LAB 6 - Resonant Quarter-Wave Transformer Using 50 Ohm Cable

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Purpose:

To frequency sweep a random length of transmission line and determine where it behaves as a series and parallel resonance.

Equipment:

- Agilent 8647A RF signal source
- Agilent E4411B Spectrum Analyzer
- Agilent 8712ES RF VNA
- BNC T connector
- BNC to BNC cable (RG-58)
- 1 open-end length of RG-58 (1 meter)

Procedure:

1. Measure the length of the RG-58 coaxial cable supplied and calculate the frequency at which it behaves as a resonant quarter wave transformer. Take into account the velocity factor. Assume an open-end termination.

2. Connect the RF signal generator to one of the inputs of the T connector at the spectrum analyzer with a 50 ohm coax cable. Connect the other end of the T connector to the open ended RG-58. Set the center frequency of the spectrum analyzer to 100 MHz and the span to 500 MHz initially. (Spectrum Analyzer settings for frequency and span will vary depending on the length of cable used.)

3. Set the control on the RF signal generator to frequency and sweep the line over a wide range of frequencies. Set the signal amplitude to an appropriate level. You can adjust the frequency range manually with the rotary control knob and note how the power levels vary in a repetitive pattern on the spectrum analyzer display.

4. Compile a table of values for power in dBm versus frequency over one wavelength and plot the results in graphical form labeling frequencies where minimum and maximum signal levels occur.

5. Use the results of step 4 to indicate where the line behaves as a series and parallel resonant circuit.

6. Repeat steps 3, 4 and 5 for a shorted termination. What phase difference exists between peaks of the open line and the shorted line.

7. Now connect the same transmission line (open end) to the Vector Network Analyzer. Sweep the line (50 MHz to 800 MHz) and note the characteristics of the line in Smith Chart and SWR format. Take note of the result. Now terminate the line with a matched load. You may need to select SCALE in order to AUTOSCALE the results. Explain the change. What happens to SWR as frequency increases? Can you account for this observation?

Note: A printout of results from the VNA can be saved on a floppy disc and inserted into a computer program for your lab report.