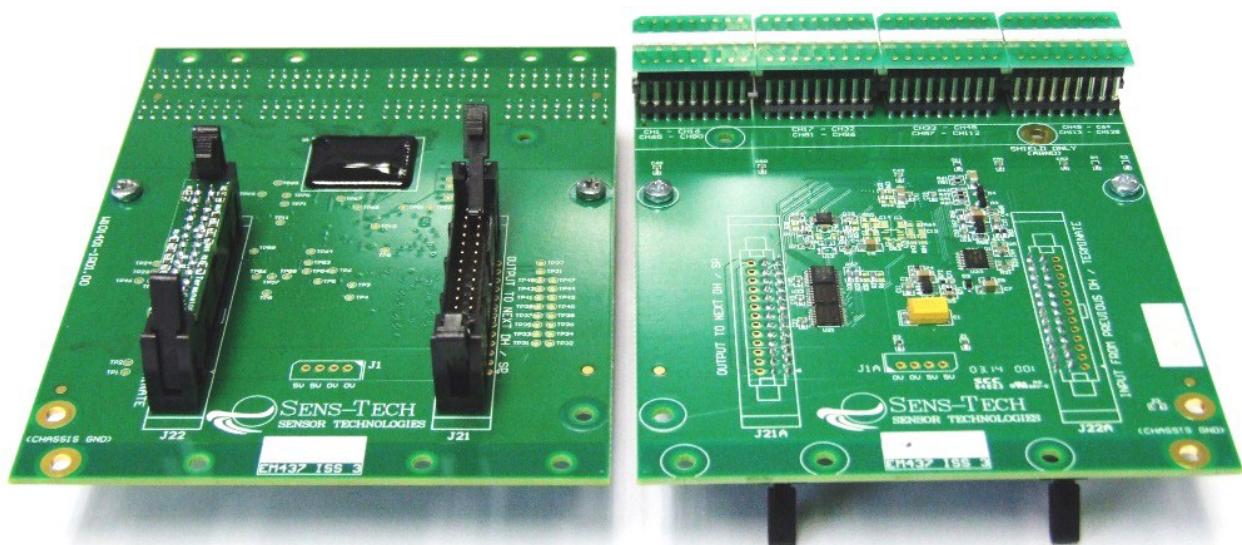


KEY FEATURES

XDAS-V3-900 system is the latest version of Sens-Tech X-ray data acquisition systems. New features include:

- 18 bit A/D conversion
- Up to 38000:1 SNR
- Programmable dynamic range from 1.875pC to 60pC in steps of 1.875 pC. * 30pC and 60pC using sub-samples
- Gain can be set for each DH board in the system
- Gain for low energy and high energy channels can be set independently
- Programmable bandwidth limiting to reduce noise
- In-system programmable Xilinx FPGA
- Choice of front lit or back lit detectors
- Read back of status and configuration parameters
- 10 μ s minimum integration time
- 105 μ s minimum scan time for continuous operation
- Programmable integration time in steps of 1 μ s
- Low power and heat dissipation
- USB 2.0 / GIGE interface to host
- X-ray energy 5keV to 320keV typical
 - * higher energy range is covered by suitable combination of photodiode and scintillator
- Software API supporting Windows and Linux



DESCRIPTION

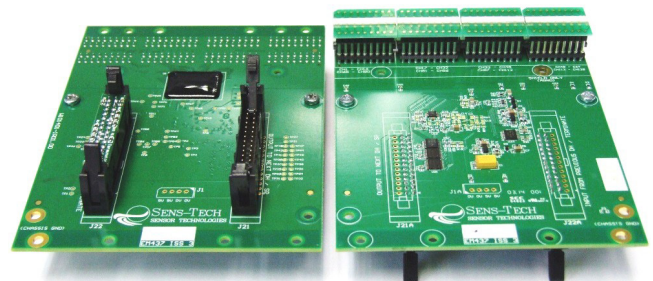
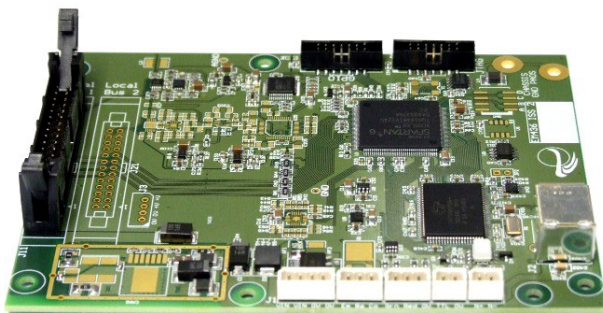
XDAS-V3-900 is a modular system of boards for data acquisition in X-ray line-scan, multi-view and CT systems. It consists of detector head (DH) boards and a signal processing board (SP) with integrated USB2.0 or GIGE interface.

A single energy DH board has 64 detector channels. A dual energy DH board has 64 low energy channels and 64 high en-ergy channels. 32 + 32 DH board is also available. DH boards can be butted end-to-end to form a continuous array. An SP board can process up to 24 DH boards in a daisy chain.

DH boards with 1.2 mm, 1.6 mm and 2.5 mm detector pitch are available. 0.4 mm and 0.8 mm pitch shall be available soon.

APPLICATIONS

- Security inspection
- CT Imaging
- Multi-view imaging
- Non-destructive testing
- Food inspection
- Thickness measurement
- Foreign particle detection
- Bone densitometry
- Industrial process control
- Mineral sorting
- Waste sorting



GENERAL SPECIFICATION

INTEGRATION TIME (SINGLE SAMPLE) 105 μ s to 50 ms	INTEGRATION TIME (MULTIPLE SAMPLES) 200 ms (max)
SUB-SAMPLES 1, 2 or 4	POWER SUPPLY 5 V (4.9V to 5.5V), 100mVp-p ripple
CROSS-TALK (BOARD TO BOARD) <0.01%	CURRENT (TYPICAL) SP with USB2: 300mA SP with GIGE: 450mA DH: 110mA
CROSS-TALK (CHANNEL TO CHANNEL) <0.1%	
DATA RATE (MAXIMUM) 6 MB/s	SNR* (ELECTRONIC) 3.75pC 14500:1 15pC 19000:1 60pC 38000:1
NON-LINEARITY <0.03%	
A/D CONVERSION 18 bits	
DATA OUTPUT 16 bits	SNR* (<30PF DETECTOR CAPACITANCE) 3.75pC 9500:1 15pC 17500:1 60pC 35500:1
DETECTOR PITCH (MM) 1.2, 1.6, 2.5	
NUMBER OF DH BOARDS PER SP up to 24	
	NUMBER OF CHANNELS PER SP up to 3072

Note 1: SNR is calculated for ADC full scale and with bandwidth limiting enabled.

Note 2: SP boards are available in single or dual ADC configuration.



ENVIRONMENTAL SPECIFICATION

TEMPERATURE		HUMIDITY (NON-CONDENSING)	
Operating	0 to +60 °C	Operating	30°C 93%
Storage	-40 °C to +70 °C	Storage	40°C 93%

PRINCIPLES OF OPERATION

Current from the photodiodes is integrated by an ASIC containing 128 charge sensitive amplifiers. Correlated double sampling is used to minimise low frequency noise and reject offset error. The microcircuit provides a multiplexed serial analogue output to the signal processing board where data is converted into 18-bit format. Operation is continuous with one set of data being read out whilst the next set is acquired. Dead time is less than 2.4µs at full bandwidth.

Dynamic range of the system is programmable for each DH board and is determined by the storage capacitors within the ASIC. These can be set from 1.25 pF to 10 pF in steps of 1.25 pF, providing charge storage of 1.875 pC to 15 pC in 1.875 pC steps. The dynamic range can be set separately for high and low energy channels.

Multiple sampling facility is available on the SP board. This enables 2 or 4 samples to be added providing a maximum dynamic range of 60 pC.

Integration time can be adjusted in 1µs steps, enabling fine tuning of the dynamic range for low and high energy channels.

Operation of system is controlled by a gate array which provides central intelligence and control signals for signal processing. Control settings are transmitted to the SP board via USB interface. All settings can be stored in non-volatile RAM such that on power-on, the system is initiated in the last mode saved.

A system is assembled by interconnecting multiple DH boards.

SYSTEM DESIGN

DETECTOR BOARDS

This is calculated by dividing the required active length by width of a DH board.

no. of DH boards = active length / width of a DH board

example: number of 1.6mm pitch DH boards in a 90cm long system shall be $90/10 = 9$ boards

INTEGRATION TIME

Signal integration time in a typical linescan application is calculated using following formula:

Integration time (ms) = pixel width (mm) / belt speed (m/s)

example: integration time setting for 1.6mm wide (assuming square pixels) detector scanning at 1m/s belt speed shall be $1.6 / 1 = 1.6$ ms

SIGNAL PROCESSING BOARD

Following interfaces are available for connecting XDAS to a laptop, computer or SBC:

1. High Speed USB 2.0 interface (up to 5m cable)
2. Gigabit Ethernet interface (up to 100m cable)

SP boards are available with single or dual ADC. Standard SP board comes with single ADC and can process up to 24 DH boards in a single daisy chain.

Dual ADC SP board can process up to 24 DH boards in two chains of up to 12 DH boards in parallel, thereby halving the processing time per line. The DH boards are split equally between the two ADC's.

example: 16 DH boards must be split 8 and 8 whereas 17 DH

An SP board takes 102.4us to process a DH board. Minimum continuous integration time of a system can be calculated using following formula:

Tint (minimum) = $2.4\mu s + (\text{numDH per ADC} \times 102.4\mu s)$

example (single ADC): minimum integration time for a 9 DH board system using single ADC shall be $2.4 + 9 \times 102.4 = 924 \mu s$

example (dual ADC): minimum integration time for a 17 DH board system using dual ADC shall be $2.4 + 9 \times 102.4 = 924 \mu s$

For larger systems, multiple SP boards can be used to process DH boards in parallel. SP boards connect to Host computer using separate USB/GIGE ports. Software can identify each SP board from its programmed serial number or IP address. External triggering can be used to synchronise start of scans.

SYSTEM DESIGN

DATA RATE

A total of 258 bytes are read out per DH board. This includes 2 bytes per pixel and 2 header bytes representing SP address and DH board address. When integration time is longer than T_{int} (minimum), average host data rate can be calculated using following formula:

$$\text{Data rate (MB/s)} = (258 \times \text{numDH}) / T_{int}$$

POWER SUPPLY

There is single power input to SP board. Current can be calculated using values given in specification section. System designer should ensure that power at SP input is between 5V to 5.5V.

Power is supplied to DH boards over ribbon cables. DH boards require minimum 4.3V for correct operation. The voltage drop for up to 24 DH board system using 10cm ribbon cables meets this requirement. Longer systems can be supplied up to 5.5V to SP board. This will compensate for cable losses.

GENERAL

Place all DH and SP boards inside detector box. SP board can be stacked on top of first DH board such that USB/GIGE connector is away from detectors. Use adequate radiation shield for SP board. Ensure all DH and SP boards have a good Ground connection to chassis through respective Grounding pad. Avoid running cables close to detectors on DH boards.

Use Bulkhead connectors for external power and data cables. Keep power and data cables inside the box short by placing external IO points close to SP board.

It is recommended to use Ferrites on power and data cables.

EVALUATION SYSTEM

An evaluation system is available, consisting of a detector head board, signal processing board, USB/GIGE output and evaluation software. This is mounted in a test box (LINX type, see data sheet) to provide electrical and radiation screening.

Demonstration software is available via download link and can be loaded on to a Windows PC (Pentium 4 or later) to check basic function of the system. A high speed USB 2.0 or a Gigabit Ethernet port is required for the host interface. The software enables setting of gain and integration time and single lines of data to be acquired.

Data can be logged to a csv file and can be displayed in graphical form. Offset and gain correction can be applied via the software.

Imaging Application is available, contact Sens-Tech for details.

ORDERING INFORMATION

XDAS-DH3-9500E 1.2mm pitch 64+64 DH board	XDAS-DH3-9400E 2.5mm pitch 64+64 DH board
XDAS-DH3-9502E-xx 64+64 DE with Gadox, 4mm CSI ('xx' is thickness of Copper filter in multiples of 0.1mm)	XDAS-DH3-9032E-xx 32+32 DE with Gadox, 4mm CSI
XDAS-DH3-9000E 1.6mm pitch 64+64 DH board	XDAS-DH3-9041E 32 SE with Gadox
XDAS-DH3-9002E-xx 64+64 DE with Gadox, 4mm CSI	XDAS-DH3-9042E 32 SE with 4mm CSI
XDAS-DH3-9011E 64 SE with Gadox	XDAS-DH3-9400E 2.5mm pitch 64+64 DH board
XDAS-DH3-9012E 64 SE with 4mm CSI	XDAS-DH3-9402E-xx 64+64 DE with Gadox, 4mm CSI
XDAS-DH3-9030E 1.6mm pitch 32+32 DH board	XDAS-DH3-9411E 64 SE with Gadox
XDAS-DH3-9032E-xx 32+32 DE with Gadox, 4mm CSI	XDAS-DH3-9412E 64 SE with 4mm CSI
XDAS-DH3-9041E 32 SE with Gadox	XDAS-DH3-9413E-00-02 64 SE with 30mm CdWO4x
XDAS-DH3-9042E 32 SE with 4mm CSI	XDAS-SP3-USB2-901 SP board with USB
	XDAS-SP3-GIGE-901 SP board with GIGE

Notes:

1. Replace suffix 'E' in part number with 'A' for front-lit detectors.
2. Replace suffix 'E' with 'C' for low profile connectors.
3. See detectors section for other detector combinations. Contact sens-tech for part numbers.

ORDERING INFORMATION

XDAS-TERMINATOR3-901t local bus terminator for DH (one per DH chain)	CABLE-XDASLED-01 bulkhead diagnostic LED 20cm
CABLE-XDASPCB9xx 26way local bus DH to DH and DH to SP cable where 'xx' is cable length in cm	XDAS-SOFTWARE evaluation software and SDK
CABLE-XDASPWR9xx 4way power cable for SP board where 'xx' is cable length in cm	

DETECTORS

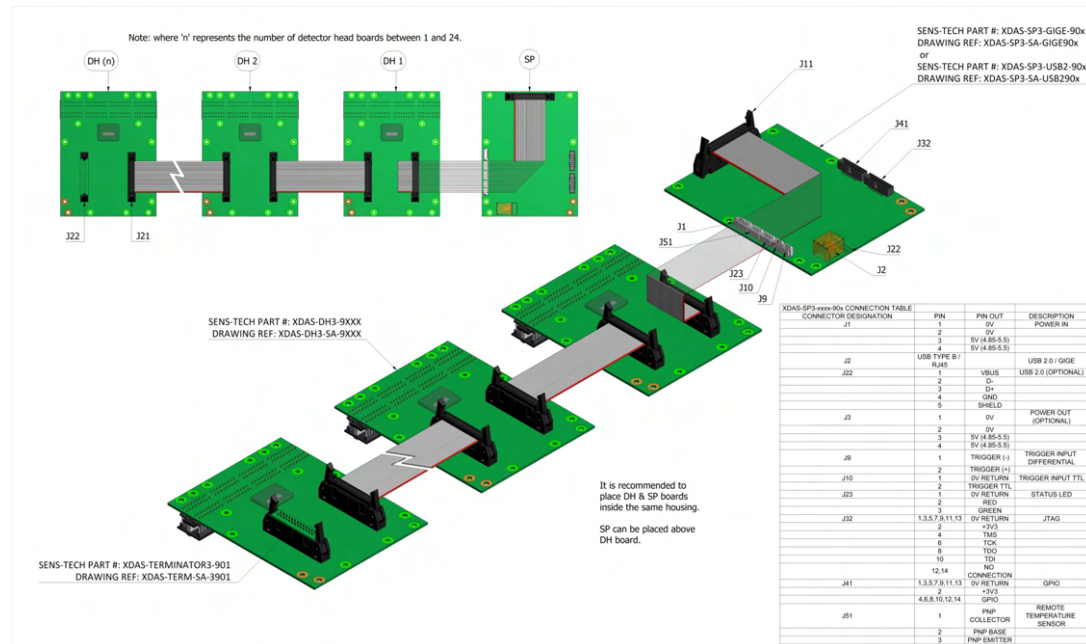
TYPE OF SCINTILLATOR	THICKNESS	ENERGY RANGE	SIGNAL OUTPUT PER UNIT ENERGY	DECAY TIME CONSTANT	COMMENTS	FORMAT
Silicon	0.15 mm	5 – 30 keV	highest	1 μ s for unbiased diode	direct conversion, no scintillator cost	standard
Gadox (Tb)	0.2 mm 0.3 mm 0.4 mm	20 – 120 keV	20% lower similar to CSI 10% higher	<1 ms 2 – 3 ms <1 ms	phosphor strip	standard, narrow
CsI	0.4 mm 3 mm 4 mm 10 mm	40 – 320 keV	best light output	2 components, slow decay of secondary component (seconds)	pixelated arrays to reduce crosstalk	standard, narrow
CdWO4	2.5 mm 30 mm	80 – 1.4 MeV	25% of CSI	20 μ s	pixelated arrays, highest cost material	standard, narrow
GOS	2.9 mm	80 – 225 KeV	50% more than CdWO4 at 160keV	3 μ s	pixelated arrays, resistant to radiation damage	standard, narrow

Note: Thicknesses shown are of standard products.

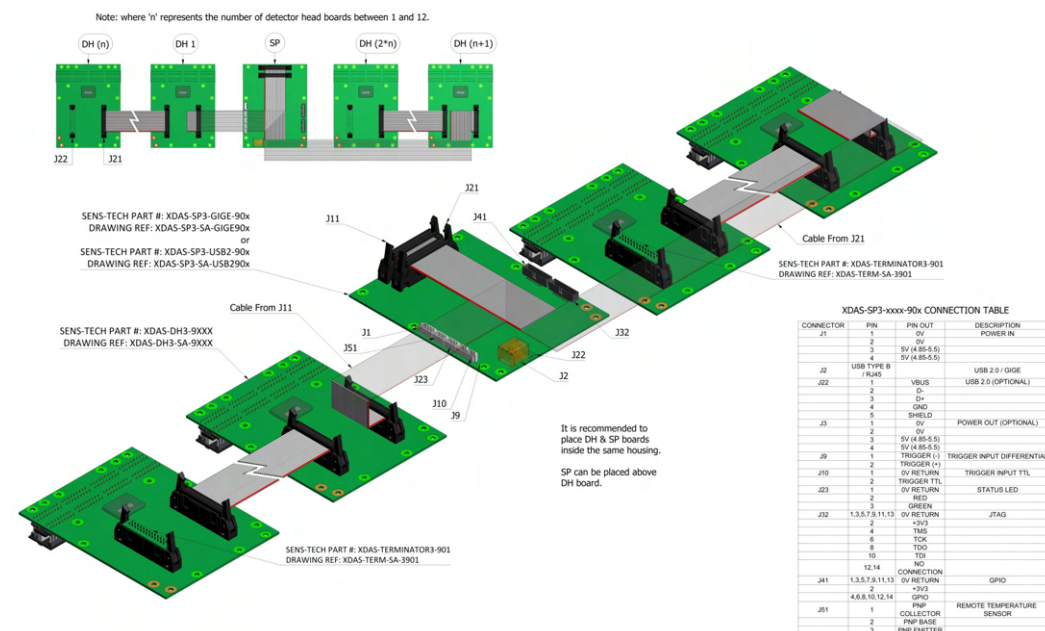
Other thicknesses are available on order which will cover wide energy ranges

SYSTEM CONFIGURATION

System using SP board with single ADC (up to 24 DH boards daisy chained)



System using SP board with dual ADC (up to 24 DH boards in two equally split daisy chains)

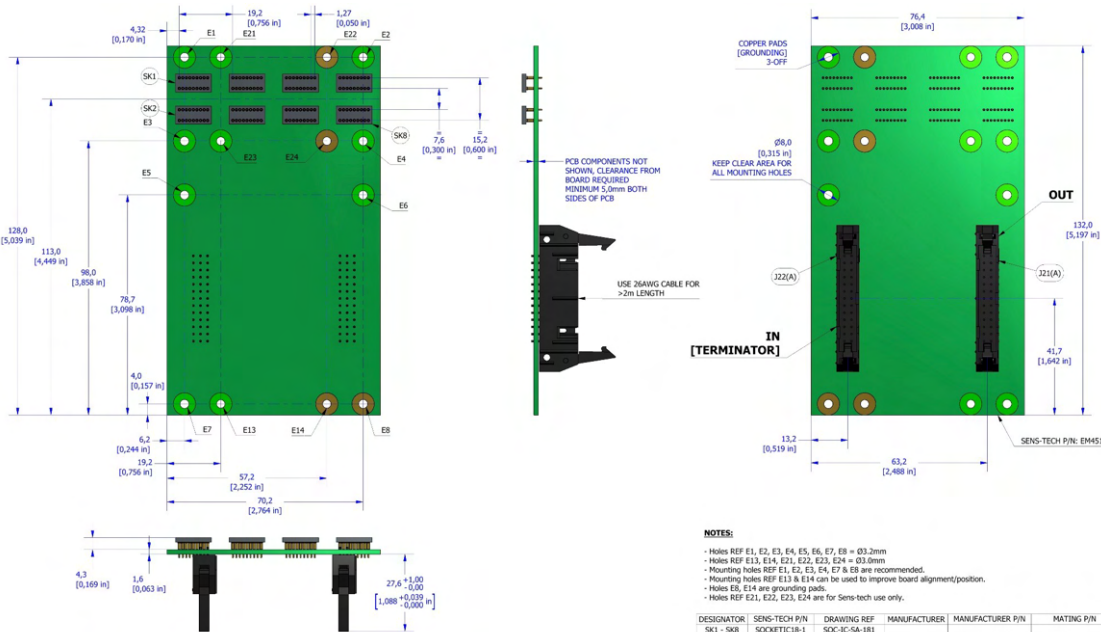


Note: Following drawings are for reference.
Contact Sens-tech for latest mechanical drawings and 3D CAD models.

OUTLINE DRAWINGS

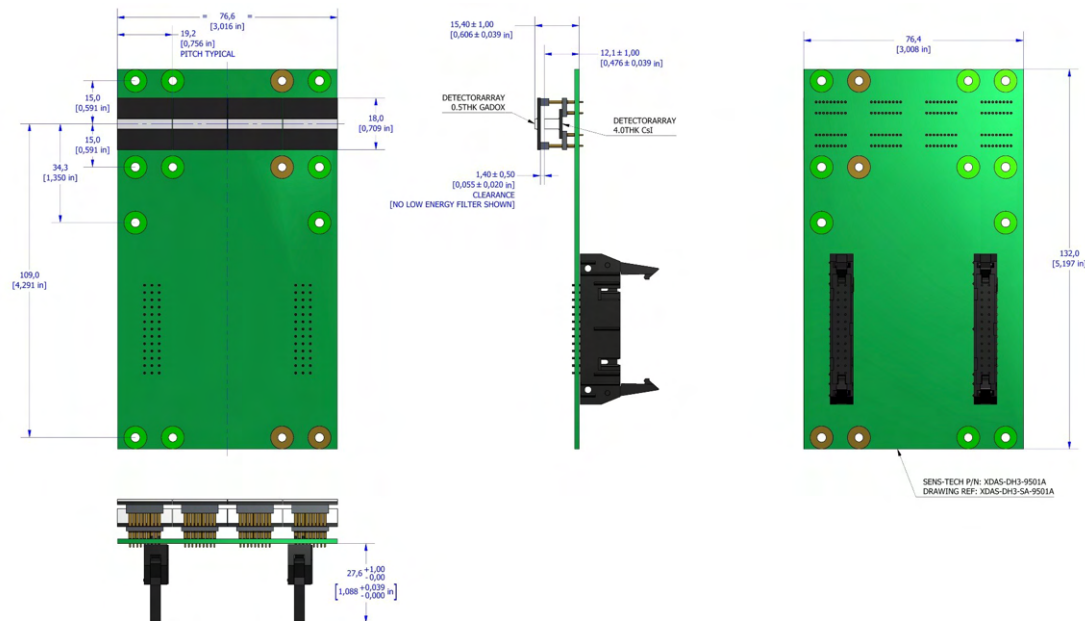
XDAS-DH3-9501E

1.2mm 64+64 detector head board



XDAS-DH3-9502E-xx

1.2mm 64+64 detector head board with detectors

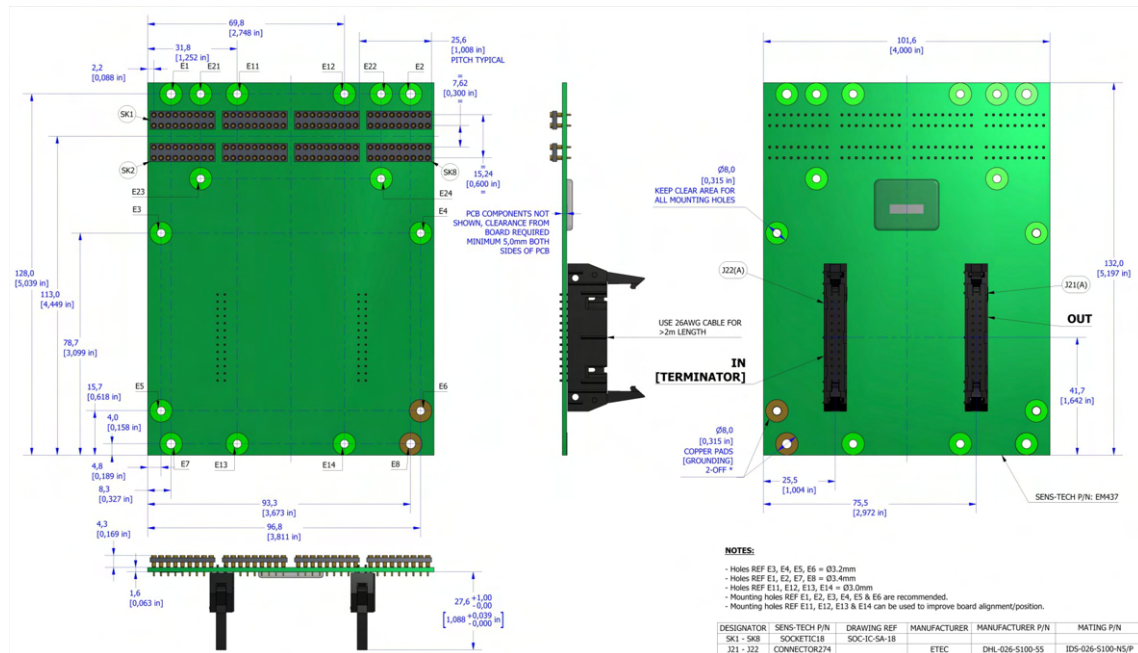


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OUTLINE DRAWINGS CONTINUED...

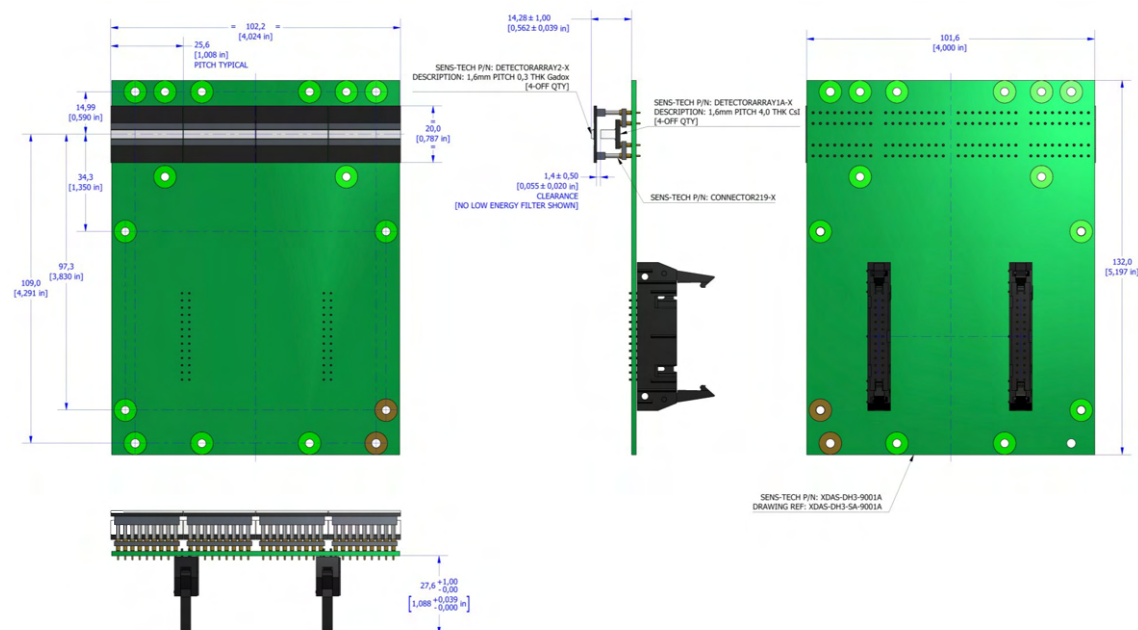
XDAS-DH3-9001E

1.6mm 64+64 detector head board



XDAS-DH3-9002E-xx

1.6mm 64+64 detector head board with detectors

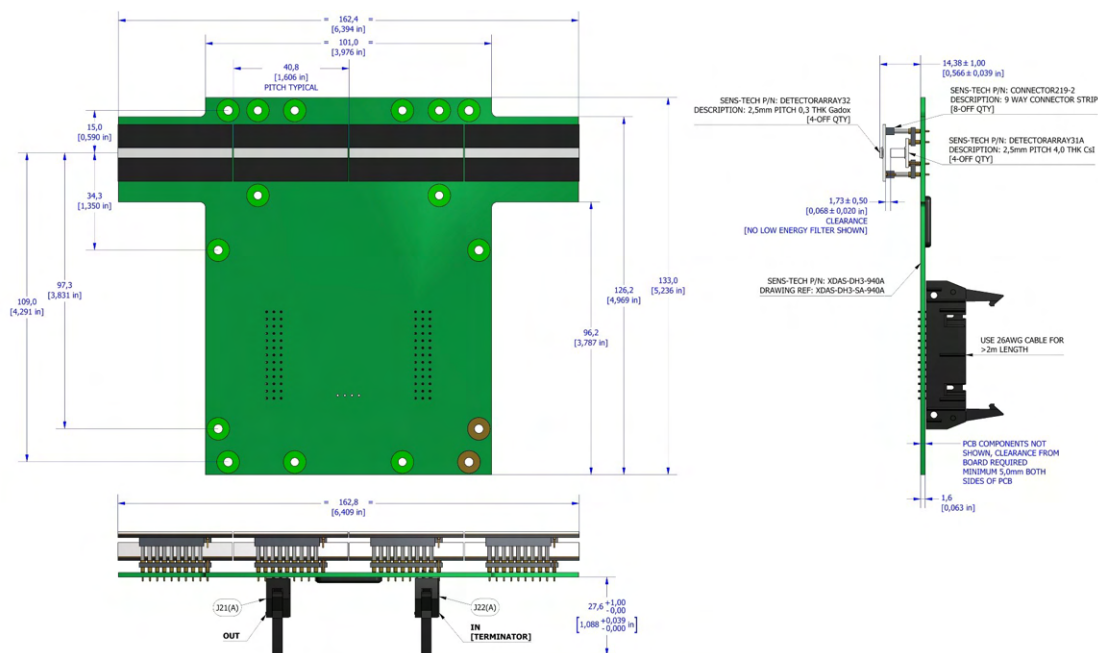


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Contact Sens-tech for latest mechanical drawings and 3D CAD models.

OUTLINE DRAWINGS CONTINUED...

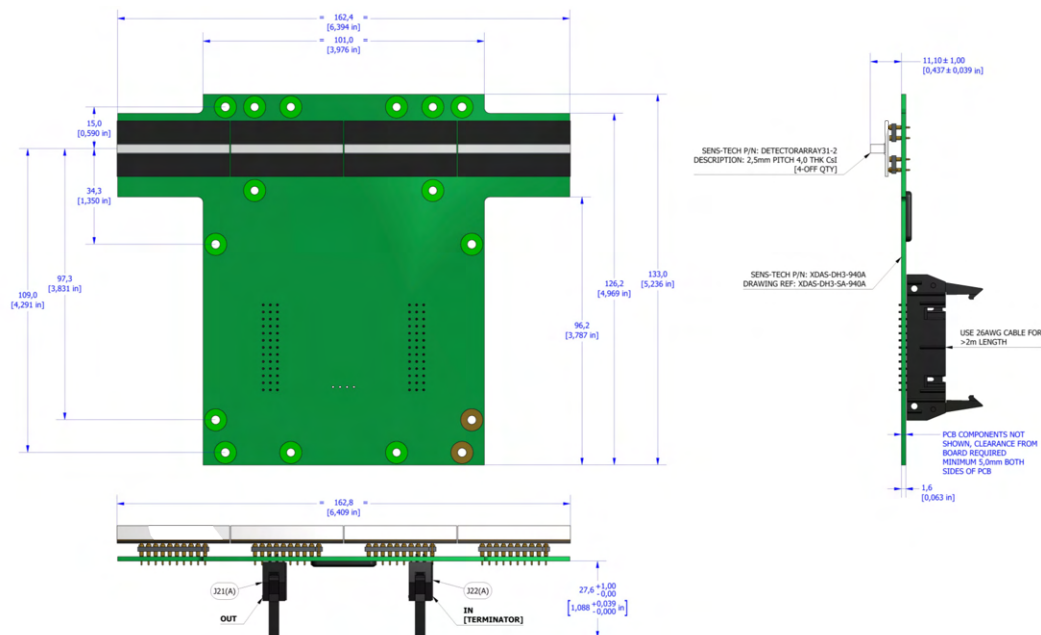
XDAS-DH3-9402E-xx

2.5mm 64+64 detector head board with detectors



XDAS-DH3-9412E-xx

2.5mm 64SE detector head board with detectors

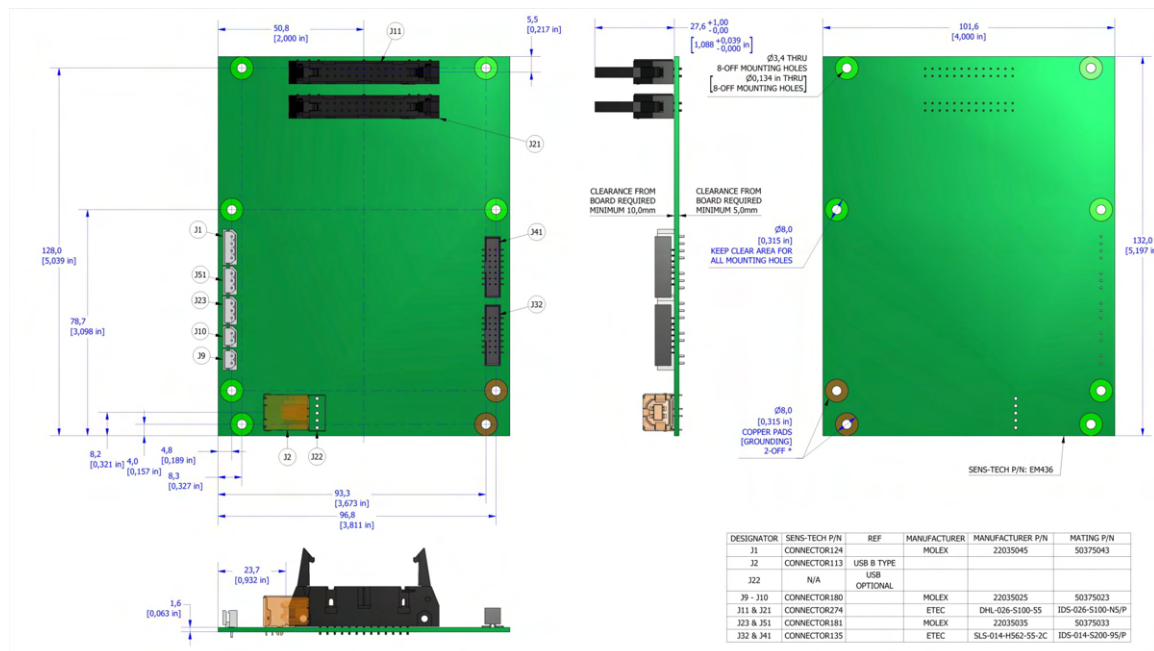


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OUTLINE DRAWINGS CONTINUED...

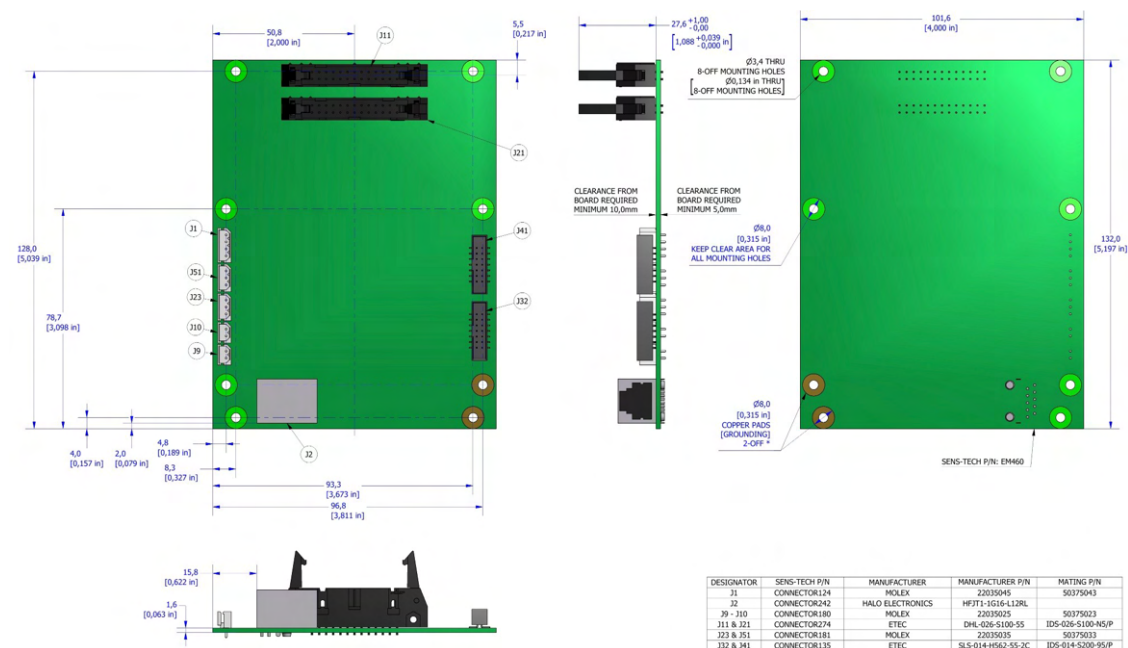
XDAS-SP3-USB2-90x

signal processing board with USB2



XDAS-SP3-GIGE-90x

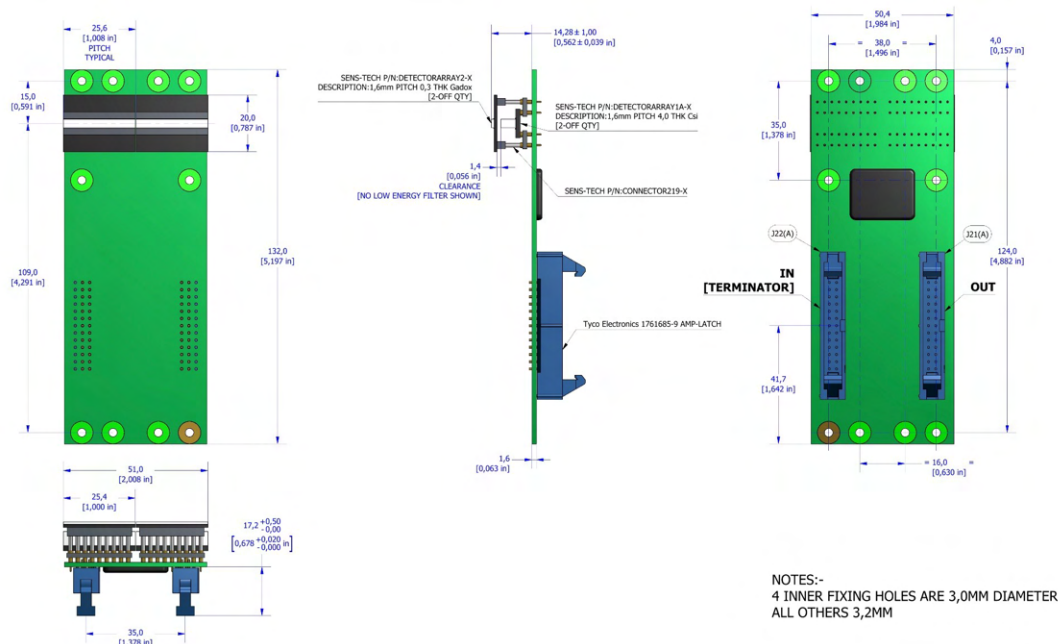
signal processing board with GIGE



Note: Following drawings are for reference.
Contact Sens-tech for latest mechanical drawings and 3D CAD models.

OUTLINE DRAWINGS CONTINUED...

XDAS-DH3-9032C-xx 1.6mm 32+32 detector head board with detectors (low profile IDC connectors)



XDAS-TERMINTOR3-901

local bus terminator (one per DH board chain)

