**中山大学**

**电路与电子学实验课程实验报告**



实验主题\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

实验时间\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **实验原理：**  基尔霍夫定律包括电流定律（KCL）和电压定律（KVL），简单地来说，我们需要验证的是电路中任一节点的Σi=0及任意一个回路ΣV=0。而叠加定理则是验证任一支路电流（电压）是电路中各个独立电源单独作用在该路产生的电流（或电压）之和。 |
| **注意事项：**  这两个实验可以用同一个电路完成，只需要对电路进行稍微的改进即可。进行基尔霍夫定律的验证时，一定要记住电流方向会影响代数和的值，我们以从“+”极流入的电流（电压）为正，“-”极流入的电流（电压）为负。而在整个实验中必须牢记的是：电压表、电流表不能超出其量程，而且在基尔霍夫定律的验证时，万用表的极性一定不能接反（或者干脆整个实验全部接反）。而我们因仪器不足或损坏，采用的是万用表测同一个元件的电压和电流，因此不需要进行电流（压）表校正。 |
| **实验仪器、设备：**  电子实验实验箱1个，RIGOL DM3058万用表1个，导线若干。 |
| **本实验所采用的仿真图纸：** |
| **实验步骤：**  （1）将SW3拨至R1处，SW4拨至R3处。将SW1拨到与B2连接，SW2拨到与B1断开，使得B2单独激励。记录R1,R2,R3上面的电流、电压。  （2）断开B2与电路的连接，将SW2拨到与B1连接，使得B1单独激励，记录R1,R2,R3上面的电流、电压。  （3）将SW1拨到与B2连接，使得B1、B2共同激励，记录R1,R2,R3上面的电流、电压。  （4）断开SW1,SW2。将SW4拨至D1处，重复（1）、（2）、（3）步测量对称非线性电路的数据。  （5）断开SW1,SW2。将SW4拨至R3处，将SW3拨至R4处，重复（1）、（2）、（3）步测量非对称线性电路的数据。  （6）断开SW1,SW2，将SW4拨至D1处，重复（1）、（2）、（3）步，测量非对称非线性电路的数据。 |
| 仿真数据表格（无内阻理想电源）：   |  |  |  |  | | --- | --- | --- | --- | | 实验条件 | 元件（物理量）名称 | 电流（mA） | 电压（V） | | 5V电源，对称线性电路 | R1 | 7.57 | -1.67 | |  | R2 | 15.1 | 3.33 | |  | R3 | 7.57 | +1.67 | | 5V电源，对称非线性电路 | R1 | 3.23 | -0.71 | |  | R2 | 19.5 | 4.28 | |  | D1 | 16.2 | 0.71 | | 5V电源，非对称非线性电路 | R4 | 3.55 | -0.71 | |  | R2 | 19.5 | 4.29 | |  | D1 | 15.9 | 0.71 | | 12V电源，对称线性电路 | R1 | 7.57 | -1.67 | |  | R2 | 15.1 | 3.33 | |  | R3 | 7.57 | 1.67 | | 12V电源，对称非线性电路 | R1 | 3.23 | -0.71 | |  | R2 | 19.5 | 4.28 | |  | D1 | 16.2 | 0.71 | | 12V电源，非对称非线性电路 | R4 | 3.55 | -0.71 | |  | R2 | 19.5 | 4.29 | |  | D1 | 15.9 | 0.71 | | 5V+12V电源，对称线性电路 | R1 | -28.8 | 6.33 | |  | R2 | -3.02 | -0.66 | |  | R3 | 25.7 | 5.66 | | 5V+12V电源，对称非线性电路 | R1 | -50.9 | 11.2 | |  | R2 | 19.1 | 4.21 | |  | D1 | 70.0 | 0.79 | | 5V+12V电源，非对称非线性电路 | R4 | -56.0 | 11.2 | |  | R2 | 19.1 | 4.21 | |  | D1 | 75.1 | 0.79 | |

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| **实验数据表格**   |  |  |  |  | | --- | --- | --- | --- | | 实验条件 | 元件名称 | 电流(mA) | 电压（V） | | 1.对称线性 |  |  |  | | 5V Source Only | R1 | 7.582 | -1.669 | |  | R2 | 15.209 | 3.328 | |  | R3 | 7.582 | 1.671 | |  |  |  |  | | 12V Source Only | R1 | -18.26 | -4.013 | |  | R2 | -36.502 | 7.985 | |  | R3 | 18.239 | 4.015 | |  |  |  |  | | 5V & 12V Source | R1 | -3.019 | -0.674 | |  | R2 | -28.975 | 6.321 | |  | R3 | 25.73 | 5.674 | |  |  |  |  | | 2.对称非线性 |  |  |  | | 5V Source Only | R1 | 3.032 | -0.667 | |  | R2 | 19.779 | 4.328 | |  | D1 | 16.657 | 0.667 | |  |  |  |  | | 12V Source Only | R1 | -51.644 | -11.278 | |  | R2 | -3.25 | -0.714 | |  | D1 | 48.248 | 0.714 | |  |  |  |  | | 5V & 12V Source | R1 | -51.806 | 11.26 | |  | R2 | 19.418 | 4.226 | |  | D1 | 70.915 | 0.731 | |  |  |  |  | | 3.非对称非线性 |  |  |  | | 5V Source Only | R1 | 19.715 | -4.33 | |  | R2 | 3.323 | 0.665 | |  | D1 | 16.29 | 0.667 | |  |  |  |  | | 12V Source Only | R1 | -56.43 | 11.272 | |  | R2 | -3.267 | -0.718 | |  | D1 | 53.318 | 0.719 | |  |  |  |  | | 5V & 12V Source | R1 | -56.956 | 11.256 | |  | R2 | 19.397 | 4.262 | |  | D1 | 75.296 | 0.734 | |
| **由实验数据得出的结论**  在实验误差的范围内，通过分析数据可得IR2=IR1(4)+IR3(D1)，验证了KCL定律。通过分析数据可得VR1(4)+VR3(D1)+VB1=0或VR2+VR3(D1)+VB2=0，验证了KVL定律。而在线性电路中，可得B1单独激励的IR1+B2单独激励的IR1=B1、B2共同激励的IR1叠加定理成立。而对于非线性电路来说，叠加定理不成立。 |
| **实验数据误差分析**  我们可以从数据中观察到，当电路中没有二极管1N5401时，实验数据与仿真数据误差相当小，其误差应在于电阻及导线还有万用表的功率损耗所导致的分流或压降。而当接入二极管到电路时，实测数据与仿真数据有一定较小误差，但误差率比线性电路要大，初步认为是仿真软件中对二极管的拟合有差异或者实验中所用二极管与仿真中的二极管差别较大。 |
| **对该实验的总结和反思**  一定要学会怎么排除故障！QAQ。我们就是因为万用表表笔坏了，排除了至少半小时的故障，从而导致我们的非线性对称电路实验无法完成（时间不够了）。心情就非常糟。而且画仿真图纸的时候接线接的特别丑！我们俩都受不了于是又有相当一部分的时间花在了如何让接线变得美观上，当日心情：暴躁。然后发现仿真图纸上的KCL定律验证的物理量居然误差很大（？）冷静分析，发现是调的单位精度太小（以A为单位），于是调到mA级别，成功将误差减小。 |