TAS28

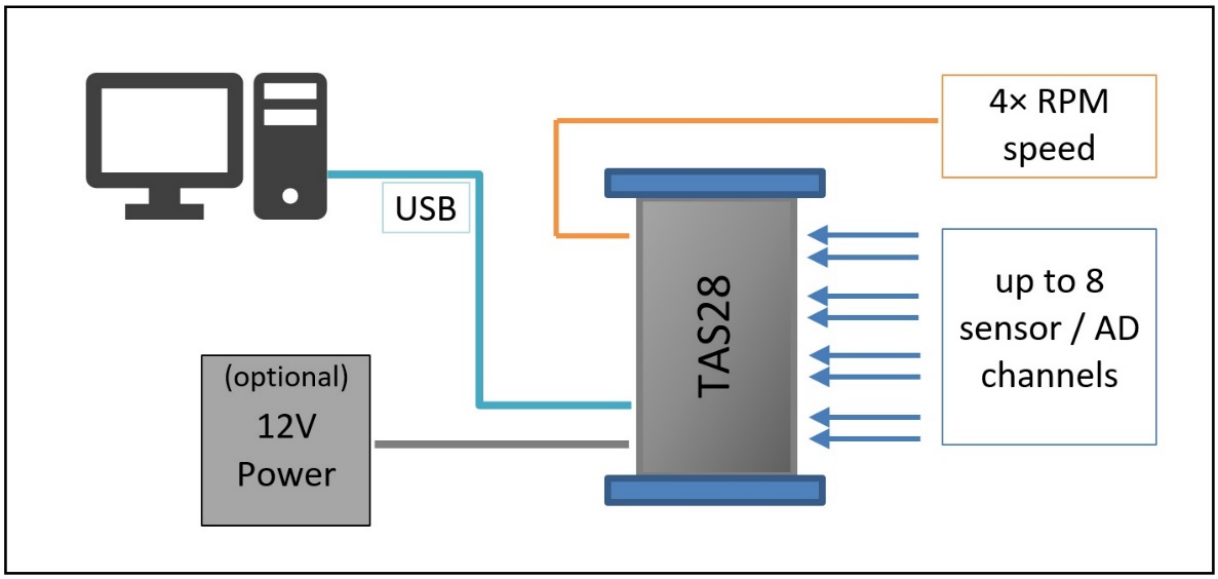
Data Acquisition Front-End

- ✓ Industrial, universal, modular front-end for acoustical and vibration measurements
- ✓ up to 8 universal channels for analog voltage or IEPE with high resolution A/D converters
- ✓ 4 high resolution RPM channels
- ✓ Optional optical SPDIF channel for torsional vibration (see TAC sensor)
- ✓ Modularity enables optimal configuration for your testing application

TAS28

TAS28 is a modular multi-channel data acquisition front-end with the following features:

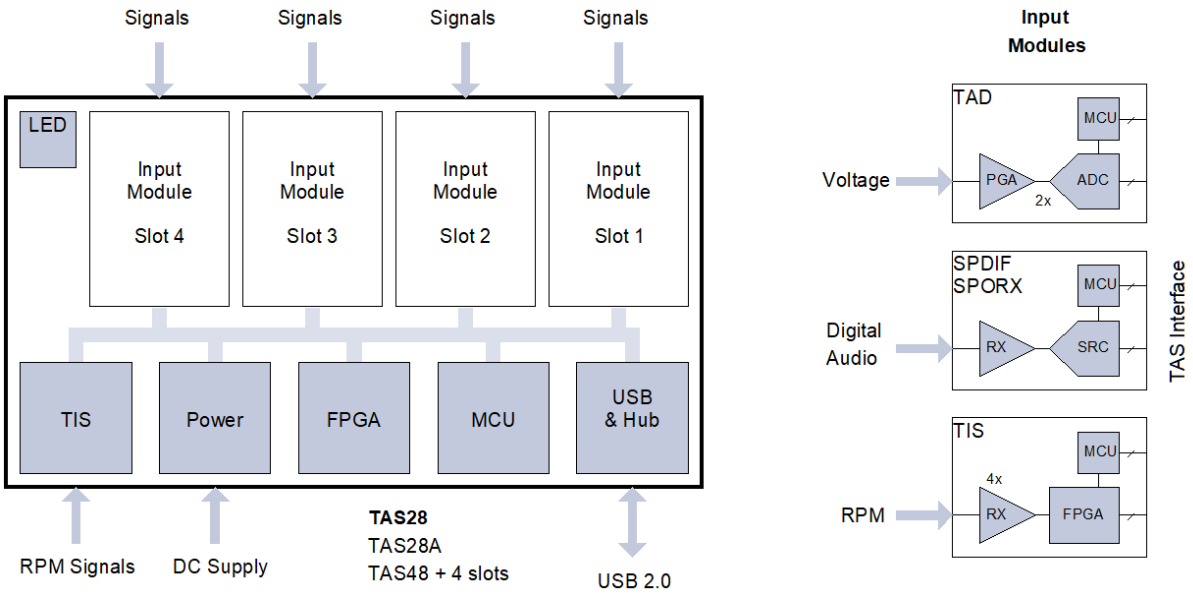
- ADC: Up to 8 analog voltage / IEPE channels with 24bit / 100kHz A/D converters
- RPM: 4 high resolution isolated RPM inputs on-board, easily expandable with further modules
- Sampling: 2 main system clocks are available, providing either 24/48/96kHz or 25/50/100kHz sampling rates
- USB 2.0 high speed interface to the host PC
- Bus powered: TAS28 can run on power supplied by USB with up to 3 modules (e.g. 4 analog / IEPE inputs, plus 2 optical input channels)
- Dimensions: 102.7mm × 230mm × 20.6mm, 715g, in a robust aluminum housing



Specifications

The following pages contain the detailed specifications of the base system and available modules.

TAS28 can contain up to 4 input modules and always has a built-in TIS module:



Picture above: block diagram of TAS base board and modules

1 TAS28 Environmental & Dimensions

TAS28 System Specifications		
Environment		
Temperature	0°C .. 45°C - Operation -20°C .. 70°C - Storage	
Humidity	85% rel. humidity - Operation 95% rel. humidity - Storage	non-condensing at 20°C non-condensing at 50°C
Mechanical		
Dimensions	102.7mm × 230mm × 20.6mm	
Weight	715g	
Electrical		
Power Supply	12V DC / 1A or USB only	dedicated power supply, no other loads connected; USB bus power limits, *see end of document*

back to top

2 TAS28_BASE – USB Interface

TAS28_BASE Specifications		
Interface	USB 2.0	
Datarate	Max. 480Mbit/sec	theoretical USB2.0 maximum
Internal Interface	Quad I2S decoder for ADC data to 8-bit parallel bus to USB	FPGA, SW-reconfigurable
Data Buffers	512kB SRAM for AD & RPM data 4kB FPGA SRAM for control data	for host latency compensation (320ms for 8 AD/RPM channels at f_S = 50kHz)
Power Input	10V – 18V DC, 300mA via LEMO connector, or USB powered	Attention: USB bus power limits, *see end of document*
Power Monitoring	10-bit ADC	all internal voltages are monitored by the MCU's 10-bit ADC
Temperature Sensor	±2.0°C from −25°C to +85°C (max)	internal monitoring only
IEPE Supply Voltage (ICP®, CCLD®)	24V ±5% / 20mA	21V for mobile systems, 10mA with USB power
RPM Features	4 RPM / TIS inputs on board	for specs see *TAS28_TIS* below
Clocks	2 crystal oscillators on board: 25.6MHz 24.576MHz	for sampling rates of 25kHz, 50kHz, 100kHz or 24kHz, 48kHz, 96kHz
Clock Accuracy	±50ppm	affects frequency measurements
Calibration	-	-
Power Consumption	1.2W	with 12V external supply, on-board TIS at f_S = 100kHz
PCB Dimensions	212.5mm x 92.0mm	

back to top

3 TAD28 – Analog Input

TAD28 Specifications		
Analog Inputs	2 BNC	
Input Coupling	AC / DC / IEPE Single-Ended (SE) / Differential (DIF)	IEPE: ICP®, CCLD® DIF: not for IEPE
Input Impedance, SE	33.7kΩ ±2% || 150pF max 26.8kΩ ±2% || 150pF max (±30V)	
AC Coupling	f_C = 4.7Hz ±20% * f_C = 5.9Hz ±20% * (±30V)	f_C : -3dB corner frequency * when both channels are AC coupled, the ADC's internal high pass is used to cancel DC offsets. The ADC's HPF scales with the sampling rate, that's the reason for the ±20%
IEPE Supply Current	2.2mA ±5%	
IEPE Supply Voltage	depends on base card (24.5V or 21.0V for mob. sys.)	
IEPE Coupling	AC / SE DC / SE with ±30V input range	
Input Range Max.	±30V peak	
Without Damage	$60V_{PP}$ DC/AC	
Gain Accuracy @ 1kHz	± 0.5dB at 25°C ±10°C	without calibration
Offset ±10V	≤ 50mV (0.5% FS) with DC coupling ≤ 1mV (0.01% FS) with 2 ch AC	when both channels are AC coupled, the ADC's digital high pass is used to cancel DC offsets
Offset ±1V	≤ 10mV (1% FS) with DC coupling ≤ 0.1mV (0.01% FS) with 2 ch AC	
Offset ±100mV	≤ 3mV (3% FS) with DC coupling ≤ 0.1mV (0.1% FS) with 2 ch AC	
Noise (BW 20kHz)	≤ 15µVrms RTI @ max gain	
SNR (BW 20kHz)	≥ 96dB (±30V) ≥ 100dB (±10V) ≥ 90dB (±1V)	
THD (1kHz)	≥ 90dB (±10V) ≥ 80dB (±1V)	
CMRR	≥ 60dB @ 50Hz ≥ 50dB @ 1kHz	DC/DIF coupling
Crosstalk	≥ 110dB @ 1kHz ≥ 100dB @ 10kHz	attenuation adjacent channels
Anti-Aliasing Filter	3-pole, f_C = 200kHz	f_C : -3dB corner frequency
Passband (-0.06dB)	0.46 * f_S	f_S = sampling rate

PB Ripple (BW 20kHz)	± 0.2dB	
Stopband	0.55 * f_S	f_S = sampling rate
Stopband Attenuation	≥ 80dB	
Phase Match	1 sample	adjacent channels
ADC Resolution	24 bits	
Sampling Rate	100kHz max	
Overall Dynamic Range	> 120dB (BW 20kHz)	incl. gain
SFDR	> 110dB (BW 20kHz)	
ADC Group Delay	27.6 samples	compensated by TasAlyser
Calibration	ext. manual / SW calib.	recom. calibration interval: 1/year
Power Consumption	≤ 0.4W without IEPE	f_S = 100kHz IEPE: + 60mW / channel
PCB Dimensions	70mm x 48mm per 2 channels	

back to top

4 TIS28 – RPM / Encoder Input

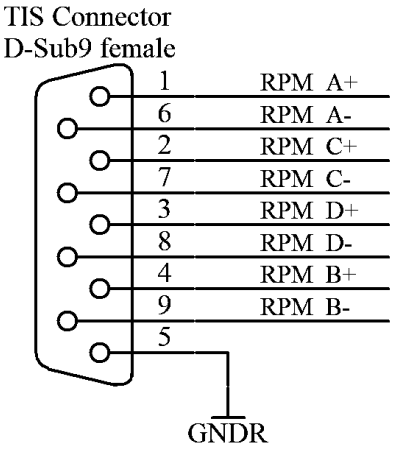
TIS28 Specifications (also for TAS28 / TAS48 on-board TIS)				
Inputs	4 differential, RS-485			see connector layout below
Input Connector	D-Sub9, female			
Standard Input Voltage	3.3V, differential RS-485			
Input Options	• Divider for 12V & 24V signals • Single Ended Reference • Rising or Falling Edge Detection			these options can be switched only for channel pairs
Maximum Input Voltage	$24V_{PEAK}$ single ended with attenuator			
Without Damage	$\pm 30V_{PEAK}$			
Pulse Detection Algorithm Frequency f_{RPM} and Timing Resolution T_{RPM}	f_S	f_{RPM}	T_{RPM}	f_S : TAS sampling rate
	200kHz	12.8MHz	78.125ns	
	100kHz	12.8MHz	78.125ns	
	50kHz	12.8MHz	78.125ns	
	25kHz	6.4MHz	156.25ns	
Frequency Dividers	up to 65534 (even numbers only)			
RPM Bandwidth	10MHz differential, 10MHz single-ended (min. 5V TTL)			with input frequency divider to keep divided signal < TAS' f_S
Frequency Accuracy	±50ppm			depends on base card's oscillator
Rotary IE / AB Detection Algorithm Frequency f_{IEAB} and Timing Resolution T_{IEAB}	f_S	f_{IEAB}	T_{IEAB}	TIS48 only (FPGA firmware version ≥ 0x0B) IE = incremental encoder
	200kHz	25.6MHz	39.0625ns	
	100kHz	25.6MHz	39.0625ns	
	50kHz	25.6MHz	39.0625ns	
	25kHz	12.8MHz	78.125ns	
Rotary IE / AB Detection Max. IEAB Signal Input Frequency f_{IEMAX}	f_S	f_{IEMAX}		TIS48 only (FPGA firmware version ≥ 0x0B) quadrature decoding
	200kHz	3.2MHz		
	100kHz	2.1MHz		
	50kHz	1.5MHz		
	25kHz	0.7MHz		
RPM LED	2			to show any channel's activity
RPM LED Dividers	2^n ; with n = 0..14			
RPM LED Hold Time	25ms			
Isolation	≥ 1kV to TAS			cable shield must be connected on one side only
Calibration	-			
Power Consumption	≤ 0.5W			f_S = 100kHz
PCB Dimensions	70mm x 48mm			as module

back to top

4.1 TIS Connector

This is the layout of the **female 9-pin D-Sub** connector:

D-Sub 9 Pin	Signal	RPM Channel
1	RPM_A+	1+
2	RPM_C+	3+
3	RPM_D+	4+
4	RPM_B+	2+
5	GND	GND
6	RPM_A-	1-
7	RPM_C-	3-
8	RPM_D-	4-
9	RPM_B-	2-



TIS: single-ended input signal switching thresholds

"-" input pin		SW setting		threshold (referred to single-ended signal on +input pin)		
adapter	voltage	high reference	attenuation	low to high ±20%	high to low ±20%	hysteresis ±20%
GND	0.0V	-	-	0.9V	-0.7V	1.6V
open	0.7V	-	-	2.5V	0.8V	1.7V
GND	0.0V	ON	-	3.9V	2.2V	1.7V
open	1.7V	ON	-	5.2V	3.5V	1.7V
GND	0.0V	-	ON	3.3V	1.1V	2.2V
open	0.8V	-	ON	6.8V	4.4V	2.4V
GND	0.0V	ON	ON	9.6V	7.5V	2.1V
open	1.7V	ON	ON	12.6V	10.2V	2.4V

TIS: differential input signal and connection requirements

- GND must be connected between differential source and TIS.
- Cable shield must be connected on one side only to prevent ground loops.

Common Mode Voltage V_{CM}	-2V .. +5V
V_{CM} max. deviation between +/- input	±30%
Differential Input Threshold V_{TH}	1.4V
Hysteresis V_{HY} (V_{CM} = 1.5V)	0.7V

back to top

5 TAS28_SPORX – Optical Digital Input

TAS28_SPORX Specifications		
Input Connector	3.5mm (TRS) jack: • optical circular plug (EIAJ RC-5720B) • 3-pole small-sized concentric plug (JIS C 6560)	optical and differential electrical input: **T**ip: +IN **R**ing: -IN **S**leeve: GND
Input Formats	S/PDIF, AES3	
Input Channels	2	stereo digital audio stream
Sample Rate Conversion (SRC)		
Sample Rate Input Range	11kHz .. 96kHz	automatic conversion to TAS28 sample rate
Sample Rate Input / Output Ratios Maximum	1:6 F_{SI}:F_{SO} Up 6:1 F_{SI}:F_{SO} Down	F_{SI}: input sample rate F_{SO}: output sample rate
Output Resolution	24 bits	
Interchannel Gain Mismatch	0dB	
Interchannel Phase Deviation	0°	
Gain Error	< -0.2dB	
Dynamic Range	> 130dB	depends on F_{SI} / F_{SO} ratio
THD (1kHz)	> 110dB	depends on F_{SI} / F_{SO} ratio
Passband (Up or Down Sampling)	0.4535 * min (F_{SI}, F_{SO})	
Passband Ripple	± 0.05dB	
Stopband	0.5465 * F_{SO} (output sample rate)	
Stopband Attenuation	125dB	
Group Delay	Total Group Delay = 8.7/ F_{SI} + 8/ F_{SO}	
Isolation, Electrical Input	≥ 2kV to TAS28	
Calibration	-	
Power Consumption	≤ 0.4W	f_S = 100kHz
PCB Dimensions	70mm x 48mm	

back to top

6 Power Considerations for Mobile Systems

The TAS28 system is a very low power, high resolution, mobile data acquisition system.
The mobile version can run on USB supply only, with some limitations.

These are the **limitations** *for* ***USB supply*** *only*:

- There must be no more than **3 slave modules** altogether
- Do not activate more than **5 IEPE channels** at a time.

Attention: This all depends very much on the laptop's USB supply. We have not yet found any one laptop that was not able to run with 4 slave modules, including 5 AD channels with activated IEPE. But this is slightly out of the USB specs, so if you'll encounter some trouble, please try an external supply to power TAS28.
If you know your laptop has a whacky USB supply, use an external power supply from the start!

Note: These limitations do not apply to **TASnano**, which has only 2 slave slots with a maximum of 4 IEPE channels, and it is supplied by USB only.

When TAS is **USB-powered** only, the following **restrictions** apply concerning ADC modules:

- a total maximum of **3 ADC modules** is allowed - only if these are supplied with **±2.7V** (TAD28 and TAD48 only)
- a total maximum of **5 channels with IEPE** supply are allowed

back to top