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Appendix A

Software appendix

A.1 LabVIEW™

The LabVIEW™ program, which is used to calculate the parameters of the Randles cell and the Randles-Warburg cell, is illustrated in Figure A.1 to Figure A.6. The figures are used to illustrate how the parameters are calculated using LabVIEW™.

A.1.1 Front panels

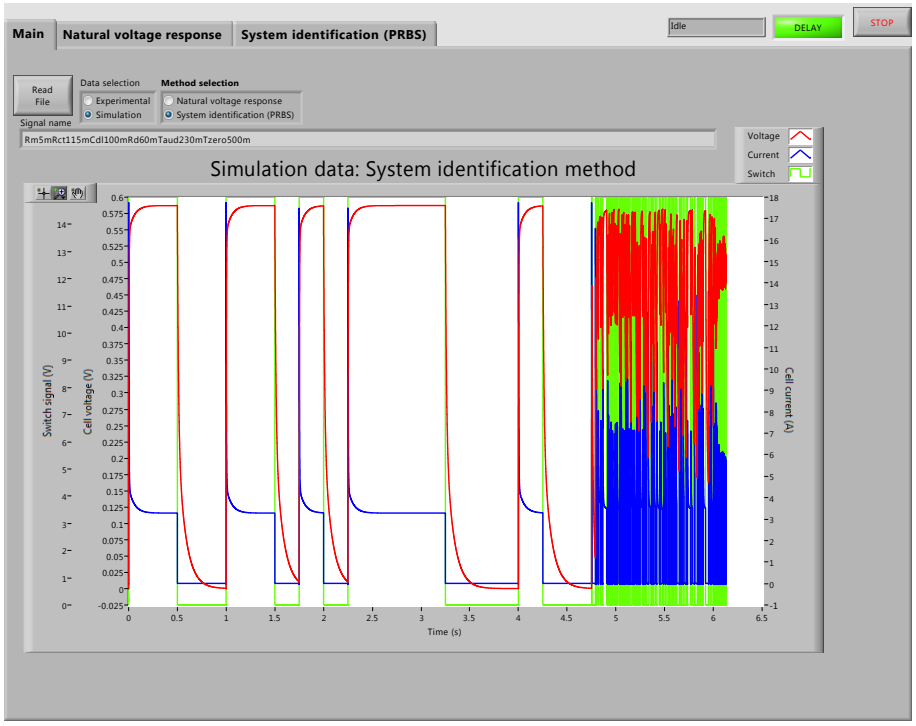


Figure A.1: LabVIEW™ front panel 1

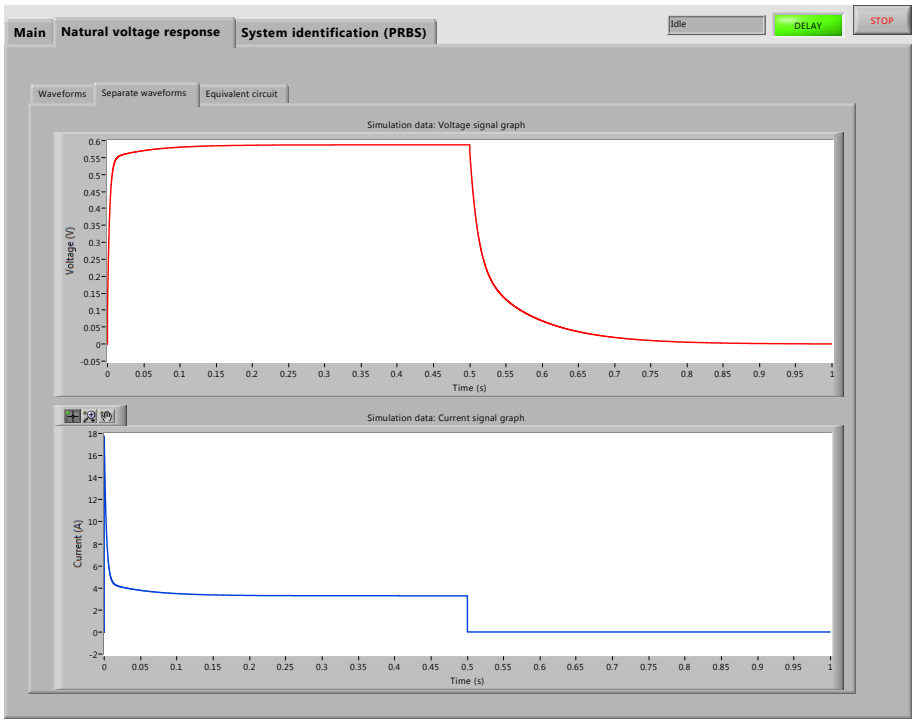


Figure A.2: LabVIEW™ front panel 2

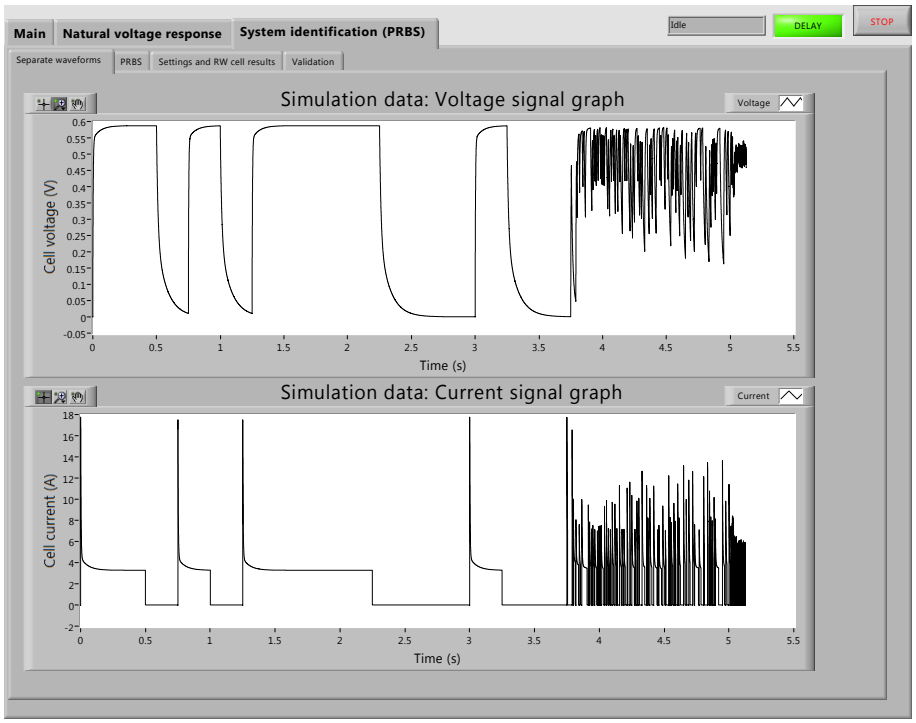


Figure A.3: LabVIEW™ front panel 3

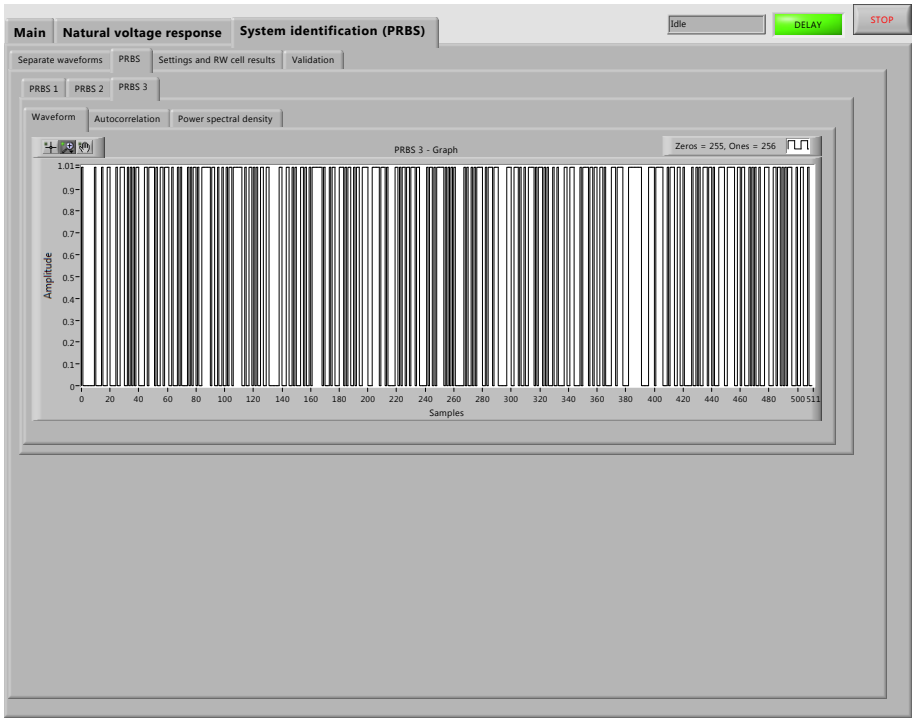


Figure A.4: LabVIEW™ front panel 4

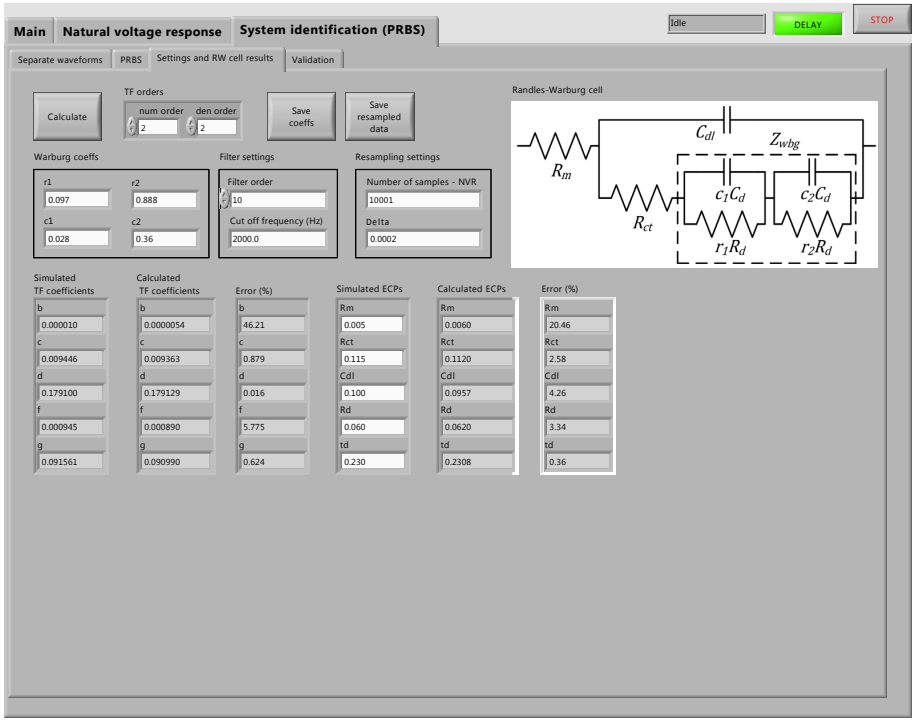


Figure A.5: LabVIEW™ front panel 5

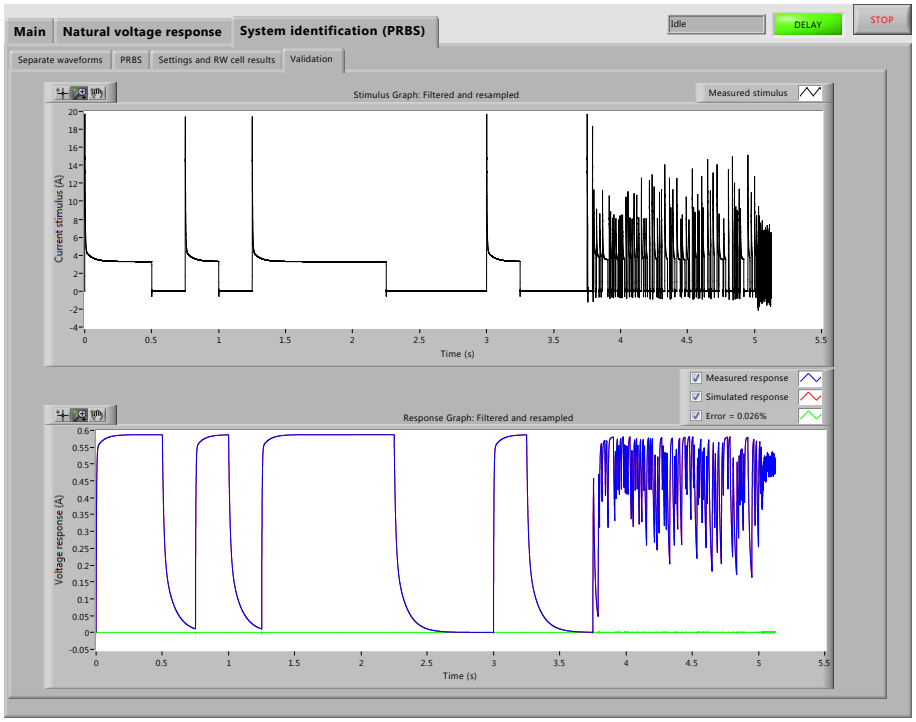


Figure A.6: LabVIEW™ front panel 6

A.2 MALAB® code

The MALAB® code for generating simultaneous equations of the transfer function equations is presented in generateTFeqs.m.

```
syms r1 c1 r2 c2 Rm Rct Cdl Rd Cd td s

Zw = Rd*((r1/(s*td*r1*c1+1)) + (r2/(s*td*r2*c2+1)));
Zser = Zw + Rct;
Zpar = 1/((s*Cdl) + (1/Zser));
Zcell = Rm + Zpar;

[num,den] = numden(Zcell);
numStr = char(collect(num,s));
denStr = char(collect(den,s));

searchStr = {'Rct','Cdl','Rd','td',};
replaceStr = {'x(1)','x(2)','x(3)','(x(4))'};

numStr = regexprep(numStr,searchStr,replaceStr);
denStr = regexprep(denStr,searchStr,replaceStr);

sIndexNum = strfind(numStr,'s');
strA = strcat(numStr(1:sIndexNum(1)-2),' - a;');
strB = strcat(numStr(sIndexNum(1)+6:sIndexNum(2)-2),' - b;');
strC = strcat(numStr(sIndexNum(2)+6:sIndexNum(3)-2),' - c;');
strD = strcat('(',numStr(sIndexNum(3)+4:length(numStr)),') - d;');

sIndexDen = strfind(denStr,'s');
strE = strcat(denStr(1:sIndexDen(1)-2),' - e;');
strF = strcat(denStr(sIndexDen(1)+6:sIndexDen(2)-2),' - f;');
strG = strcat(denStr(sIndexDen(2)+6:sIndexDen(3)-2),' - g');
```

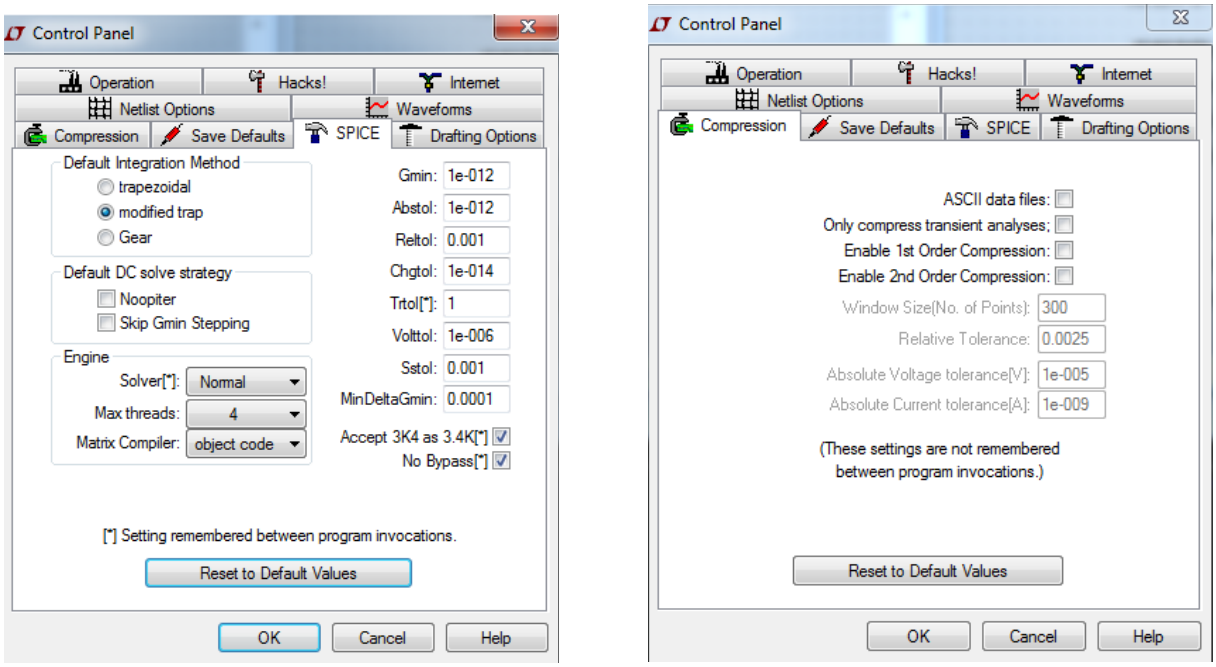
The MALAB® code for solving the generated simultaneous transfer function equations is presented in genSimEqs.m. The paramter R_{ct} is x(1), C_{dl} is x(2), R_d is x(3) and τ_d is x(4).

```
function F = genSimEqs(x,r1,c1,r2,c2,Rm,b,c,d,f,g)

F = [(x(1)*c1*c2*r1*r2*(x(4))^2 + Rm*c1*c2*r1*r2*(x(4))^2 + x(2)*x(1)*Rm*c1*r1*(x(4)) + x
(2)*x(1)*Rm*c2*r2*(x(4)) + x(2)*x(3)*Rm*c1*r1*r2*(x(4)) + x(2)*x(3)*Rm*c2*r1*r2*(x(4))) -
b;
(x(2)*x(1)*Rm + x(2)*x(3)*Rm*r1 + x(2)*x(3)*Rm*r2 + x(1)*c1*r1*(x(4)) + x(1)*c2*r2*(x(4))
+ Rm*c1*r1*(x(4)) + Rm*c2*r2*(x(4)) + x(3)*c1*r1*r2*(x(4)) + x(3)*c2*r1*r2*(x(4))) - c;
(x(1) + Rm + x(3)*r1 + x(3)*r2) - d;
(x(2)*x(1)*c1*r1*(x(4)) + x(2)*x(1)*c2*r2*(x(4)) + c1*c2*r1*r2*(x(4))^2 + x(2)*x(3)
*c1*r1*r2*(x(4)) + x(2)*x(3)*c2*r1*r2*(x(4))) - f;
(x(2)*x(1) + x(2)*x(3)*r1 + x(2)*x(3)*r2 + c1*r1*(x(4)) + c2*r2*(x(4))) - g];
```

A.3 LTspice© program settings

The simulation data were generated with the LTspice© program settings portrayed in Figure A.7.



(a) (b)

Figure A.7: LTspice© settings: (a) SPICE settings (b) Data compression settings

Appendix B

Switch design and layout

B.1 Switch schematic

The schematics of the switch is depicted in Figure B.2.

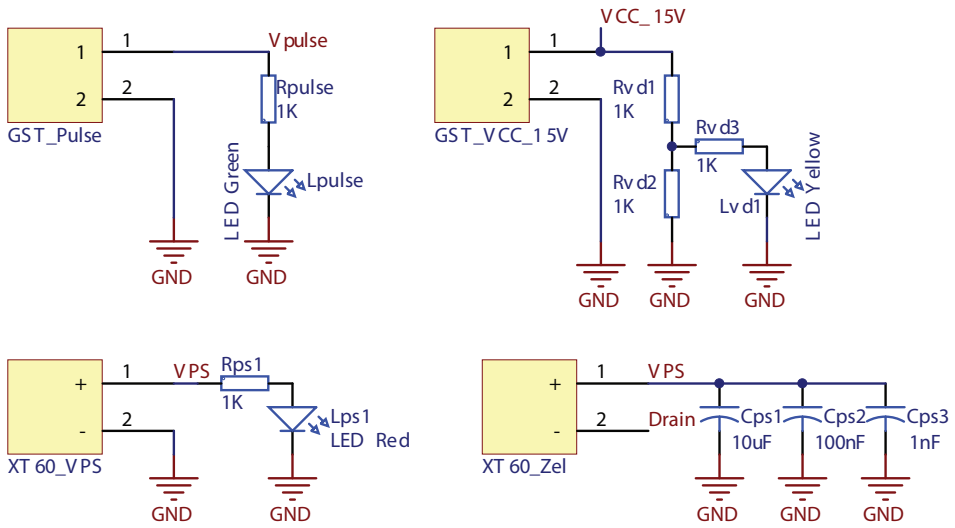


Figure B.1: Switch schematic layout: Part one

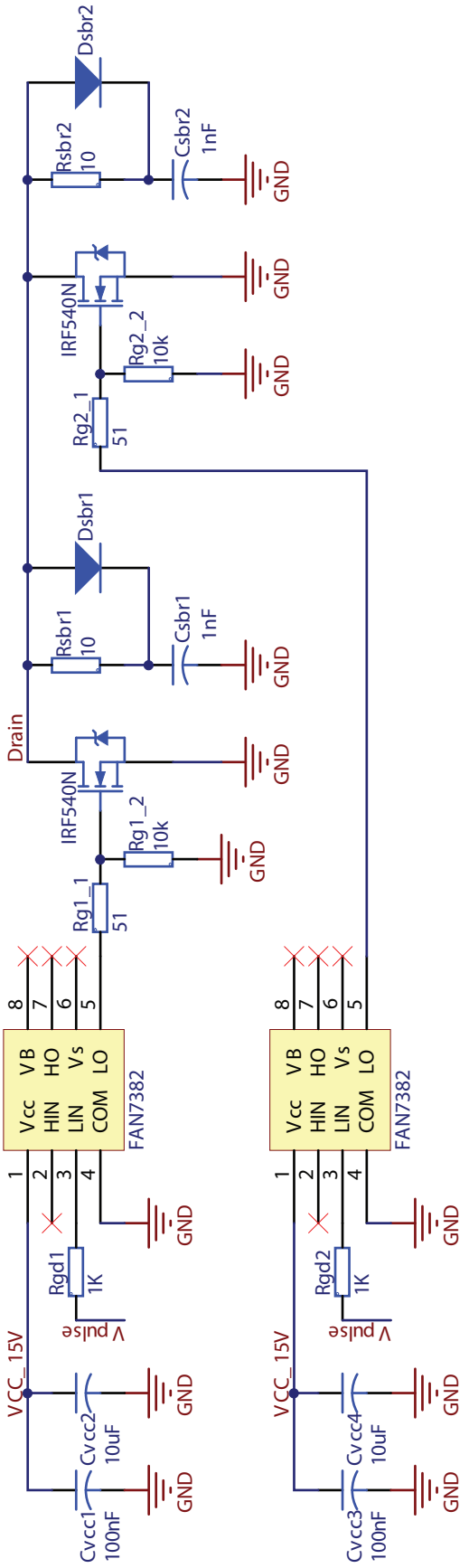


Figure B.2: Switch schematic layout: Part two

B.2 Switch PCB layout

The top display of the switch PCB layout is depicted in Figure B.4.

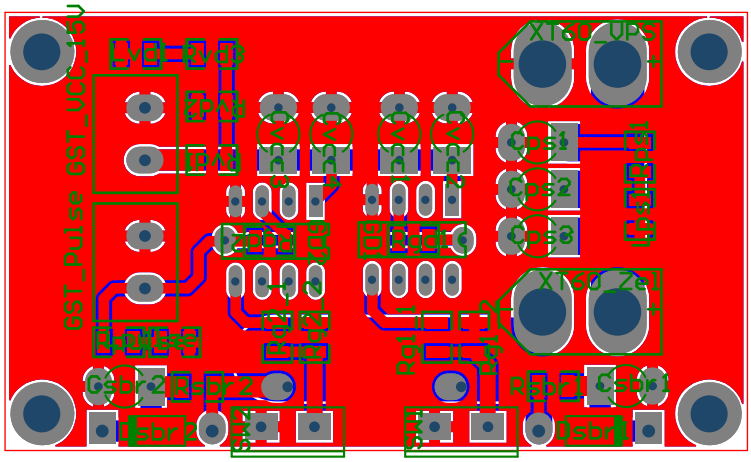


Figure B.3: Switch PCB layout: Top display

The bottom display of the switch PCB layout is given in Figure B.4.

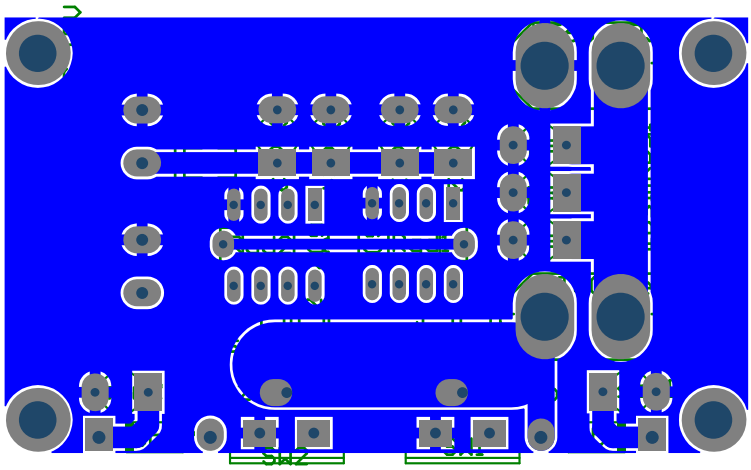


Figure B.4: Switch PCB: Top display

B.3 Visual depiction

A visual depiction of the switch is given in Figure B.5.

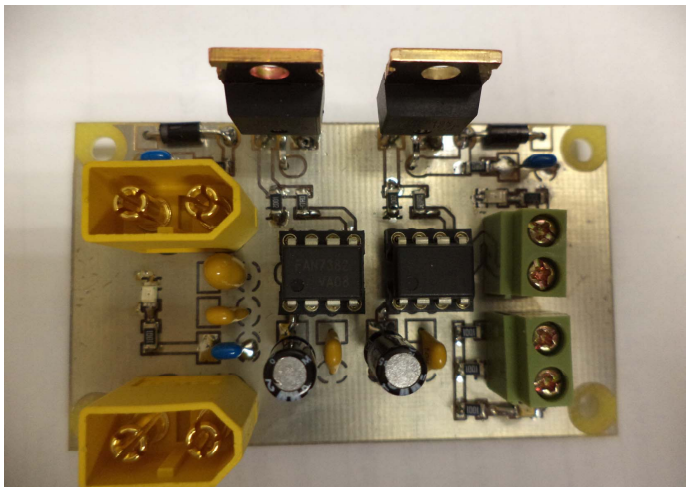


Figure B.5: Visual depiction of switch

A visual depiction of the switch that was used for the duration of the CI method is given in B.6.

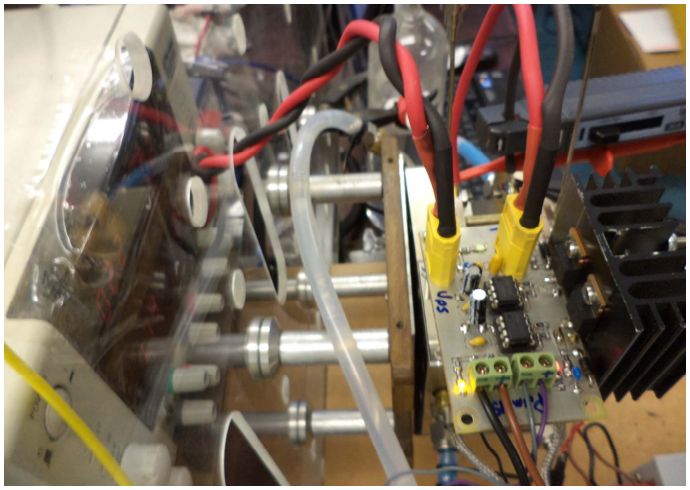


Figure B.6: Visual depiction of switch in experimental setup