ELECTRONICALLY TUNABLE, OCTAVE-WIDE, BACKWARD-WAVE PARAMETRIC AMPLIFIER WITH CONSTANT OUTPUT FREQUENCY*

by

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The conventional cavity-reactance amplifier uses a single variable-reactance diode that couples several tuned circuits together. There are many modes of operation of this type of amplifier, each of which has been analyzed in detail.

Although the cavity-type reactance amplifier has proved to be a practical low-noise microwave receiver, it is essentially a fixed-frequency device that cannot be tuned conveniently at a rapid rate. In receiving systems used for countermeasures, frequency-jumping radars, spectrum analysis, etc., it is extremely desirable to have a narrow-band receiver that is capable of being tuned rapidly across a wide bandwidth and that has a maximum sensitivity. The backward-wave parametric amplifier (BWPA) has these desirable properties; however, the center frequency of its output pass band, which is the same as that of the input pass band, varies as the amplifier is tuned. This requires a complex demodulator at the output port to convert the variable output frequency to a fixed intermediate frequency. Therefore, a more desirable form of this amplifier is one in which the center frequency of the output pass band remains constant as the input pass band is tuned. Such a mode of operation is possible. Thus, since the tuning of the input pass band can be accomplished solely by electronically varying the pump frequency, the amplifier requirements stated can be met quite simply.

A low-frequency model of a BWPA, operating in this mode (constant idler output frequency), has been designed and tested. Experimental data on the amplifier characteristics were taken and were shown to correlate well with theory. The amplifier yielded stable gains in excess of 20 db over a greater than octave tuning range, and the idler variation was less than ± 1.6 percent over an octave tuning range. The overall effective receiver input-noise temperatures were measured and agreed well with theory, being about $160^{\circ}K$ at the low-frequency end of the band and increasing to $300^{\circ}K$ at the high-frequency end. The feasibility of this mode of operation of a BWPA has been demonstrated, and appears to be practical at the higher UHF and microwave frequencies.

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