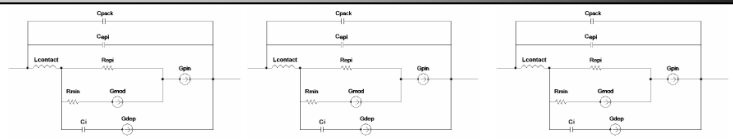

SPICE MODEL DATA

Circuit simulators such as SPICE are widely used by microwave and RF design engineers for more rapid time to market circuit designs. A number of papers have been published on various aspects of PIN diode behavior of the last approximately 15 years. Based on these previous efforts, a number of PIN diode models suitable for use in circuit simulators such as SPICE have been developed and predict a number of PIN diode forward and reverse bias characteristics. For designers using Microsemi PIN diodes, a SPICE PIN diode model of Microsemi's products line will allow Microsemi and their customers to readily incorporate these models & devices in their circuit designs.

The overall SPICE PIN diode model developed for the UMX5601 exhibits the equivalent circuit shown below where:

- C_{PACK} is the package capacitance
- $L_{CONTACT}$ is the contact inductance
- C_I is the punch through I-region capacitance
- R_{EPI} is a resistance describing the zero bias impedance
- R_{MIN} is the minimum I-region resistance
- G_{DEP} and C_{DEP} model the reverse bias characteristics (G_{DEP} requires fit parameters R_{DEP} and $V_{REVERSE}$)
- G_{MOD} is a controlled current source representing the I-region stored charge current relationship versus frequency
- G_{PIN} is a controlled current source representing the PN junction portion of the PIN diode

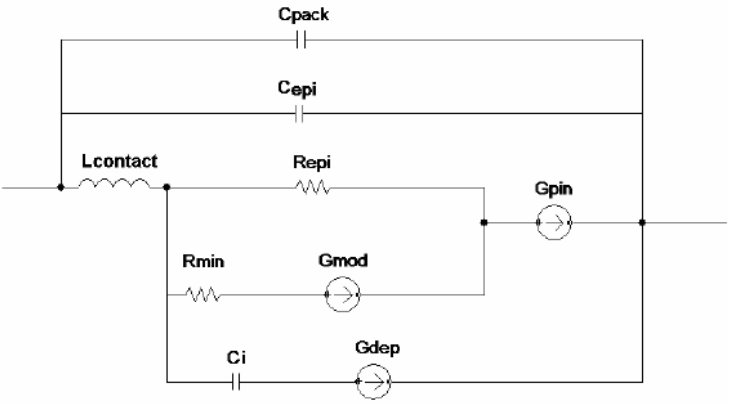

Figure 1. RF equivalent circuit of the PIN diode. The definitions for the controlled current sources (G_{MOD}, G_{PIN}, G_{DEP}) are shown in the SPICE netlist file below.

```
* subcircuit for UMX5601 PIN diode
.subckt pin 9 20 params:
+ is= 2.00E-8 n = 1.94 m=0.5 ikf=0.10
+ rs = 18m rmin = 18m
+ rdep=15k repi= 22k
+ bv = 3000 ibv = 10E-06 vreverse=6
+ vj = 0.6 phi=0.6
+ W = 175u tau=26u iknee=0.018
+ cepi = 0.6pf ci=2pf
+ lcontact = 900ph cpackage=1.70pf cjo=2.0pf
.param to={125*w*w}
.param vi={11.8*w*w/tau}
.param beta={to/tau}
```


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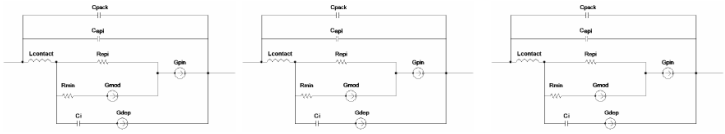

```
cpackage 9 20 {cpackage}
lcontact 9 10 {lcontact}
ci 10 25 {ci}
rconverge2 10 25 1e15
rconverge1 12 25 1e15
gdep 25 20 value={v(25,12)/(rdep*(1+(abs((v(9,20))/vreverse)^2.0)))}
rmin 10 11 {rmin}
gmod 11 12 value={2*(v(11,12)*v(2,3)/vi)}
rconverge3 11 12 1e15
gpin 12 20 value={i(vs2)}
repi 10 12 {repi}
cepi 9 20 {cepi}
ej 30 0 value={v(12,20)}
vs1 30 31 0
* single diode model
d1 31 0 dj
.model dj d is={is} ikf={ikf} n={n} bv={bv} ibv={ibv} rs={rs} cjo={cjo} vj={vj} m={m}
e1 1 0 value={i(vs1)}
vs2 1 2 0
* ge describes the current-dependent tau
ge 2 0 value={(v(2)*v(2))/iknee}
* 8th order approximation for base region
rp1 2 3 1
cp1 2 3 {tau}
rs1 3 0 {beta/3}
rp2 3 4 5
cp2 3 4 {tau/5}
rs3 4 0 {beta/7}
rp4 4 5 9
cp4 4 5 {tau/9}
rs5 5 0 {beta/11}
rp6 5 6 13
cp6 5 6 {tau/13}
rs6 6 0 {beta/15}
rp7 6 7 17
cp7 6 7 {tau/17}
rs7 7 0 {beta/19}
.ends
```

This model was developed as a cooperative effort between Microsemi and Villanova University Department of Electrical and Computer Engineering.

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