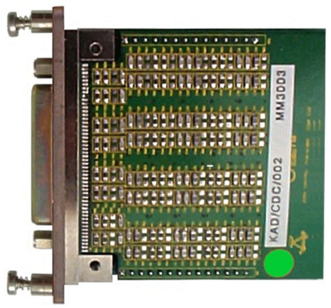
KAD/CDC/002

Differential ended current-to-digital converter (1.1kHz b/w) - 24ch at 17.5ksps



Key Features

- 24 current input channels
- Input range ±20mA
- Accuracy (0.5% FSR typical for input range of ±20mA)
- Short on any channel does not affect others
- 14-bit simultaneous sampling on each channel

Applications

- For use with 4 - 20mA transmitters
- Current measurement

Overview

The KAD/CDC/002 is used to condition and digitize up to 24 differential ended current channels.

At the heart of the KAD/CDC/002 is a hard-wired state-machine that over-samples all channels and digitally filters any noise above the user-programmable cutoff frequency. This is achieved using cascaded, half-band, decimate by 2, 15-tap, Finite-Impulse-Response (FIR) filters with 32-bit coefficients.

All signals are sampled simultaneously. Secondary gain and offset are achieved digitally according to specified range.

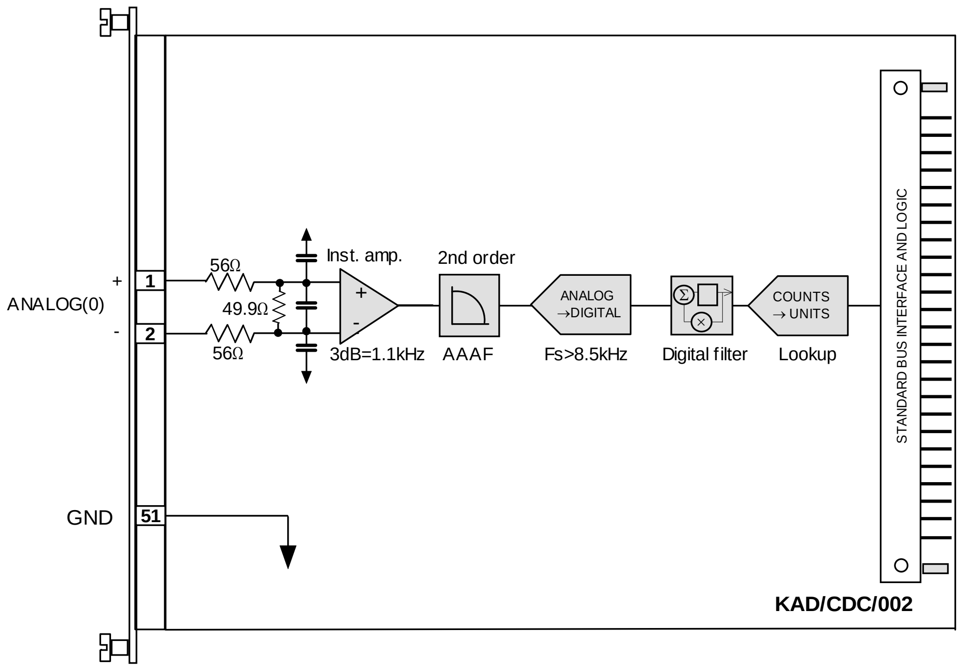


Figure 1: First of 24 channels on the KAD/CDC/002

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.

TABLE 1	General specifications				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Slots	–	–	1	–	Can be placed in any user-slot in any combination.
Mass					
	–	75	–	g	
	–	2.64	–	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	–	–	0.5	Msps	Maximum combined access rate for read and write.
Power consumption					
+5V	200	–	300	mA	
±7V	0	–	0	mA	
+12V	15	–	70	mA	
-12V	20	–	40	mA	
total power	1.42	–	2.82	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	Differential ended analog inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
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[23:0]	1	–	17,500	sps	
Input current					
operating range	-20	–	20	mA	
overcurrent protection	-30	–	30	mA	Currents outside of this range can damage input.
DC error					
	–	–	0.5	%FSR	For input current range of ±20mA.
	–	–	1.25	%FSR	For input current range of 4mA to 20mA.
Effective number of bits	–	9	–	bits	
Crosstalk	–	-72	–	dB	

TABLE 2	Differential ended analog inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Analog filter					Analog filter is Butterworth.
poles	–	–	2	–	
filter cutoff -3dB	1	1.2	1.4	kHz	
Digital filter					Digital filter is cascaded 15 tap FIR.
poles	–	–	–	–	Not applicable for FIR type filters.
filter cutoff -6dB	0.25	–	16	f_s	The maximum value is limited to 4.375kHz (f_s: sampling frequency). In order to maximize anti-aliasing protection, it is strongly recommended to use $f_c = f_s / 4$.
0.1dB bandwidth	–	0.64	–	f_c	
aliasing to 0.1dB band	–	–	-27	dB	
aliasing to f_c	–	–	-31	dB	
Filter delay	–	190	–	ms	Where $f_{in} = f_c$ = 25Hz (f_{in} : input signal frequency). See “Understanding filter delays” on page 5.
Input resistance					
between inputs	150	162	–	Ω	Module powered off.

Setting up the KAD/CDC/002

Setting up parameters

For channels Analog(0) to Analog(23)

SET-UP DATA	CHOICE	DEFAULT	NOTES
Name	No limit to characters	MySignal	Range can be set to any sub-range of ±20mA wider than 10mA. Any range narrower than 16mA may have error larger than 1% FSR.
Base Unit	mA	mA	
maximum	-20 to 20	20	
minimum	-20 to 20	-20	
Data Format	Offset binary	Offset binary	
Size In Bits	4 to 16	16	

Setting up instrumentation

This module uses the X-Module-Analog-In XidML schema. (See http://www.xidml.org).

For channels Analog(0) to Analog(23)

SET-UP DATA	CHOICES	DEFAULT	NOTES
Manufacturer			
name	ACRA CONTROL	ACRA CONTROL	
part reference	KAD/CDC/002	KAD/CDC/002	ACRA CONTROL part number.
serial number	Fixed 6 characters	FE1234	Unique number for each module.
Sub location	1 to 80 characters	MyDAU	Name of DAU.
slot	3 to N	3	The DAU slot the module fits into. First user-module goes into slot 3, where N is the number of user-slots +2 in the DAU.
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 strongly recommended as any higher may lead to aliasing. 1 is the sample rate.

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/CDC/002

If the signal source is isolated from the Acra KAM-500, a common-mode resistance between the negative input and ground (GND) can be used to reduce common-mode noise pick-up. Because the bias currents are in the order of nAs, resistors up to 10kΩ can be used. Digital filters, as used in the KAD/CDC/002, cause no phase distortion. However, like all low-pass filters they cause a delay inversely proportional to the cutoff point (see formula in “Understanding filter delays” on page 5). However, to simplify the time-correlation of data when processing (especially in real-time) it may be worth considering setting the same cutoff point on all channels even if the sampling rates are different. The sensor used for this module must be capable of driving 150Ω, that is, if the highest current produced by the sensor is 20mA, it must be capable of outputting 3V.

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 are always 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. All filters cause a delay inversely proportional to the filter cutoff frequency (f_c).

The filter delay for the KAD/CDC/002 may be calculated as:

$$T_D \approx T_A + \left(19.1 - \frac{20}{2^N}\right) \cdot \frac{1}{4 \cdot f_C}$$

$$N = INT(15.15 - \log_2(4 \cdot f_C))$$

INT is for the integer part of the value. For example, if x = 13.5, *INT*(x) = 13.

N cannot be lower than 1. If N is lower than 1, then use 1.

T_D is the filter delay

T_A (analog filter delay) ≈ 200μs.

CURTISS-WRIGHT

Connector pinout of the KAD/CDC/002

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

Ordering information

PART NUMBER	DESCRIPTION
KAD/CDC/002	Differential ended current-to-digital converter (1.1kHz b/w) - 24ch at 17.5ksps (with 52-way connector)
KAM/CDC/002	Differential ended current-to-digital converter (1.1kHz b/w) - 24ch at 17.5ksps (with 51-way 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/CDC/002 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/CDC/002	First release	Recommended for new programs

Supporting software

SOFTWARE	DETAILS
KSM-500	This module is supported by the KSM-500 suite of software tools

Related documentation

DOCUMENT	DETAILS
DOC/MAN/018	KSM-500 Databook
DOC/HBK/002	Environmental Qualification Handbook
DOC/DBK/001	Acra KAM-500 Databook

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