Feng Chia University

Electrical Engineering Fundamentals I Lab

Laboratory 7

Step Response Measurement

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Experiment Date:30/11/2023

1. Introduction
2. Display a specified step response on your oscilloscope of a specified network.
3. Document the step response and accurately calculate time constants for the specified network.
4. Use the step response technique to characterize an unknown capacitor or inductor which includes:
   1. Selecting and analyzing the model for the device under test
   2. (DUT).
   3. Designing and preparing an appropriate measurement circuit.
   4. Computing the capacitance or the inductance based on the time constant and analysis of the measurement circuit.
5. Materials
   1. Waveform Generator
   2. Oscilloscope
   3. Components
      1. Variable Resistor RT
      2. Resistors: R = 1 kΩ

Capacitor: C = 0.1µF

* + 1. Resistors: R = 1 kΩ

Inductor: L = 4.7 mH

1. Circuit diagram

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自動產生的描述

▲ Figure 1. Circuit of Experiment 7.a Properties of Instruments step 1

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▲ Figure 2. Circuit of Experiment 7.a Properties of Instruments step 2

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▲ Figure 3. Circuit of Experiment 7.a Properties of Instruments step 3~5

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▲ Figure 4. Circuit of Experiment 7.b Measurement of a Known Typical

Capacitor

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▲ Figure 5. Circuit of Experiment 7.c Measurement of a Precision Inductor

1. Methods

Make measurements on oscilloscope and use digital multimeter on the resistor

1. Experiments data
   1. Experiment 7.a Properties of Instruments

Table 1: Results of the capacitor of Oscilloscope

|  |  |  |  |
| --- | --- | --- | --- |
| Rs | Rsc | τ | Csc |
| 52.9020 Ω | 0.9842 MΩ | 49.0000 ns | 926.2410 pF |

* 1. Experiment 7.b Measurement of a Known Typical Capacitor

Table 2: Measurement of known capacitor

|  |  |  |  |
| --- | --- | --- | --- |
| RTh | τ | Ceq | C |
| 1052.9020 Ω | 102.6000 μs | 97.4450 nF | 96.5187 nF |

Table 3: Percentage error of measurement of known capacitor

|  |  |  |
| --- | --- | --- |
| Measured | Theoretical | % Error |
| 96.5187 nF | 100 nF | -3.48% |

* 1. Experiment 7.c Measurement of a Precision Inductor

Table 4: Measurement of inductor

|  |  |  |
| --- | --- | --- |
| Req | τ | L |
| 1052.902 Ω | 4.4800 μs | 4.7170 mH |

Table 5: Percentage error of measurement of inductor

|  |  |  |
| --- | --- | --- |
| Measured | Theoretical | % Error |
| 4.7170 mH | 4.7 mH | 0.36% |

1. Results

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▲ Figure 6. Curve of Experiment 7.a Properties of Instruments

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▲ Figure 7. Curve of Experiment 7.b Measurement of a Known Typical

Capacitor

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▲ Figure 8. Curve of Experiment 7.c Measurement of a Precision Inductor

1. Discussion

With proper measurement, the value of capacitors and inductors can be obtained easily.

1. Conclusion

On capacitors and inductors, it’s easy to observe that these two kinds of circuits can make step response and let the waves become smooth.