

## PSpice Help

### Index of PSpice A/D symbol and part properties

The following index lists every symbol/part property that can be used with PSpice A/D , its associated symbol/part, what libraries the symbol/part can be found in, and a brief description of what the property is used for. This list should be used when preparing a circuit for simulation by setting up property assignments for symbols/parts that are placed in Capture. The properties are listed alphabetically for easy searching.

Property	Symbol(s)/ Part(s)	PSpice A/D Library	Description	Required	Default	Units
AC	VPWL, VSIN, VPWL_F_RE_ FOREVER, VPWL_RE_N_ TIMES, VPULSE, VPWL_ENH, VPWL_RE_F OREVER, VPWL_FILE, VSFFM, VSRC, VPWL_F_RE_ N_TIMES, VSTIM	SOURCE, SOURCST M	AC magnitude (used in AC sweep analysis only)	No	0	V
AC	IPWL, ISIN, IPWL_F_RE_ FOREVER, IPWL_RE_N_ TIMES, IPULSE, IPWL_ENH, IPWL_RE_FO REVER, IPWL_FILE, ISFFM, ISRC, IPWL_F_RE_ N_TIMES, ISTIM	SOURCE, SOURCST M	AC magnitude (used in AC sweep analysis only)	No	0	A
AC	IPRINT, VPRINT1, VPRINT2	SPECIAL	Print AC sweep results for signal to output file (Y N)	No	N	none

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ACMAG	IAC	SOURCE	AC magnitude (used in AC sweep analysis only)	Yes	0	A
ACPHASE	IAC	SOURCE	AC phase (used in AC sweep analysis only)	No	0	Degrees
ACMAG	VAC	SOURCE	AC magnitude (used in AC sweep analysis only)	Yes	0	V
ACPHASE	VAC	SOURCE	AC phase (used in AC sweep analysis only)	No	0	Degrees
AD	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Drain diffusion area	No	DEF AD	m <sup>2</sup>
AGD	ZbreakN	BREAKOUT	Gate-drain overlap area	No	5.0e- 6	m <sup>2</sup>
ANALYSIS	PRINT1, WATCH1	SPECIAL	Analysis type (AC DC TRAN)	No	TRA N	none
AREA	DbreakCR, JbreakN, QbreakP3, DbreakW, JbreakP, QbreakP4, QbreakL, QbreakN3, QbreakN4, QbreakN, QbreakP, DbreakZ, Dbreak, Bbreak, ZbreakN	BREAKOUT	Area value (for scaling)	No	1.0	none

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ARM_MA SS	Relay_SPDT_ phy	ANL_MISC	Contact arm mass (moment)	Yes	0.5	g*cm *sec* sec
AS	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Source diffusion area	No	DEF AS	m^2
ASSERT ION	HOLD<SIZE>	DIG_MISC	Assert hold violation when low to high or high to low (LH HL)	Yes	LH	none
ASSERT ION	SETUP<SIZE >	DIG_MISC	Assert setup violation when low to high or high to low (LH HL)	Yes	LH	none
BACKEM F	BLDCMTR	MIX_MISC	Back EMF constant	Yes	0.12	Volt* sec/ rev
BIT	VECTOR<SIZ E>	SPECIAL	Bit position within a single hex or octal digit (see .VECTOR)	No	none	none
C	TLOSSY, TLURC<SIZE >, TLUMP<SIZE >	ANALOG, TLINE	Capacitance value per unit length of transmission line	Yes	1	F
C	T<SIZE>coupl ed	TLINE	Capacitance value per unit length of coupled transmission line	Yes	-1	F
C1	T<SIZE>coupl edX	TLINE	Capacitance value per unit length of first coupled transmission line	Yes	-1	F

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C2	T<SIZE>coupledX	TLINE	Capacitance value per unit length of second coupled transmission line	Yes	-1	F
C3	T<SIZE>coupledX	TLINE	Capacitance value per unit length of third coupled transmission line	Yes	-1	F
C4	T<SIZE>coupledX	TLINE	Capacitance value per unit length of fourth coupled transmission line	Yes	-1	F
C5	T<SIZE>coupledX	TLINE	Capacitance value per unit length of fifth coupled transmission line	Yes	-1	F
CAP	DIGCAP	DIG_MISC	Capacitance value for digital I/O model	Yes	10P	F
CAPACITANCE	BLDCMTR	MIX_MISC	Winding capacitance to ground	Yes	0.001u	F
CIN	ADCPAR<SIZE>	DATA CONV	Input capacitance	Yes	10P	F
CIN	ADCMIC<SIZE>	DATA CONV	Input capacitance	Yes	22p	F
CKDPDMAX	ADCSER<SIZE>	DATA CONV	Maximum clock to data delay	Yes	80n	sec
CKDPDMIN	ADCSER<SIZE>	DATA CONV	Minimum clock to data delay	Yes	25n	sec
CLKHI	ADCSER<SIZE>	DATA CONV	Minimum clock high pulse width	Yes	40n	sec
CLKLO	ADCSER<SIZE>	DATA CONV	Minimum clock low pulse width	Yes	60n	sec
CLKMAX	ADCSER<SIZE>	DATA CONV	Maximum clock frequency	Yes	5Meg	Hz

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CLKMIN	ADCSER<SIZE> E>	DATA CONV	Minimum clock frequency	Yes	Hz	178.571K
CM	T<SIZE>coupled, T<SIZE>coupledX	TLINE	Mutual capacitance per unit length	Yes	0	F
CM	Kcouple2	TLINE	Mutual coupling capacitance per unit length	Yes	none	F
CM12	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 1 and 2	Yes	0	F
CM13	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 1 and 3	Yes	0	F
CM14	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 1 and 4	Yes	0	F
CM15	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 1 and 5	Yes	0	F
CM21	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 2 and 1	Yes	none	F
CM23	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 2 and 3	Yes	0	F
CM24	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 2 and 4	Yes	0	F

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CM25	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 2 and 5	Yes	0	F
CM31	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 3 and 1	Yes	none	F
CM32	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 3 and 2	Yes	none	F
CM34	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 3 and 4	Yes	0	F
CM35	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 3 and 5	Yes	0	F
CM41	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 4 and 1	Yes	none	F
CM42	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 4 and 2	Yes	none	F
CM43	Kcouple<SIZE>	TLINE	Mutual coupling capacitance per unit length between tlines 4 and 3	Yes	none	F
CM45	T<SIZE>coupledX	TLINE	Mutual coupling capacitance per unit length between tlines 4 and 5	Yes	0	F

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CM51	Kcouple<SIZE >	TLINE	Mutual coupling capacitance per unit length between tlines 5 and 1	Yes	none	F
CM52	Kcouple<SIZE >	TLINE	Mutual coupling capacitance per unit length between tlines 5 and 2	Yes	none	F
CM53	Kcouple<SIZE >	TLINE	Mutual coupling capacitance per unit length between tlines 5 and 3	Yes	none	F
CM54	Kcouple<SIZE >	TLINE	Mutual coupling capacitance per unit length between tlines 5 and 4	Yes	none	F
CO	QRLSZCS	SWIT_RAV	Resonant capacitor value	Yes	.1u	F
COEFF	EPOLY	ANALOG	Voltage gain	Yes	1	V/V
COEFF	FPOLY	ANALOG	Current gain	Yes	1	A/A
COEFF	GPOLY	ANALOG	Transconductance	Yes	1	A/V
COEFF	HPOLY	ANALOG	Transresistance	Yes	1	V/A
COMMAN D<LINE >	STIM1	SOURCE	(time, bit value) pairs of stimuli to be generated (see Stimulus Generator)	Yes	0s 0	pair
COMMAN D<LINE >	STIM16	SOURCE	(time, hex value) pairs of stimuli to be generated (see Stimulus Generator)	Yes	0s 0000	pair
COMMAN D<LINE >	STIM4	SOURCE	(time, bit value) pairs of stimuli to be generated (see Stimulus Generator)	Yes	0s 0000	pair

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COMMAN D<LINE >	STIM8	SOURCE	(time, bit value) pairs of stimuli to be generated (see Stimulus Generator)	Yes	0s 0000 0000	pair
CONTA C T_MAT C H	Relay_DPDT_ b, Relay_DPDT_ nb	MIX_MISC	Matching of contact make/break/bounce times: 1 = exact	Yes	0.95	none
CONVW H I	ADCSER<SIZ E>	DATACONV	Minimum high width of convert pulse	Yes	40n	sec
CONVW H I	ADCPAR<SIZ E>	DATACONV	Minimum high width of convert pulse	Yes	45n	sec
CONVW H I	ADCMIC<SIZ E>	DATACONV	Minimum high width of convert pulse	Yes	50n	sec
CONVW L O	ADCPAR<SIZ E>	DATACONV	Minimum low width of convert pulse	Yes	45n	sec
CONVW L O	ADCMIC<SIZ E>	DATACONV	Minimum low width of convert pulse	Yes	50n	sec
CONVW L O	ADCSER<SIZ E>	DATACONV	Minimum low width of convert pulse	Yes	60n	sec
COUPLI NG	XFRM_LINEA R, XFRM_NONLI NEAR, K_LINEAR, kbreak	ANALOG, BREAKOUT	Coupling coefficient	Yes	1	none
COUT	DACCUR<SIZ E>	DATACONV	Output capacitance	Yes	10p	F
CSMINL O	DACPAR<SIZ E>	DATACONV	Minimum low width of CS	Yes	90n	sec
D	CMSSCCM	SWIT_RAV	Duty cycle	Yes	0.75	none
D	VMSSCCM	SWIT_RAV	Duty cycle	Yes	0.4	none
DAMPIN G	BLDCMTR	MIX_MISC	Damping and eddy current losses (linear torque with speed)	Yes	0.36	g*cm *sec/ rad

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DAMPING	Relay_SPDT_phy	ANL_MISC	Limit damping rate	Yes	1000	g*cm*sec/rad
DB	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write signal in DB in output file (Y N)	No	N	none
DC	VDC	SOURCE	DC voltage magnitude (used for bias point and in transient analysis)	Yes	0	V
DC	IDC	SOURCE	DC current magnitude (used for bias point and in transient analysis)	Yes	0	A
DC	VPWL, VSIN, VPWL_F_RE_FOREVER, VPWL_RE_N_TIMES, VPULSE, VPWL_ENH, VPWL_RE_FOREVER, VPWL_FILE, VSFFM, VSRC, VPWL_F_RE_N_TIMES, VSTIM, VAC	SOURCE, SOURCSTM	DC voltage magnitude (used for bias point)	No	0	V

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DC	IPWL, ISIN, IPWL_F_RE_ FOREVER, IPWL_RE_N_ TIMES, IPULSE, IPWL_ENH, IPWL_RE_FO REVER, IPWL_FILE, ISFFM, ISRC, IPWL_F_RE_ N_TIMES, ISTIM, IAC	SOURCE, SOURCST M	DC current magnitude (used for bias point)	No	0	A
DC	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write DC analysis results to output file (Y N)	No	N	none
DEADTI ME	SG1525A/ 25C, SG1526B, SG1525, SG1524B, SG1529	SWIT_REG	Dead time	Yes	1u	sec
DEADTI ME	SG1842, SG1843, SG1844, SG1845, SG1846	SWIT_REG	Dead time	Yes	2u	sec
DEADTI ME	SG1825	SWIT_REG	Dead time	Yes	5E- 08	sec
DELAY	DIGCLOCK	SOURCE	Delay before clock starts	No	0	sec
DELAY	EFREQ, FTABLE, GFREQ	ABM	Phase delay to apply to data in frequency table	No	0	sec
DELAY	DELAY	DIG_MISC	Digital delay	Yes	50n	sec

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DENOM	LAPLACE	ABM	Denominator of Laplace transform	Yes	1 + s	none
DETENT	BLDCMTR	MIX_MISC	Magnetic detent torque	Yes	2.9	g*cm
DF	VSIN, ISIN	SOURCE	Damping factor	No	0	none
DHOLD	DACSER<SIZE> E>	DATA CONV	Data hold time	Yes	10n	sec
DIG_GND	STIM<SIZE>	SOURCE	Digital ground reference node (change for user power supply)	Yes	\$G_DGN	none
DIG_POWER	STIM<SIZE>	SOURCE	Digital power reference node (change for user power supply)	Yes	\$G_DPWR	none
DRAG	Relay_SPDT_phy	ANL_MISC	Air and other contact arm drag	Yes	1	g*cm / sec <sup>2</sup>
DSET	DACSER<SIZE> E>	DATA CONV	Data setup time	Yes	100n	sec
ERRORLIMIT	RELEASE<SIZE>, HOLD<SIZE>, CONSTRAINT<SIZE>, SETUP<SIZE>, WIDTH_HI, WIDTH_LO, MAXFREQ	DIG_MISC	Maximum number of constraint checker violations to report	No	20	none

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EXP<LINE>	PWR, PWRS, ABM2, ABM3, ABM1, ABM1/I, ABM3/I, ABM2/I, ABM/I, ABM	ABM	ABM expression line containing circuit variables and math functions and operators forming controlling expression. Start with lowest number. Lines are concatenated.	Yes	1	none
EXPR	ELAPLACE, GTABLE, EFREQ, ETABLE, GVALUE, GFREQ, EVALUE, GLAPLACE	ABM	ABM expression line containing circuit variables and math functions and operators forming controlling expression. Default is signal connected to input pins of symbol.	No		instance V(%IN+, %IN-)
F	T	ANALOG	Frequency for NL parameter (see Transmission Line device)	No	none	Hz
F0	BANDREJ, BANDPASS	ABM	Lower stopband frequency of filter	Yes	10	Hz
F1	BANDREJ, BANDPASS	ABM	Lower passband frequency of filter	Yes	100	Hz
F2	BANDREJ, BANDPASS	ABM	Upper passband frequency of filter	Yes	300	Hz
F3	BANDREJ, BANDPASS	ABM	Upper stopband frequency of filter	Yes	1000	Hz
FC	VSFFM, ISFFM	SOURCE	Carrier frequency	Yes	none	Hz

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FILE	VPWL_F_RE_ FOREVER, IPWL_F_RE_ N_TIMES, VPWL_FILE, IPWL_F_RE_ FOREVER, VPWL_F_RE_ N_TIMES	SOURCE	Input file containing PWL source data, (time, analog value) pairs	Yes	none	none
FILE	VECTOR<SIZ E>	SPECIAL	Output file for .VECTOR results	No	none	none
FILENA ME	FileStim<SIZE >	SOURCE	Input file containing STIM source data, (time, digital value) pairs	Yes	none	none
FILENA ME	LIB	SPECIAL	Library file name to be included	Yes	none	none
FILENA ME	INCLUDE	SPECIAL	Include file name to be included	Yes	none	none
FIRST_ NPAIRS	IPWL_RE_FO REVER, VPWL_RE_N_ TIMES, VPWL_ENH, VPWL_RE_F OREVER, IPWL_ENH, IPWL_RE_N_ TIMES	SOURCE	First line containing PWL data, (time, analog value) pairs. Lines will be concatenated.	Yes	none	pairs
FLOAT			Property that should be added on an unconnected pin. Add this property on unconnected pins instead of using a No Connect symbol.			

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See  
Using  
the  
FLOAT  
property

FM	VSFFM, ISFFM	SOURCE	Modulation frequency	Yes	none	Hz
FORMAT	STIM1	SOURCE	Digital data format (1=bit, 4=hex).	No	1	binary
FORMAT	STIM4	SOURCE	Digital data format (1=bit, 4=hex)	No	1111	binary
FORMAT	STIM8	SOURCE	Digital data format (1=bit, 4=hex)	No	1111 1111	binary
FORMAT	STIM16	SOURCE	Digital data format (1=bit, 4=hex)	No	4444	hex
FP	HIPASS	ABM	Pass band cutoff frequency	Yes	100	Hz
FP	LOPASS	ABM	Pass band cutoff frequency	Yes	10	Hz
FREQ	VSIN, ISIN	SOURCE	Frequency of sinusoid (transient analysis only)	Yes	none	Hz
FRIC TION	BLDCMTR	MIX_MISC	Friction/drag losses (constant torque losses)	Yes	0.72	g*cm



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FRQ	TP19AWG, TP26AWG, TP24AWG, TP22AWG	TLINE	Frequency to evaluate expressions for R and G (conductor and dielectric losses). If specified, R and G are constant in the model. No assignment to FRQ (leaving the value empty) will select Laplace expression for R and G to model skin effect (use for AC Sweep analysis only).	No	5k	Hz
FS	LOPASS	ABM	Stop band cutoff frequency	Yes	100	Hz
FS	CMLSCCM	SWIT_RAV	Operating frequency	Yes	100k	Hz
FS	CMSSCCM	SWIT_RAV	Operating frequency	Yes	100k	Hz
FS	HIPASS	ABM	Stop band cutoff frequency	Yes	10	Hz
FS	VMLSDCM	SWIT_RAV	Operating frequency	Yes	50k	Hz
FS	VMCCMDCM	SWIT_RAV	Operating frequency	Yes	50k	Hz
FSOFFS ET	QRLSZCS	SWIT_RAV	Frequency from Vco at zero Vc	Yes	280k	Hz
G	T<SIZE>coupled, TLUMP<SIZE>	TLINE	Per unit length conductance	Yes	0	Siemens
G	TLOSSY	ANALOG	Per unit length conductance	Yes	1	Siemens
G1	T<SIZE>coupledX	TLINE	Per unit length conductance of first conductor	Yes	0	Siemens

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G2	T<SIZE>coupledX	TLINE	Per unit length conductance of second conductor	Yes	0	Siemens
G3	T<SIZE>coupledX	TLINE	Per unit length conductance of third conductor	Yes	0	Siemens
G4	T<SIZE>coupledX	TLINE	Per unit length conductance of fourth conductor	Yes	0	Siemens
G5	T<SIZE>coupledX	TLINE	Per unit length conductance of fifth conductor	Yes	0	Siemens
GAIN	E	ANALOG	Voltage gain	Yes	1	V/V
GAIN	F	ANALOG	Current gain	Yes	1	A/A
GAIN	G	ANALOG	Transconductance	Yes	1	I/V
GAIN	H	ANALOG	Transresistance	Yes	1	V/I
GAIN	DIFFER	ABM	Prescaling factor before differentiation	Yes	1	instance
GAIN	INTEG	ABM	Prescaling factor before integration	Yes	1	instance
GAIN	GAIN	ABM	Gain	Yes	1000	instance
GAIN	GLIMIT	ABM	Prescaling factor before limiting	Yes	1k	instance
GAIN	HILO	ABM	Prescaling factor before limiting	Yes	1k	instance
GAIN	SOFTLIM	ABM	Prescaling factor before limiting	Yes	1k	instance
GAIN_REFF	ADCPAR<SIZE>	DATA CONV	Upper input voltage limit	Yes	0.4	none
GAIN_REFF_GND	ADCPAR<SIZE>	DATA CONV	Lower input voltage limit	Yes	-0.4	none
HCTAU	BULB	OPTO	Heat capacity time constant	Yes	4.082	sec

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HI	WATCH1	SPECIAL	Upper limit value for .WATCH	Yes	none	V
HI	GLIMIT, HILO, SOFTLIM	ABM	Upper limit	Yes	10	V
HOLDTIME	HOLD<SIZE>	DIG_MISC	Hold time for constant checking	Yes	none	sec
I_DROP	BOUNCE, NO_BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb	ANL_MISC	Drop-out current	Yes	25m	A
I_PULL	BOUNCE, NO_BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb	ANL_MISC	Pull-in current	Yes	35m	A
I1	IPULSE, IEXP	SOURCE	First current level	Yes	none	A
I2	IPULSE, IEXP	SOURCE	Second current level	Yes	none	A
I1	IPWL	SOURCE	First PWL point (0s, current value)	Yes	none	A
I2	IPWL	SOURCE	Second PWL point (time, current value)	No	none	A
I3	IPWL	SOURCE	Third PWL point (time, current value)	No	none	A
I4	IPWL	SOURCE	Fourth PWL point (time, current value)	No	none	A

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I5	IPWL	SOURCE	Fifth PWL point (time, current value)	No		A none
I6	IPWL	SOURCE	Sixth PWL point (time, current value)	No		A none
I7	IPWL	SOURCE	Seventh PWL point (time, current value)	No		A none
I8	IPWL	SOURCE	Eighth PWL point (time, current value)	No		A none
IAMPL	ISIN	SOURCE	Current amplitude of sinusoid (transient analysis only)	Yes		A none
IAMPL	ISFFM	SOURCE	Current amplitude of SFFM (transient analysis only)	Yes		A none
IC	Cbreak, C	BREAKOUT , ANALOG	Initial voltage condition on capacitor	No	0	V
IC	Lbreak, L	BREAKOUT , ANALOG	Initial current condition on inductor	No	0	A
IC	INTEG	ABM	Initial condition for integrator	Yes	0	instance
IC	VMSSCCM	SWIT_RAV	Current flowing from terminal C	Yes	1	A
IC	CMSSCCM	SWIT_RAV	Current flowing from terminal C	Yes	100	A
IMAG	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write signal in IMAGINARY format in output file (Y N)	No	N	none
INDUCTANCE	BLDCMTR	MIX_MISC	Winding inductance	Yes	3m	Hz
INERTIA	BLDCMTR	MIX_MISC	Moment of inertia of rotor	Yes	0.30	g*cm *sec* sec

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IO_MOD EL	DACSER<SIZE> E>, DACCUR<SIZE> E>, ADCSER<SIZE> E>, ADCPAR<SIZE> E>, DACPAR<SIZE> E>, ADCMIC<SIZE> E>	DATA CONV	I/O model to use for and D/A converter models	No		none IO_H CT
IO_MOD EL	STIM<SIZE>, DIGCLOCK, DIGSTIM	SOURCE	I/O model to use for digital stimulus	No		none IO_S TM
IOFF	ISIN, ISFFM	SOURCE	Offset current of transient analysis source	Yes		A none
ISINK	DACPAR<SIZE> E>	DATA CONV	Typical output sink current	Yes	-	A 400u
ISOURCE	DACPAR<SIZE> E>	DATA CONV	Typical output source current	Yes	5m	A
K_COEF	3phase	ANL_MISC	Mutual coupling coefficient	Yes	0.99	none 99
KP	ZbreakN	BREAKOUT	MOS transconductance for IGBT	No	0.38	A/ V^2
L	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Length	no	DEF	m L
L	TLOSSY, TLUMP<SIZE> >, >	ANALOG, TLINE	Per unit length inductance	Yes	1	H

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L	T<SIZE>coupled	TLINE	Per unit length inductance	Yes	-1	H
L_COIL	BOUNCE, NO_BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb, Relay_SPDT_ phy	ANL_MISC, MIX_MISC	Coil inductance	Yes	5m	H
L1	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of first coupled inductor	Yes	L1	refdes
L1	T<SIZE>coupledX	TLINE	Per unit length inductance of first conductor	Yes	-1	H
L1_TURNS	XFRM_NONLINEAR	BREAKOUT	Number of turns for first inductor	Yes	none	none
L1_VALUE	XFRM_LINEAR	ANALOG	Inductance value of first inductor	Yes	none	H
L2	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of second coupled inductor	Yes	L2	refdes
L2	T<SIZE>coupledX	TLINE	Per unit length inductance of second conductor	Yes	-1	H
L2_TURNS	XFRM_NONLINEAR	BREAKOUT	Number of turns for second inductor	Yes	none	none
L2_VALUE	XFRM_LINEAR	ANALOG	Inductance value of second inductor	Yes	none	H
L3	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of third coupled inductor	Yes	L3	refdes

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L3	T<SIZE>coupledX	TLINE	Per unit length inductance of third conductor	Yes	-1	H
L4	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of fourth coupled inductor	Yes	L4	refdes
L4	T<SIZE>coupledX	TLINE	Per unit length inductance of fourth conductor	Yes	-1	H
L5	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of fifth coupled inductor	Yes	L5	refdes
L5	T<SIZE>coupledX	TLINE	Per unit length inductance of fifth conductor	Yes	-1	H
L6	K_LINEAR, kbreak	ANALOG, BREAKOUT	Reference Designator of sixth coupled inductor	Yes	L6	refdes
LDACMINLO	DACPAR<SIZE> E>	DATACONV	Minimum pulse width low for LDAC	Yes	90n	sec

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LEN	COAX, RG6/U, TLINE, RG58A/U, ANALOG RG59B/U, RG8A/U, RG9B/U, RG174/U, RG8/U, RG12A/U, RG58C/U, RG6A/U, RG11A/U, RG59/u=, RG22B/U, RG55B/U, RG58/U+, RG8/u+, RG62/U RG179B/U, RG178B/U, RG188A/U, RG212/U, RG223/U, RG11/u+, RG62A/U, RG63B/U, RG187A/U, RG213/U, RG214/U, RG11/U, RG55/U, RG196A/U, RG215/U, RG71B/U, RG195A/U, RG217/U, RG58/U, RG218/U, RG59/U, RG219/U, RG180B/U, TWSTPAIR, TP24AWG, TP22AWG, TP19AWG, TP16AWG, TLOSSY, TLURC<SIZE >, TLUMP<SIZE	Length of transmission line. The characteristic parameters R, L, G, and C are defined per unit length. For coax and twisted pair models, the length must be specified in meters.	Yes   none   m
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LFIL	VMLSDCM, VMCCMDCM	SWIT_RAV	Filter inductance	Yes	500u	H
LFIL	CMLSCCM, CMSSCCM	SWIT_RAV	Filter inductance	Yes	5u	H
LIM_K	Relay_SPDT_ phy	ANL_MISC	Limit spring rate	Yes	1000 g/ 000 sec	
LM	T<SIZE>coupl ed, T<SIZE>coupl edX	TLINE	Mutual inductance per unit length	Yes	0	H
LM	Kcouple2	TLINE	Mutual coupling inductance per unit length	Yes	none	H
LM12	T<SIZE>coupl edX, Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 1 and 2	Yes	0	H
LM13	T<SIZE>coupl edX, Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 1 and 3	Yes	0	H
LM14	T<SIZE>coupl edX, Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 1 and 4	Yes	0	H
LM15	T<SIZE>coupl edX, Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 1 and 5	Yes	0	H
LM21	Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 2 and 1	Yes	none	H
LM23	T<SIZE>coupl edX, Kcouple<SIZE >	TLINE	Mutual coupling inductance per unit length between tlines 2 and 3	Yes	0	H

## PSpice Help

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LM24	T<SIZE>coupledX, Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 2 and 4	Yes	0	H
LM25	T<SIZE>coupledX, Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 2 and 5	Yes	0	H
LM31	Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 3 and 1	Yes	none	H
LM32	Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 3 and 2	Yes	none	H
LM34	T<SIZE>coupledX, Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 3 and 4	Yes	0	H
LM35	T<SIZE>coupledX, Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 3 and 5	Yes	0	H
LM41	Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 4 and 1	Yes	none	H
LM42	Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 4 and 2	Yes	none	H
LM43	Kcouple<SIZE> >	TLINE	Mutual coupling inductance per unit length between tlines 4 and 3	Yes	none	H

## P Spice Help

LM45	T<SIZE>coupledX, Kcouple<SIZE>	TLINE	Mutual coupling inductance per unit length between tlines 4 and 5	Yes	0	H
LO	WATCH1	SPECIAL	Lower voltage value for .WATCH	Yes	none	none
LO	GLIMIT, HILO, LIMIT, SOFTLIM	ABM	Lower limit voltage	Yes	0	V
LO	QRLSZCS	SWIT_RAV	Resonant inductor value	Yes	20n	H
M	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Multiplier	No	1	none
MAG	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write signal in MAGNITUDE format in output file (Y N)	No	Y	none
MAGUNITS	EFREQ, FTABLE, GFREQ	ABM	Units for magnitude table entries (MAG DB)	No	MAG	none
MAXFREQ	MAXFREQ	DIG_MISC	Maximum frequency for constraint checker	Yes	none	Hz
MAXFREQ	ADCPAR<SIZE>	DATACONV	Maximum clock frequency	Yes	11Meg	Hz
MAXP	Relay_SPDT_phy	ANL_MISC	Maximum permeance (when arm is close to coil)	Yes	5	gauss*m^2/A
MINFREQ	MINFREQ	DIG_MISC	Minimum frequency for constraint checker	Yes	none	Hz

## PSpice Help

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MINFRE Q	ADCPAR<SIZ E>	DATA CONV	Minimum clock frequency	Yes	10K	Hz
MINHOL D	ADCMIC<SIZ E>	DATA CONV	R/Cbar to CSbar hold time	Yes	10n	sec
MINLO	ADCMIC<SIZ E>	DATA CONV	R/Cbar minimum pulse width	Yes	50n	sec
MINP	Relay_SPDT_ phy	ANL_MISC	Minimum permeance (when arm is close to coil)	Yes	1	gaus s*m^ 2/A
MINPER	ADCMIC<SIZ E>	DATA CONV	Minimum time between conversions	Yes	10u	sec
MINSET	ADCMIC<SIZ E>	DATA CONV	R/Cbar to CSbar setup time	Yes	10n	sec
MINW	DACSER<SIZ E>	DATA CONV	LDAC low minimum pulse width	Yes	50n	sec
MOD	VSFFM, ISFFM	SOURCE	Modulation Index	Yes	none	none
MUTUAL _IND	BLDCMTR	MIX_MISC	Adjacent winding mutual coupling factor	Yes	0.5	none
N	QRLSZCS	SWIT_RAV	Full-wave=1; half- wave=2	Yes	2	none
NL	T	ANALOG	Number of wavelengths	No	none	none
NRB	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Multiplier of RSH to get RB	No	0	none

## P Spice Help

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NRD	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Multiplier of RSH to get RD	No	0	none
NRG	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Multiplier of RSH to get RG	No	0	none
NRS	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Multiplier of RSH to get RS	No	0	none
NUM	LAPLACE	ABM	Numerator of Laplace transform	Yes	1	none
OFFTIME	DIGCLOCK	SOURCE	Time clock is low	Yes	.5u	sec
ONTIME	DIGCLOCK	SOURCE	Time clock is high	Yes	.5u	sec
OPPVAL	DIGCLOCK	SOURCE	State to transition to from low (usually 1)	Yes	1	none
PD	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Perimeter of drain	No	0	m

## PSpice Help

PER	IPULSE, VPULSE	SOURCE	Period	No	TST OP	sec
PERIOD	SG1525A/ 25C, SG1526B, SG1525, SG1524B, SG1529	SWIT_REG	Period of internal oscillator	Yes	1m	sec
PERIOD	SG1825	SWIT_REG	Period of internal oscillator	Yes	2.5u	sec
PERIOD	SG1825, SG1842, SG1843, SG1844, SG1845, SG1846	SWIT_REG	Period of internal oscillator	Yes	22.5 u	sec
PERMEAN- CE_RATIO	3phase	ANL_MISC	Ratio of Permeance_inner/ Permeance_outer	Yes	1	none
PHASE	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write signal in PHASE format in output file (Y N)	No	N	none
PHASEUN- ITS	EFREQ, FTABLE, GFREQ	ABM	Units for phase table entries (DEG RAD)	No	DEG	none
PNOM	BULB	OPTO	Nominal power	Yes	100	W
POS	VECTOR<SIZ E>	SPECIAL	Column position (see .VECTOR)	No	see .VEC TOR	none
PRIMARY IND	3phase	ANL_MISC	Primary inductance	Yes	200 m	H
PRIMARY RES	3phase	ANL_MISC	Primary resistance	Yes	0.1	Ohm s

## PSpice Help

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PS	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Perimeter of source	No	0	m
PULSE	74LS122, 74LS123	1_SHOT	Pulsewidth	Yes	116n	sec
PULSE	CD4098B	1_SHOT	Pulsewidth	Yes	1u	sec
PULSE	CD4538B	1_SHOT	Pulsewidth	Yes	20u	sec
PULSE	74121	1_SHOT	Pulsewidth	Yes	30n	sec
PULSE	54L121	1_SHOT	Pulsewidth	Yes	35n	sec
PULSE	74122	1_SHOT	Pulsewidth	Yes	45n	sec
PULSE	74123	1_SHOT	Pulsewidth	Yes	45n	sec
PULSE	54L122, 54L123	1_SHOT	Pulsewidth	Yes	90n	sec
PW	IPULSE, VPULSE	SOURCE	Pulsewidth	No	TST OP	sec
QUIESC UR	SG1842, SG1843	SWIT_REG	Quiescent current	Yes	11m	A
R	T<SIZE>coupl ed, TLUMP<SIZE >, TLOSSY, TLURC<SIZE >	TLINE, ANALOG	Per unit length resistance	Yes	0	Ohm s

## PSpice Help

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R_CLOS E	BOUNCE, Relay_SPDT_ phy, NO_BOUNCE, Relay_DPDT_ B, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb	ANL_MISC, MIX_MISC	Closed state resistance	Yes	0.05	Ohm s
R_COIL	BOUNCE, Relay_SPDT_ phy, NO_BOUNCE, Relay_DPDT_ B, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb	ANL_MISC, MIX_MISC	Series resistance of coil	Yes	10	Ohm s
R_I	EFREQ, FTABLE, GFREQ	ABM	Use real and imaginary (set value to R_I). Default is magnitude and phase	No	mag nitud e/ phas e	none
R_OPEN	BOUNCE, Relay_SPDT_ phy, NO_BOUNCE, Relay_DPDT_ B, Relay_SPDT_ b, Relay_SPDT_ nb, Relay_DPDT_ nb	ANL_MISC, MIX_MISC	Closed state resistance	Yes	100 MEG	Ohm s

## PSpice Help

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R_REF_IN	ADCPAR<SIZE> E>	DATA CONV	Input resistance of reference	Yes	5K	Ohms
R_REF_OUT	ADCPAR<SIZE> E>	DATA CONV	Output resistance of reference out	Yes	12	Ohms
R_REF_OUT	ADCMIC<SIZE> E>	DATA CONV	Output resistance of reference out	Yes	4K	Ohms
R1	T<SIZE>coupledX	TLINE	Per unit length resistance of first conductor	Yes	0	Ohms
R2	T<SIZE>coupledX	TLINE	Per unit length resistance of second conductor	Yes	0	Ohms
R3	T<SIZE>coupledX	TLINE	Per unit length resistance of third conductor	Yes	0	Ohms
R4	T<SIZE>coupledX	TLINE	Per unit length resistance of fourth conductor	Yes	0	Ohms
R5	T<SIZE>coupledX	TLINE	Per unit length resistance of fifth conductor	Yes	0	Ohms
RADIX	VECTOR<SIZE> E>	SPECIAL	Radix of values of the specified nodes	No	see .VECTOR	none
RCLOSED	Sw_tClose, Sw_tOpen	ANL_MISC	Closed state resistance	Yes	0.01	Ohms
RD	VMSSCCM	SWIT_RAV	Diode on resistance	Yes	0.00001	Ohms
RE	VMSSCCM	SWIT_RAV	Models ripple across esr of cap	Yes	0.00001	Ohms
REAL	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write signal in REAL format in output file (Y N)	No	N	none

## PSpice Help

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REF_AS SERTION	RELEASE<SIZ ZE>	DIG_MISC	Reference edge of clock	Yes	LH	none
REF_VO LT_GAIN	ADCMIC<SIZ E>	DATA CONV	Reference voltage gain	Yes	4	none
REFERENCE	CD4000_PWR , DIGIFPWR	SPECIAL	Negative power supply value	Yes	0	V

## PSpice Help

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REL_CT R	A4N27, A4N28, CNY17-1, CNY17-2, PS2561, CNY17-3, H11A520, PS1001, A4N49A, BPW32, A4N48A, A4N47A, A4N32, A4N25A, MRD510, PS2565-1, PS2621, A4N33, H11A2, MRD500, H11AV1, MCT2, H11A3, PS2501-1, PS2601, H11AV2, H11A4, H11AV3, A4N25, A4N26, MCT2E, MLED96, PS2505-1, MOC1005, MOC1006, IL300, SLD1121VS	OPTO	Relative current transfer ratio	Yes	0.5	none
RELEASETIME	RELEASE<SI ZE>	DIG_MISC	Minimum time between signal inactive and clock edge	Yes	none	sec

## PSpice Help

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REPEAT _VALUE	VPWL_RE_N_ TIMES, IPWL_F_RE_ N_TIMES, VPWL_ENH, VPWL_FILE, IPWL_ENH, IPWL_RE_N_ TIMES, VPWL_F_RE_ N_TIMES	SOURCE	Number of repetitions of specified window of signal	No	1	none
RESIST ANCE	BLDCMTR	MIX_MISC	Winding resistance	Yes	6	Ohm s
RI	CMLSCCM, CMSSCCM	SWIT_RAV	Current feedback coefficient	Yes	0.01	none
RIN	ADCPAR<SIZ E>	DATA CONV	Input resistance of analog input	Yes	50K	Ohm s
RIPPLE	HIPASS, LOPASS, BANDREJ, BANDPASS	ABM	Ripple specification	Yes	1dB	none
RM	VMSSCCM	SWIT_RAV	Resistance modeling the base storage effects	Yes	0.00 0001	Ohm s
RMPHIT E	VMLSCCM, VMLSDCM, VMSSCCM, VMCCMDCM	SWIT_RAV	External ramp height	Yes	2	V
ROFF	Sbreak	BREAKOUT	Off-state resistance	Yes	1000 000	Ohm s
RON	Sbreak	BREAKOUT	On-state resistance	Yes	1	Ohm s
ROPEN	Sw_tClose, Sw_tOpen	ANL_MISC	Open-state resistance	Yes	1Me g	Ohm s
ROW1	FTABLE	ABM	First row of data triplets (freq, mag, phase)	Yes	(0Hz , 0, 0)	triple t

## P Spice Help

ROW1	TABLE	ABM	First row of data pairs (input, output)	Yes	(0v, 0v)	pair
ROW2	FTABLE	ABM	Second row of data triplets (freq, mag, phase); rows are concatenated	No	(10Hz, -30)	triple t
ROW2	TABLE	ABM	Second row of data pairs (input, output); rows are concatenated	No	(1v, 1v)	pair
ROW3	FTABLE	ABM	Third row of data triplets (freq, mag, phase); rows are concatenated	No	(20Hz, -90)	triple t
ROW3	TABLE	ABM	Third row of data pairs (input, output); rows are concatenated	No	(2v, 4v)	pair
ROW4	FTABLE	ABM	Fourth row of data triplets (freq, mag, phase); rows are concatenated	No	(30Hz, -120)	triple t
ROW4	TABLE	ABM	Fourth row of data pairs (input, output); rows are concatenated	No	(3v, 9v)	pair
ROW5	FTABLE	ABM	Fifth row of data triplets (freq, mag, phase); rows are concatenated	No	(40Hz, -150)	triple t
ROW5	TABLE	ABM	Fifth row of data pairs (input, output); rows are concatenated	No	(4v, 16v)	pair
RSW	VMSSCCM	SWIT_RAV	Switch on resistance	Yes	0.00001	Ohm s
RTR_PO LE_PA RS	BLDCMTR	MIX_MISC	Number of north poles on the rotor	Yes	2	none

## PSpice Help

SCHOLD	DACSER<SIZE> E>	DATA CONV	SYNC to SCLK hold time	Yes	120n	sec
SCLK	DACSER<SIZE> E>	DATA CONV	SCLK cycle time	Yes	200n	sec
SCSET	DACSER<SIZE> E>	DATA CONV	SYNC to SCLK setup time	Yes	50n	sec
SE	CMLSCCM, CMSSCCM	SWIT_RAV	External ramp slope	Yes	1000	V/ 00 sec
SEC_R	3phase	ANL_MISC	Secondary winding resistance	Yes	0.1	Ohm s
SECOND _NPAIR S	IPWL_RE_FO REVER, VPWL_RE_N_ TIMES, VPWL_ENH, VPWL_RE_F OREVER, IPWL_ENH, IPWL_RE_N_ TIMES	SOURCE	Second line containing PWL data, (time, analog value) pairs. Lines will be concatenated.	No	none	pairs
SET	R_VAR, C_VAR, POT	ANALOG, BREAKOUT	Position of slider between minimum and maximum value (linear interpolation)	Yes	0.5	none
SETUPT IME	SETUP<SIZE> >	DIG_MISC	Setup time	Yes	none	sec
SIG_ED GE	RELEASE<SI ZE>	DIG_MISC	Signal edge for constraint checking	Yes	LH	none
SIGNAM E	FileStim<SIZE> >	SOURCE	Signal name in file	No	none	none
SIGNAM ES	VECTOR<SIZE> E>	SPECIAL	Names of signals which appear in the header of the vector file	No	node nam es	none
SN	CMSSCCM	SWIT_RAV	Current sese ramp slope	Yes	1000	V/ 00 sec

## PSpice Help

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SPR	Relay_SPDT_ phy	ANL_MISC	Contact arm spring force	Yes	40	g_c m/ sec <sup>2</sup>
SR	DACPAR<SIZ E>	DATA CONV	Slew rate of output	Yes	2.5M	V/ sec eg
STARTV AL	DIGCLOCK	SOURCE	First digital value of clock	Yes	0	none
STOP	HIPASS, LOPASS, BANDREJ, BANDPASS	ABM	Stopband attenuation	Yes	50dB	none
T_BOUN CE	BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b	ANL_MISC, MIX_MISC	Bounce time (after contact is closed)	Yes	5m	sec
T_BREA K	BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b, NO_BOUNCE, Relay_DPDT_ nb, Relay_SPDT_ nb	ANL_MISC, MIX_MISC	Time for contact to open when current is turned off/on	Yes	10m	sec
T_MAKE	BOUNCE, Relay_DPDT_ b, Relay_SPDT_ b, NO_BOUNCE, Relay_DPDT_ nb, Relay_SPDT_ nb	ANL_MISC, MIX_MISC	Time for contact to close when current is turned off/on	Yes	20m	sec

## PSpice Help

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T1	VPWL, IPWL	SOURCE	Time for first PWL pair (should be 0)	Yes	none	sec
T1	Kcouple<SIZE >	TLINE	Reference designator of first coupled transmission line	Yes	T1	refdes
T10	VPWL, IPWL	SOURCE	Time for tenth PWL pair	Yes	none	sec
T2	VPWL, IPWL	SOURCE	Time for second PWL pair	Yes	none	sec
T2	Kcouple<SIZE >	TLINE	Reference designator of second coupled transmission line	Yes	T2	refdes
T3	VPWL, IPWL	SOURCE	Time for third PWL pair	Yes	none	sec
T3	Kcouple<SIZE >	TLINE	Reference designator of third coupled transmission line	Yes	T3	refdes
T4	VPWL, IPWL	SOURCE	Time for fourth PWL pair	Yes	none	sec
T4	Kcouple<SIZE >	TLINE	Reference designator of fourth coupled transmission line	Yes	T4	refdes
T5	VPWL, IPWL	SOURCE	Time for fifth PWL pair	Yes	none	sec
T5	Kcouple<SIZE >	TLINE	Reference designator of fifth coupled transmission line	Yes	T5	refdes
T6	VPWL, IPWL	SOURCE	Time for sixth PWL pair	Yes	none	sec
T7	VPWL, IPWL	SOURCE	Time for seventh PWL pair	Yes	none	sec
T8	VPWL, IPWL	SOURCE	Time for eighth PWL pair	Yes	none	sec
T9	VPWL, IPWL	SOURCE	Time for ninth PWL pair	Yes	none	sec

## PSpice Help

TABLE	EFREQ, GFREQ	ABM	Triplets (freq, mag, phase) for frequency table	Yes	(0,0, 0) (1Me g,- 10,9 0)	triple ts
TABLE	ETABLE, GTABLE	ABM	Pairs (input, output) for nonlinear table	Yes	(- 15,- 15) (15,1 5)	pairs
TAU	ZbreakN	BREAKOUT	Ambipolar recombination lifetime	No	7.1e- 6	sec
TBUSY	ADCMIC<SIZ E>	DATA CONV	BUSYbar low time	Yes	8u	sec
TBUSYR C	ADCMIC<SIZ E>	DATA CONV	TBUSYRC - BUSYbar Delay from R/Cbar low	Yes	83n	sec
TC1	IEXP, VEXP	SOURCE	Rise (fall) time constant	No	TST EP	sec
TC2	IEXP, VEXP	SOURCE	Fall (rise) time constant	No	TST EP	sec
TCLOSE	Sw_tClose	ANL_MISC	Time at which switch closes	Yes	0	sec
TD	IPULSE, VPULSE	SOURCE	Delay	No	0	sec
TD	T	ANALOG	Propagation delay	No	none	sec
TD	ISIN, VSIN	SOURCE	Delay	No	0	sec
TD1	IEXP, VEXP	SOURCE	Rise (fall) delay	No	0	sec
TD2	IEXP, VEXP	SOURCE	Fall (rise) delay	No	<td1 >+ TST EP	sec
TF	IPULSE, VPULSE	SOURCE	Fall time	No	TST EP	sec

## PSpice Help

THDGMN	DACPAR<SIZE> E>	DATA CONV	Data valid to Write hold time	Yes	10n	sec
THIRD_NPAIRS	IPWL_RE_FOREVER, VPWL_RE_N_TIMES, VPWL_ENH, VPWL_RE_FOREVER, IPWL_ENH, IPWL_RE_N_TIMES	SOURCE	Second line containing PWL data, (time, analog value) pairs. Lines will be concatenated.	No	none	pairs
TIMESTEP	STIM<SIZE>	SOURCE	Number of seconds per clock cycle, or step when using the "C" suffix	No	0	sec
TOL	DELAY	DIG_MISC	Tolerance for delay in percent	Yes	10	%
TOLERANCE	R, L, C	ANALOG	Tolerance (e.g. 5%) for monte carlo/worst case analysis	No	none	none
TOPEN	Sw_tOpen	ANL_MISC	Time at which switch opens	Yes	0	sec
TORQUE_CONST	BLDCMTR	MIX_MISC	Torque constant	Yes	300	g*cm/amp
TPADHIGH	ADCPAR<SIZE> E>	DATA CONV	Minimum output delay high	Yes	10n	sec
TPADHTY	ADCPAR<SIZE> E>	DATA CONV	Typical output delay high	Yes	20n	sec
TPADLMN	ADCPAR<SIZE> E>	DATA CONV	Minimum output delay low	Yes	10n	sec
TPADLTY	ADCPAR<SIZE> E>	DATA CONV	Typical output delay low	Yes	20n	sec
TPHZMN	ADCMIC<SIZE> E>	DATA CONV	Minimum bus relinquish time H-Z	Yes	10n	sec
TPHZMX	ADCMIC<SIZE> E>	DATA CONV	Maximum bus relinquish time H-Z	Yes	83n	sec

## PSpice Help

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TPHZTY	ADCMIC<SIZ E>	DATA CONV	Typical bus relinquish time H-Z	Yes	35n	sec
TPHZTY	ADCPAR<SIZ E>	DATA CONV	Typical output float delay H-Z	Yes	50n	sec
TPLZMN	ADCMIC<SIZ E>	DATA CONV	Minimum bus relinquish time L-Z	Yes	10n	sec
TPLZMX	ADCMIC<SIZ E>	DATA CONV	Maximum bus relinquish time L-Z	Yes	83n	sec
TPLZTY	ADCMIC<SIZ E>	DATA CONV	Typical bus relinquish time L-Z	Yes	35n	sec
TPLZTY	ADCPAR<SIZ E>	DATA CONV	Typical ouptut float delay L-Z	Yes	50n	sec
TPZHMN	ADCMIC<SIZ E>	DATA CONV	Minimum data access time Z-H	Yes	10n	sec
TPZHMX	ADCMIC<SIZ E>	DATA CONV	Maximum data access time Z-H	Yes	83n	sec
TPZH TY	ADCMIC<SIZ E>	DATA CONV	Typical data access time Z-H	Yes	35n	sec
TPZH TY	ADCPAR<SIZ E>	DATA CONV	Typical data access time Z-H	Yes	50n	sec
TPZLMN	ADCMIC<SIZ E>	DATA CONV	Minimum data access time Z-L	Yes	10n	sec
TPZLMX	ADCMIC<SIZ E>	DATA CONV	Maximum data access time Z-L	Yes	83n	sec
TPZLTY	ADCMIC<SIZ E>	DATA CONV	Typical data access time Z-L	Yes	35n	sec
TPZLTY	ADCPAR<SIZ E>	DATA CONV	Typical data access time Z-L	Yes	50n	sec
TR	IPULSE, VPULSE	SOURCE	Rise time	No	TST	sec EP
TRAN	ISRC, VSRC	SOURCE	Transient specification - EXP(), PULSE(), PWL(), SFFM() OR SIN()	No	none	none

## PSpice Help

TRAN	IPRINT, IPLOT, VPLOT1, VPLOT2, VPRINT1, VPRINT2	SPECIAL	Write TRAN analysis results to output file (Y N)	No	Y	none
TSC0	ADCSER<SIZE>	DATA CONV	CONVST/EOC* to CLOCK Skew (typical)	Yes	40n	sec
TSF	IPWL_RE_FOREVER, VPWL_F_RE_FOREVER, VPWL_RE_N_TIMES, IPWL_F_RE_N_TIMES, IPWL_F_RE_FOREVER, VPWL_ENH, VPWL_RE_FOREVER, VPWL_FILE, IPWL_ENH, IPWL_RE_N_TIMES, VPWL_F_RE_N_TIMES	SOURCE	Time scaling factor (multiplies time values)	No	1	none
TSUDGMN	DACPAR<SIZE>	DATA CONV	Data valid to Write setup time	Yes	90n	sec
TTRAN	Sw_tClose	ANL_MISC	Transition time for switch to close	Yes	1u	sec
TTRAN	Sw_tOpen	ANL_MISC	Transition time for switch to open	Yes	1u	sec
TURNS	Relay_SPDT_phy	ANL_MISC	Number of turns	Yes	100	none
V_RATIO	3phase	ANL_MISC			1	

## PSpice Help

V1	VPULSE, VEXP	SOURCE	First voltage level	Yes	none	V
V2	VPULSE, VEXP	SOURCE	Second voltage level	Yes	none	V
V1	VPWL	SOURCE	First PWL point (0s, current value)	Yes	none	V
V2	VPWL	SOURCE	Second PWL point (time, current value)	No	none	V
V3	VPWL	SOURCE	Third PWL point (time, current value)	No	none	V
V4	VPWL	SOURCE	Fourth PWL point (time, current value)	No	none	V
V5	VPWL	SOURCE	Fifth PWL point (time, current value)	No	none	V
V6	VPWL	SOURCE	Sixth PWL point (time, current value)	No	none	V
V7	VPWL	SOURCE	Seventh PWL point (time, current value)	No	none	V
V8	VPWL	SOURCE	Eighth PWL point (time, current value)	No	none	V
V9	VPWL	SOURCE	Ninth PWL point (time, current value)	No	none	V
V10	VPWL	SOURCE	Tenth PWL point (time, current value)	No	none	V
VALLEY V	VMLSCCM, VMLSDCM, VMCCMDCM	SWIT_RAV	Valley voltage of external ramp	Yes	1	V
VALUE	IC1, IC2	SPECIAL	.IC value	Yes	0	V
VALUE	NODESET1, NODESET2	SPECIAL	.NODESET value	Yes	0	V
VALUE	R, Rbreak	ANALOG, BREAKOUT	Resistance	Yes	1K	Ohm s
VALUE	L, Lbreak	ANALOG, BREAKOUT	Inductance	Yes	1m	H

## PSpice Help

VALUE	C, Cbreak	ANALOG, BREAKOUT	Capacitance	Yes	1n	F
VAMPL	VSIN	SOURCE	Voltage amplitude of sinusoid (transient analysis only)	Yes	none	V
VAMPL	VSFFM	SOURCE	Voltage amplitude of SFFM (transient analysis only)	Yes	none	V
VAP	VMSSCCM, CMSSCCM	SWIT_RAV	Voltage across terminal A P	Yes	20	V
VCC1	ECL_10K_PW R, ECL_100K_P WR	SPECIAL	First power supply voltage for ECL supply	Yes	0	V
VCC2	ECL_10K_PW R, ECL_100K_P WR	SPECIAL	Second power supply voltage for ECL supply	Yes	0	V
VCOCOE FF	QRLSZCS	SWIT_RAV	Coefficient for voltage to frequency conversion	Yes	20k	none
VEE	ECL_100K_P WR	SPECIAL	VEE	Yes	-4.5	V
VEE	ECL_10K_PW R	SPECIAL	VEE	Yes	-5.2	V
VNOM	BULB	OPTO	Nominal operating voltage	Yes	120	V
VOFF	VSIN, VSFFM	SOURCE	Offset voltage	Yes	none	V
VOFF	Sbreak	BREAKOUT	Voltage lower threshold	Yes	0	V
VOLTAGE	CD4000_PWR , DIGIFPWR	SPECIAL	Digital power supply voltage	Yes	5	V
VON	Sbreak	BREAKOUT	Voltage upper threshold	Yes	1	V

## PSpice Help

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VSF	IPWL_RE_FO REVER, VPWL_F_RE_ FOREVER, VPWL_RE_N_ TIMES, IPWL_F_RE_ N_TIMES, IPWL_F_RE_ FOREVER, VPWL_ENH, VPWL_RE_F OREVER, VPWL_FILE, IPWL_ENH, IPWL_RE_N_ TIMES, VPWL_F_RE_ N_TIMES	SOURCE	Voltage scaling factor (multiplies voltages)	No	1	none
VSINK	DACPAR<SIZ E>	DATA CONV	Output sink voltage (@ISINK)	Yes	-0.1	V
VSOURCE	DACPAR<SIZ E>	DATA CONV	Output source voltage (@ISOURCE)	Yes	10	V
VTT	ECL_10K_PW R, ECL_100K_P WR	SPECIAL	VTT, termination voltage	Yes	-2	V
W	MbreakN4, MbreakN, MbreakN3, MbreakP4, MbreakP, MbreakP3, Mbreak P4, MbreakN3	BREAKOUT	Length	No	DEF	m W
WB	ZbreakN	BREAKOUT	Metallurgical base width	No	9.0e-	m 5

## PSpice Help

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WHEN	RELEASE<SIZE>, HOLD<SIZE>, CONSTRAINT <SIZE>, SETUP<SIZE>, WIDTH_HI, WIDTH_LO, MINFREQ, MAXFREQ	DIG_MISC	Used to define a boolean expression describing a condition for a constraint checker primitive	No	none	none
WIDTH	WIDTH_HI	DIG_MISC	Minimum width high constraint	Yes	none	sec
WIDTH	WIDTH_LO	DIG_MISC	Minimum width low constraint	Yes	none	sec
WIDTH	STIM1	SOURCE	Number of bits	Yes	1	none
WIDTH	STIM16	SOURCE	Number of bits	Yes	16	none
WIDTH	STIM4	SOURCE	Number of bits	Yes	4	none
WIDTH	STIM8	SOURCE	Number of bits	Yes	8	none
WIDTH_ MIN_HI	ADCPAR<SIZE>	DATA CONV	Minimum width high	Yes	45n	sec
WIDTH_ MIN_LO	ADCPAR<SIZE>	DATA CONV	Minimum width low	Yes	45n	sec
WRMINL O	DACPAR<SIZE>	DATA CONV	Minimum width low of WR	Yes	90n	sec
XFORM	ELAPLACE, GLAPLACE	ABM	Laplace transform	Yes	1/s	none
Z0	T	ANALOG	Characteristic impedance	Yes	none	Ohms

## PSpice Help

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## PSpice Help

### **Menu Bar**

Click each menu bar item to see its pull-down menu.

### **Open button**

Click to open a data file.

### **Append button**

Click to add data from another data file to the existing data.

### **Print button**

Click to print one copy of the current plot window.

### **Cut button**

Click to cut the currently selected item.

### **Copy button**

Click to copy the currently selected item.

### **Paste button**

Click to paste the currently copied or cut item.

### **Zoom buttons**

Click to zoom the displayed view in or out.

### **View Area button**

Click to zoom in to the selected area.

### **View Fit button**

Click to zoom out so that all the data is visible in the selected plot.

### **X Scale button**

Click to toggle the X axis between log and linear scaling.

### **Fourier Transform button**

Click to display the Fourier Transform of all traces in the selected plot.

### **Performance Analysis button**

Click to enter Performance Analysis.

### **Y Scale button**

Click to toggle the Y axis between log and linear scaling.

### **Add Trace button**

Click to add a trace.

### **Eval Goal Function button**

Click to evaluate the goal function or expression of goal functions on data from one PSpice A/D run.

### **Text button**

Click to type text to place on the displayed plot.

### **Display Cursor button**

Click to turn the data cursor on or off.

### **Peak button**

Click to move the cursor to the next peak.

### **Trough button**

Click to move the cursor to the next trough.

### **Slope button**

Click to move the cursor to the next point of maximum slope.

### **Min button**

Click to move the cursor to the minimum Y value.

### **Max button**

Click to move the cursor to the maximum Y value.

### **Point button**

Click to move the cursor to the next data point.

### **Search button**

Click to display the Search dialog box.

### **Next Transition button**

Click to move the cursor to the next digital transition.

### **Previous Transition button**

Click to move the cursor to the previous digital transition.

### **Mark Data Points button**

Click to view data points on the plot.

### **X Axis Data Range**

Click Auto Range to let Probe set the range, or click User Defined and type a specific data range to display.

### **Processing Options**

Click to select either Fourier Transform or Performance Analysis:

- Fourier Transform displays a line graph.
- Performance Analysis displays a histogram.

### **Variable**

Click to display the Axis Variable dialog box.

### **Text Area**

The definition of the goal function is shown here.

### **This Goal Function is Saved in the File**

The location of the goal function on your system.

### **Use Symbols**

Click to select when and how Probe uses symbols when displaying traces.

### **Use Scroll Bars**

Click to set scroll bar usage.

### **Trace Color Scheme**

Click to set how Probe uses color to display traces.

### **Highlight Error States**

Select to enable automatic highlighting of error states when digital traces are displayed.

### **Number of Histogram Divisions**

Type the number of histogram divisions to be used when Probe displays a Performance Analysis result from a Monte Carlo simulation.

### **Number of Cursor Digits**

Type the number of digits Probe will display when the cursor position is shown.

### **New Name**

Type a name to save this display as.

### **List**

Click to select one of the available displays shown here.

### **Save**

Click to save the display with the assigned name.

### **Save To**

Click to save the display to a specific place.

### **Copy To**

Click to copy the selected display.

### **Delete**

Click to delete the selected display.

You can only delete local displays using the Delete button. To delete a display from a remote or global .PRB file, click Delete From.

### **Delete From**

Click to delete a display from a remote or global .PRB file.

### **Restore**

Click to use the selected display.

### **Load**

Click to load another file with displays.

### **Close**

Click to close the Save/Restore dialog box.

### **Box**

Type the search command in this box.

### **Cursor To Move**

Click to select the cursor to search.

### **List**

Click to select one of the available traces and goal functions listed here.

### **Analog**

Click to select whether analog node names are listed.

### **Digital**

Click to select whether digital node names are listed.

### **Voltages**

Click to select whether voltage node names are listed.

### **Currents**

Click to select whether current node names are listed.

### **Alias Names**

Click to select whether alias node names are listed.

### **Internal Subcircuit Nodes**

Click to select whether Internal Subcircuit Nodes names are listed.

### **Goal Functions**

Click to select whether goal functions are listed.

### **Trace Command**

Type the command or expression to use with the selected trace or goal function.

### **Margins**

Type the margins in inches in the text boxes.

### **Plots Per Page**

Click to select the number of plots to print on each page.

### **Orientation**

Click to select the orientation of the page.

### **Cursor Information**

Click to select where the cursor information is printed.

### **Draw Border**

Click to select whether a border is used when the trace is printed.

### **Draw Plot Title**

Click to select whether the plot title is printed on the page.

### **Header**

Click to display the Header dialog box.

### **Footer**

Click to display the Footer dialog box.

### **Printer Setup**

Click to display the Printer Setup dialog box.

### **Printer Select**

Click to display the Printer Select dialog box.

### **Set Default**

Click to set the current settings as the default settings.

### **Reset Default**

Click to reset the current settings to the default settings.

### **New Goal Function Name**

Type the name of the new goal function.

### **File to Keep Goal Function In**

Click to select the location of the saved goal function.

### **Box**

Type the name of the window title.

### **Definition**

Type the name and definition of the macro.

### **List**

The available macros and the definitions are listed here.

### **Save**

Click to save the current macro and definition.

### **Save To**

Click to save the current macro and definition to a specific location on your system.

### **Delete**

Click to delete the current macro and definition.

You can only delete local macros using the Delete button. To delete a macro from a remote or global .PRB file, click Delete From.

### **Delete From**

Click to delete a macro and definition from remote or global .PRB file.

### **Load**

Click to load another file with macros and definitions.

### **Close**

Click to close the Macros dialog box.

### **Left Side**

Type the text for the left side of the header.

### **Center**

Type the text for the center of the header.

### **Right Side**

Type the text for the right side of the header.

### **OK**

Click to use the current header definitions and close the Header dialog box.

### **Cancel**

Click to close the window and abandon your changes.

### **Set Default**

Click to set the current header settings as the default.

### **Reset Default**

Click to reset the header to the default settings.

### **Date Run button**

Click to insert the date in the selected header area.

### **Header Date & Time button**

Click to insert the date and time in the selected header area.

### **Header Time Run button**

Click to insert the time the trace was run in the selected header area.

### **Header Temperature button**

Click to insert the temperature information in the selected header area.

### **Left Side**

Type the text for the left side of the footer.

### **Center**

Type the text for the center of the footer.

### **Right Side**

Type the text for the right side of the footer.

### **OK**

Click to use the current footer settings and close the Footer dialog box.

### **Cancel**

Click to close the window and abandon your changes.

### **Set Default**

Click to set the current footer settings as the default.

### **Reset Default**

Click to reset the footer to the default settings.

### **Date Run button**

Click to insert the time the trace was run in the selected footer area.

### **Date & Time button**

Click to insert the date and time in the selected header area.

### **Time Run button**

Click to insert the time the trace was run in the selected header area.

### **Temperature button**

Click to insert the temperature information in the selected header area.

### **List**

The available goal functions are listed.

### **New**

Click to create a new goal function.

### **Copy**

Click to copy a goal function.

### **View**

Click to view a goal function definition.

### **Edit**

Click to edit an existing goal function.

### **Delete**

Click to delete the selected goal function.

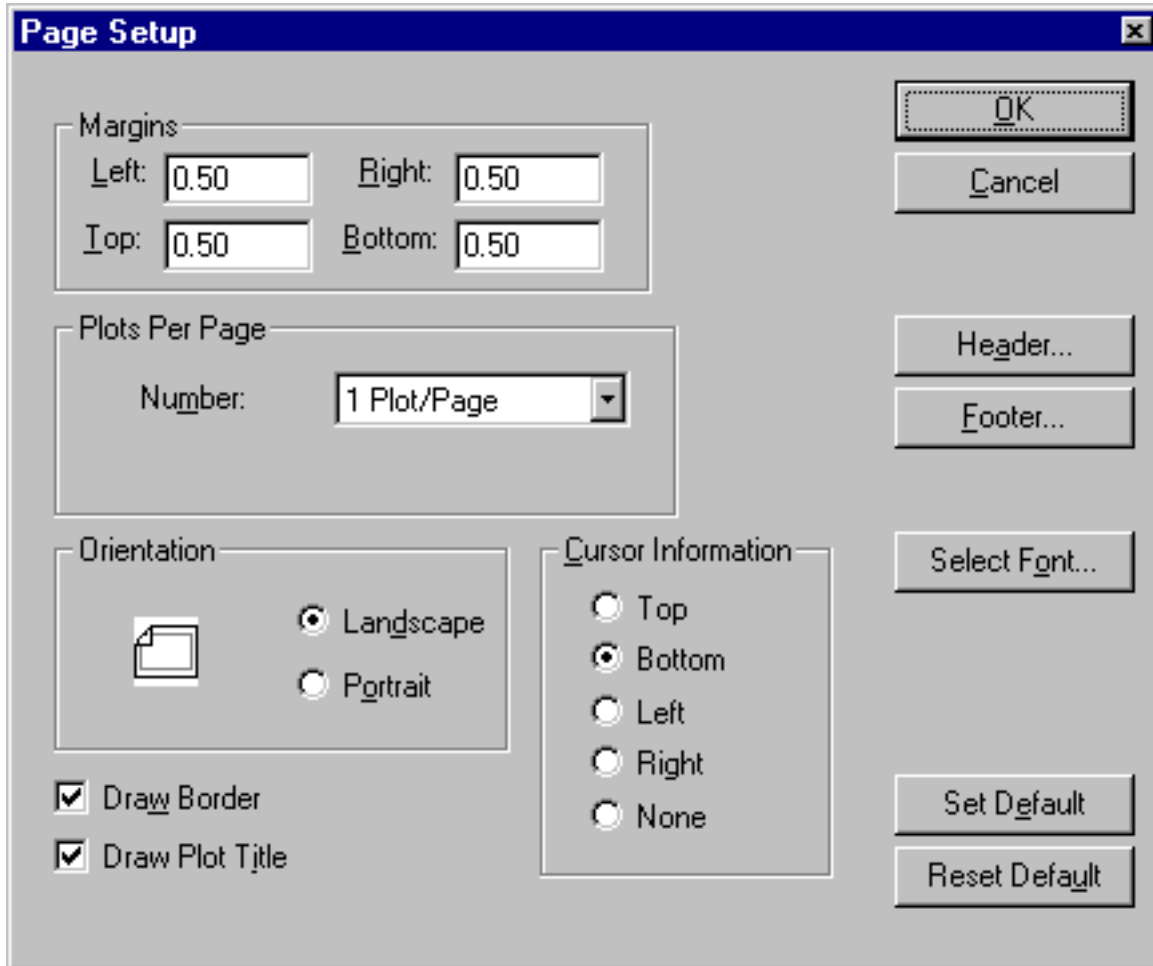
### **Eval**

Click to evaluate the selected goal function.

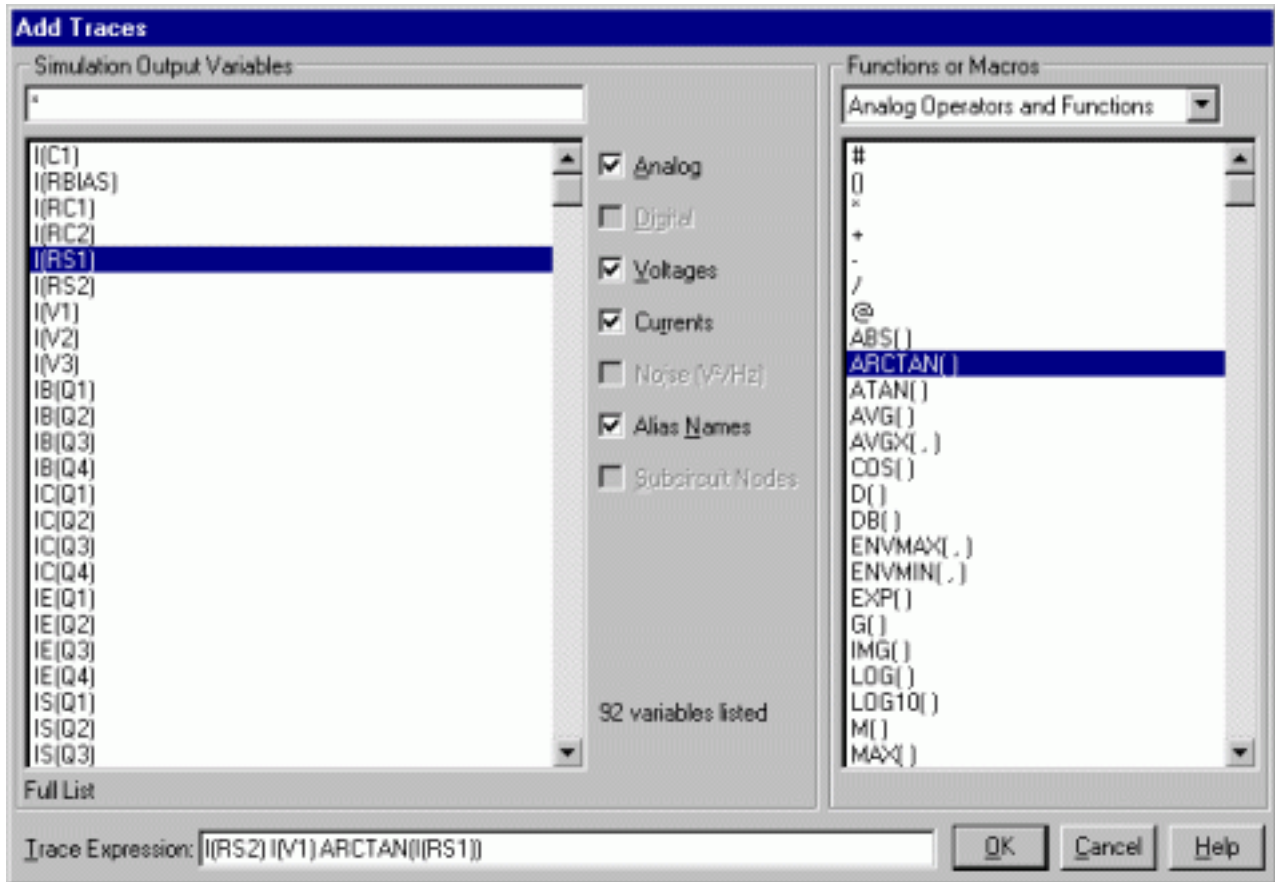
### **Load**

Click to load another file with goal function definitions.

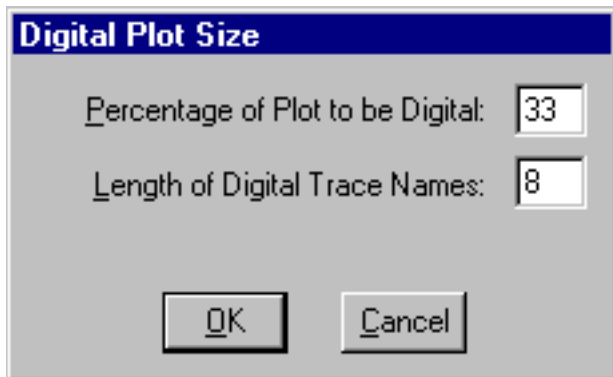
Page Setup dialog box



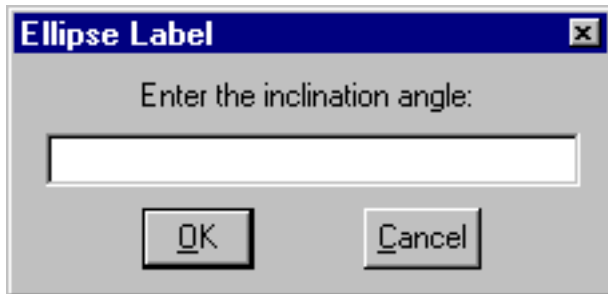
Add Trace dialog box



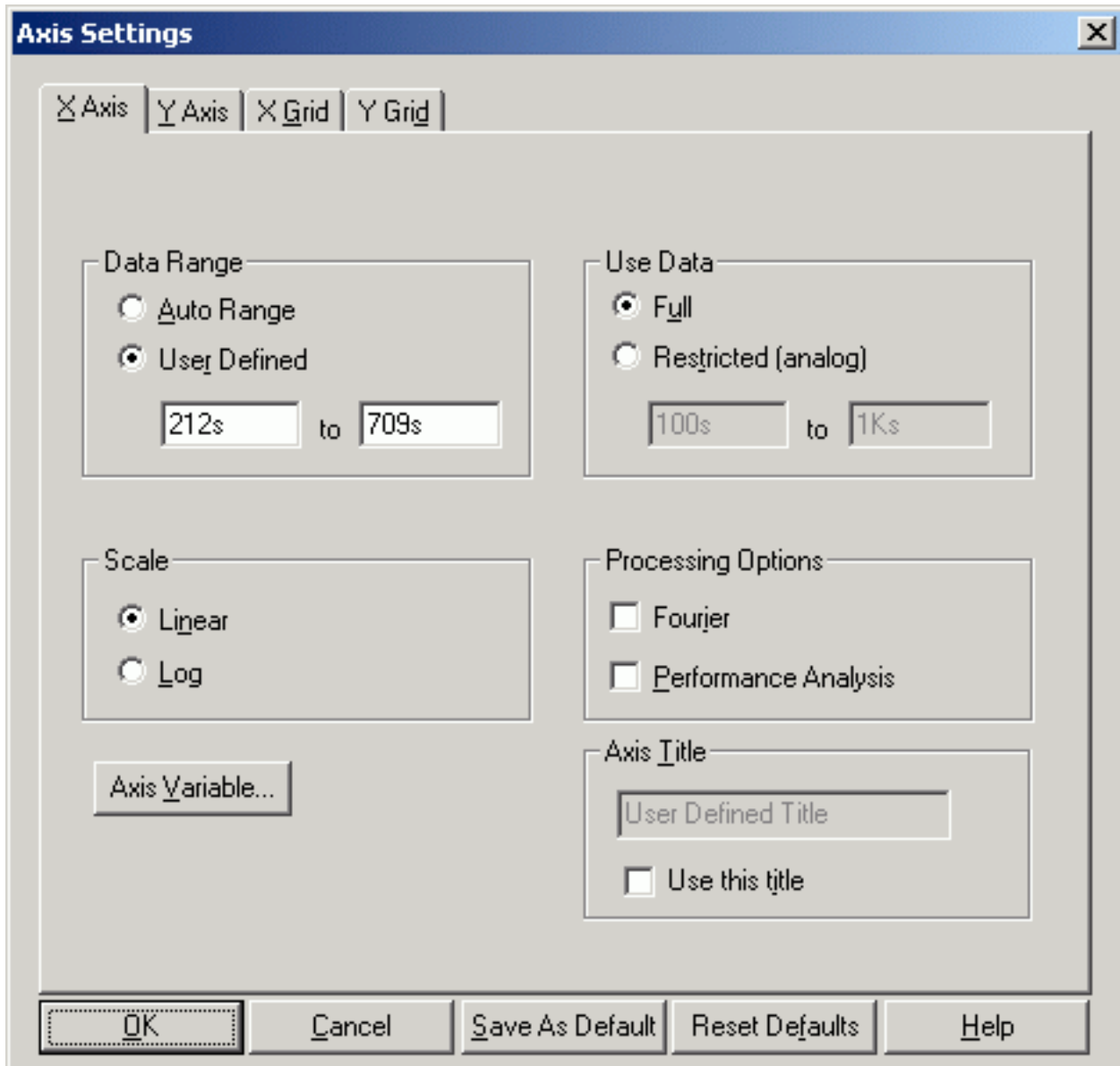
Digital Size dialog box



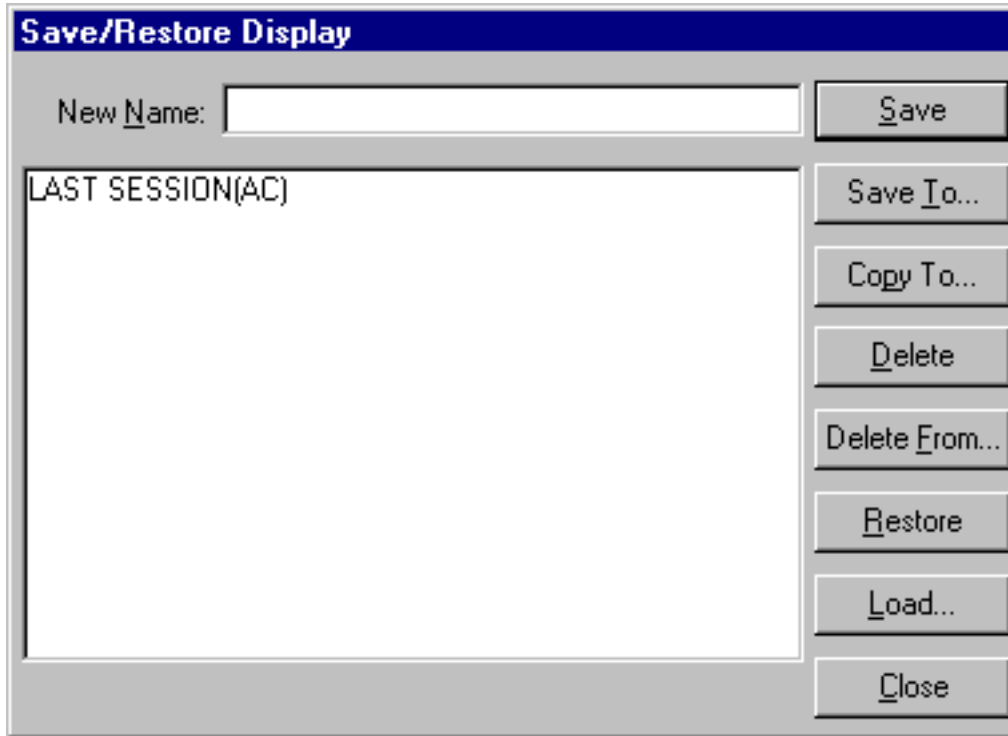
### Ellipse dialog box



X Axis tab



**Display Control dialog box**



**Open File button**



**Append File button**



**Printer button**



## PSpice Help

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### Zoom In button



### Zoom Out button



### Area button



### Cursor button



### Copy button



### Fourier Transform button



# PSpice Help

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## Text button



## Paste button



## Cut button



## Fit button



## Peak button



## Trough button



## Slope button



## Point button



## Min button



## Max button



## Next Transition button



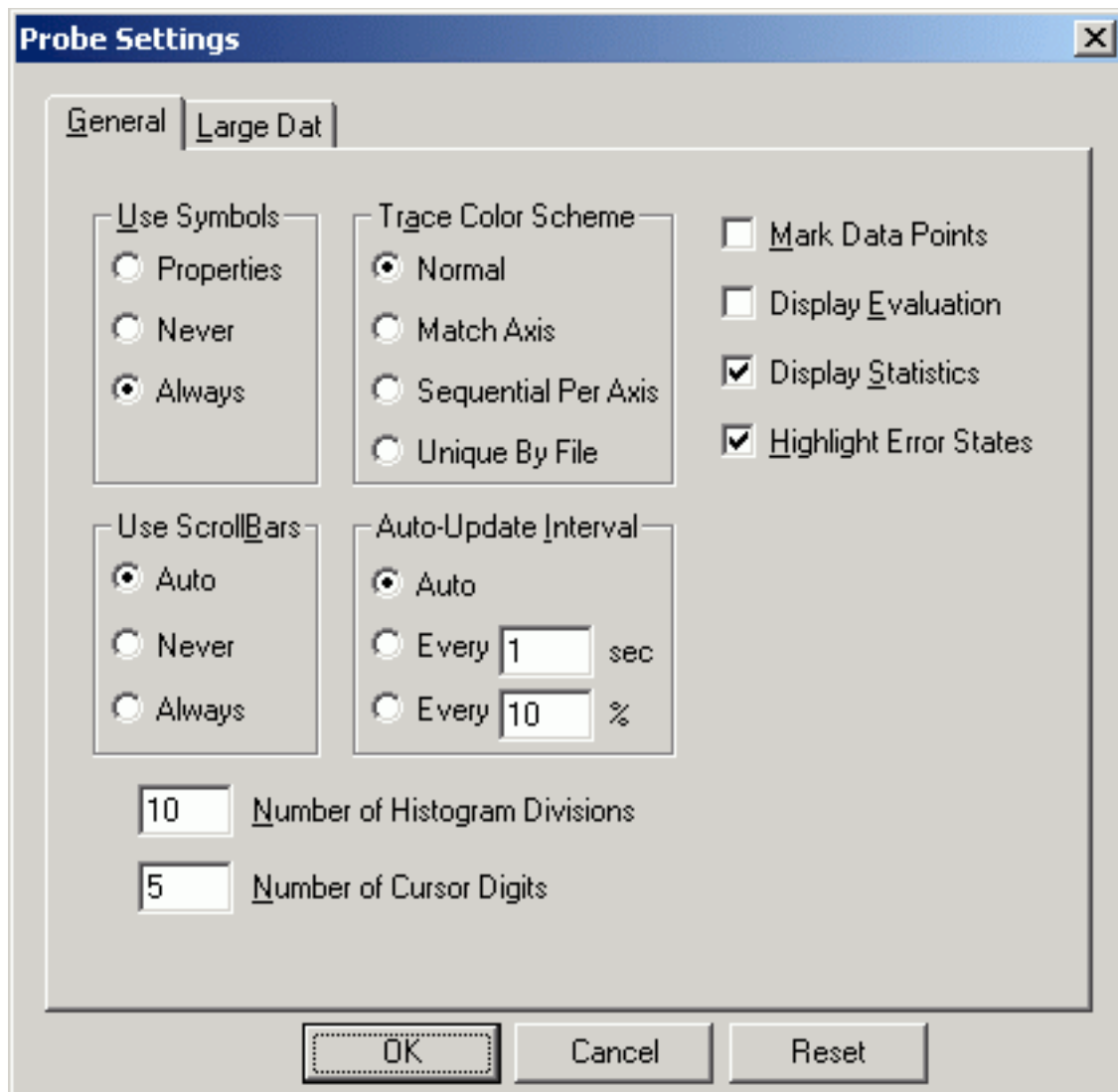
## Previous Transition button



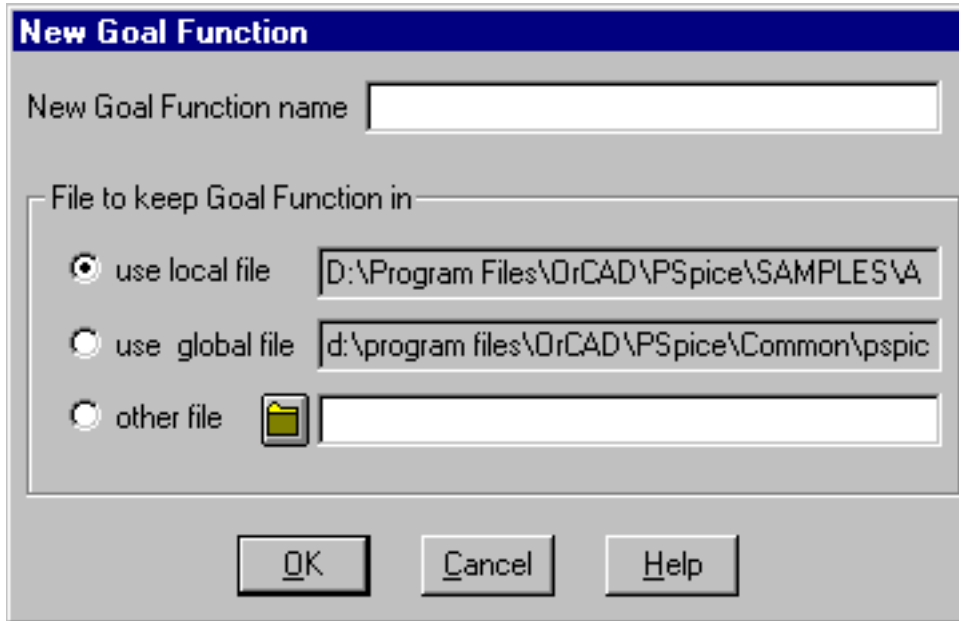
## Add Trace button



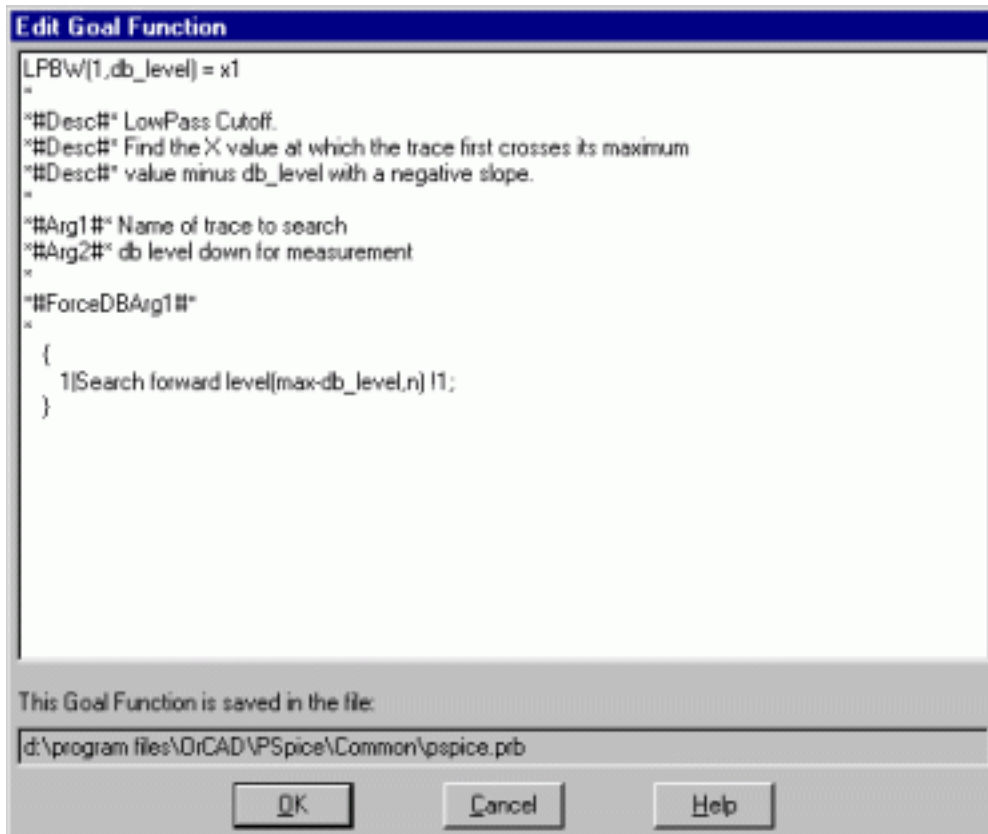
## Probe Options dialog box



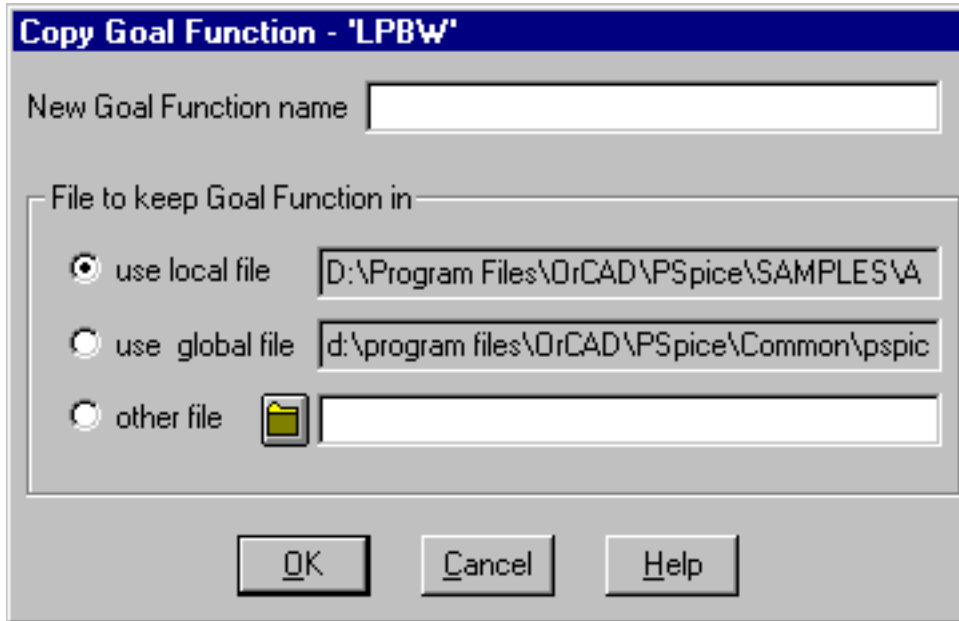
## New Goal Function dialog box



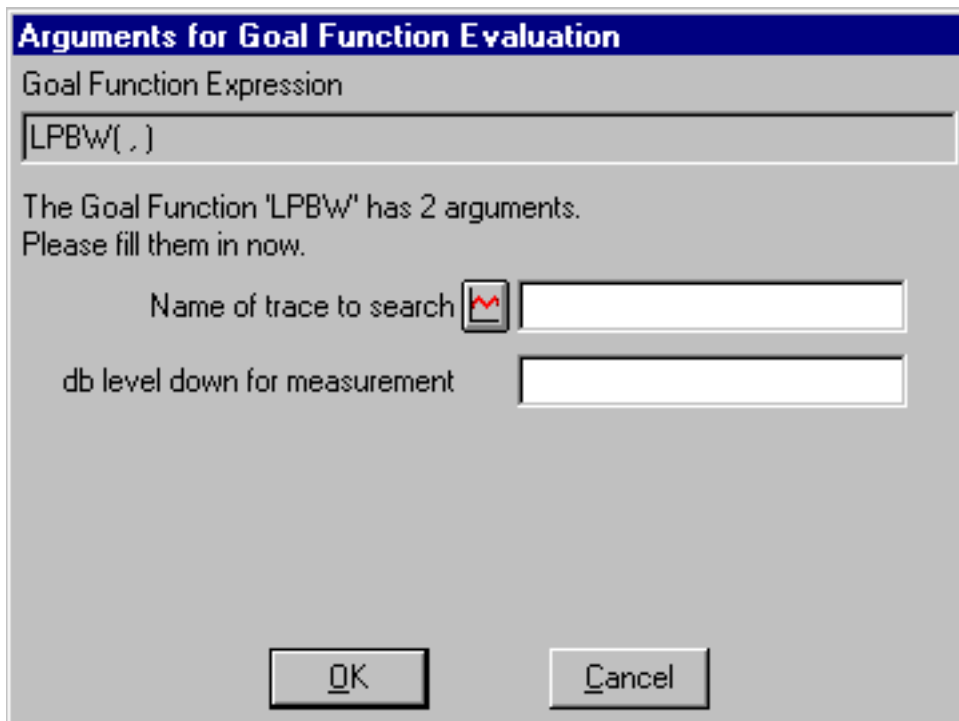
## Edit Goal Function dialog box



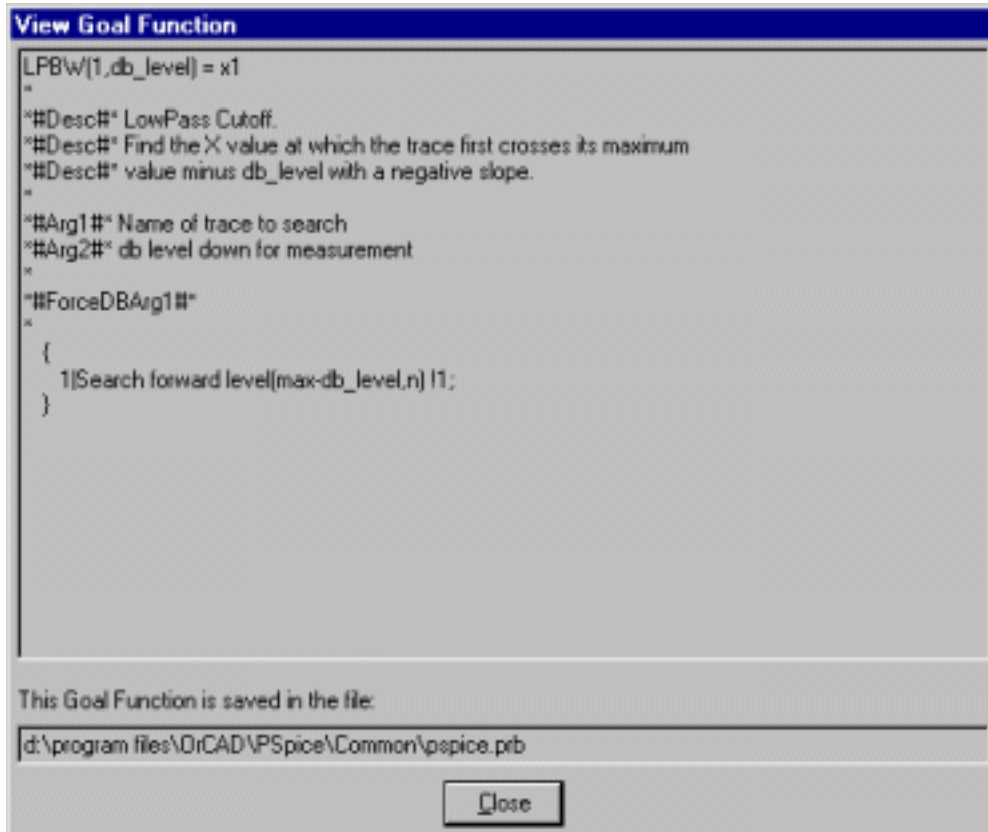
Copy Goal Function dialog box



Arguments for Goal Function Evaluation dialog box



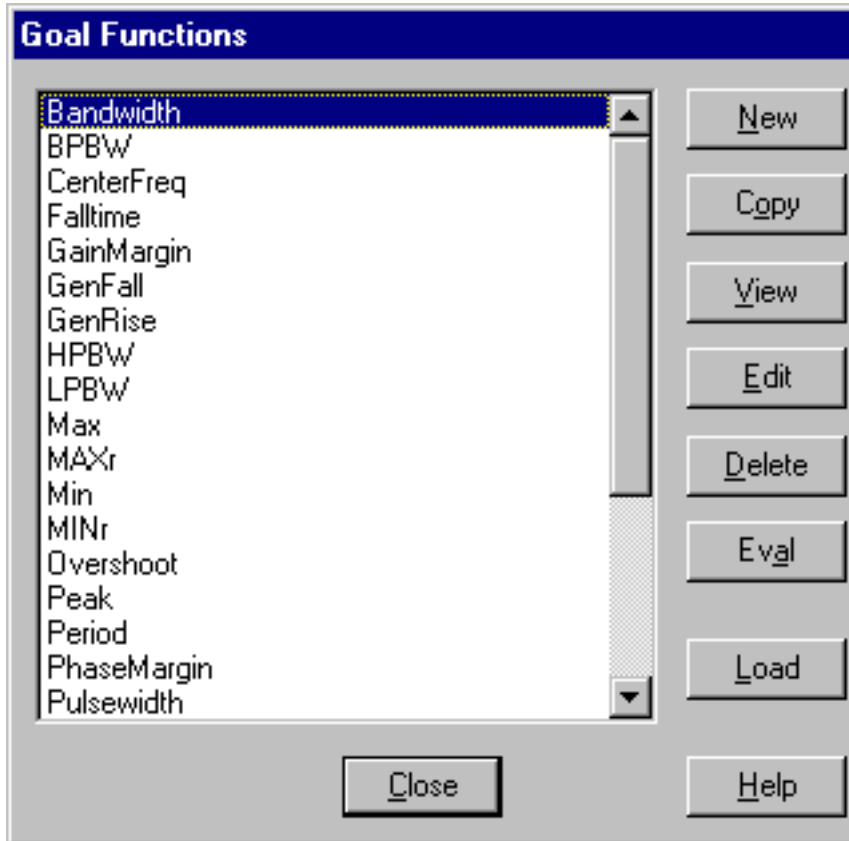
## View Goal Function dialog box



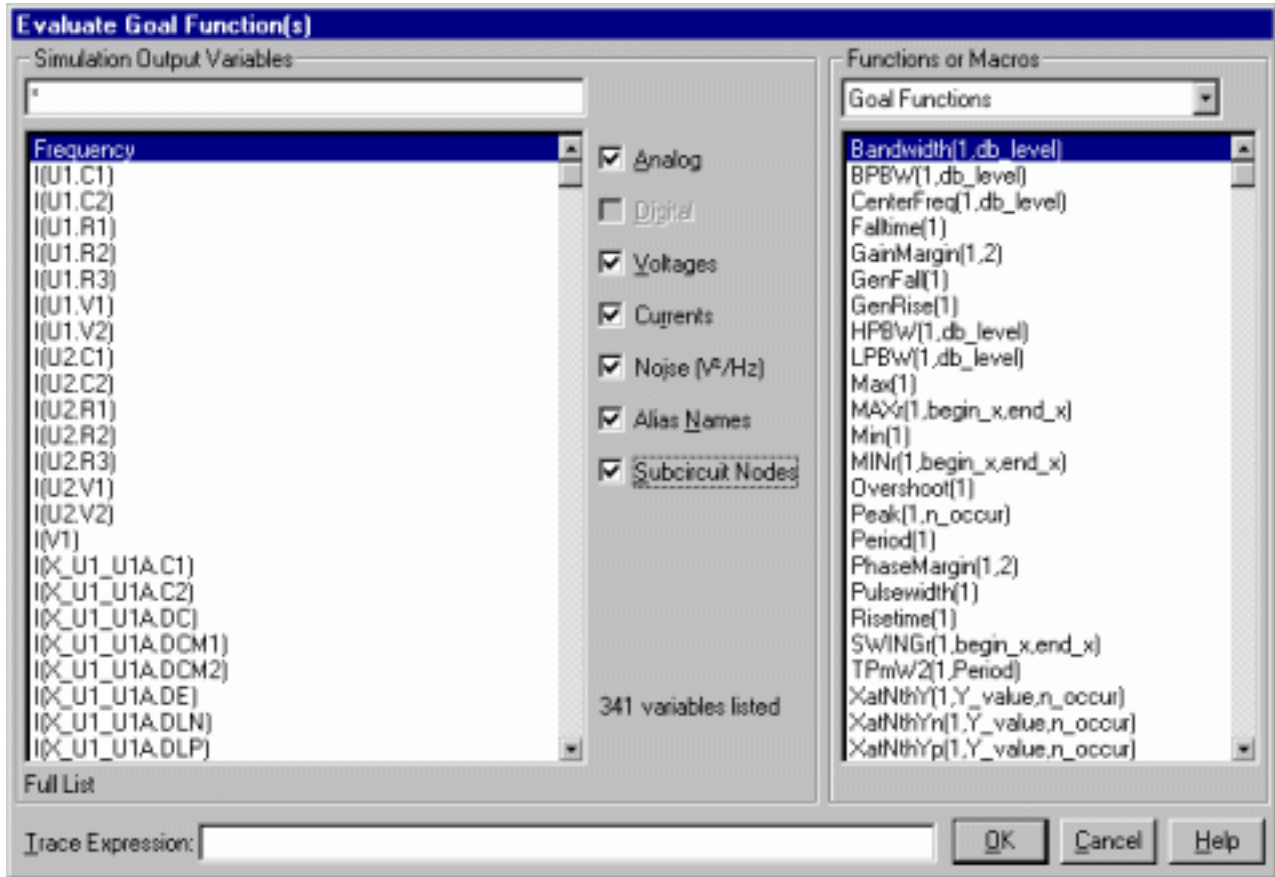
## PSpice Help

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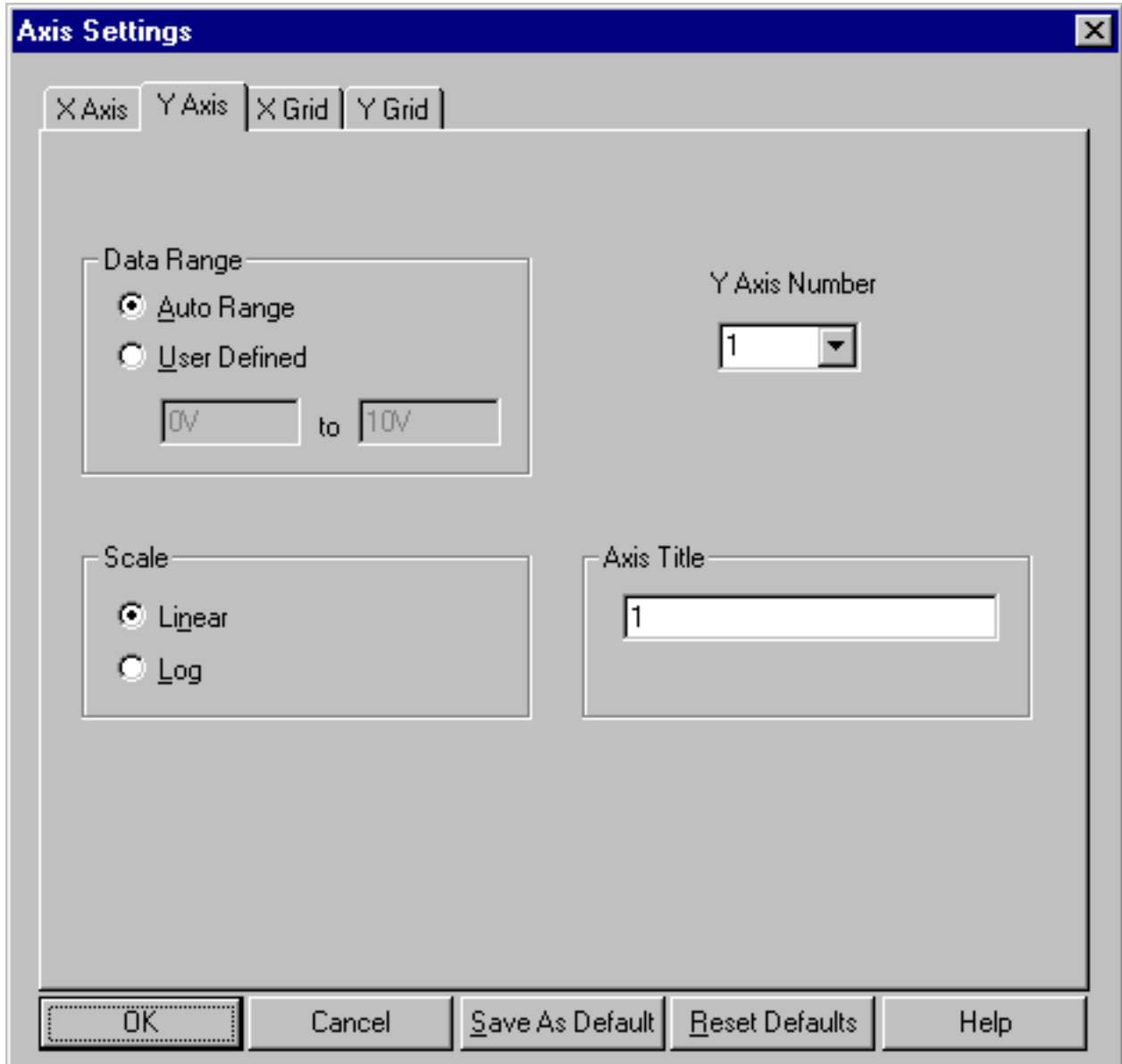
### Goal Functions dialog box



Traces for Goal Function Arguments dialog box



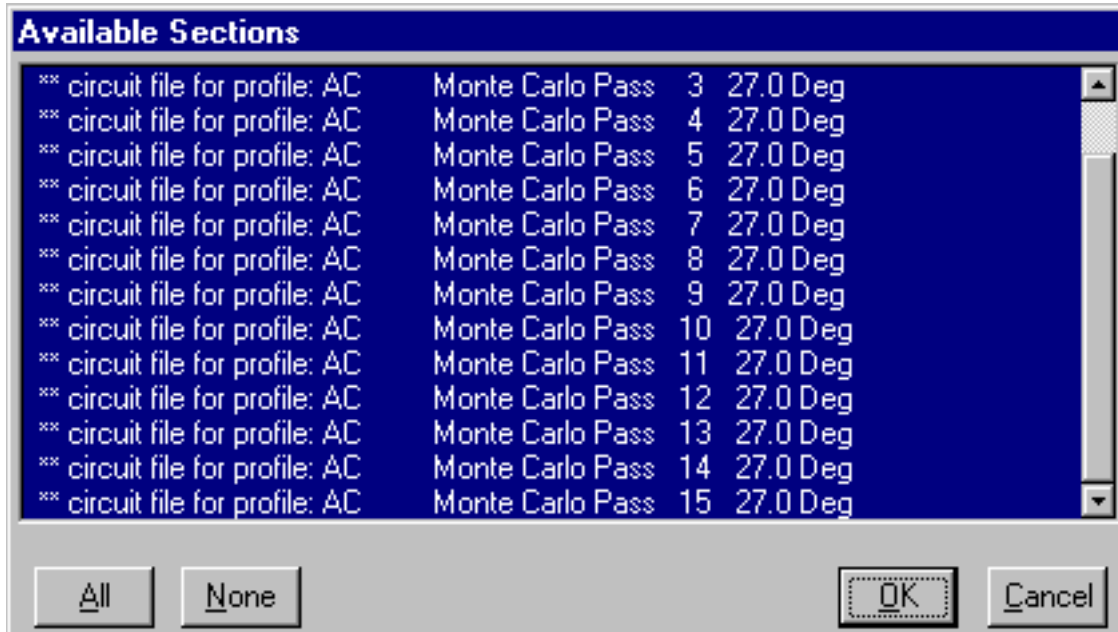
Y Axis tab



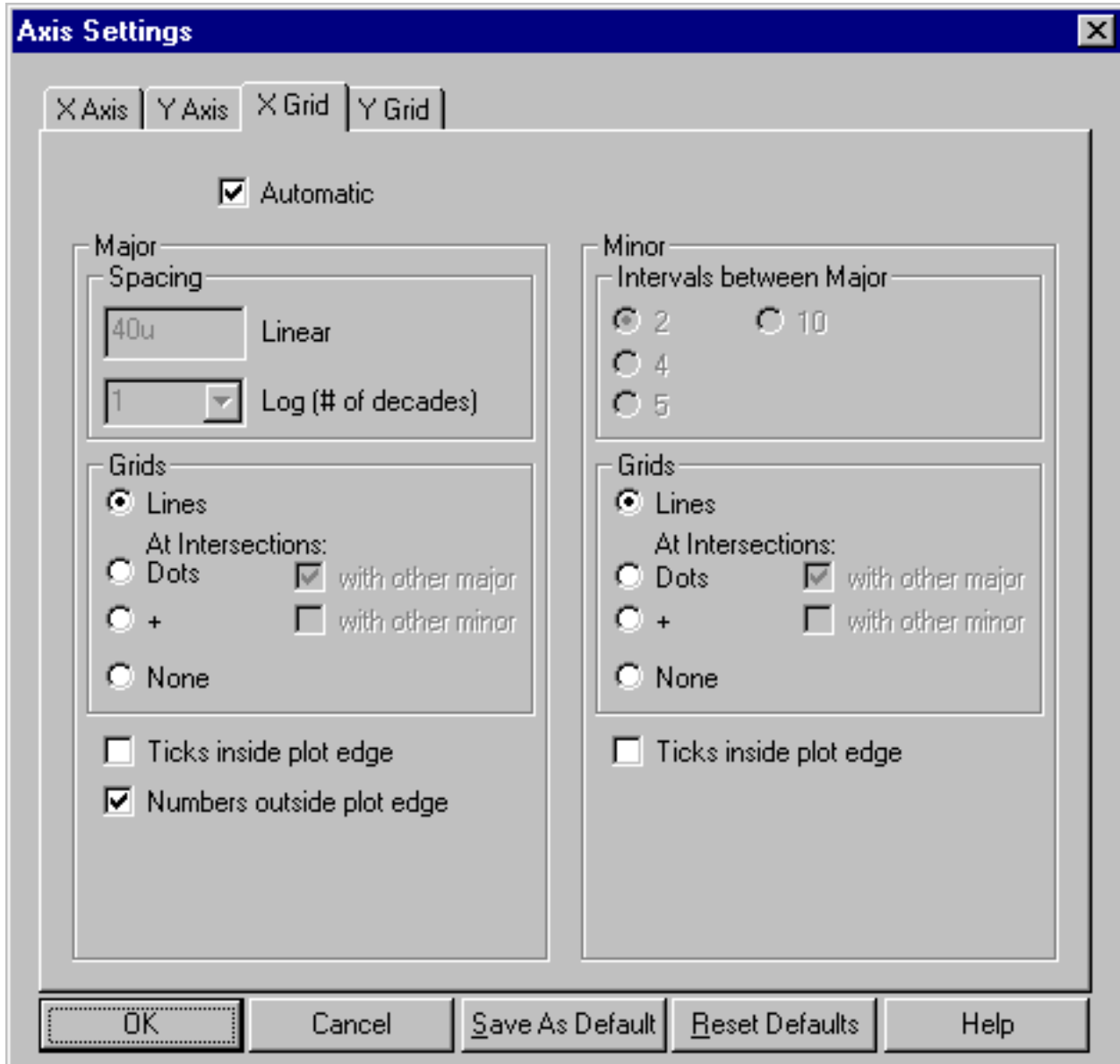
## PSpice Help

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### Available Sections dialog box



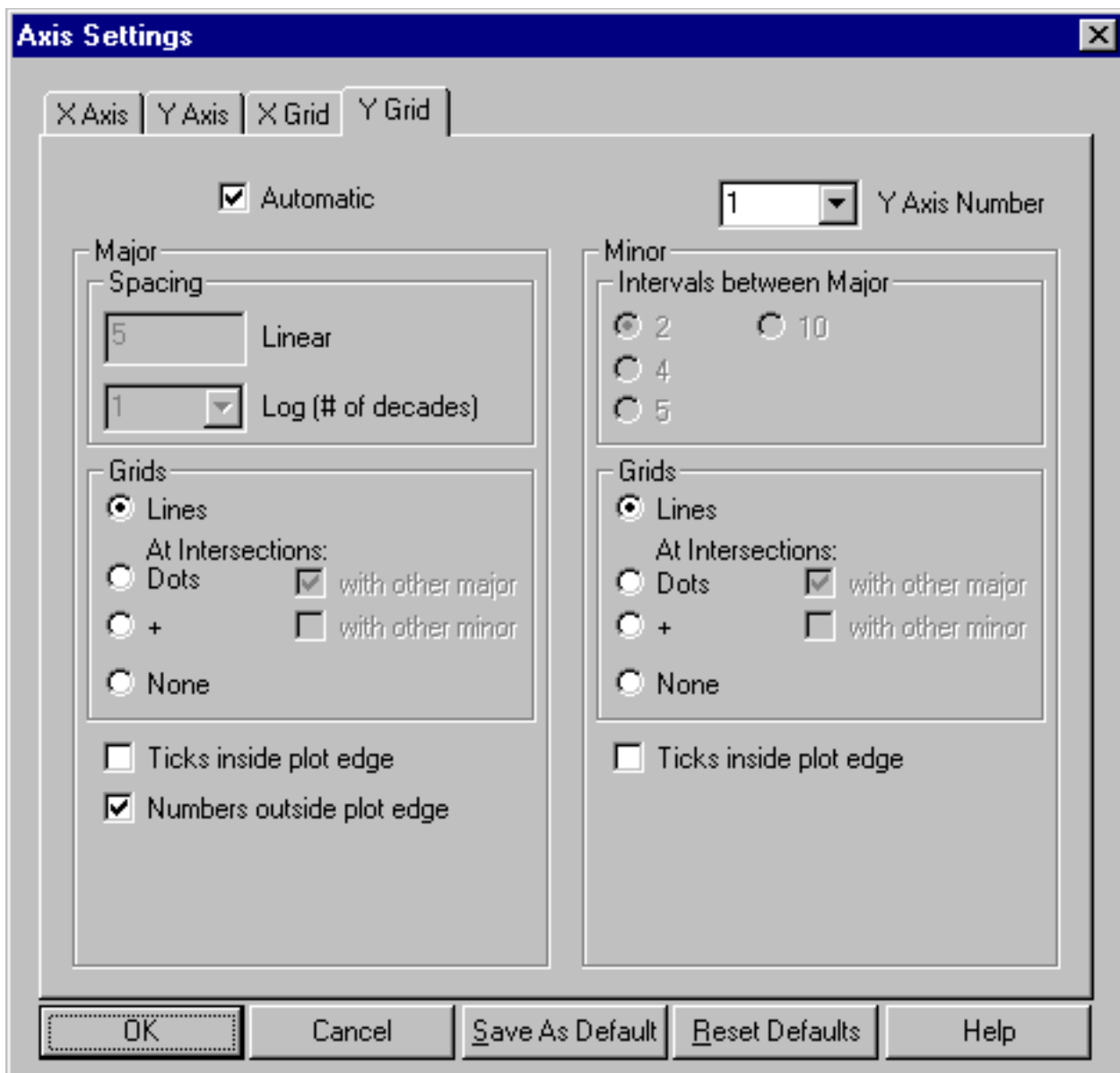
**X Grid tab**



**Y Grid tab**

{bmc BM101.SHG}

## PSpice Help



## PSpice Help

### **Voltage source**

This sets the source's voltage to the sweep value during the sweep.

In the Name text box, type a reference designator of an independent voltage source, such as V1.

### **Current source**

This sets the source's current to the sweep value during the sweep.

In the Name text box, type the name of an independent current source.

### **Global parameter**

This sets the value to the sweep value and all expressions are re-evaluated.

In the Parameter name text box, type a global parameter name.

### **Model parameter**

This sets the parameter in the model to the sweep value.

From the Model type list, select a model type. In the Model Name text box, type the model name. In the Parameter name text box, type a parameter name.

### **Temperature**

This sets the temperature to the sweep value. For each value in the sweep, the model parameters of all the circuit components are updated to that temperature.

### **Linear**

Indicates a linear sweep. The swept variable is swept linearly from the starting to the ending value. The Increment value is the step size.

### **Octave**

Indicates sweep by octaves. The sweep variable is swept logarithmically by octaves.

### **Decade**

Indicates sweep by decades. The sweep variable is swept logarithmically by decades.

### **Value list**

Uses a list of values. In this case, there are no start and end values. Instead, the numbers you type in the Values List text box are the values that the sweep variable is set to.

### **YMAX**

Finds the greatest difference in each waveform from the nominal run.

### **MAX**

Finds the maximum value of each waveform.

### **MIN**

Finds the minimum value of each waveform.

### **RISE\_EDGE**

Finds the first occurrence of the waveform crossing above the threshold value. Type a threshold value in the Threshold value text box.

### **FALL\_EDGE**

Finds the first occurrence of the waveform crossing below the threshold value. Type a threshold value in the Threshold value text box.

### **Low**

Specifies the lower limit of the range over which the function is evaluated.

### **Hi**

Specifies the upper limit of the range over which the function is evaluated.

### **None**

Forces the nominal run to produce output.

### **All**

Forces all output to be generated, including the nominal run.

### **First**

Generates output only during the first n runs. Type the value for n in the Runs text box.

### **Every**

Generates output every nth run. Type the value for n in the Runs text box.

### **Runs**

Performs an analysis and generates output only for listed runs. Up to 25 values can be specified in the Runs text box. Prints out at the beginning of each run the model parameter values actually used for each component during that run.

### **Random number seed**

Defines the seed for the random number generator within the Monte Carlo analysis. You must type an odd integer ranging from 1 to 32767. If the seed value is not set, it defaults to 17533.

### **Output All**

Requests output from the sensitivity runs, after the first run. The sensitivity and worst case runs are done with variations on model parameters as specified by the DEV and LOT tolerances. The default is to vary by BOTH.

### **Vary both DEV and LOT, Vary DEV, Vary LOT**

Vary DEV and Vary LOT limit the devices analyzed to only the device types that have a DEV tolerance or a LOT tolerance.

Vary both DEV and LOT includes all the device types in the analysis.

### **Limit devices to type(s)**

In the text box, type a list of the specific device types you want included in the analysis. The list is a string containing the initial letters of PSpice A/D primitives.

### **Primary Sweep value**

The first DC sweep value at which the bias point is to be saved. If there is only one sweep value, type a value in the Primary Sweep value text box. If there are two sweep variables, then Primary Sweep value specifies the first sweep value.

### **Secondary Sweep value**

The second DC sweep value at which the bias point is to be saved. If there is only one sweep value, type a value in the Primary Sweep value text box. If there are two sweep variables, then Secondary Sweep value specifies the second sweep value.

### **Parametric Sweep value**

The step value at which the bias point is to be saved for parametric analyses.

### **Number of runs**

The number of the Monte Carlo or worst case analyses run for which the bias point is to be saved.

### **Use distribution**

This option is the default distribution for Monte Carlo deviations.

From the list, select Uniform or Gaussian, or click the Distributions button to enter your own distribution.

### **Initialize flip-flops to X, 0, or 1**

If set to X, all flip-flops and latches produce an X (unknown state) until explicitly set or cleared, or until a known state is clocked in.

If set to 0, all such devices are cleared.

If set to 1, all such devices are preset.

### **default propagation delay mode**

You can change the mode for an individual part in your design by changing the part's MNTYMXDLY property. By default, this part value is set to 0, which tells PSpice A/D to use the default value set in the Options tab.

Enter this...	To set this mode as the default
1	minimum
2	typical
3	maximum
4	worst-case (min/max)

### **Temperature Sweep temperature**

Defines the temperature at which the bias point is to be saved for temperature analyses.

### **Include detailed bias point information for nonlinear controlled sources and semiconductors**

This option saves the small-signal (linearized) parameters of all the nonlinear controlled sources and all the semiconductor devices to the output file.

This is equivalent to the .OP (bias point) PSpice A/D circuit file command.

### **Perform Sensitivity analysis**

In the Output Variable(s) text box, type

This option is equivalent to the .SENS (DC sensitivity) PSpice A/D circuit file command.

### **Calculate small-signal DC gain**

This option calculates the small-signal DC gain by linearizing the circuit around the bias point.

In the From Input Source Name text box, type

In the To Output Variable text box, type

## PSpice Help

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This option is equivalent to the .TF (small-signal DC transfer function) PSpice A/D circuit file command.

### Data collection parameters

Choose this option... To do this...

All voltages, currents, and digital states	Save Probe data for all nodes and devices in the circuit. This is the default.
All but internal subcircuit data	Save data for all nodes and devices, except internal subcircuit nodes and devices.
At Markers only	Save the Probe data at those nodes and devices where markers are placed.
None	Disable Probe data collection.

### Text Data File Format (CSDF)

Select the Save data in the CSDF format (.CSD) option to write Probe data in text format rather than binary format. This option is not available if the Run Probe During Simulation option is used.

### Introduction to device equations

The purpose of the Device Equations option is to change the built-in model equations for one or more of the semiconductor devices (GaAsFET, Diode, Junction FET, MOSFET, Bipolar transistor, and IGBT). This means you can extend PSpice A/D to support user-defined or proprietary native device models.

This option is not an addition to PSpice A/D: it is a different packaging of the program that includes the source code for the device model subroutines. You need a Device Equations license to modify and extend PSpice A/D code, but you do not need a Device Equations license to use the modified code.

There are several kinds of changes that can be made using the Device Equations option. These include, in ascending order of complexity:

- Changing a parameter name
- Giving a parameter an alias
- Adding a parameter
- Changing the device equations
- Adding a new device
- Specifying new internal device structure

You need a supported C++ compiler to compile Device Equations extensions; for Windows 95/98 and NT, you need Microsoft Visual C++ 6.0 or later.

Device Equations extensions are implemented using a dynamic-link library, which means you can share your models with other users by distributing just a DLL.

If you want to run PSpice A/D on Windows 95 or NT with a Device Equations DLL developed by someone else, then you do not need a compiler or a Device Equations license. Just copy the DLL into the directory with your PSpice A/D program file. For more information, see [Simulating with the device equations option<link>](#).

### Making device model changes

To get started, look at the files M.H and MOS.CPP, which implement the MOSFET equations. The other devices have similar structures.

M.H contains two important class definitions:

- the class for the MOS transistor (class M\_Device)

- the class for the MOS model (class M\_Model)

During read-in, the simulator creates an instance of the transistor class for every MOSFET in the circuit and an instance of the model class for every .MODEL statement of type NMOS or PMOS. The transistor instance is set up using information particular to that transistor, such as the nodes to which it is connected, its length and width, and the locations of its entries in the circuit's conductance matrix. All parameters of the model object are set up using the values from the .MODEL statement, if one exists; otherwise, the default values are used.

The transistor object corresponds to the LOC, LOCV, and LX tables in U.C. Berkeley SPICE2. The model object corresponds to the LOC and LOCM tables in SPICE.

**Note:** Do not change the transistor object (class M\_Device), except when changing the internal device topology. It is included only to allow compiling of MOS.CPP.

The simulator needs to associate each entry in the model class with a model parameter name (and default value) in the .MODEL statement. You can accomplish this by using the ASSOCIATE macro. Just below the device class in M.H there is a list of all the parameters, each in an ASSOCIATE macro. The occurrence of ASSOCIATE binds together the class entry, the parameter name, and the default value. The read-in section of the simulator uses this information to parse the .MODEL statement.

For more details on how to change parameters, click the following:

[Changing a parameter name](#)

[Giving a parameter an alias](#)

[Adding a parameter](#)

### Changing a parameter name

This is the easiest change. Find the parameter in the list of ASSOCIATE macros. Change the parameter's name (last item on the line) and/or the default value (middle item). The names and defaults of the model parameters that are supplied can be changed, as well as those parameters that are added.

When the simulator runs, it prints the parameter values for each .MODEL statement unless the NOMOD option is used in the .OPTIONS statement. Normally only parameters which have not been defaulted are listed. A parameter can be forced to be listed, whether or not it has been defaulted, by preceding its name using an asterisk (\*). For example, VTO is listed that way in M.H.

### Giving a parameter an alias

Sometimes a parameter requires an alternate name (an alias). Several bipolar model parameters, such as ISE, already have alternate names. The alias for ISE is C2. Look in Q.H at the occurrences of the parameters ISE and C2 in the ASSOCIATE macros for an example of how this is accomplished. There is only one entry in the model class (Q\_ise) for the parameter, but there are two ASSOCIATE entries. This means that either name (ISE or C2) on the .MODEL statement can put a number into the class entry Q\_ise.

**Note:** When model parameters are listed, the first name found in the ASSOCIATE list (searching downward) is the name which is echoed on the output.

Insert the new name first if it is the name to be printed.

### Adding a parameter

Adding a parameter is probably the most common case. The parameter must be added to both the model class (e.g., class M\_Model) and the corresponding ASSOCIATE list. It is recommended to follow the PSpice A/D naming convention (e.g., M\_wd and M\_vto), but it is not required.

Model parameters are set forth as pairs of elements instead of simple floating point values. This is to provide the use of expressions for model parameters. Because of this, when adding a parameter (for example, M\_new), the following line is required:

```
MXPR( M_new, Mx_new );
```

instead of

```
float M_new;
```

**Note:** Do not modify the value of the Mx\_new class element.

The read-in mechanism can handle expressions for user-added parameters. By the time the model code is called, the expressions have been evaluated and their value placed in the appropriate fields. See the include file m.h for further examples and comments.

When the simulator is doing a read-in, model parameters are listed for each .MODEL statement (unless NOMOD has been specified on the .OPTIONS statement). Normally, only those parameters that have not been defaulted are listed. A parameter can be forced to be listed, even if it has been defaulted, by preceding its name using an asterisk (\*) in the ASSOCIATE macro. For instance, VTO in M.H is listed in that manner.

The default value, OMITTED, is used by the simulator to force the calculation of a parameter's value during read-in. For instance, VTO is calculated from other values if it is not given a

value. These calculations are built into the read-in and are fixed. Cadence recommends that parameters that you add be given a normal default value and not be computed by using OMITTED.

Once the parameter has been added, the model class becomes one parameter longer, and the read-in section of PSpice A/D places a value in its entry. The parameter can now be used in the device code (e.g., MOS.CPP).

### Changing the device equations

The device equations are in the file that has the same name as the type of device (DIODE.CPP, BJT.CPP, JFET.CPP, MOS.CPP, GASFET.CPP). The files D.CPP, Q.CPP, J.CPP, M.CPP, and B.CPP contain auxiliary functions that implement the AC equations, matrix setup, temperature updating, etc. The code in these subroutines use the model parameters and the device's terminal voltages to calculate the branch currents and conductances, and, during transient analysis, the terminal charges and branch capacitances. These equations are neither simple nor easy. A good understanding of U.C. Berkeley's SPICE2G is recommended before making such a change. Two useful references are:

1. Nagel, L.W., "SPICE2: A Computer Program to Simulate Semiconductor Circuits", Memorandum No. M520, May 1975.
2. Cohen, Ellis, "Program Reference for SPICE2", Memorandum No. M592, June 1976.

which are available from:

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For more details about device source files, see Functional subsections of the device source file.

### Functional subsections of the device source file

The code in each of the device source files is arranged into separate functional subsections. Each subsection occurs at least once, but can occur several times for devices that have more than one level. The subsections required are outlined below.

Subsection	Description
Initialization	This consists of locating and binding the device instance and its model, initializing any local variables, and obtaining appropriate values for the device branch voltages. The branch voltages (e.g., vds, vgs) are set differently depending upon whether there are user-specified initial conditions (using IC= or .IC), and on whether the present Newton Raphson cycle has finished or not.
Computing new nonlinear branch voltage:	This is needed to monitor progress towards a Newton Raphson solution.
Test if the solution has changed:	If there is not significant change bypass the rest of the computation. Otherwise, continue.
Limit any nonlinear branch voltages:	This code uses the macro PNJLIM() to insure that the branch voltages are in the appropriate operating region.
Compute currents and conductances:	This is the meat of the Device Equations code, and involves obtaining all the branch currents (e.g., ibs, ibd) as well as all the derivatives to be used in the conductance matrix.
Charge calculations:	Internal charges are calculated and updated.
Check convergence:	Check to see if the nonlinear device branches now have values that are within a small tolerance range of those obtained in the last repeat cycle, and set a return flag to signal whether the device converged.
Load the current vector and conductance matrix:	The macro Y_MATRIX () is used to obtain handles to the proper matrix elements, and the elements are assigned their values based on the present evaluation of the device equations and derivatives.

## PSpice Help

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SPICE2G is written in FORTRAN, whereas PSpice A/D is in C/C++. For the device subroutines, as much correspondence as possible has been maintained between the two. Because of FORTRAN, SPICE kept integer and real numbers in different tables: NODPLC (indexed by LOC) and VALUE (indexed by LOCV or LOCM). In PSpice A/D, these have been combined into one object (e.g., class M\_Device).

The state vector information is constructed somewhat differently, though the overall pattern is similar. In SPICE the state vector information is kept in a set of vectors in VALUE. There is one vector for each time point “remembered” (from 4 to 7, depending on the order of the integration method). Each device’s LOC table contains an offset, LX, to its portion of the information in each state vector. In PSpice A/D the number of state vectors is fixed, and each device’s state information is kept in its own device object (e.g., class M\_Device).

For example, for MOSFETs the state vectors are an array, struct msv\_def m\_sv[MSTVCT] in class M\_Device. MSTVCT is the number of state vectors and is defined in TRAN.H to be equal to 4. The definition of msv\_def (also in M.H) lists the various currents, conductances, charges, and capacitances that are in the state vector. Finally, M.H contains a set of #defines, which allows accessing of the entries to the state vectors by name. It is these (uppercase) names which are then used in MOS.CPP. This may seem like a roundabout way of constructing the state vector information, but the actual usage (in MOS.CPP) is quite straightforward and is similar to that in SPICE.

### Adding a new device

The Device Equations option does not allow the addition of an entirely new device. However, in many cases the same thing can be achieved by making use of an existing device.

Suppose, for example, that a lightning arrester device is to be added. The lightning arrester has two terminals, therefore it can be built into the diode equations, because the diode also has two terminals. This means that in the circuit (.CIR) file the lightning arresters would use the letter D to start and would refer to a .MODEL statement of the type D.

At first glance it appears that this would preclude using diodes in circuits, since they have been replaced by lightning arresters. This problem is avoided by keeping all the diode model parameters, adding the lightning arrester parameters, adding a LEVEL parameter, and giving the LEVEL parameter a default of 1. In the diode subroutine (in DIODE.CPP), a large if test would select all the old diode code if LEVEL=1 and all the new lightning arrester code otherwise. The new LEVEL parameter would switch between diode and lightning arrester.

This approach can be extended to as many devices as wanted. This could be:

- LEVEL=1 as a diode
- LEVEL=2 as a lightning arrester

- LEVEL=3 as a gas discharge tube

And so on. The restriction is that all of the devices added to the diode must have two terminals. If the device to be added has three terminals, it must be built into a three terminal device, such as the JFET. The highest number of terminals that can be modeled is four, using the MOSFET. There is not a good way to add devices, such as pentodes, that have five or more terminals.

### Specifying new internal device structure

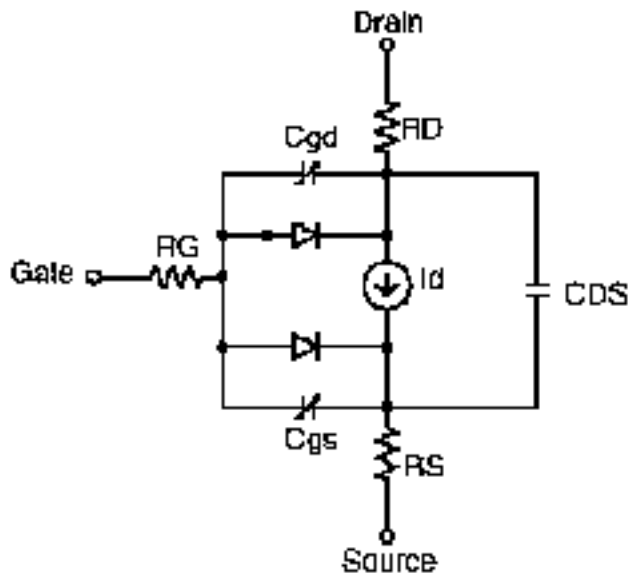
You may want to change the topology of a device in order to accommodate a more elaborate set of parasitic resistances and/or capacitances. To do this requires that positions in the conductance matrix be assigned to include the terms that the additional equations generate. This requires five steps:

1. Ensuring that all of the new internal nodes and matrix conductance terms are added to the device class in the device header file
2. Allocating the new matrix elements
3. Providing handles to access the new matrix elements and to bind the nodes to the branches
4. Including logic, if needed, to support device model parameter checking and updating
5. Adding the new device equations to the device code

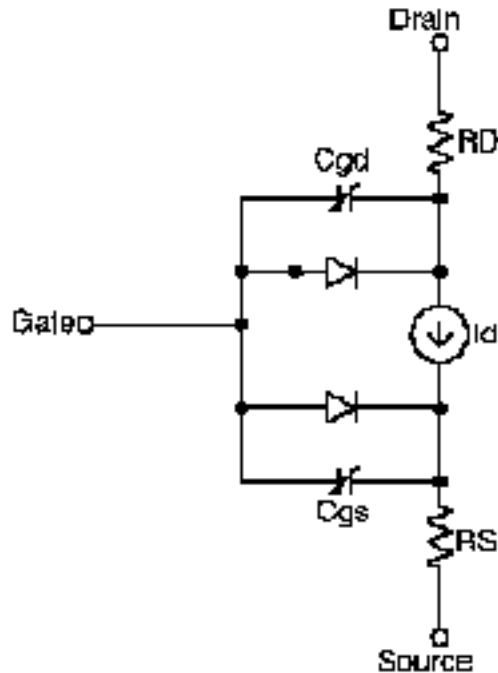
### Example

This process can be illustrated by looking at the PSpice A/D JFET and GaAsFET devices, as shown in the procedure below. The topologies of these two devices are nearly identical, except that the GaAsFET has an additional internal capacitance, CDS, between the source and drain, and an additional internal resistance, RG, at the gate. This gives the GaAsFET topology one additional node where RG joins the rest of the structure and two additional internal branches.

**GaAsFET Model**



**JFET Model**



## Procedure

### **Step one: editing the device header file**

These differences are reflected in the device class definitions in J.H and B.H. Each of the device nodes is given a name and declared to be of type CKT\_IDX.

The JFET device class, J\_Device, lists the two internal nodes j\_d and j\_s, while the GaAsFET device class, B\_Device, has three internal nodes b\_d, b\_s, and a new one, b\_g. The two additional branches in the GaAsFET require three new matrix conductance terms.

The conductance terms are declared type MTX\_IDX and are listed immediately following the internal nodes.

The JFET has a term j\_GG, which appears on the matrix diagonal for the external gate node.

The GaAsFET has an additional gate node which requires one additional matrix diagonal conductance term, b\_gg, along with two off-diagonal conductance terms, b\_gg and b\_gG. These are used by the source code in GASFET.CPP to designate where the conductance

terms associated with RG go when the matrix is loaded. CDS doesn't need any additional nodes or matrix terms because the items required are already in place to accommodate the parallel current source, id.

With the nodes and conductance terms taken care of in the device header file, the first step is completed.

### ***Step two: setting up memory allocation for the new matrix elements***

You can set up memory allocation to properly incorporate the new equations into the conductance matrix by modifying J.CPP. In this file is the function J\_Device::MatPtr(), while B.CPP contains B\_Device::MatPtr(). These functions call the function Reserve() once for each conductance matrix term that was declared in the header file. For instance, when b\_gg, b\_Gg, and b\_gG are added for the GaAsFET, these require corresponding code in B\_Device::MatPtr() as follows:

```
flag &= Reserve (ng,ng);
```

```
flag &= Reserve (nG,ng);
```

```
flag &= Reserve (ng,nG);
```

The arguments ng and nG are local variables that serve as aliases for the respective device nodes, b\_g and b\_G, and are assigned at the beginning of B\_Device::MatPtr() as follows:

```
ng = bloc -> b_g;
```

```
nG = bloc -> b_G;
```

### ***Step three: binding the nodes and branches***

The mechanics of step three, binding the nodes and branches, are very similar to the mechanics of step two. The functions of interest are J\_Device::MatLoc() and B\_Device::MatLoc(), and they now call Indxcl() instead of Reserve(). The GaAsFET again has three more lines of code:

```
flag &= Indxcl (&(bloc->b_gg),ng,ng);
```

```
flag &= Indxcl (&(bloc->b_Gg),nG,ng);
```

```
flag &= Indxcl (&(bloc->b_gG),ng,nG);
```

### ***Step four: handling model parameters***

Step four, handling model parameters, is basically the same as it would be for a case not involving topology changes, with one significant exception: this requires handling the case where the parasitics associated with an internal node can be zero. In this case the node must be generated conditionally. An instance of this is the GaAsFET internal resistance  $R_G$ . If  $R_G$  is zero, the parasitic resistance between the internal node  $b_g$  and the external node  $b_G$  can be removed from the circuit. This is accomplished in the function `B_Device::AddInternalNodes()` in `B.CPP`, using the following line of code:

```
INTERNAL_NODE(P->B_rg,b_g,b_G);
```

`INTERNAL_NODE()` is a macro that performs the required logic, depending on whether the model parameter  $B_{rg}$  is zero or not. The other two calls to this macro in `B_Device::AddInternalNodes()` correspond to the  $R_D$  and  $R_S$  resistances that also exist for the JFET.

### ***Step five: implementing the new device equations***

The final step does not involve any further topological considerations and is carried out just as it would be if the device internal topology weren't being changed.

## **Recompiling and linking the device equations option**

The source files needed to create the Device Equations DLL can be copied from the CD to any directory you choose, though it is recommended that you create a new empty directory. The MSVC++ project files, `DEVEQ.DSP` and `DEVEQ.MAK`, are included to compile and link the DLL.

For information on obtaining the Microsoft compiler, contact Microsoft Corporation directly.

### **To create a new `deveq.dll`:**

1. Load `DEVEQ.DSP` into the Visual C++ development environment.
2. From the Build menu, select Build `Deveq.dll`.
3. The project supports debug and release versions of the build target.
4. After `DEVEQ.DLL` is built, copy it to the directory that contains `PSpice A/D.EXE`.

For details on how to personalize your `DEVEQ.DLL` file, click [Personalizing your DLL](#).

### Personalizing your DLL

The function `DLLMain()` in `DEVEQDLL.CPP` contains the following line of code:

```
DEVEQVERSIONINFO("Device Equations",VERSIONNUM);
```

To personalize your DLL, change the first argument to a string which identifies you as the author of the DLL, as in:

```
DEVEQVERSIONINFO("(c)Copyright 1998\nMyCorp\n123 MyAddress\nMyCity, ST 12345"  
,"9.0.1");
```

You can leave the `VERSIONNUM` argument alone, in which case it will match the version number of your PSpice A/D release, or you can substitute your own version numbers. It is useful to be able to relate the DLL to the PSpice A/D release it was built from, so you should use `VERSIONNUM` unless there is a compelling need to change it.

### Simulating with the device equations option

After you obtain a working Device Equations DLL, place it in the directory that contains PSpice A/D.EXE.

PSpice A/D will locate and load `DEVEQ.DLL` when you start the program, provided the `.INI` file entry is specified correctly. For instructions on modifying the `.INI` file, click [Selecting which models to use from a Device Equations DLL](#).

The code in the DLL will be substituted for the device model code that ships with the plain version of PSpice A/D. The presence of the DLL is also noted in the `Devices` tab of the PSpice A/D Simulation Status Window and in the `.OUT` file.

If PSpice A/D doesn't find the DLL, it runs as the normally configured PSpice A/D.

### Selecting which models to use from a Device Equations DLL

You can tell PSpice A/D which device models to use from a custom DLL by adding an entry to the PSpice A/D.INI configuration file; for any device type you do not specify, PSpice A/D uses the normally configured PSpice A/D models.

To specify which models to use from a custom DLL:

1. In a standard text editor (such as Notepad), open `PSpice A/D.INI`, located in your Windows directory.

## PSpice Help

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2. Find the [PSpice A/D] section and add this line to the section:

```
USE_DEVEQ_MODELS="<device letters>"
```

where <device letters> is any or all of the following:

For this device type...	Use this device letter...
GaAsFET	B
Diode	D
Junction FET	J
MOSFET	M
Bipolar transistor	Q

For example, to use all of the possible device models from your custom DLL, type the following:

```
USE_DEVEQ_MODELS="BDJMQ"
```

3. Save PSpice A/D.INI.
4. Start PSpice A/D and run a simulation.