Woodruff Scientific Inc
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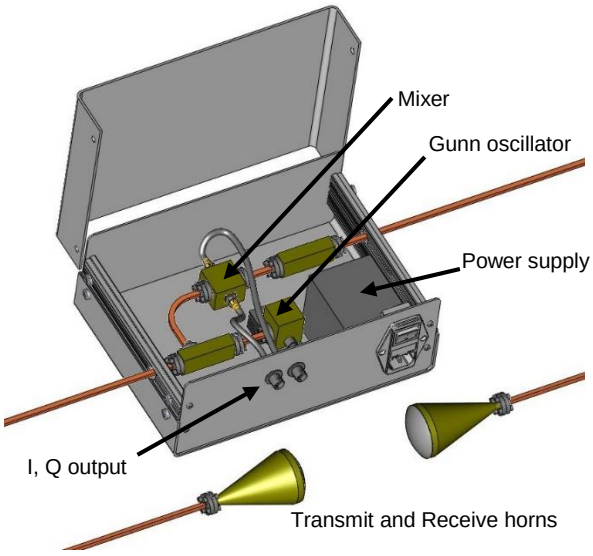
Model number(s): R1-M-Q, R1-M-V, R1-M-W
Descriptive name: Microwave Interferometer

Features:

- Measures chord-averaged electron density
- Heterodyne configuration for extended measurement range
- I-Q mixer for robustness against attenuation from changes in plasma
- Extendable to multiple chords
- Gunn diode microwave sources in Q, V, or W bands (43, 60, 94 GHz)
- Standard waveguide connections
- Microwave lenses also available to improve collimation and received power



R1-M-W, shown in homodyne configuration

Operational ratings:
Electron density (n_e): $< 10^{20}\ m^{-3}$, depending on frequency selection
Slew rate (1/n dn/dt): $< 10^{8}\ s^{-1}$, depending on data acquisition

Signal Output:
The I-Q mixer outputs two signals (I and Q) in the range +- 1.5 V. The phase shift due to the plasma is given by a 4-quadrant arctangent of Q/I, and the line-integrated density is calculated from the phase shift by a simple quadratic polynomial in most cases.

Options:

- Microwave frequency in the range 43-94 GHz
  Higher frequencies allow greater density before reaching cutoff, faster temporal response, better spatial resolution, and smaller waveguide components. Lower frequencies are less sensitive to mechanical motion and can be more economical in many applications.
- Launch and Receive optics
  Standard horn antennas are sufficient for some applications. Microwave lenses can be added to collimate the beam and to compensate for power loss due to plasma refraction.
- Contact us for more information on interfacing with your experimental control and data acquisition systems.

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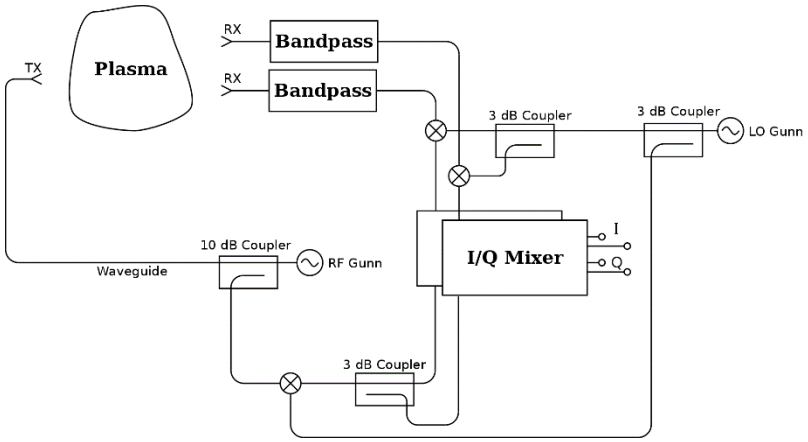
Schematic (2-chord option shown):



Example data:
At left is example data from an R1-M-W interferometer. The I and Q signals represent the cosine and sine of the phase shift, respectively. The right-side plot of Q vs. I demonstrates this relationship; ideal signals would trace a constant-radius arc or circle, the real-world plasma distorts the radius of the arc on the hodogram without changing the polar angle. The line-integrated electron density is shown bottom left.