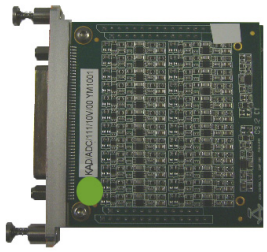
KAD/ADC/111

Single ended ADC (1kHz b/w) - 48ch at 4ksps

CURTISSWRIGHTDS.com



Key Features

- 48 single ended input channels
- Ordering input range of ±10V or ±40V
- High accuracy (0.01% FSR typical for /10V variant and 0.05% for /40V variant
- 16-bit simultaneous sampling on each channel

Applications

- Analog signal acquisition
- FTI, OLM, HUMS

Overview

The KAD/ADC/111 is used to condition and digitize up to 48 single ended analog channels using a 16-bit A/D per channel.

At the heart of the KAD/ADC/111 is a hard-wired state-machine that oversamples all channels at a rate between 16ksps and 32ksps 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. Therefore, when several channels are sampled at different sampling rates, at the start of an acquisition cycle, all channels are aligned.

The KAD/ADC/111 is available with two different input ranges (±40V, ±10V). The input range must be specified when ordering.

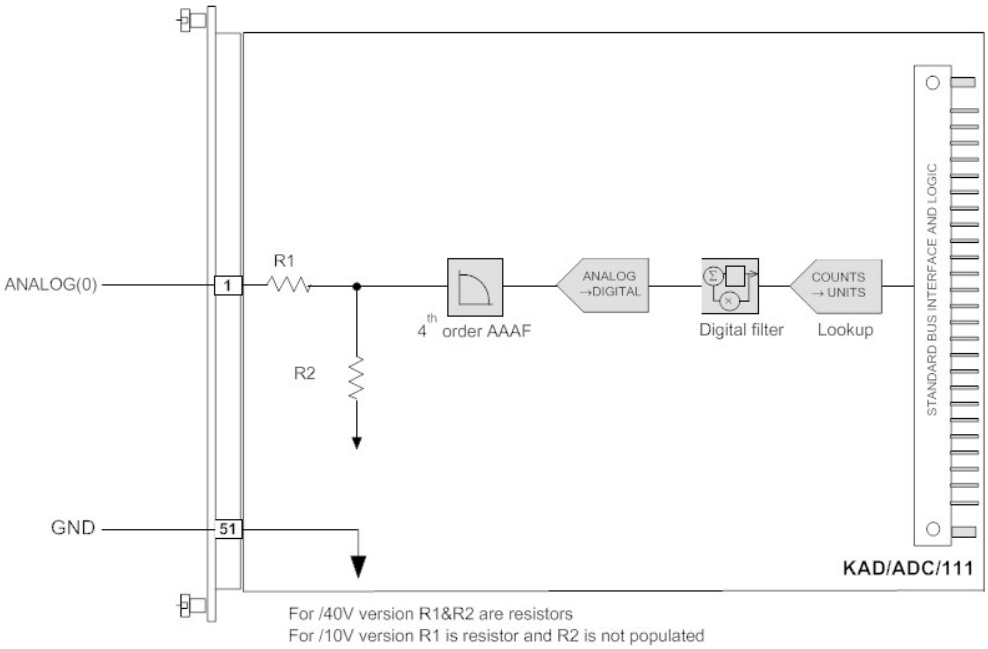


Figure 1: First of 48 channels on the KAD/ADC/111

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	215	250	275	mA	
±7V	0	–	0	mA	
±12V	45	60	80	mA	
total power	2.16	2.69	3.3	W	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see *TEC/NOT/016 - Power dissipation, TEC/NOT/049 - Power estimation*, and the relevant chassis data sheet.
Environmental ratings					See *Environmental Qualification Handbook*.
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.
storage temperature	-55	–	105	°C	

TABLE 2	Single ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	48	–	
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[47:0]	1.0	–	4,000	sps	
Input voltage					
operating range (KAD/ADC/111/10V)	-10	–	10	V	
operating range (KAD/ADC/111/40V)	-40	–	40	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
DC error					DC signal averaged over 200 samples.
gain = 1	–	0.01	0.05	%FSR	KAD/ADC/111/10V.
gain = 2	–	–	0.08	%FSR	KAD/ADC/111/10V.
gain = 4	–	–	0.14	%FSR	KAD/ADC/111/10V.
gain = 8	–	–	0.25	%FSR	KAD/ADC/111/10V.

TABLE 2	Single ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
gain = 1	–	0.05	0.08	%FSR	KAD/ADC/111/40V.
gain = 2	–	–	0.12	%FSR	KAD/ADC/111/40V.
gain = 4	–	–	0.22	%FSR	KAD/ADC/111/40V.
gain = 8	–	–	0.35	%FSR	KAD/ADC/111/40V.
AC gain error					
for 0Hz < f_{in} ≤ 100Hz	–	0.1	0.3	%FSR	Gain = 1, f_s = 4ksps, f_c = f_s / 4 (f_{in} : input signal frequency; f_s : sampling frequency; f_c : filter cutoff frequency).
for 100Hz < f_{in} ≤ 300Hz	–	0.1	0.35	%FSR	Gain = 1, f_s = 4ksps, f_c = f_s / 4.
for 300Hz < f_{in} ≤ 650Hz	–	0.2	0.6	%FSR	Gain = 1, f_s = 4ksps, f_c = f_s / 4.
Effective number of bits	12.5	13	–	bits	f_c ≤ 1kHz. Secondary gain of 1.
Crosstalk	–	-80	-75	dB	f_c ≤ 1kHz. Secondary gain of 1.
Analog filter					Analog filter is Butterworth.
poles	–	–	4	–	
filter cutoff -3dB	1.9	2	2.1	kHz	
Digital filter					Digital filter is Butterworth.
poles	–	–	8	–	
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 1kHz (f_s : sampling frequency).
0.1dB bandwidth	–	0.8	–	f_c	
aliasing to 0.1dB band	–	–	-72	dB	
aliasing to f_c	–	–	-74	dB	
Filter delay	–	2	–	ms	Where f_{in} = f_c = 1kHz. See “Unused single ended inputs” on page 5.
Input resistance					
each input to GND	100	–	–	kΩ	Module powered off, KAD/ADC/111/10V.
each input to GND	10	–	–	MΩ	Module powered on, KAD/ADC/111/10V.
each input to GND	300	350	–	kΩ	Module powered off, KAD/ADC/111/40V.
each input to GND	390	400	–	kΩ	Module powered on, KAD/ADC/111/40V.

Setting up the KAD/ADC/111

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

NOTE: The PartReference, RangeMaximum, and RangeMinimum settings are specific to each module variant as shown under “Specifications” on page 2. Only one variant is shown below.

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/ADC/111/10V	KAD/ADC/111/10V	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Channels	-	-	-
Analog(47:0) 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
Analog(47:0) Parameters				
Analog Analog signal data.	Volt	OffsetBinary	16	R[15:0]

Configurable parameters

Analog(47:0)

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/111

Unused single ended inputs

Unused inputs should not be left floating, as this may increase current consumption from the ±12V backplane lines. Floating inputs may cause the output voltage of the internal amplifiers to approach one of the supply rails, which causes increased quiescent currents within specific channel circuits. Each unused single ended input must be shorted to GND.

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 8^{th} 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 8^{th} 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.

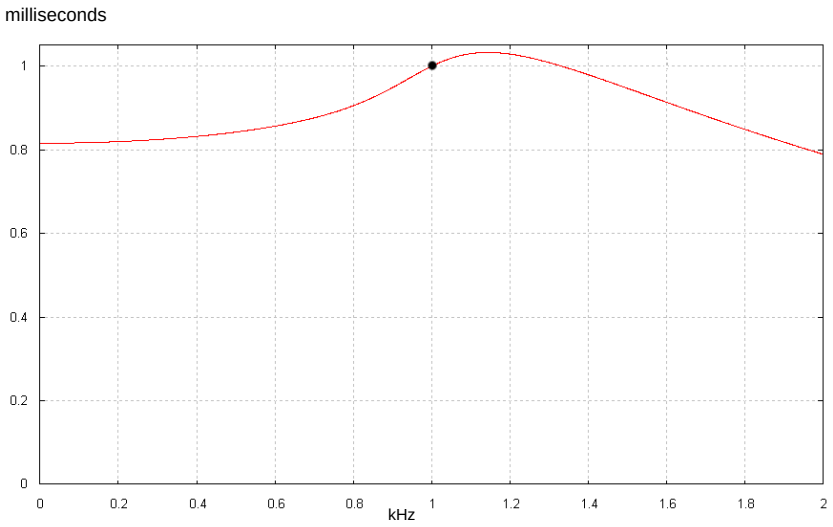


Figure 2: Filter delay for 8^{th} order Butterworth filter where f_c = 1kHz

The filter delay for the KAD/ADC/111 is:

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

T_D is the filter delay

T_A (analog filter delay) ≈ 0

Connector pinout of the KAD/ADC/111

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

Ordering information

PART NUMBER	DESCRIPTION
KAD/ADC/111/10V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±10V input range (with 52-way double-density connector)
KAD/ADC/111/40V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±40V input range (with 52-way double-density connector)
KAM/ADC/111/10V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±10V input range (with 51-way micro-miniature module top connector)
KAM/ADC/111/40V	Single ended ADC (1kHz b/w) - 48ch at 4ksps, with ±40V input range (with 51-way micro-miniature module top 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/111 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/ADC/111	First release	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 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/019	An introduction to digital filtering
TEC/NOT/049	Power estimation

This page is intentionally blank