DRIVING APLAC FROM MATLAB – CB AMPLIFIER EXAMPLE

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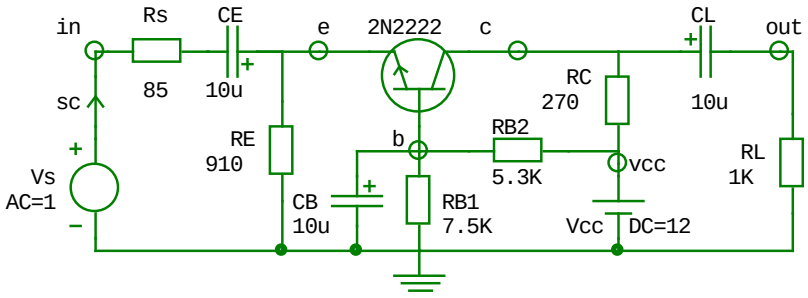
APLAC can be driven from Matlab in the following manner:

1. Create the APLAC simulation file (`*.i`) either with a text editor or using APLAC's schematic editor. Test the APLAC simulation file and make sure it works fine.
2. Redirect the output to text files: substitute "show" commands by "print" commands in the `*.i` file, so that the results are saved in text files.
3. Write a parameterized Matlab file to drive APLAC simulation: a) generate a new `*.i` file using Matlab capabilities for manipulating strings; b) use a Matlab statement to run APLAC from the command line with the `*.i` filename as a parameter; c) read the `*.txt` files and assign the output data to the corresponding vectors of responses.

Example: Common Base Amplifier

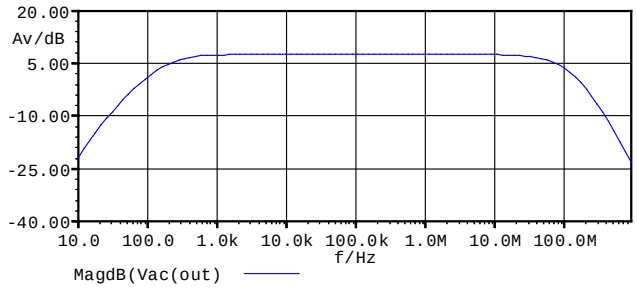
1. Create a conventional APLAC project using APLAC's schematic editor.

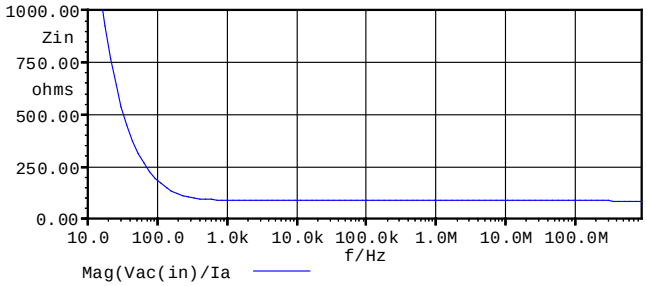



```
Sweep
"Common Base Amp - AC Analysis"
LOOP 100 FREQ LOG  10Hz 900MEGHz
WINDOW=0 grid Y "Av" "dB" -40 20
WINDOW=1 grid Y "Zin" "ohms" 0 1K

Show W=0 Y=MagdB(Vac(out))
Show W=1 Y=Mag(Vac(in)/Iac(sc))
EndSweep
```

Responses



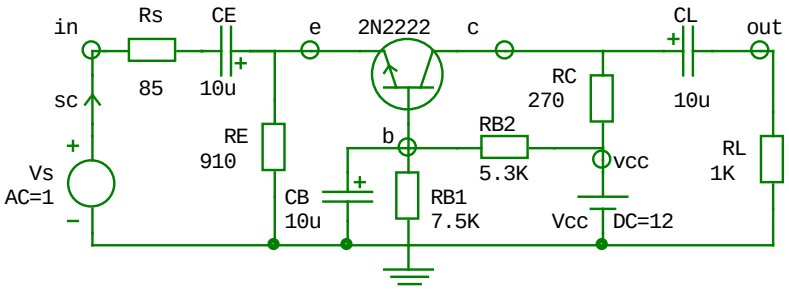


Simulation file (contents of file `CB_AMP _student_ver.i`)

```
$ ------------------------------------------------------------
$ File     : C:\... \CB_AMP _student_ver.i
$ Schema file  : C:\... \CB_AMP _student_ver.N
$ Generated with APLAC Editor version 3.1.2
$ Wed May 07 11:49:46 2014
$ ------------------------------------------------------------

Res Rs in node1
+ 85
Res RB2 b vcc
+ 5.3K
Res RE e GND
+ 910
Res RB1 b GND
+ 7.5K
Res RC c vcc
+ 270
Res RL out GND
+ 1K
Bjt 2N2222 c b e
+ NPN
+ IS=3.108E-15 XTI=3 EG=1.11 VAF=131.5 BF=217.5
+ NE=1.541 ISE=190.7E-15 IKF=1.296 XTB=1.5 BR=6.18
+ NC=2 ISC=0 IKR=0 RC=1 CJC=14.57E-12 VJC=.75
+ MJC=.3333 FC=.5 CJE=26.08E-12 VJE=.75 MJE=.3333
+ TR=51.35E-9 TF=451E-12 ITF=.1 VTF=10 XTF=2
Cap CE e node1
+ 10u
Cap CB b GND
+ 10u
Volt Vs node2 GND
+ AC=1
Volt Vcc vcc GND
+ DC=12
Cap CL c out
+ 10u
Short sc node2 in
+ I = sc
Sweep "Common Base Amp - AC Analysis"
+ LOOP 100 FREQ LOG  10Hz 900MEGHz
+ WINDOW=0 grid Y "Av" "dB" -40 20
+ WINDOW=1 grid Y "Zin" "ohms" 0 1K
Show W=0 Y=MagdB(Vac(out))
Show W=1 Y=Mag(Vac(in)/Iac(sc))
EndSweep
```

2. Re-directing output to text files




```
Sweep
"Common Base Amp - AC Analysis"
LOOP 100 FREQ LOG  10Hz 900MEGHz

Print appendfile "ac.txt" real f bl real MagdB(Vac(out)) bl real Mag(Vac(in)/Iac(sc)) lf
EndSweep
```

New simulation file:

```
$ ------------------------------------------------------------
$ File     : C:\...\CB_AMP_txt_out_student_ver.i
$ Schema file  : C:\...\CB_AMP_txt_out_student_ver.N
$ Generated with APLAC Editor version 3.1.2
$ Wed May 07 13:10:56 2014
$ ------------------------------------------------------------

Res Rs in node1
+ 85
Res RB2 b vcc
+ 5.3K
Res RE e GND
+ 910
Res RB1 b GND
+ 7.5K
Res RC c vcc
+ 270
Res RL out GND
+ 1K
Bjt 2N2222 c b e
+ NPN
+ IS=3.108E-15 XTI=3 EG=1.11 VAF=131.5 BF=217.5
+ NE=1.541 ISE=190.7E-15 IKF=1.296 XTB=1.5 BR=6.18
+ NC=2 ISC=0 IKR=0 RC=1 CJC=14.57E-12 VJC=.75
+ MJC=.3333 FC=.5 CJE=26.08E-12 VJE=.75 MJE=.3333
+ TR=51.35E-9 TF=451E-12 ITF=.1 VTF=10 XTF=2
Cap CE e node1
+ 10u
Cap CB b GND
+ 10u
Volt Vs node2 GND
+ AC=1
Volt Vcc vcc GND
+ DC=12
Cap CL c out
+ 10u
Short sc node2 in
+ I = sc
Sweep "Common Base Amp - AC Analysis"
+ LOOP 100 FREQ LOG  10Hz 900MEGHz
```

```
Print appendfile "ac.txt" real f bl real MagdB(Vac(out)) bl real Mag(Vac(in)/Iac(sc)) lf
EndSweep
```

4. Write a parameterized Matlab file to drive APLAC simulation

```
% ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
%                     Driving CB_Amp_m.i from Matlab
%
% This function drives the Aplac file CB_AMP_m.i from
% Matlab, and returns the simulation results in arrays psi and R.
%
% Usage: [f,mAv,mZin] = CB_Amp_Aplac(x)
%       x = [Rs RB2 RE RB1 RC RL] (ohms).
%       f: Column vector of simulated frequency points (Hz).
%       mAv: Column vector of AC voltage gain magnitude (V/V).
%       mZin: Column vector of AC input impedance magnitude (ohms).

function [f,mAv,mZin] = CB_Amp_Aplac(x)

% Define APLAC Script, as
as{1} = '$ ------------------------------------------------------------';
as{2} = '$ File     : C:\...\CB_AMP_txt_out_student_ver.i';
as{3} = '$ Schema file  : C:\...\CB_AMP_txt_out_student_ver.N';
as{4} = '$ Generated with APLAC Editor version 3.1.2';
as{5} = '$ Wed May 07 13:10:56 2014';
as{6} = '$ ------------------------------------------------------------';
as{7} = ['Res Rs in node1 ' mat2str(x(1))];
as{8} = ['Res RB2 b vcc ' mat2str(x(2))];
as{9} = ['Res RE e GND ' mat2str(x(3))];
as{10} = ['Res RB1 b GND ' mat2str(x(4))];
as{11} = ['Res RC c vcc ' mat2str(x(5))];
as{12} = ['Res RL out GND ' mat2str(x(6))];
as{13} = 'Bjt 2N2222 c b e';
as{14} = '+ NPN';
as{15} = '+ IS=3.108E-15 XTI=3 EG=1.11 VAF=131.5 BF=217.5';
as{16} = '+ NE=1.541 ISE=190.7E-15 IKF=1.296 XTB=1.5 BR=6.18';
as{17} = '+ NC=2 ISC=0 IKR=0 RC=1 CJC=14.57E-12 VJC=.75';
as{18} = '+ MJC=.3333 FC=.5 CJE=26.08E-12 VJE=.75 MJE=.3333';
as{19} = '+ TR=51.35E-9 TF=451E-12 ITF=.1 VTF=10 XTF=2';
as{20} = 'Cap CE e node1  10u';
as{21} = 'Cap CB b GND  10u';
as{22} = 'Volt Vs node2 GND  AC=1';
as{23} = 'Volt Vcc vcc GND DC=12';
as{24} = 'Cap CL c out 10u';
as{25} = 'Short sc node2 in I = sc';
as{26} = 'Sweep "Common Base Amp - AC Analysis"';
as{27} = '+ LOOP 100 FREQ LOG  10Hz 900MEGHz';
as{28} = 'Print appendfile "ac.txt" real f bl real MagdB(Vac(out)) bl real
Mag(Vac(in)/Iac(sc)) lf';
as{29} = 'EndSweep';

% Save APLAC Script as a Circuit File in Matlab Working Directory
CircuitFileName = 'CB_Amp_m.i';
ckt_file = str2mat(as);
[rows,columns] = size(ckt_file);
fid = fopen(CircuitFileName,'w+');  % File identifier opened.
for i = 1:rows
   fprintf(fid, '%s', ckt_file(i,:)); % Save each row of ckt_file.
   fprintf(fid, '%s\r\n', '');
end
fclose(fid);  % File identifier closed.

% Run APLAC Circuit File
ExecFile = 'C:\command_line_Aplac_Student\aplac -aq ';
system([ExecFile CircuitFileName]);
```

```
% Read APLAC Output Files
load ac.txt
f = ac(:,1);
mAv = ac(:,2);
mZin = ac(:,3);

% Erase APLAC Output Files
delete ac.txt;
```

Testing the APLAC driver

```
% ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
%     Ploting Responses of a Common Base Amplifier simulated with APLAC

Rs = 85;
RB2 = 5.3e3;
RE = 910;
RB1 = 7.5e3;
RC = 270;
RL = 1e3;

% Calculate Responses
x = [Rs RB2 RE RB1 RC RL];
[f,mAv,mZin] = CB_Amp_Aplac(x);

% Plot Responses
figure
set(axes,'FontName','Times','FontSize',14,'Position',[0.15 0.15 0.75 0.7]);
grid on
hold on
plot(f,mAv,'-k')
set(gca,'XScale','log')
title('Common Base Amplifier')
xlabel('frequency (Hz)')
ylabel('{|\itA}_v|  (dB)');

figure
set(axes,'FontName','Times','FontSize',14,'Position',[0.15 0.15 0.75 0.7]);
grid on
hold on
plot(f,mZin,'-k')
set(gca,'XScale','log')
title('Common Base Amplifier')
xlabel('frequency (Hz)')
ylabel('{|\itZ}_i_n|  (ohms)');
```