

The Latest Developments of Microwave Diagnostics for High Temperature Plasma in ELVA-1 Company

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For nearly 30 years, we have been designing and supplying instruments for microwave diagnostics of high temperature plasma. This report provides a description of the mm-wave components we utilize to make diagnostics within the frequency range of 26-330 GHz. While most of these components are standard and readily available on the market, we have also developed a few specific devices that simplify the architecture of our instruments. The article includes descriptions of these devices: Backward Wave Oscillators (BWO), IMPATT sources, IMPATT Active Frequency Multipliers, Noise Sources, and Electronically Controlled Attenuators. Furthermore, we offer an overview of the microwave plasma diagnostics we have supplied, including ECE radiometers operating at 50-220 GHz, as well as heterodyne interferometers operating at fixed frequency 94 GHz, 140 GHz, or 300 GHz. We also discuss methods employed to ensure measurement stability and present the achieved results. The advent of the new era of modern MMIC-based devices has brought forth exciting possibilities. As an example, we discuss the upgrade of the low noise receiver for the Collective Thomson Scattering (CTS) diagnostic at Wendelstein 7-X, which enables ion temperature measurements in the plasma core [1]. Lastly, we provide a list of MMIC-based devices that are currently available and have garnered the attention of the plasma diagnostics community.

[1] Ponomarenko, S., Moseev, D., Stange, T., Braune, H., Gantenbein, G., Jelonnek, J., *et al.* (2023). Development and Commissioning of Upgraded Microwave Radiometer for CTS Diagnostics at W7-X Stellarator. Talk presented at 5th European Conference on Plasma Diagnostics (ECPD 2023). Rethymno. 2023-04-23 - 2023-04-27.

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