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Hot S22 Measurement of LHC Circulators

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The LHC accelerating RF system merely consists of a 300 kW klystron, a 3-port circulator, a superconducting cavity and an RF load. The resonance of the superconducting structure is strongly influenced by the external RF system. The loaded Q, i.e. the external quality factor of the cavity, therefore also depends on the reflection of the circulator.

The circulators are equipped with a temperature control unit (TCU) compensating the thermal drift of the used ferrites for different power levels and phases. The response of the TCU is slow (as expected) and fast variations in power result in impedance changes in the circulator and therefore in a change of the loaded Q.

A study is being conducted on the RF behavior of the LHC circulators. The objectives are to understand the the relationship between the different reflection coefficients (S11 and S22) and their dependence on the applied RF power, compensation current and operating temperature. At high output power levels the S22 evades direct measurements, i.e. it has to be derived from transmission measurements.

We present the two different measurement setups for low and high power, respectively, and show first results. We discuss problems and limitations of the approach.

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