摘　　要

本論文中主要針對衛星降頻接收器(Satellite Down conversion Receiver)架構中混波器進行研究與設計，並透過對砷化稼元件特性的研究及量測來設計”主動平衡切換式混波器”,此混波器具有低雜訊指數, 高轉換增益,低射頻反射損失等特性。

在混波器的設計方面，我使用 RO4003 20mil 1/2 OZ 的電路板及 NEC HEMT 異質接面元件來設計電路。電路架構參考主動平衡汲集驅動混波器，並利用量測的結果設計由本地震盪信號控制的阻抗轉換電路取代射頻輸入端的分合器(Hybrid), 以降低雜訊指數及降低射頻反射損失, 再於汲集輸出端以”Balun”相連接於本地震盪信號, 分時驅動兩個微波主動元件.

我們利用向量網路分析儀 HP-8510 的 TRL 校正功能, 使用低損失電路板 RO4003 20mil 1/2 OZ 設計 ”Thru”, “Line”和”Short”測具, 並量測 NEC HEMT 元件在 10~13GHz 頻率範圍,不同偏'壓狀況之下的 S-參數.

我使用量測的 S-參數設計”主動平衡切換式混波器”, 此混波器經由實作後量測結果得到,在射頻輸入 11.95GHz，本地震盪信號 10.0GHz,中頻 1.95GHz 的操作狀態下，得到 6dB 轉換增益，<-20dB 的射頻反射損失，4.3dB 的雜訊指數,合乎原始設計需求。

ABSTRACT

In this thesis, researches and studies on Mixer topologies that mainly used for satellite down conversion receiver are presented by characterizing and measuring parameter of GaAs devices. A high performance mixer " Active balanced switching mixer" with low noise, high gain and low reflection coefficient could be attained.

I choose a low-loss PCB (RO4003, 20mil, 1/2 once copper coating, loss tangent=0.002) and NEC HEMT FET device to design our circuit. The circuit structure of Mixers presented in this thesis is mainly composed of active balance common collector FETs; the Hybrid circuit of RF input in typical mixer structures is replaced by using the design of phase-shifters to reduce the noise figure and improve return-loss. In the collector output, balun connecting LO signal is used to drive two active microwave devices simultaneously.

The GaAs device are measured by VNA (Vector Network Analyzer, Agilent 8510C) with specific TRL calibration, witch design and fabricate the calibration tooling and fixtures of through, short, and line with RO4003 PCB (20mils, 1/2 once copper coating). And we can get some different S-parameters of such devices with varying bias condition at the frequency range from 10 to 13 GHz.

I used the parameters from measured devices to implement in the "Active balanced switching mixer", make a measurement results show that with a RF input signal of 11.95GHz, LO signal of 10GHz, then an IF signal at 1.95GHz, the conversion gain of mixer is 6.5dB, maximum return loss is -20dB and noise figure is 4.3dB, meet our requirement.

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