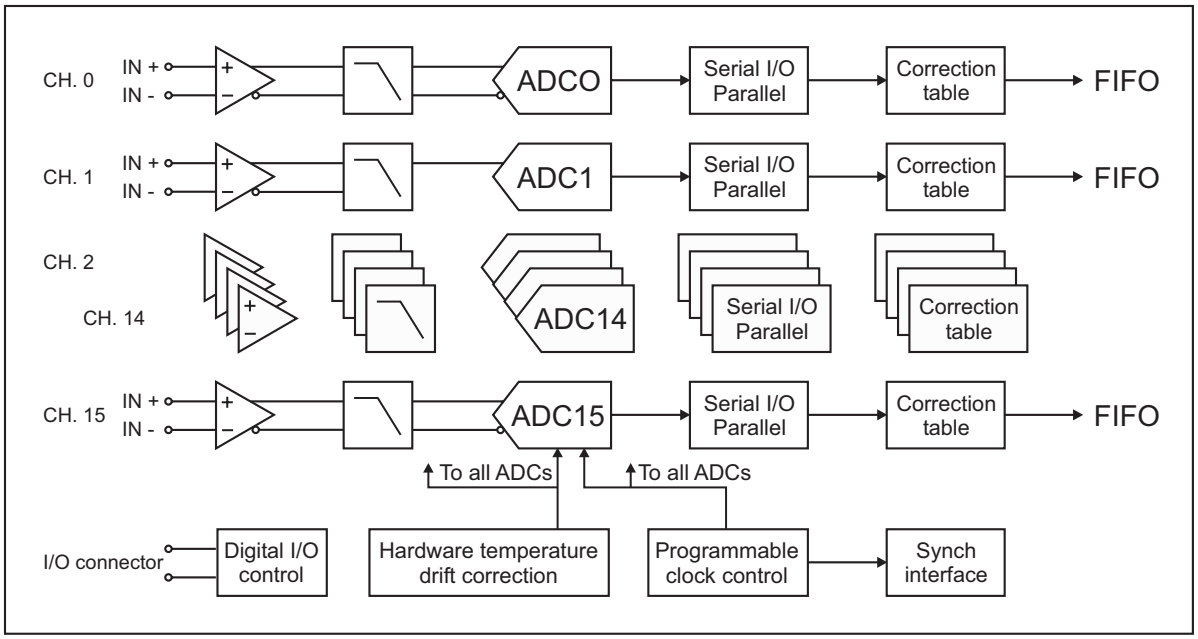




3 Theory of operation

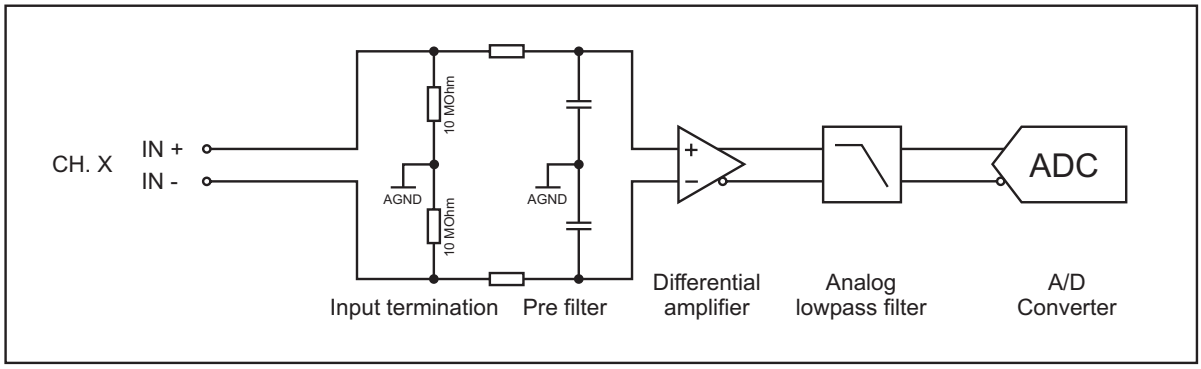
3.1 Functional overview

The analog function block diagram below shows the signal processing of the DEWE-ORION-1624.



3.2 Analog input configuration

Block diagram for one of the 16 identical DEWE-ORION-1624 analog inputs.



The high input impedance (10 MOhm ground referenced) has no distortion influence to the measured signals. 24-bit resolution and software-programmable rates up to 200 kS/s allow high performance data acquisition.

3.3 Analog to digital conversion

3.3.1 ADC basics

The DEWE-ORION-1624 uses 16 delta-sigma A/D converters. If you sample with a data rate of 102.4 kS/s, the ADC actually samples the input signal with 13.1072 MS/s (multiply the data rate with 128) and produces 1-bit samples which are applied to the digital filter. The filter expands the data to 24-bits and rejects signal parts greater than 51.2 kHz (Nyquist frequency). It also re-samples the data to the more conventional rate of 102.4 kS/s.

A 1-bit quantizer introduces many quantization errors to the signal. The 1-bit, 13.1072 MS/s from the ADC carry all information to produce 24-bit samples at 102.4 kS/s. The delta-sigma ADC converts from high speed to high resolution by adding much random noise to the signal. In this way the resulting quantization noise is restricted to frequencies above 100 kHz. This noise is not correlated with the useful signal and is rejected by the digital filter.

3.3.2 Anti-alias filter

ADCs can only represent signals of a limited bandwidth. The maximum frequency you can represent is the half of the sampling rate. This maximum frequency is also called Nyquist frequency. The bandwidth between 0 Hz and the Nyquist frequency is called Nyquist bandwidth. Signals exceeding this frequency range can not be converted correctly by the sampler.

For example, the sample rate is 1000 S/s, the Nyquist frequency is 500 Hz. If the input signal is a 375 Hz sine wave, the resulting samples represent a 375 Hz sine wave. If a 625 Hz sine wave is sampled, the resulting samples represent a 375 Hz sine wave too. This happens because signals exceeds the Nyquist frequency (500 Hz). The represented frequency of the sine wave is the absolute value of the difference between the input frequency and the closest integer multiple of the sampling rate (in this case 1000 Hz).

Some examples:

Input sine wave 2280 Hz, sampling frequency 1000 Hz: 2280 - 2 * 1000 = 280 Hz

Input sine wave 3890 Hz, sampling frequency 1000 Hz: 4 * 1000 - 3890 = 110 Hz

When the sampler modulates frequencies out of the Nyquist bandwidth back to the 0 to 500 Hz baseband it is called aliasing. Signals which are not pure sine wave can have many components (harmonics) above the Nyquist frequency. These harmonics are erroneously aliased back to the baseband, added to parts of the accurately sampled signal and produces a distorted data set. To block frequencies out of the Nyquist bandwidth, a lowpass filter is applied to the signal before it reaches the sampler.

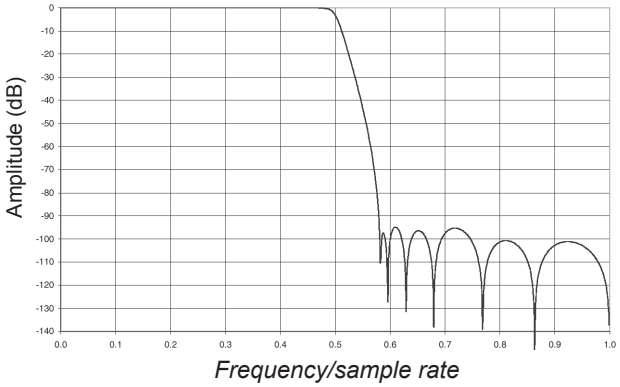
Each input channel has its two pole anti-alias lowpass filter with a cutoff frequency of about 250 kHz. The very high cutoff frequency allows an extremely flat frequency response in the bandwidth of interest and a small phase error. The analog filter precedes the analog sampler. The analog sampler operates at 256 times the selected sample rate for rates below 51.2 kS/s, 128 times for rates between 51.2 kS/s and 102.4 kS/s. For rates over 102.4 kS/s the oversampling is 64 times. That means, the ADC operates at 13.1072 MS/s if you select a sample rate of 102.4 kS/s (128 * 102.4 kS/s).

The 1-bit oversampled data is passed to a digital anti-aliasing filter. This filter has no phase error and an extremely flat frequency response. It also has an extremely sharp roll-off near the cutoff frequency (0.38 to 0.494 times the sample rate) and the rejection above 0.5465 times the sample rate is greater than 92 dB. The output stage of the digital filter resamples higher frequencies to 24-bit samples.

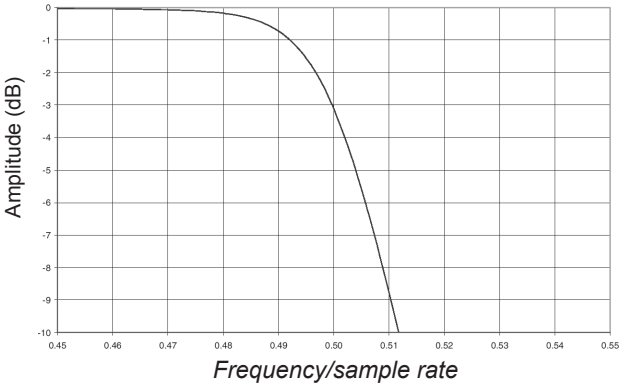
The digital filter passes only signal components within the Nyquist bandwidth or within multiples of the Nyquist bandwidth of 64, 128 or 256 times (depending on sampling rate). The analog filter rejects most noise near these multiples. The following diagrams show the frequency response of the input circuitry.

Sample rate 1 kS/s to 51.2 kS/s

Input frequency response

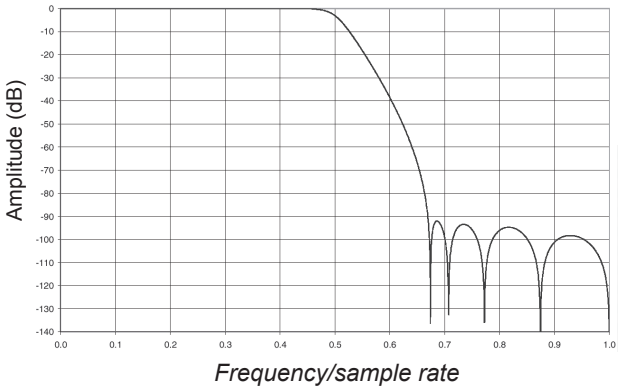


Input frequency response near the cutoff

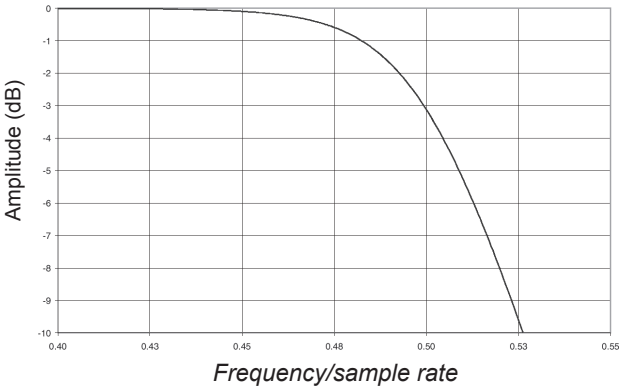


Sample rate 51.2 kS/s to 102.4 kS/s

Input frequency response

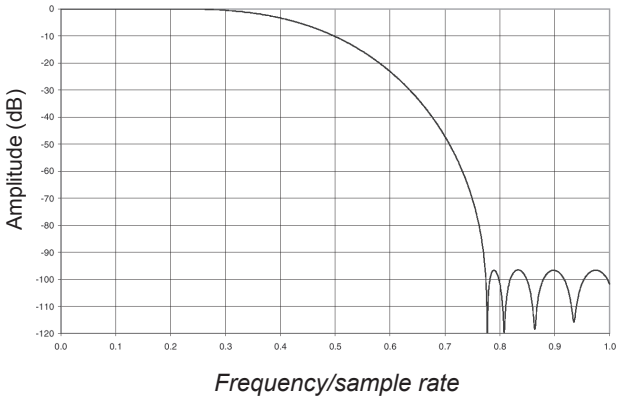


Input frequency response near the cutoff

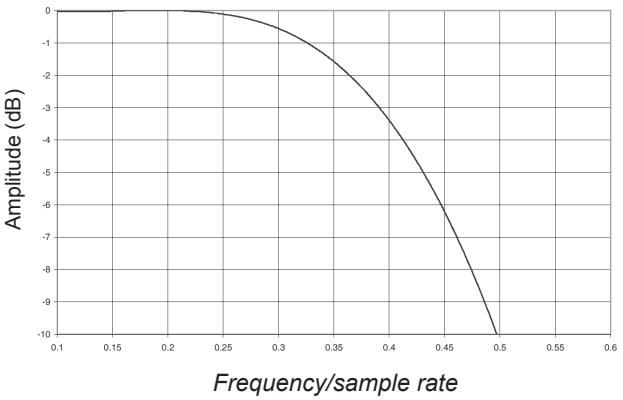


Sample rate 102.4 kS/s to 200 kS/s

Input frequency response



Input frequency response near the cutoff



The ADC samples at 64, 128 or 256 times the data rate (depending on the adjusted sample rate). Frequency components above one half of the oversampling rate (> 32, 64 or 128) can alias. Most of this frequency range is rejected by the digital filter. The filter can not reject components that lie close to integer multiples of the oversampling rate because it can not differentiate these components from components between 0 Hz and the Nyquist frequency. That means, if the sample rate is 100 kS/s and a signal component is between 50 kHz and 12.8 MHz (128 x 100 kHz), this signal will be aliased into the passband region of the digital filter and is not rejected. The analog filter removes these components before they get to the digital filter and the sampler.

The frequency response of the analog filter is fixed. The filter is optimized to produce high-frequency alias rejection and to have a flat in-band frequency response. It is a second order filter with a slow roll-off that rejects aliases at lower sample rates not so good. But the filter has very good alias rejection at higher sample rates.

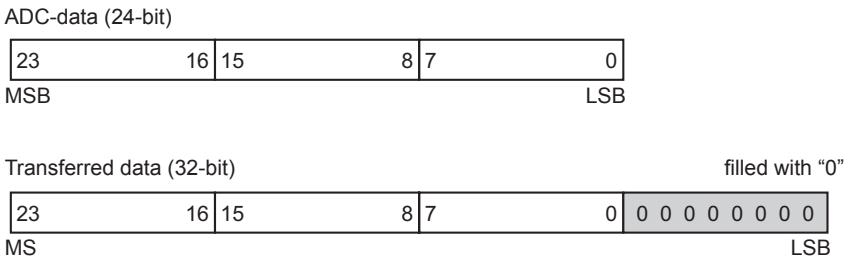
If aliasing is caused by a clipped or overranged waveform, (exceeding the voltage range of the ADC) it can not be rejected with any filter. The ADC assumes the closest value to the actual value of the signal in its digital range when the signal is clipping. The result of clipping is also a sudden change in the signal slope and results in corrupt digital data with high-frequency energy. This energy is spread over the complete frequency spectrum and is aliased back into the baseband. Do not allow the signal to exceed the input range to avoid this.

3.3.3 Calibration

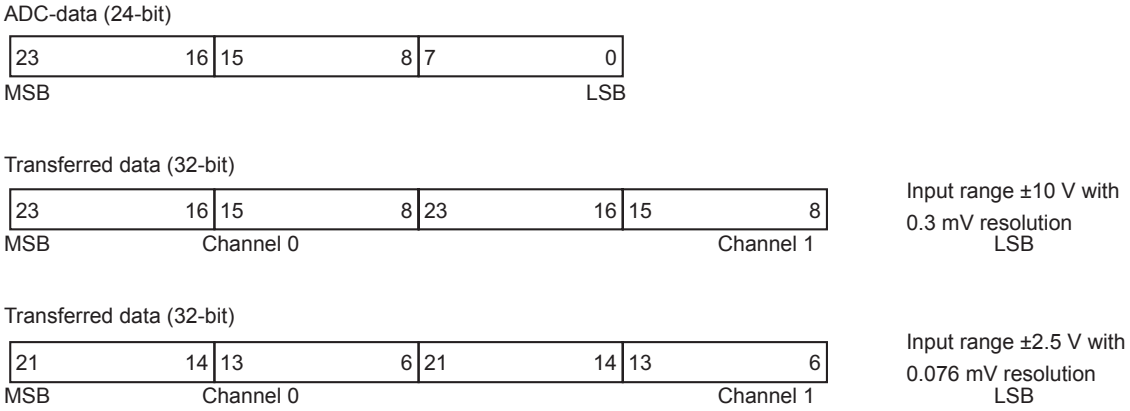
Your DEWE-ORION-1624 is shipped with a calibration certificate. Typically a recalibration is required every year. The calibration constants are stored in the on-board EEPROM. The calibration can only be done with an optional available calibration kit or send the DEWE-ORION-1624 back to DEWETRON for recalibration.

3.3.4 Output data format

Due to the nature of the PCI Bus, each channel is transferred as a 32-bit value, although the converter output is only a 24-bit value. Multiple channel applications with high sample rates may limit the maximum sample rate. A 128 channel system with 100 kS/s will give a total output data stream of 51.2 MByte/sec.



To reduce this high amount of data by half, a 16-bit mode is implemented. This 16-bit mode will only transfer 16 bits per ADC. Due to the selection of most significant 16 bits of the 24-bit ADC value, it is also possible to define the interesting array of bits which should be transferred. That means you have a kind of programmable range, using this packed mode.



For detailed information about this feature, please refer to the programmers manual.

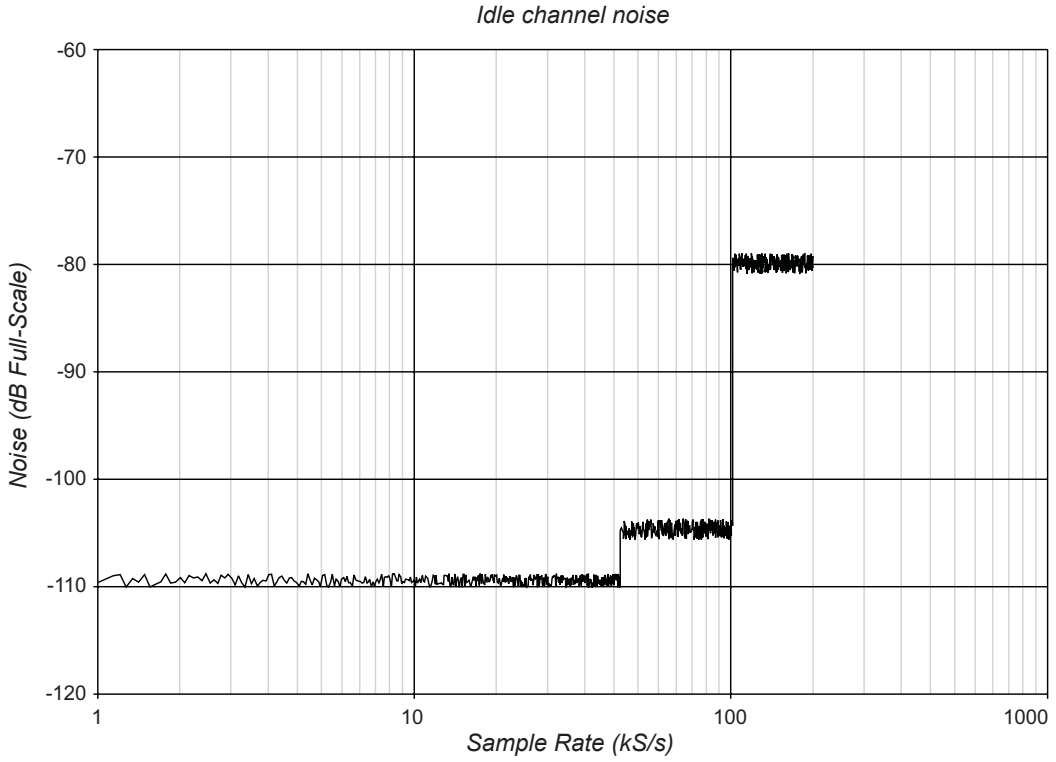
4 Specifications

4.1 Analog input

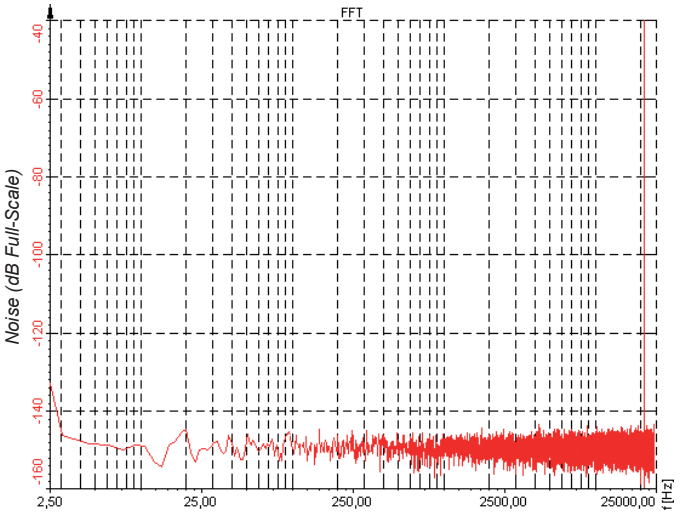
Analog input	
Channel characteristics	
Number of channels	16, simultaneously sampled
Input configuration	Symmetric, differential
Resolution	24-bit, nominal
Type of ADC	Delta-sigma
Sampling rate	200 kS/s per channel
Data throughput	3.2 MS/s
Oversampling, for sample rate (fs)	
Frequency accuracy	±35 ppm
1 kS/s ≤ f_s ≤ 51.2 kS/s	256 f_s
51.2 kS/s < f_s ≤ 102.4 kS/s	128 f_s
102.4 kS/s < f_s ≤ 200 kS/s	64 f_s
Input signal range	±10 V peak
FIFO buffer size	4096 samples
Data transfers	DMA
Transfer characteristics	
Offset (residual DC)	
1 kS/s ≤ f_s ≤ 51.2 kS/s	±0.5 mV
51.2 kS/s < f_s ≤ 102.4 kS/s	±0.7 mV
102.4 kS/s < f_s ≤ 200 kS/s	±1.5 mV
Gain (amplitude accuracy)	±0.005 dB @ DC (±0.06% of reading @ DC)
Gain drift	±15 ppm/K
Amplifier characteristics	
Input impedance (ground referenced)	
Positive input	10 MΩ in parallel with 60 pF
Negative input	10 MΩ in parallel with 60 pF
Overvoltage protection	
Positive input	±30 V
Negative input	±30 V
Common mode rejection ratio (CMRR)	
f_{in} < 1 kHz	> 60 dB, typ.
Flatness	
1 kS/s ≤ f_s ≤ 51.2 kS/s	-0.035 dB to +0.01 dB, DC to 0.475 f_s
51.2 kS/s < f_s ≤ 102.4 kS/s	-0.035 dB to +0.01 dB, DC to 0.45 f_s
102.4 kS/s < f_s ≤ 200 kS/s	-0.035 dB to +0.01 dB, DC to 0.246 f_s
-3 dB Bandwidth	
1 kS/s ≤ f_s ≤ 51.2 kS/s	0.494 f_s
51.2 kS/s < f_s ≤ 102.4 kS/s	0.49 f_s
102.4 kS/s < f_s ≤ 200 kS/s	0.38 f_s
Maximum working voltage	
Channel-to-ground, channel-to-channel	10 V, installation category I
Max. working voltage refers to the signal voltage plus common-mode voltage.	

4.2 Dynamic characteristics

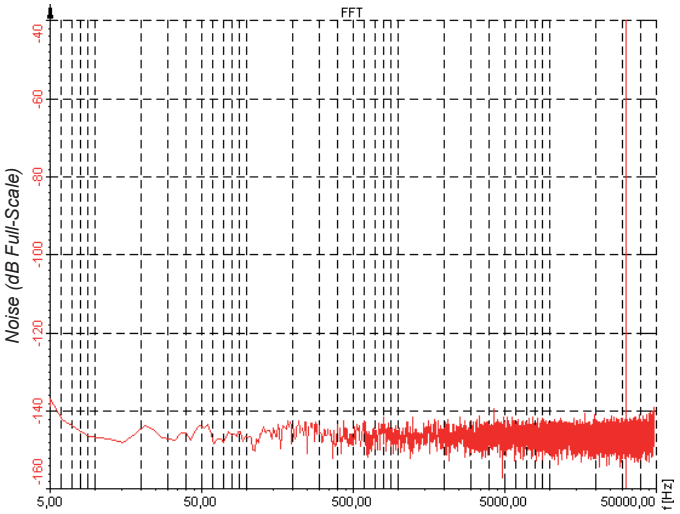
Dynamic characteristics	
Alias-free bandwidth (passband)	
1 kS/s ≤ f_s ≤ 51.2 kS/s	DC (0 Hz) to 0.42 f_s
51.2 kS/s < f_s ≤ 102.4 kS/s	DC (0 Hz) to 0.32 f_s
102.4 kS/s < f_s ≤ 200 kS/s	DC (0 Hz) to 0.22 f_s
Alias rejection	
1 kS/s ≤ f_s ≤ 51.2 kS/s	-95 dB
51.2 kS/s < f_s ≤ 102.4 kS/s	-92 dB
102.4 kS/s < f_s ≤ 200 kS/s	-97 dB
Signal to noise	
1 kS/s ≤ f_s ≤ 51.2 kS/s	108 dB
51.2 kS/s < f_s ≤ 102.4 kS/s	105 dB
102.4 kS/s < f_s ≤ 200 kS/s	80 dB
Spurious free dynamic range	
1kS to 51.2 kS/s	140 dB
51.2kS to 102.4 kS/s	137 dB
102.4kS to 200 kS/s	106 dB
THD (1kS/s <= f_s <= 102.4 kS/s)	0 dB_{FS} input < -90 dB -20 dB_{FS} input < -100 dB -60 dB_{FS} input < -60 dB
Crosstalk (channel separation)	
f_{in} 0 to 10 kHz	120 dB
f_{in} 10 to 50 kHz	105 dB
Interchannel gain mismatch	±0.002 dB
Filter delay through ADC	
1 kS/s ≤ f_s ≤ 51.2 kS/s	12 / f_s
51.2 kS/s < f_s ≤ 102.4 kS/s	9 / f_s
102.4 kS/s < f_s ≤ 200 kS/s	5 / f_s
Inter channel phase mismatch	0.02° * f_{in} (kHz) + 0.08°



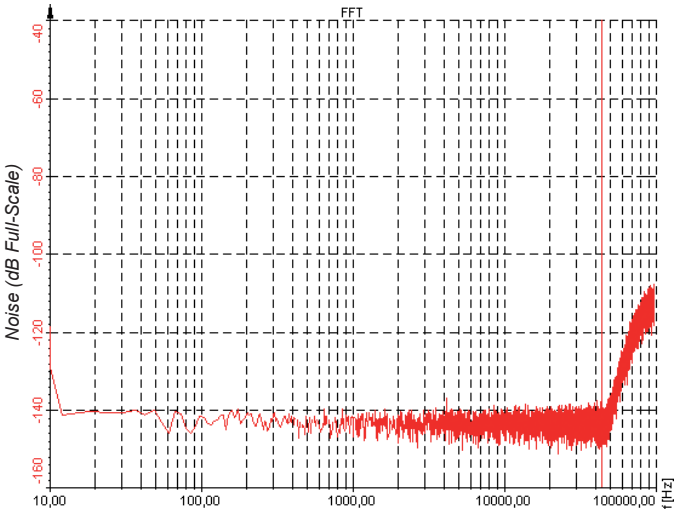
Spectral noise - Idle input - 10 averages 16k lines @ 50 kHz sampling rate



Spectral noise - Idle input - 10 averages 16k lines @ 100 kHz sampling rate



Spectral noise - Idle input - 10 averages 16k lines @ 200 kHz sampling rate



4.3 General specifications

Trigger	
Digital trigger: compatibility	5 V TTL/CMOS
Power requirements	
+3.3 V_{DC}	0 mA
+5 V_{DC}	800 mA max
+12 V_{DC}	400 mA max
Environmental	
Operating temperature	0 to 50 °C
Storage temperature	-20 to 70 °C
Relative humidity	10 to 90%, non condensing
Maximum altitude	2000 m
Pollution degree (indoor use only)	2
Physical	
Dimensions (not including connectors)	17.5 x 10.7 cm (6.9 x 4.2 in.)
Analog I/O connector	68-pin SCSI PCB male