Getting the right signal amplitude

The density of created e-h pairs by the laser pulse should always be as low as possible (unless the goal of the measurement is studying the occupation probability of deep traps) in order to assure a minimum influence of the non-equilibrium generated carriers to the structure properties. However, the signal should on the other side be large enough for reliable detection. There are several factors which influence the size of the measured signal – induced current:

- Intensity of the light - controlled by laser DAC setting in laser program
- Attenuation of the light by neutral density filters NFD – various filters are available of different attenuation and more can be used together to achieve the desired attenuation
- Iris setting (note that iris setting may affect the focusing performance)
- Amplification of the amplifier (note that the nominal application can be reduced by lowering the amplifier bias voltage)

There is a distinct difference between the light of short and long penetration depth. While for the former the way of using the TCT (edge, top) is not crucial for the amplitude of the measured signal, the opposite is true for the latter. In this case the size of the sensitive electrode and the length of the beam path underneath the sensitive electrode play a crucial role.

The latter cases require huge dynamic range of the system to cover all the possible uses. All of the above settings can be used to control the amplitude of the measured signal. This is even more so if the digitizing board/oscilloscope has a limited ADC conversion range (e.g. DRS board +/-0.5 V) or if the saturation of the amplifier limits the available range of the digitizing board/oscilloscope.

The combined use of the above setting results in dynamic range of :

- ~20x intensity of light
- ~10x NDF (multiple NFDs with different attenuation can acquired)
- ~10x amplification of the amplifier
- optimum iris setting for best focusing performance allow corrections which do not affect ball park of the dynamic range

at least 2000. That is sufficient to cover all the possible applications (known to us) of the TCT.

What is the best method to reduce the signal?

In order to have as short signal as possible the reduction of light intensity is inherently reached. As long as the laser performance is stable reduction of the light intensity by making the pulse shorter is the best way. If the signal is still too high use the NDF to largest possible extent. If focusing performance is not an issue you can also close the iris. In the end you can reduce the bias of the amplifier.

What is the best method to increase the signal?

Increase the DAC parameter of the laser setting. It will make the signal wider, but for a large portion of the settings the current pulses are short enough for most applications. Do not use any filter and open the iris to the level where it doesn't spoil the required focusing performance. Use the nominal bias setting of the amplifier.