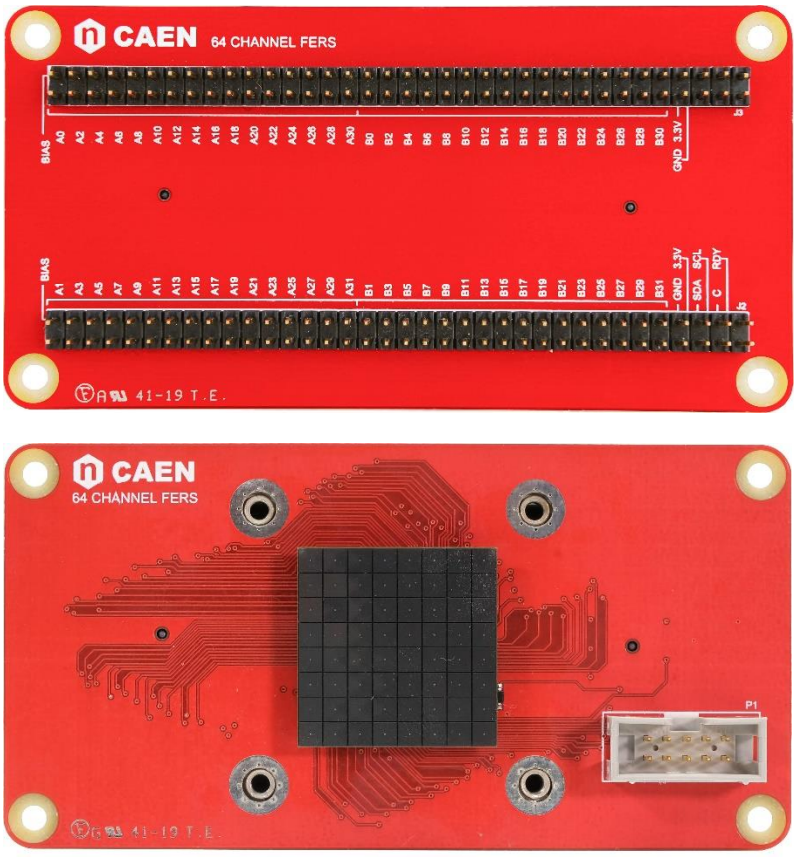
Rev.3– June 19th, 2023

A525x

Adapters for FERS-5200 Board Inputs



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User Manual
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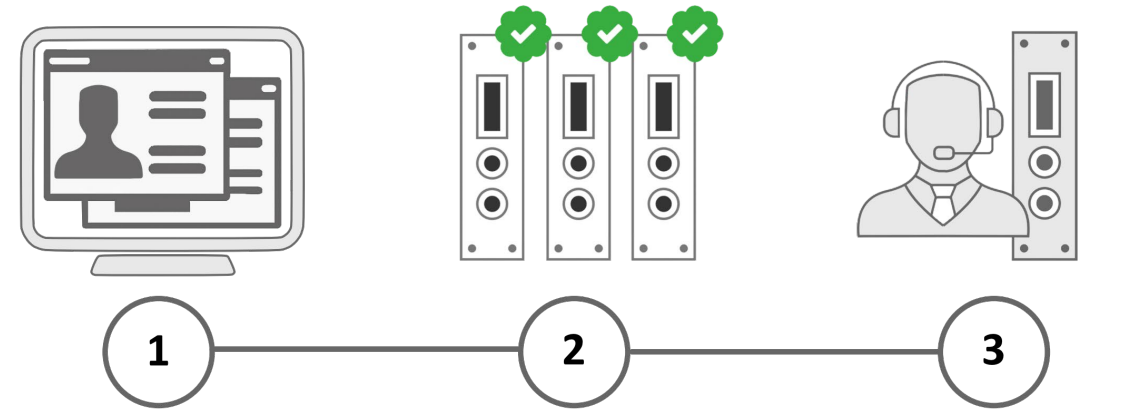


ADAPTER MODELS

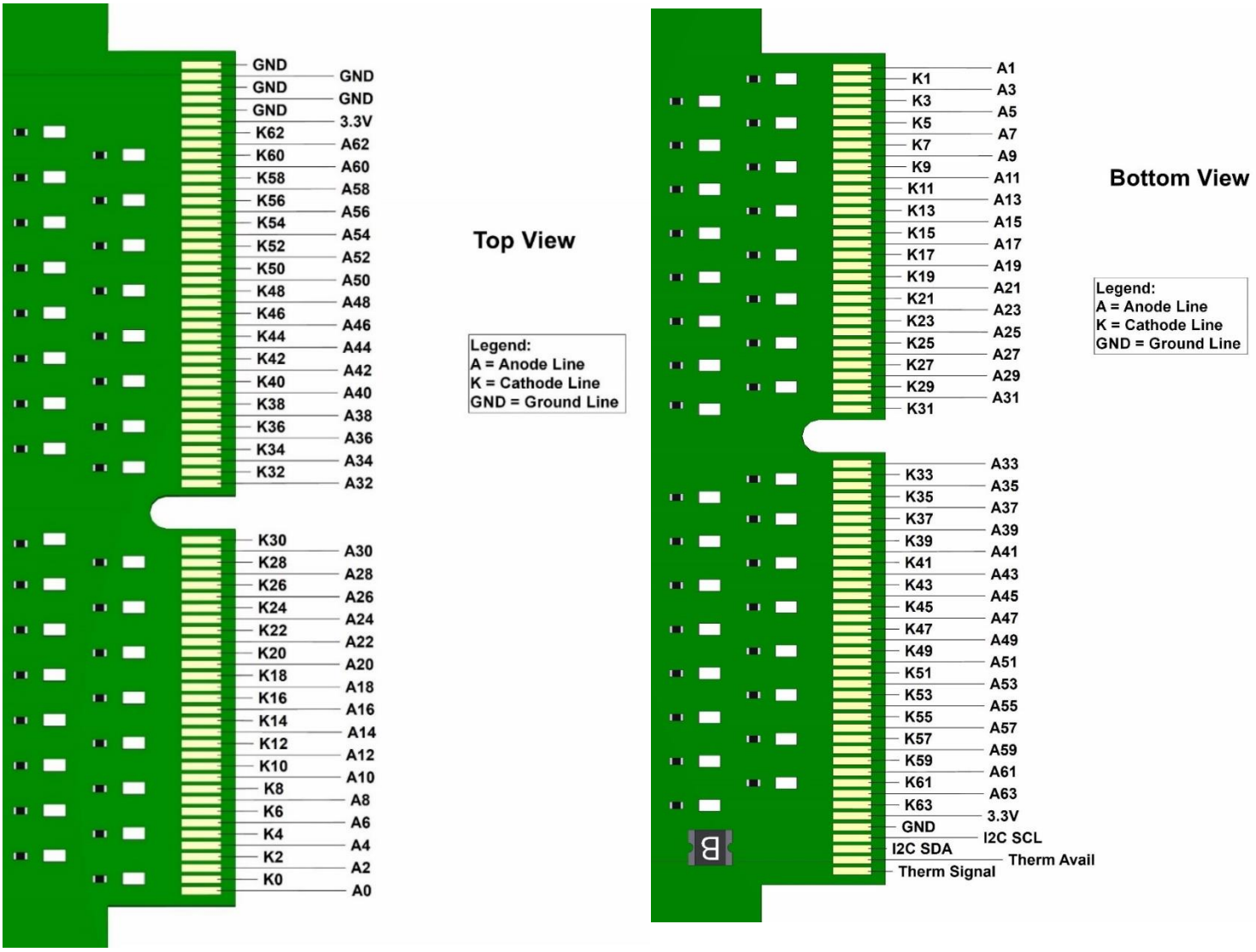
- **A5250 adapts to 2.54 mm pin header**
- **A5251 adapts to Samtec SS4-40-3.0-L-D-K-TR** (to readout Hamamatsu SiPMs matrix S13361-3050AE-08)
- **A5253 adapts to 3-pin connectors**
- **A5254 adapts to three Samtec QSE−040−01−F−D−A connectors** (to readout OnSemi (ex SensL) SiPMs matrix ARRAYJ-60035-64P-PCB and ARRAYC-60035-64P-PCB)

Introduction

FERS-5200 is CAEN Front-End Readout System designed for large detector arrays, where each A5202/DT5202 unit is a small card which houses 64 channels and includes Front End electronics, A/D converters, trigger logic, synchronization, local memory, and readout interface. The units are available in two form factors: naked (e.g., A5202), allowing the user to build customizable mechanical frames and adapters, and desktop (e.g. DT5202).

A5202

The A5202 is the first member of the FERS-5200 family, designed to readout SiPMs. The board has an input edge connector type HSEC8-170, mating to a Samtec HSEC8-170-01-S-DV connector. The A5202 connector has 140 contacts (0.8 mm pitch) and brings 64 couples of SiPM anodes and cathodes, the temperature sensor connectors, and several grounds.
In the pictures below, the A5202 pin-out is presented, while a detailed pin numbering scheme is presented in the A5202 User Manual.

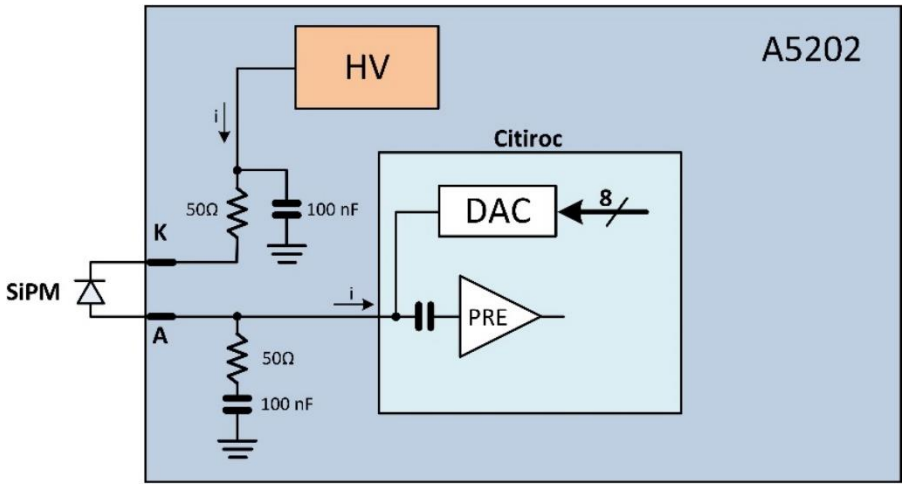


Apart from the 64 anode and cathode lines and apart from the ground lines:

- I^2C SCL indicates the Serial Clock pin of the I^2C slave bus (*not yet implemented*).
- I^2C SDA indicates the Serial Data pin of the I^2C slave bus (*not yet implemented*).
- Therm Avail indicates the pin that allows to signal the presence of a temperature sensor to the internal A7585D power supply module. When the pin is disconnected, the temperature measurement and compensation is enabled in the A7585D module.
- Therm Signal indicates the pin to transmit the signal proportional to the detector temperature (if a temperature sensor is connected) to the A7585D power supply module.

The A5202 is designed to provide positive bias voltage to the SiPMs. In this standard configuration, suitable for a wide range of SiPM matrices, the A7585D internal power supply feeds the SiPMs with positive high voltage: the anodes of SiPMs have to be independently connected to the Citiroc-1A input lines, while cathodes have to be connected to the HV line.

In the next page, a schematic representation of the SiPM connection scheme for the A5202 board is presented.

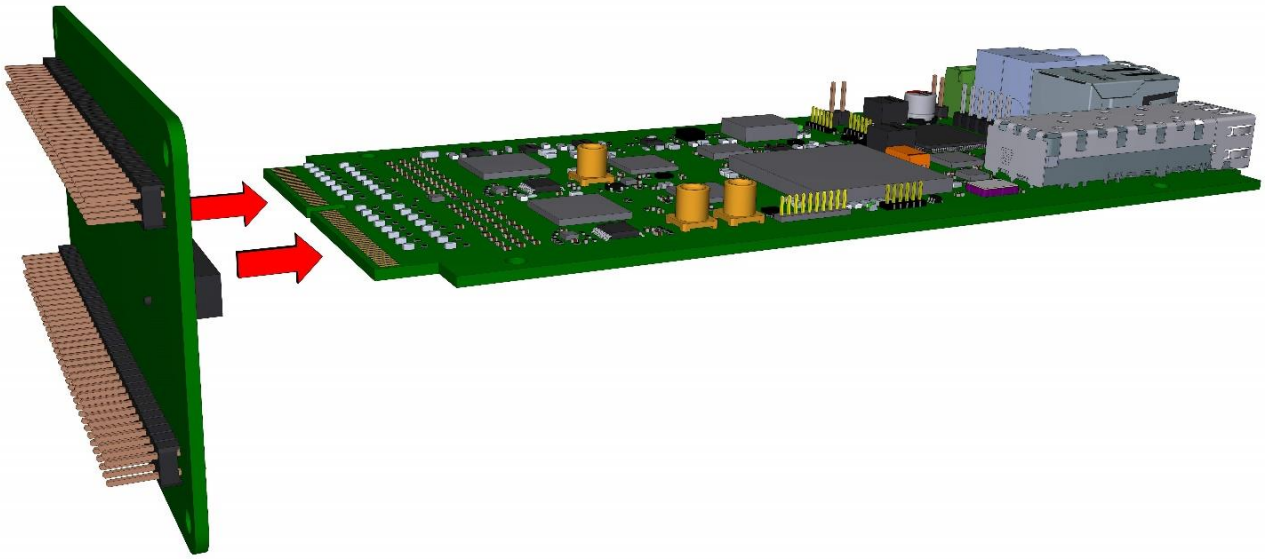


To readout SiPM detectors with the A5202 board, the user has to consider these three main options:

1. Use one of the FERS-5200 header adapter described in this Datasheet (A525x) mating directly on the A5202 input edge connector.
2. Use a flat remotization cable, e.g. A5260, adapting the HSEC8-170 edge card connector to the user need.
3. Build his/her own PCB mating directly on the A5202 edge connector.

A5202 Adapter Mounting

In case one of the A525x connector is bought (separately from the A5202 delivered kit), the adapter mounting has to take place as shown in the figure below.



THE HEADER ADAPTER MUST BE PLUGGED IN OR REMOVED WHEN THE BOARD IS DISCONNECTED FROM THE DC POWER SUPPLY!

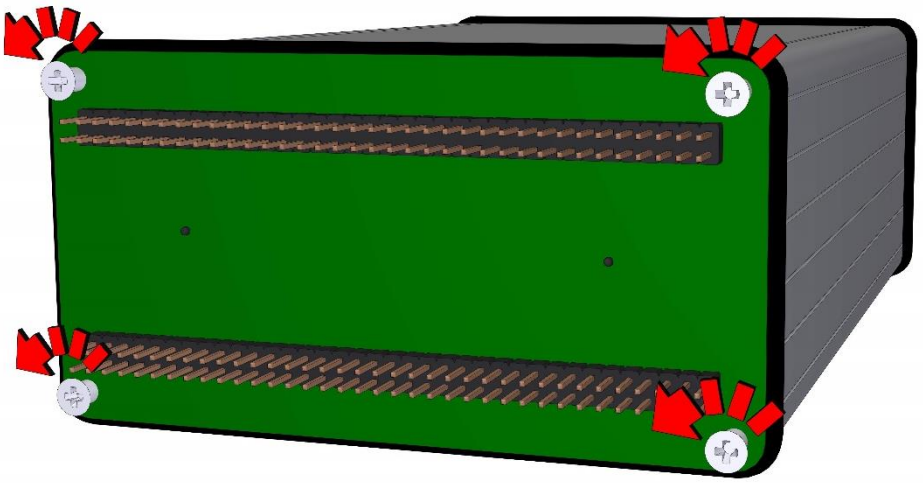
DT5202

The DT5202 is the boxed version of the A5202 board, designed for desktop use. For this reason, the pinout and SiPM connection scheme is the same as that presented for the A5202 board in the previous section and we invite the user to refer to it for further details.
The DT5202 is delivered to the user with the A5250 header adapter already mounted as rear panel of the module, while other CAEN adapters are optional and have to be purchased separately.
All the header adapters presented in this Datasheet were mechanically designed to be mounted as rear panel of the DT5202 module.

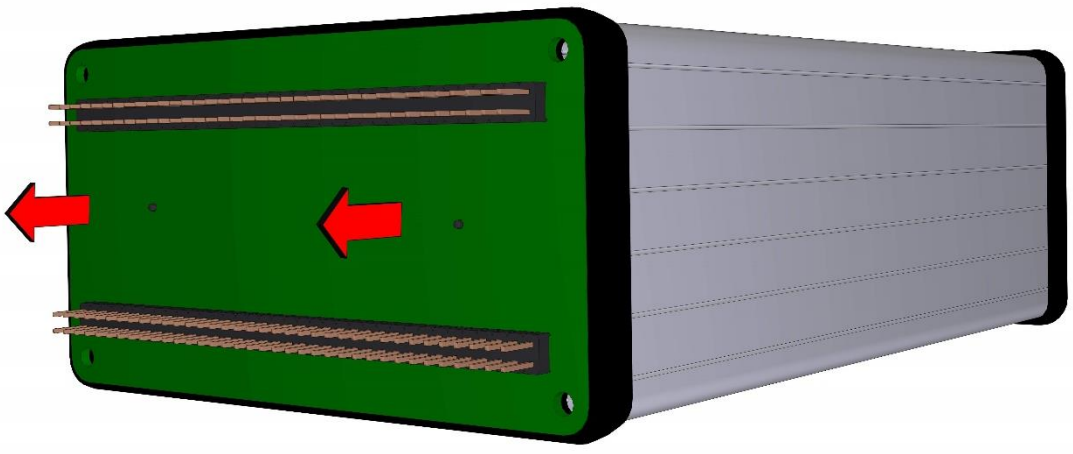
DT5202 Adapter Mounting

In case a header adapter different from the already mounted A5250 is bought by the user, the adapter mounting has to take place as described below:

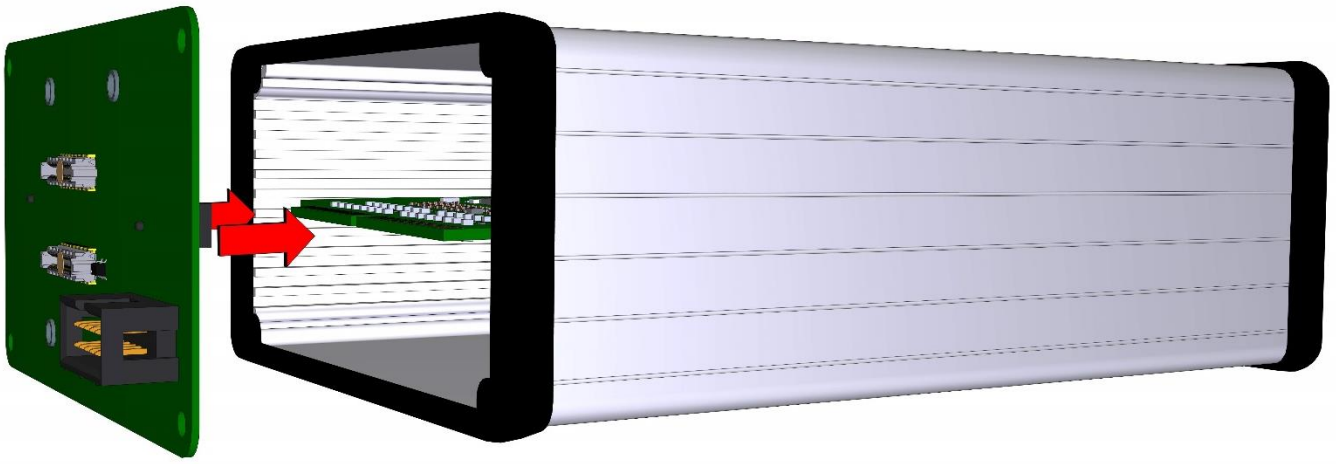
1. Remove the 4 screws from the DT5202 rear panel.



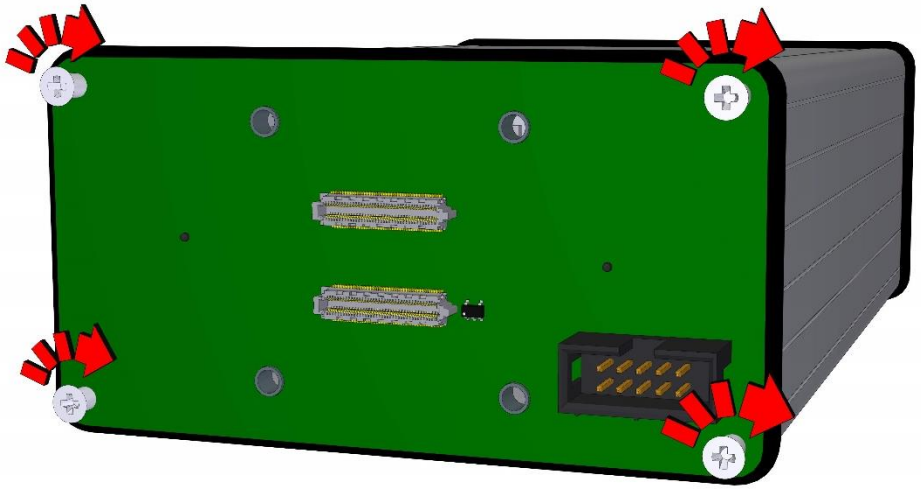
2. Remove the header adapter by taking care of not removing the dark plastic frame around the rear panel. If by chance the frame is removed by the user, it has to be reassembled in the direction so that it is externally flush with the header adapter.



3. Plug the Samtec HSEC8-170-01-S-DV connector of the new header adapter (A5251 in the picture below) into the HSEC8-170 DT5202 edge connector.



4. Apply again the 4 screws after having checked that the adapter is correctly plugged into the edge connector.

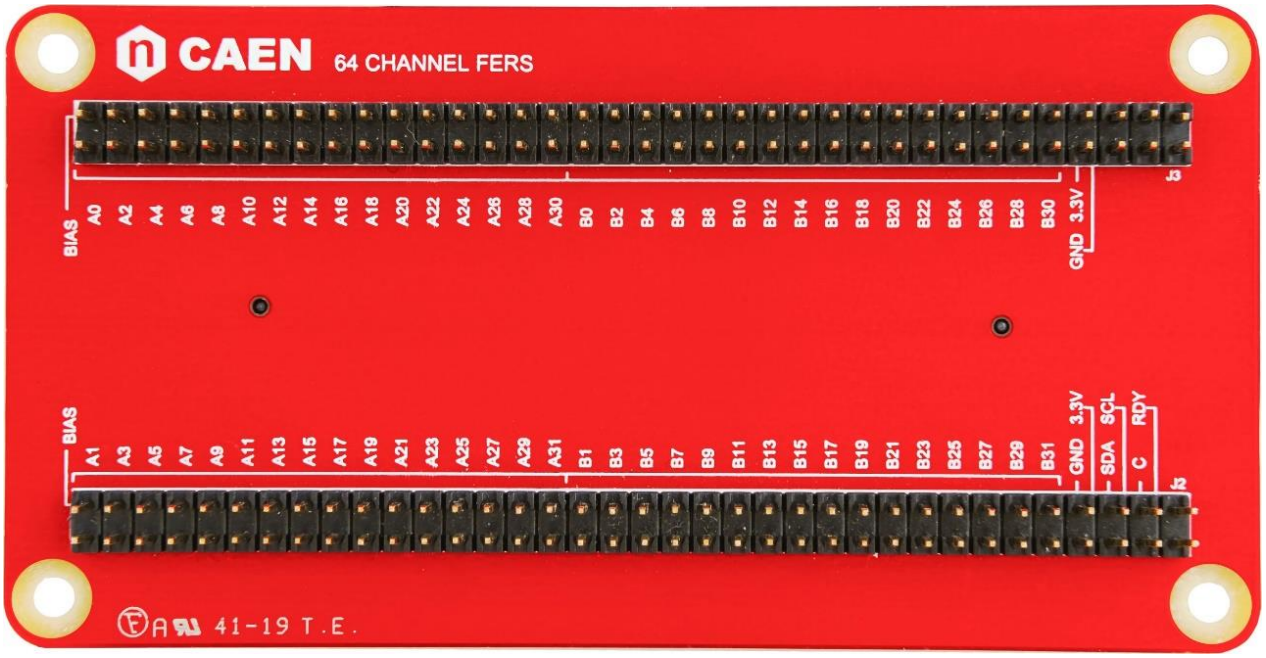


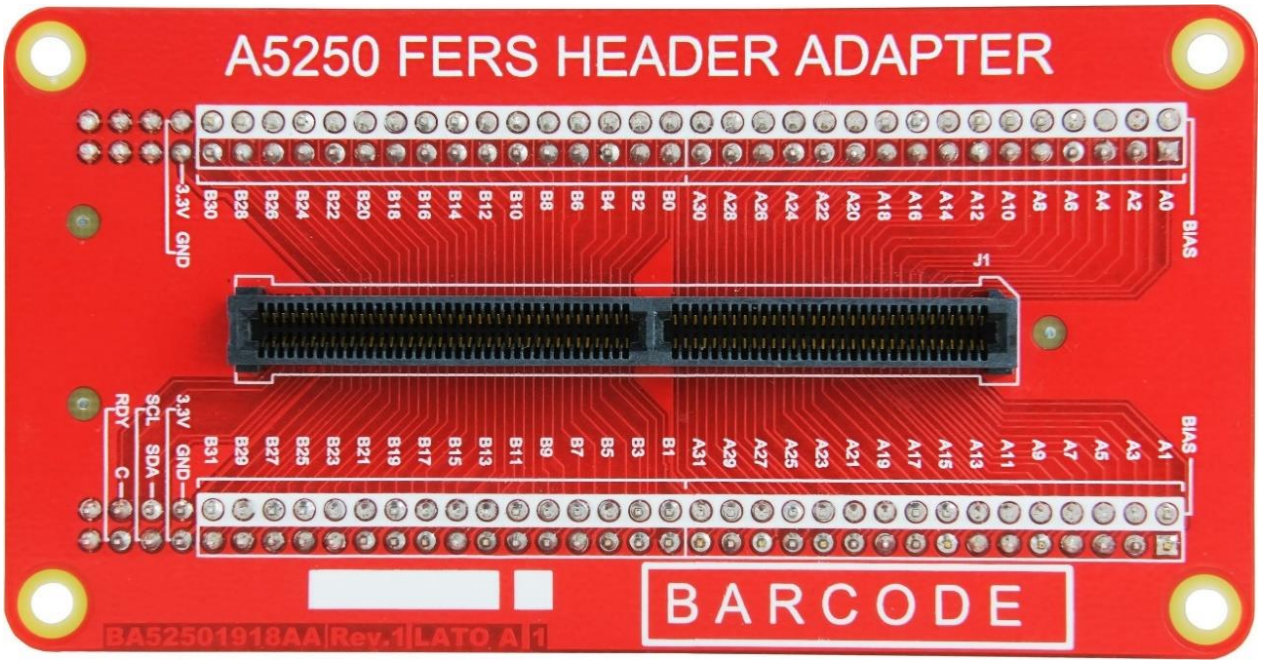
THE HEADER ADAPTER MUST BE PLUGGED IN OR REMOVED WHEN THE BOARD IS DISCONNECTED FROM THE DC POWER SUPPLY!

A5250

The **A5250** adapter is compliant with all the form factors of the FERS-5200 boards. It mechanically adapts from the FERS-5200 input edge card connector (type HSEC8-170) to 2.54 mm pin header. Each strip on the adapter exposes 32 bias (cathode)/signal (anode) couples. Several ground and temperature sensor connectors are also present. The adapter is already mounted in the back panel of the DT5202 board.

A5250 Views

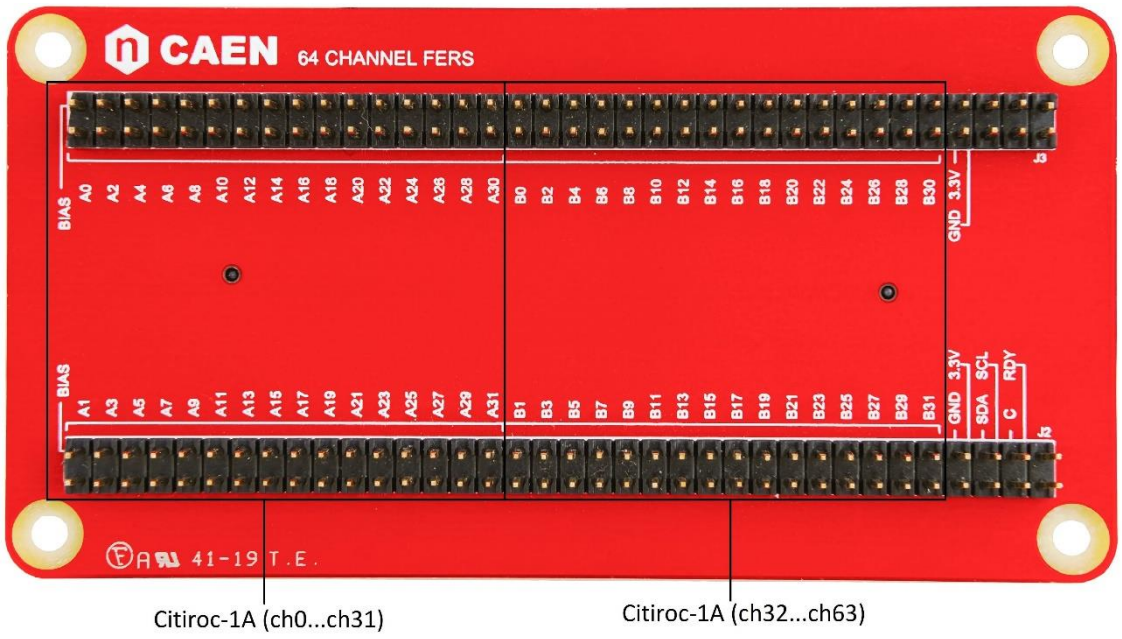




A5250 Pin-out

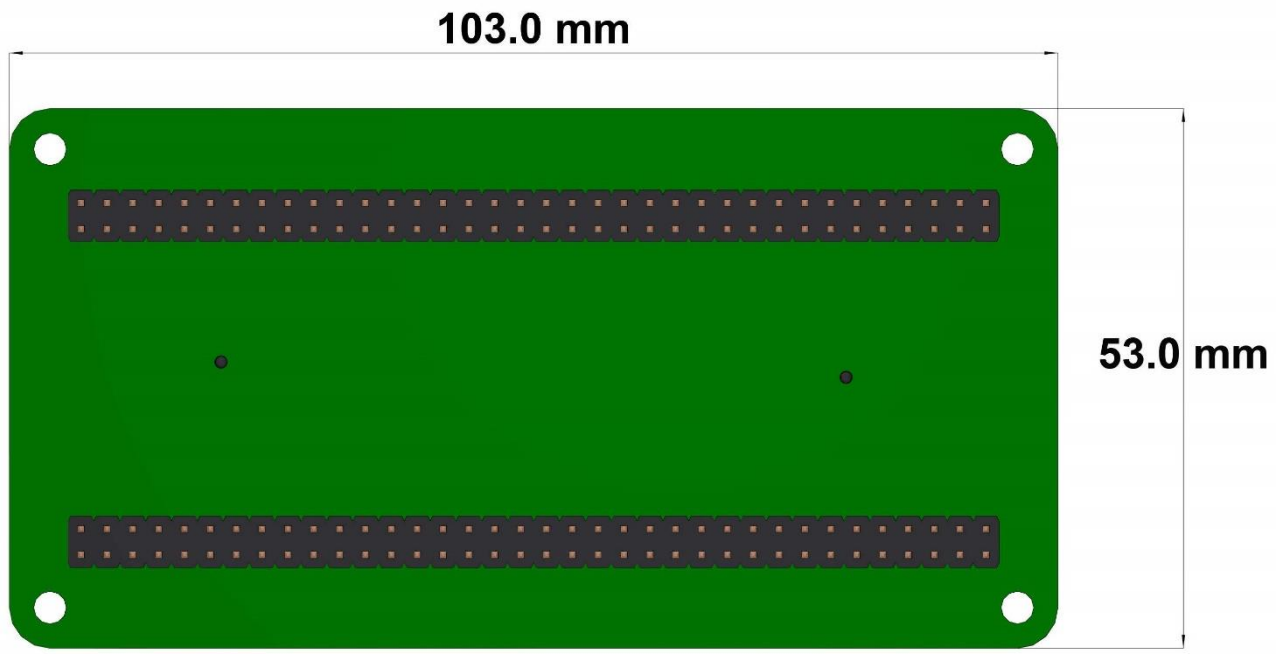
Apart from the Channel Inputs, HV Bias and GND (ground) lines, the A5250 exposes the following pins:

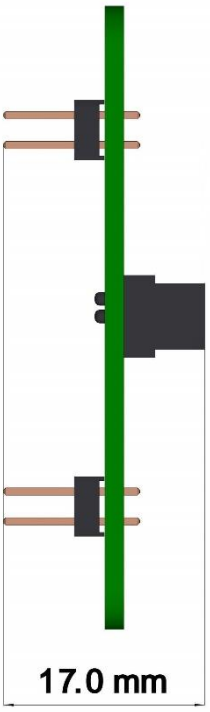
- **SDA**, indicates the Serial Data pin of the I^{2}C slave bus (*not yet supported*).
- **SCL**, indicates the Serial Clock pin of the I^{2}C slave bus (*not yet supported*).
- **C**, indicates the pin to transmit the signal proportional to the detector temperature (if a temperature sensor is connected) to the board internal power supply module for temperature readout and compensation.
- **RDY,** indicates the pin that allows to signal the presence of a temperature sensor to the board internal power supply module. When the pin is disconnected, the temperature readout and compensation is enabled if using the A5202/DT5202 board.



Pinout based on A5202/DT5202 board connection

A5250 Overall Dimensions

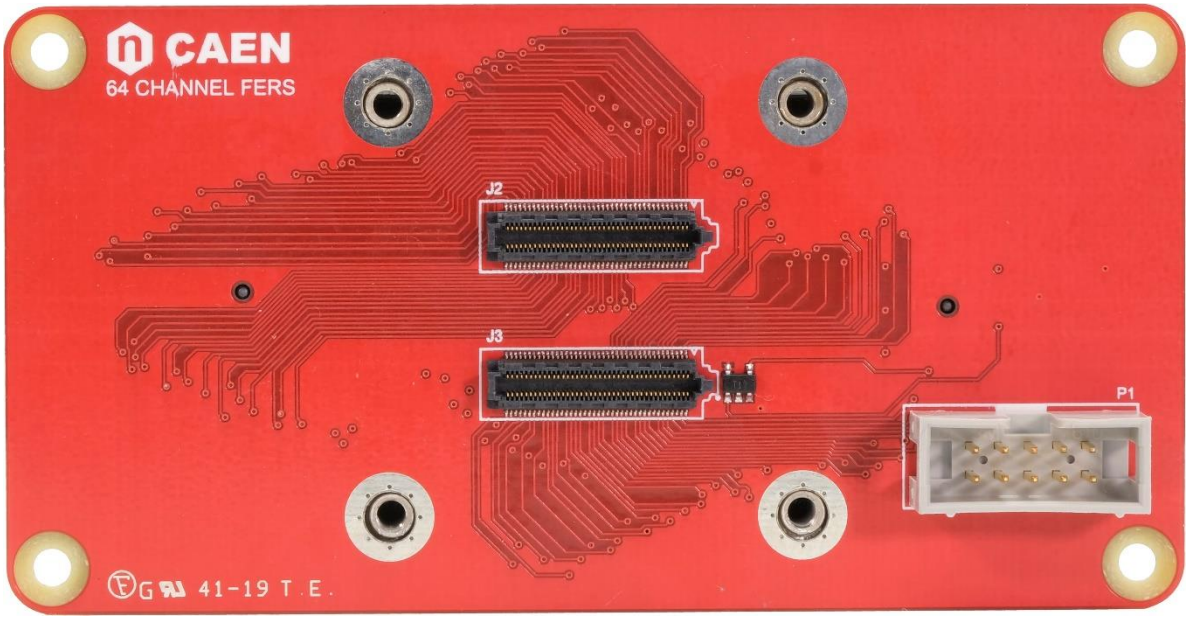


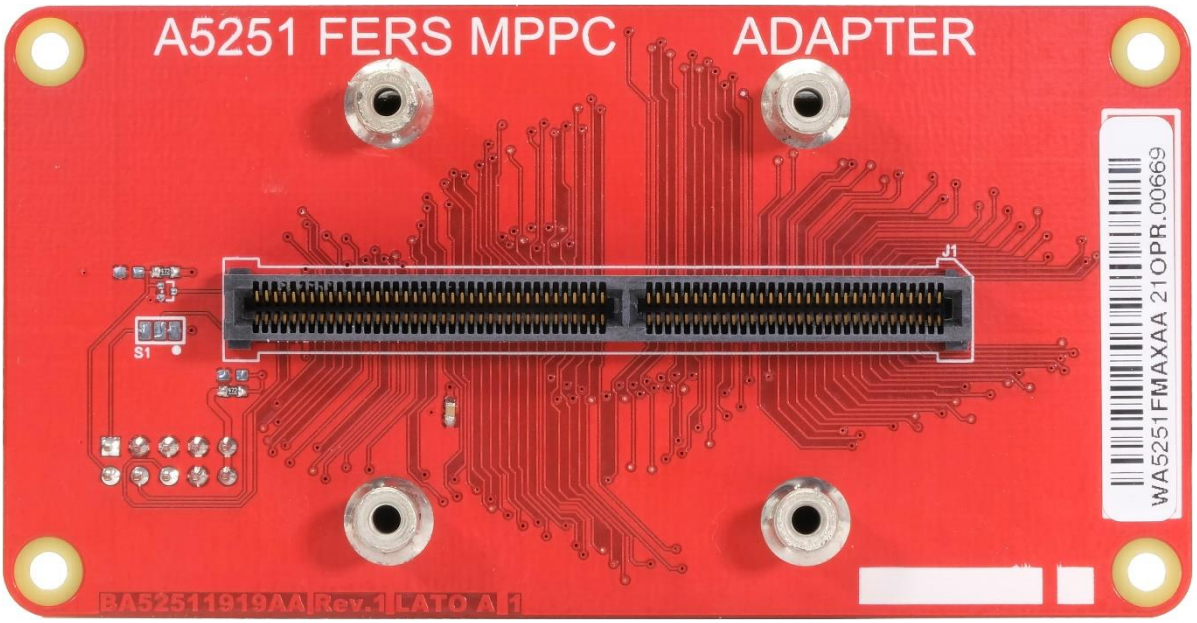


A5251

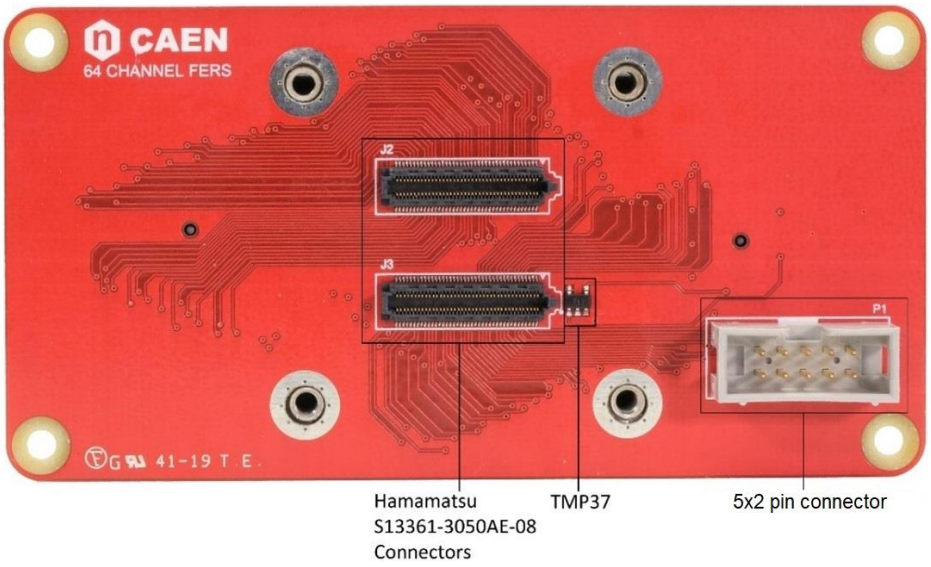
The **A5251** adapter is compliant with A5202/DT5202 boards. It mechanically adapts from the input edge card connector (type HSEC8-170) to a couple of Samtec SS4-40-3.0-L-D-K-TR connectors. The adapter is suited for biasing and reading out an 8×8 Hamamatsu S13361-3050AE-08 SiPM matrix. The A5251 is equipped with a TMP37 temperature sensor. A dark plastic box is also included in the delivered kit, which is ideal for shielding environmental light and pulsing the matrix via the fiber optic connector placed on top of it. A 5x2 pin (2.54 mm pitch) connector is included in the adapter and brings several grounds, the I^2C lines (*not yet supported*) and the signals for an additional temperature sensor (different form the internal TMP37).

A5251 Views

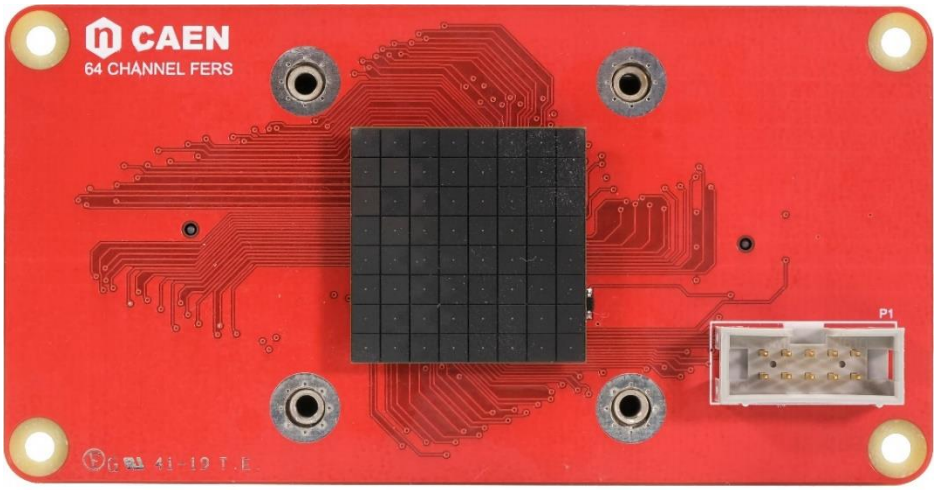




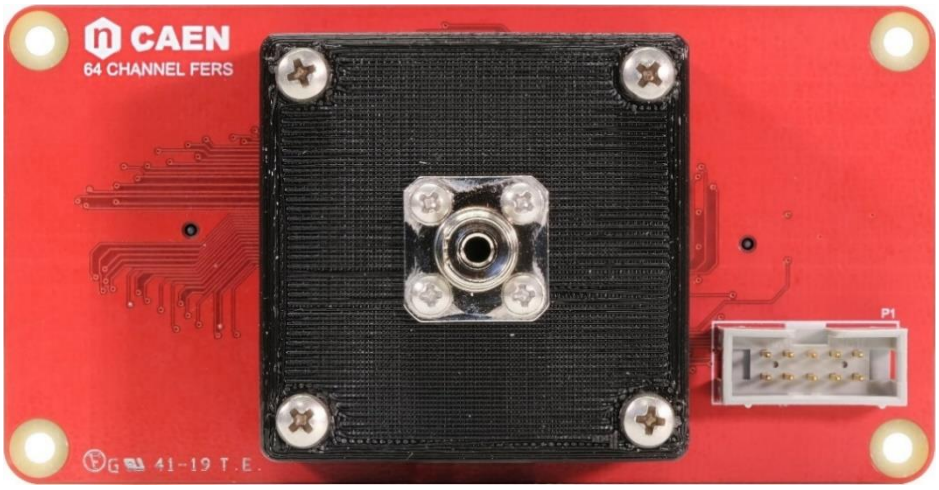
The picture below shows the A5251 header adapter with indicated the SiPM connectors, the TMP37 temperature sensor and the 5x2 pin connector.



The picture below shows the A5251 header adapter with an Hamamatsu S13361-3050AE-08 SiPM matrix mounted.

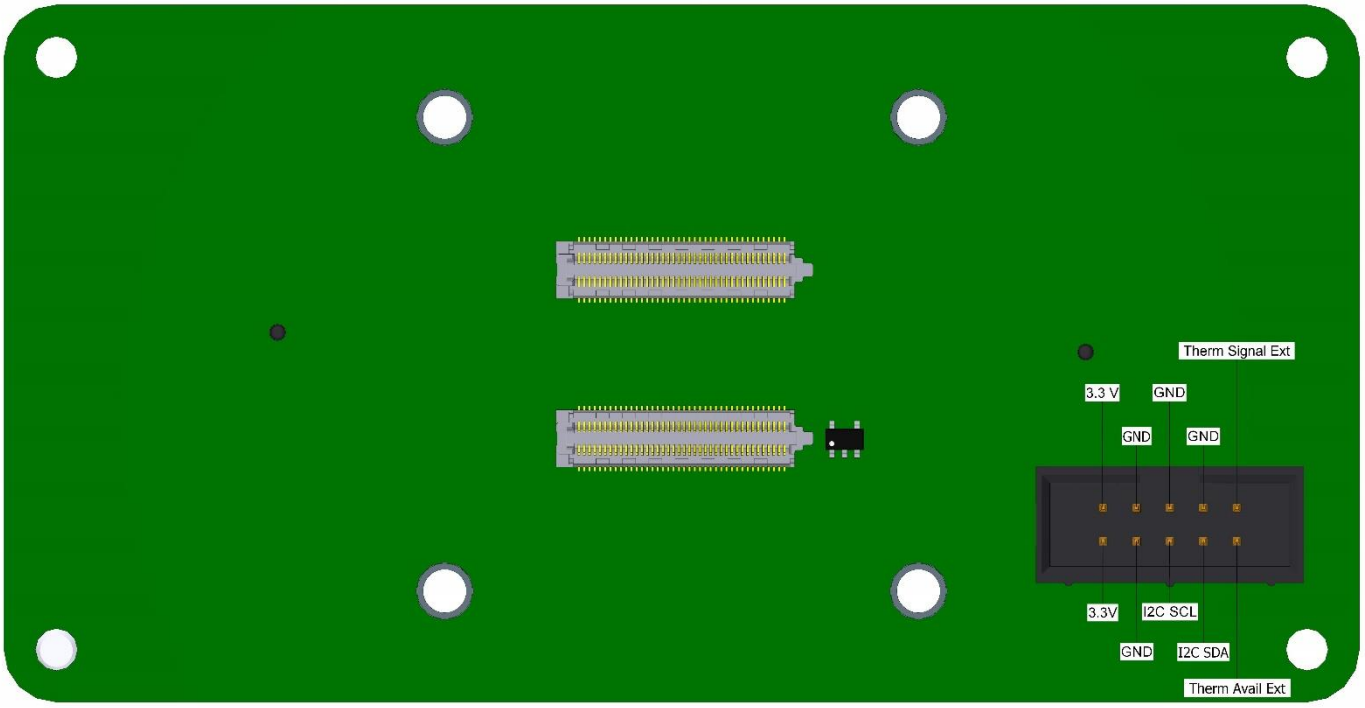


The picture below shows the A5251 header adapter with the dark plastic box for light shielding mounted.



5x2 Pin Connector (2.54 mm pitch)

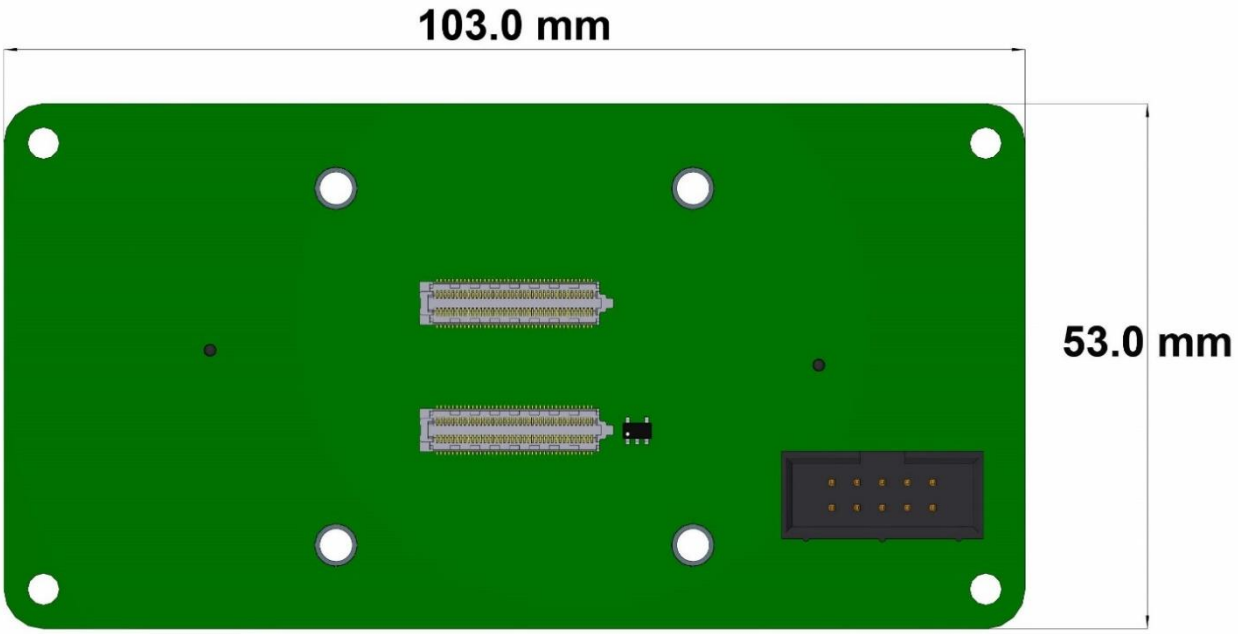
The SS4-40-3.0-L-D-K-TR connector and TMP37 sensor pin out descriptions should not be relevant for the user. Indeed, the two SS4-40-3.0-L-D-K-TR connectors already bring the cathode and anode lines for the readout of an 8×8 Hamamatsu S13361-3050AE-08 SiPM matrix. The TMP37 sensor is directly read out by the A5202/DT5202 board and the bias/temperature compensation is already managed at software level. For this reason, only the description of the 5x2 pin (2.54 mm pitch) connector pin-out is provided.

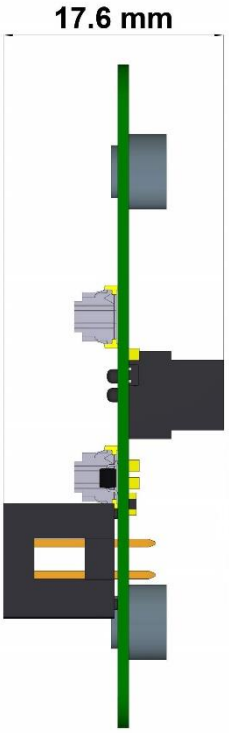


Pin N.	Signal	Pin N.	Signal
1	Therm Signal Ext	6	I2C SCL
2	Therm Avail Ext	7	GND
3	GND	8	GND
4	I2C SDA	9	3.3 V
5	GND	10	3.3 V

- **Therm Signal Ext** is the pin to transmit the signal proportional to the detector temperature (if an external temperature sensor different from the internal TMP37 is connected) to the A7585D power supply module for temperature readout and compensation.
- **Therm Avail Ext** is the pin that allows to signal the presence of a temperature sensor (different from the internal TMP37) to the A7585D power supply module. When the pin is disconnected, the temperature compensation is enabled in the A7585D internal power supply module.
- **I2C SDA** is the Serial Data pin of the I^2C slave bus.
- **I2C SCL** is the Serial Clock pin of the I^2C slave bus.

A5251 Overall Dimensions

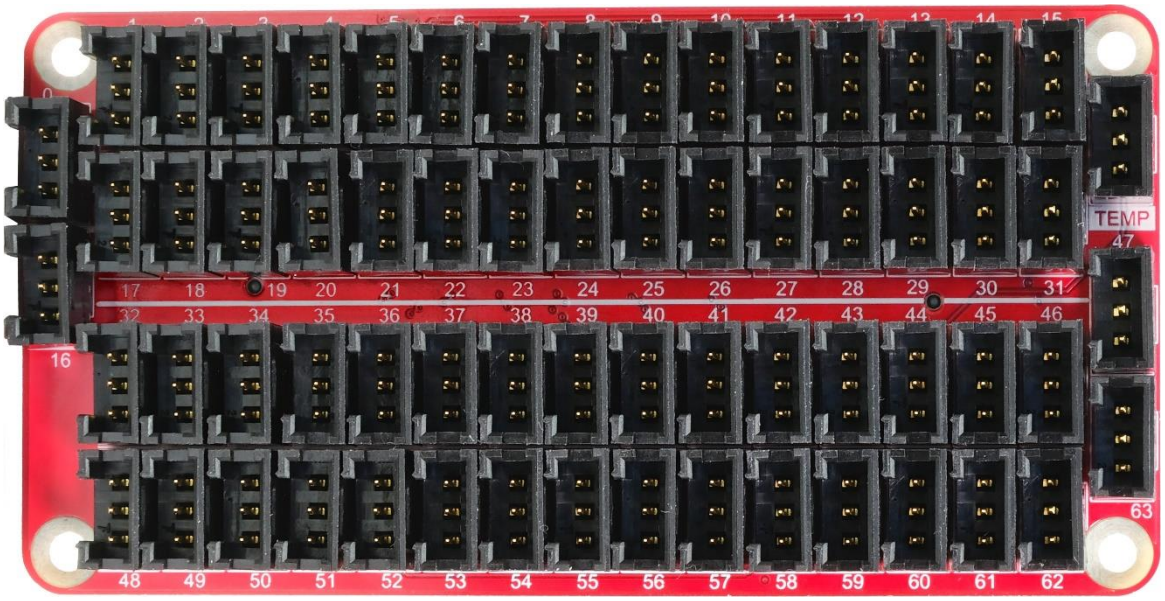


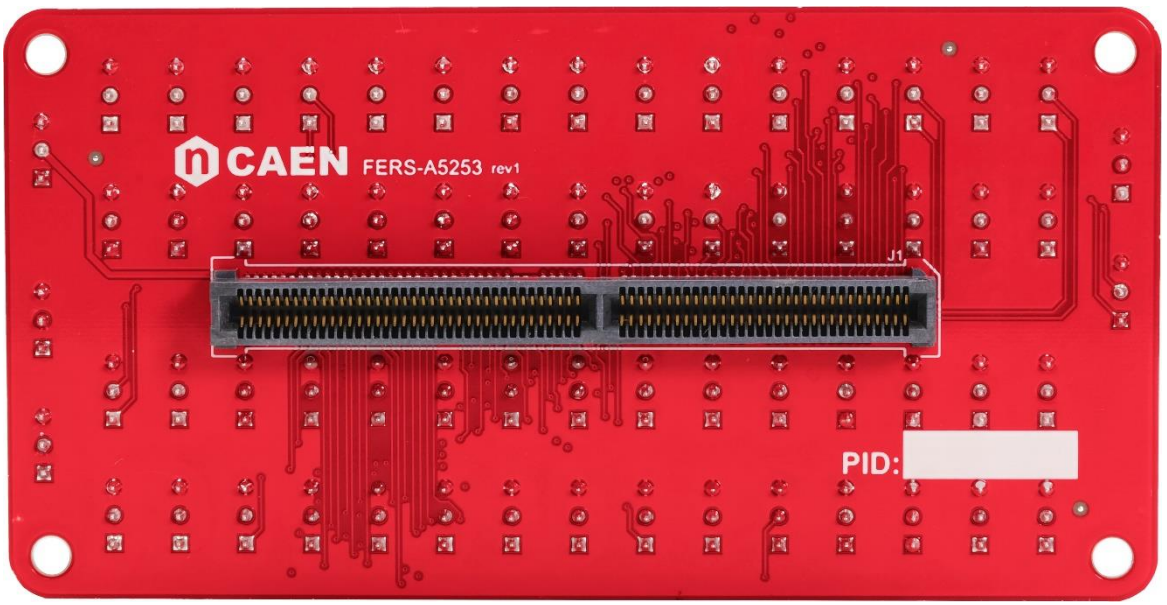


A5253

The **A5253** header adapter is compliant with A5202/DT5202 FERS-5200 boards. It mechanically adapts from the input edge card connector (type HSEC8-170) to 65 3-pin connectors (AMPMODU type 3-102203-4). Each 3-pin connector mates to an AMPMODU type 102241-1 (as the one present in A5261 cables). Of the headers mounted, 64 allows reading out and biasing as many SiPMs, while 1 allows reading out an external temperature sensor. The A5253 header adapter was designed to allow the reading out of remote SiPMs, by having the channels and associated cables unbundled rather than grouped in a single flat cable.

A5253 Views

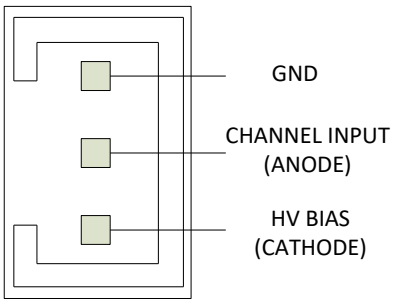




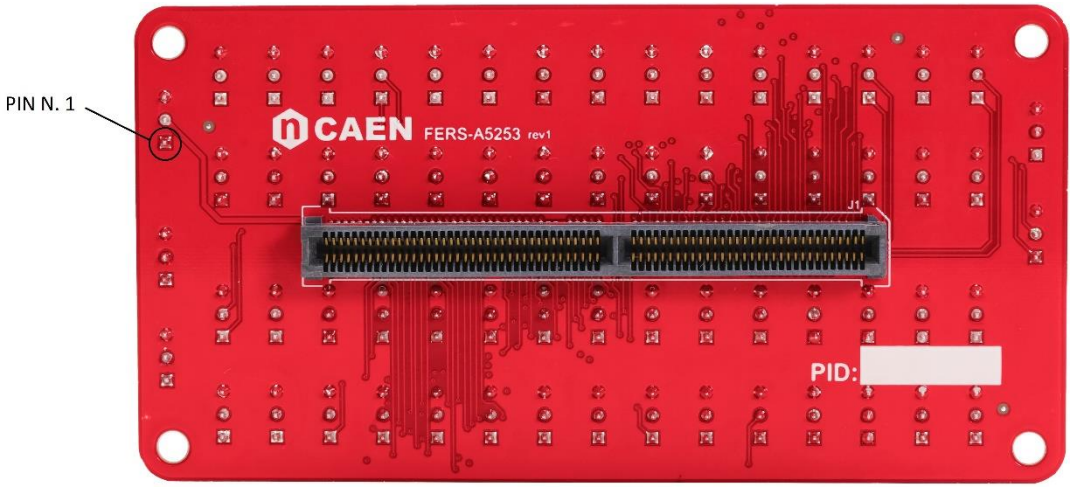
A5253 Pin-out

The A5253 connectors dedicated to reading out and biasing SiPMs have the following pin-out.

Pin N.	Signal
1	HV Bias (Cathode)
2	Channel Input (Anode)
3	GND

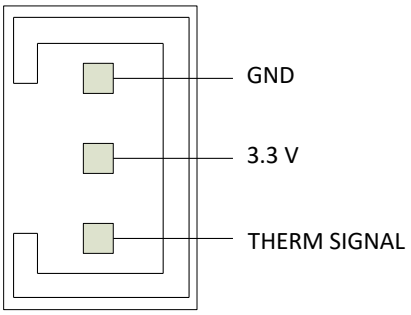


For each connector, the pin number 1 is also indicated by a square soldering on the A5253 adapter rear panel. In the picture below, the pin number 1 of a 3-pin connector is indicated.



The A5253 connector dedicated to reading out an external temperature sensor have the following pin-out.

Pin N.	Signal
1	Therm Signal
2	3.3 V
3	GND



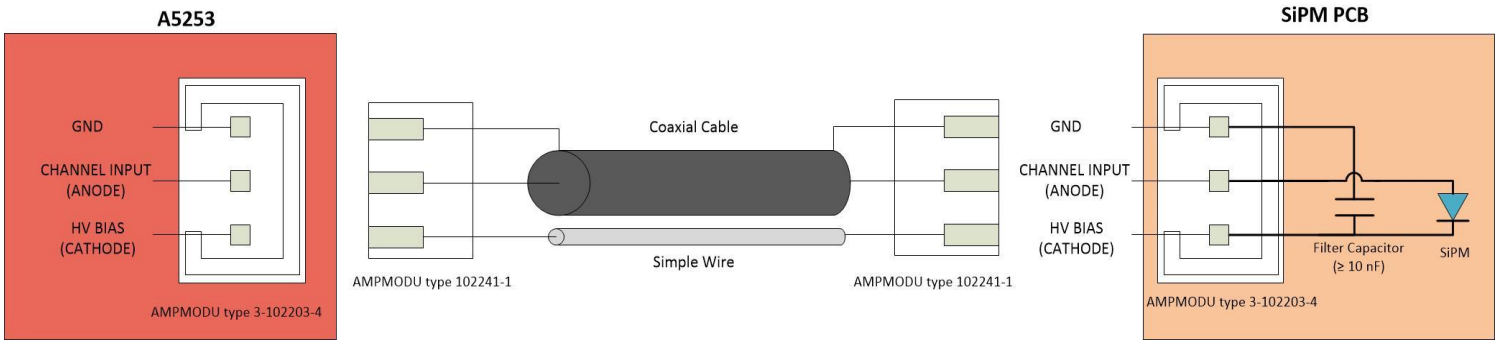
Therm Signal indicates the pin to transmit the signal proportional to the detector temperature (if a temperature sensor is connected) to the A7585D power supply module.

A5253 SiPM Connection Example

In order to connect the SiPMs to the A5253 header adapter, the CAEN A5261 remotization cables can be used. Alternatively, the user can build its own remotization cables having an AMPMODU type 102241-1 female connector on each side. In this case, the cable should be composed of the following elements (see also figure below):

1. The copper core of a coaxial cable, to be connected to the channel input (anode) line.
2. The external woven copper shield of the same coaxial cable, to be connected to the ground line.
3. A simple electrical wire, to be connected to the HV bias (cathode) line.

The user should also build a PCB hosting the SiPM and an AMPMODU type 3-102203-4 connector. The PCB where the SiPM is mounted should be schematically similar to that presented in the picture below.

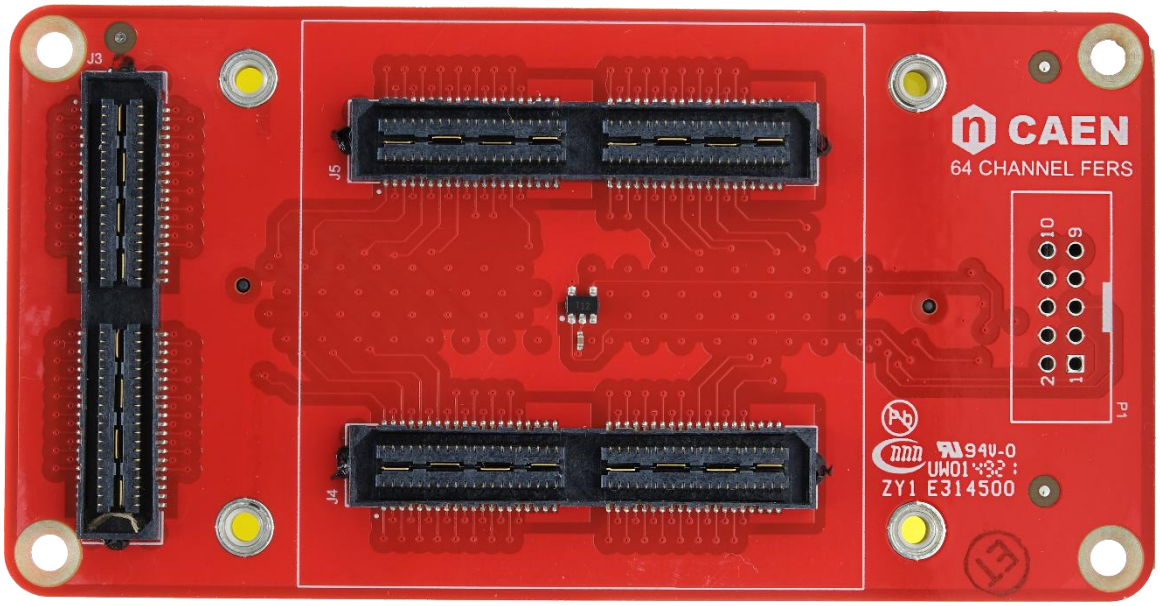


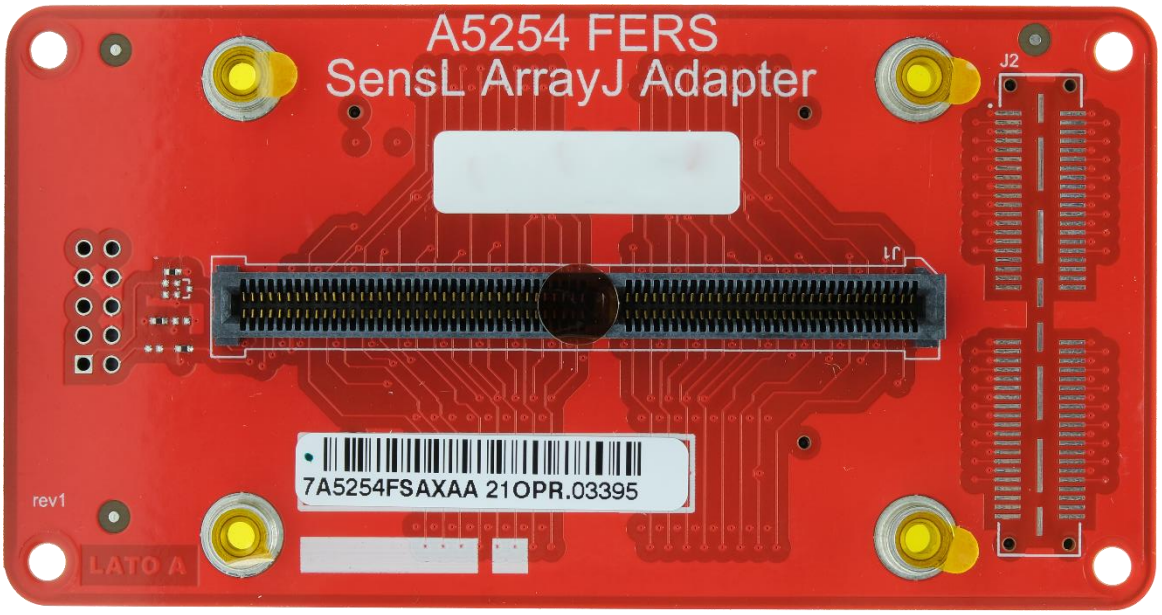
Apart from the connection of the SiPM to the cathode and anode lines, a filter capacitor, with a capacitance of at least 10 nF and a voltage rating of approximately 100 V, should be connected between the ground and cathode lines.

A5254

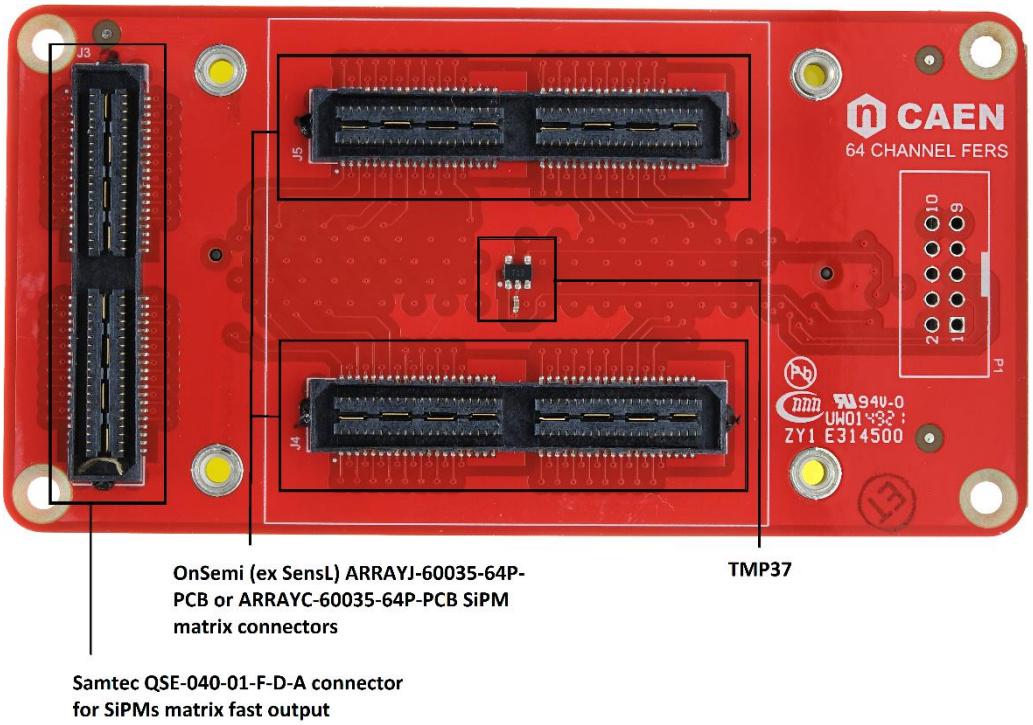
The **A5254** adapter is compliant with A5202/DT5202 boards. It mechanically adapts from the input edge card connector (type HSEC8-170) to a couple of Samtec QSE−040−01−F−D−A connectors. The adapter is suited for biasing and reading out 8x8 OnSemi (ex SensL) ARRAYJ-60035-64P-PCB or ARRAYC-60035-64P-PCB SiPMs matrices. Moreover, this adapter provides access to the individual fast output of the cells on a side Samtec QSE−040−01−F−D−A connector.
The A5254 is equipped with a TMP37 temperature sensor. A dark plastic box is also included in the delivered kit, which is ideal for shielding environmental light and pulsing the matrix via the fiber optic connector placed on top of it.
The A5254 is also arranged for housing a 5x2 pin (2.54 mm pitch) connector, where could be connected several grounds, the I2C lines and the signals for an additional temperature sensor (different form the internal TMP37).

A5254 Views



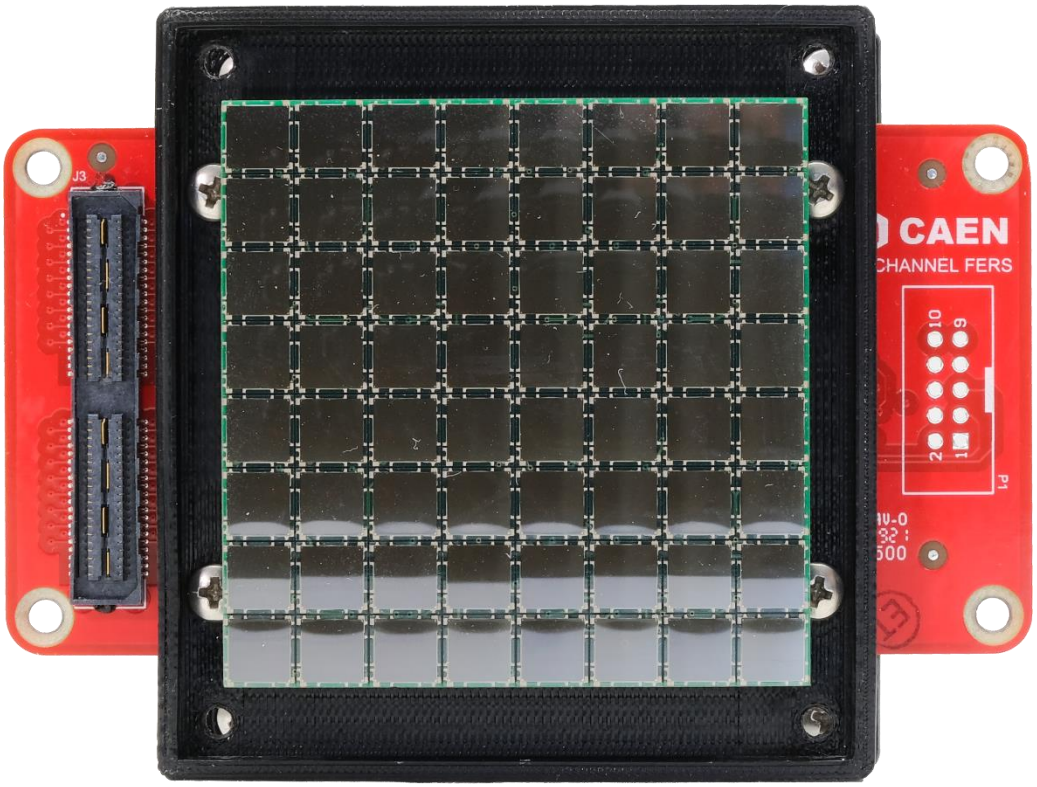


The picture below shows the A5254 header adapter with indicated the SiPM matrix connectors and the TMP37 temperature sensor.



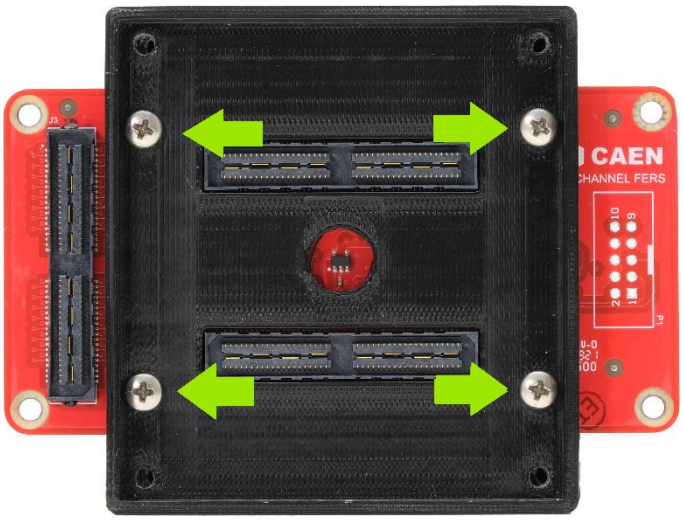
The two QSE−040−01−F−D−A connectors bring the cathode and anode lines for the readout of an 8×8 OnSemi ARRAYJ-60035-64P-PCB or ARRAYC-60035-64P-PCB SiPMs matrices. The TMP37 sensor is directly read out by the A5202/DT5202 board and the bias/temperature compensation is already managed at software level.

The picture below shows the A5254 header adapter with an OnSemi ARRAYC-60035-64P-PCB SiPMs matrix mounted.



The picture below shows the A5254 header adapter with the dark plastic box for light shielding mounted.

The dark plastic box can be unscrewed from the A5254 adapter acting on 8 screws (shown in the figure below). Firstly, the screws on the side of the box visible from the side A of the A5254 shall be removed. After opening the dark box, the 4 screws semi-covered by the SiPMs matrix, visible from the side B of the A5254, shall be removed.



A5254 Pin-out

The A5254 connectors dedicated for reading out (standard signals) and biasing SiPMs have the following pin-out:

Pin N. (J1)	SiPM array	Pin N. (J1)	SiPM array
1	2 – J5	17	10 – J5
2	2 – J4	18	10 – J4
3	Bias	19	Bias
4	Bias	20	Bias
5	1 – J5	21	9 – J5
6	1 – J4	22	9 – J4
7	Bias	23	Bias
8	Bias	24	Bias
9	6 – J5	25	14 – J5
10	6 – J4	26	14 – J4
11	Bias	27	Bias
12	Bias	28	Bias
13	5 – J5	29	13 – J5
14	5 – J4	30	13 – J4
15	Bias	31	Bias
16	Bias	32	Bias

Pin N. (J1)	SiPM array	Pin N. (J1)	SiPM array
33	18 – J5	49	26 – J5
34	18 – J4	50	26 – J4
35	Bias	51	Bias
36	Bias	52	Bias
37	17 – J5	53	25 – J5
38	17 – J4	54	25 – J4
39	Bias	55	Bias
40	Bias	56	Bias
41	22 – J5	57	30 – J5
42	22 – J4	58	30 – J4
43	Bias	59	Bias
44	Bias	60	Bias
45	21 – J5	61	29 – J5
46	21 – J4	62	29 – J4
47	Bias	63	Bias
48	Bias	64	Bias

Pin N. (J1)	SiPM array	Pin N. (J1)	SiPM array
65	42 – J5	84	Bias
66	42 – J4	85	49 – J5
67	Bias	86	49 – J4
68	Bias	87	Bias
69	41 – J5	88	Bias
70	41 – J4	89	54 – J5
71	Bias	90	54 – J4
72	Bias	91	Bias
73	46 – J5	92	Bias
74	46 – J4	93	53 – J5
75	Bias	94	53 – J4
76	Bias	95	Bias
77	45 – J5	96	Bias
78	45 – J4	97	58 – J5
79	Bias	98	58 – J4
80	Bias	99	Bias
81	50 – J5	100	Bias
82	50 – J4	101	57 – J5
83	Bias	102	57 – J4

Pin N. (J1)	SiPM array	Pin N. (J1)	SiPM array
103	Bias	122	70 – J4
104	Bias	123	Bias
105	62 – J5	124	Bias
106	62 – J4	125	69 – J5
107	Bias	126	69 – J4
108	Bias	127	Bias
109	61 – J5	128	Bias
110	61 – J4	129	3.3 V
111	Bias	130	3.3 V
112	Bias	131	GND
113	66 – J5	132	GND
114	66 – J4	133	GND
115	Bias	134	I2C SCL
116	Bias	135	GND
117	65 – J5	136	I2C SDA
118	65 – J4	137	GND
119	Bias	138	Therm. avail
120	Bias	139	GND
121	70 – J5	140	Therm. signal

The tables show the correspondence between the pins of the HSEC8-170 connector (J1 on the board serigraphy) and the ones of the Samtec QSE−040−01−F−D−A connectors (J4 and J5 on the board serigraphy). The latter are used to readout the standard signals of the SiPMs matrix (OnSemi ARRAYJ-60035-64P-PCB or ARRAYC-60035-64P-PCB). The pins [129-140] are not connected to the SiPMs matrix, but used for the Therm. Avail Ext, Therm. Signal Ext, I2C SCL and I2C SDA signals (see description given in the A5251 section).

The pixel map is:

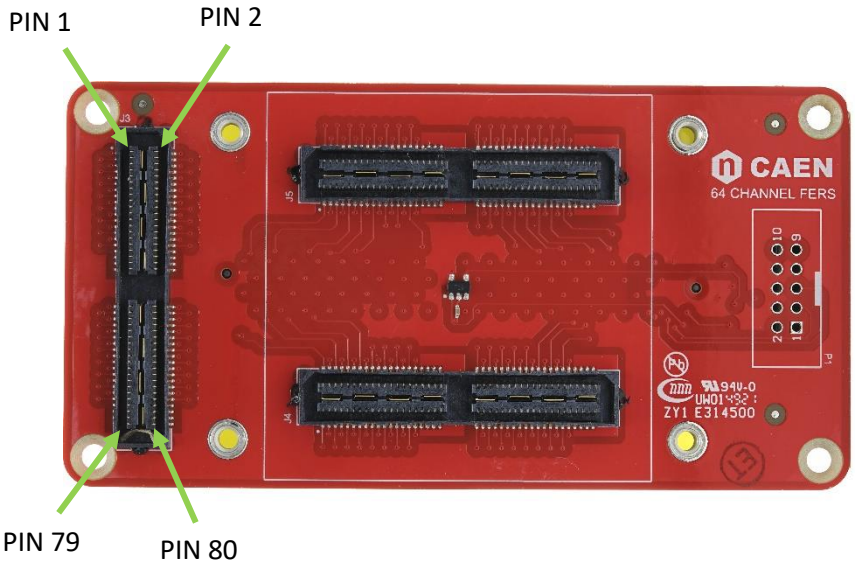
0	8	16	24	32	40	48	56
4	12	20	28	36	44	52	60
2	10	18	26	34	42	50	58
6	14	22	30	38	46	54	62
1	9	17	25	33	41	49	57
5	13	21	29	37	45	53	61
3	11	19	27	35	43	51	59
7	15	23	31	39	47	55	63

Y

X

where the numbers in the grid correspond to the Citiroc-1A input lines. Ch0 is then connected to the slow signal of the first SiPM pixel (S1), ch56 to S8, ch7 to S56 and ch63 to S64. Refer to the OnSemi ARRAYJ-60035-64P-PCB or ARRAYC-60035-64P-PCB datasheet for further details.

The A5254 connector dedicated for reading out (fast signals) SiPMs has the following pin-out:



Pin N. (J3)	SiPM array	Pin N. (J3)	SiPM array
1	F48	17	F46
2	F44	18	F42
3	F1	19	F3
4	F17	20	F19
5	F40	21	F38
6	F36	22	F34
7	F9	23	F11
8	F25	24	F27
9	F47	25	F45
10	F43	26	F41
11	F2	27	F4
12	F18	28	F20
13	F39	29	F37
14	F35	30	F33
15	F10	31	F12
16	F26	32	F28

Pin N. (J3)	SiPM array	Pin N. (J3)	SiPM array
41	F60	57	F58
42	F64	58	F62
43	F5	59	F7
44	F21	60	F23
45	F52	61	F50
46	F56	62	F54
47	F13	63	F15
48	F29	64	F31
49	F59	65	F57
50	F63	66	F61
51	F6	67	F8
52	F22	68	F24
53	F51	69	F49
54	F55	70	F53
55	F14	71	F71
56	F30	72	F32

Ordering Options

Ordering Code	Description
WA5250FHAXAA	A5250 – 2.54 mm pin header adapter for FERS-5200
WA5251FMAXAA	A5251 – MPPC header adapter for A5202/DT5202
WA5253F3AXAA	A5253 – 3-pin header adapter for FERS-5200
WKA5253X64AA	A5253 Kit – A5253 adapter and 64 SiPM remotization CABLES
WA5254FSAXAA	A5254 - SensL ArrayJ Adapter for A5202/DT5202

CAEN
Tools for Discovery

Electronic Instrumentation

CAEN S.p.A.
Via Vetraia 11
55049 - Viareggio
Italy
Phone +39 0584 388 398
Fax +39 0584 388 959
info@caen.it
www.caen.it

CAEN GmbH
Brunnenweg 9
64331 Weiterstadt
Germany
Tel. +49 (0)212 254 4077
Mobile +49 (0)151 16 548 484
info@caen-de.com
www.caen-de.com

CAEN Technologies, Inc.
1 Edgewater Street - Suite 101
Staten Island, NY 10305
USA
Phone: +1 (718) 981-0401
Fax: +1 (718) 556-9185
info@caentechnologies.com
www.caentechnologies.com

CAENspa INDIA Private Limited
B205, BLDG42, B Wing,
Azad Nagar Sangam CHS,
Mhada Layout, Azad Nagar, Andheri (W)
Mumbai, Mumbai City,
Maharashtra, India, 400053
info@caen-india.in
www.caen-india.in