



DIRAMICS

Ultra Low Noise Transistors & Circuits

Low Noise Amplifiers in Radio Astronomy

- **LNAs essential to radio telescope performance**
 - higher sensitivity → shorter integration time, ...
- **current trends / development focus**
 - broader frequency bands → reduce the number of bands
 - lower noise figure at higher frequencies
→ replace SIS mixers in some bands
 - avoid cryogenic cooling at lower frequencies (L-band)
→ much cheaper to build large arrays
- **simplify access to InP HEMT technology**
 - let people design & fabricate their own modules
 - let people design custom MMICs
 - use of our technology expanding among leading designers for radio-astronomy LNAs



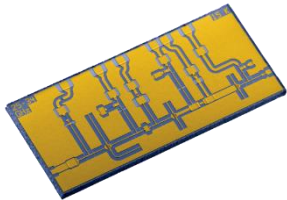
Diramics Products

Discrete InP HEMTs



- used in hybrid modules
- established product since 2016
- packaged versions in development

InP HEMT MMICs



- first customer designs fabricated & tested
- slowly expanding customer access

LNA modules



- so far only done by our customers
- own designs planned in the future

Diramics Technology in Radio Astronomy

1.2-1.6 GHz non cryogenic LNA module

- developed by S. Weinreb (Caltech) for DSA110
- record noise performance at room-temperature for these frequencies
- big potential improvement with simple thermoelectric cooling



"It is the lowest noise we have ever measured at room temperature! Congratulations on an excellent transistor!"

Sander Weinreb, Low Noise Amplifier expert, Caltech

4 - 8 GHz cryogenic LNA module

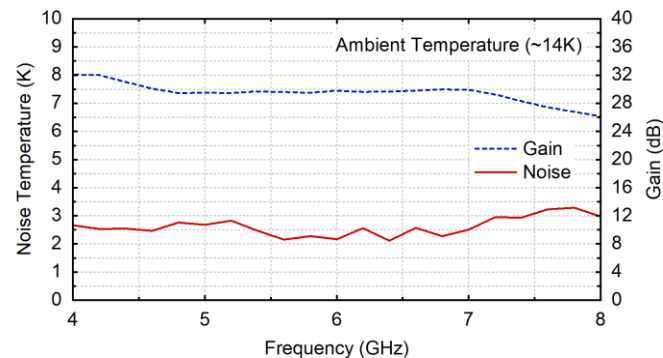
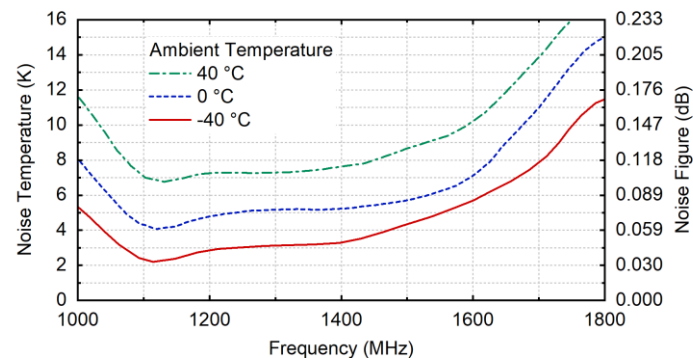
- similar results from various groups
- for quantum computing and radio astronomy receivers
- average noise temperature of ~2.6 K

IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES

Low Noise Amplifier With 7-K Noise at 1.4 GHz and 25 °C

Sander Weinreb¹, Life Fellow, IEEE, and Jun Shi², Member, IEEE

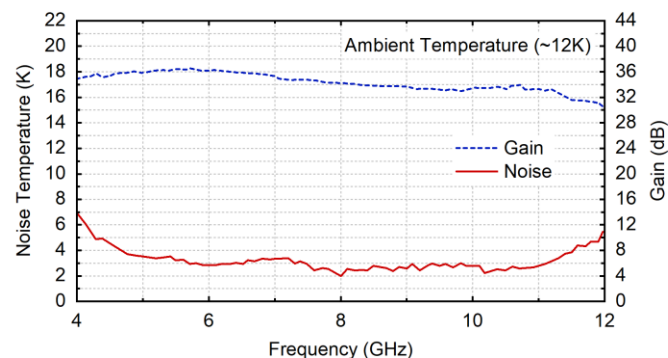
Abstract—This article describes a low noise amplifier which is believed will have a transformative impact because of the following characteristics: 1) the noise temperature at a mount monolithic microwave integrated circuit (MMIC) packages with a microstrip input network. Our LNA instead utilizes



Diramics Technology in Radio Astronomy

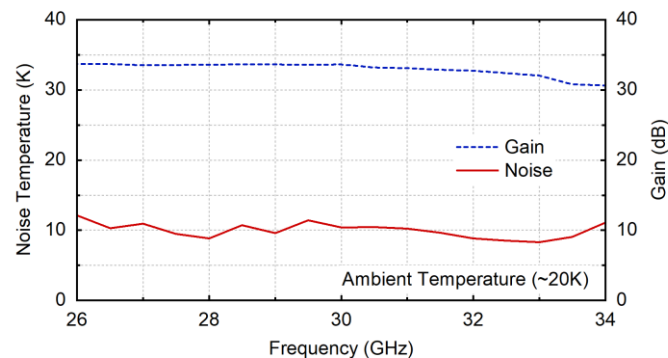
4 - 12 GHz cryogenic LNA module

- developed by M. Pospieszalski (NRAO) for ALMA – Band 6
- average noise temperature of ~3.3 K over the full band



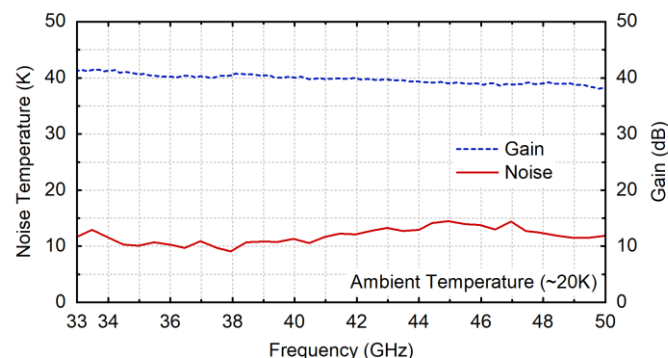
26 - 34 GHz cryogenic LNA module

- developed by CDT Yebes
- average noise temperature of ~10 K over the full band



33 - 50 GHz cryogenic LNA module

- developed by M. Pospieszalski (NRAO) for ALMA – Band 1
- below 15K noise temperature over the full band



Questions

