Electronic laboratory practise - lab report example

Electronic Laboratory Practise

Electronic Laboratory practice Electronic Laboratory practice In this report, a digital multimeter was used in taking current and resistance readings respectively. The oscilloscope was also used to determine voltage and frequency measurements. Some waveforms of AC superimposed on DC were also shown using the oscilloscope. It was noted that useful electronic applications such as a potential divider and current divider were also demonstrated. In addition, each measurement was accompanied with accuracy measurements to account for deviations from expected values.

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Electronic Laboratory Practice

1. 0 Introduction

1. 1 Objectives

The goals of the laboratory practice experiments include

i. To use digital multimeter to measure voltage, current and resistance.

ii. To use an oscilloscope to take voltage and frequency measurements.

iii. To consider and compare the accuracy of the measurements.

“ Resistors in series have the same current flowing through them while the total sum of the voltage across each resistor equals to the total voltage applied” (Duncan & Heather, 2001). Therefore, the combined resistance is given by

R= R1+R2+R3... Rn.. (1)

For resistors connected in parallel then the equivalent resistance is given by equation 2 (Monhankrishnan, 2002) below

.... (2)

In this report, knowledge and experience in the use of essential laboratory equipment was acquired. The use of the oscilloscope, the signal generator, the power supply and digital multimeter were used to understand applications of various electronic circuits. The finite accuracy of the laboratory measuring instruments was equally demonstrated.

2. 0 Methodology, Results and Analysis

2. 1 Experiment 1 (4. 1) Resistance Measurements.

Procedure:

The color coded resistors were read to establish the resistance of the resistors. After the resistance was measured using a digital meter and it was then confirmed whether the results depict similar resistance.

Results:

Table (1). Readings of resistors using (appendix 3), obtaining the tolerance values.

Resistor

1st Band

2nd Band

3rd Band

Multiplier

Tolerance

5

1

0

0

100 * 100 = 10K

%

22

2

2

Non

22 * 1 = 22

%

By measuring the resistance of the two resistors using the Agilent 34401A Digital Multimeter presented in Appendix 4, these values were obtained:

Table (2). Resistance measurements using the Agilent 34401A Digital Multimeter.

Resistors

Measured resistance

5

21. 816

22

4. 998

Analysis

The resistances measured are approximately equal with slight variation that is due to manufacturers errors that cannot be avoided in the manufacturing process (Purrington, 1997). The tolerances provided define the appropriate limit of acceptable resistance. For the 5 ohms resistor (5 ± 0. 05) therefore 4. 998 is within the range. Similarly, the lower boundary for 22 ohm resistor is (22± 1. 1) while the 20. 9 ohms lower boundary lies within the range.

2. 2 Experiment 2 (4. 2) Voltage Measurement (and the Voltage Divider).

Theory

According to the operation laws of a voltage divider, the larger resistance always gets the highest share. Thus

Where is the voltage across resistor. Voltage across can also be determined in a similar way by replacing the numerator with

Procedure

The likely estimate of the voltages when 5 ohms and 22 ohms resistors were connected to 6. 0 V supply to create a potential divider was determined theoretically. A digital multimeter was connected across each of the resistors and voltages obtained were compared. The results obtained were recorded as shown.

Results

Voltage expected was as following:

V1 =

V2 =

Measured voltage across resistors using the Agilent 34401A Multimeter gives the following values:

V1 = 1. 21 V

V2 = 4. 896 V

Analysis

From the results obtained, it is clear that the larger resistor receives the greatest share of the voltage in a voltage divider. Internal resistance of the multimeter adversely affects the measured voltage in cases where large current is drawn (Hector, Lein, & Scouten, 1943). In this case the amount of current drawn is relatively small hence there is no significant effect on the measured voltage.

2. 3 Experiment 3 (4. 3) Current Measurement (and the Current Divider).

According to ohms law

but

moreover, but for series connection

Implying that

but

but

Similarly

Theory

For a parallel connection, the current divides into two components. The resistors share resistance in such a way that the largest resistor receives the smallest current such that

for two resistors connected in a parallel circuit.

Procedure

The current through the two resistors which were in parallel was determined theoretically and using a digital multimeter. The power dissipation was equally estimated using the data obtained. The following results were obtained.

Results

The theoretical values are:

IT =

I1 = 1. 47 *

I2 =

The measured values were:

IT = 1. 47 A

I1 = 0. 276 A

I2 = 1. 203 A

Analysis

The current determined theoretically is almost the same as the current measured as shown above.

According to ohms law

but

total EMF

for parallel connection

however, substituting for

Similarly

Power dissipation

2. 4 Experiment 4 (5. 2) Voltage and Frequency Measurement

Procedure

The signal generator was set to a sinusoidal wave at a frequency of 200 kHz and 50 ohms resistor was connected to the output of the oscilloscope. The peak to peak and the root mean square voltages were measured. The period was also measured and results were recorded as shown below. The output voltage and the frequency were changed to 100 V and 2MHz respectively and the whole process was repeated.

Results

Table (3): The reading of the 51resistor.

Resistor

1st Band

2nd Band

3rd band

Multiplier

Tolerance

51

5

1

Non

51 * 1 = 51

Using the oscilloscope:

The value of the Vpp across the 51= 5. 13 ± 0. 13 V

The value of the Vrms across the 51 = 1. 80 ± 0. 03V

The theoretical Vrms = V

The value of the root mean square voltage obtained is half of the voltage from the output of the generator

A source of error in terms of was (the oscilloscope Vrms – the theoretical Vrms) = 1. 80 – 1. 77 =0. 03 V

The period of the signal was 5

The theoretical value of the period of the signal = =

After changing the output to a 100mVpp and the sinusoidal waveform to

2MHz these values were obtained:

The period = 495

The Vrms = 30. 8mV

The Vpp = 113mV

The theoretical value of Vrms =

To get the source of error subtract the oscilloscope Vrms from the theoretical Vrms

= 35. 36 - 30. 80 = 4. 56mV. The tolerance of the resistor was 5% that significantly contribute to the source of error in all cases.

Analysis

The tolerance of the resistor used suggests the most obvious source of the error in this experiment. Because the theoretical values differ significantly with the practical values, and then these seem the most likely source of the mistake. Another possible source of error could be due to the deviation of resistance from the theoretical resistance of the resistor used. This is estimated by the tolerance of the resistor.

2. 5 Experiment 5 (5. 3) AC Superimposed on DC

Procedure

The oscilloscope time base was set to 50 microseconds while channel 1 and 2 were set to DC modes respectively.

Results

After setting the oscilloscope time-base to 50, graphs were shown in the oscilloscope for ground, AC and DC.

The figure (2) displays the spectrum of DC signal obtained with a peak to peak voltage of 10. 3V and root mean square voltage of 3. 545V when the oscilloscope was set at a time base of 100 microseconds

Figure (3). DC graph on the oscilloscope when connecting the time base to 50

Analysis

From the graph, the root mean square voltage was determined to be 61mV while the peak to peak voltage was 300mV. The root mean square voltage was 6. 996V and a peak to peak voltage of 10. 3V at a time base of 100 microseconds. Switching to ground gives a straight line that represent the position of 0 Volts. Toggling the signal to DC gives the distance of the signal from the ground. Switching back to AC removes the DC component and show oscillations around the ground marker as illustrated in diagrams on the appendix.

3. 0 Discussion and Conclusion

In conclusion, majority of the objectives were satisfied. The potential divider and the current divider which are critical components of electrical circuits were demonstrated. Practice on the application of digital multimeter and oscilloscope in measurement of current, voltage and resistance was also achieved. Error estimation was also described in some cases and the impact it has especially in understanding electrical circuits. Ohms law that relates I, V and R, was equally applied in conceptualizing the operation of voltage and current dividers respectively. Thus, the knowledge acquired is necessary in design, construction, analysis and interpretation of electrical circuits.

References

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1. Appendix