V-4. Solid State V-Band Local Oscillator and Mixer

X. A. De Angelis

Sylvania Electronic Systems Laboratories, Williamsville, N. Y.

The technique used to obtain an all-solid-state local oscillator at 68.5 Gc consisted of driving a varactor harmonic generator chain with a transistor-power amplifier. The source was a crystal-controlled transistor oscillator in a temperature-compensated oven yielding a stability of three parts in 10^6 at a frequency of 44.596 Mc. Alternatively, an external stable source with a 4 milliwatt, 50 ohm output may be used to drive the exciter-power amplifier. The exciter-power amplifier contains a buffer amplifier, a tripler and appropriate power amplification to yield 14 watts at 133.789 Mc from two 2N2876 transistors.

A summary of the circuit techniques, power levels, and diodes utilized up to X band are shown in the table below:

Input Frequency (Gc)	Function	Circuit	Diodes	Conversion Loss	P_{out}(watts)
0.133789	X2X2	Lumped element, balanced	2-D4265-2M 2-D4264-1M	3 db	7
0.535	X2	Coaxial	1-D5003	2.1	2.72*
1.07	X2	Coaxial	1-D5004	2.72	1.45
2.14	X2	Coaxial	1-D4252E	2.86	0.750
4.28	X2	Coaxial-Waveguide	1-D4231H	3.7	0.320

*A 2 db pad was inserted to reduce output level.

From 8.56 Gc to 68.5 Gc, several problems were resolved with varying degrees of success. In the initial waveguide multiplier designs, it was found quite easy to get high output levels at the three-halves frequency. To eliminate this nuisance effect, a short section of cutoff waveguide was utilized as a high-pass filter in the output of all multipliers. Both D4200-series and D4600-series diodes were tested in the 8.56 Gc to 17.1 Gc doubler. As might be expected, even though junction parameters were essentially the same, much better results were obtained with the smaller D4600 series diodes. The final results obtained at 17.1 Gc were a 100 mw output with 320 mw input utilizing a D4630K diode.

A quadrupler was utilized as the last stage of the chain. Again several diodes and packages were tested. The Solrac 103B gallium arsenide diode yielded the best results at 68.5 Gc.

The output power of approximately 0.1 mw was used to drive a balanced mixer yielding a noise figure of less than 20 db. A significant increase in local oscillator power level and subsequently better noise figures can be projected by the use of two doublers from 17.1 Gc to 68.5 Gc rather than a quadrupler.

The feasibility of completely solid state crystal-controlled millimeter wave superhetrodyne receivers has been established. The design and test data obtained in the course of this work points the way to reliable, economical, completely solid state receivers and low-power sources for operational applications.