

Design and development of V-Sync. Generator Synchronizing CCD camera with an external trigger for acquiring ADITYA plasma images

Institute for Plasma Research, Gandhinagar, India – 382 428

N. C. Patel*, S. M. Ahmed, Vinay Kumar and Aditya team
*e-mail: ncpatel@ipr.res.in

Abstract

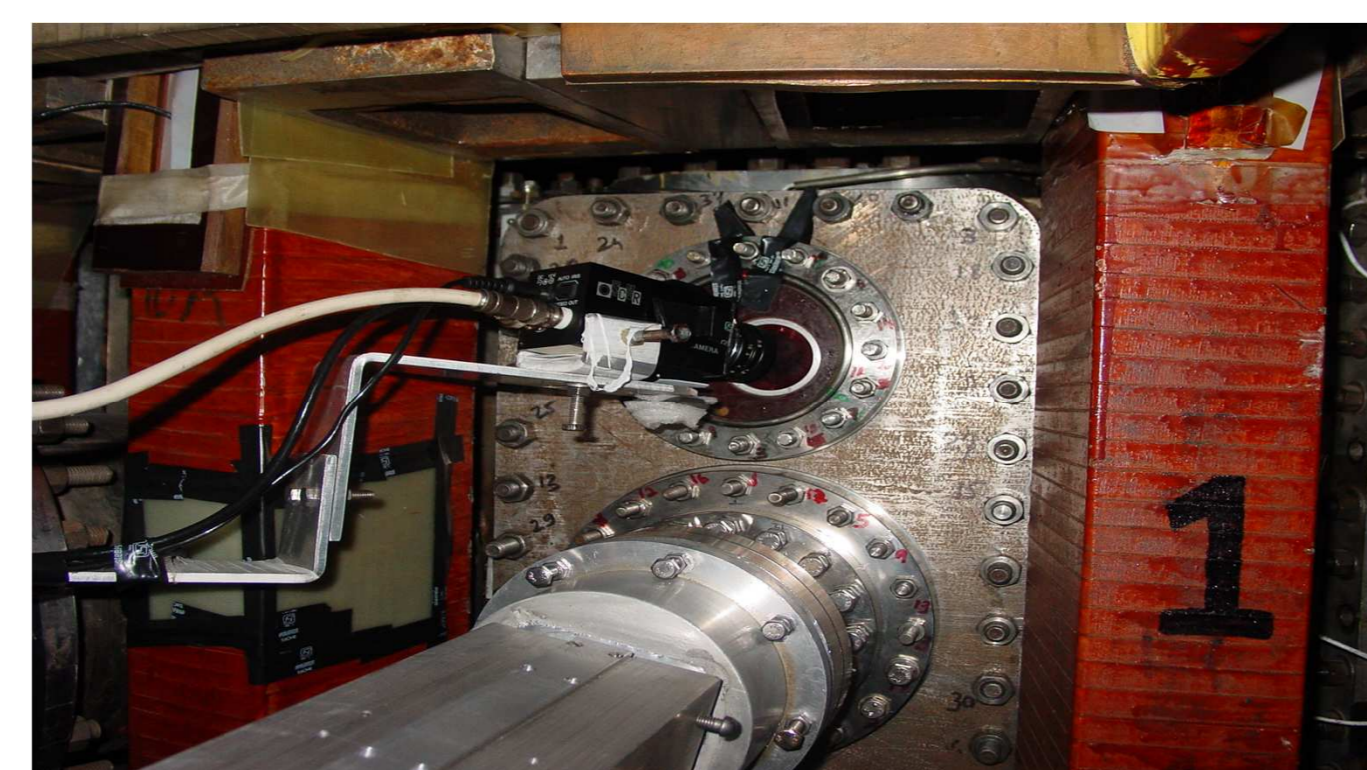
A quick look at the plasma formed in Aditya Tokamak is achieved by an Optical imaging diagnostics. A V-Sync. generator has been designed to get time tag on the video frames.

Recently a CCD based camera system has been installed on the radial port of Aditya Tokamak to view the poloidal cross-section of the plasma encompassed within the limiter. The line of sight chosen for the camera terminates on the limiter ring which offers a good view in front of the limiter. The basic component of this imaging system consist of a commercially available low cost B/W high resolution CCD camera (1/2 inch, interline transfer, 25 frames per second), whose images are stored on a video cassette recorder (VCR) and also on a PC. This diagnostics is capable of providing quick pictures of plasma evolution with temporal resolution of 40 msec.

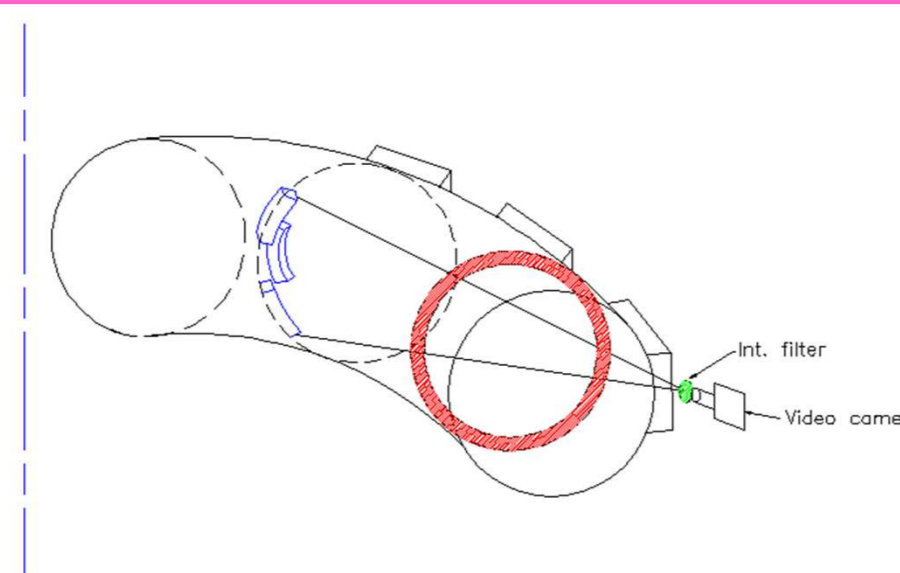
This camera needs to be externally triggered to synchronize with an external event to start the acquisition of images. Basically, starting the acquisition as soon as the plasma formation starts. A pre-trigger TTL pulse is available with a prior time period of -25 ms which is used here in producing a V-sync. for the camera synchronization. Having received the pre-trigger TTL pulse, the developed V-Sync. generator would produce a V-sync. Pulse (burst of 5-pulses). This would eventually give a time stamp on the recorded images of a plasma shot.

A suitable circuit (vertical sync. generator) is designed to synchronize the CCD camera with an external event (Plasma shot) to start the acquisition of images. The circuit has already been tested to verify the Synchronization of the Plasma shot and found to be working satisfactorily. The details of the circuit and its performance are presented.

Experimental Arrangement



Physical location of the CCD Camera on Aditya Tokamak



Schematic of the optical Imaging system on Aditya tokamak



Photograph of the monochrome CCD camera

Camera Details

Camera type: **B & W**

CCD size : 7.95 X 6.45 mm² ; pixels: 795 X 596

Optical

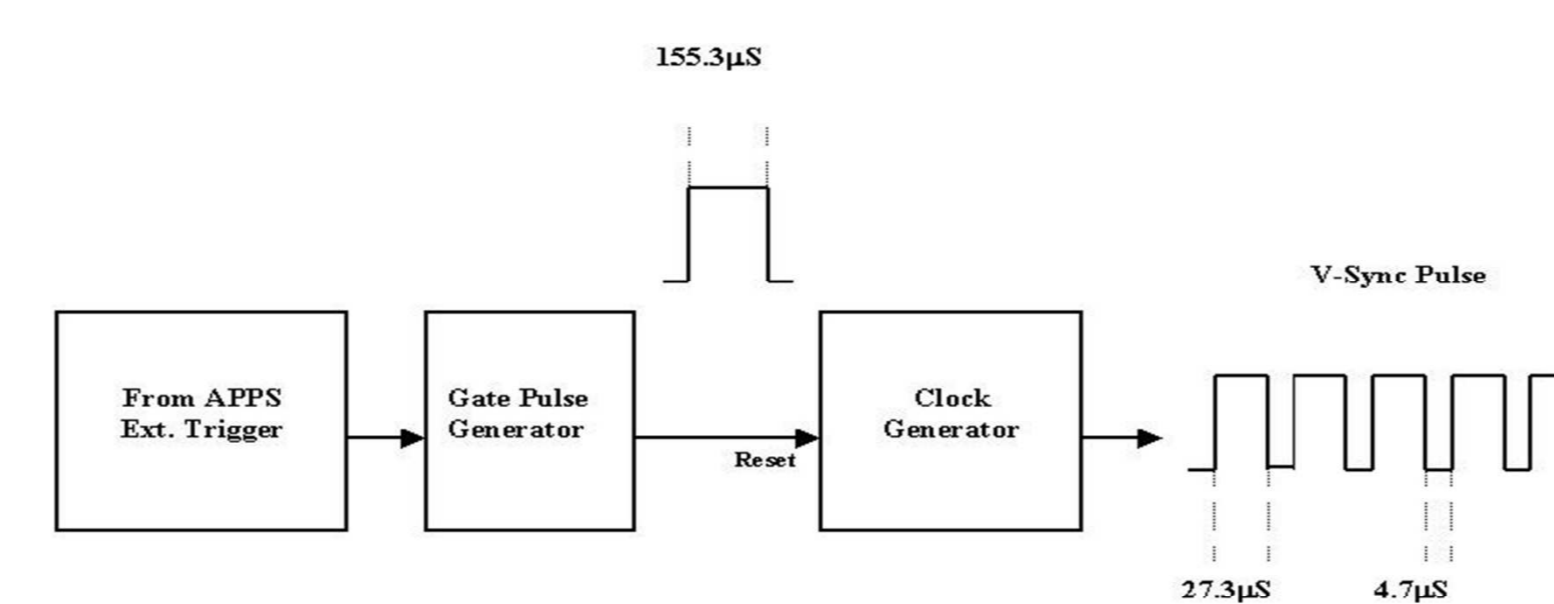
16-mm; Field of View (diagonal) = 28°

Variable aperture f-1.6 to f-16

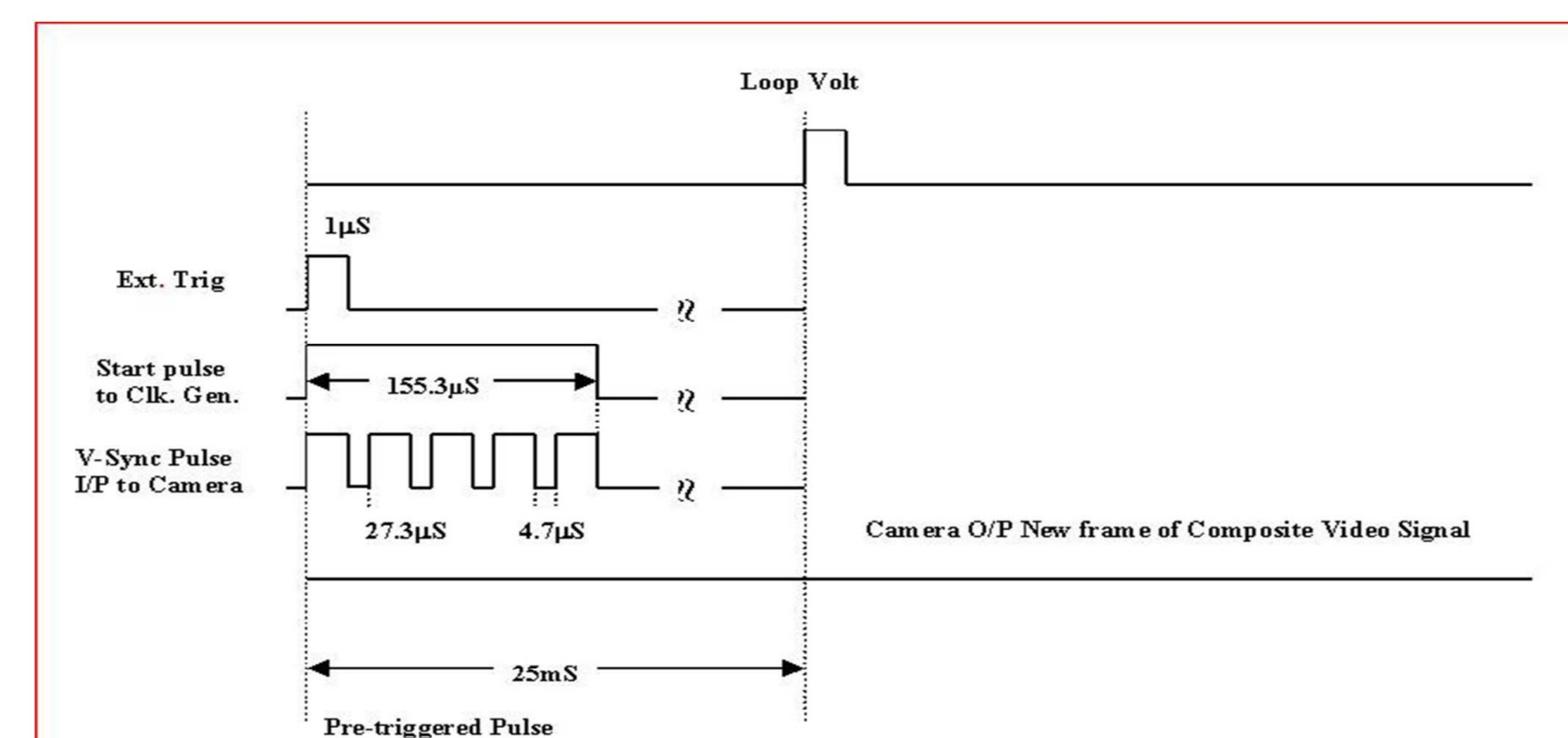
Temporal resolution : 25 frames per sec. (40 ms)

Area covered: 39 cms wide X 28 cms high

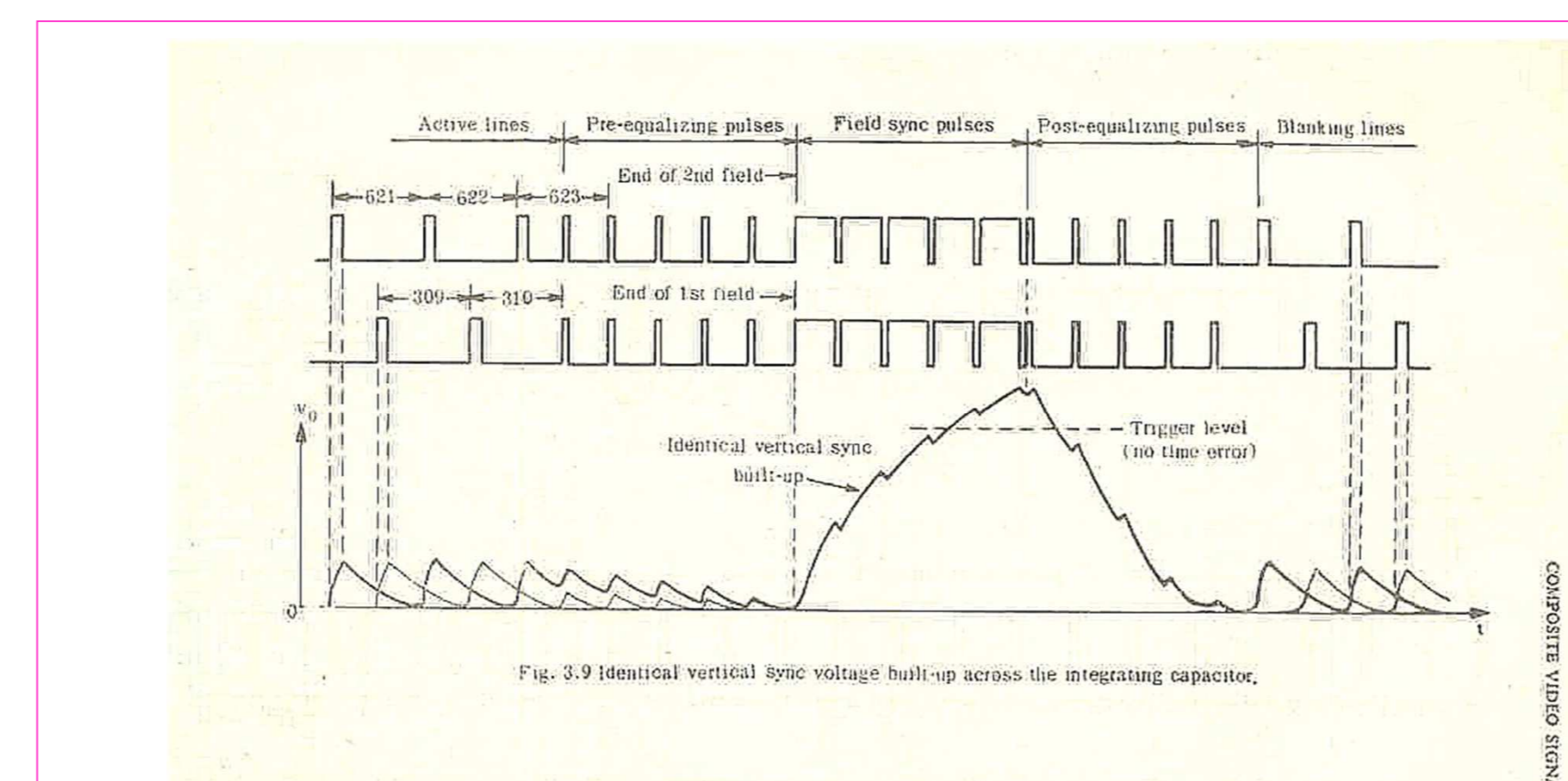
V-Synchronization Pulse Generator



Block Diagram



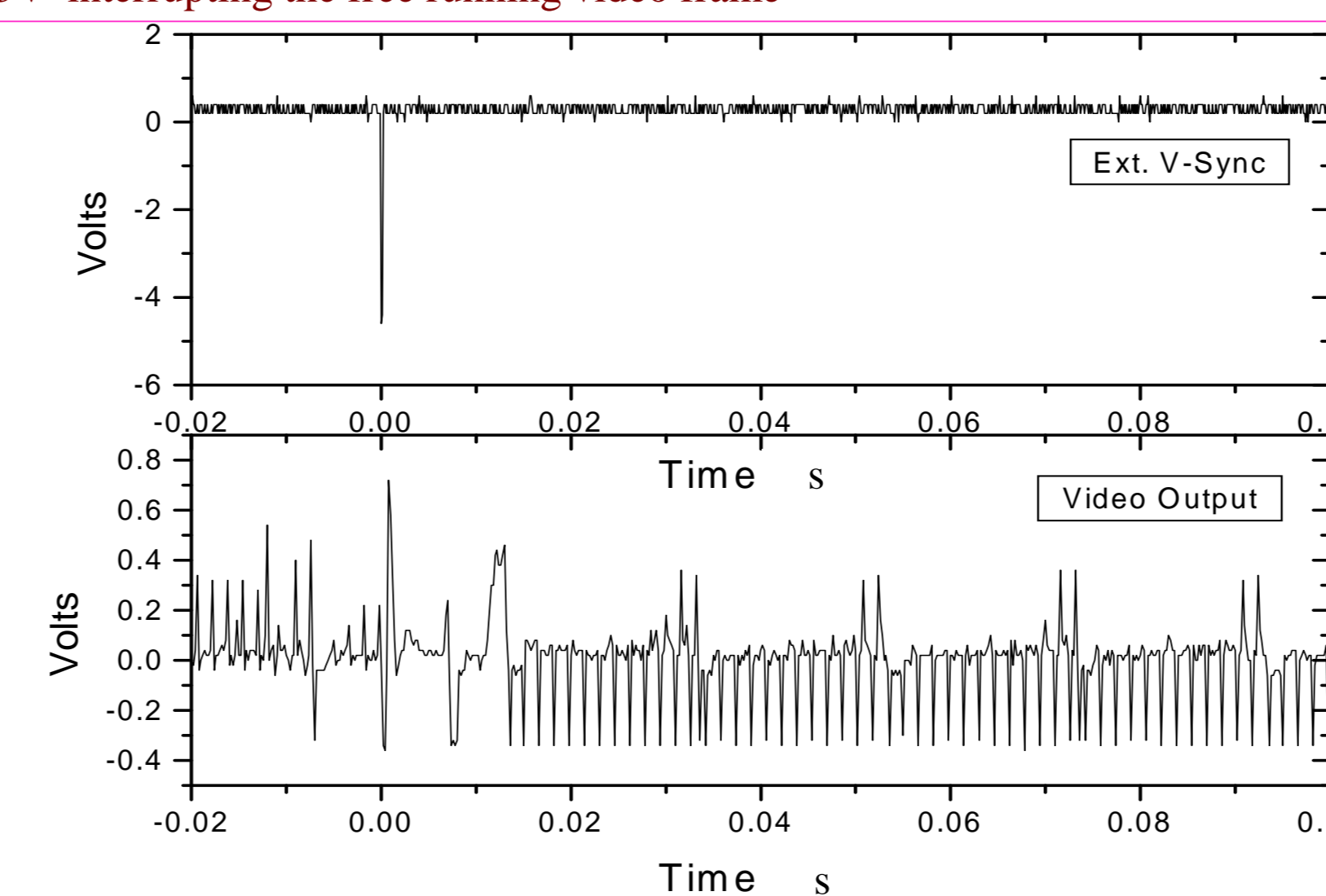
Timing Diagram



•Each video frame comprises of ONE odd and ONE even field (312.5 lines each)

•Vertical sync. Pulse is added at the end of each field (as shown above)

•Figure below shows observed V-Sync. Generator produced 5-pulses of TTL level -5V interrupting the free running video frame

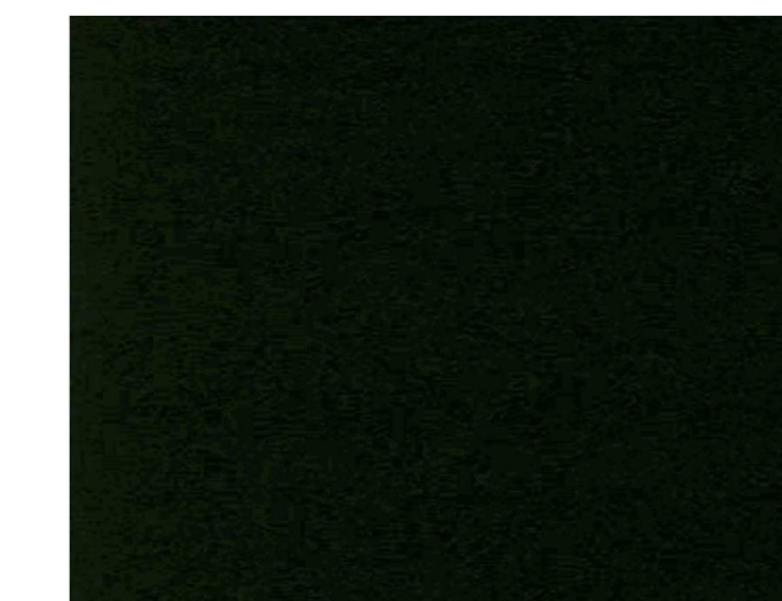


Results

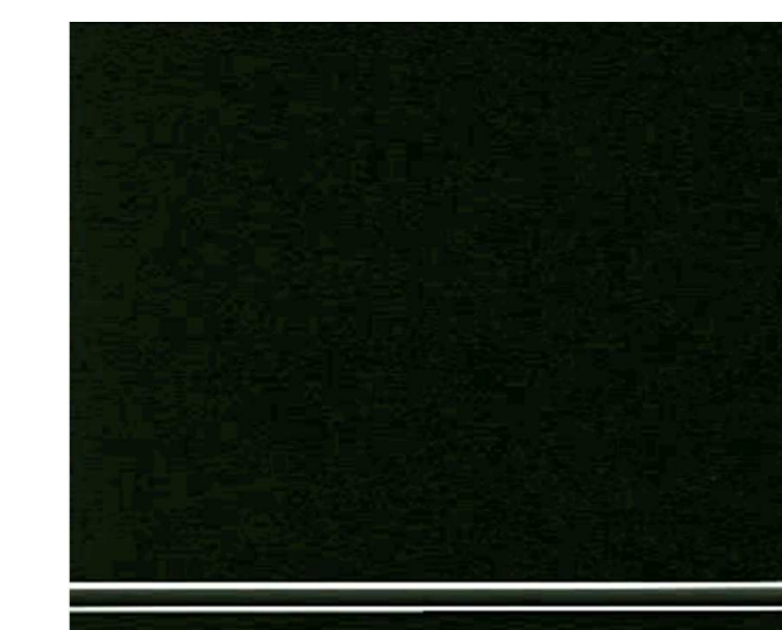
Reference frame taken in normal light illumination



Free running video frame before plasma shot



Demonstration of a break in the video frame due to V-Synch. interruption



Frame#1 (@ ~10 ms) : Evolution of plasma



Frame #2 (~50 ms) : Plasma interaction on top tile



Frame #3 (~90 ms) : Plasma interaction on top tile



Frame #4 (~130 ms) : Plasma interaction spreads to mid plane

