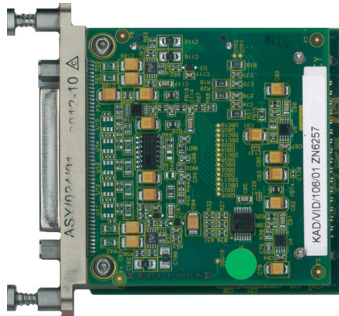


# KAD/VID/106

H.264 video encoder (analog video input) - 1ch



## Key Features

- H.264 compression of video input channels (NTSC or PAL)
- Supports digital video formats CIF, 2CIF, D1
- Configurable I-frame to P-frame ratio
- Programmable frame rates
- Advanced Audio Codec (AAC) audio encoding
- Constant compressed video bit-rate target can be set to between 250 kbps and 10 Mbps

## Applications

- Video monitoring of cockpit and control surfaces
- Direct monitoring of video compatible head/up and head/down displays

## Overview

The KAD/VID/106 is an H.264 video encoder card that converts one of three composite analog video inputs, or one Y/C analog video input to digital video and compresses it. Compressed video bit-rate is kept constant using multi-pass encoding and padding of the transport stream. Optional audio encoding produces a digital audio data stream. The left and right audio channels can be individually turned on or off; and the audio bit rate can be selected. An audio only mode (without video) can also be enabled. Selection of PAL or NTSC input format is a configurable setting.

The KAD/VID/106 latency is less than 80 ms. The latency measures the amount of time it takes to encode and transfer one video frame from the backplane interface of the module.

The KAD/VID/106 offers two generator lock outputs (CAM\_2\_GENLOCK\_OUT and CAM\_3\_GENLOCK\_OUT) to allow synchronization of all four video input signals.

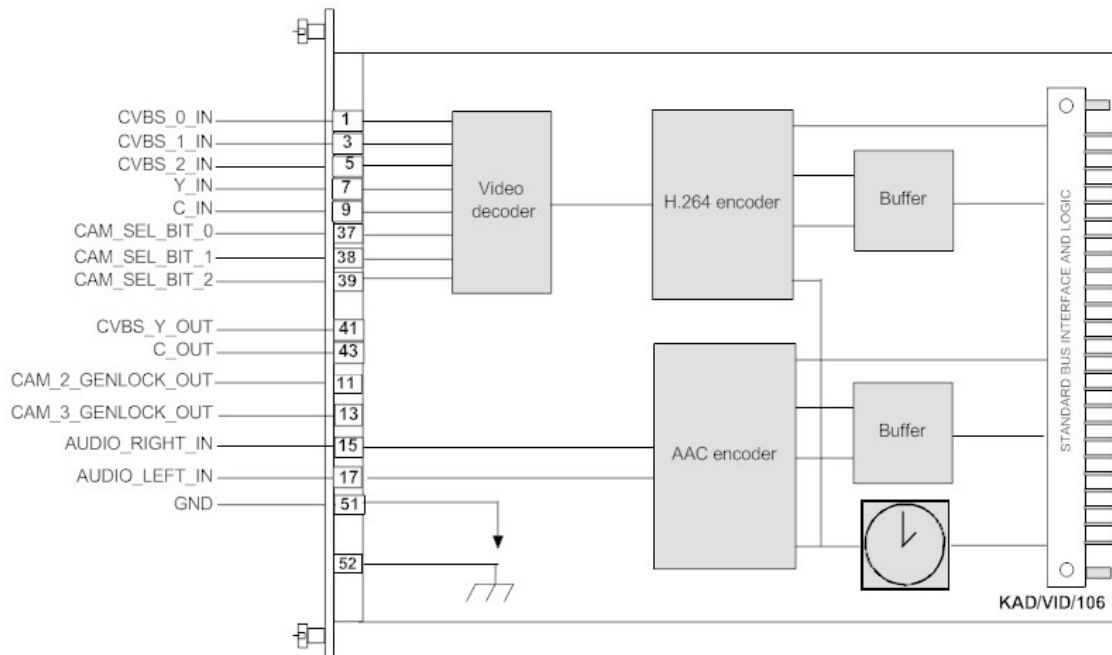


Figure 1: Audio and video interfaces of the KAD/VID/106

## 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						
	–	95	–	g		
	–	3.36	–	oz	Design metric is grams.	
Height above chassis					For recommended clearance requirements see the <i>CON/KAD/002/CP</i> data sheet.	
bare connector	–	–	11	mm		
bare connector	–	–	0.43	in.	Design metric is millimeters.	
Access rate	–	–	2	Msp/s	Maximum combined access rate for read and write.	
Power consumption						
+5V	–	–	294.8	mA		
+12V	–	–	71.5	mA		
-12V	–	–	23.1	mA		
total power	–	–	2,609.2	mW	Particular combinations of chassis and Acra KAM-500 modules may have power or current limitations. For details, see <i>TEC/NOT/016 - Power dissipation</i> , <i>TEC/NOT/049 - Power estimation</i> , and the relevant chassis data sheet.	
Environmental ratings					See <i>Environmental Qualification Handbook</i> .	
operating temperature	-40	–	85	°C	Chassis base/side plate temperature.	
storage temperature	-55	–	105	°C		

TABLE 2		Video inputs				
PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS	
Inputs	–	–	4	–		
Encoded video rate						
CVBS_[2:0]_IN	0.250	–	10	Mbps	One of three possible composite video inputs.	
Y_IN/C_IN	0.250	–	10	Mbps	Y_IN and C_IN must be used as a pair.	
Video input format	–	NTSC/ PAL	–	–		
Input level	–	1	–	V <sub>pp</sub>		
Input resistance						
each input to GND	–	75	–	Ω	Each input is terminated with a 75Ω impedance-matching resistor. When Y_IN/C_IN is not selected, the input impedance of the C_IN input is 120 kΩ. When Y_IN/C_IN is selected, the input impedance of C_IN is 75Ω.	

**TABLE 3** BTTL inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	3	–	
Signaling rate					
CAM_SEL_BIT_[2:0]	–	–	1	Hz	See “Selecting a camera” on page 7.
Input voltage					
operating range	0	3.3	–	V	Internally pulled high; can be brought low by connecting to GND. (see “Getting the most from the KAD/VID/106” on page 7.)
logic 0	0	–	0.8	V	
logic 1	2	–	3.6	V	
overvoltage protection	-40	–	40	V	Voltages outside of this range can damage input.
Input resistance					
each input to GND	10	–	–	MΩ	Module powered on.
each input to GND	10	–	–	kΩ	Module powered off.

**TABLE 4** Audio inputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Inputs	–	–	2	–	
Encoded audio rate					Each audio channel can optionally be encoded at 64 kbps.
AUDIO_LEFT_IN	0	–	64	kbps	
AUDIO_RIGHT_IN	0	–	64	kbps	
Input level	–	1	–	V <sub>rms</sub>	
Input resistance					
each input to GND	–	11	–	kΩ	

**TABLE 5** Video outputs

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITION/DETAILS
Outputs	–	–	2	–	Camera synchronization output derived from CVBS_0_IN.
Generator lock outputs					
CAM_2_GENLOCK_OUT	–	1	–	V <sub>pp</sub>	AC coupled output with a 75Ω resistor in series for impedance matching.
CAM_3_GENLOCK_OUT	–	1	–	V <sub>pp</sub>	AC coupled output with a 75Ω resistor in series for impedance matching.
Source copy outputs					
CVBS_Y_OUT	–	–	–	–	Composite video/component video luminance output.
C_OUT	–	–	–	–	Component video chrominance output.
Output level	–	1	–	V <sub>pp</sub>	
Output resistance	–	75	–	Ω	AC coupled output with a 75Ω resistor in series for impedance matching.

## Setting up the KAD/VID/106

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/VID/106/B	KAD/VID/106/B	The instrument part reference.
SerialNumber	AB1234	AB1234	Unique name for each module.
Settings	-	-	-
Encapsulation Mode	Packetizer FIFO	Packetizer	Switches between FIFO mode and Packetizer mode. Packetizer mode transmits iNET-X block-type payloads.
Audio Video Mode	Normal Audio Only	Normal	Switches between Normal (video and audio) and Audio Only mode.
Sample Width	16-bit 12-bit	16-bit	Controls the sample width; 16-bit or 12-bit samples.
Settings	-	-	-
Video Input	-	-	-
Video Format	NTSC PAL	PAL	Used to select the video format.
Video Source	CVBS_IN(0) CVBS_IN(1) CVBS_IN(2) Test Y/C_IN CameraSelect(2:0) None	CVBS_IN(0)	Used to select between three composite input channels, one Y/C input channel or a test picture.
Settings	-	-	-
Time Overlay	-	-	-
Video Timer On	True False	True	Specifies whether time overlay is present.
Text Color	Black White	Black	Specifies the color of the text.
Background Style	Solid None	Solid	Specifies the style of the text background.
Horizontal Placement	0 to 719	40	Specifies the left most Time Overlay horizontal placement in terms of pixel position where (0,0) represents the top-left corner of the image. When a value larger than 577 is used, the Time Overlay will start go off the screen.
Vertical Placement	0 to 575	40	Specifies the top most Time Overlay vertical placement in terms of pixel position. When a value larger than 542 (PAL) or 447 (NTSC) is used, the Time Overlay will start go off the screen.
Settings	-	-	-
Compression	-	-	-
Video Resolution	CIF 2CIF D1	CIF	Used to specify the digital video resolution.

SETUP DATA	CHOICE	DEFAULT	NOTES
Video Bit Rate	250 kbps 512 kbps 750 kbps 900 kbps 1 Mbps 2 Mbps 5 Mbps 10 Mbps	1 Mbps	H.264 encoding produces a bit stream with an average bit-rate close to the value specified in this setting. When Encapsulation Mode is FIFO, 5 Mbps and 10 Mbps are not supported.
GOP Mode	All I 1:1 1:5 1:15 1:25 1:30 1:50 1:60	1:15	I-frame to P-frame ratio.
Frame Rate	1 5 8.33 12.5 25	25	Used to set the number of frames per second. This setting is context sensitive and depends on which video format is selected; NTSC or PAL. Settings shown here are for PAL. When NTSC is selected, available settings are: 1, 6, 10, 15, 30.
Audio Setting	Stereo Left Right None	Stereo	Describes the audio settings of the instrument. The allowed values are Mono, Stereo, Left, Right and None. None means that there is no audio.
Audio Channel Bit Rate	64 kbps 32 kbps	64 kbps	Audio encoding bit-rate per channel.
Channels	-	-	-
CVBS_IN(2:0) Video Input	-	-	Single ended composite video inputs.
Y/C_IN Video Input	-	-	S-video input made up of two physical channels. Y luminance and C chromance.
CameraGenLock(1:0) CameraGenLock Output	-	-	GenLock camera synchronization signal derived from CVBS_IN(0).
CameraSelect(2:0) CameraSelect Input	-	-	Physical pins used to select between three composite input channels, one component input channel or a test picture.
VideoCopyOut(1:0) VideoCopyOut Output	-	-	Buffered copy of the selected input video source.
MPEG2TSIn MPEG2 Transport Stream Input Settings	-	-	iNET-X packetizer channel for audio and video MPEG-2 transport stream.
Stream Id	00 to FFFFFFFF	FFFFFFF	iNET-X stream ID for selected channel if a packet is generated via the assertion of Packetization Enabled. This setting is only supported in DAS Studio 3.
Packetization Enabled	True False	False	Enables the transmission of an iNET-X packet containing the contents of this channel if an iNET-X transmitter is present in the chassis. This setting is only supported in DAS Studio 3.

## Parameter definitions

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Global Parameters				
MPEG2TS MPEG2 transport stream of H.264 encoded video data and AAC encoded audio data.	BitVector	BitVector	16	R[15:0]

NAME/DESCRIPTION	BASE UNIT	DATA FORMAT	BITS	REGISTER DEFINITION
Report Reports the status of the module.	BitVector	BitVector	16	<p>R[15:0]</p> <p>R(15) Fresh Error - Indicates occurrence of a new error. Resets to 0 when read from the backplane.</p> <p>R[14:8] DSP Timeout Count - Helps detect problems in the DSP processor by giving the amount of timeouts detected.</p> <p>R[7:5] Error Code - 3-bit error code used to indicate the most recent error detected in the motherboard FPGA.</p> <p>000: No error</p> <p>101: Malformed audio packet length. Error code is generated when an AAC packet length of zero is detected.</p> <p>R(4) Audio FIFO Overflow - The internal audio FIFO of the MPEG2 transport stream frame overflowed at least once.</p> <p>R(3) Video FIFO Overflow - The internal video FIFO of the MPEG2 transport stream frame overflowed at least once.</p> <p>R(2) BIST Passed - Built in test passed and DSP processor is up and running.</p> <p>R(1) ACC Encoded Audio Present - ACC audio from DSP processor present.</p> <p>R(0) H.264 Encoded Video Present - H.264 video from DSP processor present.</p>

**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/VID/106

For a detailed description on iNET-X payloads, see *TEC/NOT/070 - iNET-X payload structures*.

### KAD/VID/106 video decoder and encoder

The KAD/VID/106 video section consists of two units; an analog video decoder and an H.264 baseline profile encoder. The video decoder operates on one of the three composite or Y/C input signals and supports both NTSC and PAL. The H.264 encoder unit is highly configurable and can be tuned to suit various applications by setting the frame rate (fps), GOP mode, and output video resolution. The sample width can be set to 16 bits or 12 bits.

### Enabling video and audio

The module can encapsulate via software, video only, audio only, or both video and audio into the MPEG2 transport stream.

Set Audio Video Mode to Normal for both video and audio; set to Audio Only for audio.

However, if you only want video, you need to set Audio Video Mode to Normal and then set Audio Setting to None.

**WARNING:** If Audio Video Mode is set to Audio Only, then Audio Setting must not be None. Otherwise, no MPEG transport stream is output as no audio or video have been requested.

### Setting the I-frame to P-frame ratio

The GOP can be set via software to I-frame mode only (All I) or up to I-frame to 60 P-frames (1:60) to achieve a higher compression ratio. Reducing the P-frame to I-frame ratio improves real-time characteristics and loss recovery. Increasing the P-frame to I-frame ratio gives a higher compression ratio at the expense of loss recovery.

### Setting the video output resolution

The digital video output resolutions can be set via software to D1, 2CIF, and CIF depending on picture detail required. Also, the number of fps can be reduced from full frame (30 fps NTSC, 25 fps PAL) down to 1 fps. Increasing the frame rate makes the appearance of movement more fluid, but can add significantly to the output data rate and is not always necessary with graphical displays. Optional AAC audio encoding produces a digital audio data stream at 32 kbps or 64 kbps per channel. The left and right channels can be individually turned on or off.

### Synchronizing incoming video input signals

The KAD/VID/106 has two genlock outputs to allow synchronization of all four incoming video input signals. When multiple synchronized video signals are connected, the KAD/VID/106 can switch between the incoming channels via an external switch. The KAD/VID/106 also outputs a copy of the currently selected input source. This allows it to be relayed to a second KAD/VID/106 which can be set up with different encoding parameters. For example, to allow video to be recorded at a higher quality necessitating a higher bit-rate; while lower quality video is available for transmission at a lower bit-rate over a PCM or Ethernet link. Time can be optionally overlaid onto the picture. For link testing, a color bar test picture can be generated. If no input source is present, the module outputs a blue screen image.

### Selecting a camera

Camera selection can be controlled via software or via the CAM\_SEL\_BIT\_[2:0] input signals on the top connector. When the module is programmed for camera selection via the top connector input lines, then the behavior is determined as listed in the following table.

TABLE 6			Camera selection test sequence format
C_SEL_BIT_[2:0]			CABLING
0	0	0	Test screen
0	0	1	CVBS_0_IN
0	1	0	CVBS_1_IN
0	1	1	CVBS_2_IN
1	0	0	Y_IN/C_IN

Only one input can be selected at a time by connecting the CAM\_SEL\_BIT\_[2:0] pin to GND on pin 40. These signals are internally pulled high. The amount of time it takes to switch from one video input to another via the top block CAM\_SEL\_BIT\_[2:0] is 500ms or less.

### Optimal configuration

The two optimal video settings tables below display the recommended H.264 bit-rate range for different resolution and frame rate settings.

**NOTE:** The optimal video settings tables represent a subset of the results gathered during tests. For more information on the optimal configuration for specific setups, contact Curtiss-Wright support (acra-support@curtiss-wright.com).

TABLE 7		KAD/VID/106 optimal PAL video settings		
BIT-RATE (MBPS)	RESOLUTION	FRAME RATE (FPS)	GOP	
0.250	CIF	25	15	
0.250	2CIF	12.5	5	
0.250	D1	8	15	
0.512	CIF	12.5	5	
0.512	2CIF	25	15	
0.512	D1	12.5	5	
0.75	CIF	25	15	
0.75	D1	25	5	
0.9	CIF	25	5	
0.9	D1	25	15	
1	2CIF	25	15	
1	D1	25	15	
2	2CIF	25	5	
2	D1	25	15	
5	2CIF	25	5	
5	D1	25	5	
10	2CIF	25	5	
10	D1	25	5	

TABLE 8		KAD/VID/106 optimal NTSC video settings		
BIT-RATE (MBPS)	RESOLUTION	FRAME RATE (FPS)	GOP	
0.250	CIF	15	5	
0.250	2CIF	15	15	
0.512	CIF	15	5	
0.512	2CIF	15	15	
0.75	CIF	30	5	
0.75	2CIF	30	15	
0.75	D1	1	5	
0.9	CIF	30	5	
0.9	2CIF	30	15	
0.9	D1	1	5	
0.9	D1	15	15	
1	2CIF	30	5	
1	D1	30	15	
2	2CIF	30	5	
2	D1	30	5	
5	2CIF	30	5	
5	D1	30	5	
10	2CIF	30	5	
10	D1	30	5	



It is recommended to use high bit-rates if the video content contains fine details or fast moving scenes. If the application is constrained to low bit-rates, then either reduce the resolution of the encoded video (for example, use CIF instead of D1) or reduce the frame rate. Increasing the value of the GOP increases the number of predicted frames used thus effectively increasing the compression ratio. A higher compression ratio may help in reducing the bandwidth requirements of the encoded video.

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**NOTE:** Set **Audio Setting** to **None** when 10 Mbps and 250 kbps video bit-rates are used.

## Connector pinout of the KAD/VID/106

PIN	NAME	SEE SPECIFICATIONS TABLE	COMMENT
1	CVBS_0_IN	Video inputs	Composite video input channel 0
2	DNC		Do not connect
3	CVBS_1_IN	Video inputs	Composite video input channel 1
4	DNC		Do not connect
5	CVBS_2_IN	Video inputs	Composite video input channel 2
6	DNC		Do not connect
7	Y_IN	Video inputs	Component video input (luminance)
8	DNC		Do not connect
9	C_IN	Video inputs	Component video input (chrominance)
10	DNC		Do not connect
11	CAM_2_GENLOCK_OUT	Video outputs	Synchronization output
12	DNC		Do not connect
13	CAM_3_GENLOCK_OUT	Video outputs	Synchronization output
14	DNC		Do not connect
15	AUDIO_RIGHT_IN	Audio inputs	Analog audio input
16	DNC		Do not connect
17	AUDIO_LEFT_IN	Audio inputs	Analog audio input
18	GND	Internal ground	
19	DNC		Do not connect
20	GND	Internal ground	
21	DNC		Do not connect
22	GND	Internal ground	
23	DNC		Do not connect
24	GND	Internal ground	
25	DNC		Do not connect
26	GND	Internal ground	
27	DNC		Do not connect
28	GND	Internal ground	
29	DNC		Do not connect
30	GND	Internal ground	
31	DNC		Do not connect
32	GND	Internal ground	
33	DNC		Do not connect
34	GND	Internal ground	
35	DNC		Do not connect
36	GND	Internal ground	
37	CAM_SEL_BIT_0	BTTL inputs	Internally pulled high
38	CAM_SEL_BIT_1	BTTL inputs	Internally pulled high
39	CAM_SEL_BIT_2	BTTL inputs	Internally pulled high
40	GND	Internal ground	
41	CVBS_Y_OUT	Video outputs	Composite video/component video luminance output
42	GND	Internal ground	
43	C_OUT	Video outputs	Component video chrominance output
44	GND	Internal ground	
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/VID/106/B	H.264 video encoder (analog video input) - 1ch

By default, the standard mating connector, CON/KAD/002/CP, 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).

## Revision history

REVISION	DIFFERENCES	STATUS
KAD/VID/106/B	250kbps video bit-rate supported; audio bit-rate per channel can be 32kbps as well as 64kbps; audio only mode supported; 12-bit sampling mode implemented; format switching supported; audio video synchronization improved	Recommended for new programs
KAD/VID/106	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/MAN/018	KSM-500 Databook
DOC/GBK/002	Environmental Qualification Handbook
DOC/MAN/030	DAS Studio 3 User Manual
TEC/NOT/016	Power dissipation
TEC/NOT/049	Power estimation
TEC/NOT/050	Understanding how data is stored in Ethernet packets
TEC/NOT/051	Ethernet frames, Wireshark® and FAT32
TEC/NOT/067	IENA and iNET-X packet payload formats
TEC/NOT/073	Using the KAD/VID/106

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