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640 GHz SIS Receiver for Limb Emission Sounder SMILES

MASUMICHI SETA[1], KENICHI KIKUCHI[2], TOSHIYUKI NISHIBORI[2], SEIKOU ARIMURA[2], TEKESHI MANABE[1], RYOUTA SATO[2], HIROYUKI OZEKI[2], AKINOBU OKABAYASHI[12] SATOSHI OCHIAI[1], HARUNOBU MASUKO[1] and JUNJI INATANI[2]

[1]*National Institute of Information and Communications Technology, Japan*
[2]*Japan Aerospace Exploration Agency, Japan*

National Institute of Information and Communications Technology (NICT) and Japan Aerospace Exploration Agency (JAXA) are developing a limb emission sounder SMILES for observation of ozone layer from the International Space Station [1]. SMILES is equipped with superconducting mixer (SIS) receiver first time on space. It operates two SIS mixers simultaneously for heterodyne detection of thermal emissions of molecules in the stratosphere in the upper side band of 649.12-650.32 GHz and lower side band of 624.32-626.32 GHz. The noise of the receiver is designed to be less than 500 K (SSB) for detection of 0.5 K signals with a unit integration time of 0.47 sec and frequency bandwidth of 2.5 MHz. We expect to detect minor constituents such as BrO and HO_2 in addition to O_3 ClO, and HCl. We paid attention for improving accuracy of intensity scale for the observed data. Gain variation of the receiver is specified to be less than 1% for a calibration interval of 53 sec. Gain linearity of the receiver is specified to be better than 1%. A newly developed quasi-optical single side band filter is designed to suppress image signals greater than 15 dB over whole the observational bands [2]. The engineering model of the 640 GHz SIS receiver had already been manufactured and its basic performances were evaluated for comparison with the design. A mechanical cooler succeeded in cooling 20 mW, 200 mW, and 1000 mW at 4 K, 20 K, and 100 K stage of the receiver respectively with a power consumption of 120 W. The noise of the cryo receiver was 230 K in DSB and it is small enough to realize the highly sensitive 500 K receiver. We expect to start operation of SMILES from 2008.

References

[1] SMILES Mission Team, "JEM/SMILES Mission Plan", available at http://smiles.tksc.jaxa.go.jp/

[2] Takeshi Manabe, Junji Inantani, Axel Murk, Richard J. Wylde, Masumichi Seta, Derek H. Martin, "A New Configuration of Polarization-Rotating Dual-Beam Interferometer for Space Use", IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES , 51, 6, 1696-1704, 2003.