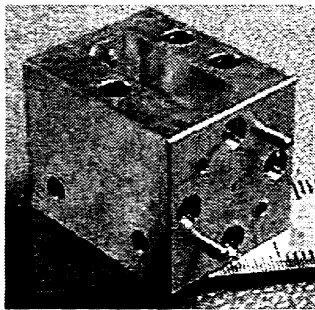


Broadband Submillimeter Receiver and Source Development

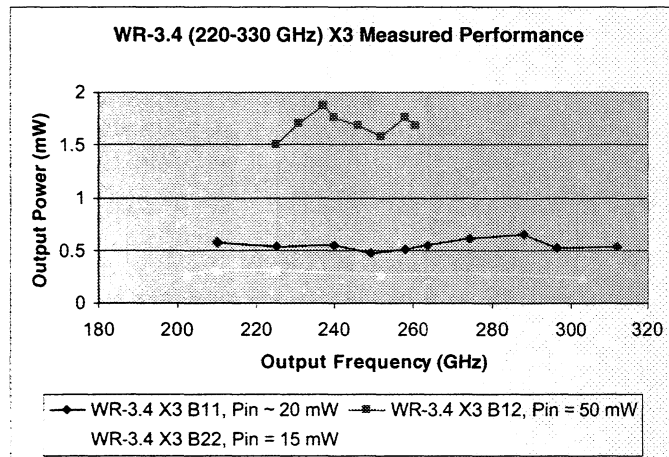
J.L. Hesler, D.W. Porterfield, W.L. Bishop, D.S. Kurtz and T.W. Crowe
Virginia Diodes, Inc.
Charlottesville, VA
www.virginiadiodes.com

This talk will describe recent developments in broadband fixed-tuned receivers and sources at millimeter and submillimeter wavelengths. These components rely on a strong fusion between novel integrated planar diode technology and innovative broadband circuit topologies. Using these methods excellent performance can be achieved over full-waveguide bands without the need for mechanical tuners or electrical bias.

Broadband multipliers have been developed over bands ranging from WR-12 (60-90 GHz) to WR-1.2 (600-900 GHz). As an example, a WR-3.4 tripler (220-330 GHz), pictured below, yields efficiencies of 2-4% over the band. WR-3.4 triplers optimized for different input power levels have been developed, with output powers ranging from $\frac{1}{4}$ mW to $1\frac{1}{2}$ mW for input powers from 15 mW to 50 mW. Broadband quintupler designs with efficiencies ranging from 0.2-0.6% have been developed. For example, a quintupler to 900 GHz has produced 66 uW of output power using 20 mW of input power. A quintupler to 1.6 THz is currently under development.



(a)



(b)

Fig. 1: (a) Picture of WR-3.4 Tripler, (b) measured performance.

A range of broadband receivers has also been developed, with RF bands ranging from WR-8 (90-140 GHz) to WR-1.7 (440-660 GHz). The subharmonic mixers use an LO at half the RF, and also provide LO noise suppression. Measurements at 600 GHz on a WR-1.7 subharmonic mixer have yielded a mixer noise temperature of 1550 K (DSB) and a conversion loss of 8 dB (DSB) using only 4 mW of LO power at 300 GHz. A WR-1.2 mixer covering the range from 600-900 GHz is currently under development.

Balanced varactor doublers are used to drive both the broadband multipliers and the mixers. A 300 GHz all-solid-state chain was used as the local oscillator for the 600 GHz mixer measurement. This doubler chain, with an output power in excess of 5 mW, consists of three cascaded doublers (at 75 GHz, 150 GHz and 300 GHz) driven by a commercially available millimeter-wave amplifier.