

Trigger Board User Manual

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1. Introduction

The trigger board is designed as a handy tool to build a trigger system using single-channel SiPMs. Different types of output signals are provided to users via SMA connectors. An on-board low ripple high voltage DC-DC converter (SIP100) is provided to bias the SiPMs. By tuning the trim potentiometer on board, users can set the SiPM bias voltage from 27V up to 100V with a granularity of $\sim 100\text{mV}$. It is also possible to bias the SiPMs via external power supplies, more details can be found in section 2 of this manual.

A low noise plug-in amplifier (MAN-1LN) is used to amplify the SiPM signal and the output can be directly accessed via the LEMO connector, P5 AMP_OUT.

The amplified SiPM signal is followed by a high-speed comparator, of which the threshold can be tuned via a trim potentiometer. The output of the comparator is accessible via another LEMO connector, P7 CMP_OUT. An optional 100ns fixed-width output of the comparator is also available via the LEMO connector, P9 BUFFER_OUT. Users can choose either of these for their trigger setup. For the SciFi mats/modules QA system, the BUFFER_OUT is used.

There is a simple AND logic gate on-board to build the coincidence between the comparator output and an external input 3.3V-TTL signal. Users can choose whether to use the CMP_OUT or the BUFFER_OUT for the coincidence, by connecting Jumper J1 at the corresponding positions marked on board. For the SciFi mats/modules QA system, the jumper is set to position WIDTH by default, therefore using the BUFFER_OUT.

A fully assembled trigger board is shown in Fig.1.

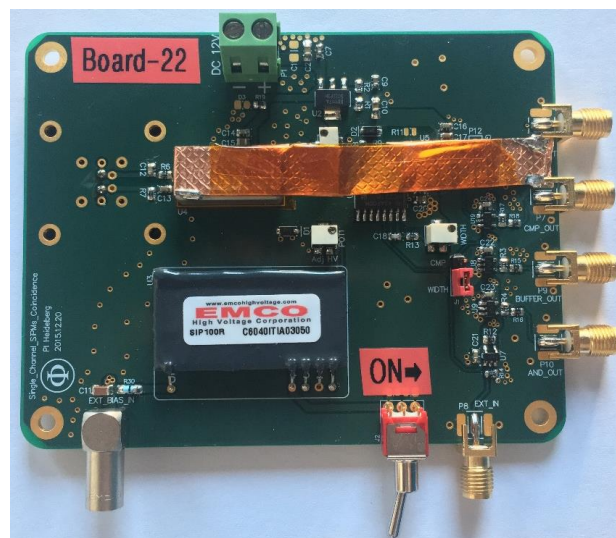


Fig.1. Top view of the trigger board

2. Operation requirements

The Board requires a +12V DC power supply. When you receive the board, please compare it with Fig.1 before power on, make sure there is nothing damaged or missing due to the transportation.

All the input/output signals, trim potentiometers and test points are shown in Fig.2.

The SiPM used on the trigger board is a 3mm×3mm single-channel MPPC with the pixel size of 50μm×50μm (*HAMAMATSU S13360-3050CS*). The breakdown voltage of this type of SiPMs is around 52V, with a spread of about ±500mV. In order to make all trigger boards have the same behaviour, the SiPM bias voltage of each trigger board should be set properly depends on the specific SiPM mounted on board. A recommended bias voltage value for each trigger board can be found in Table 1 in the appendix. **Please recheck this value the first time you receive/use the trigger board, make sure it is set properly, since the trim potentiometer might become loose during the transportation.** The bias voltage can be measured via the two test points shown in Fig.2: the bias voltage test point TP1 and the ground test point TP2. By tuning the corresponding trim potentiometer clockwise, the bias voltage will be reduced.

For the SciFi module/mat QA system, the threshold on the trigger board is normally set to ~70mV, which corresponds to ~3.5photoelectrons. This value should also be checked after you receive the trigger board. The threshold can be measured via the two test points shown in Fig.2: threshold test point TP3 and the ground test point TP4. By tuning the corresponding trim potentiometer clockwise, the threshold will be increased.

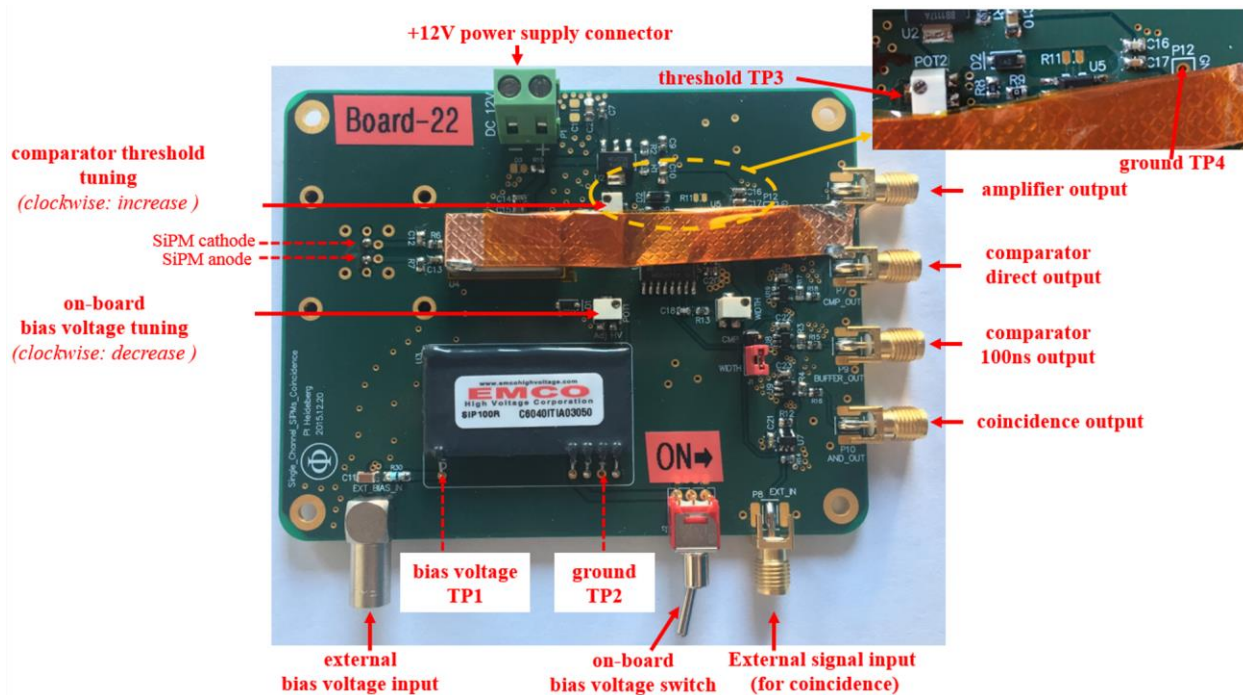


Fig.2. functional blocks and test points on board

3. Signal View

A typical oscilloscope view of the signal outputs of the trigger board is shown in Fig.3. The **blue** waveform is the amplified SiPM signal for a single photoelectron with 50Ω termination. The **cyan** waveform is the CMP_OUT and the **purple** one is the BUFFER_OUT.

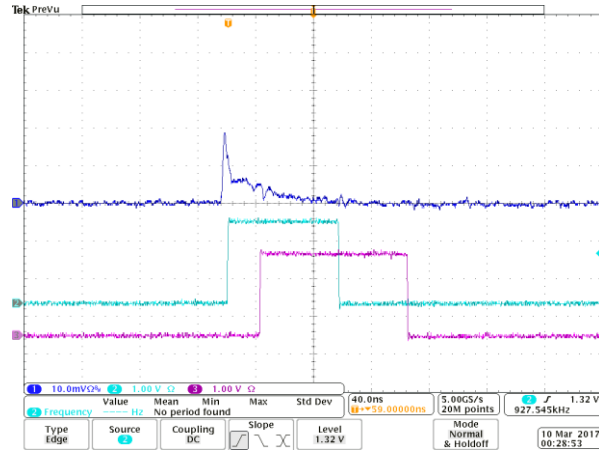


Fig.3. output signals of the trigger board observed on the oscilloscope

4. Appendixes

Tab.1. bias voltage for each trigger board

Trigger Board Number	HAMAMATSU MPPC Serial Number.	Vop Set (V) <i>+4V over-voltage</i>
3	10927	56.3
4	10928	56.0
5	10929	55.9
6	10930	56.0
7	10931	56.2
8	10932	55.8
9	10933	56.0
10	10934	56.1
11	10935	56.1
12	10936	56.2
13	10937	55.7
14	10938	55.6
15	10939	55.4
16	10940	56.3
17	10941	56.1
18	10942	55.7
19	10943	55.9
20	10944	55.9
21	10945	56.0
22	10946	56.4
23	11855	56.3
24	11856	56.0
25	11857	56.6
26	11858	56.2
27	11859	56.3
28	11860	56.1
29	11861	56.6
30	11862	56.3