

[54] DIRECT QAM MODULATOR

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[56] References Cited

U.S. PATENT DOCUMENTS

5,140,200	8/1992	Stanton	307/540
5,349,312	9/1994	Huettnner et al.	333/81
5,351,030	9/1994	Kobayashi et al.	338/295
5,453,720	9/1995	McCullough et al.	332/103
5,477,200	12/1995	Ono	333/81
5,502,421	3/1996	Nakahara	333/81

OTHER PUBLICATIONS

A Broadband I & Q Vector Modulator, G. T. Microwave Inc., Microwave Journal, Dec., 1996, p. 108-112.

A Direct 64QAM Modulator Suitable for MMIC Implementation, Surinder Kumar, Abbas Mohammadi, and David Klymyshyn, unpublished submitted and accepted for publication in Microwave Journal, 16 pages.

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[57] ABSTRACT

A direct QAM modulator for generating a high power QAM modulated signal at microwave frequencies comprises a hybrid to create the required RF signals for I and Q paths. In each path, a rat-race coupler is used to get the in phase and out of phase RF signal. The subsequent circuit blocks in each path consist of a single pole double throw switch (SPDT) switched by the polarity of the incoming data, a reflection attenuator, implemented by using forward biased pin diode terminations and controlled by the absolute values of the baseband pulse amplitude modulation (PAM) signal, and a variable reflection phase shifter to adjust for the phase error. To realize modulated signal filtering and to compensate for the nonlinearities, a combined prefiltering and predistortion block is used to shape the baseband PAM signal in each path. Finally, a power combiner is used to combine signals from the two paths into one high power QAM modulated and filtered output signal at microwave frequency.

18 Claims, 3 Drawing Sheets

