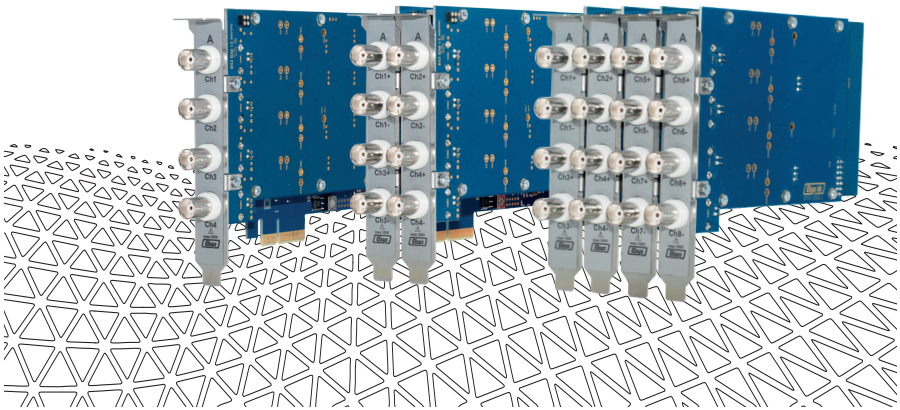
TPCE

Data Acquisition Cards



User Manual

TPCE
TPCE-LE

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Legal Notice

Thank you!

Thank you for purchasing Elsys High Precision Data Acquisition Equipment.
For more information, please visit www.elsys-instruments.com

Notice

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Personal safety when installing in your computer

High voltages may be present inside computer equipment. Before installing any of the hardware in this package, or removing the protective covers of any computer equipment, turn off power switches and disconnect power cords. Do not reconnect the power cords until the hardware is installed and the system cover is closed.

Attention

The boards must not be installed into industrial PC's, which do not keep the necessary EMC standards.

ESD (Electrostatic Discharge) precautions

To avoid damaging computer components and accessories when installing or removing an Elsys Instruments Data Acquisition module, follow standard electrostatic discharge (ESD) precautions:

- When your computer case is open and its internal parts are exposed, do not touch any internal parts unnecessarily.
- Always wear a grounded strap or work on an ESD-protective mat.
- Do not remove the Data Acquisition module from its protective bag until you are properly grounded.
- Handle the Data Acquisition module by its edges or by the metal bracket.
- Do not touch any pin, contact, lead or component on the Data Acquisition module.

Content

1. Introduction

1.1 Quick Installation

- Before installing the TPCE module into the computer, the correct channel group must be set with the small rotary switch. See Chapter „Board Number Configuration“.
- If sufficient free PCIe card slots are available, single places can remain empty between the modules. Thus the heat dissipation improves. Besides the BNC plugs are better accessible.
- If more than one board is installed, a StarHub synchronization board must be connected to all installed boards.
- For precise measurements, good ground contact between the boards and the chassis is needed.
- Close the computer and turn it on
- Install the TpcServer Setup which installs all device drivers and services needed for proper operation.

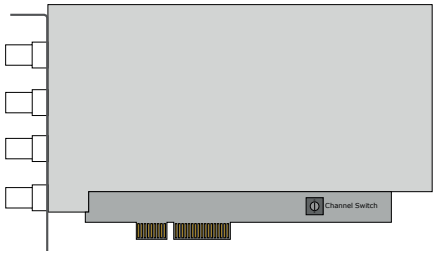
1.2 System Requirements

The TPCE cards require the following minimal computer configuration:

- Industrial PC or compatible
- CPU Intel i5 or better
- 17 inch Full HD Screen with a resolution of 1920x1080 or higher
- RAM minimum 2 GB, recommended 4 GB
- TPCE: One x4 PCIe slot each per 4-channel board
- TPCE-LE: One x1 PCIe slot each per 4-channel board
- 8-channel boards need two slots. With differential modules the number of required slots has to be doubled.
- Windows 10 or 11, 64 Bit
- Power supply inside of the PC with enough power.

1.3 Multi-Board Systems

Large data acquisition systems can be set up based on all Elsys DAQ cards. Depending on the host system, instruments with up to 64 channels can be realized in one device. Larger or distributed systems can be set up by synchronizing several devices with each other.



Board Number Configuration

If more than one card is installed in a device, each card must be configured with a different card letter. This can be done by configuring the channel switch on the measuring card.

Switch Position	Board Letter	Channels
0	A	A1 - A4 / A1 - A8
1	B	B1 - B4 / B1 - B8
2	C	C1 - C4 / C1 - C8
...	...	...
F	P	P1 - P4 / P1 - P8

1.4 Operation Modes

There are four different operation modes in which the data acquisition cards can be used. Any of these operation modes are ready to use in all driver interfaces or Application software.

Scope

In Scope mode, the board runs like an Oscilloscope. Incoming data from the ADC are written into the on-board memory until a trigger condition occurs. After the trigger condition, the measurement continuous until the post-trigger time is over and stops. The length of the measurement is limited by the maximum memory available on the board.

Multi-Block

Multi-Block Mode works like the Scope mode but with the addition that the available on-board memory is split up in several blocks. On each trigger, a new part of the memory is used. This way, the on-board memory can be used more effective than in the Scope mode. The maximum number of blocks is limited by the block size and the available memory.

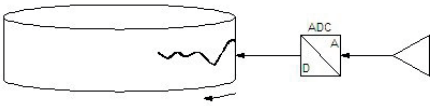
Continuous

In the Continuous mode incoming data from the ADC's are buffered on the on-board memory an then transfered immediately to the hard disk. The maximum recording length is only limited by the hard disk size. The amount of data produced per second depend on the used sampling rate and the number of activated channels. If the data rate is higher than the PCIe interface or the hard-disk write throughput, some data from the on-board buffer get lost.

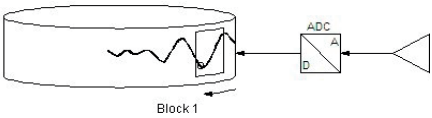
ECR Event Controlled Recording

(This mode is optional)

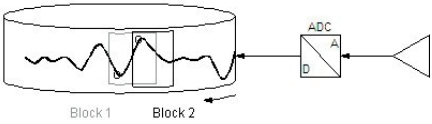
The ECR mode allows targeted acquisition of cyclic or sporadically arising events. This implies that the registration of measuring data only occurs if certain signal conditions (trigger, time window, repetitions, etc.) are fulfilled. Thus many unwanted and unneeded signal data will not be stored.



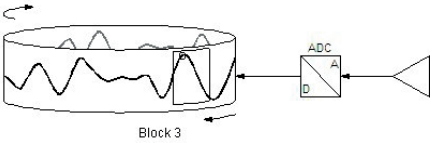
The digitalized signal will be stored to the on-board memory which acts as a ring buffer.



As soon as the trigger is released, a block of samples will be read from the ring buffer and will be saved to the hard disk.



If a new trigger event within the actual block occurs, a new overlapping block will be saved.

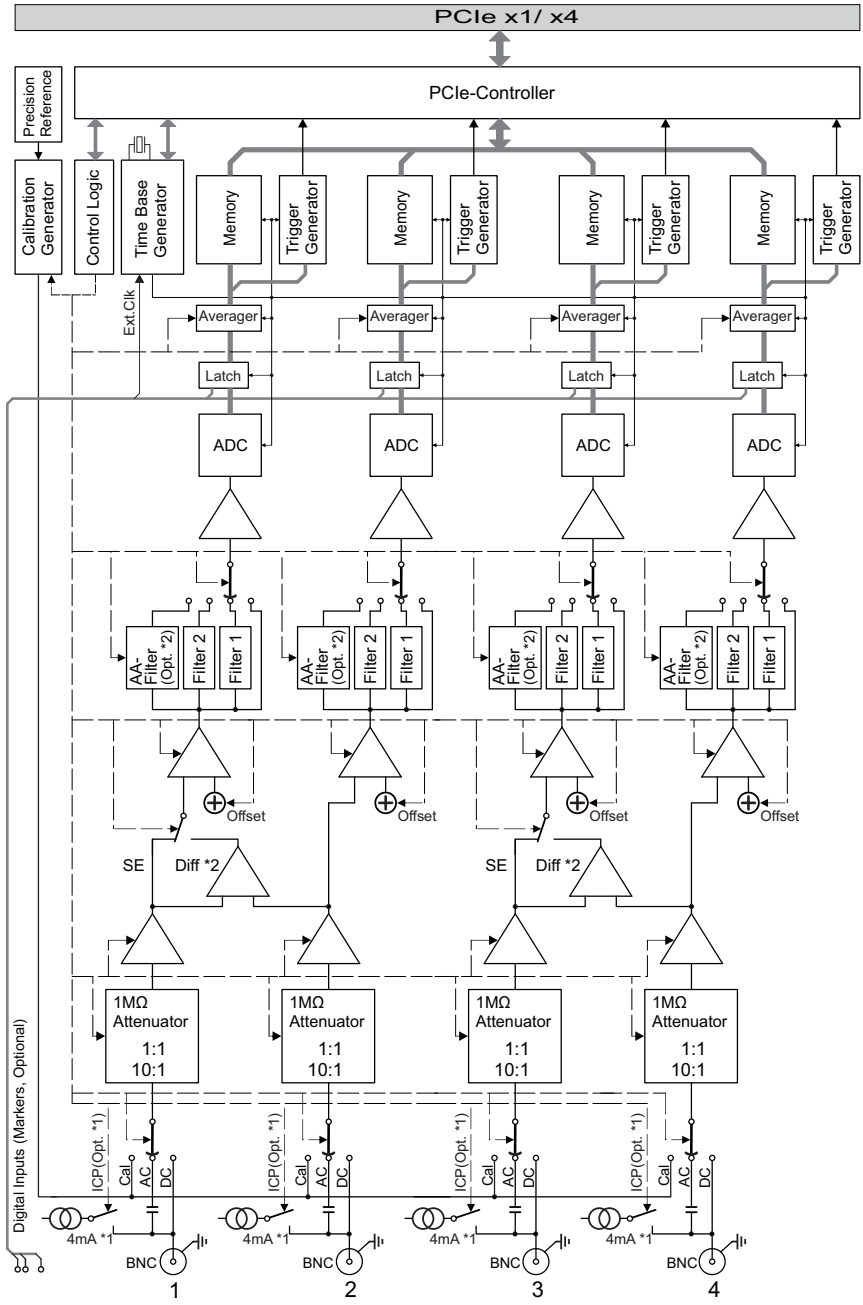


If the ring buffer is full, the oldest measurement data will be overwritten with new incoming data. Usually, the overwritten data would be transferred to the hard disk before this happens. If too many events occur in a period of time, the ring buffer may overflow.

ECR Dual Mode

An other feature of ECR is the "Dual Mode". It allows to store a continuous measurement at a slower sampling rate than the captured blocks. For example fast transient can be captured at 10 MS/s by the triggered blocks while storing slower signals at 100 kHz over a long period of time.

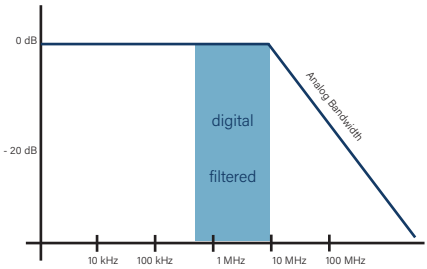
1.5 TPCE & TPCE-LE Block Diagram



1.6 Standard Filter

On each channel a Low-Pass First Order Filter with 100 kHz or 1 MHz bandwidth can be activated. The analog bandwidth of the amplifier itself is set around the half of the maximum sampling rate, eg. 10 MHz for a 20 MHz board.

When the cards are used below the maximum sampling rate an internal digital filtering is done (Averaging of the oversampled signal) . Therefor an Anti-Aliasing Filter is not needed in the most situations. The picture above shows a 20 MHz card used at 1 MHz. High frequency noise above 10 MHz is filtered by the analog bandwidth of the amplifier with 20 dB/dec. Noise between 500 kHz and 10 MHz is digital filtered with signal averaging.



1.7 Trigger Logic

Elsys DAQ cards are available with two different trigger packages, the standard trigger package and the Advance Trigger package:

Standard Trigger

- Positive/Negative Slope
- Window In/Out

Advanced Trigger Package

- all Standard Trigger
- Pulse > & Pulse <
- Delay > & Delay <
- Slew Rate Trigger
- State Trigger
- AND Trigger linking
- Trigger on multiplied signals (Power Trigger)
- Trigger on Marker Inputs

Each channels can be the trigger source at once. The first channel which detects a trigger will trigger the measurement. One external Slope trigger is available on the 25-Pol D-SUB connector

1.8 Anti-Aliasing Filter Module

Anti-Aliasing Filters are an option and must be installed at fabrication time.

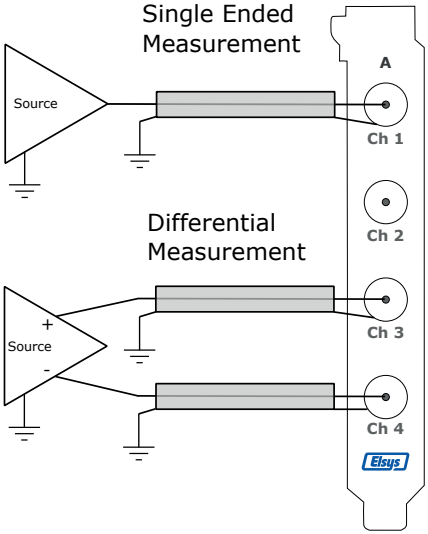
(TPCE Option AAF-4 or AAF-8).

Cut-off (-3 dB) f_0	f0 Tol. [±%]	Filter Type	Order	Stop band Attenuation @ f > 4*fo	Passband Ripple (max.) @ f < 0.6*fo	Additional Gain and Offset	
						Error [±%]	Drift [ppm/°C]
200 Hz	5	Butterw.	6	> 54 dB	± 0.2 dB	0.1	50
300 Hz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
500 Hz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
700 Hz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
1 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
1.5 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
2 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
3 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
5 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
7 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
10 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
15 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
20 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
30 kHz	5	Butterw	6	> 54 dB	± 0.2 dB	0.1	50
50 kHz	5	Butterw	6	> 54 dB	± 0.3 dB	0.1	50
70 kHz	10	Butterw	6	> 54 dB	± 0.4 dB	0.1	50
100 kHz	10	Butterw	6	> 54 dB	± 0.5 dB	0.1	50
200 kHz	10	Butterw	6	> 54 dB	± 0.5 dB	0.1	50
500 kHz	20	Elliptic	5	> 48 dB	± 0.5 dB	0.3	200
1 MHz	20	Elliptic	5	> 42 dB	± 0.5 dB	0.3	200
2 MHz	10	Butterw	4	> 42 dB	± 0.5 dB	0.2	100
5 MHz	10	Butterw	4	> 42 dB	± 0.5 dB	0.2	100

2. Input and Outputs

2.1 Analog Inputs

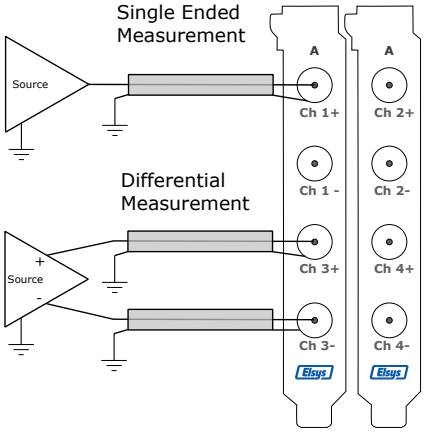
Single Ended Boards (SE)



Single Ended boards have one BNC connector per channel where the outside shielding is connected to chassis/protective Ground.

Two neighboring channel can be configured per software as differential input stage. In this case the signal must be connected as shown aside.

Differential Boards (DIFF)



Differential boards have two BNC connector per channel where the outside shielding is connected to chassis/protective Ground.

Single ended measurement can be performed by just using the + input of the BNC pair.

Input Ranges

The input range can be set individually for each channel. Different areas are available depending on the board type.

0% Offset	50% Offset	100% Offset	TPCE	TPCE-LE
0 - 100 mV	± 50 mV	-100 - 0 mV	✓	×
0 - 200 mV	± 100 mV	-200 - 0 mV	✓	✓
0 - 500 mV	± 250 mV	-500 - 0 mV	✓	✓
0 - 1 V	± 500 mV	-1 - 0 V	✓	✓
0 - 2 V	± 1 V	-2 - 0 V	✓	✓
0 - 5 V	± 2.5 V	-5 - 0 V	✓	✓
0 - 10 V	± 5 V	-10 - 0 V	✓	✓
0 - 20 V	± 10 V	-20 - 0 V	✓	✓
0 - 50 V	± 25 V	-50 - 0 V	✓	✓
0 - 70 V	± 50 V	-70 - 0 V	✓	×

Offset setting can be changed per channel in 1% steps from 0% to 100%.

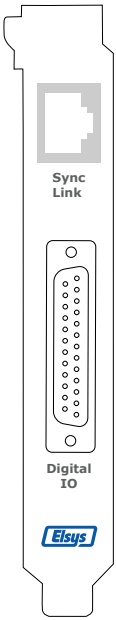
Attention

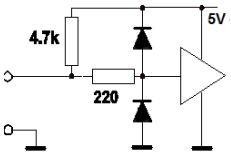
- Max. Input Voltage ± 100 VDC
- 7 V_{rms} with 50 Ω input switched on.

2.2 Digital In/Out and Markers

Pin Out

Function	Description	Pin #	Input / Output
Trigger Out	TTL Pulse when device has triggered	1	Output
Armed Sync Clock Out	High when device is ready for trigger / Synchronization Clock Output (Configured in TranAX)	14	Output
!Disarm	Deactivate any trigger when low	15	Input
Start Recording	Start Recording at negative slope	3	Input
Trigger In	TLL Trigger input Note: There is no hysteresis. Therefore the trigger signal must have a minimum slew rate of 4 V/us. Otherwise, the triggering can take place on the wrong edge.	16	Input
Timebase In / PPS	External Timebase input or GPS PPS Input	4	Input
+5V	Power Output (max 500 mA)	17	Power Output
GND	Chassis Ground	5	
Marker A1	Digital Inputs Board A TTL Level (with internal Pull-Up)	18	Input
Marker A2		6	Input
Marker A3		19	Input
Marker A4		7	Input
Marker A5		20	Input
Marker A6		8	Input
Marker A7		21	Input
Marker A8		9	Input
Marker B1	Digital Inputs Board B TTL Level (with internal Pull-Up)	22	Input
Marker B2		10	Input
Marker B3		23	Input
Marker B4		11	Input
Marker B5		24	Input
Marker B6		12	Input
Marker B7		25	Input
Marker B8		13	Input

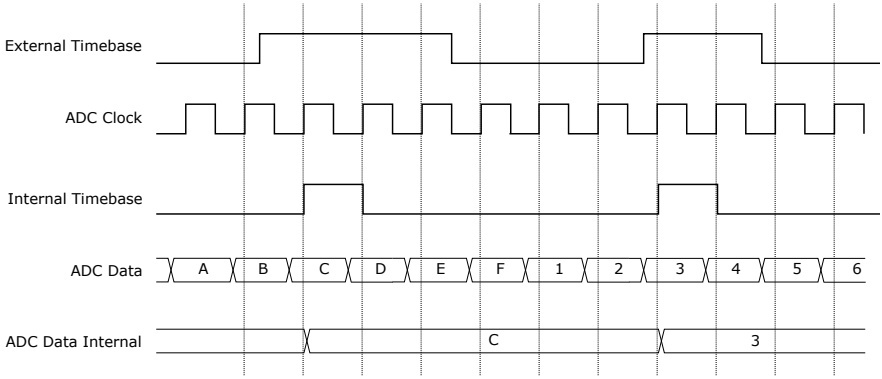




All digital inputs are pulled up to 5 V. Input Protection is ± 10 V for all inputs and outputs. Digital Marker inputs are captured synchronous with the ADC clock and are available when 14 bit resolution is used. In 16 bit mode, additional memory bits are needed and therefor no Marker are available.

External Timebase

The External Timebase can be used for capturing the measurement data at a specific moment. The external timebase is not a reference clock but will be synchronized to the internal ADC sampling clock. Therefor the external timebase must be at least two time slower than the ADC clock.



3. Specification

3.1 Power Consumption

Power Rail	4 Channel		8 Channel		4 Channel 120 & 240 MHz	
	Typ.	Max.	Typ.	Max.	Typ.	Max.
+ 3.3 V	-	-	-	-	-	-
+5 V	-	-	-	-	-	-
+ 12 V	1.3 A	2.0 A	2.2 A	3.3 A	1.4 A	2.2 A
- 12V	-	-	-	-	-	-
Total Power	15.6 W	24 W	26.4 W	39.6 W	16.8 W	26.4 W

3.2 Operating Conditions

- 0 - 45° C, 0 - 60° width active air circulation
- Max. Operating Altitude: 2000m

3.3 Mechanical Specification

TPCE

- 4 Lane PCIe Bus (x4)
- Size approx. 185x105 mm.
- 8-channel boards need 2 slots.
- With differential modules the number of required slots has to be doubled.

TPCE-LE

- 1 Lane PCIe Bus (x1)
- Size approx. 185x105 mm.
- 8-channel boards need 2 slots.
- With differential modules the number of required slots has to be doubled.

3.4 TPCE Specification

Module Type	TPCE-24016-4	TPCE-12016-4	TPCE-8016-4/8	TPCE-4016-4/8	
Number of Input Channels SE Module	4 single ended or 2 differential software switchable		4-Channel Modules: 4 single ended or 2 differential 8-Channel Modules: 8 single ended or 4 differential		
Number of Input Channels DIF Module	4 single ended or 4 differential software switchable		4-Channel Modules: 4 single ended or 4 differential 8-Channel Modules: 8 single ended or 8 differential		
Max. Sample Rate (all channels are sampled simultaneously)	**240 MHz**	**120 MHz**	**80 MHz**	**40 MHz**	
Amplitude Resolution	16 Bit up to 60 MHz 14 Bit up to 240 MHz	16 Bit up to 60 MHz 14 Bit up to 120 MHz	16 Bit up to 20 MHz 14 Bit up to 80 MHz	16 Bit up to 10 MHz 14 Bit up to 40 MHz	
Memory 4 Channel Module	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Memory 8 Channel Module	-		Standard: 8 x 16 MWords (= 256 MByte) Optional: 8 x 64 MWords (= 1 GByte)		
Input Amplifier					
Measurement Ranges	±50 mV – ±50 V rsp. 0.1 V – 100 V (100 V limited to 70 V) in 1, 2, 5 Steps				
Offset	0 – 100 % in steps of 0.1% (Resolution 0.01 %)				
Input Impedance	1 MΩ (± 0.2 %) or 50 Ω (± 0.5 %) // 26 pF (± 5 %)		1 MΩ (± 0.2 %) // 35 pF (± 5 %)		
Coupling	AC / DC software switchable (AC: -3 dB at < 5 Hz), Inputs invertible				
Bandwidth at Range ≥ 1 V	120 MHz	60 MHz	30 MHz	18 MHz	
Bandwidth at Range < 1 V	80 MHz	50 MHz	8 MHz	7 MHz	
Slew Rate (10 – 90 %) @ Range ≥ 1 V	4 ns	6 ns	13 ns	25 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	6 ns	9 ns	50 ns	60 ns	
Settling Time to 1%	< 200 ns	< 200 ns	< 200ns	< 200 ns	
Low Pass Filter (RC-Filter)	2 Steps (1 MHz and 100 kHz) software switchable				
Antialiasing-Filter (optional)	200 Hz – 5 MHz, min. 4. order Butterworth, software setable				
Common Mode Range	Differential-Mode: ±8 V or +/-80 V at ranges. > 5 V				
Common Mode Rejection	> 74 dB (DC – 1 kHz); > 60 dB (– 100 kHz); > 40 dB (– 5 MHz)				
Range Error (±)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.03 % (after autocalibration)		
Offset Error (±)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.02 % (after autocalibration)		
Offset Drift (±)	max. (0.0100 % + 0.1 mV) per °C, typ. (0.0050 % + 0.03 mV) per °C (will be compensated by autocalibration)				
Input Noise: @ max. Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 < 0.250 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.025 mVrms	 < 0.200 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.025 mVrms	 < 0.200 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.020 mVrms	 < 0.180 mVrms < 0.110 mVrms < 0.060 mVrms < 0.040 mVrms < 0.015 mVrms	*2
Signal to Noise Ratio SNR: @ max. Sample Rate @ 10 MHz Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 58 dB 70 dB 72 dB 77 dB 81 dB 84 dB	 60 dB 70 dB 72 dB 77 dB 81 dB 84 dB	 59 dB 62 dB 66 dB 69 dB 79 dB 89 dB	 62 dB 68 dB 70 dB 74 dB 82 dB 90 dB	*3
Channel Isolation (Crosstalk) @ 10 kHz Ranges < 1V	> 74 dB		> 80 dB > 60 dB		
Special : Autocalibration	Auto adjustment of gain and offset in all measurement ranges. (Initiated by software)				
Trigger					
Number of Trigger Channels	4 coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT				
Advanced Trigger (Option)	On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long = Missing Event), State (above / below), AND link, Product (trigger signal is calculated from 2 channels)				
External Trigger input	1 per System (TTL), pos. or neg. Edge				
Trigger Delay	-100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps				
Miscellaneous					
Digital Inputs (Marker)	8 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				
Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, Ext. Sampling (fmax = 10 MHz), external command to start recording				
Status Outputs (TTL)	Trigger Output, Armed (=True during recording)				
ICP® Sensor Supply (Option)	4mA Integrated Current Power for piezo sensors				

Module Type	TPCE-2016-4/8	TPCE-1016-4/8	TPCE-0516-4/8	TPCE-0216-4/8	
Number of Input Channels SE Module	4-Channel Modules: 4 single ended or 2 differential 8-Channel Modules: 8 single ended or 4 differential				
Number of Input Channels DIF Module	4-Channel Modules: 4 single ended or 4 differential 8-Channel Modules: 8 single ended or 8 differential				
Max. Sample Rate (all channels are sampled simultaneously)	**20 MHz**	**10 MHz**	**5 MHz**	**2 MHz**	
Amplitude Resolution	16 Bit up to 5 MHz 14 Bit up to 20 MHz	16 Bit up to 5 MHz 14 Bit up to 10 MHz	16 Bit up to 5 MHz	16 Bit up to 2 MHz	
Memory 4 Channel Module	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Memory 8 Channel Module	Standard: 8 x 16 MWords (= 256 MByte) Optional: 8 x 64 MWords (= 1 GByte)				
Input Amplifier					
Measurement Ranges	±50 mV – ±50 V rsp. 0.1 V – 100 V (100 V limited to 70 V) in 1, 2, 5 Steps				
Offset	0 – 100 % in steps of 0.1% (Resolution 0.01 %)				
Input Impedance	1 MΩ (± 0.2 %) // 35 pF (± 5 %)				
Coupling	AC / DC software switchable (AC: -3 dB at < 5 Hz), Inputs invertible				
Bandwidth at Range ≥ 1 V	10 MHz	5 MHz	2.5 MHz	1 MHz	
Bandwidth at Range < 1 V	6 MHz	4 MHz	2.5 MHz	1 MHz	
Slew Rate (10 – 90 %) @ Range ≥ 1 V	40 ns	70 ns	80 ns	180 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	70 ns	80 ns	80 ns	180 ns	
Settling Time to 1%	< 200ns	< 200 ns	< 300 ns	< 500 ns	
Low Pass Filter (RC-Filter)	2 Steps (1 MHz and 100 kHz) software switchable				
Antialiasing-Filter (optional)	200 Hz – 5 MHz, min. 4. order Butterworth, software setable				
Common Mode Range	Differential-Mode: ±8 V or +/-80 V at ranges. > 5 V				
Common Mode Rejection	> 74 dB (DC – 1 kHz); > 60 dB (– 100 kHz); > 40 dB (– 20 MHz)				
Range Error (±)	max. 0.1 % typ. 0.03 % (after autocalibration)				
Offset Error (±)	max. 0.1 % typ. 0.03 % (after autocalibration)				
Offset Drift (±)	max. (0.0100 % + 0.1 mV) per °C, typ. (0.0050 % + 0.03 mV) per °C (will be compensated by autocalibration)				
Input Noise: @ max. Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 < 0.080 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.080 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.060 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.060 mVrms - < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	*2
Signal to Noise Ratio SNR: @ max. Sample Rate @ 10 MHz Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 67 dB 70 dB 72 dB 79 dB 84 dB 90 dB	 70 dB 70 dB 72 dB 79 dB 84 dB 90 dB	 72dB - 72 dB 79 dB 84 dB 90 dB	 72 dB - - 79 dB 84 dB 90 dB	*3 *4
Channel Isolation (Crosstalk) @ 10 kHz Ranges < 1V	> 80 dB > 60 dB				
Special : Autocalibration	Auto adjustment of gain and offset in all measurement ranges. (Initiated by software)				
Trigger					
Number of Trigger Channels	4 or 8, coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT				
Advanced Trigger (Option)	On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long = Missing Event), State (above / below), AND link, Product (trigger signal is calculated from 2 channels)				
External Trigger input	1 per System (TTL), pos. or neg. Edge				
Trigger Delay	-100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps				
Miscellaneous					
Digital Inputs (Marker)	8 rsp. 16 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				
Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, Ext. Sampling (fmax = ¼ of the max sample rate), external command to start recording				
Status Outputs (TTL)	Trigger Output, Armed (=True during recording)				
ICP® Sensor Supply (Option)	4mA Integrated Current Power for piezo sensors				

*1) At 16 bit modules, the resolution will be reduced to 14 bits at sample rates over 1/4 of the max. sample rate.

*2) The input noise depends on the sample rate.

*3) At 14 bit modules the SNR will be reduced by 2 dB

*4) At 8-channel modules the SNR will be reduced by 3 dB

3.5 TPCE-LE Specification

Module Type	TPCE-LE-24014-4	TPCE-LE-12014-4	TPCE-LE-8014-4/8	TPCE-LE-4014-4/8	
Number of Input Channels SE Module	4 single ended or 2 differential software switchable		4-Channel Modules: 4 single ended or 2 differential 8-Channel Modules: 8 single ended or 4 differential		
Number of Input Channels DIF Module	4 single ended or 4 differential software switchable		4-Channel Modules: 4 single ended or 4 differential 8-Channel Modules: 8 single ended or 8 differential		
Max. Sample Rate (all channels are sampled simultaneously)	**240 MHz**	**120 MHz**	**80 MHz**	**40 MHz**	
Amplitude Resolution	14 Bit up to 240 MHz (16 Bit up to 60 MHz optional)	14 Bit up to 120 MHz (16 Bit up to 60 MHz optional)	14 Bit up to 80 MHz (16 Bit up to 20 MHz optional)	14 Bit up to 40 MHz (16 Bit up to 10 MHz optional)	
Memory 4 Channel Module	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Memory 8 Channel Module	-		Standard: 8 x 16 MWords (= 256 MByte) Optional: 8 x 64 MWords (= 1 GByte)		
Input Amplifier					
Measurement Ranges	±100 mV – ±25 V rsp. 0.2 V – 50 V in 1, 2, 5 Steps				
Offset	0 – 100 % in steps of 0.1% (Resolution 0.01 %)				
Input Impedance	1 MΩ (± 0.2 %) or 50 Ω (± 0.5 %) // 26 pF (± 5 %)		1 MΩ (± 0.2 %) // 35 pF (± 5 %)		
Coupling	AC / DC software switchable (AC: -3 dB at < 5 Hz), Inputs invertible				
Bandwidth at Range ≥ 1 V	120 MHz	60 MHz	30 MHz	18 MHz	
Bandwidth at Range < 1 V	80 MHz	50 MHz	8 MHz	7 MHz	
Slew Rate (10 – 90 %) @ Range ≥ 1 V	4 ns	6 ns	13 ns	25 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	6 ns	9 ns	50 ns	60 ns	
Settling Time to 1%	< 200 ns	< 200 ns	< 200ns	< 200 ns	
Low Pass Filter (RC-Filter)	2 Steps (1 MHz and 100 kHz) software switchable				
Antialiasing-Filter (optional)	200 Hz – 5 MHz, min. 4. order Butterworth, software setable				
Common Mode Range	Differential-Mode: ±8 V or +/-80 V at ranges. > 5 V				
Common Mode Rejection	> 60 dB (DC – 1 kHz); > 54 dB (– 100 kHz); > 40 dB (– 20 MHz)				
Range Error (±)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.03 % (after autocalibration)		
Offset Error (±)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.02 % (after autocalibration)		
Offset Drift (±)	max. (0.0100 % + 0.1 mV) per °C, typ. (0.0050 % + 0.03 mV) per °C (will be compensated by autocalibration)				
Input Noise: @ max. Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 < 0.250 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.025 mVrms	 < 0.200 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.025 mVrms	 < 0.200 mVrms < 0.120 mVrms < 0.070 mVrms < 0.040 mVrms < 0.020 mVrms	 < 0.180 mVrms < 0.110 mVrms < 0.060 mVrms < 0.040 mVrms < 0.015 mVrms	*2
Signal to Noise Ratio SNR: @ max. Sample Rate @ 10 MHz Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 58 dB 70 dB 72 dB 77 dB 81 dB 84 dB	 60 dB 70 dB 72 dB 77 dB 81 dB 84 dB	 59 dB 62 dB 66 dB 69 dB 79 dB 89 dB	 62 dB 68 dB 70 dB 74 dB 82 dB 90 dB	*3
Channel Isolation (Crosstalk) @ 10 kHz Ranges < 1V	> 74 dB		> 80 dB > 60 dB		
Special : Autocalibration	Auto adjustment of gain and offset in all measurement ranges. (Initiated by software)				
Trigger					
Number of Trigger Channels	4 coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT				
Advanced Trigger (Option)	On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long = Missing Event), State (above / below), AND link, Product (trigger signal is calculated from 2 channels)				
External Trigger input	1 per System (TTL), pos. or neg. Edge				
Trigger Delay	-100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps				
Miscellaneous					
Digital Inputs (Marker)	8 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				
Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, Ext. Sampling (fmax = 10 MHz), external command to start recording				
Status Outputs (TTL)	Trigger Output, Armed (=True during recording)				
ICP® Sensor Supply (Option)	4mA Integrated Current Power for piezo sensors				

Module Type	TPCE-LE-2014-4/8	TPCE-LE-1014-4/8	TPCE-LE-0514-4/8	TPCE-LE-0214-4/8	
Number of Input Channels SE Module	4-Channel Modules: 4 single ended or 2 differential 8-Channel Modules: 8 single ended or 4 differential				
Number of Input Channels DIF Module	4-Channel Modules: 4 single ended or 4 differential 8-Channel Modules: 8 single ended or 8 differential				
Max. Sample Rate (all channels are sampled simultaneously)	20 MHz	10 MHz	5 MHz	2 MHz	
Amplitude Resolution	14 Bit up to 20 MHz (16 Bit up to 5 MHz optiona)	14 Bit up to 10 MHz (16 Bit up to 5 MHz optional)	14 Bit (16 Bit Optional)	14 Bit (16 Bit Optional)	
Memory 4 Channel Module	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Memory 8 Channel Module	Standard: 8 x 16 MWords (= 256 MByte) Optional: 8 x 64 MWords (= 1 GByte)				
Input Amplifier					
Measurement Ranges	±100 mV – ±25 V rsp. 0.2 V – 50 V in 1, 2, 5 Steps				
Offset	0 – 100 % in steps of 0.1% (Resolution 0.01 %)				
Input Impedance	1 MΩ (± 0.2 %) // 35 pF (± 5 %)				
Coupling	AC / DC software switchable (AC: -3 dB at < 5 Hz), Inputs invertible				
Bandwidth at Range ≥ 1 V	10 MHz	5 MHz	2.5 MHz	1 MHz	
Bandwidth at Range < 1 V	6 MHz	4 MHz	2.5 MHz	1 MHz	
Slew Rate (10 – 90 %) @ Range ≥ 1 V	40 ns	70 ns	80 ns	180 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	70 ns	80 ns	80 ns	180 ns	
Settling Time to 1%	< 200ns	< 200 ns	< 300 ns	< 500 ns	
Low Pass Filter (RC-Filter)	2 Steps (1 MHz and 100 kHz) software switchable				
Antialiasing-Filter (optional)	200 Hz – 5 MHz, min. 4. order Butterworth, software setable				
Common Mode Range	Differential-Mode: ±8 V or +/-80 V at ranges. > 5 V				
Common Mode Rejection	> 60 dB (DC – 1 kHz); > 54 dB (– 100 kHz); > 40 dB (– 1 MHz)				
Range Error (±)	max. 0.1 % typ. 0.03 % (after autocalibration)				
Offset Error (±)	max. 0.1 % typ. 0.03 % (after autocalibration)				
Offset Drift (±)	max. (0.0100 % + 0.1 mV) per °C, typ. (0.0050 % + 0.03 mV) per °C (will be compensated by autocalibration)				
Input Noise: @ max. Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 < 0.080 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.080 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.060 mVrms < 0.060 mVrms < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	 < 0.060 mVrms - < 0.030 mVrms < 0.020 mVrms < 0.010 mVrms	*2
Signal to Noise Ratio SNR: @ max. Sample Rate @ 10 MHz Sample Rate @ 5 MHz Sample Rate @ 1 MHz Sample Rate @ 100 kHz Sample Rate @ 10 kHz Sample Rate	 67 dB 70 dB 72 dB 79 dB 84 dB 90 dB	 70 dB 70 dB 72 dB 79 dB 84 dB 90 dB	 72dB - 72 dB 79 dB 84 dB 90 dB	 72 dB - - 79 dB 84 dB 90 dB	*3 *4
Channel Isolation (Crosstalk) @ 10 kHz Ranges < 1V	> 80 dB > 60 dB				
Special : Autocalibration	Auto adjustment of gain and offset in all measurement ranges. (Initiated by software)				
Trigger					
Number of Trigger Channels	4 or 8, coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT				
Advanced Trigger (Option)	On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long = Missing Event), State (above / below), AND link, Product (trigger signal is calculated from 2 channels)				
External Trigger input	1 per System (TTL), pos. or neg. Edge				
Trigger Delay	-100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps				
Miscellaneous					
Digital Inputs (Marker)	8 rsp. 16 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				
Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, Ext. Sampling (fmax = ¼ of the max sample rate), external command to start recording				
Status Outputs (TTL)	Trigger Output, Armed (=True during recording)				
ICP® Sensor Supply (Option)	4mA Integrated Current Power for piezo sensors				

*2) The input noise depends on the sample rate.
*3) At 14 bit modules the SNR will be reduced by 2 dB
*4) At 8-channel modules the SNR will be reduced by 3 dB

4. Synchronization

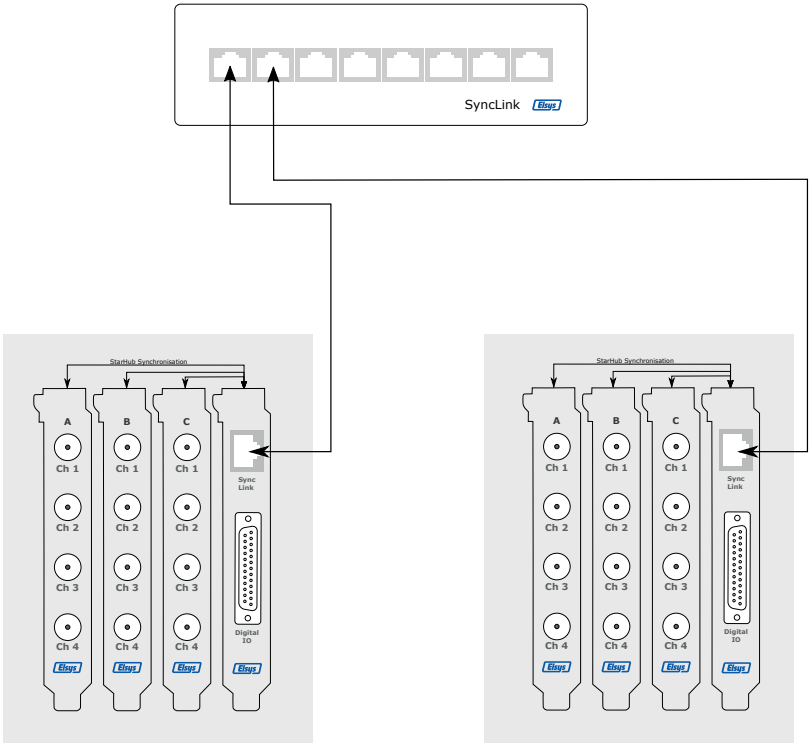
4.1 StarHub

The StarHub synchronization board allows to synchronize up to 16 Boards inside of an instruments. The StarHub generates a master Clock and distributes any Trigger event from and to all connected boards. This way, every board in the system can be source and destination of any trigger event. The synchronization precision is one sample over all connected boards.

4.2 SyncLink

The SyncLink is the next higher level of synchronization and allows to synchronize up to 8 instruments. The connection is made over standard Cat. 6 Ethernet cables up to 10 m length. When connected, the SyncLink act as master clock generator and distributes any trigger event from and to all devices. Any device can be the source of the trigger.

Note: No measurement data are transmitted over the Sync-Link connection. Therefor an Ethernet connection must be established in addition.



5. Software API

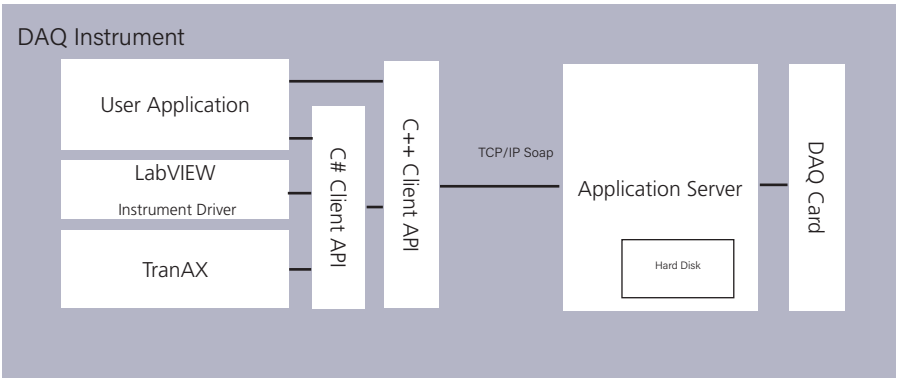
All DAQ cards as also the TraNET devices are based on the same Server-Client Software architecture. Any client application can access the data acquisition device over an IP address either locally or over a network. This way distributed measurement set-ups can be easily built-up.

The lowest level accessible from a user application is a C++ interface. This interface handles all network communication between the Application and the Application Server.

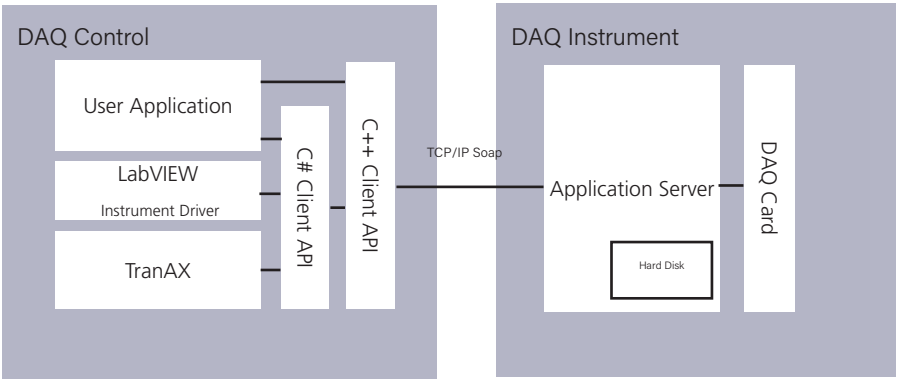
C# Applications can access a high level API for easy software integration. Several application can access the same device on the same time and get updated about any status change of the device automatically.

For more information visit:
https://www.elsys-instruments.com/en/rdk-tp-caccess/

https://github.com/elsysdaq/tpcaccess



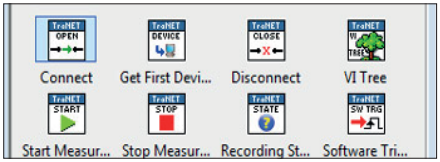
Control/DAQ Software runs on machine where the DAQ cards are installed



Control/DAQ Software runs on a different machine and controls multiple DAQ instruments.

5.1 LabVIEW

Elsys provides a LabVIEW instrument driver which is fully compliant with the NI driver design guidelines.



The application server encapsulates all necessary task for controlling the different measurement modes described above, including data streaming to the hard drive. Therefor no challenging programming is needed for streaming application as this is already integrated into the Server software.

For more information visit:

https://www.elsys-instruments.com/en/lab-view/

EU Declaration of Conformity

Declaration Number: 231014

The Manufacturer: Elsys AG
Mellingerstrasse 12
5443 Niederrohrdorf
Switzerland

Declare that the product: **Data Acquisition Module TPCE | TPCE-LE | TPCE-GN**

4 or 8 channel data acquisition modules with voltage and IEPE input channel type and 2 to 240 MS/s max sampling rate.

is conformal to the following directives and standards:

Product Standards:
IEC 61326-1:2020 (ed.3.0)
CISPR 11:2015 class B
CISPR 11:2015/AMD1:2016 class B
CISPR 11:2015/AMD2:2019 class B
CISPR 32:2015 class B
CISPR 32:2015/AMD1:2019 class B

Basic Standards:
EN 61000-3-2:2019
IEC 61000-3-2:2018/AMD1:2020
EN 61000-3-3:2013+AMD:2019
IEC 61000-3-3:2013
IEC 61000-3-3:2013/AMD1:2017
IEC 61000-3-3:2013/AMD2:2021
EN 61000-4-2:2009
IEC 61000-4-2:2008
EN 61000-4-3:2020
IEC 61000-4-3:2020
EN 61000-4-4:2012
IEC 61000-4-4:2012
EN 61000-4-5:2014+A1:2017
IEC 61000-4-5:2014
IEC 61000-4-5:2014/AMD1:2017
EN 61000-4-6:2014IEC 61000-4-6:2013 (ed 4.0)
EN 61000-4-8:2010
IEC 61000-4-8:2009
EN 61000-4-11:2020
IEC 61000-4-11:2020

This declaration of conformity is issued under the exclusive responsibility of the manufacturer.

Niederrohrdorf, 09.10.2023

Elsys AG
Roman Bertschi

File Revision:

Date	Description
29.01.2021	Manual Update
09.11.2023	Manual Update