Goals of IBIS-Spice

1. **Easy to generate by extraction tools.**
2. **Easy to consume by simulators.**

Berkley Spice Interconnect Models

Data fields that are enclosed in less-than and greater-than signs ('< >') are optional. All indicated punctuation (parentheses, equal signs, etc.) is optional but indicate the presence of any delimiter. Further, future implementations may require the punctuation as stated. A consistent style adhering to the punctuation shown here makes the input easier to understand. With respect to branch voltages and currents, SPICE uniformly uses the associated reference convention (current flows in the direction of voltage drop).

Resistors

General form:

```
      RXXXXXXX N1 N2 VALUE
```

Examples:

```
      R1 1 2 100
      RC1 12 17 1K
```

N1 and N2 are the two element nodes. VALUE is the resistance (in ohms) and may be positive or negative but not zero.

Capacitors

General form:

```
      CXXXXXXX N+ N- VALUE <IC=INCOND>
```

Examples:

```
      CBYP 13 0 1UF
      COSC 17 23 10U IC=3V
```

N+ and N- are the positive and negative element nodes, respectively. VALUE is the capacitance in Farads.

The (optional) initial condition is the initial (time-zero) value of capacitor voltage (in Volts). Note that the initial conditions (if any) apply 'only' if the UIC option is specified on the .TRAN control line.

Inductors

General form:

LYYYYYYY N+ N- VALUE <IC=INCOND>

Examples:

LLINK 42 69 1UH

LSHUNT 23 51 10U IC=15.7MA

N+ and N- are the positive and negative element nodes, respectively. VALUE is the inductance in Henries.

The (optional) initial condition is the initial (time-zero) value of inductor current (in Amps) that flows from N+, through the inductor, to N-. Note that the initial conditions (if any) apply only if the UIC option is specified on the .TRAN analysis line.

Coupled (Mutual) Inductors

General form:

KXXXXXXX LYYYYYYY LZZZZZZZ VALUE

Examples:

K43 LAA LBB 0.999

KXFRMR L1 L2 0.87

LYYYYYYY and LZZZZZZZ are the names of the two coupled inductors, and VALUE is the coefficient of coupling, K, which must be greater than 0 and less than or equal to 1. Using the 'dot' convention, place a 'dot' on the first node of each inductor.

Lossless Transmission Lines

General form:

TXXXXXXX N1 N2 N3 N4 Z0=VALUE <TD=VALUE>

Independent Sources

General form:

VXXXXXXX N+ N- DC <Value>

Linear Voltage-Controlled Current Sources

General form:

GXXXXXXX N+ N- NC+ NC- VALUE

Examples:

G1 2 0 5 0 0.1MMHO

N+ and N- are the positive and negative nodes, respectively. NC+ and NC- are the positive and negative controlling nodes, respectively. VALUE is the transconductance (in mhos).

Linear Voltage-Controlled Voltage Sources

General form:

EXXXXXXX N+ N- NC+ NC- VALUE

Examples:

E1 2 3 14 1 2.0

N+ is the positive node, and N- is the negative node. NC+ and NC- are the positive and negative controlling nodes, respectively. VALUE is the voltage gain.

Linear Current-Controlled Current Sources

General form:

FXXXXXXX N+ N- VNAM VALUE

Examples:

F1 13 5 VSENS 5

N+ and N- are the positive and negative nodes, respectively. VNAM is the name of a voltage source through which the controlling current flows. VALUE is the current gain.

Linear Current-Controlled Voltage Sources

General form:

HXXXXXXX N+ N- VNAM VALUE

Examples:

HX 5 17 VZ 0.5K

N+ and N- are the positive and negative nodes, respectively. VNAM is the name of a voltage source through which the controlling current flows. VALUE is the transresistance (in ohms).

.SUBCKT

General form:

```
.SUBCKT subnam N1 <N2 N3 ...>
```

Examples:

```
.SUBCKT OPAMP 1 2 3 4
```

A circuit definition is begun with a .SUBCKT line. SUBNAM is the subcircuit name, and N1, N2, ... are the external nodes, which cannot be zero. The group of element lines which immediately follow the .SUBCKT line define the subcircuit. The last line in a subcircuit definition is the .ENDS line (see below). Control lines may not appear within a subcircuit definition; however, subcircuit definitions may contain anything else, including other subcircuit definitions, device models, and subcircuit calls (see below). Note that any device models or subcircuit definitions included as part of a subcircuit definition are strictly local (i.e., such models and definitions are not known outside the subcircuit definition). Also, any element nodes not included on the .SUBCKT line are strictly local, with the exception of 0 (ground) which is always global.

.ENDS

General form:

```
.ENDS &ltSUBNAM;>
```

Examples:

```
.ENDS OPAMP
```

The "Ends" line must be the last one for any subcircuit definition. The subcircuit name, if included, indicates which subcircuit definition is being terminated; if omitted, all subcircuits being defined are terminated. The name is needed only when nested subcircuit definitions are being made.

Subcircuit Calls

General form:

```
XYYYYYYY N1 <N2 N3 ...> SUBNA
```

Examples:

```
X1 2 4 17 3 1 MULTI
```

Subcircuits are used in SPICE by specifying pseudo-elements beginning with the letter X, followed by the circuit nodes to be used in expanding the subcircuit.

Required Additional Interconnect Models

S-element Syntax

Use the following S-element syntax to show the connections within a circuit:

```
Sxxx nd1 nd2 ... ndN ndRef
+ <MNAME=Smodel_name> <FQMODEL=sp_model_name>
+ <TYPE=[s|y]> <Zo=[value | vector_value]>
+ <FBASE = base_frequency> <FMAX=maximum_frequency>
+ <PRECFAC=val> <DELAYHANDLE=[1|0|ON|OFF]>
+ <DELAYFREQ=val>
+ <INTERPOLATION=STEP|LINEAR|SPLINE|HYBRID>
+ <INTDATTYP =[RI|MA|DBA]> <HIGHPASS=[1|2|3|4]>
+ <LOWPASS=[0|1|2]3> <MIXEDMODE=[0|1]>
+ <DATATYPE=data_string>
+ <NOISE=[1|0]> <NoiPassiveChk=1|0> <DTEMP=val>
+ <PASSIVE=[0|1]>
+ <RATIONAL_FUNC=[0|1]> <RATIONAL_FUNC_REUSE=[0|1]>
+ <STAMP=[S|Y|YSTS|SSTS]>
```

S Model Syntax

Use the following syntax to describe specific S models:

```
.MODEL Smodel_name S
+ <N=dimension>
+ [FQMODEL=sp_model_name | TSTONEFILE=filename|
+ CITIFILE=filename]
+ <TYPE=[s|y]> <Zo=[value | vector_value]>
+ <FBASE=base_frequency> <FMAX=maximum_frequency>
+ <INTERPOLATION=STEP|LINEAR|SPLINE|HYBRID>
+ <INTDATTYP =[RI|MA|DBA]>
+ <HIGHPASS=[0|1|2|3|4]> <LOWPASS=[0|1|2|3]>
+ <PRECFAC=val> <DELAYHANDLE=[1|0|ON|OFF]>
+ <DELAYFREQ=val> <MIXEDMODE=[0|1]>
+ <DATATYPE=data_string> <XLINELENGTH=val> <PASSIVE=[0|1]>
+ <NoiPassiveChk [1|0]>
+ <SMOOTH=val> <SMOOTHPTS=val>
+ <RATIONAL_FUNC=[0|1]> <RATIONAL_FUNC_REUSE=[0|1]>
+ RFMFILE=<file_name>.rfm
+ <STAMP=[S|Y|YSTS|SSTS]>
```

Input Syntax for the W-element

Syntax:

```
Wxxx i1 i2 ... iN iR o1 o2 ... oN oR N=val L=val
+ <RLGCMODEL=name | RLGCFILE=name | UMODEL=name
+ FSMODEL=name | TABLEMODEL=name | SMODEL=name>
+ [ INCLUDERSIMAG=YES|NO FGD=val ] [ DELAYOPT=0|1|2|3 ]
+ [ INCLUDEGDIMAG=YES|NO <NODEMAP=XiYj...>
+ <NOISE=[1|0]> <DTEMP=val>
+ <PRINTZO=frequency_sweep MIXEDMODE=0|1>
+ <SCALE_RS=val>
```

```
.MODEL name W MODELTYPE=RLGC [FITGC] N=val
Lo=matrix_entries
+ Co=matrix_entries [ Ro=matrix_entries Go=matrix_entries
+ Rs=matrix_entries wp=val Gd=matrix_entries Rognd=val
+ Rsgnd=val Lgnd=val
```

Parameter Description

FITCG Keyword for w-model (w/ MODELTYPE=TABLE

N Number of conductors (same as in the element card).

L

DC inductance matrix, per unit length .

C

DC capacitance matrix, per unit length .

Ro

DC resistance matrix, per unit length .

Go

DC shunt conductance matrix, per unit length .

Rs

Skin effect resistance matrix, per unit length .

Gd

Dielectric loss conductance matrix, per unit length .

wp Angular frequency of the polarization constant [radian/sec] (see Introduction to the Complex Dielectric Loss Model on page 76). When the wp value is specified, the unit of Gd becomes [S/m].

Lgnd

DC inductance value, per unit length for grounds (reference line).

Rognd

DC resistance value, per unit length for ground .

Rsgnd

Skin effect resistance value, per unit length for ground .

Table Model Card Syntax

```
.MODEL name W MODELTYPE=TABLE N=val
+ LMODEL=l_freq_model CMODEL=c_freq_model
+ [ RMODEL=r_freq_model GMODEL=g_freq_model ]
```

Parameter Description-

LMODEL SP model name for the inductance matrix array.

CMODEL SP model name for the capacitance matrix array.

RLMODEL SP model name for the resistance matrix array. By default, it is zero.

GMODEL SP model name for the conductance matrix array. By default, it is zero.

Laplace and Pole-Zero

```
HSPICE and some other SPICEs implement the Laplace and pole-zero
     elements as a network function WITHIN controlled sources including
     the VCVS (E) and VCCS (G) elements.  The documention is hard to
     find, but the HSPICE syntax is in the HSPICE Applications Manual:

     Exxx n+ n- LAPLACE in+ in-  k0 k1 ... kn / b0 b1 ... bm
     Gxxx n+ n- LAPLACE in+ in-  k0 k1 ... kn / b0 b1 ... bm

     Exxx n+ n- POLE in+ in-  a {cmpl zeros) / b (cmpl poles}
     Gxxx n+ n- POLE in+ in-  a {cmpl zeros) / b (cmpl poles}
```

P Element

P element used to define the ports of a subckt to enable EDA tools to generate an sNp.

Y Element

Reserve the letter Y for future expansion (e.g.)

YA
YB