

WR-3.4 Oscillator Waveguide Module with Frequency Controlled via Injected Signal

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This presentation covers the design and waveguide packaging of an oscillator integrated circuit that employs an injected signal to control its oscillation frequency. Injection-locked oscillators offer benefits beyond frequency control, including enhanced phase noise performance.

The differential-mode oscillator circuit, illustrated in Fig. 1(a), is designed for WR-3.4 operation using Teledyne's InP 250-nm DHBT technology. The circuit comprises an oscillator core and a buffer amplifier, both utilizing a common-base HBT configuration. The core features an opening at the optimum location in the reactive tank termination to enable coupling with an external injection signal. The oscillator's input and output are connected to either RF probe pads or dipole-type waveguide transitions. The dipole transitions used in the waveguide-mounted circuit, as shown in Fig. 1(b), have previously demonstrated a total loss of 3 dB for a back-to-back connection across the entire WR-3.4 band. These dipoles enable efficient coupling of the oscillator signal into the waveguide, reducing signal loss and ensuring compatibility with standard WR-3.4 waveguides. Both frequency and output power are measured simultaneously using a 3-dB waveguide coupler. Frequency measurements are performed with a VDI WR-3.4 subharmonic mixer and a spectrum analyzer, while output power is measured using a VDI PM4 power meter.

The measured results in Fig. 1(c) indicate a free-running oscillation frequency of 272 GHz and an output power of 5.2 dBm for the IC, compared to 273 GHz and 4.8 dBm for the module. This difference is likely caused by impedance mismatches between the probe pads and the dipole transitions. The frequency ranges are 33 GHz for the IC and 22 GHz for the module. As expected, higher input power is required to steer the frequency further from the free-running frequency. The successful packaging of the oscillator in a waveguide module represents a significant step forward in developing practical terahertz signal sources.

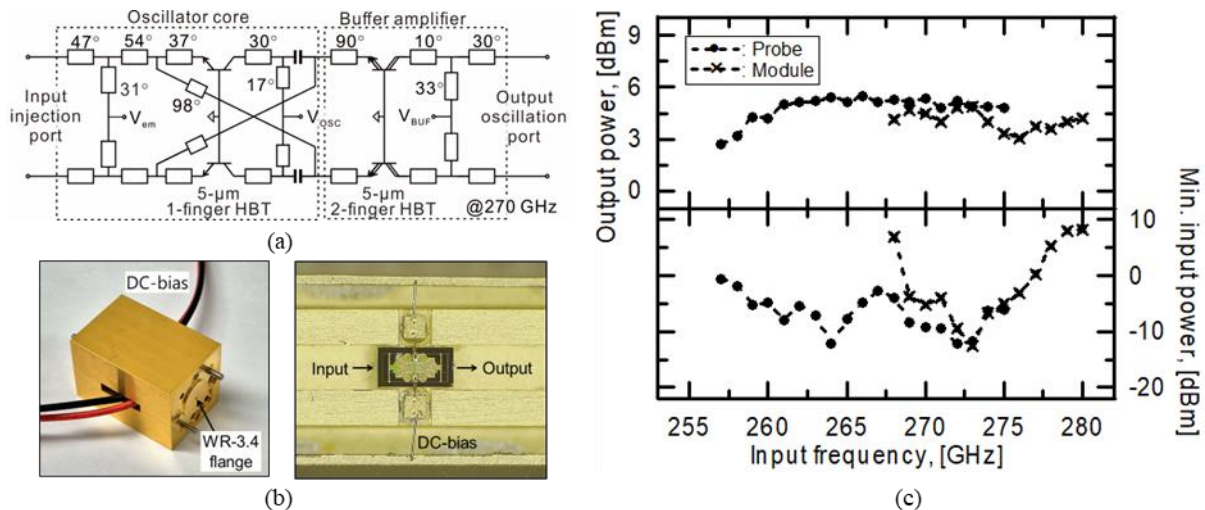


Figure 1. (a) Circuit schematic of the injection-locked oscillator (ILO), (b) Photographs of the ILO WR-3.4 module and the oscillator chip mounted inside the waveguide module. (c) Measured performances of the oscillator IC and module showing output power for input signal frequency.

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