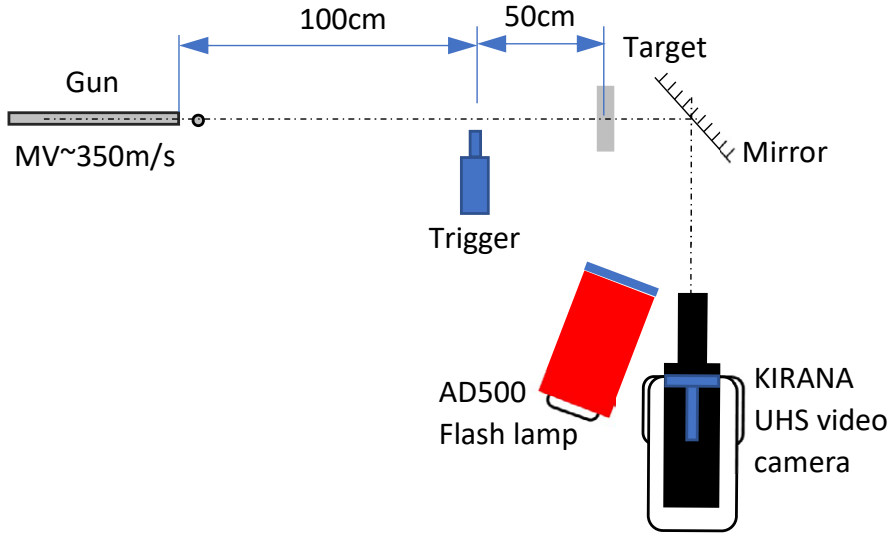
Application note

# No. 18

## KIRANA Features – Built in Velocity Chronograph for accurate Triggering


Accurate and consistent triggering of an Ultra high-speed camera is one crucial element of an experiment. Record durations and events are in the tens of microsecond timescale, so single digit microsecond accuracy is required to make full use of the limited number of images available. Experiments involving ballistic impacts, whether to observe shock waves or crack propagation will be in the order of 100 - 1000m/s, while the areas being observed are on the mm length scale.

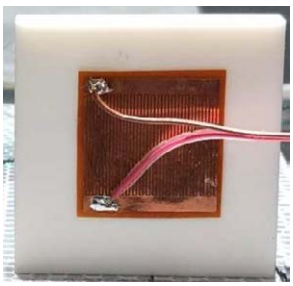
These more critical timing considerations are compounded when the velocities of the projectile are inconsistent. Consider a simple ballistic – back face crack/deformation test below:



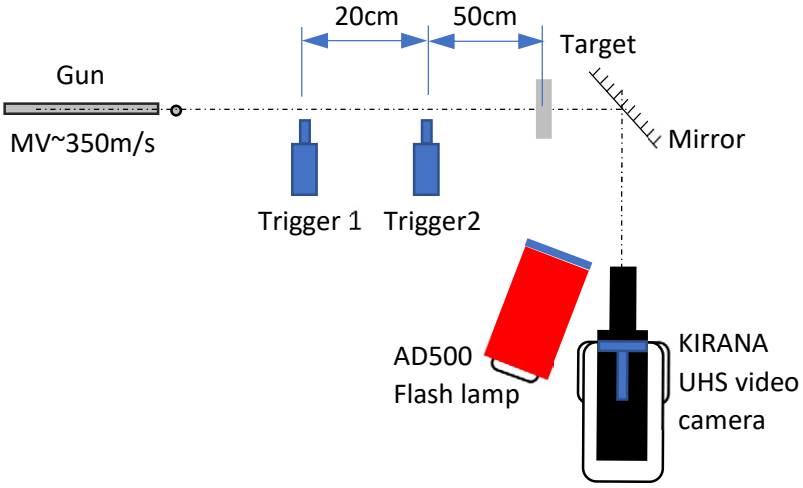

If the nominal muzzle velocity of the projectile is 350m/s varies by 2% (343m/s - 357m/s) the time to travel 50cm between trigger and target could vary from -28.0µs (early) and +29µS (late). This is not a significant problem with a high-speed video camera with seconds of record duration. When using a true ultra high-speed camera such as the KIRANA at a moderate 2Million fps, the fixed number of180 images provides a limited record duration of 90µS. A nominal muzzle velocity of 350m/s and single trigger could mean missing the first 28µs of the event if 2% faster or capturing only the first 61µs of the event if 2% slower. If capturing at 7MHz the 25.7µS record duration could miss the whole event with the same 2% velocity variation.

There are two possible ways to trigger the camera and mitigate the effects of velocity variation.

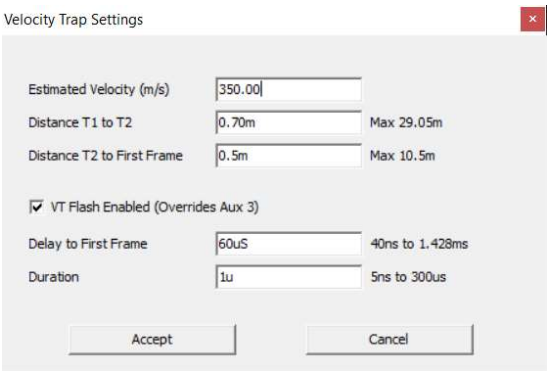
1) Trigger on impact using a contact "make" trigger foils on the front face of the target. However, these:
    a. Prevent the front face being filmed – if required.
    b. Prevent the use of flash lamps, which are typically used with UHS cameras, because they require rise times of up to 100µS to reach full brightness.



2) Using the KIRANA built-in real time velocity calculator and trigger with two timing gates at known distances between the gun and target. The timing gates can be:
    a. Replaceable "make" pins or foils (as above). These are cheap but require replacing after each shot and prone to inconsistency.
    b. Light gates. Consistent but more expensive.




The KIRANA control software Velocity Trap settings window, allows the operator to input the relative distances of the triggers and target. The estimated velocity is added in case one of the triggers fails to work. If a flash is used for illumination the software can adjust the output trigger to the flash and ensure maximum brightness when required.




This standard feature of a built in real time velocity trap provided by the KIRANA camera system significantly reduces the likelihood of missing extremely fast events such as cracking of a ceramic plate or back face deformation of a carbon fibre panel when hit by a projectile of variable velocity.

**UK (Head Office / Factory)**
6 Harvington Park, Pitstone Green Business Park, Pitstone.
LU7 9GX England
**+44 (0) 1442 827728**

**USA**
Specialised Imaging Inc.
40935 County Center Dr. Suite D
Temecula, CA 92591, USA
**+1 951-296-6406**

**GERMANY**
Hauptstr. 10,
82275 Emmering
Germany
**+49 8141 666 89 50**

**specialised-imaging.com** **info@specialised-imaging.com**