

TraNET® FE 204/404 MK3

Data Acquisition Instrument



The family of modular TraNET data acquisition instruments provides turnkey solutions to many complex measurement problems. TraNET data acquisition systems are flexible, compact and portable. They can be used to solve in situ problems in many different applications like blast, ballistics, automotive, power or transportation systems. With the Continuous Data Recorder mode, a long duration event can be stored to disk, gap free in real-time, and analysed later. If applications require complex triggering across many channels, TraNET can help you capture sequential blocks of data, without any loss, using the unique ECR Event Controlled Recording mode. The powerful application software TranAX not only helps to quickly configure

many acquisition channels, but also provides the right post-processing tools to analyse complex waveforms.

The TraNET FE 204/404 can be equipped the powerful TPCE data acquisition card and is available as 4 to 16 channel device. Larger channel counts can be realized by either synchronizing several TraNET devices or with the TraNET FE 408 DP device which available also as 32 channel instrument.

General Specification

Connection	Ethernet 1 GBit, RJ45 front connector USB3 port for external HD
Harddisk	400 GB SSD
Power Supply	100 V - 250 V, 50/60 Hz
DC Power (Optional)	10 - 36 V DC
Power Consumption	~ 40 - 60 W (depends on the installed DAQ card)
Operating Condition	0 .. 45 °C Rel. Humidity: - Up to 31°C: < 80% , - 31°C ..45°C: decreasing to < 50% Max. Operating Elevation: 2'000m
Storage Temperature	-20 .. 60 °C
Channel Configuration	TraNET FE 204: 4 SE, 8 SE, 4 DIFF TraNET FE 404: 4 SE, 8 SE, 12 SE, 16 SE, 4 DIFF, 8 DIFF
Recording Modes	Scope, Multi Block, Continuous, Event Controlled Recording (ECR), Dual Sampling Rate (with ECR only)
Digital IO's (TTL)	Trigger In, Trigger Out, External Timebase In, Disarm In, Armed Out, SyncClock Out Optional: 8 Digital Marker Inputs
Synchronisation	SynLink Port, IEEE 1588 (PTP) Optional: Internal GPS receiver
Software	TranAX 4 LE, TranAX 4 LabVIEW Instrument Driver C++/C#/Python API
Mechanical Specification	TraNET FE 204: 234 x 76 x 289 mm TraNET FE 404: 234 x 115 x 289 mm



TraNET FE 204

TraNET FE 204 devices are equipped with up to two 4-channel modules or one 8-channel TPCE DAQ module.

On Single Ended modules (SE), two inputs can be linked together for having a differential input. Differential ended modules (Diff) can also be used in single ended mode by using only the positive input.

For more detailed information see the specification table.

Dimensions & Weight

- 234 x 76 x 289 mm
- 3.1 kg

Model Name	# of Channels		Max. Sample Rate	ADC Resolution	Memory per channel*
	SE	DIFF			
1x4S/02/16	4	2	2 MS/s	16 Bit	32 MS (128 MS)
1x4D/02/16	4	4			
2x4S/02/16	8	4			
1x8S/02/16	8	4			16 MS (64 MS)
1x4S/10/16	4	2	10 MS/s	14 Bit 16 Bit up to 5 MS/s	32 MS (128 MS)
1x4D/10/16	4	4			
2x4S/10/16	4	2			
1x8S/10/16	8	4			16 MS (64 MS)
1x4S/20/16	4	2	20 MS/s	14 Bit 16 Bit up to 5 MS/s	32 MS (128 MS)
1x4D/20/16	4	4			
2x4S/20/16	8	4			
1x8S/20/16	8	4			16 MS (64 MS)
1x4S/40/16	4	2	40 MS/s	14 Bit 16 Bit up to 10 MS/s	32 MS (128 MS)
1x4D/40/16	4	4			
2x4S/40/16	8	4			
1x8S/40/16	8	4			16 MS (64 MS)
1x4S/80/16	4	2	80 MS/s	14 Bit 16 Bit up to 20 MS/s	32 MS (128 MS)
1x4D/80/16	4	4			
2x4S/80/16	8	4			
1x8S/80/16	8	4			16 MS (64 MS)
1x4S/120/16	4	2	120 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
1x4D/120/16	4	4			
2x4S/120/16	8	4			
1x4S/240/16	4	2	240 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
1x4D/240/16	4	4			
2x4S/240/16	8	4			

TraNET 204 FE Device Configurations

* Values in () are optional



TraNET FE 404

TraNET FE 404 devices are equipped with up to four 4-channel modules or two 8-channel TPCE DAQ modules.

On Single Ended modules (SE) two inputs can be linked together for having a differential input. Differential ended modules (Diff) can also be used in single ended mode by using only the positive input.

Dimensions & Weight

- 234 x 115 x 289 mm
- 4.3 kg

Model Name	# of channels		Max. Sample Rate	ADC Resolution	Memory per channel*
	SE	DIFF			
3x4S/02/16	12	6	2 MS/s	16 Bit	32 MS (128 MS)
2x4D/02/16	8	8			
4x4S/02/16	16	8			
2x8S/02/16	16	8			16 MS (64 MS)
3x4S/10/16	12	6	10 MS/s	14 Bit 16 Bit up to 5 MS/s	32 MS (128 MS)
2x4D/10/16	8	8			
4x4S/10/16	16	8			
2x8S/10/16	16	8			16 MS (64 MS)
3x4S/20/16	12	6	20 MS/s	14 Bit 16 Bit up to 5 MS/s	32 MS (128 MS)
2x4D/20/16	8	8			
4x4S/20/16	16	8			
2x8S/20/16	16	8			16 MS (64 MS)
3x4S/40/16	12	6	40 MS/s	14 Bit 16 Bit up to 10 MS/s	32 MS (128 MS)
2x4D/40/16	8	8			
4x4S/40/16	16	8			
2x8S/40/16	16	8			16 MS (64 MS)
3x4S/80/16	12	6	80 MS/s	14 Bit 16 Bit up to 20 MS/s	32 MS (128 MS)
2x4D/80/16	8	8			
4x4S/80/16	16	8			
2x8S/18/16	16	8			16 MS (64 MS)
3x4S/120/16	12	6	120 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
2x4D/120/16	8	8			
4x4S/120/16	16	8			
3x4S/240/16	12	6	240 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
2x4D/240/16	8	8			
4x4S/240/16	16	8			

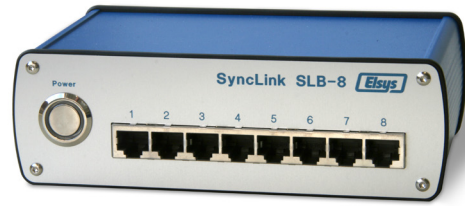
TraNET 404 FE Device Configurations

* Values in () are optional

Device Synchronization

The synchronization of several TraNET FE devices has always been a strength of Elsys measuring devices. With the help of the synchronization unit **SyncLink SLB-8** or **SyncLink 2.0**, several TraNET FE devices can be precisely synchronized on a sample basis. Not only is the internal timebase of all devices synchronized, but trigger messages are also transmitted with sample accuracy.

The latest generation MK3 of the TraNET FE devices now also masters the network synchronization standard **IEEE-1588 (PTP: Precision Time Protocol)** and enables, on the one hand, much simpler synchronization topologies since no additional cables are required for synchronization and, on the other hand, the TraNET FE devices can be easily synchronized with other data acquisition systems or devices such as high-speed cameras.



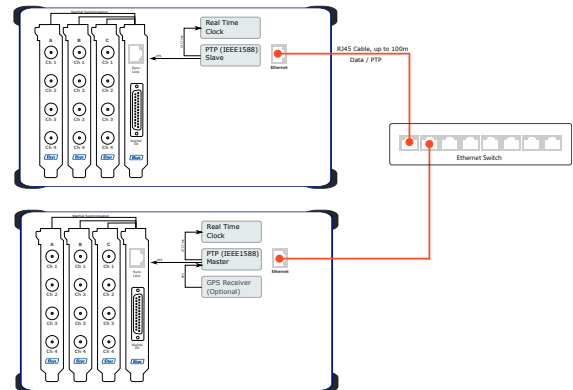
SyncLink Synchronization Box

Specification SyncLink

- Timing precision: < 12.5 ns
- Connector/Cable: RJ45, Cat. 6
- Max Cable length: 50 m

Specification PTP/GPS/PPS:

- Timing precision: ± 2 us
(PTP: depends on network infrastructure)
- Long time drift: 0 ppm



DC Powered

TraNET FE devices are equipped with an internal 110/230V AC power supply. Optional the device is available with a DC power supply input. This allows to use 12 V car DC power or solar panels and battery packs. DC powered TraNET FE are delivered with an external 110/230V AC/DC power supply for using the device at the standard main power line.

Specification:

- Input Voltage: 10 - 36 VDC
- Power Consumption: 30 - 60 W
(depends on installed cards)
- Powerplug: SFV 40 (IEC 60130-9)



Dust-Proof

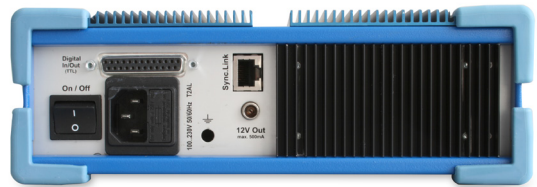
TraNET FE Dust-Proof devices are the perfect data acquisition instruments for dusty and muddy environment. They do not have any ventilation to the outside, preventing any air flow entering the device.

The Dust-Proof option is available for the 204 or 404 chassis type and all different sampling rates.



Operating conditions

- Operating Temperature: 0 .. 35 °C, higher temperature possible when free air flow is applied over the instrument.
- Storage Temperature: -20 .. 60 °C
- Rel. Humidity: Up to 31°C: < 80%
- 31°C ..45°C: decreasing to < 50%
- Max. Operating Elevation: 2'000m



TranAX 4

TranAX 4 is the universal data acquisition software from Elsys designed for all types of data acquisition cards and the turnkey TraNET data acquisition instruments.

Key Features

- Configures quick and easy many analog input channels, no programming required
- Data visualization in Multi-Waveform displays
- Several cursor for easy data readout and reporting
- X-Y data display
- FFT Analysis

- Measurement data - video synchronization
- More than 40 scalar functions to measure any significant waveform parameter on time or FFT curves
- Powerful formula editor for more than 60 mathematics functions, syntax highlighting, for-loops, array calculations, string manipulations, etc.
- Curve fitting (Polynomial regression)
- Autosequence-macro's for easy to set up, fast automated measurements
- English, German and Chinese version

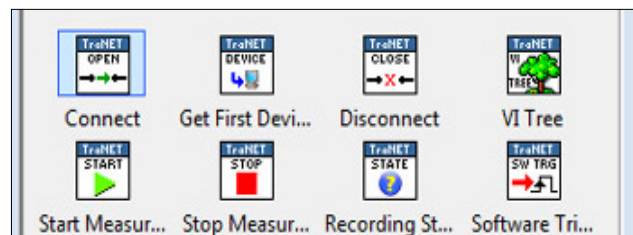


LabVIEW Instrument Driver

Elsys provides a LabVIEW instrument driver which is fully compliant with the NI driver design guidelines. The instrument drivers provides the following features:

Key Features:

- Ready-made measurement flow-control VI's for scope, multi-block, continuous and ECR measurement modes
- Express VI's for amplifier and trigger settings
- VI's for data readout
- Express VI's for setup the connection to the modules/instruments



Data Acquisition Card Specification

TPCE DAQ Card

Module Type	TPCE-24016-4	TPCE-12016-4	TPCE-8016-4	TPCE-4016-4	
Number of Input Channels SE Module	4 single ended or 2 differential software switchable		4 single ended or 2 differential software switchable		
Number of Input Channels DIF Module	4 single ended or 4 differential software switchable		4 single ended or 4 differential software switchable		
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 (per Module)	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Input Amplifier					
Measurement Ranges	± 50 mV – ± 50 V resp. 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 M Ω (\pm 0.2 %) or 50 Ω (\pm 0.5 %) // 26 pF (\pm 5 %)		1 M Ω (\pm 0.2 %) // 35 pF (\pm 5 %)		
Coupling	AC / DC software switchable (AC: -3 dB at < 5 Hz), Inputs invertible				
Bandwidth at Range \geq 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 \geq 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 (\pm)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.03 % (after autocalibration)		
Offset Error (\pm)	max. 0.1 % typ. 0.07 % (after autocalibration)		max. 0.1 % typ. 0.02 % (after autocalibration)		
Offset Drift (\pm)	max. (0.0100 % + 0.1 mV) per $^{\circ}$ C, typ. (0.0050 % + 0.03 mV) per $^{\circ}$ C (will be compensated by autocalibration)				
Input Noise:					
@ max. Sample Rate	< 0.250 mVrms	< 0.200 mVrms	< 0.200 mVrms	< 0.180 mVrms	*2
@ 5 MHz Sample Rate	< 0.120 mVrms	< 0.120 mVrms	< 0.120 mVrms	< 0.110 mVrms	
@ 1 MHz Sample Rate	< 0.070 mVrms	< 0.070 mVrms	< 0.070 mVrms	< 0.060 mVrms	
@ 100 kHz Sample Rate	< 0.040 mVrms	< 0.040 mVrms	< 0.040 mVrms	< 0.040 mVrms	
@ 10 kHz Sample Rate	< 0.025 mVrms	< 0.025 mVrms	< 0.020 mVrms	< 0.015 mVrms	
Signal to Noise Ratio SNR:					
@ max. Sample Rate	58 dB	60 dB	59 dB	62 dB	*3
@ 10 MHz Sample Rate	70 dB	70 dB	62 dB	68 dB	
@ 5 MHz Sample Rate	72 dB	72 dB	66 dB	70 dB	
@ 1 MHz Sample Rate	77 dB	77 dB	69 dB	74 dB	
@ 100 kHz Sample Rate	81 dB	81 dB	79 dB	82 dB	
@ 10 kHz Sample Rate	84 dB	84 dB	89 dB	90 dB	
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 settable				
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	< 0.080 mVrms	< 0.080 mVrms	< 0.060 mVrms	< 0.060 mVrms	*2
@ 5 MHz Sample Rate	< 0.060 mVrms	< 0.060 mVrms	< 0.060 mVrms	-	
@ 1 MHz Sample Rate	< 0.030 mVrms	< 0.030 mVrms	< 0.030 mVrms	< 0.030 mVrms	
@ 100 kHz Sample Rate	< 0.020 mVrms	< 0.020 mVrms	< 0.020 mVrms	< 0.020 mVrms	
@ 10 kHz Sample Rate	< 0.010 mVrms	< 0.010 mVrms	< 0.010 mVrms	< 0.010 mVrms	
Signal to Noise Ratio SNR:					
@ max. Sample Rate	67 dB	70 dB	72dB	72 dB	*3 *4
@ 10 MHz Sample Rate	70 dB	70 dB	-	-	
@ 5 MHz Sample Rate	72 dB	72 dB	72 dB	-	
@ 1 MHz Sample Rate	79 dB	79 dB	79 dB	79 dB	
@ 100 kHz Sample Rate	84 dB	84 dB	84 dB	84 dB	
@ 10 kHz Sample Rate	90 dB	90 dB	90 dB	90 dB	
Channel Isolation (Crosstalk) @ 10 kHz	> 80 dB				
Ranges < 1V	> 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				

TPCE-LE DAQ Card

Module Type	TPCE-LE-24014-4	TPCE-LE-12014-4	TPCE-LE-8014-4	TPCE-LE-4014-4	
Number of Input Channels SE Module	4 single ended or 2 differential software switchable		4 single ended or 2 differential software switchable		
Number of Input Channels DIF Module	4 single ended or 4 differential software switchable		4 single ended or 4 differential software switchable		
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 (per Module)	Standard: 4 x 32 MWords (= 256 MByte) Optional: 4 x 128 MWords (= 1 GByte)				
Input Amplifier					
Measurement Ranges	±100 mV – ±25 V resp. 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	59 dB 62 dB 66 dB 69 dB 79 dB 89 dB	62 dB 68 dB 70 dB 74 dB 82 dB 90 dB	67 dB 70 dB 72 dB 76 dB 84 dB 92 dB	70 dB 70 dB 72 dB 76 dB 84 dB 92 dB	*3
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 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 optional)	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

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