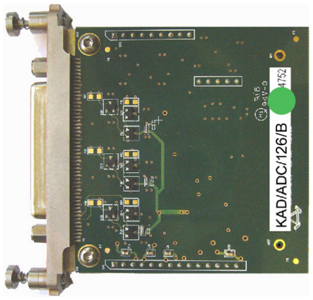
KAD/ADC/126

Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps



Key Features

- Four accelerometer input channels with DC-reject
- Programmable input range (±1V, ±10V)
- High accuracy (gain error of 0.1% FSR typical at 10kHz)
- Constant current source excitation on each channel (3.6mA typical)
- Short on any channel does not affect others
- 16-bit simultaneous sampling on each channel

Applications

- Accelerometer signal conditioning and digitalization
- Suitable for ICP©, Isotron©, Piezotron© and Deltatron© sensors

Overview

The KAD/ADC/126 is used to condition and digitize up to four single ended analog channels. All of these channels have a constant current source and high-pass (DC-reject) filter for use with integrated charge-amp piezoelectric (ICP) accelerometer devices.

At the heart of the KAD/ADC/126 is a hard-wired state machine that over-samples all channels at a rate between 200ksps and 400ksps and digitally filters any noise above the user-programmable cutoff frequency.

This is achieved using cascaded, half-band, Finite-Impulse-Response (FIR) filters followed by an 8th order Butterworth IIR filter with a default cutoff point set at one quarter of the sampling frequency ($f_c = f_s / 4$).

All signals are sampled simultaneously (isochronously). Thus, when several channels are sampled at different sampling rates, at the start of an acquisition cycle all channels are aligned.

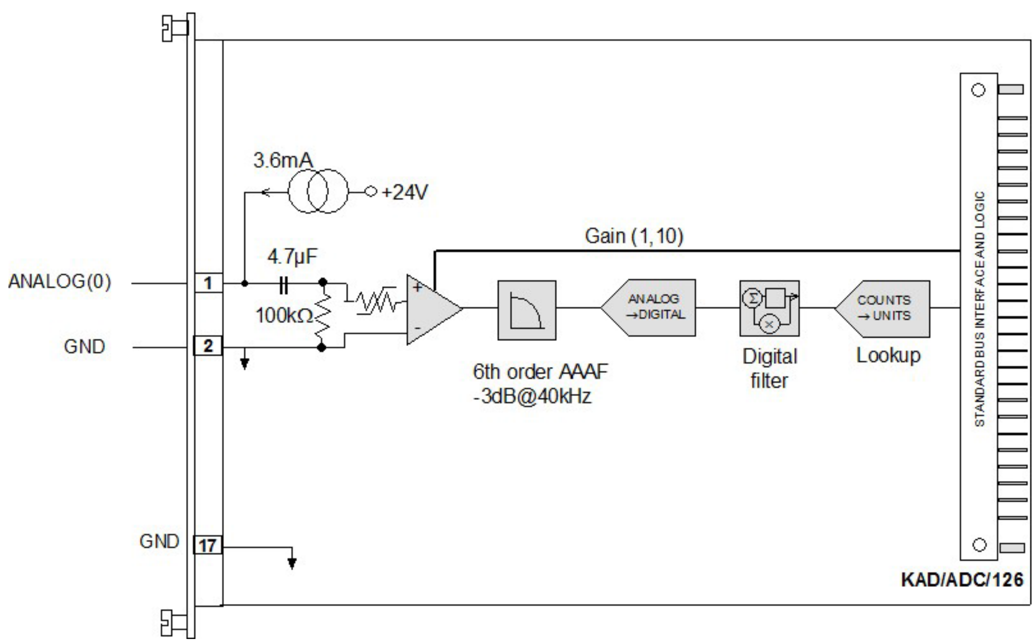


Figure 1: First of four accelerometer channels and first D/E channel on the KAD/ADC/126

Specifications

All values provided in the following specification tables are valid within the operating temperature range specified under “Environmental ratings” in the “General specifications” table. Module specifications are met for up to 97% of Full Scale Range (FSR).

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	90	–	g	
	–	3.18	–	oz	Design metric is grams.
Height above chassis					For recommended clearance requirements see the *CON/KAD/002/CP* data sheet.
bare connector	–	–	11	mm	
bare connector	–	–	0.43	in.	Design metric is millimeters.
Access rate	–	–	2	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	120	–	215	mA	
±7V	0	–	0	mA	
+12V	65	–	95	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate +12V line current.
-12V	50	–	75	mA	Excludes current used by excitation. As a DC/DC converter is used, multiply excitation current by 1.5 to calculate -12V line current.
total power	1.98	–	3.12	W	
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	AC analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	4	–	
Sampling rate					While the sampling rate can be set individually, each must have a power of two times any other (¼, ½...2, 4).
ANALOG[3:0]	2	–	100,000	sps	
Input voltage					
operating range (G_p = 1)	-10	–	10	V	Primary gain=1
operating range (G_p = 10)	-1	–	1	V	Primary gain=10
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
AC gain error					
Primary gain = 1, 10	–	0.02	0.1	%FSR	For 10Hz < $f_{in} \leq$ 3kHz, f_s = 100kHz, $f_c = F_s / 4$ (f_{in} : input signal frequency ; f_s : sampling frequency ; f_c : filter cutoff frequency)

TABLE 2	AC analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Primary gain = 1, 10	–	0.1	0.4	%FSR	For 3kHz < f_{in} ≤ 10kHz, f_s = 100kHz, f_c = F_s /4
Primary gain = 1, 10	–	0.35	0.95	%FSR	For 10kHz < f_{in} ≤ 15kHz, f_s = 100kHz, f_c = F_s /4
Effective number of bits					
gain = 1, 10	12	13.5	–	bits	f_{in} ≤ 25kHz and secondary gain of 1
Crosstalk					
gain=1, 10	–	-96	-90	dB	f_{in}≤ 25kHz and secondary gain of 1
Analog filter					Analog filter is Butterworth.
High pass filter					
poles	–	–	1	–	
filter cutoff -3dB	0.28	0.33	0.38	Hz	
Anti aliasing filter					
poles	–	–	6		
filter cutoff -3dB	38	40	42	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -3dB	0.25	–	16	f_s	The maximum value is limited to 25kHz (f_s: sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-80	dB	
aliasing to f_c	–	–	-80	dB	
Filter delay	–	200	–	µs	Where f_{in} = f_c = 10kHz.
Input impedance					
each input to GND	–	100	–	kΩ	Module powered off (measured at 3kHz).
each input to GND	–	65	–	kΩ	Module powered on (measured at 3kHz).

TABLE 3	Single ended DC current excitation outputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	4	–	Applied per channel. Connected internally with ANALOG(x) inputs
Output current					
operating range	–	3.6	–	mA	
compliance	0	–	24	V	
short circuit current	–	–	4.9	mA	
short circuit duration	∞	–	–	s	
DC error					
error	–	–	1.3	mA	With a constant 2.2kΩ load.
noise	–	3	–	mV_{rms}	As measured on analog input.

Setting up the KAD/ADC/126

All module setup can be defined in XML using XidML® schemas (see http://www.xidml.org).

Instrument settings

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/126/B	KAD/ADC/126/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Acceleration(3:0) Analog Input	-	-	Settings for this channel.
Settings	-	-	-
Filter Cutoff	0.25 0.5 1 2 4 8 16	0.25	Required cutoff point for the filter is the chosen value multiplied by the user sampling frequency. 0.25 is recommended as any higher may lead to aliasing. 1 is the sampling rate.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Acceleration(3:0) Parameters				
Acceleration Acceleration signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Acceleration(3:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	-10 to 10	10	-
Range Minimum	-10 to 10	-10	-

NOTE: It is recommended that names are less than 20 characters, have no white space or contain any of the following five characters "/><\.

Getting the most from the KAD/ADC/126

Signal return path

Each channel is single ended so a return (GND) for the constant current must be provided. Return path effects are minimized if a ground pin on the module is used. These channels are band-pass filtered (that is, the DC component is also removed) so that when a sensor is first connected or powered, it takes about 60 seconds to settle.

Understanding filter delays

The Acra KAM-500 uniquely samples all signals at the start of an acquisition cycle and at equal intervals of time thereafter. Signals sampled at the same sample rate will always be sampled at the same time independently of how they are stored or transmitted. (This has significant advantages for issues such as time correlation.) However, before signals are sampled they are filtered to remove noise components that might alias. The recommended cutoff point is one quarter the sampling frequency, as this results in the maximum filtering of aliasing frequencies.

The Acra KAM-500 filters signals using over-sampling signal processing techniques. The following figure shows a delay for an 8th order filter where f_c = 1kHz. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c), so to calculate the delay for other f_c values, multiply the delay by (1kHz / f_c). The frequency axis then needs to be rescaled to the new f_c by dividing the frequency values by (1kHz / f_c). For example, an 8th order Butterworth filter with an f_c of 1kHz delays a 1kHz signal by 1ms; a filter with an f_c of 10Hz delays a 10Hz signal by 0.1s. The delay for IIR filters (for example Butterworth) varies with the input frequency.

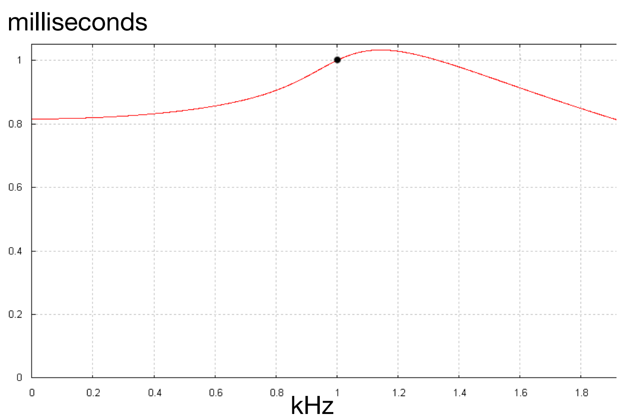


Figure 2: Filter delay for 8th order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/126 is:

$$T_D \approx T_A + \frac{1}{f_C} + T_{Butterworth8}(f)$$

T_A (analog filter delay) ≈ 0

T_D is the filter delay

Additional delay sources

Primary gains higher than 1 cause an additional delay from 1st order filters in the instrumentation amplifier. That additional delay is 2µs for a gain of 10, 15µs for a gain of 100, and 150µs for a gain of 1,000. In applications where time correlation is more important than suppression of aliasing, set the same cutoff point on all channels, even if the sampling rates are different.

Connector pinout of the KAD/ADC/126

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	ANALOG(0)	AC analog inputs	Constant current output
2	GND	Internal ground	
3	ANALOG(1)	AC analog inputs	Constant current output
4	GND	Internal ground	
5	ANALOG(2)	AC analog inputs	Constant current output
6	GND	Internal ground	
7	ANALOG(3)	AC analog inputs	Constant current output
8	GND	Internal ground	
9	DNC		Do not connect
10	GND	Internal ground	
11	DNC		Do not connect
12	GND	Internal ground	
13	DNC		Do not connect
14	DNC		Do not connect
15	DNC		Do not connect
16	DNC		Do not connect
17	GND	Internal ground	
18	DNC		Do not connect
19	DNC		Do not connect
20	DNC		Do not connect
21	DNC		Do not connect
22	DNC		Do not connect
23	DNC		Do not connect
24	DNC		Do not connect
25	DNC		Do not connect
26	DNC		Do not connect
27	DNC		Do not connect
28	DNC		Do not connect
29	DNC		Do not connect
30	DNC		Do not connect
31	DNC		Do not connect
32	DNC		Do not connect
33	DNC		Do not connect
34	DNC		Do not connect
35	DNC		Do not connect
36	DNC		Do not connect
37	DNC		Do not connect
38	DNC		Do not connect
39	DNC		Do not connect
40	DNC		Do not connect
41	DNC		Do not connect
42	DNC		Do not connect
43	DNC		Do not connect
44	DNC		Do not connect
45	DNC		Do not connect
46	DNC		Do not connect
47	DNC		Do not connect
48	DNC		Do not connect
49	DNC		Do not connect
50	DNC		Do not connect
51	GND	Internal ground	
52	CHASSIS	Chassis	

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/126/B	Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 52-way double-density connector)
KAM/ADC/126/B	Accelerometer ADC (current excitation, programmable analog gain, 25kHz b/w) - 4ch at 100ksps (with 51-way micro-miniature connector)

By default, the standard mating connector (CON/KAD/002/CP for KAD modules; or ACC/CON/008/04 for KAM modules), is included with each module in the shipment. Its part number will be added to the Confirmation of Order unless an alternative option is specified (see the *Cables* data sheet). In this data sheet, KAD/ADC/126 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/126/B	Corrected an issue with signal distortion in slave chassis, or in chassis externally receiving X_Sync signals, or in chassis containing a KAD/BCU/105 receiving IEEE 1588 PTP	Recommended for new programs
KAD/ADC/126	First release	Not recommended for new programs

Supporting software

SOFTWARE	DETAILS
DAS Studio 3	User interface for setup and management of data acquisition, network switches, recorders and ground stations in an integrated environment
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/DBK/001	Acra KAM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/MAN/018	KSM-500 Databook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation

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