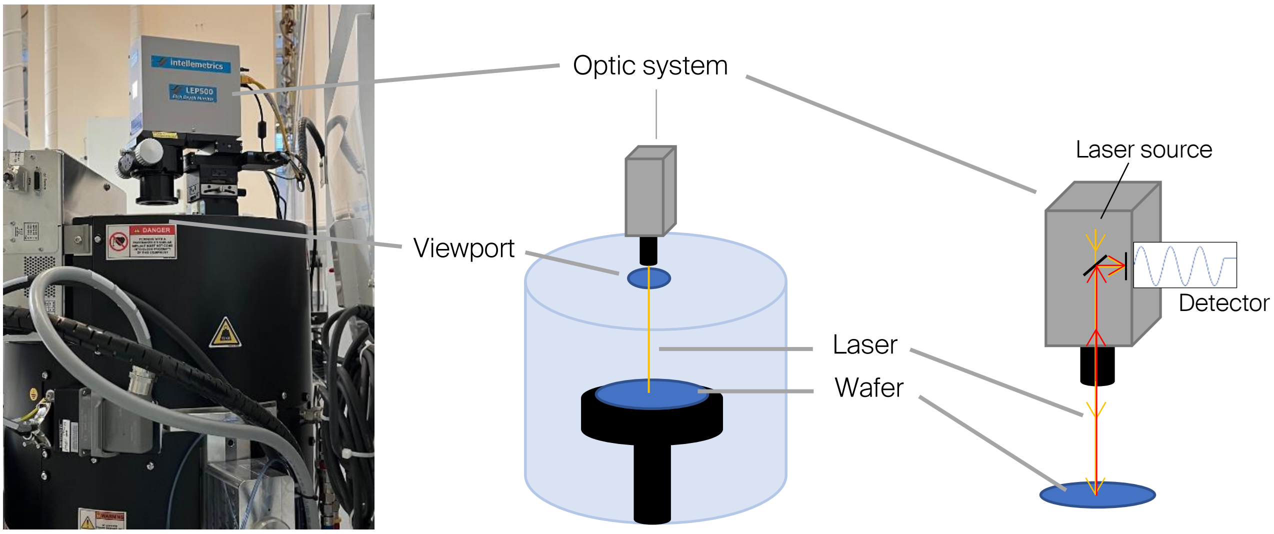
# Laser end point detection manual on Synapse and APS

## Theory behind it

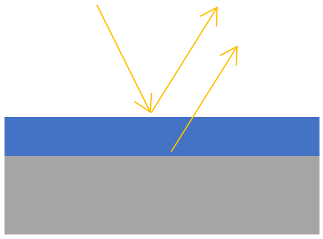


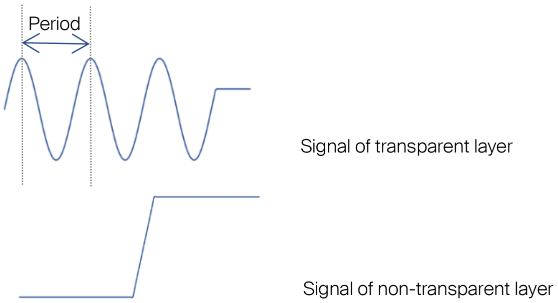
This end point detection uses interferometry or reflectometry to track the etch depth and etch rate of the sample.

Interferometry: a part of the laser will be reflected on the surface while the other is penetrating the material and will be reflected on the next layer. Both rays will interfere in a constructive or destructive manner, creating a sinusoid signal on a graph.

Reflectometry: if the material is not transparent (metals for example), no interference will occur and the graph will show a flat line (proportional to the reflected light intensity).

No matter whether your material is transparent or not, the end of the layer can be detected in the real-time graph due to any variation in the signal (such as a change in reflection intensity or a change in the signal's periodicity).





Thanks to the period of the signal and the refractive index of the material, one can determine the material's etch rate following:

$$ER\ [nm/s] = \frac{\frac{\lambda}{2*n}[nm]}{P\ \ [s]},$$

where λ is the wavelength in nm (APS and Synapse λ=670[nm], Rapier λ=980[nm]),
n is the refractive index ($SiO_2$ at 670[nm], n = 1.45; $SiO_2$ at 980[nm], n = 1.45),
and P is the period of the signal.

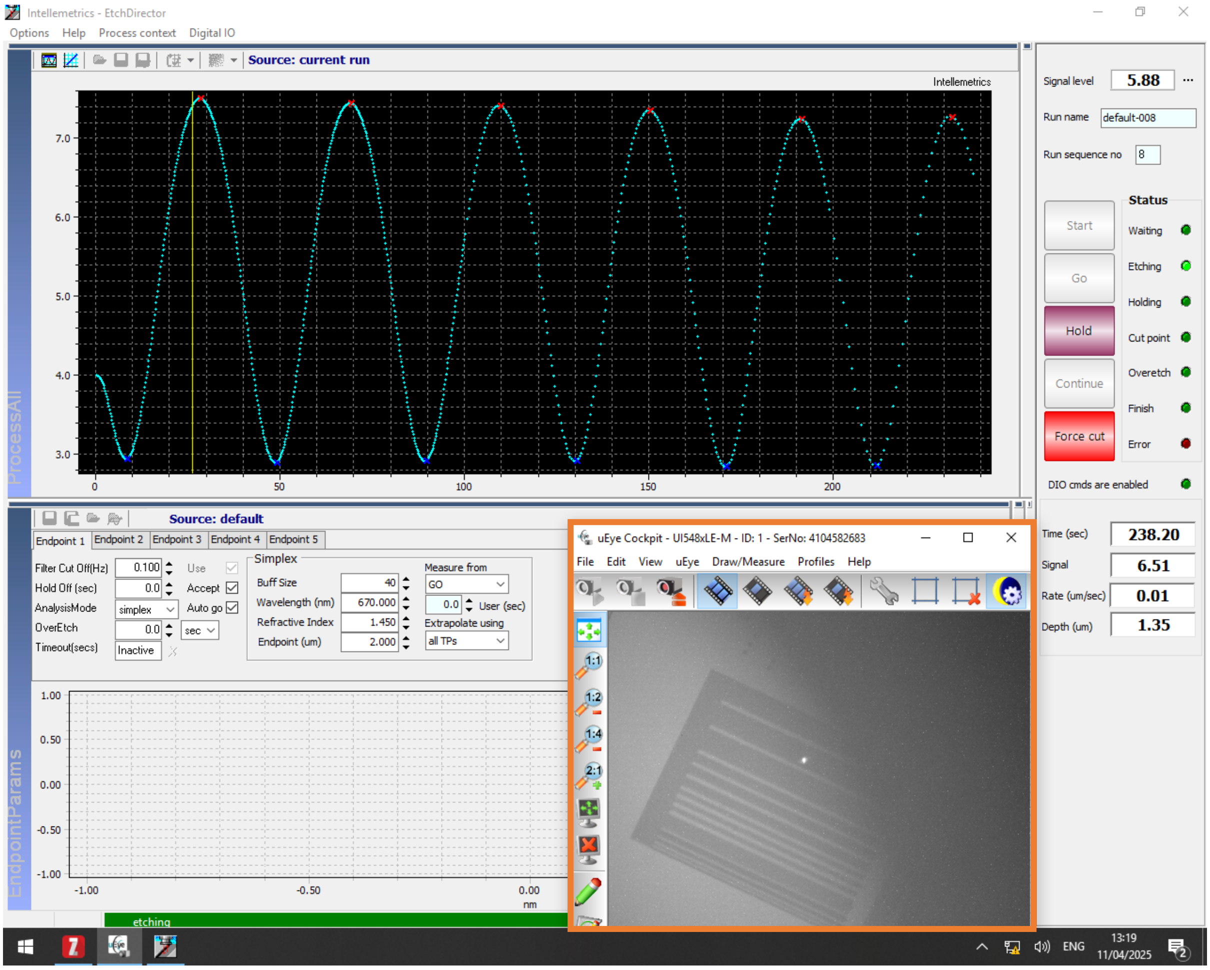
# User manual

Two different windows are used to take your measurements:

- Vision system (uEye Cockpit)
- EtchDirector

## uEye Cockpit

The first step is to position the laser spot on the substrate at the location where you want to obtain the signal information. On the uEye Cockpit, the laser spot is found in the middle on the screen. Use the joystick to align the laser with the area of the wafer of interest.



Signal level: 5.88
Run name: default-008
Run sequence no: 8

Filter Cut Off(Hz): 0.100
Use: ☑
Hold Off (sec): 0.0
Accept: ☑
AnalysisMode: simplex
Auto go: ☑
OverEtch: 0.0 sec
Timeout(secs): Inactive

Buff Size: 40
Wavelength (nm): 670.000
Refractive Index: 1.450
Endpoint (um): 2.000
Measure from: GO
User (sec): 0.0
Extrapolate using: all TPs

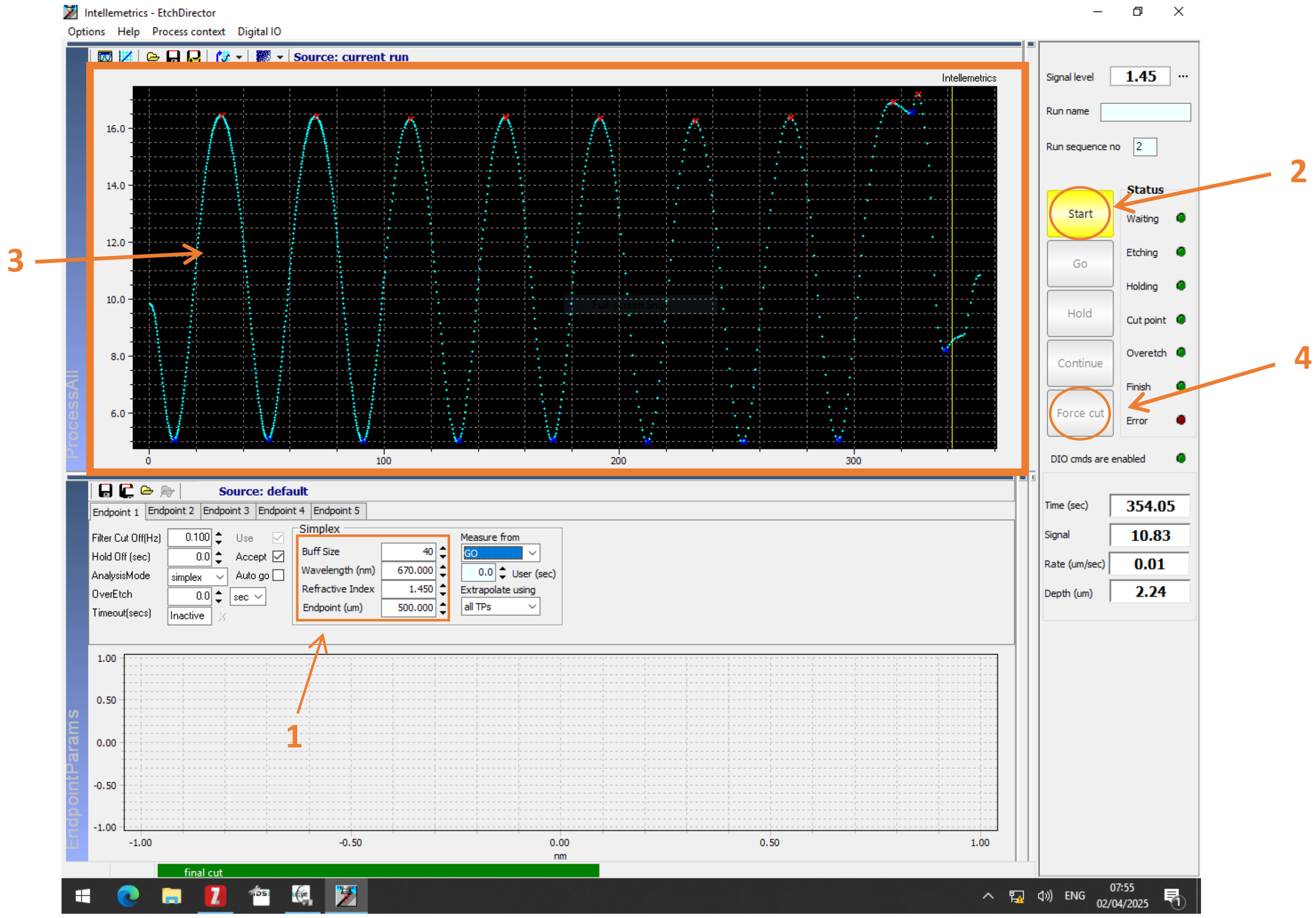
Time (sec): 238.20
Signal: 6.51
Rate (um/sec): 0.01
Depth (um): 1.35

## EtchDirector

Once the laser is aligned with your wafer, use EtchDirector to control your etching process.

The software presents different sub-windows:

- On the top, the ProcessAll window displays the real time signal of your etching process.
- On the bottom, the EndpointParams, is used to enter the material's parameters, especially the refractive index.



Filter Cut Off(Hz) 0.100
Use ☑
Hold Off (sec) 0.0
Accept ☑
AnalysisMode simplex
Auto go ☐
OverEtch 0.0 sec
Timeout(secs) Inactive

Buff Size 40
Wavelength (nm) 670.000
Refractive Index 1.450
Endpoint (um) 500.000

Measure from GO
0.0 User (sec)
Extrapolate using all TPs

Signal level 1.45
Run name
Run sequence no 2

Time (sec) 354.05
Signal 10.83
Rate (um/sec) 0.01
Depth (um) 2.24

Step by step user manual:

1. Enter your end point data (refractive index).
2. Press on **Start** before the beginning of the etching step to initiate the graph.
3. Observe your graph. When your signal changes, it means that the present layer has been etched.
4. When the etching is done, press on **Force cut**. If you want to end the etching process sooner than planned, you should end it on the tool's software. <u>The computers are not connected</u>!!

To save your data, right click on the graph. You can choose if you want to save your graph in .csv or in .bmp.