A Very Fast and Stable Millimeter to Submillimeter Power Meter

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Abstract

A calorimetric power meter is now available with extremely high sensitivity, and fairly fast response. The model PM1B responds over a frequency range extending from 75 GHz up to the THz range. The power sensor uses a matched load in WR10 waveguide, and for thermal stability measures the difference between this and a second waveguide with an identical load. In the WR10 band the VSWR is <1.15, and analysis of the waveguide load shows that it should have a low VSWR up through 2 THz. The method of measurement is essentially calorimetric, but with feedback circuitry added to speed up the response. The waveguide load is biased at a power level slightly above full scale power and then the bias power is reduced as input increases to maintain constant temperature. The basic sensor time constant is 7.5 sec, with sufficient stability to permit measurements down to 0.2 μW, under conditions of good ambient temperature stability. For power levels above 20 μW the measurement time constant can be reduced to 1.5 sec, and above 2 mW it decreases to 0.25 sec. The drift level is <1 μW in a typical measurement with only moderate room temperature control, while accuracy is better than 3%. The sensor head is quite small, comparable in size to typical mm-wave power heads for other meters.

In recent work the original PM1 sensor has been improved to reduce the noise level in the temperature readout to 0.05 μW p-p, and the drift level by a factor of 3. In addition the time constant has been reduced slightly through the use of a lower mass waveguide load. A $4^1/_2$ digit meter is now used to extend the useful dynamic range of a single scale to >100:1 power level.