JSIM Preliminary Version User's Guide

E. S. Fang and T. Van Duzer

Department of Electrical Engineering and Computer Science

University of California

Berkeley, CA 94720

1. Introduction

JSIM (Josephson SIMulator) is a circuit simulation program for Josephson circuits. Circuits may contain resistors, capacitors, inductors, mutual inductors, independent voltage and current sources, lossless transmission lines and Josephson junctions. At present time, only transient analysis is allowed.

The input format of JSIM is quite similar to SPICE. If you are not familiar with SPICE, it is recommended that you read the SPICE user guide also.

2. Circuit Description

2.1. Resistors

General form : RXXXX N1 N2 VALUE

Example : RC1 12 9 1KOHM

2.2. Capacitors

General form : CXXXX N1 N2 VALUE <IC=VALUE>

Example : C1 10 11 1PF

Initial value may be specified, but currently it is ignored. This applies to ALL initial values.

2.3. Inductors

General form : LXXXX N1 N2 VALUE <FCHECK> <IC=VALUE>

Example : L2 1 0 2.3PH FCHECK

If FCHECK （flux check） is specified, JSIM will keep track of the change of flux through the inductor. It is recommended particularly for

phase mode circuit. In each superconductive loop, at least one inductor should be considered for FCHECK option.

2.4. Mutual Inductors

General form : KXXXX LXXXX LYYYY VALUE

Example : K1 L1 L2 0.9

2.5. Independent Voltage Sources

2.5.1. Sinusoidal Sources

General form : VXXXX N1 N2 SIN(VO VA FREQ TD THETA)

Example : V1 1 0 SIN(0 1MV 100MEGHZ 0US 0)

Note VO must be zero.

2.5.2. Pulse Sources

General form : VXXXX N1 N2 PULSE(V1 V2 TD TR TF PW PER)

Example : V2 2 0 PULSE(0MV 1MV 0PS 2PS 2PS 10PS 50PS)

Note V1 must be zero.

2.5.3. Piece-wise Linear Sources

General form : VXXXX N1 N2 PWL(T0 V0 T1 V1 ....)

Example : V3 3 0 PWL(0PS 0MV 1PS 1MV)

Note T0 and V0 must be zero.

2.6. Independent Current Sources

2.6.1. Sinusoidal Sources

General form : IXXXX N1 N2 SIN(IO IA FREQ TD THETA)

Example : I1 1 0 SIN(0 1MA 100MEGHZ 0US 0)

Note IO must be zero.

2.6.2. Pulse Sources

General form : IXXXX N1 N2 PULSE(I1 I2 TD TR TF PW PER)

Example ： I2　2 0 PULSE(0MA 1MA 0PS 2PS 2PS 10PS 50PS)

Note I1 must be zero.

2.6.3.　Piece-wise Linear Sources

General form : IXXXX N1 N2 PWL(T0 I0 T1 I1 ....)

Example : I3 3 0 PWL(0PS 0MA 1PS 1MA)

Note T0 and I0 must be zero.

2.7.　Josephson Junctions

General form : BXXXX N1 N2　MODNAME　<AREA>　<CONDEV=DEVNAME> <IC=V0,PHI0>

Example : B1 2 3 JJMOD1 AREA=1.5 CONDEV=L2

MODNAME is the model name, CONDEV is used to simulate the modulation of　critical　current　due　to magnetic　field,　DEVNAME　can　only be inductors, voltage and current sources.

2.8. Transmission Line

General form ： TXXXX N1 N2 N3 N4 LOSSLESS
<Z0=VALUE> <TD=VALUE>

Example：T1 1 0 2 0 LOSSLESS Z0=50 TD=100PS

N1 and N2 are nodes for port 1, and N3 and N4 are
nodes for port 2. Default Z0=50ohm, TD=1sec.

2.9. Subcircuit Calls

General form：XYYYY SUBDEFNAME N1 N2 .....

Example：X1 SGA 1 3 4 5

3. Subcircuit Definition

General form：.SUBCKT SUBDEFNAME N1 N2 ......

General form：<circuit elements>

General form：.ENDS

Example：.SUBCKT TEST 1 2 3

Example：R1 1 2 3K

Example : C1 2 3 3PF

Example : .ENDS

4. Model Specification

4.1. Josephson Models

General form : .MODEL MNAME JJ(<PARAM=VALUE>,....)

Example ： .MODEL JJMOD1 JJ(VG=2.5MV, CAP=0.6PF, ICRIT=100UA)

RTYPE : quasiparticle model, can be zero or one. Zero is for zero conductance, and one is for piece-wise linear conductance curve, default is 0.

CCT ： control current type, can be zero or one. Zero is for no control current, and one is for sine x over x, default is 0.

VG : gap voltage, default is 2.8mV.

DELV : gap transition voltage, default is 0.1mV.

ICON : control current scale, default is 1mA.

R0 : subgap resistance, default is 30ohm.

RN : normal resistance, default is 5ohm.

CAP : junction capacitance, default is 2.5pf

ICRIT : critical current, default is 1mA.

5. Transient Analysis Specification

General form : .TRAN PRSTEP TSTOP <TSTART> <MAXTSTEP>

Example : .TRAN 1PS 100PS 20PS 0.5PS

PRSTEP is the printing step.

TSTOP is the stop time.

TSTART is the starting time for printing,   default is 0.

MAXTSTEP   is   the   maximum   internal   time   step, default is 1ps.

6. Print and File Specifications

General form：.FILE FILENAME

General form：.PRINT PRTYPE PRNAME <PART>

Example：.FILE OUT1

Example：.PRINT NODEV 2 0

Example：.PRINT DEVV X1_X2_B1

Example：.FILE OUT2

Example：.PRINT DEVI B2 JJTOTAL

Example：.PRINT PHASE B3

Example：.PRINT DEVV T1 PORT1

Example：.PRINT DEVI T1

To print out device voltage or current of a sub-
circuit element, just expand the element name by
the subcircuit call name. In the above examples,
X1_X2_B1, means B1 belong to subcircuit call X2
which is in turn called by X1. This eliminates
the need for a long node list in the subcircuit
definition in order to print out values associated
with subcircuit elements as in SPICE.

JJTOTAL：total current.

JJJOSEPH：Josephson current.

JJCAP：current due to capacitive effect.

JJRESIS : quasi-partical current.

JJALL : print all currents in the order specified.

PORT1 : print port1 of transmission line.

PORT2 : print port2 of transmission line, no   port specification prints both ports.

7. Option Specifications

General form : .OPTIONS <PARAM, ...>

Example : .OPTIONS RELTOL=0.01 MAXPHISTEP=1.5

RELTOL=VALUE ： relative tolerance, default is 0.001.

PHITOL=VALUE ： absolute tolerance for   phase, default is 0.0001, (too small, set it to 0.01).

VNTOL=VALUE : absolute voltage tolerance, default
is 0.1 uV, only in effect when LTE option is used.

INTOL=VALUE : absolute current tolerance, default
is 0.1 uA, only in effect when LTE option is used.

MAXPHISTEP=VALUE : maximum phase change allowed in
one time step, default is 1.5.

MAXFLUXSTEP=VALUE : maximum flux change in induc-
tor allowed in one time step. Only applies to
those inductors with FCHECK flag specified.
Default is 0.5e-15.

LTE : check for local truncation error in choosing
step size, default no LTE.

IGWARN : ignore warning and proceed with simula-
tion.

NUMDGT=VALUE : number of digits to be printed,
default is 3.

8. Special Files

JSIM will generate some special files. All the
speical files start with .jsim. They are devlist,
devname, model, nodemap and subdef.

9. CAUTION

This is a preliminary version of the program. Many
parameters have no defaults, and have to be specified.

10. BUGS

If you find any problems, please send e-mail to esfang@argon.berkeley.edu, include the input deck that causes the problem and a description of the problem. Also you may call (415) 642-0502 and contact Emerson Fang, or write to Prof. Ted Van Duzer at the above address.

nroff -ms noise.ms

delim $$ gsize 12 gfont R define hbar '{ h back 70 up 35 - ~
}'

Noise supplement JSIM Preliminary   Version   User's Guide

J S Satchell
DRA(Malvern)
St. Andrews Rd.,

Worcs, UK

WR14 3PS

1.   Introduction

     JSIM (Josephson SIMulator) is a circuit simulation pro-
gram for Josephson circuits. The noise   extension   adds   two
new device types, and is intended to be a strict superset of
standard JSIM, documented in the file manual.ms.

     Modifications, makefile, awk script, this document   and
the contents of the test directory are

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2.   Circuit Description

2.1.   Independent Voltage Sources

2.1.1.   Noise Sources

          General form : VXXXX N1 N2 NOISE(VO VA TSTEP TD)

          Example : V1 1 0 NOISE(0 1P 1PS 0PS)

Note VO must be zero. VA is the spectral amplitude density of the noise source in Volts/root(Hz). TSTEP is a the maximum time step that will be used, this provides an opportunity to limit ther-rors in the stochastic algorithm. 1pS seems to be reasonable for HTS junction parameters. TD is a time delay before noise starts.

2.2.   Independent Current Sources

2.2.1.   Noise Sources

General form : IXXXX N1 N2 SIN(IO   IA TSTEP TD)

Example : I1 1 0 NOISE(0 1P 1PS 0PS)

Note IO must be zero. IA is the spectral amplitude density of the noise source in Amps/root(Hz). TSTEP is a the maximum time step that will be used, this pro-vides an opportunity to limit therrors in the stochastic algorithm. 1pS seems to be reasonable for HTS junction param-eters. TD is a time delay before noise

starts.

BUGS

If you find any problems with the stochastic extension, please send e-mail to satchell@dra.hmg.gb, include the input deck that causes the problem and a description of the problem. Warning: I may ignore you, be too busy or be unable to help.