

Band 3 Receiver for ALMA

S. M. Claude, C. C. Chin, P. F. Dindo, D. Erickson, F. Jiang and K. K. Yeung

The Atacama Large Millimetre Array (ALMA) that will be built in the Atacama desert in Chile at 5000 m altitude consists of an array of 64 12 m antennas operating in the millimeter and sub-millimetre range. Out of the 10 bands, band 3, covering 84 – 116 GHz will be one of the 4 day-one bands to be commissioned on ALMA.

Band 3 receivers will operate in spectroscopic and continuum modes. The ground state rotational transition of CO, at 115 GHz will be one of the most important lines to be detected. Astrochemistry studies will be achieved by detecting other lines common to the interstellar molecules. Also, higher excitation lines of CO are redshifted in this band, permitting observations and distance determination of star-forming galaxies to high values of z . Observation of the continuum will be used to determine the thermal dust emission, in order to estimate dust properties.

The band 3 receivers will also be used for pointing checks with the 87 GHz SiO maser line. Holographic setting of the antenna panels will use the SiO maser and continuum emission from compact non-thermal sources.

The receiver consists of a cartridge that can be inserted in the main ALMA front-end receiver. The core of the receiver is a superconductor-insulator-superconductor (SIS) mixer for converting the millimeter signal down to an intermediate frequency (IF) signal centered at 8 GHz with a bandwidth of 8 GHz. The SIS mixers must be operated at 4K. This is done with a close cycle refrigerator on the ALMA receiver providing three cooling stages at 4 K, 15K and 80 K. The input signal is split in two linear polarizations using a waveguide Orthomode Transducer. The down converted IF signal from the mixer is then amplified with a Low Noise Amplifier (LNA) that consists of three stage High Electron Mobility Transistors (HEMT). We will present recent development in the abovementioned critical components. The challenge of this project lies in the fact that not only the detection must be low noise but also, the design must be tailored to a series production of 64 receivers targeting cost and reliability issues.