



Introduction

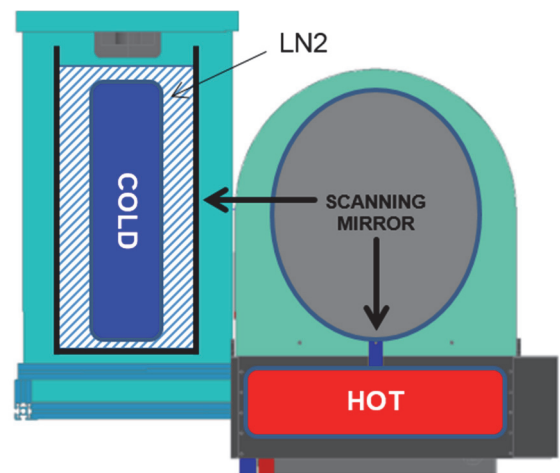
A major progress has been achieved in radiometer calibration accuracy and repeatability. RPG has developed a novel liquid nitrogen (LN2) cooled high-precision calibration target (PT-V1).

The new target effectively eliminates reflections and standing wave contributions during the calibration process. The PT-V1 improves the absolute calibration for all generations of RPG standard radiometers. In combination with a generation 5 instrument (G5), an absolute accuracy of ± 0.1 K and a calibration repeatability of better than 25 mK is achieved.



Absolute Calibration of RPG Radiometers

The optical path of the new precision target PT-V1 has changed compared to the previously used cold targets. The blackbody absorber is now oriented vertically instead of horizontally. The insulating container is made of a material which is 100% transparent for microwave signals below 200 GHz. This container is cased in a protection housing with handles for carrying and lifting the target. The target has two observation windows – one for each receiver. Both windows use anti-reflection coatings, which are sensitive to polarization. Each window is optimized to the polarization plane of the corresponding receiver (V / H).



Improvements

The old calibration targets suffered from the fact that the microwave beam is partially reflected by the air/liquid interface, leading to a not exactly quantifiable impact on brightness temperatures observations on the cold target. Additionally, the reflective component was modulated by a standing wave that built up between target and receivers while LN2 was evaporating from the target container. Both effects have been observed with the previous generation of the cold calibration target and required to apply corrections by the operating software. The residual uncertainty of these corrections motivated a new target design, which completely eliminates reflections at the cold target and - as a

consequence - also prevents the built-up of standing waves. The suppression of reflections on the liquid surface works only perfectly well for microwave signals of a certain polarization. Within RPG radiometers, the main beam is optically split by a wire grid and then distributed to the two receivers, resulting in orthogonal polarizations for both receivers. The new PT-V1 calibration target offers two windows optimized for each polarization. During an absolute calibration, the target is turned once from one side to the other while the calibration routine is integrating on receiver 1 or receiver 2.

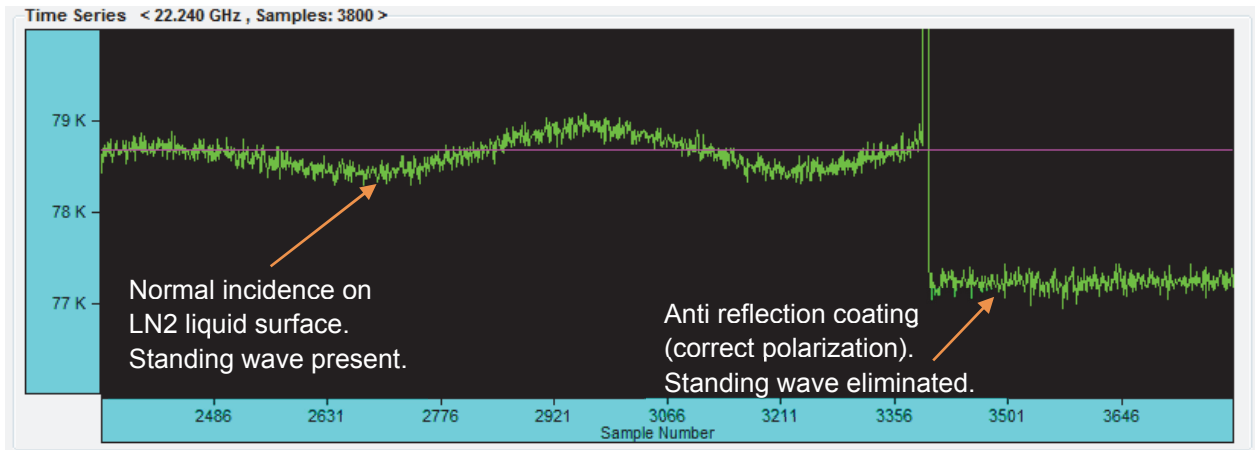


Fig. 1: Comparison of a 22.24 GHz brightness temperature time series measured on an old target with normal incidence and the new PT-V1 target.

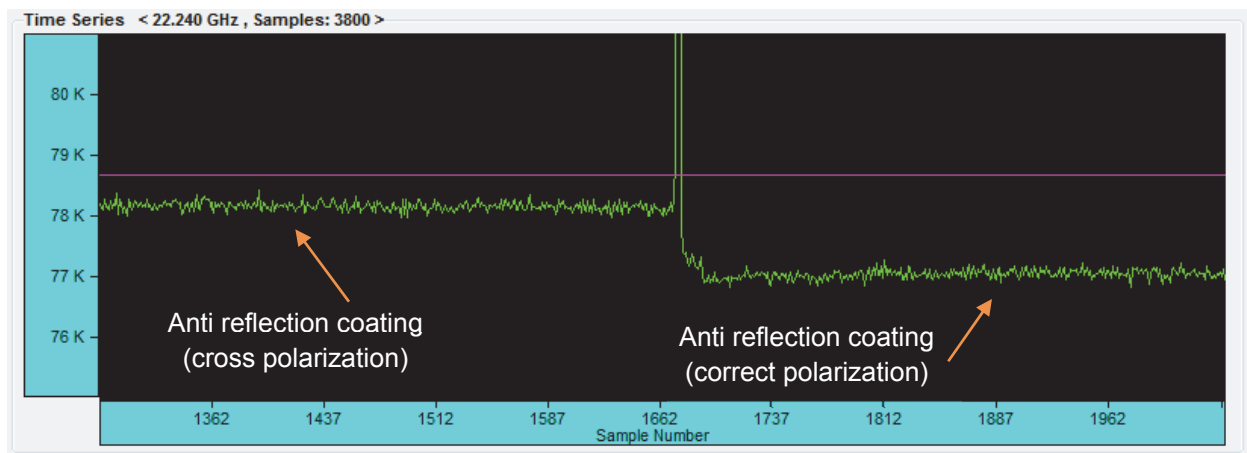


Fig. 2: Effect of different polarizations incidence to the PT-V1 anti reflection coating.

The new precision target is equipped with an insulation lid to avoid a fast wind induced LN2 evaporation and the entrainment of oxygen from the outside air. A small channel in the insulation container provides the LN2 gas exhaust which also effectively prevents the outside air from entering the target.

Summary

- Major progress in radiometer calibration accuracy (± 0.1 K) and repeatability (25 mK)
- Effective elimination of reflections and standing waves at the air/LN2
- An insulation lid avoids rapid evaporation of LN2 and the entrainment of environmental oxygen.