International Journal of Electrical and Computer Engineering (IJECE)
Vol. 7, No. 2, April 2017, pp. 791~798
ISSN: 2088-8708, DOI: 10.11591/ijece.v7i2.pp791-798

Development of Compact P-Band Vector Reflectometer

Yi Lung Then[1], Kok Yeow You[2], Ming Hao Lee[3], Chia Yew Lee[4]
[1]Electrical and Electronic Engineering Department, Faculty of Engineering, Computing and Science, Swinburne University of Technology, Sarawak Campus, 93350 Kuching, Malaysia
[2,3,4]Communication Engineering Department, Faculty of Electrical Engineering, Universiti Teknologi Malaysia, 81300 UTM Skudai, Malaysia

Article Info

Article history:

Received Aug 9, 2016
Revised Mar 18, 2017
Accepted Mar 30, 2017

Keyword:

One port calibration
P-band
Reflection coefficient
Surface mount device (SMD)
Vector reflectometer

ABSTRACT

A compact and low cost portable vector reflectometer is designed for a reliable measurement of reflection coefficient, S_{11}. This reflectometer focuses on return loss measurement of frequency ranges from 450 MHz to 550 MHz. The detection of magnitude and phase is based on the utilization of surface mount Analog Devices AD8302 gain/phase detector. The data acquisition is controlled by using Arduino-Nano 3.0 microcontroller, with the use of two analog to digital converter (ADC) and a digital to analog converter (DAC). One port (Open, short and matched load) calibration technique is used to eliminate systematic errors prior to data acquisition. The evaluation of the reflectometer is done by comparing the result of the measurement to that of vector network analyzer.

Corresponding Author:

Kok Yeow You,
Communication Engineering Department,
Faculty of Electrical Engineering,
Universiti Teknologi Malaysia, 81300 UTM Skudai, Malaysia.
Email: kyyou@fke.utm.my

1. INTRODUCTION

The demand for analysis and measurement equipment for microwave device is rather promising due to the rapid development of communication devices. Existing equipment for measuring parameters, specifically the S-parameters in high frequency circuits or radio frequency (RF) devices, such as network analyzers are too costly and bulky to be portable for handheld measurement purposes. As an alternative to this matter, a more compact and low cost reflectometer is developed for reliable measurement of reflection coefficient, S_{11} or so-called return loss.

Reflection coefficient is the complex ratio of reflected voltage, V_r to incident voltage V_i, from which the operating frequency and response of a device under test (DUT) over a range of frequency is determined. In other words, reflectometer measures how much power is reflected from the DUT with reference to the incident power.

Some of the earlier researches were on the development of six-ports vector reflectometers for industrial purposes covering frequency from 2.2 GHz to 2.7 GHz, especially for determining operating frequency of microwave device and assist in impedance matching [1]. The six-port reflectometer obtained phase reading by deducing from the power measurement readings at several ports based on the idea of phase-shift interferometry. However, there are some of crucial issues with six-port reflectometer, such as complicated calibration and requirement of complex computation to obtain the actual measurement. Therefore, some modifications are implemented by simplifying the complexity of circuit to fewer ports, which lead to four-port reflectometer which utilizes a single detector [2] and able to operate in both reflection and transmission modes.