Part 2

Experiments Manual

Note: The tables in this part contain representative data for the experiments in the ninth edition. Variations from the data may be expected, depending on the accuracy of the equipment used and the tolerance of the components. Measurements were made with both digital and analog test equipment, along with Multisim simulation software.

Experiment 1

TABLE 1-1 VOLTAGE SOURCE

R	Estimated V_L	Measured V_L
0 Ω	10 V	10 V
10 Ω	10 V	9.99 V
100 Ω	9.9 V	9.91 V
470 Ω	9.5 V	9.53 V

TABLE 1-2 CURRENT SOURCE

R_L	Estimated I_L	Measured I_L
0 Ω	10 mA	9.36 mA
10 Ω	9.9 mA	9.28 mA
47 Ω	9.5 mA	8.94 mA
100 Ω	9 mA	8.56 mA

TABLE 1-3 TROUBLESHOOTING

Trouble	Measured V_L
Shorted load	0 V
Open load	10 V

TABLE 1-4 CRITICAL THINKING

Type	R	Measured Quantity
Voltage source	100 Ω	9.91 V
Current source	10 kΩ	0.98 mA

ANSWERS

1. **d**
2. **b**
3. **b**
4. **b**
5. **a**
6. A stiff voltage source has an internal resistance that is less than 1⁄100 of the load resistance, whereas a stiff current source has an internal resistance that is at least 100 times the load resistance.
7. A shorted load has zero resistance. Ohm's law says that the load voltage equals the load current times the load resistance. The product of load current times zero gives zero load voltage.
8. With the load resistor open, the current through the series resistor R of Fig. 1-1 is zero. Therefore, Ohm's law tells us that no voltage is dropped across R. Kirchhoff's voltage law tells us the sum of voltages around the loop is zero; therefore, the load voltage equals the source voltage.
9. 1 MΩ: For the current source to appear stiff, its internal resistance must be at least 100 times the maximum load resistance. In this case, 100(10 kΩ) is 1 MΩ.

Experiment 2

TABLE 2-1 THEVENIN VALUES

	V_{TH}	R_{TH}	I_N
Calculated	5.43 V	2.39 kΩ	2.23 mA
Measured	5.67 V	2.36 kΩ	2.40 mA

TABLE 2-2 LOAD VOLTAGES

	V_L for 1 kΩ	V_L for 4.7 kΩ
Calculated	1.6 V	3.6 V
Measured	1.76 V	3.83 V

TABLE 2-3 TROUBLESHOOTING

	Estimated		Measured	
Trouble	V_{TH}	R_{TH}	V_{TH}	R_{TH}
Shorted 2.2 kΩ	1.5 V	1 kΩ	1.52 V	1.13 kΩ
Open 2.2 kΩ	15 V	5.4 kΩ	15 V	5.13 kΩ

TABLE 2-4 CRITICAL THINKING

			R_{TH}	V_{TH}
Thev Calculated Values			2.2 kΩ	13.2 V
	Calculated		Thev	Measured
	Nor Ckt	Thev Ckt	Multisim	Actual
I_{Load}	1.08 mA	1.08 mA	1.08 mA	1 mA
V_{Load}	10.8 V	10.8 V	10.80 V	10.8 V

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TABLE 2-5

R_{TH} =600 Ω

ANSWERS

1. b
2. c
3. d
4. d
5. a

6. The calculated Thevenin resistance is 2.39 kΩ. A load of 100 kΩ implies the load voltage will be down approximately 2 percent from the ideal open-load or Thevenin voltage. This means the voltmeter reads slightly less than the ideal Thevenin voltage.
7. In Fig. 2-1*a*, a shorted 2.2-kΩ resistor means the voltage
8. between point *A* and common is lower than it should be, which implies a Thevenin voltage that is less than before.

   Also, the shorted resistor means less Thevenin resistance.
9. In Fig. 2-1*a*, an open 2.2-kΩ resistor implies that all of the source voltage will appear across the *AB* terminals when the load is open. Furthermore, opening the resistor will increase the Thevenin resistance.
10. If I wanted to stay in business, I had better produce batteries with very low internal resistance because batteries are supposed to act like stiff voltage sources for most load resistances.

Experiment 3

TABLE 3-1 TROUBLES AND VOLTAGES

Trouble	V_A	V_B
Circuit OK	5.21 V	1.06 V
R_1 open	0	0
R_2 open	6.9 V	1.41 V
R_3 open	6.81 V	0
R_4 open	6.81 V	6.81 V
R_1 shorted	10 V	2.04 V
R_2 shorted	0	0
R_3 shorted	2.72 V	2.72 V
R_4 shorted	4.92 V	0

TABLE 3-2 TROUBLES AND VOLTAGES

	TP-A	TP-B	TP-C	TP-D
Circuit OK	11.8 Vp-p	10.8 Vp-p	8.6 Vp-p	4.7 Vp-p
R_1 Shorted	11.8 Vp-p	11.8 Vp-p	9.39 Vp-p	5.13 Vp-p
R_2 Open	11.8 Vp-p	11.8 Vp-p	0 Vp-p	0 Vp-p
R_3 Shorted	11.8 Vp-p	10.3 Vp-p	7.02 Vp-p	7.02 Vp-p
R_4 Open	11.8 Vp-p	11.8 Vp-p	11.8 Vp-p	11.8 Vp-p
OBSERVATIONS				
Shorted Component	The voltage is the same on both sides of the component. The other circuit voltages have changed in value.			
Open Component	The voltage remains at the applied voltage value up to the open component.			

ANSWERS

1. a
2. c
3. d
4. d
5. d
6. a
7. c
8. a
9. a
10. d

Experiment 4

TABLE 4-1 OHMMETER TESTING

	Expected	Measured 1	Measured 2	Measured 3
R_F	Low	25 Ω	24 Ω	26 Ω
R_R	High	Infinite	Infinite	Infinite

TABLE 4-2 DMM TESTING

	Measured 1	Measured 2	Measured 3
Forward	0.552 V	0.571 V	0.544 V
Reverse	OL	OL	OL

TABLE 4-3 DATA FOR FORWARD BIAS

	Calculated		Measured	
	V_D	V_L	V_D	V_L
Diode 1	0.7 V	9.3 V	0.68 V	9.32 V
Diode 2	0.7 V	9.3 V	0.72 V	9.28 V

TABLE 4-4 DATA FOR REVERSE BIAS

	Calculated		Measured	
	V_D	V_L	V_D	V_L
Diode 1	10 V	0	10 V	0
Diode 2	10 V	0	10 V	0
Diode 3	10 V	0	10 V	0

TABLE 4-5 DIODE CONDUCTION

	D_1	D_2	D_3	D_4
Normal	On	Off	Off	On
Reversed	Off	On	On	Off

TABLE 4-6 DIODE CONDUCTION

	D_1	D_2	D_3	D_4
Normal	On	On	Off	Off
Reversed	Off	Off	On	On

TABLE 4-7 DIODE AND LOAD VOLTAGES

V_{D1}	V_{D2}	V_{D3}	V_{D4}	V_L	
Calculated	0.7 V	0.7 V	9.3 V	9.3 V	8.6 V
Measured	0.68 V	0.72 V	9.32 V	9.28 V	8.6 V

ANSWERS

1. a
2. b
3. d
4. c
5. b
6. b
7. c
8. b
9. a
10. c

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