

Product Datasheet - Technical Specifications



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Specifications

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Analog Input Specifications

Table 22 lists the specifications for the analog input subsystem on the DT9837 Series modules. Unless otherwise noted, specifications are typical at 25° C.

Table 22: Analog Input Subsystem Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications	DT9837C Specifications
Number of analog input channels	4, single-ended, simultaneous	4, single-ended, simultaneous	4, single-ended, simultaneous	4, single-ended, simultaneous
Resolution	24 bits	24 bits	24 bits	24 bits
Ranges and gains Gain of 1: Gain of 10:	±10 V ±1 V	±10 V ±1 V	±10 V ±1 V	±10 V ±1 V
A/D type	Delta Sigma	Delta Sigma	Delta Sigma	Delta Sigma
Data encoding	Offset binary	Offset binary	Offset binary	Offset binary
Maximum sample rate	52.734 kHz ^a	52.734 kHz ^a	105.469 kHz ^a	105.469 kHz ^a
Minimum sample rate	195.3 Hz	195.3 Hz	195.3 Hz	195.3 Hz
Group delay	39/data rate, in seconds	39/data rate, in seconds	39/data rate, in seconds	39/data rate, in seconds
ADC Delta Sigma filter ^b Passband, -3 dB:	0.49 x sample frequency, Hz	0.49 x sample frequency, Hz	0.49 x sample frequency, Hz	0.49 x sample frequency, Hz
Passband ripple, ±0.005 dB:	0.453 x sample frequency, Hz	0.453 x sample frequency, Hz	0.453 x sample frequency, Hz	0.453 x sample frequency, Hz
Stopband, -100 dB:	0.547 x sample frequency, Hz	0.547 x sample frequency, Hz	0.547 x sample frequency, Hz	0.547 x sample frequency, Hz
Analog filter ^b Low pass cutoff, -3 dB: High pass cutoff, -3 dB (AC coupling):	400 kHz 0.5 Hz	400 kHz 0.1 Hz	400 kHz 0.5 Hz	400 kHz 1 Hz
Channel-to-channel crosstalk ^c Input Signal = 10 kHz:	> -110 dB with 50 Ω termination > -105 dB with 1 kΩ termination	> -110 dB with 50 Ω termination > -105 dB with 1 kΩ termination	> -110 dB with 50 Ω termination > -105 dB with 1 kΩ termination	> -110 dB with 50 Ω termination > -105 dB with 1 kΩ termination
Input impedance	1 MΩ, 20 pF ^d	1 MΩ, 20 pF ^d	1 MΩ, 20 pF ^d	1 MΩ, 20 pF ^d
Coupling	AC/DC (software-selectable per channel)	AC/DC (software-selectable per channel)	AC/DC (software-selectable per channel)	AC/DC (software-selectable per channel)
IEPE current source	4 mA ±0.5%	4 mA ±0.5%	4 mA ±0.5%	2 mA ±0.5%
IEPE compliance voltage	18 V	18 V	18 V	18 V

Table 22: Analog Input Subsystem Specifications (cont.)

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications	DT9837C Specifications
IEPE current source noise DC to 1 kHz	5 nARMS	5 nARMS	5 nARMS	5 nARMS
DC Accuracy				
Offset error ^e	1.5 mV	1.5 mV	1.5 mV	1.5 mV
Offset error temperature coefficient	(10 $\mu\text{V}/^\circ\text{C}$ x Gain) + 100 μV	(10 $\mu\text{V}/^\circ\text{C}$ x Gain) + 100 μV	(10 $\mu\text{V}/^\circ\text{C}$ x Gain) + 100 μV	(10 $\mu\text{V}/^\circ\text{C}$ x Gain) + 100 μV
Gain error Gain of 1: Gain of 10:	$\pm 0.02\%$ $\pm 0.5\%$	$\pm 0.02\%$ $\pm 0.5\%$	$\pm 0.02\%$ $\pm 0.5\%$	$\pm 0.02\%$ $\pm 0.5\%$
Gain error temperature coefficient	25 ppm/ $^\circ\text{C}$	25 ppm/ $^\circ\text{C}$	25 ppm/ $^\circ\text{C}$	25 ppm/ $^\circ\text{C}$
ADC Integral Non-Linearity error, INL	$\pm 0.0006\%$ of full-scale range	$\pm 0.0006\%$ of full-scale range	$\pm 0.0006\%$ of full-scale range	$\pm 0.0006\%$ of full-scale range
ADC Differential Non-Linearity error, DNL	Monotonic to 24 bits	Monotonic to 24 bits	Monotonic to 24 bits	Monotonic to 24 bits
D/A Readback in A/D Stream A/D resolution: Zero error: Full-scale error: Clock on input A/D Done	– – – –	16 bits ± 15 mV +0, –2% 42 ns to 83 ns	– – – –	– – – –
Dynamic Performance^f	See Table 23 on page 120.			
Maximum input voltage (without damage) Power on: Power off:	± 30 V ± 20 V	± 40 V ± 40 V	± 40 V ± 40 V	± 40 V ± 40 V
Overvoltage Protection				
Overvoltage protection (power on/off)	± 40 V	± 40 V	± 40 V	± 40 V
ESD protection Arc: Contact:	8 kV 4 kV	8 kV 4 kV	8 kV 4 kV	8 kV 4 kV

a. For frequencies of 52.734 kHz or less, Conversion Rate = Sample Rate * 512.

For frequencies greater than 52.734 kHz, Conversion Rate = Sample rate * 256.

b. The total frequency response is the combined frequency response of the ADC Sigma Delta filter and the analog filter.

c. Channel 0 is the reference channel with a 20 V PP signal and a maximum sample rate of 52.734 kSamples/s.

d. Cable capacitance of typically 30 pF per foot must be added.

e. Offset errors are referred to the input.

f. ENOB, SINAD, SNR, THD, and SFDR measurements were made with a 16384 point FFT with a minimum 4-term Blackman Harris window.

Table 23: Dynamic Performance Specifications

Dynamic Performance ^a	DT9837 Specifications		DT9837A Specifications		DT9837B and DT9837C Specifications	
	Gain of 1	Gain of 10	Gain of 1	Gain of 10	Gain of 1	Gain of 10
Effective Number of Bits, ENOB ^b (1 kHz input, 52.734 kSPS) -1 dBFS input: -6 dBFS input:	15.2 bits 15.8 bits	14.6 bits 15.3 bits	15.3 bits 16.3 bits	14.7 bits 15.6 bits	14.8 bits 16.0 bits	14.3 bits 15.4 bits
Signal to Noise and Distortion Ratio, SINAD ^c (1 kHz input) -1 dBFS input: -6 dBFS input:	92 dB 91 dB	88 dB 88 dB	93 dB 94 dB	89 dB 90 dB	90 dB 92 dB	87 dB 88 dB
Signal to Noise Ratio, SNR ^d (1 kHz input) -1 dBFS input: -6 dBFS input:	95 dB 91 dB	94 dB 91 dB	98 dB 95 dB	96 dB 94 dB	97 dB 93 dB	95 dB 92 dB
Total Harmonic Distortion, THD ^e (1 kHz input) -1 dBFS input: -6 dBFS input:	-96 dB -104 dB	-90 dB -91 dB	-95 dB -102 dB	-90 dB -92 dB	-91 dB -99 dB	-88 dB -91 dB
Spurious Free Dynamic Range, SFDR ^f (1 kHz input) -1 dBFS input: -6 dBFS input:	100 dBFS 110 dBFS	93 dBFS 101 dBFS	98 dBFS 108 dBFS	93 dBFS 100 dBFS	94 dBFS 107 dBFS	91 dBFS 100 dBFS
Noise Floor (50 Ω input termination)	100 μVRMS	10 μVRMS	60 μVRMS	10 μVRMS	80 μVRMS	9 μVRMS

a. ENOB, SINAD, SNR, THD, and SFDR measurements were made with a 16384 point FFT using a minimum 4-term Blackman Harris window at the maximum sampling rate.

b. Effective Number of Bits (ENOB) is calculated from the SINAD value with adjustment for level below full-scale of the input signal.

$$ENOB = \frac{(SINAD - 1.76 + IBFS)}{6.02}$$

where, IBFS is a positive value in dB, representing the ratio of a full-scale signal to the input signal.

c. Signal to Noise and Distortion (SINAD) is the ratio of the RMS value of the input signal to the RMS sum of all other spectral components, excluding DC.

d. Signal to Noise Ratio (SNR) is the ratio of the RMS value of the input signal to the RMS sum of all other spectral components, excluding harmonics and DC.

e. Total Harmonic Distortion (THD) is the ratio of the RMS value of the input signal to the RMS sum of all harmonics.

f. Spurious Free Dynamic Range (SFDR) is the ratio of the RMS full-scale range to the RMS value of the largest peak spurious component, including harmonics.

Analog Output Specifications

Table 24 lists the specifications for the analog output subsystem on the DT9837, DT9837A, and DT9837C modules. Unless otherwise noted, specifications are typical at 25° C.

Table 24: Analog Output Subsystem Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837C Specifications
Number of analog output channels	1	1	1
Resolution	24 bits	24 bits	24 bits
D/A type	Delta Sigma	Delta Sigma	Delta Sigma
Output range	±10 V	±10 V	±3 V
Data encoding	Offset binary	Offset binary	Offset binary
Minimum sample frequency	46.875 kHz	10 kHz	10 kHz
Maximum sample frequency	46.875 kHz	52.734 kHz	96.0 kHz
Group delay (typical)	34/sample rate, in s	29/sample rate, in s	29/sample rate, in s
D/A master clock range	output frequency x 256	output frequency x 512	output frequency x 512
DAC Delta Sigma filter ^a Passband, -3 dB: Passband ripple, ±0.002 dB: Stopband, -82 dB:	0.49 x sample frequency, Hz 0.454 x sample frequency, Hz 0.546 x sample frequency, Hz	0.49 x sample frequency, Hz 0.454 x sample frequency, Hz 0.5646 x sample frequency, Hz	0.49 x sample frequency, Hz 0.454 x sample frequency, Hz 0.5646 x sample frequency, Hz
Analog filter ^a	10 kHz, 2-pole, low-pass Butterworth	10 kHz, 2-pole, low-pass Butterworth	40 kHz smoothing filter
Output current	±1 mA maximum load (10 V across 10 K)	±3 mA maximum load (10 V across 3.3 K)	±2 mA maximum load (3 V across 1.5 K)
Output FIFO	8192 Samples, total	8192 Samples, total	8192 Samples, total
Idle channel noise (216 kSPS)	600 μVRMS	100 μVRMS	30 μVRMS
Total Harmonic Distortion, THD ^b -1 dBFS, 1 kHz output, 10 kΩ load: -6 dBFS, 1 kHz output, 10 kΩ load:	-80 dB -80 dB	-78 dB -78 dB	-97 dB -100 dB
Spurious Free Dynamic Range, SFDR ^b -1 dBFS, 1 kHz output, 10 kΩ load: -6 dBFS, 1 kHz output, 10 kΩ load:	84 dBFS 86 dBFS	88 dBFS 88 dBFS	100 dBFS 109 dBFS
Offset error	±1.5 mV	±1.5 mV	±1.5 mV
Offset error temperature coefficient	200 μV/° C	200 μV/° C	200 μV/° C
Gain error	±3.0%	±0.03%	±0.03%

Table 24: Analog Output Subsystem Specifications (cont.)

Feature	DT9837 Specifications	DT9837A Specifications	DT9837C Specifications
Gain error temperature coefficient	50 ppm/° C	50 ppm/° C	50 ppm/° C
Power fault and reset	Goes to 0 V ±10 mV if the USB cable is removed or the power fails		
ESD protection Arc: Contact:	8 kV 4 kV	8 kV 4 kV	8 kV 4 kV

a. The total frequency response is the combined frequency response of the DAC Sigma Delta filter and the analog filter.

b. THD and SFDR measurements were made with a 16384 point FFT using a minimum 4-term Blackman Harris window at the maximum sample rate.

Tachometer Input Specifications

Table 25 lists the specifications for the tachometer input on the DT9837, DT9837A, and DT9837B modules. The tachometer is not supported by the DT9837C module.

Table 25: Tachometer Input Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications
Number of channels	1	1	1
Resolution	31 bits per channel	31 bits per channel	31 bits per channel
Input voltage range	±30 V	±30 V	±30 V
Threshold voltage	+2 V with 0.5 V hysteresis	+2 V with 0.5 V hysteresis	+2 V with 0.5 V hysteresis
Maximum input frequency	380 kHz	1 MHz	1 MHz
Minimum pulse width high/low (minimum amount of time it takes a C/T to recognize an input pulse)	1.3 μs	0.4 μs	0.4 μs
Clock frequency for tachometer counter 0 measurements	12 MHz (83 ns resolution)	12 MHz (83 ns resolution)	12 MHz (83 ns resolution)
Clock frequency for tachometer counter 1 measurements	–	48 MHz (21 ns resolution)	48 MHz (21 ns resolution)

Gate Input Specifications

Table 26 lists the specifications for the gate input on the DT9837A-OEM and DT9837B modules.

Table 26: Gate Input Specifications

Feature	DT9837A-OEM and DT9837B Specifications
Signal type	LVTTL
Input voltage range for gate input signal	0 to 5 V
Threshold voltage	± 2 V with 0.5 V hysteresis
Maximum input frequency	1 MHz
Minimum pulse width (high/low)	0.4 μ s
Counter resolution	32 bits
Clock frequency for gate counter 2 measurements	48 MHz (21 ns resolution)

Trigger Specifications

Table 27 lists the specifications for the trigger on the DT9837 Series modules.

Table 27: Trigger Specifications

Feature	DT9837 Specifications	DT9837A and DT9837B Specifications	DT9837C Specifications
Trigger sources Internal software trigger: External digital trigger: Analog threshold trigger:		Software-initiated Software-selectable Software-selectable	
External digital trigger Input type: Logic family: Input logic load: Lower threshold: Upper threshold: Hysteresis: Input sink current: Minimum pulse width high/low: Maximum input signal:		Edge-sensitive, positive trigger LVTTTL inputs 1 LVTTTL 1.1 V 1.3 V 0.2 V 33 μ A 1.3 μ A \pm 30 V	
Analog threshold trigger Type: Threshold level: Hysteresis:	Positive threshold trigger on analog input channel 0 1.0 V 100 mV	Positive threshold trigger on analog input channel 0 +0.2 to +9.8 V 100 mV	Positive or negative threshold trigger on any analog input channel \pm 10 V for a gain of 1; \pm 1 V for a gain of 10 100 mV
Trigger delay	1 conversion period maximum	1 conversion period maximum	1 conversion period maximum

Master Oscillator Specifications

Table 28 lists the specifications for the master oscillator on the DT9837A, DT9837B, and DT9837C modules.

Table 28: Master Oscillator Specifications

Feature	DT9837A, DT9837B, and DT9837C Specifications
Frequency	48 MHz
Accuracy at 25° C	±30 ppm
Drift over temperature 0 to 70° C (Total)	±50 ppm
Aging (first year)	±5 ppm
Maximum error (first year)	±85 ppm

Power, Physical, and Environmental Specifications

Table 29 lists the power, physical, and environmental specifications for the DT9837 Series modules.

Table 29: Power, Physical, and Environmental Specifications

Feature	DT9837 Specifications	DT9837A Specifications	DT9837B Specifications	DT9837C Specifications
Power, +5 V	±0.5 V @ 0.5 A	±0.30 V @ 0.5 A	±0.30 V @ 425 mA	±0.30 V @ 0.5 A
Physical Dimensions of enclosure: Dimensions of PCB only: Weight: PCB assembly with enclosure: PCB assembly:	Width = 105.9 mm Length = 189 mm Height = 40 mm Width: 100 mm Length: 146.6 mm Thickness: 1.6 mm 490.7 g 153.1 g			
Environmental Operating temperature range: Storage temperature range: Relative humidity: Altitude:	0° C to 55° C -25° C to 85° C to 95%, noncondensing up to 10,000 feet			

Regulatory Specifications

The DT9837 Series is CE-compliant. [Table 30](#) lists the regulatory specifications for the DT9837 Series modules.

Table 30: Regulatory Specifications

Feature	DT9837 Series Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use <u>EMC Requirements</u> EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)

Connector Specifications

Table 31 lists the connector specifications for the DT9837A, DT9837A-OEM, DT9837B, and DT9837C modules.

Table 31: Connector Specifications

Feature	Specifications
RJ45 (LVDS) Connector	Molex part number 44661-0001
Gate Input Connector ^a	AMP/Tyco part number 5-146282-4
BNC Connectors (DT9837, DT9837A, DT9837B, and DT9837C-BNC)	Amphenol 31-5540
Mini-XLR connectors (DT9837C-XLR)	Switchcraft TRAPC3MX

a. This connector is available on the DT9837A-OEM module only.