

COMPACT CRYOGENIC RECEIVERS FOR THE 1.3 TO 43 GHz RANGE

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A series of front-ends utilizing small closed-cycle refrigerators and very low-noise, high-electron-mobility transistor (HEMT) amplifiers [1] have been developed for use in the Very Long Baseline Array (VLBA). The frequency bands, amplifier noise temperatures, expected system temperatures, and current status are shown in Table I. The receivers are designed to be light weight (~ 55 pounds except for 105 pounds at 1.5 GHz) for ease of installation and maintenance, are easily remotely controlled and monitored, and provide dual-channel circular polarization capability. Detailed descriptions of some of the front-ends are given in VLBA technical reports [2,3,4].

The HEMT amplifiers utilized in the receivers have been under development for several years. At 1.5 GHz a feedback, lumped-element amplifier has been improved by utilization of the Fujitsu FHR01FH HEMT. At 2.2 GHz through 15 GHz, coaxial designs [5] utilizing the same transistor are planned (other transistors giving still better performance may become available). At 23 GHz a hybrid integrated circuit amplifier utilizing chip transistors has been developed.

REFERENCES

- [1] M. W. Pospieszalski, S. Weinreb, "FET's and HEMT's at Cryogenic Temperatures - Their Properties and Use in Low-Noise Amplifiers," to be presented at IEEE 1987 Int. Mic. Symp., Las Vegas, June 1987.
- [2] S. Weinreb, H. Dill, and R. Harris, "Low-Noise, 8.4 GHz, Cryogenic GASFET Front-End," VLBA Technical Report No. 1, National Radio Astronomy Observatory, Charlottesville, VA, Aug. 29, 1984.
- [3] R. Norrod, "Model F103, 1.5 GHz Cryogenic Front-End," VLBA Technical Report No. 2, National Radio Astronomy Observatory, Charlottesville, VA, Sept. 10, 1986.
- [4] R. Norrod, "Model F105, 4.8 GHz Cryogenic Front-End," VLBA Technical Report No. 3, National Radio Astronomy Observatory, Charlottesville, VA, Dec. 18, 1986.
- [5] G. Tomassetti, S. Weinreb, and K. Wellington, "Low-Noise, 10.7 GHz, Cooled GaAs FET Amplifier," Electronics Letters, vol. 17, no. 25/26, pp. 949-951, Dec. 10, 1981.

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TABLE I. VLBA Cryogenic Receivers

Freq. Range GHz	Amp. Noise K	Sys. Noise K	Status March 1987	Inp. WG Diam. cm
1.35-1.75	4*	22	3 complete	16.33
2.15-2.35	5	25	Under design	9.75
4.6-5.1	9	24	3 complete	4.490
5.9-6.4	10	24	No work	3.578
8.0-8.8	12*	29*	10 on VLA	2.602
10.2-11.2	14*	32	FET prototype	2.045
14.4-15.4	22	40	FET prototype	1.487
22.2-24.6	50*	77	8 on VLA	0.931
42.3-43.5	70	105	HEMT and SIS under devel.	0.526

*Measured result, all other figures are expectations.

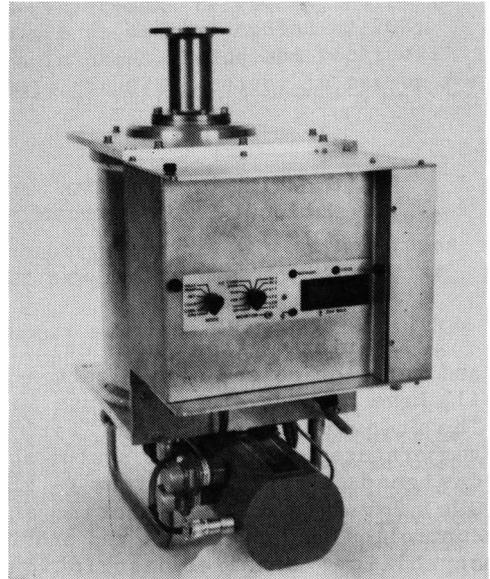


Fig. 1. Photo of typical VLBA front-end. Width is 30 cm.

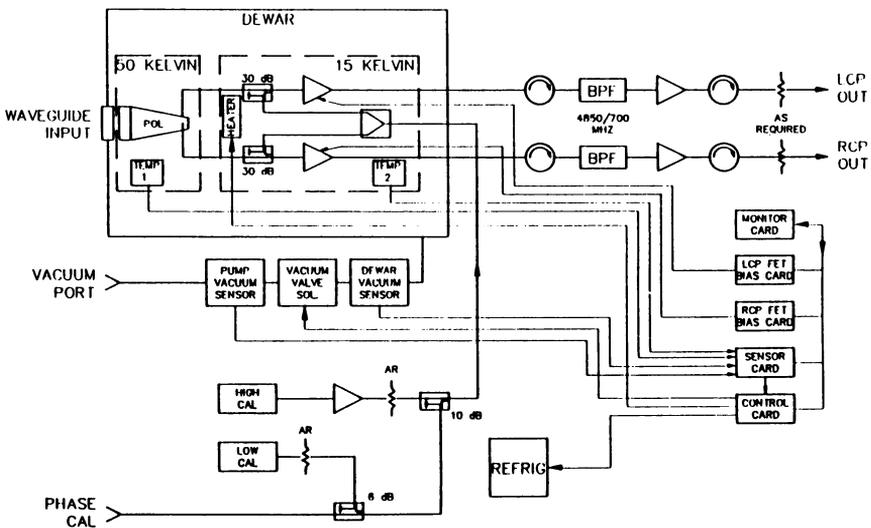


Fig. 2. Block diagram of typical VLBA front-end.