MODULI | RF Spectrometer

Impedans
PLASMA MEASUREMENT

Non-invasive fault detection and chamber health monitoring

Acquisition Unit

Radio Antenna

Measures

- Frequency Range: 0.4 MHz to 100 MHz
- Frequency Choice: Any 5 frequencies and up to 16 harmonics each

Functionality

- Data Channels: Electric and Magnetic
- Realtime Report Rate
- Continuous and Pulsed RF Monitoring

Features

- Non-invasive
- API for extending software
- Communicates via USB, RS232, Ethernet and EtherCAT

Applications

- Real-time plasma performance monitoring
- Process endpoint
- Production tool fault detection

The RF Spectrometer is a radio-frequency (RF) detector that directly monitors the electrical state of a plasma from outside the plasma chamber. This is designed for fault detection on production tools without the need for an in-line sensor in the RF path. It has been proven to detect air leaks, wafer displacement and other serious plasma faults.

The RF Spectrometer is a non-invasive solution to plasma monitoring. This Radio Emission Spectroscopy (RES) tool can be placed anywhere outside the plasma source where small RF leakage is present - at a window port, for example, or near a turbo pump. The antenna is split into two parts, so the antenna pick-up can go within the RF shielding and the amplifiers outside, to take advantage of the RF noisy environment.

The Radio Antenna collects the electric and magnetic waveforms from the chamber and sends them to the Aquisition Unit, which extracts the RF harmonics. The harmonic spectrum is very sensitive to small changes in plasma impedance, a key indicator of process repeatability.

Radio Emission Spectroscopy will soon become the new standard for plasma process monitoring. It shares the same advantages as an Optical Emission Spectroscopy (OES) system (external monitoring, sensitive to chemistry changes), with the added bonus of sensitivity to chamber impedance. Chamber impedance is impacted by chamber wall coatings, gas contamination, transmission line degradation, parasitic plasma formation and geometric changes, such as wafer misplacement and internal component breakage.

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Measuring Parameters (Frequency)

Fundamental frequency range	400 kHZ - 100 MHz
Harmonic frequency range	400 kHz - 240 MHz
Frequency resolution	1 kHz
Frequency accuracy	±10 kHz
# Fundamental frequencies	5 simultaneously
# Harmonic frequencies	≤ 15 per fundamental, ≤ 32 total simultaneously
Fundamental frequency tracking speed	10 kHz/µs
Fundamental frequency tracking range	±10% or ±2 MHz, whichever is less

Pulse Parameters (Time)

Pulse profile time resolution	1 µs Box Car Integration
Pulse profile acquisition time	> 1 second (pulse frequency dependent)
Pulse level monitor; # time frames	2 max. per pulse frequency cycle
Pulse level monitor; report rate	< 10 S/sec (pulse frequency dependent)

Measuring Parameters (Antenna)

Voltage Channel [E-Field]	Uncalibrated [Adjustable Gain]
Current Channel [B-Field]	Uncalibrated [Adjustable Gain]

Measuring Parameters (Phase)

Phase range	$\pm 180^0$
Phase resolution	0.02^0
Fundamental phase accuracy	± 1°

Note: Phase only availabel when both E - Field and B - Field channels are locked

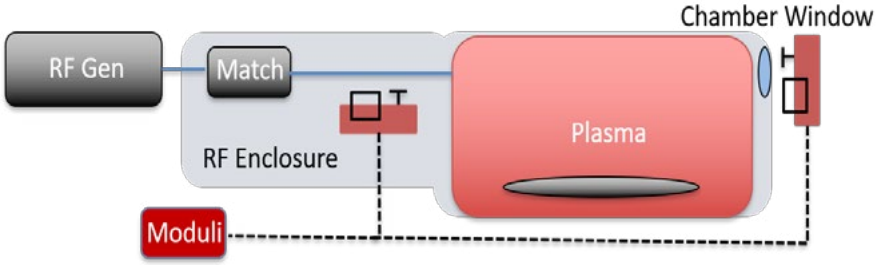
Sensor Specifications

Antenna Power	5 Vdc, 4.1 mm jack
Antenna Form Factor	[40 mm x 40 mm x 40 mm] & custom
Antenna Communication	2 x SMA coaxial cables
Acquisition Unit Power Requirements	24 Vdc, 4.1mm jack
Acquisition Unit Interfaces	Micro USB, Serial, Ethernet
Acquisition Unit Protocols	USB, HTTP Web Service, EtherCAT, Ethernet/IP, others on request
Acquisition Unit Form Factor	[122mm x 70mm x 41mm]
Parameter Report Rate	USB: 125 S/sec max. Ethernet: 125 S/sec max.
Maximum Operating Temperature	80 C

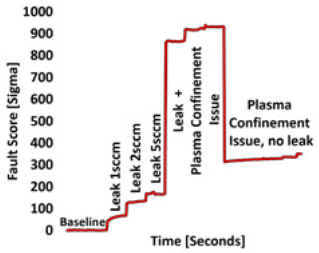
Application Software

Operating System	Windows 2000 / XP / Vista / Windows 7 / Windows 8 / Windows 10

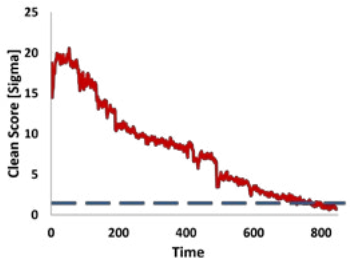
Example Installation



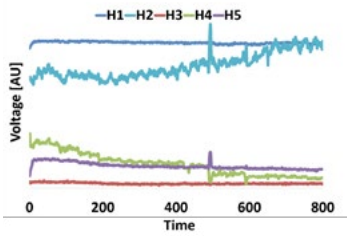
Leak Detection with Fault Score



Endpoint Applications



Plasma State Monitoring



Harmonic Spectrum