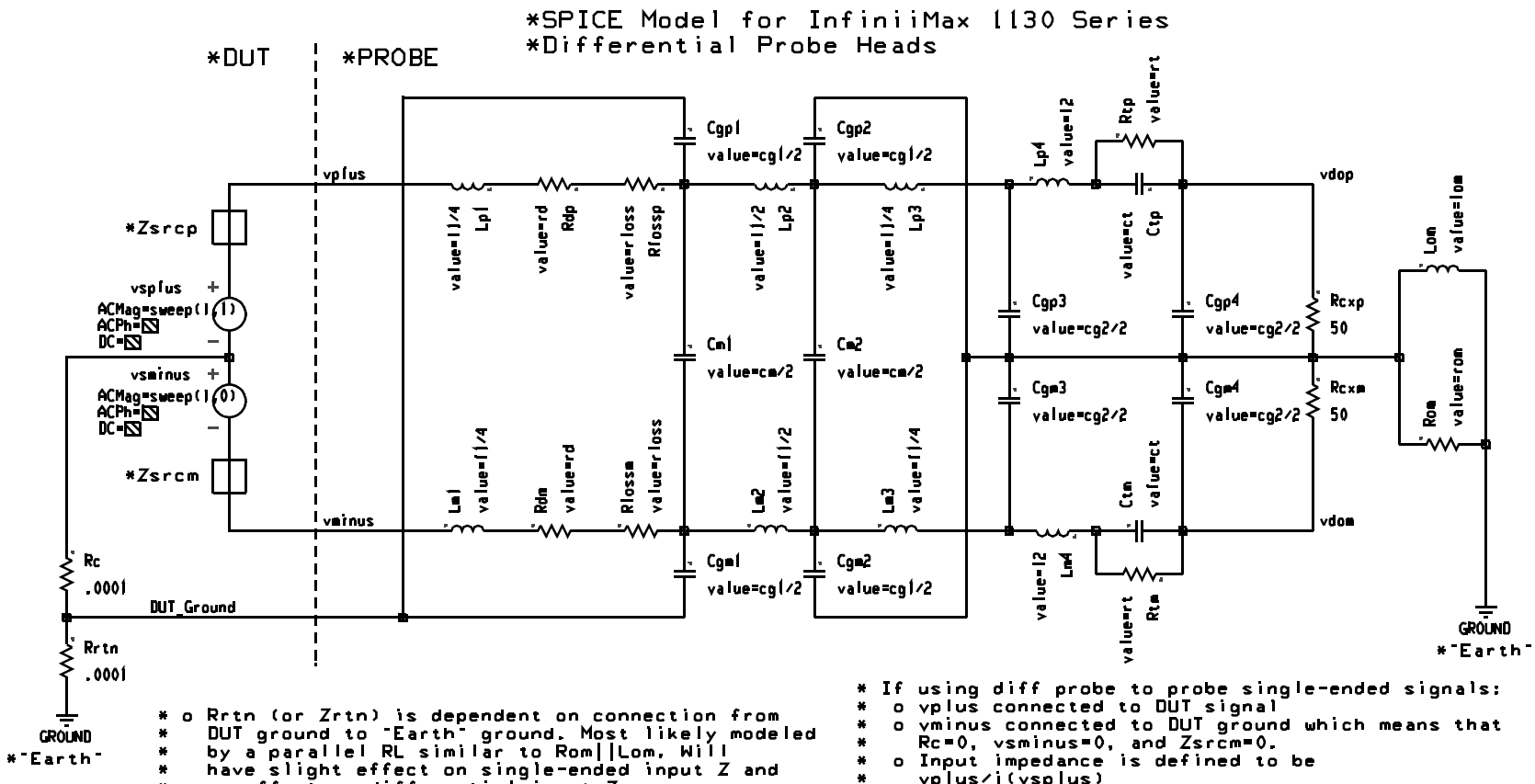
Input Impedance SPICE Models for InfiniiMax 1130 Series 3.5GHz to 7GHz Active Probes

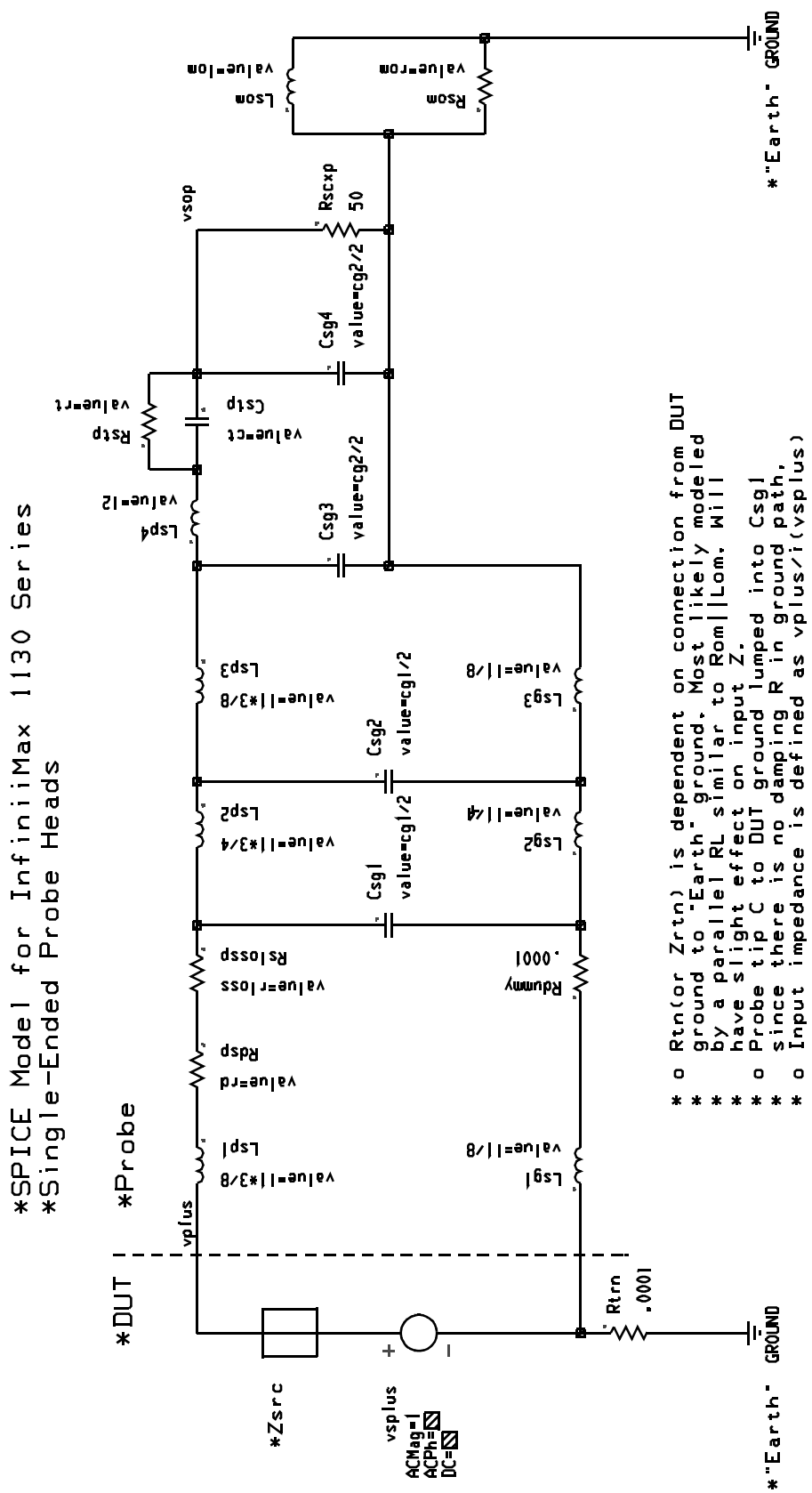
This document contains SPICE models that can be used to predict the probe loading effects of the InfiniiMax active probes. Important points about these SPICE models are:

- SPICE models shown here are currently only for input impedance which allows modeling of the probe loading effects. Probe transfer function is generally flat to the specified BW. Transfer function SPICE models may be added later if demand is sufficient.
- These input impedance is a function of the probe head type only. The probe amp bandwidth (3.5GHz 1131A, 5GHz 1132A, or 7GHz 1134A) does not have any effect on the input impedance of the probe heads.
- Five configurations are covered here:
  - Differential Browser Probe Head (E2675A)
  - Differential Socket Tip Probe Head (E2678A)
  - Differential Solder-In Probe Head (E2677A) (Full BW 91ohm resistors)
  - Single-Ended Browser Probe Head (E2676A)
  - Single-Ended Solder-In Probe Head (E2679A) (Full BW 91ohm resistor)

If damped wire accessories or longer mid-BW resistors (for solder-in probe heads) are used, they can be modeled by adding an RLC model in front of the appropriate probe head model and zeroing out the damping resistor in the probe head model.

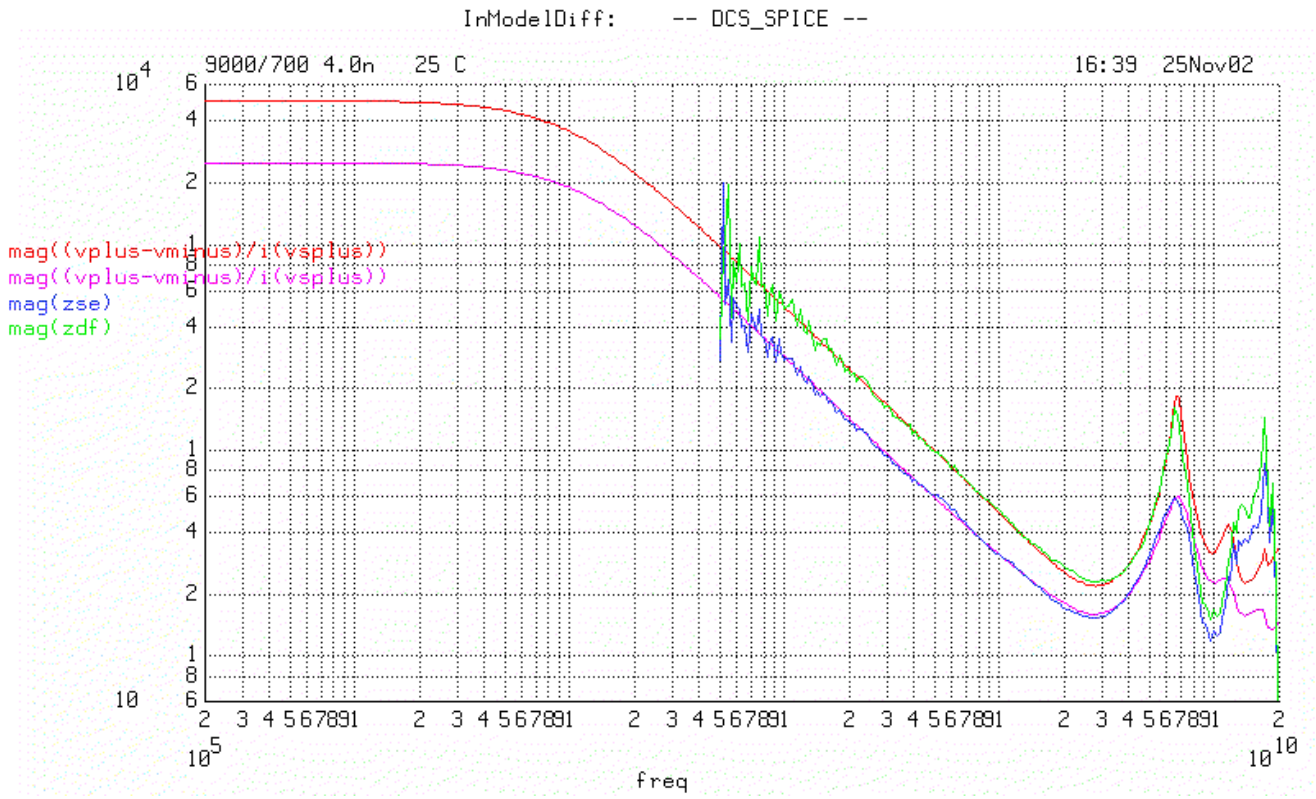
There is one SPICE schematic for the differential probe heads and one SPICE schematic for the single-ended probe heads. The schematics have parameterized R, L, and C values that are given in the SPICE deck for the specific probe head. Additionally, an input impedance plot is given that shows the matching of the measured data to the modeled data. Matching is generally very good up to the specified BW of the probe head with the 7GHz probe amp.


*SPICE Model for InfiniiMax 1130 Series
*Differential Probe Heads
*DUT
*PROBE
vplus
vminus
*Zsrcp
*Zsrcm
vsplus
ACMag=sweep(1,1)
ACPh=
DC=
vsminus
ACMag=sweep(1,0)
ACPh=
DC=
Rc
.0001
DUT_Ground
Rrtn
.0001
GROUND
*"Earth"
value=1/4 Lp1
value=rd Rdp
value=rloss Rlossp
value=1/2 Lp2
value=1/4 Lp3
Cgp1 value=cg1/2
Cgp2 value=cg1/2
Cm1 value=cm/2
Cm2 value=cm/2
Cgm1 value=cg1/2
Cgm2 value=cg1/2
value=1/4 Lm1
Rdm value=rd
Rlossm value=rloss
value=1/2 Lm2
value=1/4 Lm3
Lp4 value=l2
Rtp value=rt
value=ct Ctp
Cgp3 value=cg2/2
Cgp4 value=cg2/2
Rcxp 50
Cgm3 value=cg2/2
Cgm4 value=cg2/2
Rcxm 50
Ctm value=ct
value=l2 Lm4
value=rt Rtm
vdop
vdom
Lom value=lom
Rom value=rom
GROUND
*"Earth"
* o Rrtn (or Zrtn) is dependent on connection from
* DUT ground to "Earth" ground. Most likely modeled
* by a parallel RL similar to Rom||Lom. Will
* have slight effect on single-ended input Z and
* no effect on differential input Z
* o Cgp1 and Cgm1 represent C from probe tips
* to DUT ground near probe tips
* If using diff probe to probe single-ended signals:
* o vplus connected to DUT signal
* o vminus connected to DUT ground which means that
* Rc=0, vsminus=0, and Zsrcm=0.
* o Input impedance is defined to be
* vplus/i(vsplus)
* If using diff probe to probe differential signals:
* o Rc (or Zc) will depend on the DUT circuit
* o vplus connected to DUT plus signal
* o vminus connected to DUT minus signal
* o Input impedance is defined to be
* (vplus/vminus)/i(vsplus)


*SPICE Model for InfiniiMax 1130 Series
*Single-Ended Probe Heads
*DUT
*Probe
vplus
value=l1*3/8
Lsp1
value=l1/8
Lsg1
value=rd
Rdsp
value=rloss
Rslossp
Rdummy
.0001
Csg1
value=cg1/2
value=l1*3/4
Lsp2
value=l1/4
Lsg2
Csg2
value=cg1/2
value=l1*3/8
Lsp3
value=l1/8
Lsg3
Csg3
value=cg2/2
Lsp4
value=l2
Rstp
value=rt
Cstp
value=ct
Csg4
value=cg2/2
Rscxp
50
vsop
Lsom
value=lom
Rsom
value=rom
*"Earth" GROUND
*"Earth" GROUND
Rtrn
.0001
*Zsrc
vsplus
ACMag=1
ACPh=
DC=
+
-
* o Rtn(or Zrtn) is dependent on connection from DUT
* ground to "Earth" ground. Most likely modeled
* by a parallel RL similar to Rom||Lom. Will
* have slight effect on input Z.
* o Probe tip C to DUT ground lumped into Csg1
* since there is no damping R in ground path.
* o Input impedance is defined as vplus/i(vsplus)

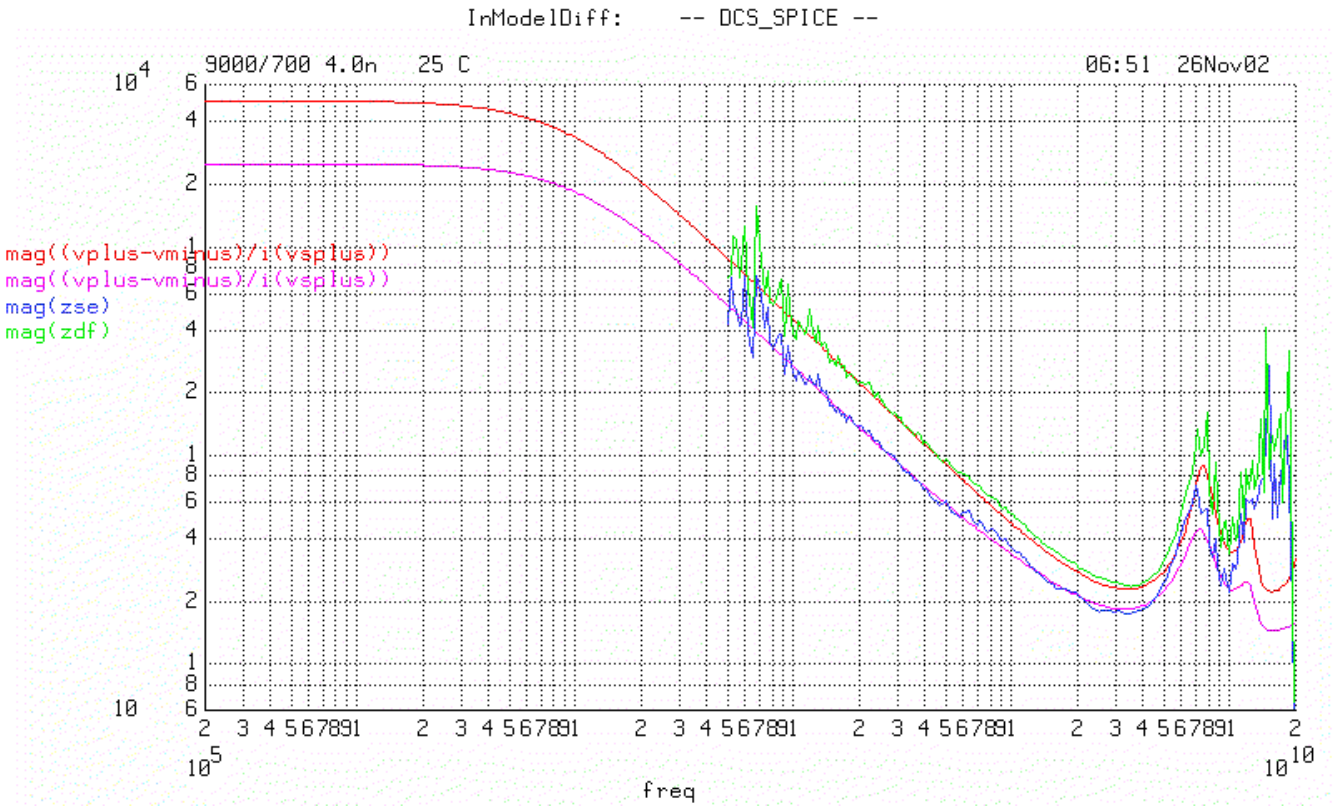
SPICE Deck and Measured/Modeled Data Matching For the Differential Browser Probe Head

```
.param rd=91 rt=25k rloss=10 rom=100 l1=6.5n l2=2n lom=2u cm=80f
cg1=120f   cg2=320f ct=200f


vsminus  %164 %vminus ACMag=sweep(1,0)
vsplus  %vplus %164 ACMag=sweep(1,1)
Cgp1  %DUT_Ground %99  value=cg1/2
Cgp2  %122 %85  value=cg1/2
Cgm2  %84 %122  value=cg1/2
Cgm1  %95 %DUT_Ground  value=cg1/2
Cm1  %99 %95  value=cm/2
Cgp3  %86 %122  value=cg2/2
Cm2  %85 %84  value=cm/2
Cgm4  %122 %vdom  value=cg2/2
Cgm3  %122 %87  value=cg2/2
Cgp4  %vdop %122  value=cg2/2
Ctp  %vdop %88  value=ct
Ctm  %89 %vdom  value=ct
Lm3  %84 %87  value=l1/4
Lp3  %86 %85  value=l1/4
Lm4  %89 %87  value=l2
Lp4  %86 %88  value=l2
Lp1  %118 %vplus  value=l1/4
Lp2  %85 %99  value=l1/2
Lm1  %vminus %117  value=l1/4
Lm2  %95 %84  value=l1/2
Lom  %122 %0  value=lom
Rrtn  %DUT_Ground %0  .0001
Rc  %164 %DUT_Ground  .0001
Rlossp  %99 %159  value=rloss
Rlossm  %160 %95  value=rloss
Rdp  %159 %118  value=rd
Rdm  %117 %160  value=rd
Rtm  %vdom %89  value=rt
Rtp  %88 %vdop  value=rt
Rcxp  %vdop %122  50
Rcxm  %122 %vdom  50
Rom  %122 %0  value=rom
```


InModelDiff: -- DCS_SPICE --
9000/700 4.0n 25 C
16:39 25Nov02
mag((vplus-vminus)/i(vsplus))
mag((vplus-vminus)/i(vsplus))
mag(zse)
mag(zdf)
freq

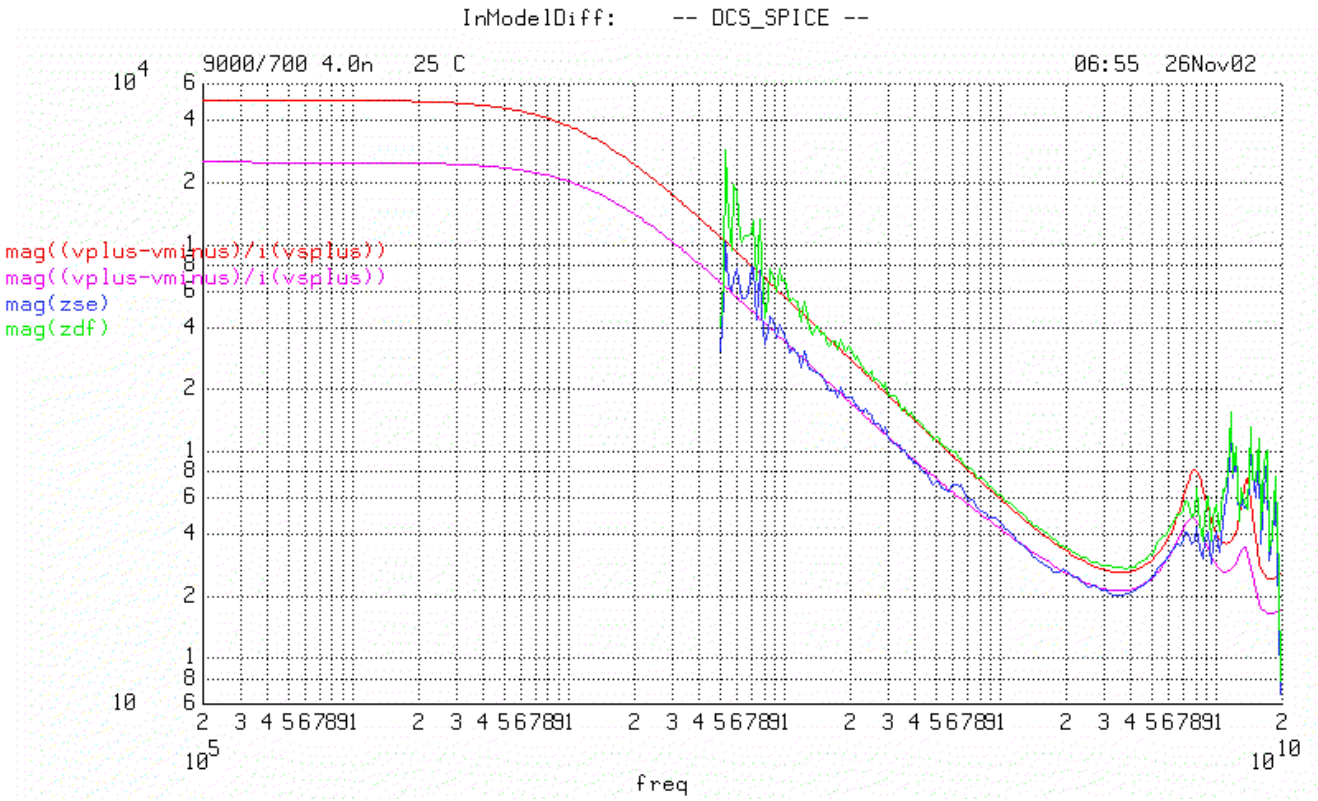
SPICE Deck and Measured/Modeled Matching for the Differential Socket Tip Probe Head

```
.param rd=82 rt=25k rloss=25 rom=200 l1=4n l2=2n lom=2u cm=117f
cg1=120f cg2=320f ct=200f

vsminus  %164 %vminus ACMag=sweep(1,0)
vsplus  %vplus %164 ACMag=sweep(1,1)
Cgp1  %DUT_Ground %99  value=cg1/2
Cgp2  %122 %85  value=cg1/2
Cgm2  %84 %122  value=cg1/2
Cgm1  %95 %DUT_Ground  value=cg1/2
Cm1  %99 %95  value=cm/2
Cgp3  %86 %122  value=cg2/2
Cm2  %85 %84  value=cm/2
Cgm4  %122 %vdom  value=cg2/2
Cgm3  %122 %87  value=cg2/2
Cgp4  %vdop %122  value=cg2/2
Ctp  %vdop %88  value=ct
Ctm  %89 %vdom  value=ct
Lm3  %84 %87  value=l1/4
Lp3  %86 %85  value=l1/4
Lm4  %89 %87  value=l2
Lp4  %86 %88  value=l2
Lp1  %118 %vplus  value=l1/4
Lp2  %85 %99  value=l1/2
Lm1  %vminus %117  value=l1/4
Lm2  %95 %84  value=l1/2
Lom  %122 %0  value=lom
Rrtn  %DUT_Ground %0  .0001
Rc  %164 %DUT_Ground  .0001
Rlossp  %99 %159  value=rloss
Rlossm  %160 %95  value=rloss
Rdp  %159 %118  value=rd
Rdm  %117 %160  value=rd
Rtm  %vdom %89  value=rt
Rtp  %88 %vdop  value=rt
Rcxp  %vdop %122  50
Rcxm  %122 %vdom  50
Rom  %122 %0  value=rom
```


InModelDiff: -- DCS_SPICE --
9000/700 4.0n 25 C
06:51 26Nov02
mag((vplus-vminus)/i(vsplus))
mag((vplus-vminus)/i(vsplus))
mag(zse)
mag(zdf)
freq

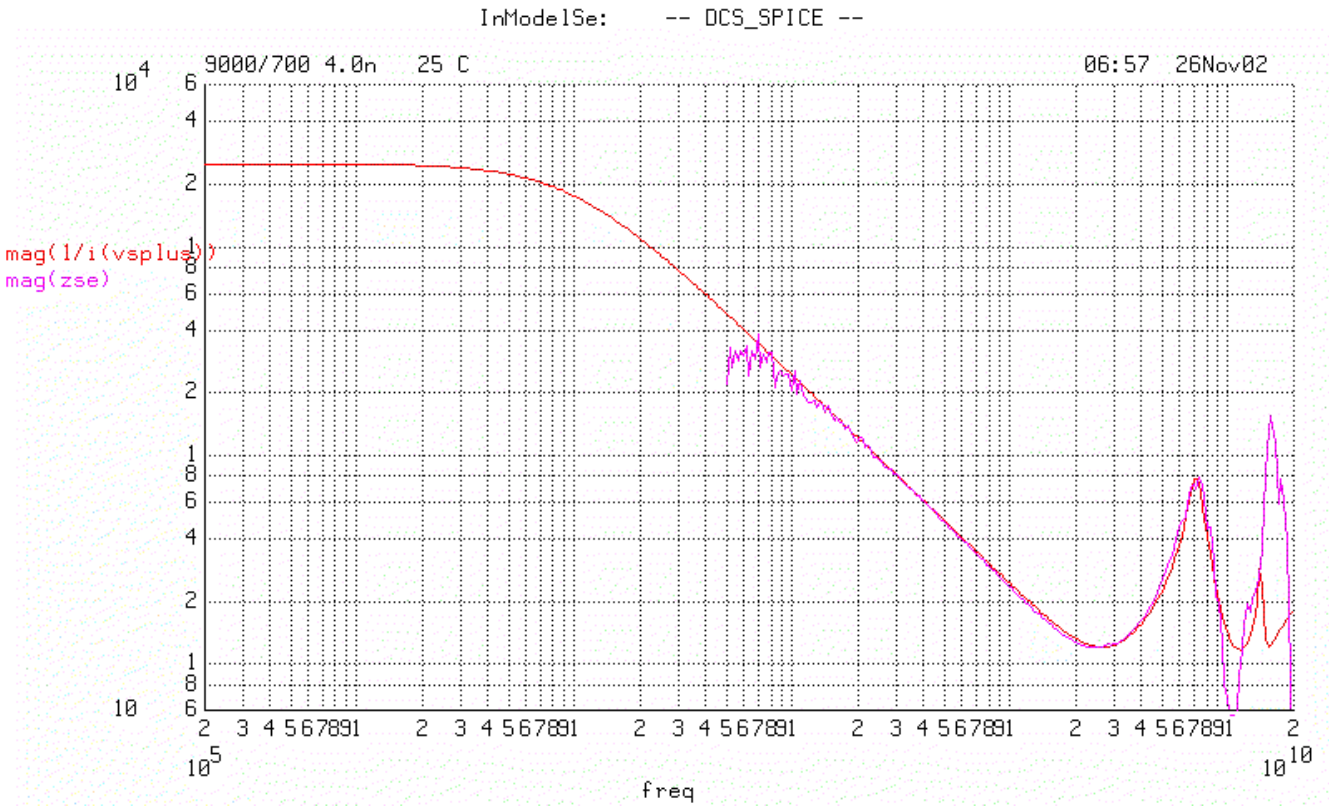
SPICE Deck and Measured/Modeled Data Matching for the Differential Solder-In Probe Head

```
.param rd=91 rloss=18 rt=25k rom=250 l1=4n l2=2n lom=2u cm=100f cg1=80f
cg2=180f ct=200f

vsminus  %164 %vminus ACMag=sweep(1,0)
vsplus  %vplus %164 ACMag=sweep(1,1)
Cgp1  %DUT_Ground %99  value=cg1/2
Cgp2  %122 %85  value=cg1/2
Cgm2  %84 %122  value=cg1/2
Cgm1  %95 %DUT_Ground  value=cg1/2
Cm1  %99 %95  value=cm/2
Cgp3  %86 %122  value=cg2/2
Cm2  %85 %84  value=cm/2
Cgm4  %122 %vdom  value=cg2/2
Cgm3  %122 %87  value=cg2/2
Cgp4  %vdop %122  value=cg2/2
Ctp  %vdop %88  value=ct
Ctm  %89 %vdom  value=ct
Lm3  %84 %87  value=l1/4
Lp3  %86 %85  value=l1/4
Lm4  %89 %87  value=l2
Lp4  %86 %88  value=l2
Lp1  %118 %vplus  value=l1/4
Lp2  %85 %99  value=l1/2
Lm1  %vminus %117  value=l1/4
Lm2  %95 %84  value=l1/2
Lom  %122 %0  value=lom
Rrtn  %DUT_Ground %0  .0001
Rc  %164 %DUT_Ground  .0001
Rlossp  %99 %159  value=rloss
Rlossm  %160 %95  value=rloss
Rdp  %159 %118  value=rd
Rdm  %117 %160  value=rd
Rtm  %vdom %89  value=rt
Rtp  %88 %vdop  value=rt
Rcxp  %vdop %122  50
Rcxm  %122 %vdom  50
Rom  %122 %0  value=rom
```


InModelDiff: -- DCS_SPICE --
9000/700 4.0n 25 C
06:55 26Nov02
mag((vplus-vminus)/i(vsplus))
mag((vplus-vminus)/i(vsplus))
mag(zse)
mag(zdf)
freq

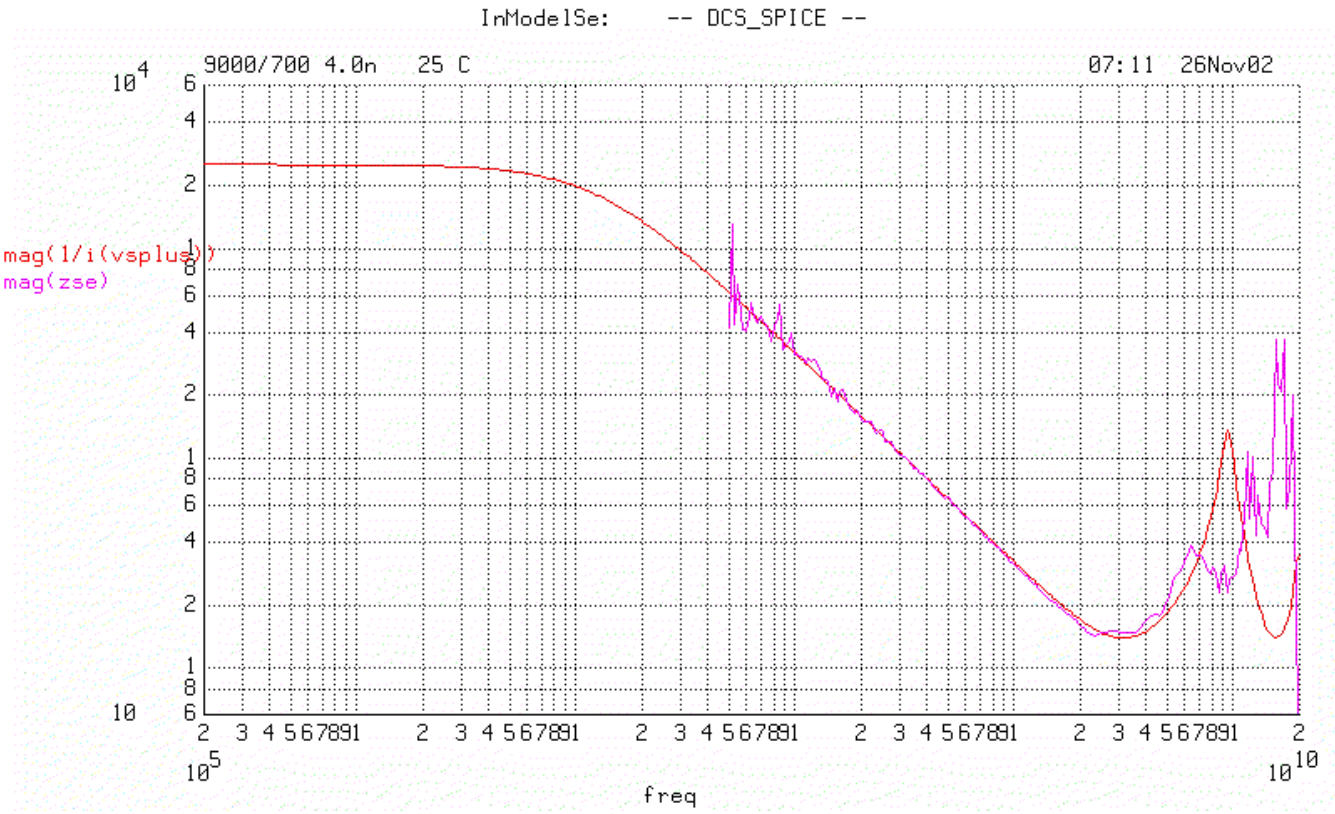
SPICE Deck and Measured/Modeled Data Matching for the Single-Ended Browser Probe Head

```
.param rd=82 rt=25k rom=100 rloss=25 l1=3.5n l2=.5n lom=2u cg1=270f
cg2=370f ct=200f

.ac dec 77 200k 19.7g
.options map
vsplus  %130 %165 ACMag=1
Csg4  %vsop %134  value=cg2/2
Cstp  %vsop %131  value=ct
Csg2  %138 %139  value=cg1/2
Csg3  %132 %134  value=cg2/2
Csg1  %137 %136  value=cg1/2
Lsp1  %141 %130  value=l1*3/8
Lsp2  %138 %137  value=l1*3/4
Lsg1  %165 %164  value=l1/8
Lsg2  %136 %139  value=l1/4
Lsom  %134 %0  value=lom
Lsp4  %132 %131  value=l2
Lsp3  %132 %138  value=l1*3/8
Lsg3  %139 %134  value=l1/8
Rtrn  %165 %0  .0001
Rdummy  %164 %136  .0001
Rslossp  %137 %161  value=rloss
Rdsp  %161 %141  value=rd
Rstp  %131 %vsop  value=rt
Rscxp  %vsop %134  50
Rsom  %134 %0  value=rom
```


InModelSe: -- DCS_SPICE --
9000/700 4.0n 25 C
06:57 26Nov02
mag(1/i(vsplus))
mag(zse)
freq

SPICE Deck and Measured/Modeled Data Matching for the Single-Ended Solder-In Probe Head

```
.param rd=91 rt=25k rom=250 rloss=25 l1=3n l2=.5n lom=2u cg1=150f
cg2=300f ct=200f

.ac dec 77 200k 19.7g
.options map
vsplus  %130 %165 ACMag=1
Csg4  %vsop %134  value=cg2/2
Cstp  %vsop %131  value=ct
Csg2  %138 %139  value=cg1/2
Csg3  %132 %134  value=cg2/2
Csg1  %137 %136  value=cg1/2
Lsp1  %141 %130  value=l1*3/8
Lsp2  %138 %137  value=l1*3/4
Lsg1  %165 %164  value=l1/8
Lsg2  %136 %139  value=l1/4
Lsom  %134 %0  value=lom
Lsp4  %132 %131  value=l2
Lsp3  %132 %138  value=l1*3/8
Lsg3  %139 %134  value=l1/8
Rtrn  %165 %0  .0001
Rdummy  %164 %136  .0001
Rslossp  %137 %161  value=rloss
Rdsp  %161 %141  value=rd
Rstp  %131 %vsop  value=rt
Rscxp  %vsop %134  50
Rsom  %134 %0  value=rom
```


InModelSe: -- DCS_SPICE --
9000/700 4.0n 25 C
07:11 26Nov02
mag(1/i(vsplus))
mag(zse)
freq

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