Plasma Diagnostics
Technical Information Sheet 534

ESP*ION* Advanced Langmuir Probe

Pulsed Plasma operation with Hiden's ESP*ION* Langmuir Probe

Summary

ESP*ION* headline specifications for pulsed plasmas:

- Plasma modulation frequency up to **3 MHz**
- Gating pulse resolution (T2) **down to 62.5 nanoseconds**

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ESP*ION* can be used to study repetitive transients in plasma afterglow. Plasma parameters can be determined at a specific point, or in a specified time window, synchronised to the transients.

For repetitive events, edge triggering allows a true event/time surface to be acquired. An unsynchronised scan will record an average of a time varying event over the period of the scan, and under certain circumstances, where the event rate of change is comparable to or faster than the scan rate for example, this can be grossly distorted. To accurately characterise such events, data acquisition must be synchronised to the event with a variable time delay from the event start to allow time slices to be taken through the required lifetime.

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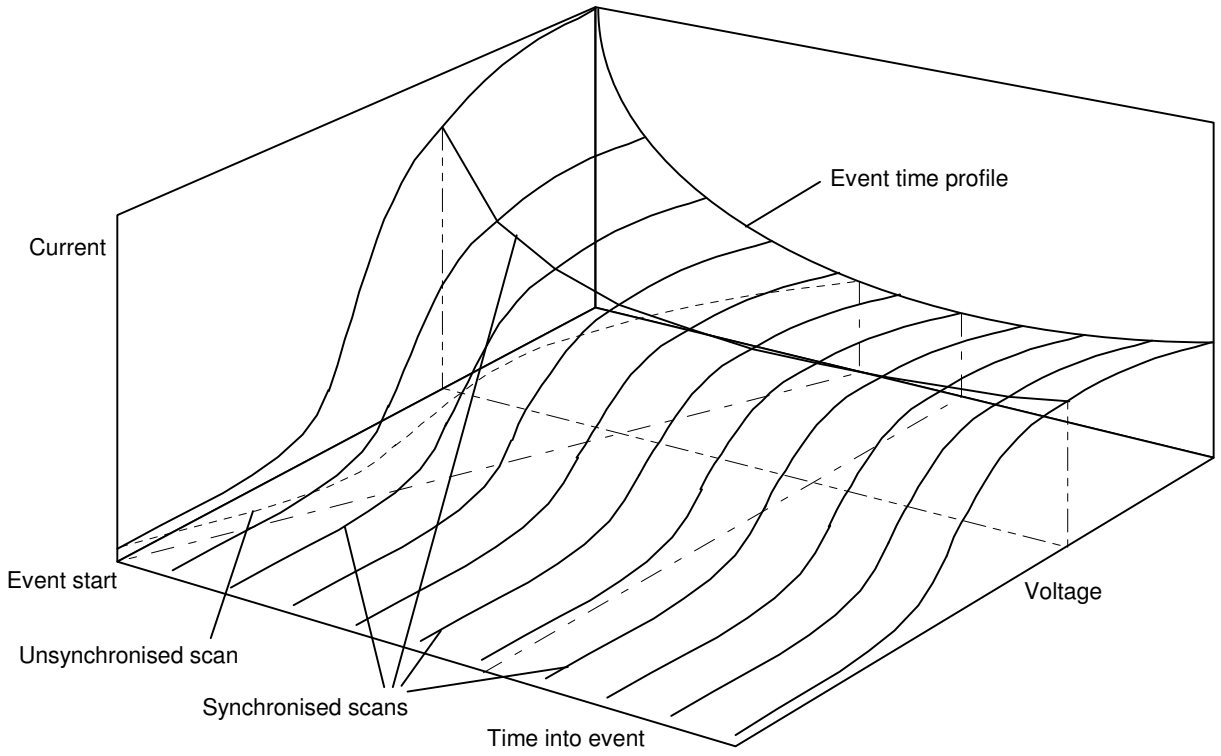
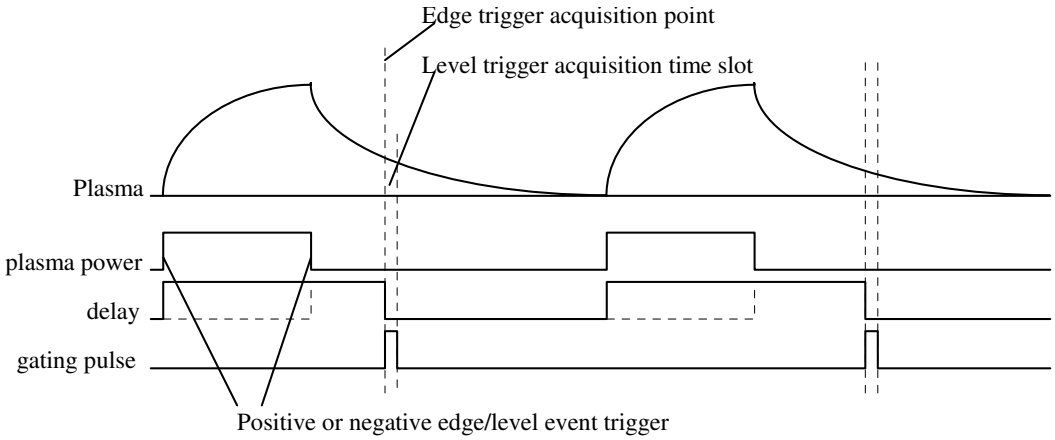


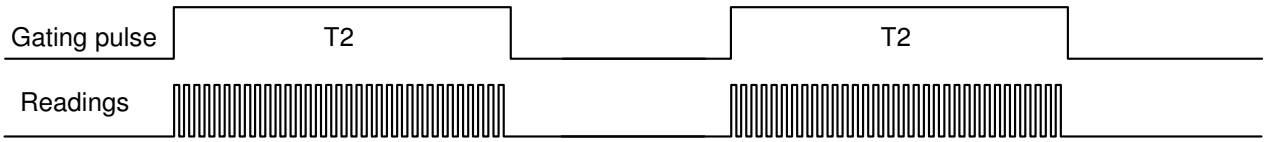
Data acquisition surface

When used in triggered mode, data acquisition may be synchronised to external events by using a TTL level signal. Two modes are supported, edge and level trigger, and both may be either positive or negative polarity edges or signals.



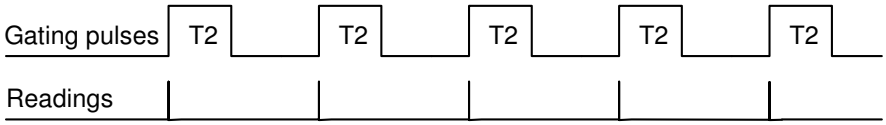
Event synchronisation

For level trigger operation, acquisition will occur when the gating pulse is “on” (either positive or negative level).



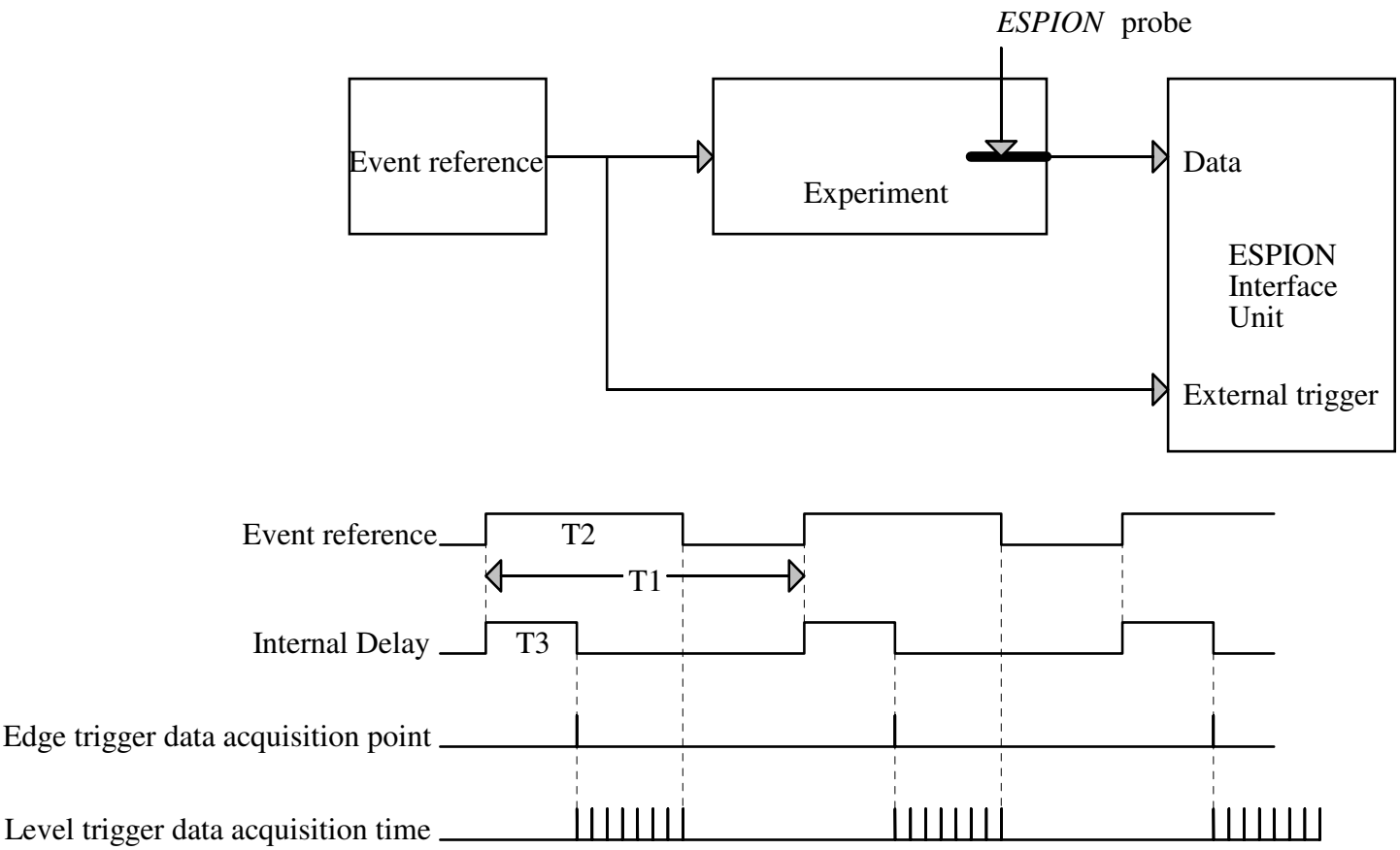
Level trigger operation

In edge trigger mode, one data point is acquired for each edge (positive or negative going) of the trigger signal.



Edge trigger operation

Both trigger modes allow acquisition to be synchronised with the events, but edge trigger provides the highest timing accuracy.



Experimental set up

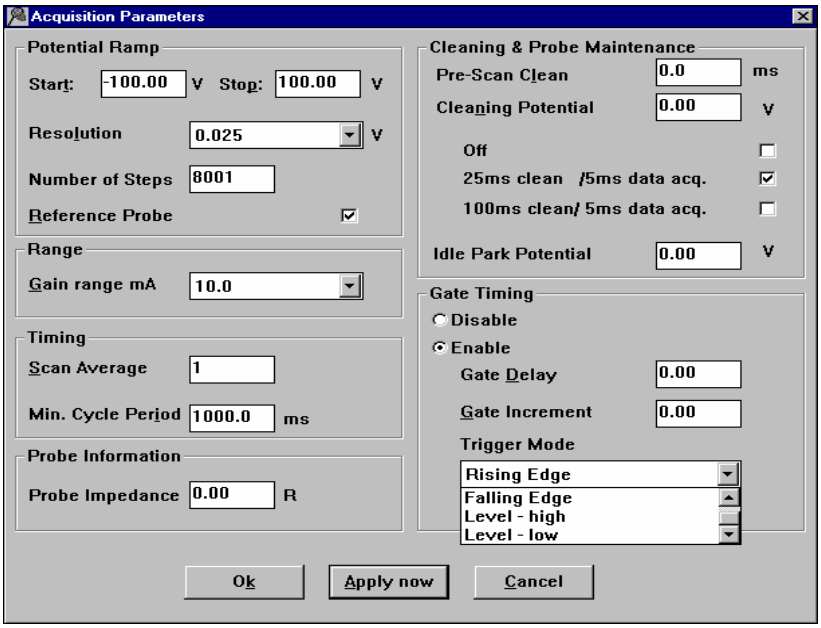
Event timings are labelled as shown above.

Plasma power is modulated by the event reference (T1). ESP*ION* bandwidths will allow monitoring up to a modulation frequency of 3 MHz.

This event reference pulse is also used to drive the internal variable delay generator (T3) which is used to delay data acquisition for a set time after the plasma is switched off (or on). Delay times can be 0 to 8 milliseconds.

After the delay time expires data is acquired. In edge trigger mode one data point is read, but in level trigger mode acquisition will continue until the event reference disables it.

With these methods, 'slices' of the plasma may be analysed at different times into the afterglow and a time-trend of the afterglow is obtained.



A data read cycle takes approximately 14.6 microseconds (69,000 readings per second), during which time the ESP*ION* :

- sets a new tip voltage
- waits for it to settle
- triggers
- reads the tip current

ESP*ION* can monitor modulation up to 3 MHz, but above 69kHz one reading will require several modulation cycles.

Only one simple connection is required from the pulse generator to the external trigger BNC connector at the rear of the interface unit. The ESP*ION* acquisition electronics are enabled/disabled by the TTL signal from the event reference.