In[670]:=
```
Δ[S11_, S12_, S21_, S22_] := S11 S22 - S12 S21;
K[S11_, S12_, S21_, S22_] := (1 - Abs[S11]^2 - Abs[S22]^2 + Abs[Δ[S11, S12, S21, S22]]^2) / (2 Abs[S12 S21])
Phase[S_] := Exp[I S Pi / 180];
B1[S11_, S12_, S21_, S22_] := 1 + Abs[S11]^2 - Abs[S22]^2 - Abs[Δ[S11, S12, S21, S22]]^2;
B2[S11_, S12_, S21_, S22_] := 1 - Abs[S11]^2 + Abs[S22]^2 - Abs[Δ[S11, S12, S21, S22]]^2;
C1[S11_, S12_, S21_, S22_] := S11 - Δ[S11, S12, S21, S22] Conjugate[S22];
C2[S11_, S12_, S21_, S22_] := S22 - Δ[S11, S12, S21, S22] Conjugate[S11];
Γ^p_ms[S11_, S12_, S21_, S22_] := (B1[S11, S12, S21, S22] + Sqrt[B1[S11, S12, S21, S22]^2 -
      4 Abs[C1[S11, S12, S21, S22]]^2]) / (2 C1[S11, S12, S21, S22]);
Γ^m_ms[S11_, S12_, S21_, S22_] := (B1[S11, S12, S21, S22] - Sqrt[B1[S11, S12, S21, S22]^2 -
      4 Abs[C1[S11, S12, S21, S22]]^2]) / (2 C1[S11, S12, S21, S22]);
Γ^p_ml[S11_, S12_, S21_, S22_] := (B2[S11, S12, S21, S22] + Sqrt[B2[S11, S12, S21, S22]^2 -
      4 Abs[C2[S11, S12, S21, S22]]^2]) / (2 C2[S11, S12, S21, S22]);
Γ^m_ml[S11_, S12_, S21_, S22_] := (B2[S11, S12, S21, S22] - Sqrt[B2[S11, S12, S21, S22]^2 -
      4 Abs[C2[S11, S12, S21, S22]]^2]) / (2 C2[S11, S12, S21, S22]);

GTMax1[S11_, S12_, S21_, S22_, Γl_, Γs_] :=
 ((1 - Abs[Γs]^2) Abs[S21]^2 (1 - Abs[Γl]^2)) / Abs[(1 - S11 Γs) (1 - S22 Γl) - S12 S21 Γs Γl]^2
GTMax2[S12_, S21_, K_] := Abs[S21] / Abs[S12] (K - Sqrt[K^2 - 1]);
```

In[681]:=
```
(* The below are the scattering parameters for the ideal bias network. *)
S11 = .732 Phase[-146.4];
S12 = .0626 Phase[60.507];
S21 = 5.7008 Phase[85.49];
S22 = .3350 Phase[147.7];
Abs[Δ[S11, S12, S21, S22]]
K1 = K[S11, S12, S21, S22]
```

Out[685]= 0.574741

Out[686]= 0.955919

In[687]:=
```
(* Below are the scattering parameters at 2GHz obtained with the
 physical bias network. I have added a shunt resistor to the gate to
 make the transistor unconditionally stable at the design frequency. *)
```

In[688]:=
```
S11 = .006 Phase[-120.590];
S12 = .006 Phase[-120.707];
S21 = .530 Phase[-95.725];
S22 = .996 Phase[178.086];
```

In[692]:=
```
Abs[Δ[S11, S12, S21, S22]]
```
Out[692]= 0.0065743

In[693]:=
```
K1 = K[S11, S12, S21, S22]
```
Out[693]= 1.25648

In[694]:=
```
Abs[(Γ^p)_ml[S11, S12, S21, S22]];
```

In[695]:=
```
Γ_ml = (Γ^m)_ml[S11, S12, S21, S22]
```
Out[695]= -0.997018 - 0.0332993 i

In[696]:=
```
Abs[(Γ^p)_ms[S11, S12, S21, S22]];
```

In[697]:=
```
Γ_ms = (Γ^m)_ms[S11, S12, S21, S22]
```
Out[697]= 0.403474 + 0.286539 i

In[698]:=
```
Gtmax1 = 10 Log10[GTMax1[S11, S12, S21, S22, Γ_ml, Γ_ms]]
```
Out[698]= 16.4137

In[699]:=
```
Gtmax2 = 10 Log10[GTMax2[S12, S21, K1]]
```
Out[699]= 16.4137

In[700]:=
```
(* Below begins the analytical calculations
 for the matching network of the device. *)
```

In[701]:=
```
Abs[Γ_ml] && Arg[Γ_ml] * 180 / Pi
```
Out[701]= 0.997574 && -178.087

In[702]:=
```
Abs[Γ_ms] && Arg[Γ_ms] * 180 / Pi
```
Out[702]= 0.49487 && 35.3816

In[703]:=
```
Γ_ms = .529 Phase[35.336];
```

In[704]:=
```
Z_ml = 50 * (1 + Γ_ml) / (1 - Γ_ml);
```

In[705]:=
```
Z_ms = 50 * (1 + Γ_ms) / (1 - Γ_ms);
```

In[706]:=
```
Y_ml = 1 / Z_ml;
```

In[707]:=
```
Lengths[ll_, ls_] := Y_c (1 + I Tan[ll] + I Tan[ls]) / (1 + I Tan[ll] - Tan[ls] Tan[ll]);
Y_c = 1 / 50;
```

In[709]:=
```
{x, y} = {ll, ls} /. FindRoot[
   {Re[Lengths[ll, ls]] == Re[Yml], Im[Lengths[ll, ls]] == Im[Yml]}, {ll, .2}, {ls, .6}]
{x,
  y} *
 180 /
  Pi
```

Out[709]= {0.0181423, 1.53592}

Out[710]= {1.03948, 88.0016}

In[711]:=
```
(* The above tells me that the load matching network should comprise a series
 stub that is ~1.04 degrees long (I can add 180 degrees with no penalty)
 and an open stub that is ~88 degrees long. *)
```

In[712]:=
```
Yms = 1/Zms;
{x, y} = {ll, ls} /. FindRoot[
   {Re[Lengths[ll, ls]] == Re[Yms], Im[Lengths[ll, ls]] == Im[Yms]}, {ll, .7}, {ls, .7}]
```

Out[713]= {1.76912, 0.894776}

In[714]:=
```
{x, y} * 180 / Pi
```

Out[714]= {101.363, 51.2669}

In[715]:=
```
(* The above tells me that the soucre matching
 network should comprise a series stub that is ~101.4 degrees
 long and a shunt open stub that is ~51.3 degrees long. *)
```