



Woodruff Scientific Inc

4000 Aurora Ave N,
Suites 5 & 6, Seattle, WA 98103
(206) 905 9477 8am to 5pm Pacific

sales@woodruffscientific.com

<http://www.woodruffscientific.com>

Model number(s): ES-SL1 / ES-DL1 / ES-TL1 / ES-MP / ES-CP

Descriptive name: Electrostatic Probes - Langmuir



2.75" CF Flange

Features:

- Single tip, double, triple tip Langmuir probes, Mach probes, and combination Langmuir/Mach probes available all built to ultra-high vacuum standards with an emphasis on miniaturization to reduce plasma disturbance
- Fast bias sweeping electronics reveal the time evolution of the plasma
- Low noise current and voltage monitors with optional filtering insure accuracy
- All probes are custom made with full translation capability designed to your specifications and can be made rotateable upon request
- A wide range of tip and insulator materials are available
- Custom designed tip collection area and spacing to diagnose a wide range plasma parameters: typical $T_e \sim 0 - 70 \text{ eV}$ and $n_e \sim 10^{14} \text{ m}^{-3} - 10^{20} \text{ m}^{-3}$

Options:

| Probe | T_e | n_e | V_f | V_p | EEDF | Mach # | Ion velocity | Plasma Disturbance | Accuracy in turbulent plasma |
|------------|-------|-------|-------|-------|------|--------|-----------------|--------------------|------------------------------|
| Single tip | Y | Y | Y | Y | Y | | | High | Low |
| Double tip | Y | Y | | | | | | Low | High |
| Triple tip | Y | Y | Y | Y | | | | Med | Med |
| Mach | | | | | | Y | Y w/ T_e, T_i | Low | High |



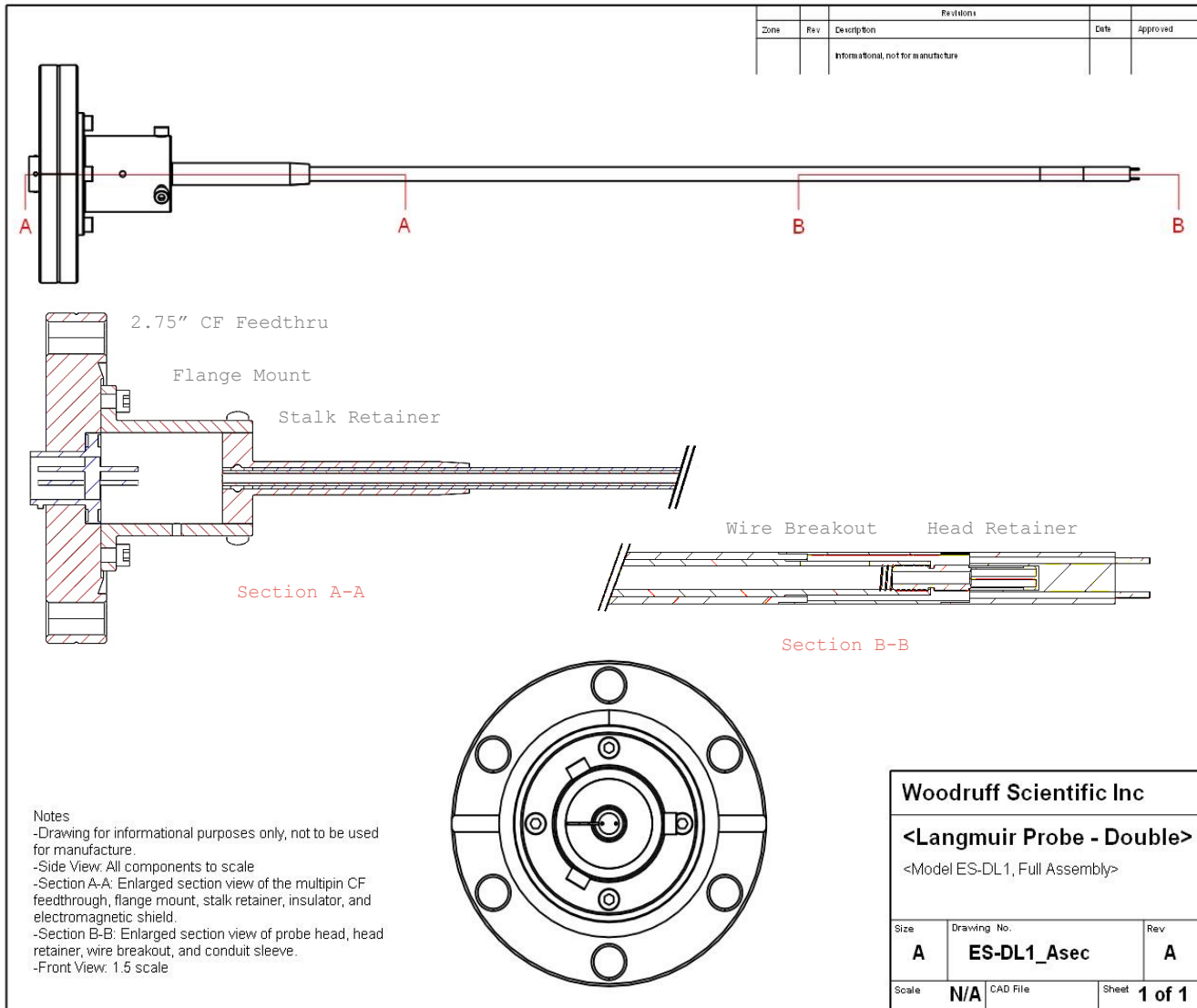
Woodruff Scientific Inc

4000 Aurora Ave N,
 Suites 5 & 6, Seattle, WA 98103
 (206) 905 9477 8am to 5pm Pacific

sales@woodruffscientific.com
<http://www.woodruffscientific.com>

Model number(s): ES-SL1 / ES-DL1 / ES-TL1 / ES-MP / ES-CP
Descriptive name: Electrostatic Probes - Langmuir

Engineering:





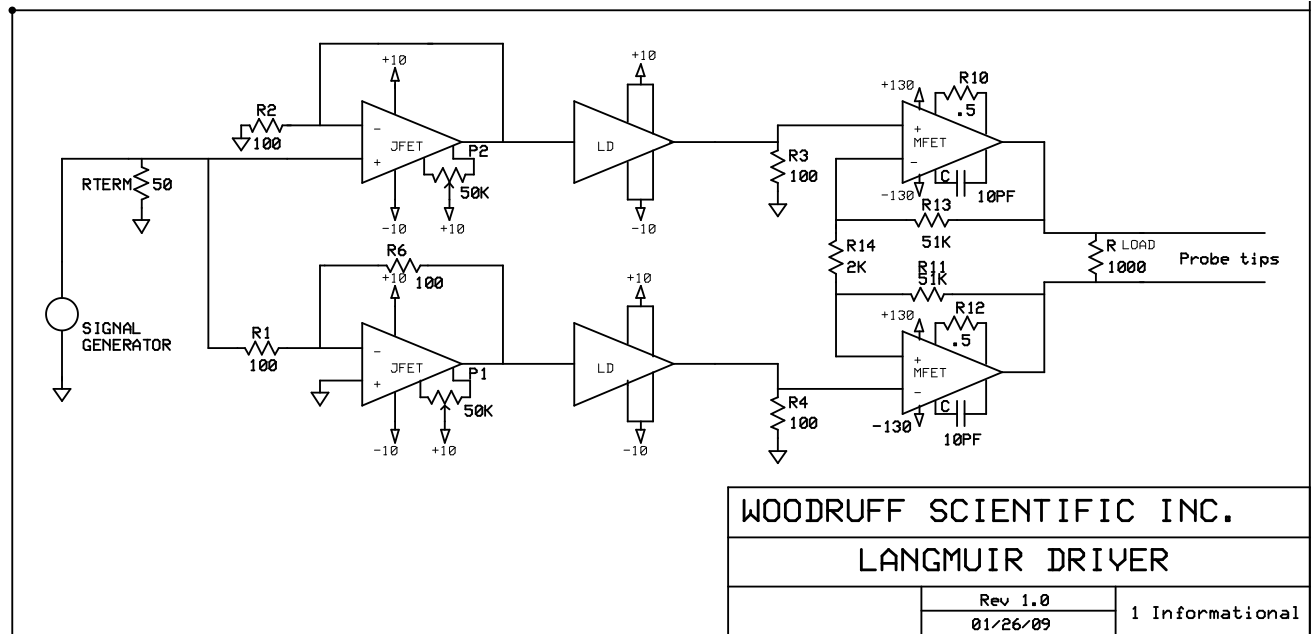
Woodruff Scientific Inc

4000 Aurora Ave N,
Suites 5 & 6, Seattle, WA 98103
(206) 905 9477 8am to 5pm Pacific

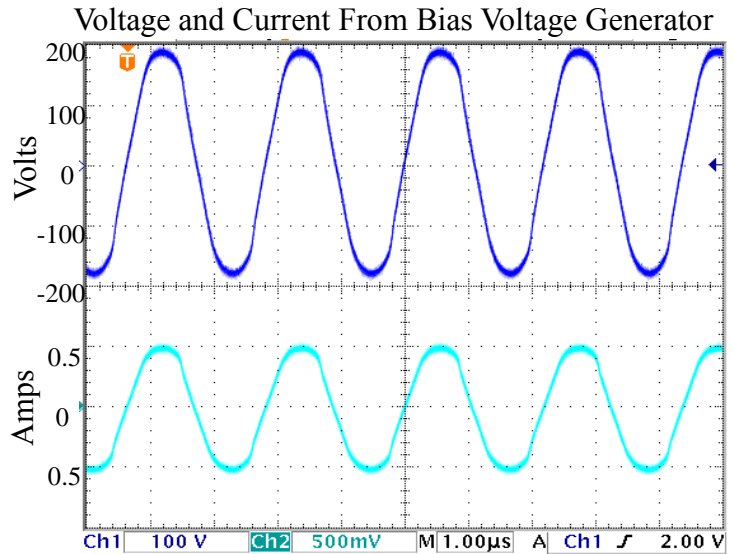
sales@woodruffscientific.com
<http://www.woodruffscientific.com>

Model number(s): ES-SL1 / ES-DL1 / ES-TL1 / ES-MP / ES-CP
Descriptive name: Electrostatic Probes - Langmuir

Electronics:



- A 130 Vdc bipolar power supply drive Mosfet amplifiers in a push-pull configuration.
- Any input signal from a waveform generator is amplified to nearly 400 V peak-to-peak at any frequency up to 1.2 MHz.
- Accurate measurements of the tip voltage and current are made with current transformers resulting in an analog output signal of +/-1 V.



1µs Time Division

© Woodruff Scientific Inc, 4000 Aurora Ave N, Suites 5&6, Seattle, WA 98103
Sales: sales@woodruffscientific.com (206) 905 9477



Woodruff Scientific Inc

4000 Aurora Ave N,
Suites 5 & 6, Seattle, WA 98103
(206) 905 9477 8am to 5pm Pacific

sales@woodruffscientific.com

<http://www.woodruffscientific.com>

Model number(s): ES-SL1 / ES-DL1 / ES-TL1 / ES-MP / ES-CP
Descriptive name: Electrostatic Probes - Langmuir



Highest Quality Probe Design and Construction:

- An 8 tip combination Langmuir/Mach probe used in a highly turbulent plasma
- Miniaturized for the lowest possible disturbance to the bulk plasma.
- .020" diameter tungsten tips housed in a .250" diameter boron nitride insulator.
- Electrical connections to the tungsten tips were made with polyimide coated Cu wires within 3/8" of tip exposure.
- Wires were twisted and shielded in stainless steel to minimize noise due to electromagnetic pickup.

© Woodruff Scientific Inc, 4000 Aurora Ave N, Suites 5&6, Seattle, WA 98103
Sales: sales@woodruffscientific.com (206) 905 9477



Woodruff Scientific Inc

4000 Aurora Ave N,
Suites 5 & 6, Seattle, WA 98103
(206) 905 9477 8am to 5pm Pacific

sales@woodruffscientific.com

<http://www.woodruffscientific.com>

Model number(s): ES-SL1 / ES-DL1 / ES-TL1 / ES-MP / ES-CP

Descriptive name: Electrostatic Probes - Langmuir

Sample Data and Post Processing:

- A Langmuir probe draws a small current from the plasma when a bias voltage is applied to the exposed tips.
- The probe current and bias voltage are independently measured and plotted as an I-V characteristic. A sample characteristic for a double probe is shown.
- The electron temperature is calculated from the ion saturation current and the slope of the I-V trace at the floating point.
- By sweeping the applied bias potential with a sine or triangle wave an I-V characteristic can be generated for every wave period. In this way the time-history of the electron temperature is calculated.
- Once the electron temperature is known the electron density can be calculated from one of the theories of ion collection often Bohm or ABR.

