```
In[581]:= 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];
Γpms[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]);
Γmms[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]);
Γpml[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]);
Γmml[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[592]:= (* 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[593]:=
S11 = .006 Phase[-120.590];
S12 = .006 Phase[-120.707];
S21 = .530 Phase[-95.725];
S22 = .996 Phase[178.086];

In[597]:= Abs[Δ[S11, S12, S21, S22]]
Out[597]= 0.0065743

In[598]:= K1 = K[S11, S12, S21, S22]
Out[598]= 1.25648
```

In[599]:=
```
Abs[(Γ^p)_ml[S11, S12, S21, S22]];

Γml = (Γ^m)_ml[S11, S12, S21, S22]
Abs[(Γ^p)_ms[S11, S12, S21, S22]];
Γms = (Γ^m)_ms[S11, S12, S21, S22]
```

Out[600]= -0.997018 - 0.0332993 i

Out[602]= 0.403474 + 0.286539 i

In[603]:=
```
Gtmax1 = 10 Log10[GTMax1[S11, S12, S21, S22, Γml, Γms]]
Gtmax2 = 10 Log10[GTMax2[S12, S21, K1]]
```

Out[603]= 16.4137

Out[604]= 16.4137

```
(* Below begins the analytical calculations
 for the matching network of the device. *)
```

In[606]:= `Abs[Γml] && Arg[Γml] * 180 / Pi`

Out[606]= 0.997574 && -178.087

In[607]:= `Abs[Γms] && Arg[Γms] * 180 / Pi`

Out[607]= 0.49487 && 35.3816

In[608]:= `Γms = .529 Phase[35.336];`

In[609]:= $Z_{ml} = 50 * \frac{1 + \Gamma_{ml}}{1 - \Gamma_{ml}};$

In[610]:= $Z_{ms} = 50 * \frac{1 + \Gamma_{ms}}{1 - \Gamma_{ms}};$

In[611]:= $Y_{ml} = 1 / Z_{ml};$

In[612]:= $\text{Lengths[ll\_, ls\_]} := Y_c \frac{(1 + I\,\text{Tan[ll]} + I\,\text{Tan[ls]})}{1 + I\,\text{Tan[ll]} - \text{Tan[ls] Tan[ll]}};$

$Y_c = 1 / 50;$

In[614]:=
```
{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[614]= {0.0181423, 1.53592}

Out[615]= {1.03948, 88.0016}

```
(* 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[617]:= $Y_{ms} = \frac{1}{Z_{ms}}$;

```
{x, y} = {ll, ls} /. FindRoot[
   {Re[Lengths[ll, ls]] == Re[Yms], Im[Lengths[ll, ls]] == Im[Yms]}, {ll, .7}, {ls, .7}]
```

Out[618]= {1.76912, 0.894776}

In[619]:= {x, y} * 180 / Pi

Out[619]= {101.363, 51.2669}

In[620]:=

```
(* 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. *)
```