Soft Glue Logic to Control the Tuning Fork Shutter at 8id

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The tuning fork shutter runs at a base frequency of 50Hz where the shutter is open for 10msec and closed 10msec. The shutter can be synchronized with an external clock running at near 50Hz.

The Soft Glue is used to generate this 50Hz clock to the tuning fork shutter as well as providing external triggers to the 480 FCCD camera. In this way the exposures will be synchronized with the shutter.

There is a number of process variables used to control the process of generating a sequence of exposures.

1. Start - A Bi which starts a sequence of exposures when toggled high and low. There is a 1! Input into a buffer with a “start” signal on the output of the buffer. The start signal can be toggled by having a having a spec scrip process the PV with 1! or by pressing return in the box with 1!.
2. Stop - A Bi which is used to abort a sequence of exposures when it is toggled high and low. Like the start input there is a 1! into a buffer with a “stop” signal coming out of the buffer. The stop signal can be toggled by having a spec scrip process the PV with the 1! or by pressing return in the box with the 1!.
3. NumImages – Number of images to take after Start has been toggled

There are a number of output signals which should be connected to the appropriate hardware.

1. Tuning\_Fork\_Shutter\_Input – 50Hz clock with a 50% duty cycle which goes into the tuning fork input.
2. ExtTrg\_To\_FCCD – External triggers that go into the 480 FCCD camera
3. OldSutter\_Input – Goes to a slower shutter and opens it during the series of exposures.

The soft glue uses an internal 8MHz base clock, which is divided by 80,000 to generate a pulse every 100Hz. This pulse is then sent into a D flip-flop which toggles its output states every time there is a pulse. So the output of this D flip-flop provides a 50Hz clock with a 50% duty cycle. This clock is used by the tuning fork shutter to synchronize it’s open/close states.

Before a sequence of exposures is taken a user or SPEC script must set the number of images to be collected by writing a value to the NumImages PV in the glue logic. This number should match the PVs on the detector MEDM screens and the PVs on the image capture MEDM screens. To take a series of images the user or the SPEC script needs to toggle the Start\_In pv. This will initiate a series of trigger pulses that are in sync with the shutter. By monitoring the OldSutter\_Input the SPEC script will know when the series of images is complete.

Initially the external trigger to the 480 FCCD Camera was a gated 50Hz clock with a 50% duty cycle. However the falling edge of the 50Hz clock was also triggering the camera when the exposure time was set to smaller times like 3 msec. After the camera receives an external trigger the trigger is not armed until the end of the exposure time plus the end of the readout time (~6 msec). So for an exposure time of 3 msec the camera would be rearmed during the falling edge of the 50Hz clock. To fix this the external trigger was changed to a 2usec pulse so there is no chance of falling edge bounce retriggering the camera.

It should be noted that there are a number of detector PVs that must be set properly to match the 50Hz cycle time. For example the detector cycle time needs to be set to 20msec, and the exposure delay needs to be set properly to synchronize the shutter with the exposure of the camera. This is done by setting up a scope to look at the exposure out from the camera and the pin diode output in the beamline.

The logic used in the soft glue is shown in the schematic below.



