LumiBelle2 – SuperKEKB IR Access
Belle2
Report v2

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Testing Method for LGAD/Diamond

To test the sensors, we used the setup shown in figure 1 to test them independently of the e-hut. We tested the new LGADs with a Sr-90 source before the access and found them to work well. This setup was bought into the tunnel to quickly test the old detectors that were thought to not be working.

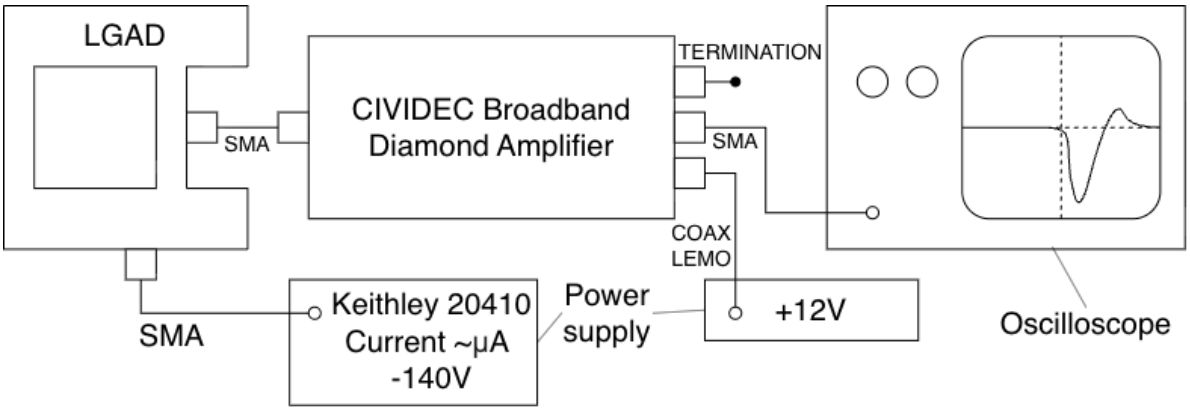

Figure 1 Testing setup for LGAD/Diamond independent of the e-hut power supplies

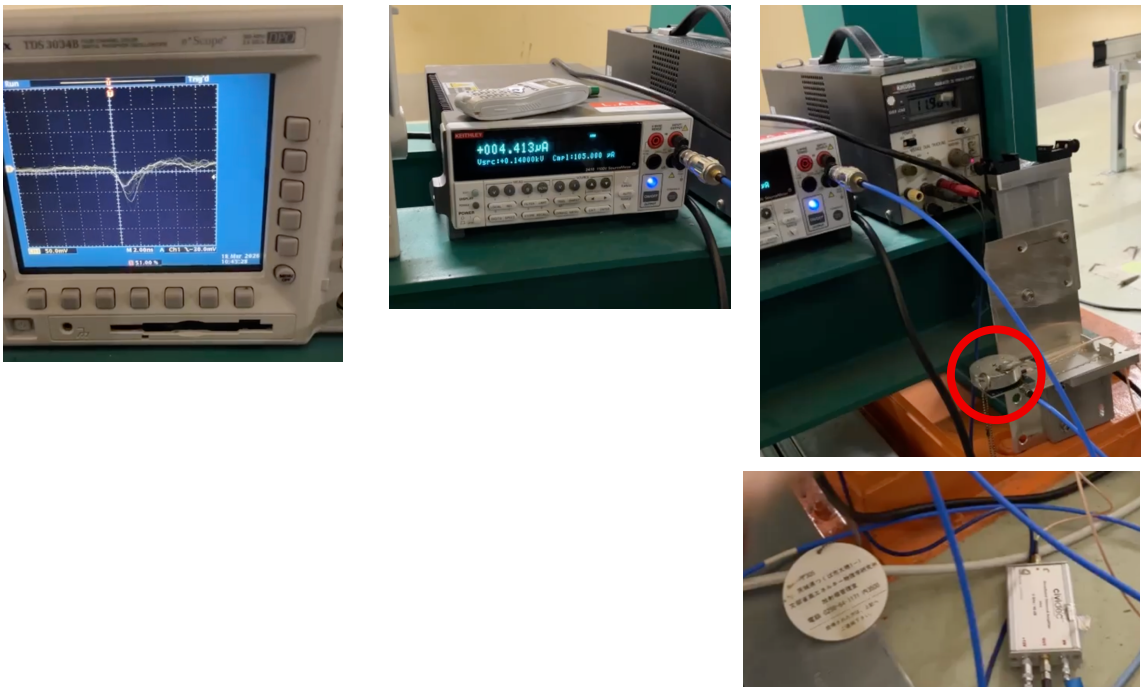

Figure 2 Screenshots from the test video to show the equipment used. The left most image showsteh scope. The middle top shows the power supply for the LGAD (-140V) and is displaying the current, the top right image shows the 12V power supply to the cividec Broadband amplifier (shown in bottom right). The LGAD and the Sr-90 source can be seen at the bottom of the top right image in the red circle. The source is the silver disk and the LGAD is the green square with the blue wire coming out of it.

e-Hut Power Supply

There are two power supplies in the e-hut, one at 12V for the diamond detectors and the top one powers the LGADs/Diamonds. There are two supplies for powering the detectors, left and right. The top left one in figure 2 is reversed (negative output despite positive on screen).

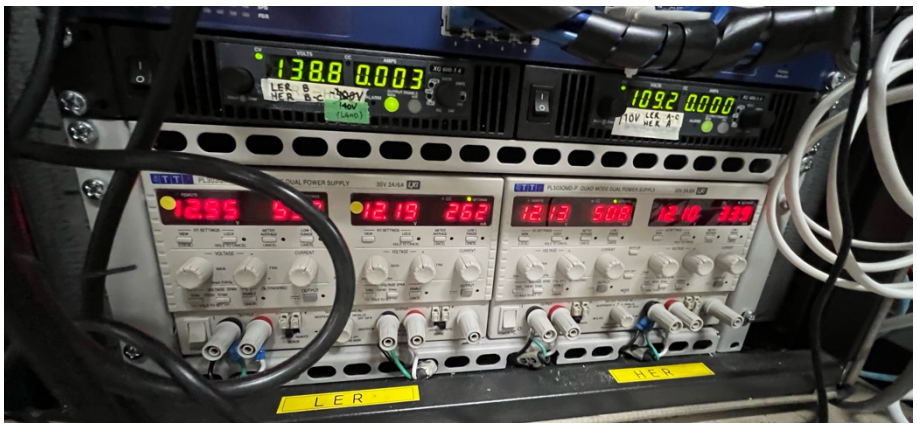

Figure 3 Power supply setup in the ehut. The light grey bottom supply is at 12V for LER and HER for both LGAD and Diamond configurations as it powers the cividec amplifiers at 12V. The thin black power supply powers the LGADs (-140V) Diamond (110V). Note: the left hand side is reversed so a positive 138.8V on the screen corresponds to -138.8V in the tunnel

Verifying power source (From e-hut power supply to tunnel)

To verify the source of the power in the tunnel (from the two supplies in the e-hut), we set each one to a unique low voltage (8v and 4v) and used a voltmeter to verify whether the power in the tunnel was from the left or the right power supply. When testing this, the voltmeter should read a negative output for the left-hand side power supply as it is reversed. For example, 8V on the left and 4V on the black power supplies in figure 3 should read -8V and 4V in the tunnel. The voltmeter on the SMA cable is used with the red on the center pin and the black on the outside.

Stage 1: Access to LER

In Figure 5a, you can see the setup we found at the start of the access. We removed the old LGAD sensors and installed the new ones. We tested them with local power supply for both the 12V for the charge amplifier and the -140V for the LGAD. We used the cividec Broadband Diamond Amplifiers that were there.

The installation of the LGADs can be seen in Figure 5b.

The old LGADs were tested and did not work and were left in the tunnel as radiation levels tested were too high.

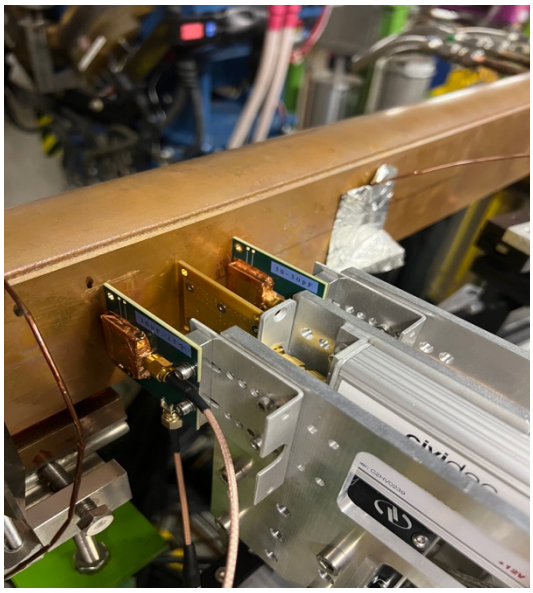

Figure 5a LER At the beginning of the access. (Left to right in image) LGAD (closest to IR), Diamond, LGAD

Figure 5b New LGAD installation on LER. 15 pixel LGAD (left) installed on the IR

Table 1 LER Sensor configuration after access March 2026

Sensor	Position	Power	Output polarity	Inverter	Amplifier
LGAD 15pix	Closest to IR	-140 V	Negative	Yes	Broadband diamond amplifier
Diamond	LER middle	+ 110 V	Positive	No	Broadband diamond amplifier
LGAD 25pix	Furthest from IR	- 140 V	Negative	Yes	Broadband diamond amplifier

Stage 2: Access to HER

The arrangement of the setup on the HER side is 2 sensors mounted, one above the other in (top/bottom). Another sensor can be installed a few meters downstream as shown in figure 6.

Figure 6: (Left) Top/Bottom config with diamond on the top and LGAD on the bottom. (Right) Diamond sensor a few metres downstream.

Table 2 HER Sensor configuration after access March 2026

Sensor	**Position**	**Power**	**Output polarity**	**Inverter**	**Amplifier**
Diamond	Top HER	+ 110 V	Negative	No	Diamond charge amplifier CSA1
Diamond	HER downstream	+ 110 V	Negative	No	Diamond charge amplifier CSA1
LGAD	HER bottom	- 140 V	Negative	Yes	Broadband diamond amplifier

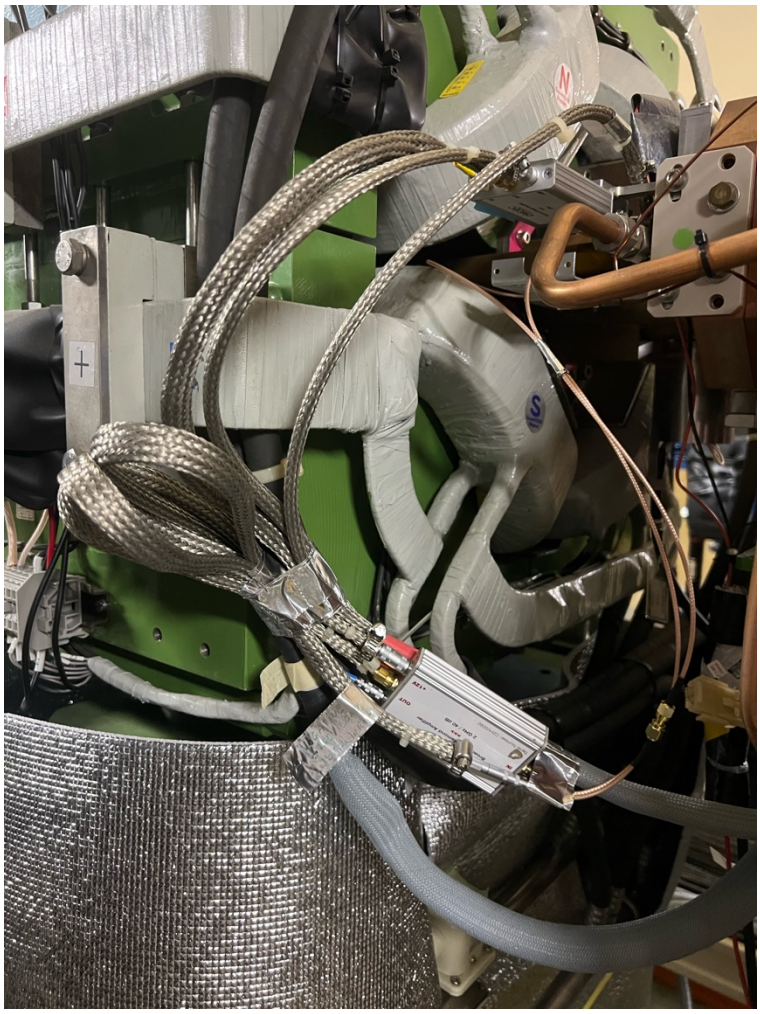

Figure 7 LGAD set up in HER

Testing LGAD on HER side

We tested the LGADs we found on the HER side. These had positive voltage through

We used two power supplies, a 12V to power cividec Broadband Diamond Amplifier and -140V for the LGAD. We used a Sr-90 source to generate signal. The current appears to fluctuate between 1-9 μA (with and without the source). This is different to the stable current we see in the new LGADs.

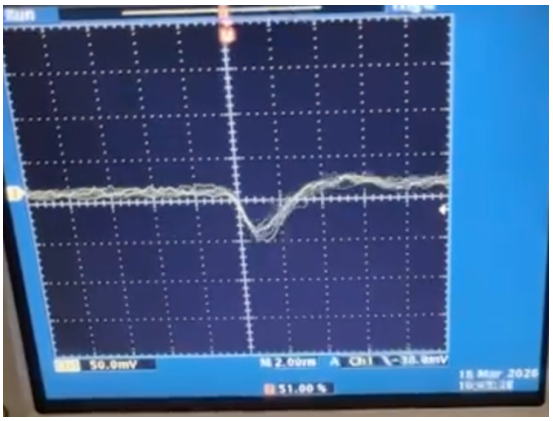

Figure 8 Old LGAD signal on oscilloscope when tested with Sr-90 source

Stage 3: e-hut

Figure 9 e-Hut inverter configuration before (left) and after access day

LGAD 15 LER – Channel 1

LGAD 25 LER – Channel 3

CVD Diamond – Channel 2. Directly positive pulse so bypasses inverters.

The LGADs produce negative pulse so are passed through the inverters. For example, LER 3c passes as a negative pulse into the at point C in the inverter and passes out as a positive from point A (ADC 3).

For the HER side, on both the two LGADs and the Diamond we received a negative pulse. Since there is only one ADC channel left (ADC0) you have to pick which signal to use (ADC 0 is connected to the inverter).