

# TPCX Specification



10 - 80 MHz, 14 & 16 Bit, 4 & 8 Channel Modules

Module Type 14 Bit-ADC	TPCX-8014-4	TPCX-4014-4	TPCX-2014-4/8	TPCX-1014-4/8	
Module Type 16 Bit-ADC	TPCX-8016-4	TPCX-4016-4	TPCX-2016-4/8	TPCX-1016-4/8	*1
Number of Input Channels	4 single ended or 2 differential software switchable		4 rsp.8 Single Ended or 2 rsp.4 Differential, software switchable		
Amplitude Resolution	14 Bit rsp. 16 Bit				*1
Max. Sample Rate (all channels are sampled simultaneously)	4 x 80 MHz (12.5 ns)	4 x 40 MHz (25 ns)	4 x 20 MHz (50 ns) 8 x 20 MHz	4 x 10 MHz (100 ns) 8 x 10 MHz	
Memory (per Module)	4 x 16 MWords rsp. 8 x 8 MWords (= 128 MByte), optional up to a total of 256 MWords (= 512 MByte)				
<b>Input Amplifier</b>					
Measurement Ranges (1-2-5 Steps)	±50 mV – ±50 V rsp. 0.1 V – 100 V (100 V limited to 70 V)				
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	30 MHz	18 MHz	10 MHz	5 MHz	
Bandwidth at Range < 1 V	8 MHz	7 MHz	6 MHz	4 MHz	
Slew Rate (10 – 90 %) @ Range ≥ 1 V	13 ns	25 ns	40 ns	70 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	50 ns	60 ns	70 ns	80 ns	
Settling Time to 1%	< 200ns	< 200 ns	< 200 ns	< 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. 0.03 % (after autocalibration)				
Offset Error (±)	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	< 0.180 mVrms	< 0.150 mVrms	< 0.150 mVrms	*2
@ 5 MHz Sample Rate	< 0.120 mVrms	< 0.110 mVrms	< 0.100 mVrms	< 0.100 mVrms	
@ 1 MHz Sample Rate	< 0.070 mVrms	< 0.060 mVrms	< 0.050 mVrms	< 0.050 mVrms	
@ 100 kHz Sample Rate	< 0.030 mVrms	< 0.025 mVrms	< 0.020 mVrms	< 0.020 mVrms	
@ 10 kHz Sample Rate	< 0.020 mVrms	< 0.015 mVrms	< 0.010 mVrms	< 0.010 mVrms	
Signal to Noise Ratio SNR:					
@ max. Sample Rate	59 dB	62 dB	67 dB	70 dB	*3
@ 10 MHz Sample Rate	62 dB	68 dB	70 dB	70 dB	
@ 5 MHz Sample Rate	66 dB	70 dB	72 dB	72 dB	
@ 1 MHz Sample Rate	69 dB	74 dB	76 dB	76 dB	
@ 100 kHz Sample Rate	79 dB	82 dB	84 dB	84 dB	
@ 10 kHz Sample Rate	89 dB	90 dB	92 dB	92 dB	
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)				
<b>Trigger</b>					
Number of Trigger Channels	4 rsp. 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				
<b>Miscellaneous</b>					
Digital Inputs (Marker) at 14Bit-Modules only *5) (Option)	8 rsp. 16 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				*5
Rate of Data Transfer	Up to 40 MSamples per sec direct recording to RAID0 Hard Disk (continuous recorder mode) up to 50MSamples per sec. (=100 MB/s) to CPU Memory				*6
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				

# TPCX Specification



120 & 240 MHz, 2 & 5 MHz Modules

Module Type 14 Bit-ADC	TPCX-24014-4	TPCX-12014-4	L514-4/8	L214-4/8	
Module Type 16 Bit-ADC	TPCX-24016-4	TPCX-12016-4	L516-4/8	L216-4/8	*1
Number of Input Channels	4 single ended or 2 differential software switchable		4 rsp.8 Single Ended or 2 rsp.4 Differential, software switchable		
Amplitude Resolution	14 Bit rsp. 16 Bit				*1
Max. Sample Rate (all channels are sampled simultaneously)	4 x 240 MHz (4.17 ns)	4 x 120 MHz (8.33 ns)	4 x 5 MHz (200 ns) 8 x 5 MHz	4 x 2 MHz (500 ns) 8 x 2 MHz	
Memory (per Module)	4 x 32 MWords (= 128 MByte), optional up to a total of 512MWords (= 1024 MByte)		4 x 16 MWords rsp. 8 x 8 MWords (= 128 MByte), optional up to a total of 256 MWords (= 512 MByte)		
<b>Input Amplifier</b>					
Measurement Ranges (1-2-5 Steps)	$\pm 50$ mV – $\pm 50$ V rsp. 0.1 V – 100 V (100 V limited to 70 V)				
Offset	0 – 100 % in steps of 0.1% (Resolution 0.01 %)				
Input Impedance	1 M $\Omega$ ( $\pm 0.2$ %) or 50 $\Omega$ ( $\pm 0.5$ %) // 26 pF ( $\pm 5$ %)		1 M $\Omega$ ( $\pm 0.2$ %) // 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	2.5 MHz	1 MHz	
Bandwidth at Range < 1 V	80 MHz	50 MHz	2.5 MHz	1 MHz	
Slew Rate (10 – 90 %) @ Range $\geq 1$ V	4 ns	6 ns	80 ns	180 ns	
Slew Rate (10 – 90 %) @ Range < 1 V	6 ns	9 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: $\pm 8$ V or +/-80 V at ranges. > 5 V				
Common Mode Rejection	> 74 dB (DC – 1 kHz); > 60 dB (– 100 kHz); > 40 dB (– 20 MHz)		> 60 dB (DC – 1 kHz); > 54 dB (– 100 kHz); > 40 dB (– 1 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. 0.03 % (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 @ 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 < 0.030 mVrms < 0.025 mVrms	< 0.200 mVrms < 0.120 mVrms < 0.070 mVrms < 0.030 mVrms < 0.025 mVrms	< 0.100 mVrms < 0.100 mVrms < 0.050 mVrms < 0.050 mVrms < 0.010 mVrms	< 0.100 mVrms - < 0.050 mVrms < 0.050 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	58 dB 70 dB 72 dB 77 dB 81 dB 84 dB	60 dB 70 dB 72 dB 77 dB 81 dB 84 dB	72 dB - 72 dB 76 dB 84 dB 92 dB	72 dB - 72 dB 76 dB 84 dB 92 dB	*3 *4
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)				
<b>Trigger</b>					
Number of Trigger Channels	4 rsp. 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				

Module Type 14 Bit-ADC	TPCX-24014-4	TPCX-12014-4	L514-4/8	L214-4/8	
Module Type 16 Bit-ADC	TPCX-24016-4	TPCX-12016-4	L516-4/8	L216-4/8	
<b>Miscellaneous</b>					
Digital Inputs (Marker) at 14Bit-Modules only *5) (Option)	8 rsp. 16 (2 per analog channel) (TTL) Optocoupler Connection Box (5 to 48 V) as additional option				*5
Rate of Data Transfer	Up to 40 MSamples per sec direct recording to RAID0 Hard Disk (continuous recorder mode) up to 100 MSamples per sec. (=200 MB/s) to CPU Memory	Up to 40 MSamples per sec direct recording to RAID0 Hard Disk (continuous recorder mode) up to 50 MSamples per sec. (=100 MB/s) to CPU Memory	*6		
Ext. Control Inputs (TTL)	Trigger, Arm/Disarm, Ext. Sampling (fmax = 20 MHz), external command to start recording	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
- \*5) To activate the marker inputs at a 16 bit module, it can be (temporary) reconfigured to 14Bit
- \*6) The max. sample rate in continuous recording mode depends on the performance of the hard disk system of the PC.

## Differential Modules

A differential-module (type designation: TPCX-xxxx-xD) consists of a single ended module extended with an additional piggyback mounted board, containing 2 or 4 complete differential preamplifiers with 4 or 8 additional BNC connectors. The specifications correspond nearly to the specs of the SE-Modules.