RECEIVER AS A RADIOMETER CALIBRATION TARGET

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Traditionally spaceborne microwave radiometers are calibrated using two point method. Depending on radiometer type and application, calibration methods vary significantly. External or internal calibration targets may be used, depending on radiometer type. Traditionally cold sky, internal matched termination and noise diodes are used in space applications. During the past decade or so, use of Active Cold Load (ACL) as an internal cold calibration target has also become viable. ACL's are based on the measurement of an input port of an amplifier. This port appears colder in noise temperature than its physical temperature if the amplifier parameters have been set in certain way.

A useful ACL requires a dedicated circuit and careful design. What is proposed in this paper as a new, novel idea is to use the input port of a complete radiometer receiver as a calibration target instead of a dedicated ACL. Modern LNA technology has made very low noise figures and return losses possible; both key parameters for a cold and stable ACL. This combined with a typical high isolation of an amplifier makes it possible to use a receiver itself as a cold calibration target. This is beneficial in instruments inherently having (at least) two receivers (pushbroom or polarimetric radiometer for example).

To use a complete receiver as a calibration target is slightly more complicated compared to ACL due to higher amount of contributors affecting the input port noise temperature. On the other hand, many radiometer systems today already include two channels at the same frequency (V- and H-polarisations for example) and the needed basic circuitry already exists. What is needed additionally is a possibility of cross- switching the input ports.

The use of ACL as a calibration target has, until now, always concentrated on noise temperature calibration. What is also proposed is in this paper, is to use this receiver input port as a phase calibration target on top of traditional power calibration target. A phase calibration target is beneficial in systems, where the relative phase of the receivers is of importance (polarimetric radiometers and synthetic aperture interferometric radiometers). The phase measurement is based on the fact that the reverse noise and forward noise of an LNA are correlated with certain amplitude and phase. Therefore, if the outputs of the two receivers are correlated, one receiving the forward noise and the other the reverse noise, the correlation amplitude and phase are determined by the LNA properties and propagation path from the LNA ports to the correlator. Although the phase stability has not yet been measured from an ACL, there should not be any limiting factor why the ACL/complete receiver could not be used as a phase calibration target as well.

This paper will present the general theory of the use of receiver as a cold calibration target. The paper will also discuss the practical aspects of different radiometer types and benefits of using the receiver target. Examples of radiometer systems benefiting from the new calibration method will also be provided.