Lab1 Introduction to the Power Meter and Spectrum Analyzer

Name _____ Student ID _____

TA _____ Score _____

Objectives

1. To learn the basic concept of frequency domain measurements.
2. To be familiar with the features and basic operations of the FieldFox Handheld Microwave Analyzer, which can not only work as a Spectrum Analyzer to measure the frequency content of a signal, but also as a Power Meter to measure the signal power.
3. To observe the typical periodic signals in frequency domain by Spectrum Analyzer so as to be familiar with the spectrum characteristics and to be able to read the key parameters from the signal spectrum.
4. To measure the Power over a defined bandwidth of the typical periodic signals by Power Meter.
5. To be familiar with Fourier transform, and be able to analyze the time domain and frequency domain characteristics of typical signals with MATLAB.
6. Have a clear understanding of the conversion between voltage and power at different load impedence.
7. To be familiar with the conversion among power units, such as W, mW, dBW and dBm.

Test and Measurement Equipment

The following equipment and accessories will be used in this lab session.

1. Signal Generator
2. FieldFox Handheld Microwave Analyzer
3. Digital oscilloscope
4. BNC Coaxial Cables
5. BNC/SMA connectors
6. SMA/N-Type connectors

Procedure

1. Setup testbench

Using the experimental setup shown in Fig.1, connect the output port of the Signal Generator to RF signal **input** port of FieldFox Handheld Microwave Analyzer by a microwave a coax able. The one side of the microwave coax able is equipped with SMA to BNC adapter so as to connect to the Signal Generator output port, the other side of the microwave coax cable is equipped with SMA to N-type adapter so as to connect to the RF signal input port of FieldFox Handheld Microwave Analyzer.

Caution :

8. It should be noted that the FieldFox Handheld Microwave Analyzer has two RF signal ports, namely RF signal input port and RF signal output port, as shown in Fig.1 Because the purpose of this experiment is to observe the spectrum characteristics of the typical signals, so the output port of the Signal Generator should connect to the RF signal **input** port of FieldFox Handheld Microwave Analyzer .
9. In addition, in order to protect the input of the spectrum analyzer, please make absolutely certain that the signal at the output of the signal generators does not exceed 5 Vp-p.
10. To avoid damaging connections, grip the adapter and spin the hex cable end to loosen. Spinning the adapter can quickly damage connectors.

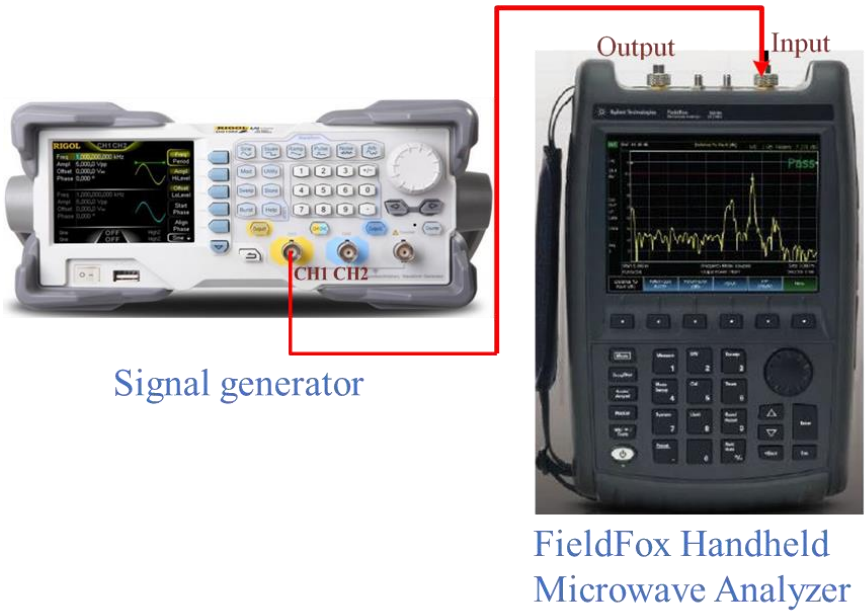

Figure 1: Experimental setup – measurement of the power spectrum

2. Spectrum Analyzer Mode

1) Use the Signal Generator to generate the waveforms listed in table1, and set FieldFox Handheld Microwave Analyzer as **Spectrum Analyzer Mode** to measure the spectrum of the waveforms.

Table 1: Signals generated by Signal Generator

Waveforms	Frequency (MHz)	Magnitude	Duty cycle
1. Sine Wave	10	1 Vpp, 0 V offset	/
2. Sine Wave	10	0.5 Vpp, 0 V offset	/
3. Square Wave	5	0.5 Vpp, 0 V offset	50%
4. Square Wave	5	0.5 Vpp, 0 V offset	75%

Please pay particular attention to appropriate selection of the spectrum analyzer settings, including the **center frequency (is the signal frequency)**, frequency span, frequency points and so on. It is recommended that the frequency span for Sine Wave is set to be 20MHz, for quare Wave is set to be 80MHz, separately.

2) Observe the spectrum on the FieldFox Handheld Microwave Analyzer.When doing so, remember to adjust the Reference Level control until the input signal spectrum can be observed well on the screen, and the marker function should be used to clearly indicate the signal power versus frequency.

3) Take photographs of your spectrums.

3. Power Meter Mode

1) Set the output impedence of Signal Generator to 50 Ω.

2) Set FieldFox Handheld Microwave Analyzer to Power Meter Mode so as to measure the signal power,and set the parameter as below:

   For Sine Wave : center frequency is 10MHz, frequency span is 1MHz

   For Square Wave : center frequency is 50MHz, frequency span is 100MHz.

3) Take photographs of your results.

4. Observe the signal in time domian

1) Disconnect the FieldFox Handheld Microwave Analyzer from the Signal Generator
2) Connect the Signal Generator to the Oscilloscope.
3) Set the output impedence of Signal Generator to High impedence.
4) Use the oscilloscope to observe the signal waveform ,maker the amplitude versus time
5) Take photographs of your results.

Report

1. General Guidelines for Writing the Lab Reports

The report you turn in after completion of each lab is the main product used for grading, therefore you should pay enough attention to the report. There is no one best format for the reports but there are a few simple rules which should be followed:

1. All the reports must be written in English, and need to be clear and coherent.
2. The lab report should be complete, where all information requested should be in the lab report, this includes overall organization, presentation of graphics and tables, grammar and wording, and overall clarity of writing
3. The discussion and conclusions are also very important in a report to show that you have a good understanding of the lab.

2. Lab1 Reports

1. The lab report shall include the waveform, spectrum and power value screenshot of each measured signal in the experiment.
2. Use the Matlab to sketch both waveform and spectrum of each signal shown in Table 1.
3. Calculate the theoretical power values of each waveform, and compare the predicted theoretical power values to the measured results (the process of theoretical calculation needs to be included in your report).
4. Give reasonable analysis for the errors.

Table 2:

Waveforms	Frequency	Magnitude	Signal Power		Error analysis
			Theoretical value	Measured value	
1. Sine Wave	10 MHz	1 Vpp, 0 V offset			
2. Sine Wave	10 MHz	0.5 Vpp, 0 V offset			
3. Square Wave	5 MHz	0.5 Vpp, 0 V offset, 50% duty cycle			
4. Square Wave	5 MHz	0.5 Vpp, 0 V offset, 75% duty cycle			