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Master Oscillator to Phase Reference Line Connection with Active Drift Compensation for the European Spallation Source

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An essential requirement for ESS is to assure a precise phase synchronization of LLRF and Beam Diagnostics systems, operating at 352.21 MHz and 704.42 MHz. The long-term required phase accuracy is 0.1° between adjacent outputs and 2.0° between any two points.

The phase synchronization system consists mainly of a Master Oscillator (MO) in the Klystron Gallery and a Phase Reference Line (PRL) - a passive RF system based on a single coaxial rigid line, distributing references along the tunnel. MO reference signals are amplified, and the high-power signals are combined in a diplexer and distributed to the tunnel by a coaxial cable over a concrete duct for cables called STUB.

The amplifiers can drift significantly and differently at both frequencies. Ambient temperature variations in the Klystron Gallery, the STUB, and the tunnel can bring another phase drifts in the phase distribution system. That is why the active drift compensation system was developed to stabilize the phase reference in the PRL input.

This paper shows the design and implementation of the MO to PRL RF connection, including the active drift compensation, the phase stability results, and the diagnostic system.

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