Impedance Matching of 640 GHz SIS Mixer in a High IF Band of 11-13 GHz

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Two 640 GHz SIS mixers are used for SMILES(*), an atmospheric research mission to be aboard the International Space Station. Those SIS mixers are operated at a relatively high IF band of 11-13 GHz, which is selected from the scientific reason of the mission. That high IF frequency, however, makes it more difficult to match the SIS device to the subsequent 50 Ω IF line. In addition to an impedance difference in real part, parasitic effects due to bonding wires, RF choke circuit as well as the capacitance of the SIS junctions will play an important role. When the IF matching is poor, the SIS mixer under test often exhibits significant gain ripples in its IF characteristics.

A solution for that is to insert a proper impedance transformer between the SIS mixer device and the IF output port and compensate the undesirable parasitic effects. To experimentally derive the output impedance of the SIS device, we have repeated measurements of the receiver gain with respect to an SIS device combined with several different types of matching transformers. We utilized the set of data with different IF characteristics to determine the SIS mixer parameters by means of a fitting technique. This has worked well and allowed us to establish the SIS mixer model to reproduce the measured data. An example of the comparison between the measured data and model is shown in Figure 1.

With a proper impedance transformer designed based on the above fitting results, we successfully realized a small ripple and better flatness in the gain profiles of the mixer.

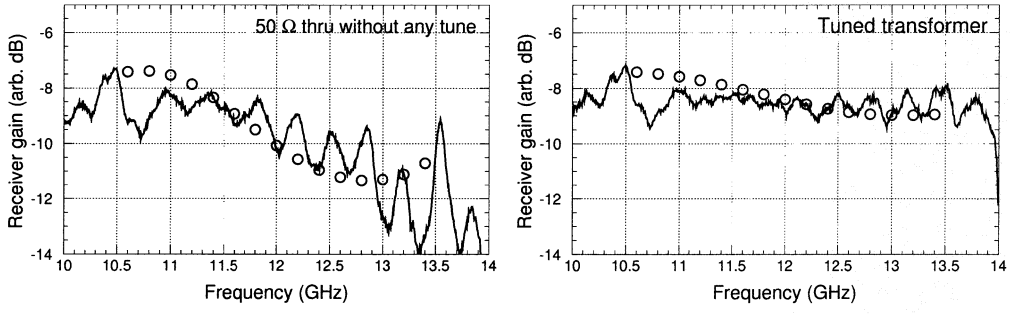

Figure 1: Example of SIS receiver gain with 50 Ω through transformer (*left panel*), and with tuned transformer based on fitting result (*right*). Solid lines show the measured data and open circles are fitted models.

* Superconducting Submillimeter-wave Limb-emission Sounder. See http://smiles.tksc.jaxa.jp/ for detail.