# TraNET® FE 204/404 мкз

### **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 poweful 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°C45°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	SyncLink 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 DAO 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.

<b>Dimens</b>	ions	& 1	Wei	ia	ht

- 234 x 76 x 289 mm
- 3.1 kg

Model Name # of 0		hannels	Max. Sample Rate	ADC Resolution	Memory		
	SE	DIFF			per channel*		
1x4S/02/16	4	2					
1x4D/02/16	4	4	2 MG/:	16 Bit	32 MS (128 MS)		
2x4S/02/16	8	4	2 MS/s				
1x8S/02/16	8	4			16 MS (64 MS)		
1x4S/10/16	4	2					
1x4D/10/16	4	4	10 MC/-	14 Bit	32 MS (128 MS)		
2x4S/10/16	4	2	10 MS/s	16 Bit up to 5 MS/s			
1x8S/10/16	8	4			16 MS (64 MS)		
1x4S/20/16	4	2					
1x4D/20/16	4	4	20.1467	20 Mg/s 14 Bit	32 MS (128 MS)		
2x4S/20/16	8	4	20 MS/c		16 E	16 Bit up to 5 MS/s	
1x8S/20/16	8	4			16 MS (64 MS)		
1x4S/40/16	4	2					
1x4D/40/16	4	4	10.1467	14 Bit	32 MS (128 MS)		
2x4S/40/16	8	4	40 MS/s	16 Bit up to 10 MS/s			
1x8S/40/16	8	4			16 MS (64 MS)		
1x4S/80/16	4	2					
1x4D/80/16	4	4		14 Bit	32 MS (128 MS)		
2x4S/80/16	8	4	80 MS/s	16 Bit up to 20 MS/s			
1x8S/80/16	8	4			16 MS (64 MS)		
1x4S/120/16	4	2					
1x4D/120/16	4	4	120 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)		
2x4S/120/16	8	4		2.c ap to 00 M3/3			
1x4S/240/16	4	2					
1x4D/240/16	4	4	240 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)		
2x4S/240/16	8	4		10 Dit up to 00 1413/3			

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	lodel Name # of chann		Max. Sample Rate	ADC Resolution	Memory
	SE	DIFF			per channel*
3x4S/02/16	12	6			
2x4D/02/16	8	8	2 MS/s	16 Bit	32 MS (128 MS)
4x4S/02/16	16	8	2 1013/5		
2x8S/02/16	16	8			16 MS (64 MS)
3x4S/10/16	12	6			
2x4D/10/16	8	8	10 MS/s	14 Bit	32 MS (128 MS)
4x4S/10/16	16	8	10 1013/5	16 Bit up to 5 MS/s	
2x8S/10/16	16	8			16 MS (64 MS)
3x4S/20/16	12	6			
2x4D/20/16	8	8	20 MS/s 16 Bit up to 5 MS/s	32 MS (128 MS)	
4x4S/20/16	16	8		16 Bit up to 5 MS/s	
2x8S/20/16	16	8			16 MS (64 MS)
3x4S/40/16	12	6			
2x4D/40/16	8	8	10.15	14 Bit	32 MS (128 MS)
4x4S/40/16	16	8	40 MS/s	16 Bit up to 10 MS/s	
2x8S/40/16	16	8			16 MS (64 MS)
3x4S/80/16	12	6			
2x4D/80/16	8	8		14 Bit	32 MS (128 MS)
4x4S/80/16	16	8	- 80 MS/s	16 Bit up to 20 MS/s	
2x8S/18/16	16	8			16 MS (64 MS)
3x4S/120/16	12	6			
2x4D/120/16	8	8	120 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
4x4S/120/16	16	8		1.0 Dit up to 00 Wisis	
3x4S/240/16	12	6			
2x4D/240/16	8	8	240 MS/s	14 Bit 16 Bit up to 60 MS/s	32 MS (128 MS)
4x4S/240/16	16	8		10 bit up to 00 Wisis	

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 can be easily synchronized with other data acquisition systems or devices such as high-speed cameras.

# Specification SyncLink

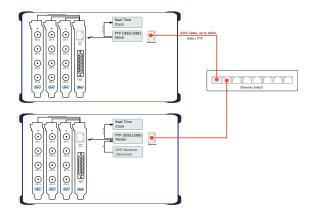
- Timing precision: < 12.5 ns</li>
- · Connector/Cable: RJ45, Cat. 6
- Max Cable length: 50 m

### Specification PTP/GPS/PPS:

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



SyncLink Synchronization Box



### **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 Consumtion: 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.

# Trailer 204S (Buyer)

### **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

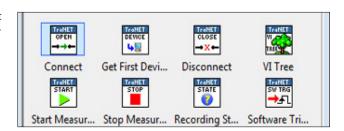


### **LabVIEW Instrument Driver**

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, multliblock, 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	9	or <b>4 differential</b> switchable	4 single ended or <b>4 differential</b> 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 10 MHz 14 Bit up to 40 MHz	
Memory (per Module)		Standard: 4 x 32 MV Optional: 4 x 128 N			
Input Amplifier					
Measurement Ranges	±50 mV - ±5	0 V rsp. 0.1 V – 100 V (	100 V limited to 70 V) ii	n 1, 2, 5 Steps	
Offset		0 – 100 % in steps of 0.			
Input Impedance	1 MΩ (± 0.2 %)	or 50 Ω (± 0.5 %) (± 5 %)		// 35 pF (± 5 %)	
Coupling		ftware switchable (AC:	-3 dB at < 5 Hz), Inpu	ts 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)		Steps (1 MHz and 100			
Antialiasing-Filter (optional)		200 Hz – 5 MHz, min. 4. order Butterworth, software setable			
Common Mode Range	Differential-Mode: $\pm 8 \text{ V}$ or $\pm 4.80 \text{ V}$ at ranges. $> 5 \text{ V}$				
Common Mode Rejection	> 74  dB (DC - 1  kHz); > 60  dB ( - 100  kHz); > 40  dB ( - 5  MHz)				
Range Error (±)	max. 0.1 % typ. 0.07 % max. 0.1 % typ. 0.03 % (after autocalibration) (after autocalibration)			71	
Offset Error (±)		max. 0.1 % typ. 0.07 % max. 0.1 % typ. 0.02 % (after autocalibration)			
Offset Drift (±)	max. (0.010	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  @ 100 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	> 7	4 dB		O dB O dB	
Special : Autocalibration	Auto adjustment o	f gain and offset in all m	neasurement ranges. (In	itiated by software)	
Trigger					
Number of Trigger Channels	4 coupled t	o analog inputs, pos./ne Window IN, \		it hysteresis,	
Advanced Trigger (Option)	9 ,	Slew Rate, Pulse Width te (above / below), AND 2 cha	link, Product (trigger sig		
External Trigger input		1 per System (TTL)	pos. or neg. Edge		
Trigger Delay	-100	% (Pretrigger) to +200		steps	
Miscellaneous	100			F -	
		8 (2 per analog	channel\ (TTL)		
Digital Inputs (Marker)		oupler Connection Box (	5 to 48 V) as additional		
Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, I	Ext. Sampling (fmax = 1	0 MHz), external comm	nand to start recording	
Status Outputs (TTL)		Trigger Output, Armed	(=True during recording	)	
ICP® Sensor Supply (Option)		4mA Integrated Current	D f		

Module Type	TPCE-2016-4/8	TPCF-1016-4/8	TPCE-0516-4/8	TPCE-0216-4/8		
		4-Channel Modules: 4 single ended or 2 differential				
Number of Input Channels SE Module		8-Channel Modules: 8 single ended or 4 differential				
Number of Input Channels DIF Module		4-Channel Modules: 4 single ended or <b>4 differential</b> 8-Channel Modules: 8 single ended or <b>8 differential</b>				
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 – ±5	0 V rsp. 0.1 V – 100 V (1	100 V limited to 70 V) in	n 1, 2, 5 Steps		
Offset	(	0 – 100 % in steps of 0.	1% (Resolution 0.01 %	b)		
Input Impedance		1 MΩ (± 0.2 %)				
Coupling		ftware switchable (AC:	•	ts 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)		Steps (1 MHz and 100				
Antialiasing-Filter (optional)	200 Hz	z – 5 MHz, min. 4. order	Butterworth, software	setable		
Common Mode Range	Di	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 autocallibration)				
Offset Error (±)		max. 0.1 % typ. 0.03 % (after autocalibration)				
Offset Drift (±)	max. (0.010	00 % + 0.1 mV) per °C, (will be compensated		mV) per °C		
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 > 60				
Special : Autocalibration	Auto adjustment o	f gain and offset in all m		itiated by software)		
Trigger	rato adjustificiti 0	. gain and onset in all II	.casarement ranges. (III			
Number of Trigger Channels	4 or 8, couple	d to analog inputs, pos Window IN, \		out hysteresis,		
Advanced Trigger (Option)		Slew Rate, Pulse Width e (above / below), AND 2 chai	, Pulse Pause or Period link, Product (trigger sig			
External Trigger input		1 per System (TTL),	,			
Trigger Delay	-100	% (Pretrigger) to +200		steps		
Miscellaneous	100	, : (, , ett.) gger, to 1200	, . (, ostalogger/ iii i /0			
Digital Inputs (Marker)	Optoco	8 rsp. 16 (2 per ana oupler Connection Box (		option		
Ext. Control Inputs (TTL))		Ext. Sampling (fmax = ½ to start r	4 of the max sample rat			
Status Outputs (TTL)		Trigger Output, Armed	<u> </u>	)		
ICP® Sensor Supply (Option)		4mA Integrated Current				
.c. o sensor supply (option)		Chinegratea Carrent	. 5 VVC1 101 p1620 3C11301			

### **TPCE-LE DAQ Card**

Number of Input Channels SE Module   A single ended or 2 differential software switchable   A single ended or 2 differential software workthable	Module Type	TPCE-LE-24014-4	TPCE-LE-12014-4	TPCE-LE-8014-4	TPCE-LE-4014-4	
Software switchable   Software switchable   A single ended or 4 differential software   A single ended or 4 differential software   A single ended or 4 differential software						
Max. Sample and provided   Software switchable   Software switchable   Max. Sample and provided   Amplitude Resolution   14 Bit up to 240 MHz   120 MHz   14 Bit up to 120 MHz   14 Bit up to 80 MHz   14 Bit up to 40 MHz   14 Bit up to 140 MHz   15 Bit up to 140 MHz   14 Bit up to 140 MHz   14 Bit up to 140 MHz   15 Bit up to 140 MHz   14 Bi				software switchable		
Amplitude Resolution   14 Bit up to 120 MHz   15 Bit up to 120 MHz	Number of Input Channels DIF Module	3				
Title Bit Lip for Stat Mer options   Title Bit Lip for Stat Merc opt		240 MHz	120 MHz	80 MHz	40 MHz	
Deptical Amplifier   Deptical Amplifier	Amplitude Resolution					
## ## ## ## ## ## ## ## ## ## ## ## ##	Memory (per Module)					
Offset         0 − 100 % in steps of 0.1% (Resolution 0.01 %)           Input Impedance         1 MΩ (± 0.2 %) or 50 Ω (± 0.5 %)         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         3 dB at < 5 Hz), Inputs invertible           Bandwidth at Range < 1 V         80 MHz         50 MHz         8 MHz         7 MHz           Slew Rate (10 − 90 %) @ Range ≥ 1 V         4 ns         6 ns         1 3 ns         25 ns           Slew Rate (10 − 90 %) @ Range ≥ 1 V         6 ns         9 ns         50 ns         60 ns           Slew Rate (10 − 90 %) @ Range ≥ 1 V         6 ns         9 ns         50 ns         60 ns           Slew Rate (10 − 90 %) @ Range ≥ 1 V         6 ns         9 ns         50 ns         60 ns           Low Pass Filter (potional)         2 Steps (1 MHz and 100 kHz) software switchable           Low Pass Filter (potional)         2 Steps (1 MHz and 100 kHz) software switchable           Common Mode Range         Differential-Mode at 8 or v - k30 v 1 ranges - 5 v           Common Mode Range         Differential-Mode at 8 or v - k30 v 1 ranges - 5 v           Common Mode Range         Differential-Mode at 8 or v - k30 v 1 ranges - 5 v           Common Mode Range         Maccord Ra	Input Amplifier					
Input Impedance	Measurement Ranges	±100 mV - ±25 V rsp. 0.2 V - 50 V in 1, 2, 5 Steps				
My   A	Offset	0	0 – 100 % in steps of 0	.1% (Resolution 0.01 %	(a)	
Bandwidth at Range ≥ 1 V   80 MHz   50 MHz   8 MHz   7 MHz	Input Impedance			1 MΩ (± 0.2 %)	// 35 pF (± 5 %)	
Bendwidth at Range < 1 V   80 MHz   50 MHz   8 MHz   7 MHz	Coupling	AC / DC so	ftware switchable (AC:	-3 dB at < 5 Hz), Inpu	ts invertible	
Slew Rate (10 - 90 %) @ Range ≥ 1 V	Bandwidth at Range ≥ 1 V	120 MHz	60 MHz	30 MHz	18 MHz	
Seet Nate (10 - 90 %) @ Range < 1 V	Bandwidth at Range < 1 V	80 MHz	50 MHz	8 MHz	7 MHz	
Settling Time to 1%	Slew Rate (10 – 90 %) @ Range ≥ 1 V	4 ns	6 ns	13 ns	25 ns	
Down Pass Filter (RC-Filter)	Slew Rate (10 – 90 %) @ Range < 1 V	6 ns	9 ns	50 ns	60 ns	
Antialiasing-Filter (optional)   200 Hz = 5 MHz, min. 4. order Butterworth, software setable	Settling Time to 1%	< 200 ns	< 200 ns	< 200ns	< 200 ns	
Differential-Mode: ±8 V or +/-80 V at ranges. > 5 V	Low Pass Filter (RC-Filter)	2	Steps (1 MHz and 100	kHz) software switchab	ole	
Common Mode Rejection   Se 0 dB (DC - 1 kHz); > 54 dB (- 20 MHz)	Antialiasing-Filter (optional)	200 Hz	– 5 MHz, min. 4. order	Butterworth, software	setable	
Range Error (±)	Common Mode Range	Dit	fferential-Mode: ±8 V o	or +/-80 V at ranges. > 5	5 V	
(after autocalibration)         (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         < 0.200 mVrms         < 0.200 mVrms         < 0.120 mVrms         < 0.110 mVrms         < 0.120 mVrms         < 0.110 mVrms         * 2           % 1 MHz Sample Rate         < 0.070 mVrms	Common Mode Rejection	> 60 dB (DC – 1 kHz); > 54 dB ( – 100 kHz); > 40 dB ( – 20 MHz)				
Offset Drift (±)         (after autocalibration)         (after autocalibration)           Offset Drift (±)         max. (0.0100 % + 0.1 mV) per °C, (will be compensated by autocalibration)           Input Noise:         (will be compensated by autocalibration)           Input Noise:         0.200 mVrms         < 0.200 mVrms	Range Error (±)					
Input Noise:	Offset Error (±)					
@ max. Sample Rate         < 0.250 mVrms	Offset Drift (±)	max. (0.010				
Signal to Noise Ratio SNR:  @ max. Sample Rate  @ 10 MHz Sample Rate  @ 10 MHz Sample Rate  @ 62 dB  @ 10 MHz Sample Rate  @ 66 dB  @ 10 MHz Sample Rate  @ 66 dB  @ 10 MHz Sample Rate  ### A Max	<ul><li>@ max. Sample Rate</li><li>@ 5 MHz Sample Rate</li><li>@ 1 MHz Sample Rate</li><li>@ 100 kHz Sample Rate</li></ul>	< 0.120 mVrms < 0.070 mVrms < 0.040 mVrms	< 0.120 mVrms < 0.070 mVrms < 0.040 mVrms	< 0.120 mVrms < 0.070 mVrms < 0.040 mVrms	< 0.110 mVrms < 0.060 mVrms < 0.040 mVrms	*2
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 coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT  On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long and sold inputs) and sold inputs. Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long and sold inputs) and sold inputs. Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long and sold inputs) and sold inputs. Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long and sold inputs) and sold inputs (Trigger signal is calculated from a 2 channels)  External Trigger input 1 per System (TTL), pos. or neg. Edge  Trigger Delay 1 per System (TTL), pos. or neg. Edge  Trigger Delay 1 per System (TTL), pos. or neg. Edge  Trigger Delay 1 per System (TTL) Steps  Miscellaneous 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)	<ul> <li>@ max. Sample Rate</li> <li>@ 10 MHz Sample Rate</li> <li>@ 5 MHz Sample Rate</li> <li>@ 1 MHz Sample Rate</li> <li>@ 100 kHz Sample Rate</li> <li>@ 10 kHz Sample Rate</li> </ul>	62 dB 66 dB 69 dB 79 dB	68 dB 70 dB 74 dB 82 dB 90 dB	70 dB 72 dB 76 dB 84 dB 92 dB	70 dB 72 dB 76 dB 84 dB	*3
Trigger  Number of Trigger Channels  4 coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT  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  1 per System (TTL), pos. or neg. Edge  Trigger Delay  1 per System (TTL), pos. or neg. Edge  100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps  Miscellaneous  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)	· · · · · · · · · · · · · · · · · · ·					
Number of Trigger Channels  4 coupled to analog inputs, pos./neg.Edge, with or without hysteresis, Window IN, Window OUT  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)  S (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)	Special : Autocalibration	Auto adjustment of	f gain and offset in all n	neasurement ranges. (In	itiated by software)	
Advanced Trigger (Option)  Advanced Trigger (Option)  External Trigger input  Trigger Delay  Digital Inputs (Marker)  Digital Inputs (Marker)  Ext. Control Inputs (TTL))  On all analog inputs: Slew Rate, Pulse Width, Pulse Pause or Period (too short or too long a Missing Event), State (above / below), AND link, Product (trigger signal is calculated from 2 channels)  1 per System (TTL), pos. or neg. Edge  -100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps  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)	Trigger					
Advanced Trigger (Option) = 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)	Number of Trigger Channels	4 coupled to			it hysteresis,	
Trigger Delay  -100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps  Miscellaneous  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)	Advanced Trigger (Option)		e (above / below), AND	link, Product (trigger si		
Trigger Delay  -100 % (Pretrigger) to +200 % (Posttrigger) in 1 % steps  Miscellaneous  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)	External Trigger input			/		
Miscellaneous  8 (2 per analog channel) (TTL)  Digital Inputs (Marker)  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)		-100			steps	
B (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)	·		, 55-1, 15 . 200	, , , , , , , , , , , , , , , , ,		
Digital Inputs (Marker)  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)			8 (2 per analog	channel) (TTL)		
Status Outputs (TTL)  Trigger Output, Armed (=True during recording)	Digital Inputs (Marker)	Optoco			option	
Status Outputs (TTL)  Trigger Output, Armed (=True during recording)	Ext. Control Inputs (TTL))	Trigger, Arm/Disarm, E	Ext. Sampling (fmax = 1	0 MHz), external comm	nand to start recording	
ICP® Sensor Supply (Option) 4mA Integrated Current Power for piezo sensors	·		· · · · · ·			
	ICP® Sensor Supply (Option)	4	1mA Integrated Current	Power for piezo sensor	S	

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	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			Nords (= 256 MByte) NWords (= 1 GByte)				
Memory 8 Channel Module			Words (= 256 MByte) 1Words (= 1 GByte)				
Input Amplifier							
Measurement Ranges	±	100 mV – ±25 V rsp. 0.2	2 V – 50 V in 1, 2, 5 Ste	ps			
Offset	(	0 – 100 % in steps of 0	.1% (Resolution 0.01 %	· b)			
Input Impedance		•	// 35 pF (± 5 %)				
Coupling	AC / DC so	ftware switchable (AC:	-3 dB at < 5 Hz), Inpu	ts 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)		Steps (1 MHz and 100					
Antialiasing-Filter (optional)		z – 5 MHz, min. 4. ordei					
Common Mode Range		fferential-Mode: ±8 V					
Common Mode Rejection		(DC – 1 kHz); > 54 dB					
·	> 00 ub			- 1 IVITIZ)			
Range Error (±)		max. 0.1 % typ. 0.03 %  (after autocalibration)					
Offset Error (±)			typ. 0.03 % calibration)				
Offset Drift (±)	max. (0.010	00 % + 0.1 mV) per °C, (will be compensate	typ. $(0.0050 \% + 0.03)$ d by autocalibration)	mV) per °C			
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  @ 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			0 dB 0 dB				
Special : Autocalibration	Auto adjustment o	of gain and offset in all n		itiated by software)			
Trigger	,		J . (	,			
Number of Trigger Channels	4 or 8, couple	ed to analog inputs, pos Window IN	./neg.Edge, with or with Window OUT	nout hysteresis,			
Advanced Trigger (Option)		Slew Rate, Pulse Width te (above / below), AND	, Pulse Pause or Period				
External Trigger input			, pos. or neg. Edge				
Trigger Delay	-100	% (Pretrigger) to +200		steps			
Miscellaneous	100	, 1 (1 · ca. ggc) to 1200	, : (, ostangger/ iii 7 /0				
Digital Inputs (Marker)	Ontoc	8 rsp. 16 (2 per an oupler Connection Box (	alog channel) (TTL) '5 to 48 V) as additional	option			
Ext. Control Inputs (TTL))		Ext. Sampling (fmax = 1	4 of the max sample rat	· •			
Status Outputs (TTL)		to start i Trigger Output, Armed	recording				
ICP® Sensor Supply (Option)		4mA Integrated Current	. Power for piezo sensor	5			

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

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