

USE OF SUBHARMONICALLY PUMPED SIS MIXER WITH HIGH HARMONICS NUMBER FOR PHASE AND AMPLITUDE ANTENNA MEASUREMENTS

A. BARYSHEV¹, M. CARTER², R. HESPER¹, S. J. WIJNHOLDS³,
W. JELLEMA³, T. ZIJLSTRA⁴

¹ NOVA, University of Groningen, the Netherlands

² IRAM, Institut Radio Astronomique Millimetric, Grenoble France

³ SRON-Groningen, Groningen, the Netherlands

⁴ Department of Applied Physics (DIMES), Delft University of Technology

For the ALMA Interferometer and FIRST Mission a means of measuring accurately the phase and amplitude of horns and other antenna structure in the submillimeter bands is required to ensure good alignment and high coupling efficiencies to the telescopes.

This paper gives a means for making these measurements by using a SIS junction as a sub-harmonically pumped mixer. The measurements that are shown were made at 640GHz, which is in the ALMA band 9, but they can be taken up to higher frequencies. A High harmonic number (>30) was used in these measurements and dynamic range of about 40 dB was achieved.

Any type of antenna structure connected to a SIS mixer could be measured. For these measurements a diagonal feed horn antenna was chosen. The mixer was mounted into a wet cryostat with a 1.2GHz to 1.7GHz IF. The cryostat was aligned against far field antenna measurement range. The transmitter moves in an X-Y raster scan in front of the cryostat window. The transmitter horn was a fundamental mode open-ended waveguide. The local oscillator in the range of 10-20 GHz was injected into the mixer by means of cold -20 dB directional coupler mounted into its IF chain. The phase locked Gunn multiplier chain was used as the transmitter. High harmonic of LO and Gunn chain output are combined to give an IF of 1.2 GHz. A homodyne phase and amplitude receiver was used for this measurement.

It is to be noted that no LO insertion was used at high frequencies. This has a great advantage for investigation of systems with wide beam because it does not limit the field of view taken up with optical local oscillator injection.

We will show the polar diagram, measured with this technique. The linearity of sub-harmonically pumped mixer was ensured by repetitive measurements of the same pattern with different signal levels. The IF output dependence from the SIS junction bias voltage will be presented. Optimal pumping power, signal level, operating bias point and conversion coefficient will be reported.