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A New Method for Measuring Noise Figure of Microwave Transistor

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ABSTRACT

Some methods for measuring noise figure of microwave transistor have been reported, such as IF attenuator method, RF attenuator method and "twice testing method".

Using IF attenuator method, the noise figure of the testing device only can be calculated by using the formula of cascade amplifiers because the contribution of receiver noise figure has been included in the overall noise figure. Using RF attenuator method, since there is a higher inset loss in microwave attenuator and need adding isolators in its two ports, so it is very difficult to measure the noise figure of single stage microwave transistor amplifier. Although the "twice testing method" can directly get the noise figure of a device, it is very troublesome for measuring and difficult for getting good accuracy.

In this paper we shall introduce a new method which only measure once and then the noise figure of the testing device can directly be obtained without using the noise figure formula of cascade amplifiers.

This method is based on a receiver which microwave signal is modulated by sine-wave as shown in Fig. 1. The microwave signal entered PIN modulator is modulated by sine-wave audio signal, then the signal enters into mix/amp stages, the signal is mixed and amplified there. After major IF, the sine-wave audio signal demodulated by diode. Finally, via high gain narrow-band selecting frequency amplifier and phase detector, the indication can be got.

During these steps, from mixing stage to major IF, the noise generated in these stages hasn't been modulated by modulator and became dc component in the demodulator. This noise signal couldn't enter into high gain selecting frequency amplifier, so there is no indication in phase detector.

The measuring system of ultilizing such microwave modulating receiver is shown in Fig.2. The measuring steps are just the same as IF attenuator method. Its main features are:

1. The measured result is only the noise figure of device without the contribution of receiver;
2. By using the microwave modulation which has a high resolution, so the measuring accuracy can be increased.

In Fig.3, the measured noise figure results of our GaAs MESFET have been drawn from 6-18 GHz frequency range.

I would like to thank Wang Tei-shan and Jiang Baochu for their technical assistance.

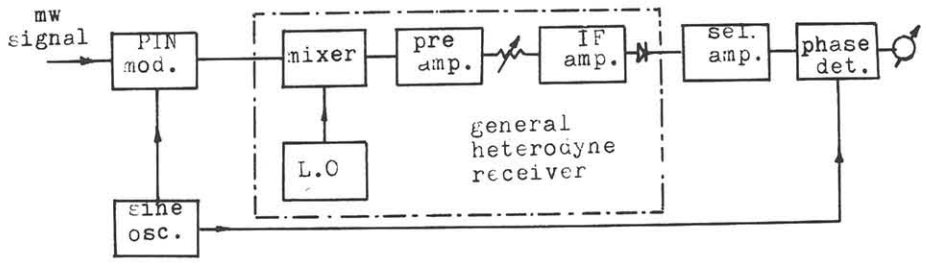

Fig. 1. Microwave modulation receiver block diagram.

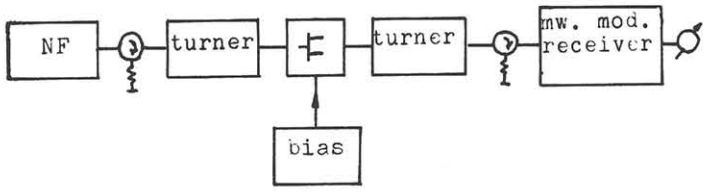

Fig. 2. Testing GaAsFET noise figure system at 6-18 GHz

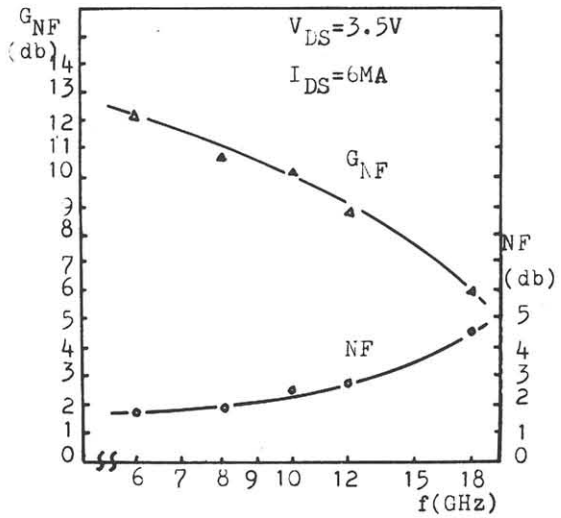

Fig.3. Measured relative of GaAsFET noise figure with frequency