XDAS-V2 1.6mm single energy X-ray data acquisition data sheet

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1   description

XDAS-V2 is a modular system of boards for use in X-ray linescan and CT Systems. It consists of a set of detector head boards and a signal processing board. Each detector head board has 64 detector channels, corresponding to a detector pitch of 1.6 mm. Seven signal processing cards can be connected in series with up to 24 detector boards feeding each one, giving a maximum system size of 168 detector head boards or 10752 channels. Detectors can be butted end-to-end to provide a continuous array.

Data output is in 16 bit format from the signal processing board. The system can be interfaced to a PC via:

> PCI-7300A data I/O card
> USB2
> standard frame grabber card (single signal processing board only)

X-rays are detected using a scintillator and photodiode array. Scintillators, such as phosphor strip, CsI(Tl) or $CdWO_4$, are offered to cover the energy range 30 keV to 450 keV.

The XDAS sensor can acquire a single line of data in a minimum time of 100 µs. Read-out rate is programmable to 2.5, 5, 10 or 20 MHz data rate.

2   applications

> security
> food inspection
> thickness measurement
> bone densitometry
> non-destructive testing

3   features

> modular system with up to 1536 channels with a single signal processing card
> 1.6 mm detector pitch
> range of scintillator types available
> simultaneous data acquisition and read-out
> wide dynamic range - 3pC to 60 pC
> 16 bit output
> 2.5, 5,10 or 20 MHz data link to CPU
> 100 µs minimum signal integration time
> up to 38000:1 SNR in 10 pF mode

4   XDAS-V2 system

A schematic of a V2 system is shown on the **detector head block diagram**, **section 11**, **signal processing block diagram, section 12** and **system block diagram, section 13**.

The 1.6mm pitch detector array is connected to the board via detector sockets on the top side of the board.

Current from the photodiodes is integrated by a custom designed microcircuit containing 64 charge sensitive amplifiers and a multiplexer. The microcircuit provides two serial analog outputs, corresponding to amplifier output voltages at the beginning and end of signal integration. These are fed via a differential amplifier, eliminating common mode

noise, to a 24 input multiplexer, which in turn passes the signal to a 14 bit ADC.

Operation is continuous with one set of data being read out whilst the next set is being acquired. Dead time is less than 1 µs.

The maximum charge that can be collected per cycle depends on the choice of the storage capacitors, one per channel, which are internal to the microcircuit. These can be set to 2 pF or 10 pF. High linearity is maintained with a charge storage of 3 pC or 15 pC per cycle.

If higher dynamic range is required, a facility for sub-sampling and data summation is incorporated on-board. Using the image data store (**see signal processing block diagram, section 12**), up to 4 sub-samples can be acquired and stored in the image data store, which is a 16 bit device. When data is ready for transmission, it is transmitted via the chosen data interface to the host CPU.

Operation is controlled by a gate array (FPGA), which provides the central intelligence for the board and the timing and control signals for system operation. The gate array is based on fused link technology, providing a high level of radiation hardness.

User settings to control integration times, sub-sampling, and refresh rate, together with information on system configuration, are transmitted via an RS485 interface and stored in non-volatile RAM such that on switch-on, the system is initiated in the last mode used.   The RS485 is compatible with the RS232 serial port on standard PCs using the interface converter supplied as part of the cable set. When the USB2 option is chosen the communications are made via this connection.

Data interface to a PC is via a PCI-7300A data I/O card, USB2 module or frame grabber card.   The same configuration of XDAS-V2 system is used for each mode but a different cable set is required to connect to the PC as shown in **section 10, ordering information**.

5 XDAS-V2 system

Up to 24 detector head boards, per signal processing board, can be daisy-chained to form a single detector system. Each detector head processes 64 detector channels producing a single multiplexed analogue output which is fed to the signal processing board.

The signal processing board is capable of acquiring data from up to 1536 channels, transmitting to the host cpu via the selected data link. This link outputs 8 bits at 2.5 to 20MHz, allowing for a 1.25 ms sample time to be achieved for a full 24 card system. Smaller systems can achieve much faster sample times. Additional signal processing boards can be used if shorter sample times are required.

6 general specification

integration time (single sample)	100 µs to 50 ms
sub-samples	4 max
integration time (multiple samples)	200ms max
signal-to-noise*	
no detector 2pF	31000:1
no detector 10pF	38000:1
with detector (Cd <28pF) 2pF	20000:1
with detector 10pF	34000:1
cross talk	<0.1 % over 10 pC
maximum read-out rate	20 MB/s
A/D conversion	14 bit
data output	16 bit
dimensions:	
detector head board	114 mm x 101 mm
signal processing board	122 mm x 101 mm
detector pitch	1.6 mm
maximum number of modules	168
maximum number of channels	10752
RS485 Interface	9600 baud, 7 data, odd parity, 1 stop bit

*500µs integration time, 4 sub samples

7 environmental specification

operating temperature	+ 5 to + 35 ºC
storage temperature	-40 to +70 ºC
humidity (non-condensing)	
operating	30 ºC 93 %
non-operating	40 ºC 93 %

8 configurations supplied

XDAS-V2 can be supplied in several configurations, with the different options listed below. Variants are as follows:

communications interface:

PCI-7300A, USB2, Framegrabber

detectors:

64 element - 1.6 mm pitch x 2 mm sensitive width

scintillator types:

phosphor strip, CsI(Tl), CdWO$_4$, Silicon

see **Section 15** for detector drawings

9 evaluation system

An evaluation system is available, consisting of a detector head board, detectors, signal processing board, and software.

This is supplied in a test box to provide electrical and radiation screening. Components can be selected from the options shown in **section 10**.

The software is available on a CD and can be loaded on to a PC (Pentium II or higher) to provide the basic functionality of the system. The following parameters can be set:
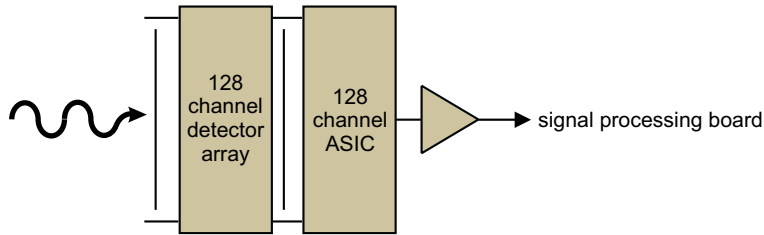
integration period, from 100 µs up to 0.2 s with multiple samples
number of sub-samples from 1 to 4
number of modules in system

Data is acquired into a spreadsheet and can be displayed in graphical form. Gain and offset correction can be applied via the software.
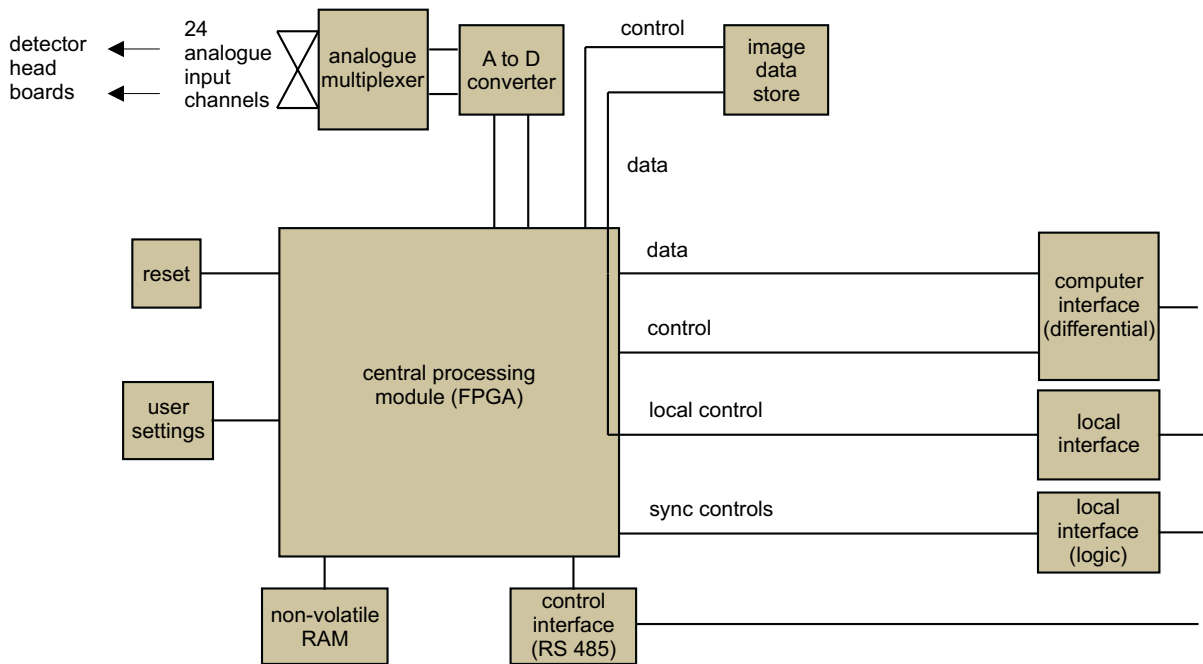
10 ordering information

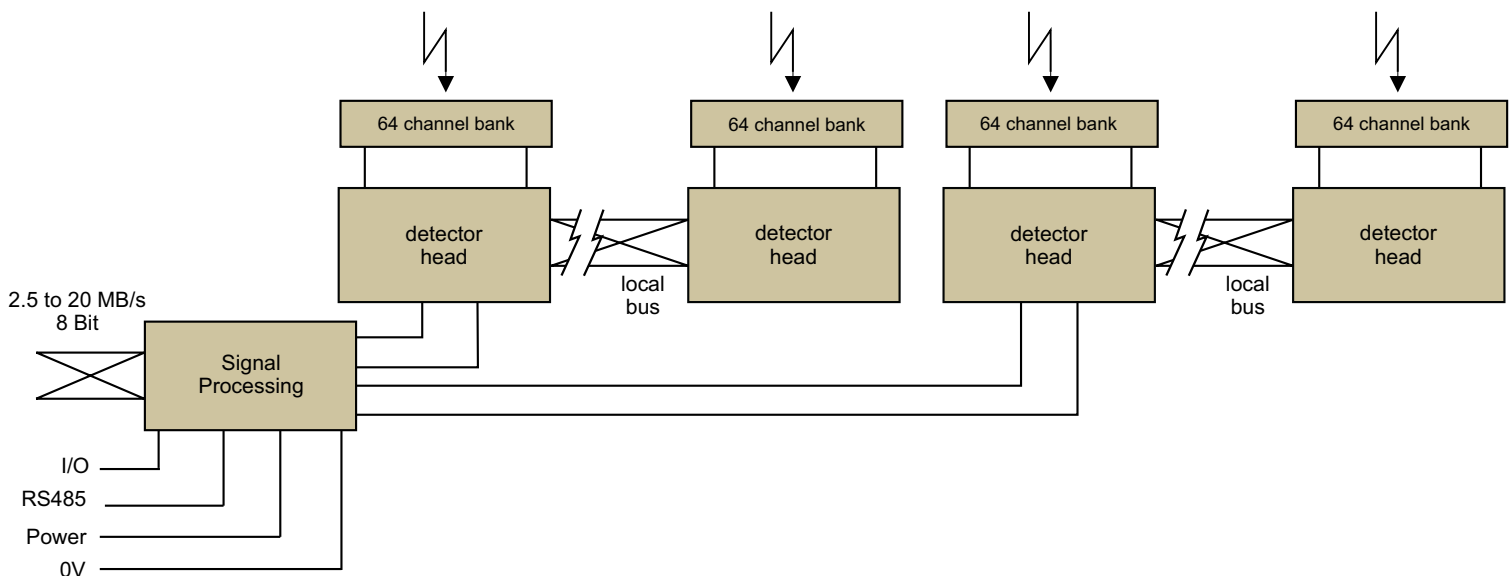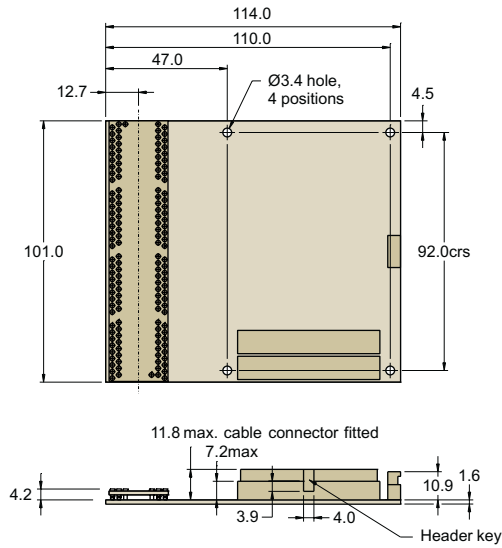| part number	description
XDAS-DH2-10	single energy (64 channels) no detectors, 1.6 pitch
XDAS-DH2-11	XDAS-DH2-10 with phosphor strip detectors, 1.6 mm pitch
XDAS-DH2-12	XDAS-DH2-10 with CsI detectors, 1.6 mm pitch
XDAS-DH2-13	XDAS-DH2-10 with CdWO4 detectors, 1.6 mm pitch
XDAS-DH2-14	XDAS-DH2-10 with bare Silicon, 1.6 mm pitch
XDAS-SP2 -01	XDAS V2 signal processing board
CABLE-XDASUSB2	cable set for USB2 interface
CABLE-XDAS7300	cable set for PCI-7300A card
CABLE-XDASDFG	cable set for frame grabber card
XDAS-SOFTWARE	demonstration software

11 detector head block diagram

128 channel detector array

128 channel ASIC

signal processing board

12 signal processing block diagram

detector head boards

24 analogue input channels

analogue multiplexer

A to D converter

control

image data store

data

reset

central processing module (FPGA)

user settings

data

control

local control

sync controls

computer interface (differential)

local interface

local interface (logic)

non-volatile RAM

control interface (RS 485)

13 system block diagram

64 channel bank

64 channel bank

64 channel bank

64 channel bank

detector head

detector head

detector head

detector head

local bus

local bus

2.5 to 20 MB/s 8 Bit

Signal Processing

I/O

RS485

Power

0V

14 outline drawings (mm)

XDAS-DH2-10 single energy board

114.0
110.0
47.0
12.7
Ø3.4 hole, 4 positions
4.5
101.0
92.0crs
11.8 max. cable connector fitted
7.2max
4.2
10.9 1.6
3.9 4.0
Header key

XDAS-SP2-01 signal processing board

122.0
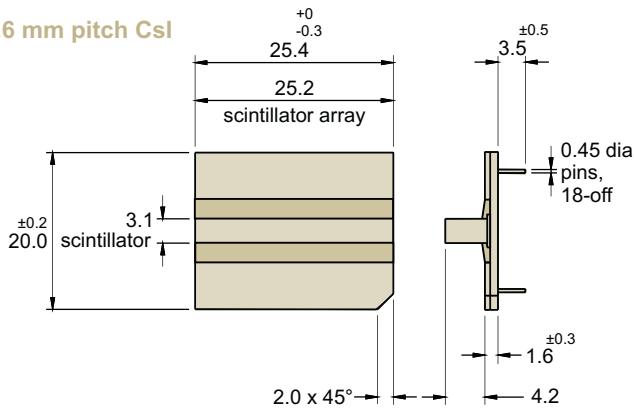113.5
50.5
5.0
4.5
40.8 crs
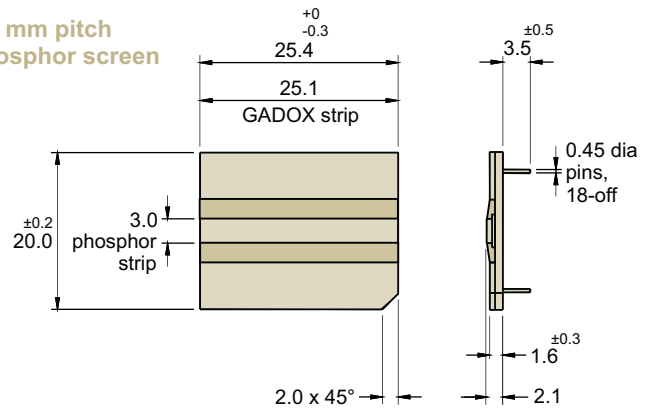101.0 96.5
40.8 crs
8 holes, Ø3.4, position as shown
11.7 1.6
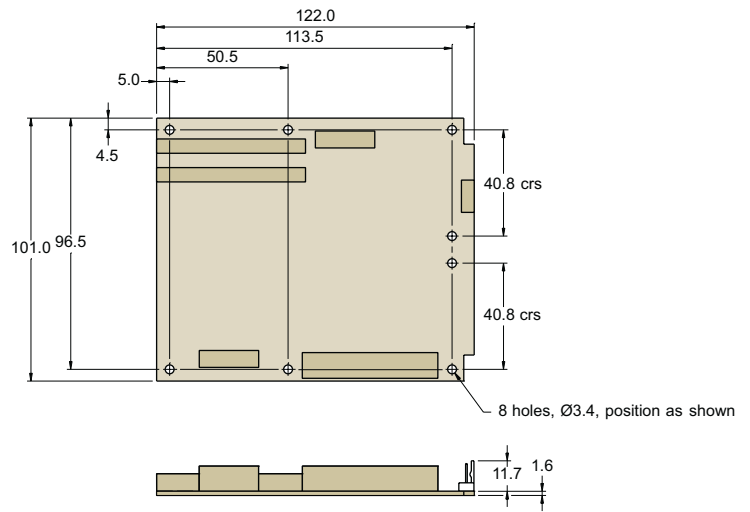
* to obtain height of detector above board, add detector socket height to detector height (excluding pins)
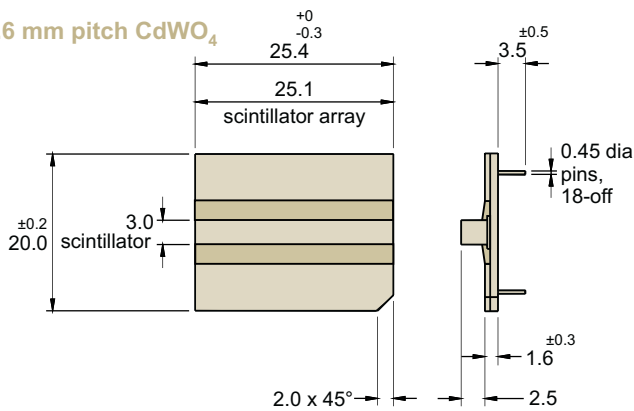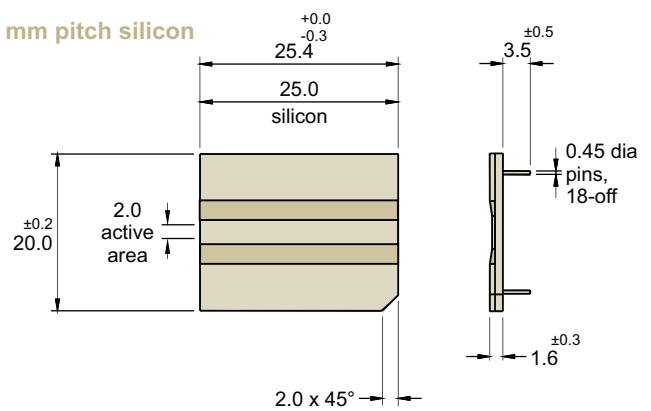
15 detector outline drawings (mm)

1.6 mm pitch CsI

+0
-0.3
25.4
±0.5
3.5
25.2
scintillator array
0.45 dia pins, 18-off
±0.2
20.0
3.1
scintillator
±0.3
1.6
2.0 x 45°
4.2

1.6 mm pitch phosphor screen

+0
-0.3
25.4
±0.5
3.5
25.1
GADOX strip
0.45 dia pins, 18-off
±0.2
20.0
3.0
phosphor strip
±0.3
1.6
2.0 x 45°
2.1

1.6 mm pitch CdWO$_4$

+0
-0.3
25.4
±0.5
3.5
25.1
scintillator array
0.45 dia pins, 18-off
±0.2
20.0
3.0
scintillator
±0.3
1.6
2.0 x 45°
2.5

1.6 mm pitch silicon

+0.0
-0.3
25.4
±0.5
3.5
25.0
silicon
0.45 dia pins, 18-off
±0.2
20.0
2.0 active area
±0.3
1.6
2.0 x 45°

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