

HRFLEXTOT

High Resolution Flexible Time over Threshold ASIC

App Note

**External connectivity for self-custom
sensor PCB**

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Review History

Version	Comments
1.1	Creation of the document
1.2	Added section with dimensions to attach an external SiPM board to the main HRFlexToT board.

1 External connector for 16ch HRFlexToT board

This application note explains how to connect an external PCB board as input to the HRFlexToT test board. It is important to check section “Considerations for the self-custom PCB board”. To properly designed a self-custom PCB.

1.1 HRFlexToT 16 channel testing board.

The HRFlexToT board permits the all functionalities of the ASIC.

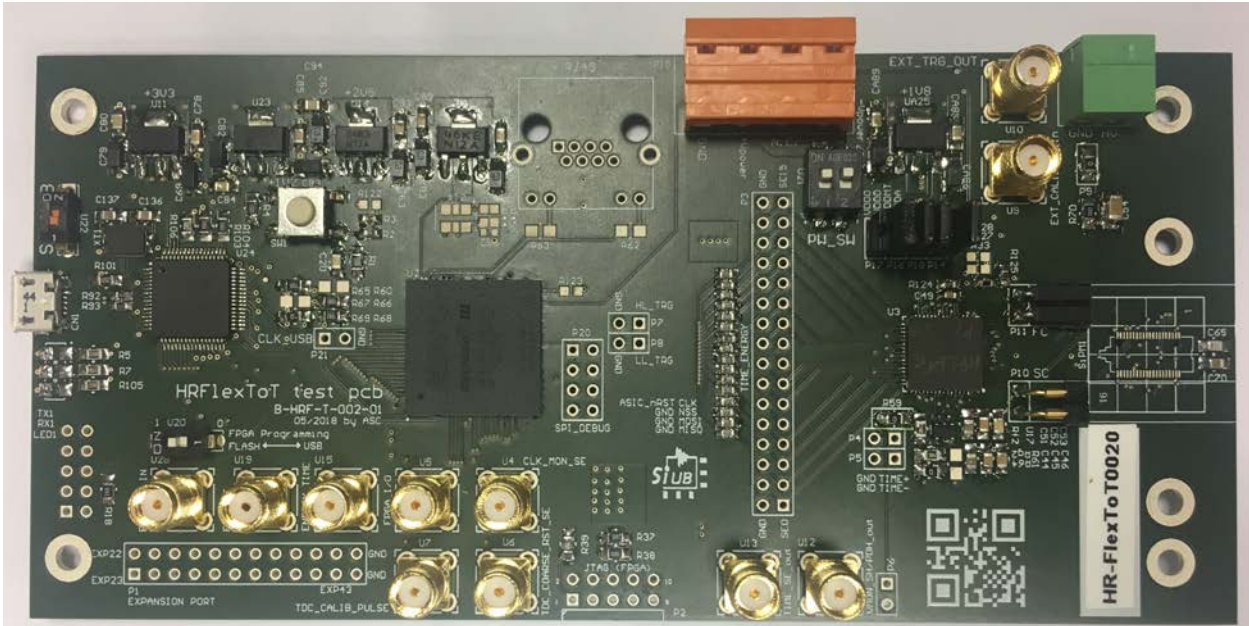


Figure 1: Top side of the HRFlexToT board.

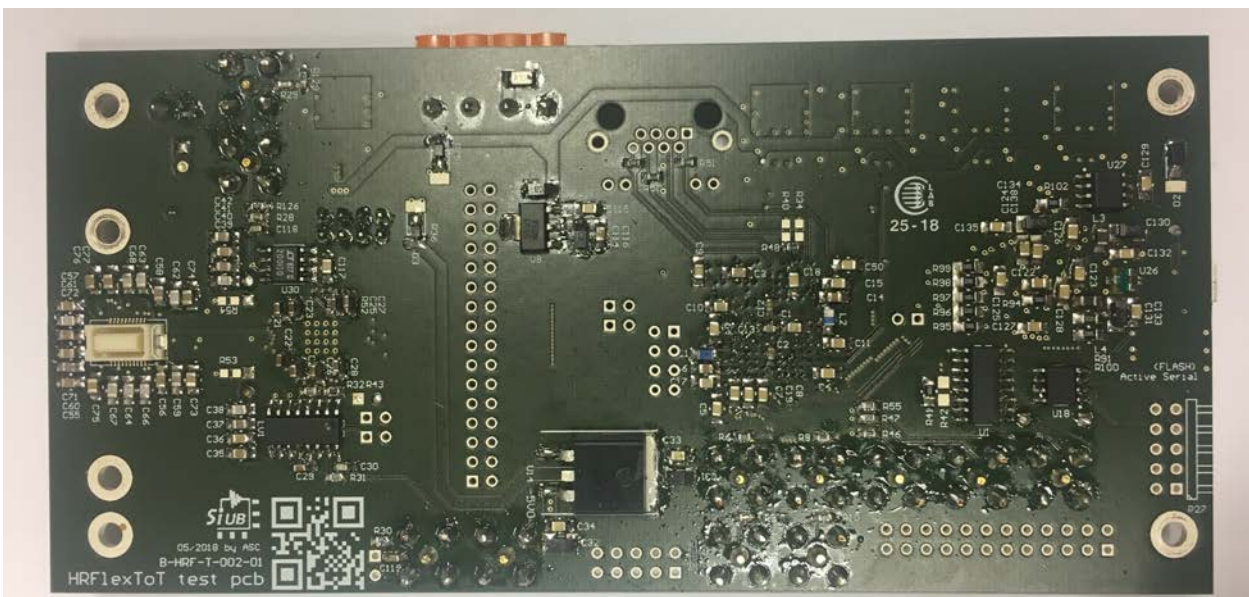


Figure 2: Bottom side of HRFlexToT board.

1.2 External Connector component in the HR FlexToT board

The HRFlexToT board gives the possibility to test 1 single SIPM (pin format) directly to the board, but it also includes an external connector, so the user can employ its own self-custom PCB.

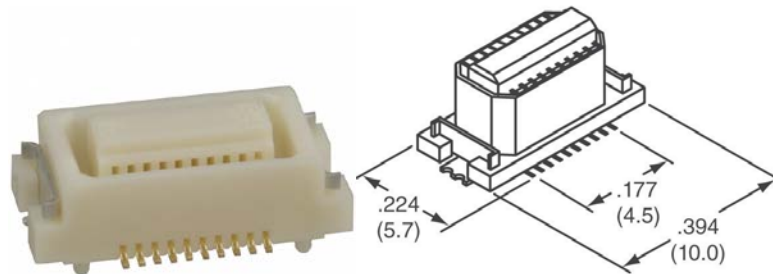


Figure 3: External connector from Hirose

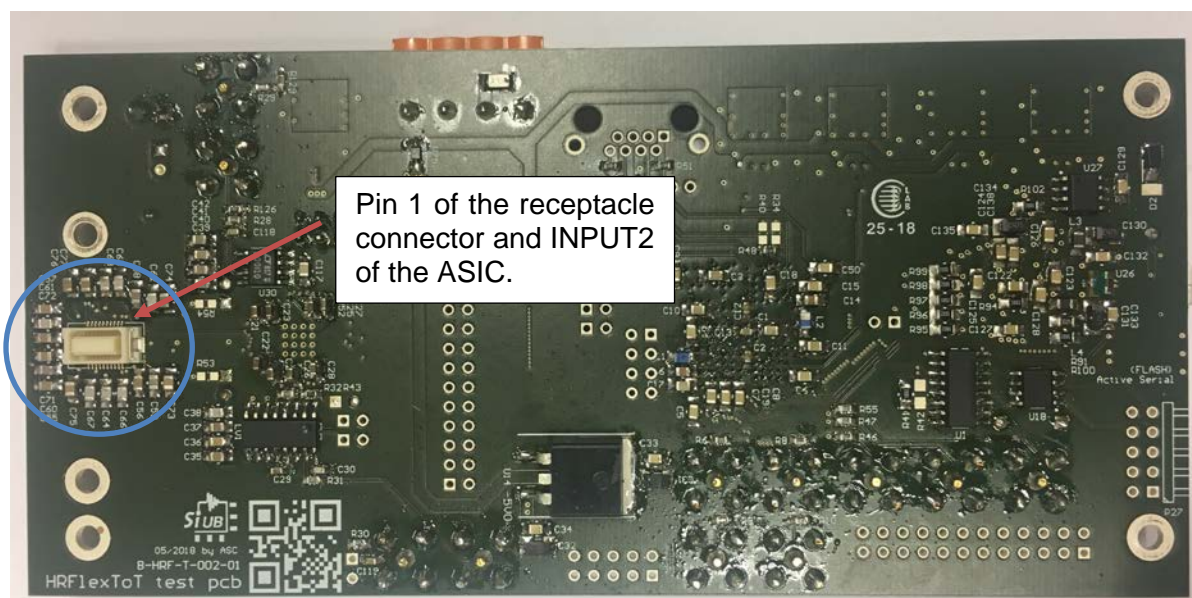
Manufacturer: Hirose

Part Number: DF17(3.0)-20DS-0.5V (57)

Description: Board-To-Board Connector, 0.5 mm, 20 Contacts, **Receptacle**, DF17 Series, Surface Mount, 2 Rows

Example Supplier: <https://www.digikey.com/product-detail/en/hirose-electric-co-ltd/DF17-3.0-20DS-0.5V-57/H11107CT-ND/1036073>

1.3 External Connector location in the HRFlexToT board



1.4 External connector Pin out: Header

Figure 4 shows the pin distribution of the external connector (receptacle) used in the HRFlexToT board. Table 1 shows the signal correspondence between the input channels of the ASIC and the external connector.

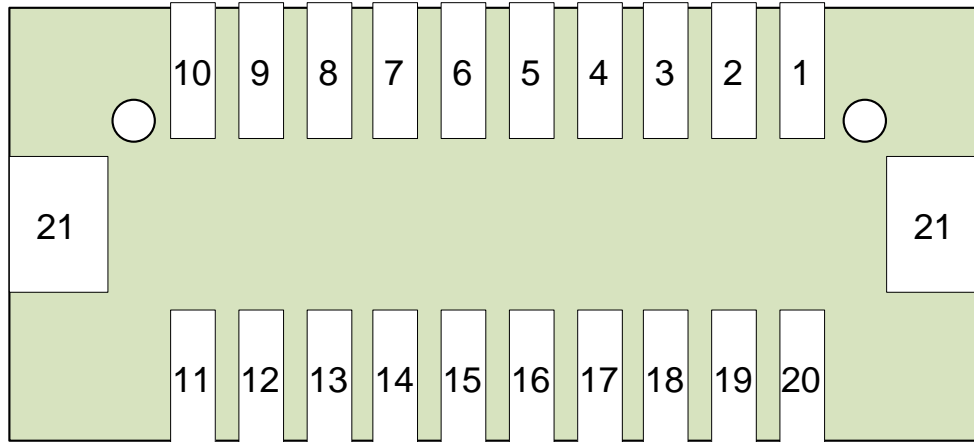


Figure 4: Pin distribution of the receptacle connector used in the HRFlexToT PCB.

Table 1: Signal correspondence between the external connector and the ASIC

Pin	Signal	Pin	Signal
1	INPUT2 (ASIC)	12	INPUT12 (ASIC)
2	INPUT3 (ASIC)	13	INPUT8 (ASIC)
3	INPUT7 (ASIC)	14	INPUT9 (ASIC)
4	INPUT6 (ASIC)	15	GND
5	GND	16	GND
6	GND	17	INPUT5 (ASIC)
7	INPUT10 (ASIC)	18	INPUT4 (ASIC)
8	INPUT11 (ASIC)	19	INPUT0 (ASIC)
9	INPUT15 (ASIC)	20	INPUT1 (ASIC)
10	INPUT14 (ASIC)	21	GND
11	INPUT13 (ASIC)		

1.5 External Connector for the external board

The external PCB that can be coupled to the HRFlexToT board must contain this connector to be placed with the main board.

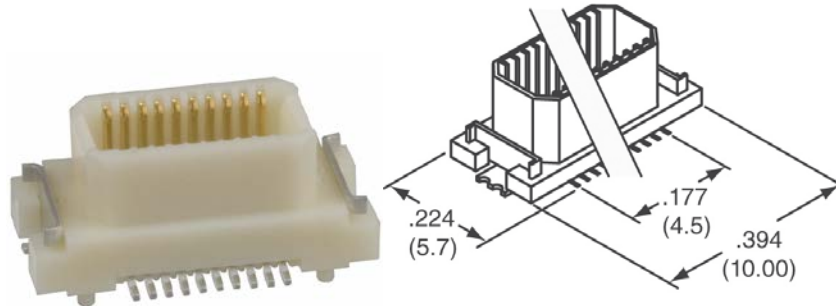


Figure 5: External connector from Hirose

Manufacturer: Hirose

Part Number: DF17(2.0)-20DP-0.5V(57)

Description: Board-To-Board Connector, 0.5 mm, 20 Contacts, **Header**, DF17 Series, Surface Mount, 2 Rows

Example Supplier: <https://www.digikey.com/product-detail/en/hirose-electric-co-ltd/DF17-2.0-20DP-0.5V-57/H11128CT-ND/1036094>

1.6 External Connector location in the external board

As a mode of example, Figure 6 shows an example of a PCB designed to connect externally 16 individual SiPMs. *Observe that pin 1 of the header connector is located in a different location (flipped horizontally compared to the HRFlexToT board) in order to ensure the same pin connectivity between both boards.*

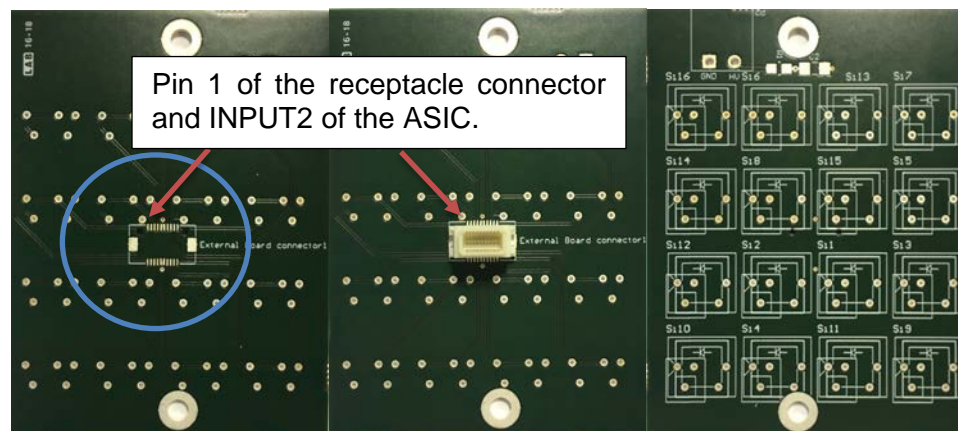


Figure 6: Example of an external board for the connection of 16 individual SiPMs. (left) Bottom side without mounting the external connector; (center): bottom side with the external connector; (right) top side of the external board to connect individual SiPMs (flipped horizontally respect to the bottom side).

1.7 External connector Pin out: Header

Figure 7 shows the pin distribution of the external connector (header) used in the external board for SiPM. Table 1 shows the signal correspondence between the input channels of the ASIC and the external connector. Observe that the pin to signal correspondence is the same as the receptacle header, *but the pin placement in the header is different.*

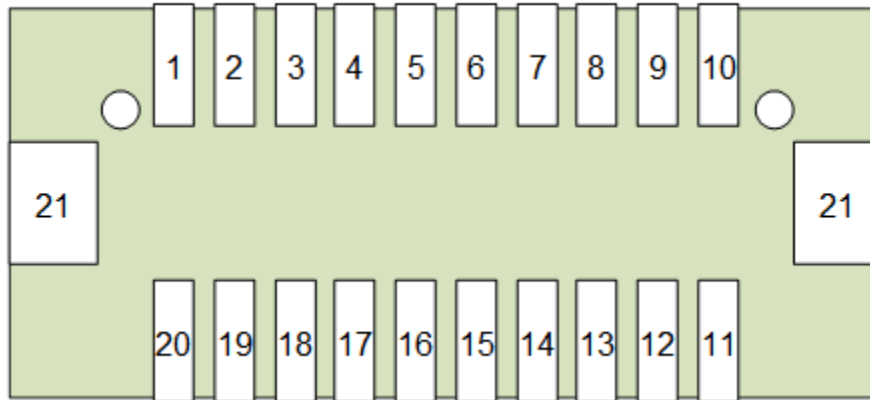


Figure 7: Pin distribution of the header connector used in the HRFlexToT PCB.

1.8 Connection between HRFlexToT board and SiPM external board.

The following examples shows how to connect a SiPM external board to the HRFlexToT board. Note that the external board is flipped horizontally to connect them together.

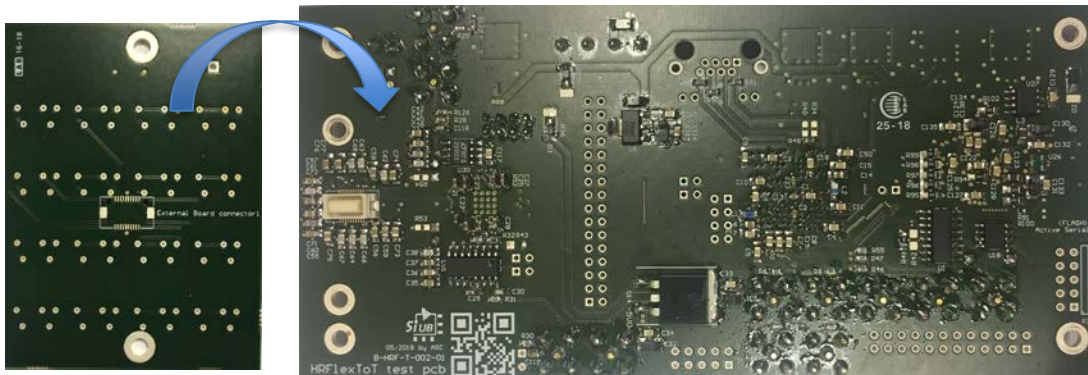


Figure 8: (left) SiPM external board; (right) HRFlexToT board.

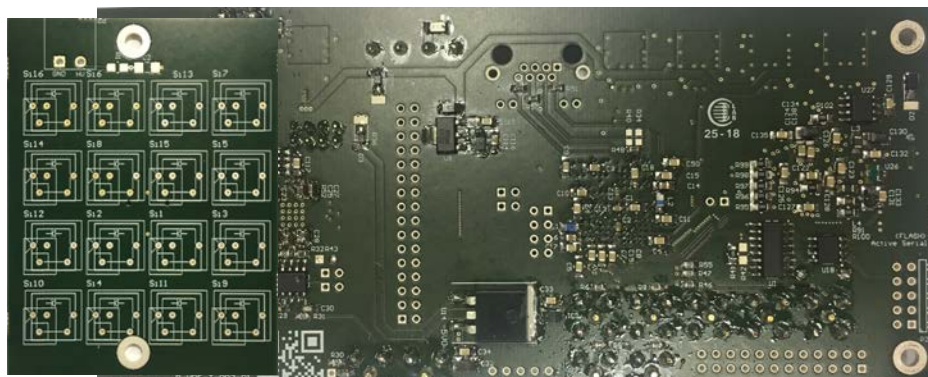


Figure 9: Example of connecting a SiPM external board with the HRFlexToT board

1.9 Subjection of the external SiPM board to the HRFlexToT board

The HRFlexToT board has several holes that can be used to attach an external SiPM board to the main HRFlexToT board. This will ensure a good connectivity and subjection between boards. Please use the measurements show in Figure 10 to design your external SiPM board.

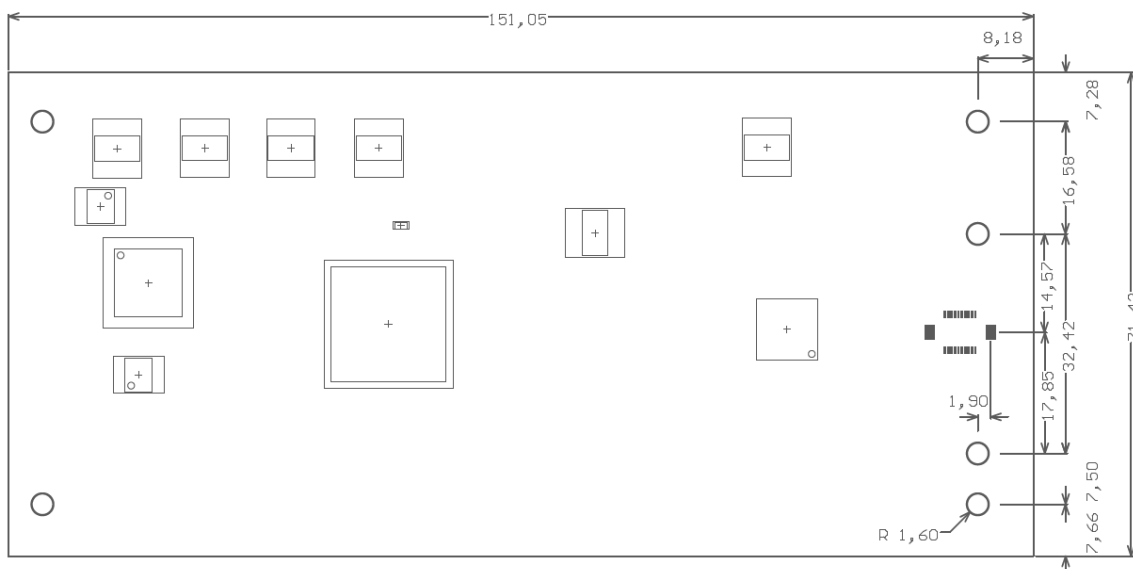


Figure 10: HRFlexToT board (bottom side). Distances from external connector to the different holes available for subjection.

1.10 Considerations for the self-custom PCB board.

Follow these considerations when designing the self-custom PCB board.

- 1) High voltage is not connected through the external connector. Therefore, the external SiPM board requires to have an external connector for High voltage.

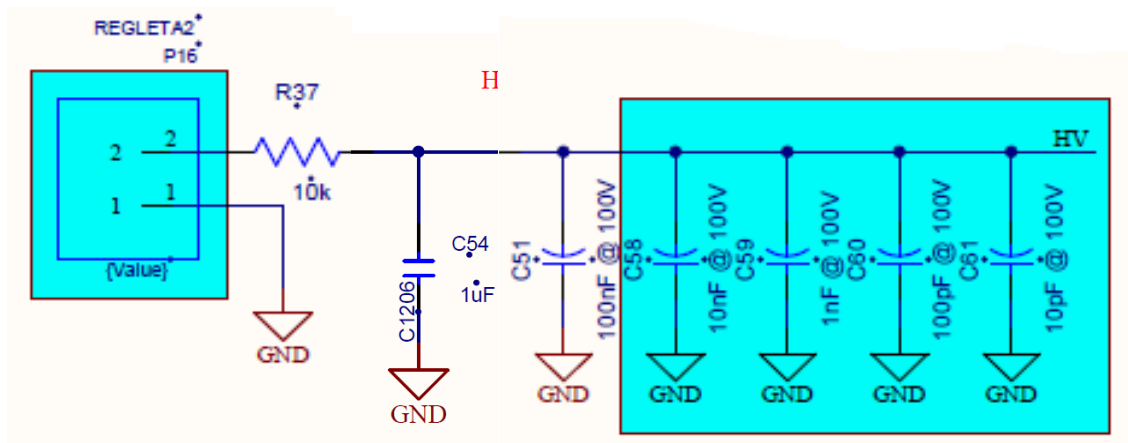


Figure 11: Example of decoupling capacitors connected to the high voltage node of a SiPM to filter noise.

It is important to add after the high voltage connector:

- i) 10K Ohms resistor to limit the maximum current injected to the board. Add these resistor after the connector.
 - ii) A single decoupling capacitor of 1uF that can hold more than the HV injected. Add these capacitor near de connector.
 - iii) Add multiple decoupling capacitors of 100nF, 10nF, 1nF, 100pF, 10pF to filter noise. Add these capacitors as closer as possible to the pin of the SiPM dedicated for HV. As closer to the sensor best filtering you can achieve. Normally, 2-3 capacitors per SiPM will be enough for small arrays. For larger arrays, it must be tested.
- 2) The best method to verify that external SiPM board is working as expected and signal is properly injected is to verify that the time or shaper output are working. Time signal can be directly seen at the output just by switching on the board. The shaper monitoring output can be seen just by enabling the “shaper monitoring” via software (shaper and peak detector uses the same SMA output connector) and by selecting the desired channel to be observed. Observe that the HRFlexToT board only has one shaper output that corresponds to one of the input channels and the user must select the desired channel, in other words, the 16 shaper output are internally multiplexed into a single output. Once this is verified, the user can proceed to evaluate the energy response. Note that, the energy needs a trigger output properly configured to generate the Linear ToT response. Check the User manual for further information about the configuration of the ASIC and its software commands.