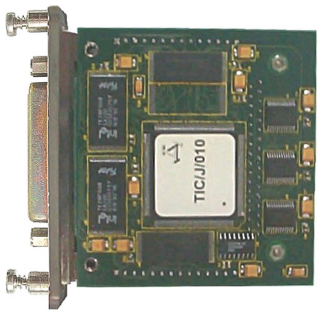
KAD/DSI/003

Bi-level input (counters, time tagging) - 24ch

CURTISSWRIGHTDS.COM



Key Features

- 24 differential ended discrete bi-level input channels
- Eight independent 32-bit counters with six different operating modes
- 9µs internal resolution
- FIFO based time tagging
- Resettable counters
- Independent channel settings for threshold, hysteresis, falling/rising edge detection

Applications

- Engine speed measurement
- Slow slew rate, high noise applications
- Timestamping of events

Overview

The KAD/DSI/003 monitors the status (high/low) of up to 24 D/E discrete channels. The first eight input channels have alternative functions as programmable counters, of which four can be configured as resettable event counters. The remaining 16 channels can be used to trigger time-tagged events.

All 24 discrete signals are sampled simultaneously and can be read as a 24-bit word (16-bit + 8-bit or 12-bit + 12-bit). The KAD/DSI/003 uses 24 separate 14-bit A/Ds operating continuously at 111ksps to sample each input so the threshold and hysteresis can be programmed separately for each channel.

The first eight counters (channels 0 to 7) can be programmed as PERIOD, FREQUENCY, EVENTS_SINCE_LAST_READ, EVENTS or ELAPSED time. The range of each counter is programmable as is the threshold, hysteresis sensitivity to the rising/falling edge, and roll-over. If the counter uses more than 16 bits, they are treated as two words.

The remaining 16 channels (8 to 23) control the time tagging to the 8K FIFO. For each input, time tagging can be triggered by a rising and/or falling edge, or neither (when the channel is disabled). Every time a trigger occurs, a 64-bit word is written to the FIFO consisting of the status of the 16 inputs (after the change) and the Binary Coded Decimal (BCD) time of when the event happened (up to 23 hours 59 minutes 59.99 9999 seconds).

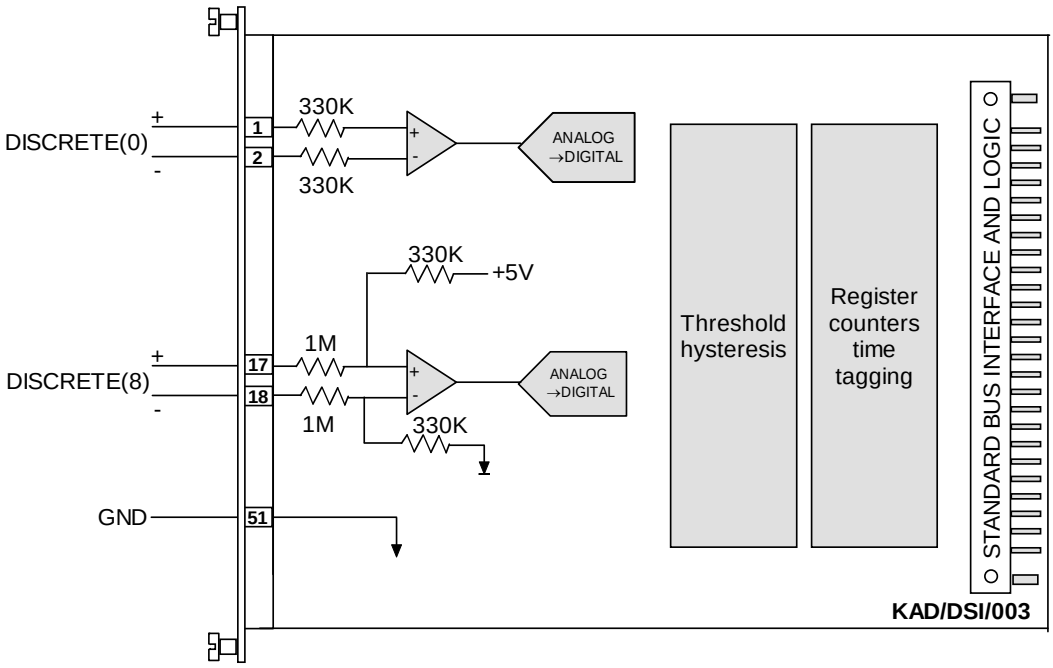


Figure 1: First of eight counter inputs and first of sixteen discrete inputs

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					
	–	80	–	g	
	–	2.82	–	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	225	–	285	mA	
±7V	0	–	0	mA	
+12V	10	–	30	mA	
-12V	10	–	20	mA	
total power	1.37	–	2.03	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 digital inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	24	–	
Sampling rate					
per channel	1	–	20,000	sps	
Input voltage					
operating range	-28	–	28	V	Primary gain = 1.
overvoltage protection	-80	–	80	V	Voltages outside of this range can damage input.
Input signal (channels 0 to 7)					
slew rate	–	4	–	V/µs	Volts per microsecond.
threshold	-10	–	10	V	
threshold steps	–	1.22	–	mV	
threshold accuracy	-50	–	50	mV	
frequency range	0	–	50	kHz	
frequency accuracy	-2	–	2	Counts	This equates to 1Hz with a sampling period of two seconds.

TABLE 2	Differential ended digital inputs (continued)				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
bandwidth ($10V_{pp}$)	0	–	30	kHz	For input amplitudes less than $10V_{pp}$.
bandwidth ($2.5V_{pp}$)	0	–	50	kHz	For input amplitudes less than $2.5V_{pp}$.
Input signal (channels 8 to 23)					
slew rate	–	1.25	–	V/µs	Volts per microsecond.
threshold	-55	–	25	V	
threshold steps	–	4.88	–	mV	
threshold accuracy	-200	–	200	mV	
frequency range	0	–	50	kHz	
frequency accuracy	-2	–	2	Counts	This equates to 1Hz with a sampling period of two seconds.
bandwidth ($40V_{pp}$)	0	–	30	kHz	For input amplitudes less than $40V_{pp}$.
bandwidth ($10V_{pp}$)	0	–	50	kHz	For input amplitudes less than $10V_{pp}$.
Time accuracy					
internal resolution	–	9	–	µs	Sample rate: 111ksps (9.009µs)
reference clock precision	–	3	–	ppm	Note that samples are driven by the system clock. For specifications, see the respective controller module data sheets.
Input resistance (channels 0 to 7)					
between inputs	0.7	1	–	MΩ	Module powered off.
between inputs	10	–	–	MΩ	Module powered on.
single ended input to GND	330	450	–	kΩ	Module powered off.
single ended input to GND	10	–	–	MΩ	Module powered on.
Input resistance (channels 8 to 23)					
between inputs	2	2.4	–	MΩ	Module powered off.
between inputs	3	4	–	MΩ	Module powered on.
single ended input to GND	1	1.1	–	MΩ	Module powered off.
single ended input to GND	1	1.2	–	MΩ	Module powered on.

Setting up the KAD/DSI/003

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

Instrument settings

SETUP DATA	CHOICE	DEFAULT	NOTES
Manufacturer	-	-	-
Name	ACRA CONTROL	ACRA CONTROL	Name of manufacturer.
PartReference	KAD/DSI/003/B	KAD/DSI/003/B	The instrument part reference.
SerialNumber	AB2345	AB2345	Unique name for each module.
Channels	-	-	-
Counter(7:0) Discrete Input	-	-	Represents a typical discrete input channel on an instrument
Settings	-	-	-
Counter Type	Period Frequency Elapsed EventsSinceRead Events Read	Period	Specifies the counter type.
Threshold Voltage Maximum	-10 to 10	10	Specifies the maximum voltage above which an event is triggered.
Threshold Voltage Minimum	-10 to 10	-10	Specifies the minimum voltage above which an event is triggered.
Trigger Edge	Rising Falling RisingOrFalling	Rising	Specifies the type of edge used by the counter channel.
Roll Over	True False	True	Specifies whether the counter should start again at the end of a cycle. Specifying "true" means that the counter will reset.
Discrete(23:8) Discrete Input	-	-	Represents a typical discrete input channel on an instrument
Settings	-	-	-
Event Armed	True False	False	Used on discrete channels to specify whether the bit is ignored. A value of 'true' means that it is not ignored.
Threshold Voltage Maximum	-55.455 to 25.152	10	Specifies the maximum voltage above which an event is triggered.
Threshold Voltage Minimum	-55.455 to 25.152	2	Specifies the minimum voltage above which an event is triggered.

Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
TagIrigTime48 48 bit wide IRIG time word	BitVector	BitVector	48	R[47:0]
TagTimeHi Hours and minutes at the start of the event	BitVector	BitVector	16	R[47:32] R[6:0] Minutes - BCD Minutes 0 to 59 R[12:7] Hours - BCD Hours 0 to 23 R[15:13] Reserved - Reserved for future use

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
TagTimeLo Seconds and centiseconds at the start of the event	Second	BCD	16	R[31:16] R[7:0] Centiseconds - Centiseconds 0 to 99 R[14:8] Seconds - Seconds 0 to 59 R(15) Reserved - Reserved for future use
TagTimeMicro Microseconds at the start of the event	Second	BCD	16	R[15:0] R[15:0] Microseconds - Microseconds 0 to 9999
TagStatus The values of the 16 discrete inputs labeled 23 down to 8 after an event. When the FIFO is empty the last values are repeated.	BitVector	BitVector	16	R[15:0] R[15:0] StatusCodes
Discrete The values of the 24 discrete inputs labeled 23 down to 0. Status is read at the start of an acquisition cycle and evenly spaced in time thereafter.	BitVector	BitVector	32	R[31:0]
DiscreteHi The values of the 8 discrete inputs labeled 23 down to 16 which is read at the start of an acquisition cycle and evenly spaced in time thereafter. Discrete_hi(15:8) = inputs(23:16), discrete_hi(7:0) reserved.	BitVector	BitVector	16	R[31:16] R[15:8] Discrete - The values of the 8 discrete inputs labeled 23 down to 16. R[7:0] Reserved
DiscreteLo The values of the 15 discrete inputs labeled 15 down to 0, which is read at the start of an acquisition cycle and evenly spaced in time thereafter.	BitVector	BitVector	16	R[15:0]
Counter(7:0) Parameters				
Counter 32-bit counter	Second	OffsetBinary	32	R[31:0]
CounterLo For Lo 16 bits, Period and Elapsed maximum ranges are 0.65535 to 5.24288 Seconds. Frequency range is 32768 to 655360 Hertz. The Read Counter range is 65536.	Second	OffsetBinary	16	R[15:0]
CounterHi For Hi 16 bit counters - Period and Elapsed maximum ranges are 42940 to 343520 Seconds. Frequency range is 2147000000 to 42940000000 Hertz. The Read Counter range is 4294967296.	Second	OffsetBinary	16	R[15:0]

Configurable parameters

Counter(7:0)

SETUP DATA	CHOICE	DEFAULT	NOTES
Range Maximum	42949.67296 85899.34592 171798.69184 343597.38368	42949.67296	For 32 bit counters - Period and Elapsed maximum ranges are 42940 to 343520 Seconds. Frequency range is 2147000000 to 42940000000 Hertz. The Read Counter range is 4294967296.
Range Minimum	0	0	The default minimum range is always 0

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/DSI/003

For single ended signals, connect to the positive input for each channel. The negative input can be left floating but it is recommended to tie it to ground (GND). When time tagging events, ensure unused inputs or inputs that are not of interest are masked such that transitions on these inputs are ignored. This helps ensure that the FIFO does not overflow due to too many events.

The READS counter increments every time it is read. For example, if a 32-bit READS counter is read once per 1ms major frame then it can act as a major frame counter that cycles every 49.7 days (= 2^{32} × 1ms).

The EVENTS counter increments on events and rolls over. For example, a 20-bit EVENTS counter connected to a 1pps output of a time source would increment every second and cycle every 12.1 days (=2^{20} × 1s).

In KSM-500, the FREQUENCY counter is used to count events over a user defined time. For example, if a 1s time base is chosen, then a 1kHz input returns a binary value of 11 1110 1000^2, that is, 1000 counts in decimal. In DAS Studio 3, the maximum range must be selected. The equation is: Count = Frequency in Hertz × 2 power of the counter size in bits / Range Maximum. So for a 16-bit counter and a 100Hz input, 100Hz × 65536 / 65536 = 1100100, that is, 100 counts in decimal.

In KSM-500, the PERIOD counter is used to measure the time between events. For example, if an 80µs interval base is chosen, then an input signal of 10Hz returns a binary value of 100 1110 0010^2, that is, 1250 counts in decimal. In DAS Studio 3, the maximum range must be selected. The equation is Count = Period in Seconds × 2 power of the counter size in bits / Range Maximum. So for a 16-bit period counter and an 0.01s period input, 0.01 × 65536 / 0.65536 = 1111101000, that is, 1000 counts in decimal.

The EVENTS_SINCE_RESET counter increments on events and rolls over. For example, a 20-bit EVENTS counter connected to a 1pps output of a time source increments every second and cycle every 12.1 days (=2^{20} × 1s). However, this counter can be reset by the input to the next counter. To do this, the next counter must be set to EVENT type and only counters 0, 2, 4 or 6 can be used as RESET inputs.

If measuring high frequency (20kHz - 50kHz) signals with the KAD/DSI/003, choose suitable threshold voltages, bearing in mind that the input signal is attenuated.

Roll Over

When Roll Over is set, the counter restarts at the end of a cycle from its maximum; so FFFFh for a 16-bit counter to 0.

When Roll Over is not set, at the end of a cycle the counter remains at its maximum; so FFFFh for a 16-bit counter.

Discrete registers

Registers available when using DAS Studio 3 software are documented in “Setting up the KAD/DSI/003” on page 4. The following discrete status registers are only available when using KSM-500 software.

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
StatusLo_16B Current state of 16 discrete inputs 15 to 0.	BitVector	BitVector	16	R[15:0] Status_15_0 - The value representing the current state of 16 discrete inputs, from 15 to 0
StatusHi_8B Current state of 8 discrete inputs, 23 to 16. Padded with 8 0s on LSB side.	BitVector	BitVector	16	R[15:0] R[15:8] Status_23_16 - The value representing the current state of 8 discrete inputs, from 23 to 16 R[7:0] - Reserved

Connector pinout of the KAD/DSI/003

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

Ordering information

PART NUMBER	DESCRIPTION
KAD/DSI/003/B	Bi-level input (counters, time tagging) - 24ch (with 52-way double-density connector)
KAM/DSI/003/B	Bi-level input (counters, time tagging) - 24ch (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/DSI/003 refers to both the KAD and KAM version of the module.

Revision history

REVISION	DIFFERENCES	STATUS
KAD/DSI/003/B	Includes an external counter reset function	Recommended for new programs
KAD/DSI/003	First release	Obsolete

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

This page is intentionally blank