

## Setting Up the Velocity EBSD System for High-Speed Collection

Velocity™ is a high-speed CMOS-based EBSD system. There are two levels of performance available: the Velocity Plus that indexes up to 3,000 patterns per second, and the Velocity Super, which indexes up to 4,500 patterns per second. For this article, we discuss the setup for 3,000 indexed patterns per second, while a future Tips and Tricks will address the higher speeds available with the Velocity Super. As the first CMOS-based detector in the EDAX EBSD product line, there are a few differences in how to set up this system compared to legacy DigiView and Hikari CCD-based systems.

One fundamental difference between CCD and CMOS systems is how camera binning works and the implications it has on EBSD setup. When binning with a CCD system, it combines the accumulated charge for each pixel during the binning process, and then reads it as a single binned pixel. This results in an overall increase in pixel intensity and image transfer speed. In contrast, each pixel with the CMOS system has its own readout electronics. That means the total image can be read out faster than a CCD sensor, but it does not combine the charge prior to the readout. From a practical setup perspective, this also means we do not need as many binning options for the Velocity when compared with CCD-based systems.

For most EBSD mapping applications, we recommend 4 x 4 binning. This provides a 120 x 120-pixel image, which is ideal for the default values of the Hough Transform used for band detection. With this setting, the 16 pixels defined by the 4 x 4 binning setting are averaged to reduce temporal noise, but there is no increase in signal intensity. Also available are 8 x 8 and 16 x 16 binning options, but they do not increase the scanning speeds of the detector and are primarily used for reducing the size of the saved pattern file during dictionary indexing applications with OIM Matrix™.

Another difference between the Velocity series and previous systems is the absence of a camera gain setting. Previously, you could adjust both the exposure time and the camera gain. Camera gain amplifies the camera signal, but also the baseline noise. The resulting amplified image appears brighter, but also noisier. With the Velocity systems, you only adjust the exposure time. As exposure time increases, the image intensity and signal-to-noise level increase, while the camera frame rate decreases. To optimize for the highest speeds, you can modify the exposure time. For 3,000 indexed patterns per second, select an exposure time of 0.27 ms, which produces a frame rate of 3,731 frames per second.

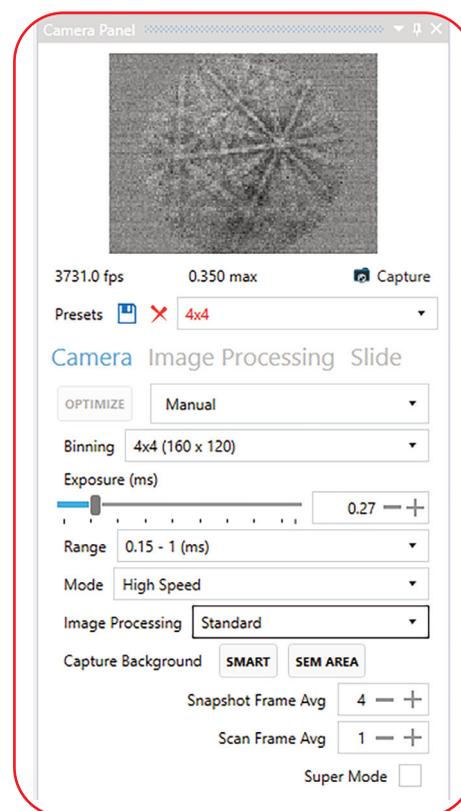


Figure 1. The Camera Panel in the APEX software platform showing Velocity settings for high-speed acquisition.

The final setting for high-speed collection is the Camera Mode setting. This setting has two options: Standard and High-Speed. The maximum speed of the Standard Mode is approximately 2,500 indexed patterns per second, and is often sufficient for many applications. The High-Speed mode improves the data throughput rate, and allows for speeds up to 3,000 indexed points per second.

To summarize, the recommended settings for 3,000 patterns per second indexing are 4 x 4 binning with a 0.27 ms exposure time using the High-Speed mode. After choosing the settings, select a background, plus the Standard Image processing mode. At this stage, evaluate the EBSD image quality and indexing performance. With the Velocity systems, these speeds require at least 10 – 15 nA. If the pattern quality is insufficient for suitable indexing performance, it may require more beam current or improved sample preparation.