Modeling Corner

The Intusoft

In this issue of The Modeling Corner we will briefly introduce a new SPICE model for IGBTs. An in-depth description of the subcircuit and how models for specific IGBT devices can be created from data sheet parameters will appear in a future newsletter.

This is the first IGBT model ever available in a form that can be used for a variety of IGBTs and for virtually all SPICE versions. The model is generic in nature, meaning, that component values in the subcircuit can be easily recalculated to emulate different IGBT devices. The new model accurately simulates:

- Switching loses
- On-voltage
- Turn-on/turn-off delay
- Active output impedance
- Nonlinear capacitance effects
- Forward/reverse breakdown
- Rise time and tail
 - Collector family curves including mobility modulation

For those who are interested in obtaining IGBT models, there are several possible opportunities. First, *Intusoft Newsletter*



.SUBCKT Name (IRGBC40U) = IRGBC40U Affects: Channel Type (N,P) =N Collector-to-Emitter Breakdown Volt,BVCES = Emitter-to-Collector Breakdown Volt,BVECS = 600.000 V. 15.000 V. BV in DO BV in DE 40.000 A. Max. Continuous Collector Current, ICmax. All Parameters 2.700 V. 40.000 A. C-to-E Saturation Voltage, VCE(on) RC, RS at Current, IC(on) and Bias, VGE(on) Gate Threshold Voltage, VGE(th) 15.000 V. 5.200 U **UTO** 14.000 S. КP Forward Transconductance, gfe at Current, IC 20.000 A. Output Conductance, go Capacitance Test Voltage, VCE LAMBDA, ETA (above VCT) 80.267 mmohs 30.000 V. Input Capacitance, Cies Output capacitance, Coes 1429.630 pF CGE 194.430 pF. CBD (CJO in DO) Reverse Transfer Capacitance, Cres 7.027 pF. CGD (CJO in DR) Capacitance Transition Voltage, UCT Capacitance Shift at VCT, (C1/C2) Rise Time, tr 19.000 ELV offset U. 14.000 DLV multiplier 0.021 us. ΤF Turn-Off Delay Time, td(off) 0.100 \mathbf{TR} us. BF Current Step at Turn-Of, (I2/I1) = 0.836 SELECT WITH ARROWS, TYPE DATA F1=HELP F2=SUBCKT F3=RESET DATA Exc=EXIT/SAVE .SUBCKT IRGBC40U 71 72 73 RLV 95 0 TERMINALS: C GE 1 ESD 96 93 POLY(1) 83 81 19 600 Volt 40 Amp 21NS 1 * N-Channel IGBT MLV 95 96 93 93 SW Q1 83 81 85 DSD 83 81 QOUT DO M1 81 82 83 83 MFIN L=1U W=1U DBE 85 81 DE .MODEL QOUT PNP (IS=377F NF=1.2 RC 85 71 21.1M RE 83 73 2.11M +BF=5.1 CJE=3.48N TF=6.04N) .MODEL MFIN NMOS (LEVEL=3 72 82 25.6 RG + VMAX=400K THETA=46.1M ETA=2M CGE 82 73 1.42N CGC 82 71 + VTO=5.2 KP=2.12) 1P EGD 91 0 82 81 .MODEL SW NMOS (LEVEL=3 VTO=0 + KP=5) VFB 93 0 0 FFB 82 81 .MODEL DR D (IS=3.77F CJO=100P VFB 1 CGD 92 93 1.41N + VJ=1 M=.82)92 .MODEL DO D (IS=3.77F BV=600 R1 0 1 + CJO=2.07N VJ=1 M=.7) 91 92 D1 DLIM .MODEL DE D (IS=3.77F BV=14.3 DHV 94 93 DR R2 91 94 1 + N=2) 94 .MODEL DLIM D (IS=100U) D2 0 DLIM .ENDS DLV 94 95 DR 13

Figure 9, The SPICEMOD 2.0 input screen (top) shows the extensive list of IGBT data sheet parameters that can be entered. The resulting subcircuit, of the International Rectifier IRGBC40U IGBT, is shown above.

subscribers will receive the enclosed model along with several other models on the newsletter floppy disk. Second, a library of 65 IGBT models is included in the PRESPICE version 3.0 package. And third, registered owners of Intusoft software can avail themselves of Intusoft's free modeling services.

At this time, several manufacturers, including International Rectifier, are preparing to release IGBT models created with SPICEMOD 2.0. Contact the manufacturer of your IGBT devices for more information. The IGBT model, like all of Intusoft's models, will work on any SPICE program on any platform.