Avant!

Chapter 18

Finding Device Libraries

For libraries with multiple models of a given element, you need to be able to automatically find the proper model for each transistor size. Use the Star-Hspice automatic model selector to accomplish this.

This chapter describes how to use the model selector, then provides listings of device libraries that you can use with Star-Hspice.

The following topics are covered in this chapter:

Selecting Models Automatically

The model selector uses the following criteria:

$$LMIN + XLREF \leq L + XL < LMAX + XLREF$$

$$WMIN + XWREF \leq W + XW < WMAX + XWREF$$

(If XLREF is not specified, XLREF is set to XL. If XWREF is not specified, XWREF is set to XW.)

The model selector syntax is based on a common model root name, with a unique extension for each model.

Note: The preceding does not apply to JFETs.

The following is an example of HSPICE syntax for models:

```
M1 drain gate source bulk NJ W=2u L=1u
.MODEL NJ4 NJF WMIN=1.5u WMAX=3u LMIN=.8u LMAX=2u
.MODEL NJ5 NJF WMIN=1.5u WMAX=3u LMIN=2u LMAX=6u
```

Figure 18-1 illustrates the model selection method.

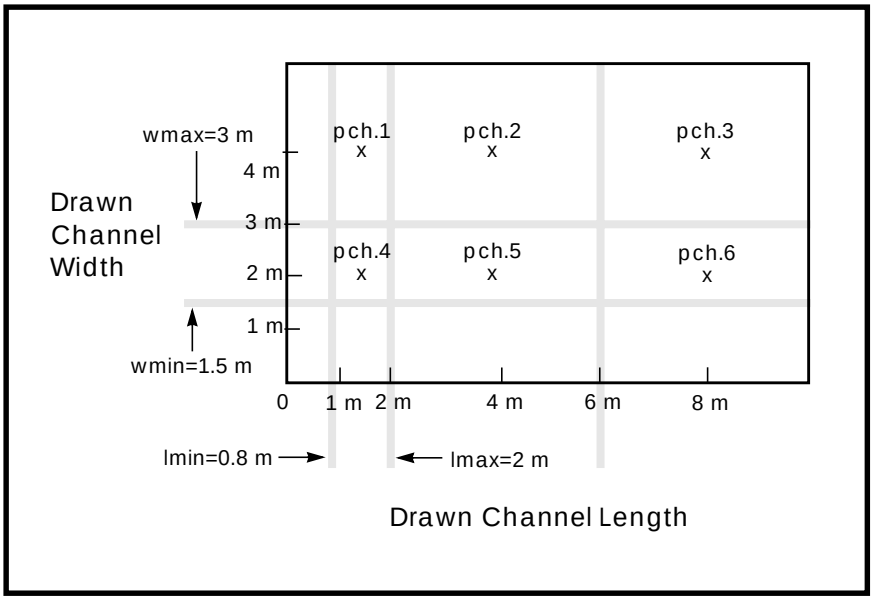

Figure 18-1: Automatic Model Selector Method

For this example, there are several pch.*x* models, with varying drawn channel lengths and widths, in the model library. (The model root name is pch and the extensions are 1, 2, ..., 6). The NJ4 instance of the NJ element (W=2 μ, L=1 μ) requires a model for which 1.5 μ ≤ channel width ≤ 3 μ, and 0.8 μ ≤ channel length ≤ 2 μ. The automatic model selector chooses the pch.4 model since that model satisfies these requirements. Similarly, the NJ5 transistor requires a model with 1.5 μ ≤ channel width ≤ 3 μ, and 2 μ ≤ channel length ≤ 6 μ. The pch.5 model satisfies these requirements. If a device size is out of range for all the models that exist, an error message is issued.

If a model within a subcircuit cannot be found, the automatic model selector searches the top level. If the automatic model selector fails to find a model, HSPICE terminates.

The following combination of conditions causes the automatic model selector to fail and terminates HSPICE:

1. In the element statement, a model name is used which contains a period (.).
2. The model library was not designed for use with the HSPICE automatic model selector.
3. Either a multisweep specification or a .TEMP temperature analysis statement is included in the HSPICE input.

The following example illustrates how a period in a model name can cause automatic model selection problems.

Case 1:

```
M1 d g s b N.CHN W=10u L=5u* Element statement
.MODEL N.CHN LMIN=1u LMAX=4u WMIN=2u WMAX=100u*
.MODEL statement
```

Case 2:

```
.TEMP 25
.M1 d g s b N.CHN W=10u L=5u* Element statement
.MODEL N.CHN LMIN=1u LMAX=4u WMIN=2u WMAX=100u*
.MODEL statement
```

In Case 1, since there is no multisweep or temperature analysis specified, the HSPICE model selector feature is not invoked, so the N.CHN model is used with no problems.

In Case 2, however, the presence of the .TEMP statement invokes the model selector feature. The model selector tries to find a model named N.*nnn* that fits within the length and width ranges given in the element statement. Because the length given in the element statement (5 μm) is not within the 1 to 4 μm range specified in the .MODEL statement, the model selector cannot find a model that matches the element statement, and HSPICE issues a “device ‘N’ not found” error message.

Examining the Library Listings

The names of models provided with Star-Hspice are listed in the following sections. Each type of model is stored in a directory that has a name indicating the type of models it contains, such as *dio* for diodes and *bjt* for bipolar junction transistors. The path to the directory is shown for each model type. This path can be specified in a .OPTION SEARCH statement, such as

```
.OPTION SEARCH '$installdir/96/parts/dio'
```

where *$installdir* is the environment variable set to the path to the HSPICE software installation directory and 96 is the HSPICE release number. All model directories are under the *parts* directory.

Analog Device Models

Search path: *$installdir/parts/ad*

Model names:

AD581	AD581J	AD581K	AD581L	AD581S
AD581T	AD581U	AD584	AD584J	AD584K
AD584L	AD584S	AD584T	AD587	AD587J
AD587K	AD587L	AD587S	AD587T	AD587U
AD600	AD600J	AD602	AD602J	AD620
AD620A	AD620B	AD620S	AD624	AD624A
AD624B	AD624C	AD624S	AD630	AD630A
AD630B	AD630J	AD630K	AD630S	AD633
AD633J	AD645	AD645A	AD645B	AD645J
AD645K	AD645S	AD704	AD704A	AD704B
AD704J	AD704K	AD704T	AD705	AD705A
AD705B	AD705J	AD705K	AD705T	AD706
AD706A	AD706B	AD706J	AD706K	AD706T
AD711	AD711A	AD711B	AD711C	AD711J
AD711K	AD711S	AD711T	AD712	AD712A
AD712B	AD712C	AD712J	AD712K	AD712S
AD712T	AD713	AD713A	AD713B	AD713J
AD713K	AD713S	AD713T	AD734	AD734A

AD734B	AD734S	AD743	AD743A	AD743B
AD743J	AD743K	AD743S	AD744	AD744A
AD744B	AD744C	AD744J	AD744K	AD744S
AD744T	AD745	AD745A	AD745B	AD745J
AD745K	AD745S	AD746	AD746A	AD746B
AD746J	AD746S	AD780	AD780A	AD780B
AD780S	AD797	AD797A	AD797B	AD797S
AD810	AD810A	AD810S	AD811	AD812
AD812A	AD813	AD813A	AD817	AD817A
AD818	AD818A	AD820	AD826	AD826A
AD828	AD828A	AD829	AD829A	AD829J
AD829S	AD830	AD830A	AD830J	AD830S
AD840	AD840J	AD840K	AD840S	AD843
AD843A	AD843B	AD843J	AD843K	AD843S
AD844	AD844A	AD844B	AD844S	AD845
AD845A	AD845B	AD845J	AD845K	AD845S
AD846	AD846A	AD846B	AD846S	AD847
AD847A	AD847J	AD847S	AD848	AD848A
AD848J	AD848S	AD9617	AD9618	AD9621
AD9622	AD9623	AD9624	AD9630	ADG411
ADG411B	ADG411T	ADG412	ADG412B	ADG412T
ADG413	ADG413B	ADG413T	AMP01	AMP02
BUF04	MAT02	MAT03	MAT04	MLT04
MLT04G	OP160	OP160A	OP160F	OP160G
OP176	OP176G	OP177	OP177A	OP177B
OP177E	OP177F	OP177G	OP20	OP200
OP200A	OP200E	OP200F	OP200G	OP20B
OP20C	OP20F	OP20G	OP20H	OP21
OP213	OP215	OP215A	OP215B	OP215C
OP215E	OP215F	OP215G	OP21A	OP21E
OP21F	OP21G	OP21H	OP220	OP220A
OP220C	OP220E	OP220F	OP220G	OP221
OP221A	OP221B	OP221C	OP221E	OP221G
OP249	OP249A	OP249E	OP249F	OP249G
OP260	OP27	OP275	OP275G	OP27A

OP27B	OP27C	OP27E	OP27F	OP27G
OP282	OP282G	OP283	OP285	OP285G
OP290	OP290A	OP290E	OP290F	OP290G
OP292	OP295	OP297	OP297A	OP297E
OP297F	OP297G	OP37	OP37A	OP37B
OP37C	OP37E	OP37F	OP37G	OP400
OP400A	OP400E	OP400F	OP400G	OP400H
OP41	OP41A	OP41B	OP41E	OP41F
OP41G	OP42	OP420	OP420B	OP420C
OP420F	OP420G	OP420H	OP421	OP421B
OP421C	OP421F	OP421G	OP421H	OP42A
OP42E	OP42F	OP42G	OP43	OP43A
OP43B	OP43E	OP43F	OP43G	OP44
OP467	OP467G	OP470	OP482	OP482G
OP490	OP490A	OP490E	OP490F	OP490G
OP492	OP497	OP497A	OP497B	OP497C
OP497F	OP497G	OP61	OP64	OP77
OP77A	OP77B	OP77E	OP77F	OP77G
OP80	OP80B	OP80E	OP80F	OP80G
OP90	OP90A	OP90E	OP90F	OP90G
OP97	OP97A	OP97E	OP97F	PM1012
REF01	REF01A	REF01C	REF01E	REF01H
REF02	REF02A	REF02C	REF02D	REF02E
REF02H	REF05	REF05A	REF05B	REF10
REF10A	REF10B	SSM2017	SSM2017P	SSM2131
SSM2210	SSM2220			

Behavioral Device Models

Required element syntax: Xyyyyy in- in+ out vcc vee modelname

Search path: *$installdir/parts/behave*

Optional parameters: vos=value, ibos=value, av=value

Model names:

AD4BIT	AD8BIT	ALF155	ALF156	ALF157
ALF255	ALF347	ALF351	ALF353	ALF355
ALF356	ALF357	ALF3741	ALM101A	ALM107
ALM108	ALM108A	ALM111	ALM118	ALM124
ALM124A	ALM139A	ALM1458	ALM1558	ALM158
ALM158A	ALM201A	ALM207	ALM208	ALM208A
ALM224	ALM258	ALM258A	ALM2901	ALM2902
ALM2904	ALM301A	ALM307	ALM308	ALM308A
ALM318	ALM324	ALM3302	ALM339	ALM358
ALM358A	ALM725	ALM741	ALM747	ALM747C
AMC1458	AMC1536	AMC1741	AMC1747	ANE5534P
ANJM4558	ANJM4559	ANJM4560	AOP04	AOP07
AOP14	AOP15B	AOP16B	AT094CNS	ATL071C
ATL072C	ATL074C	ATL081C	ATL082C	ATL084C
ATL092CP	ATL094CN	AUPC1251	AUPC358	GA201
RCFILT	TLINE			

Bipolar Transistor Models

Required element syntax: Xyyyy coll base emit modelname

Search path: *$installdir/parts/bjt*

Optional parameters: betaf=value, tauf=value

Model names:

T2N1132A	T2N2102	T2N2219A	T2N2222	T2N2222A
T2N2369	T2N2369A	T2N2501	T2N2605	T2N2642
T2N2857	T2N2894	T2N2904	T2N2904A	T2N2905
T2N2905A	T2N2906	T2N2907	T2N2907A	T2N2945A
T2N3013	T2N3227	T2N3250	T2N3250A	T2N3251
T2N3251A	T2N3467	T2N3501	T2N3546	T2N3637
T2N3742	T2N3743	T2N3866	T2N3904	T2N3906
T2N3946	T2N3947	T2N3962	T2N4261	T2N4449
T2N5058	T2N5059	T2N5179	T2N6341	T2N6438
T2N706	T2N708	T2N869	T2N869A	T2N918
T2N930	T2SA1015	T2SA950	T2SA965	T2SA970
T2SC1815	T2SC1923	T2SC2120	T2SC2235	T2SC2669
TMPS6595	TNE741	TNE901		

Burr-Brown Devices

Search path: *$installdir/parts/burr_brn*

Model names:

INA101	INA101E	INA102	INA102E	INA103
INA103E	INA105	INA105E	INA106	INA106E
INA110	INA110E	INA117	INA117E	INA120
INA120E	ISO120X	ISO121X	OPA101	OPA1013
OPA1013E	OPA101E	OPA102	OPA102E	OPA111
OPA111E	OPA121	OPA121E	OPA128	OPA128E
OPA177	OPA177E	OPA2107	OPA2107E	OPA2111
OPA2111E	OPA2541	OPA2541E	OPA2604	OPA2604E
OPA27	OPA27E	OPA27H	OPA27HE	OPA37

OPA37E	OPA404	OPA404E	OPA445	OPA445E
OPA501	OPA501E	OPA511	OPA511E	OPA512
OPA512E	OPA541	OPA541E	OPA602	OPA602E
OPA603X	OPA606	OPA606E	OPA620	OPA620E
OPA620X	OPA621	OPA621E	OPA621X	OPA627
OPA627E	OPA637	OPA637E	RCV420X	UAF42
UAF42E				

Comlinear Device Models

Search path: *$installdir/parts/comline*

Model names:

CLC109	CLC111	CLC400	CLC401	CLC402
CLC404	CLC406	CLC409	CLC410	CLC414
CLC415	CLC420	CLC425	CLC426	CLC428
CLC430	CLC431	CLC432	CLC501	CLC502
CLC505	CLC520	CLC522	CLC532	

Diode Models

Required element syntax: Xyyyyy anode cathode modelname

Search path: *$installdir/parts/dio*

Optional parameters: isat=value, tt=value

Model names:

D12BG11	D12BH11	D12DG11	D12DH11	D12FG11
D12FH11	D12GG11	D12GH11	D12JG11	D12JH11
D1N3016	D1N3017	D1N3018	D1N3019	D1N3020
D1N3021	D1N3022	D1N3023	D1N3024	D1N3025
D1N3026	D1N3027	D1N3028	D1N3029	D1N3030
D1N3031	D1N3032	D1N3033	D1N3034	D1N3035

D1N3036	D1N3037	D1N3038	D1N3039	D1N3040
D1N3041	D1N3042	D1N3043	D1N3044	D1N3045
D1N3046	D1N3047	D1N3048	D1N3049	D1N3050
D1N3051	D1N3821	D1N3822	D1N3823	D1N3824
D1N3825	D1N3826	D1N3827	D1N3828	D1N3829
D1N3830	D1N4001	D1N4002	D1N4003	D1N4004
D1N4005	D1N4006	D1N4007	D1N4148	D1N4149
D1N4150	D1N4370	D1N4371	D1N4372	D1N4446
D1N4447	D1N4448	D1N4449	D1N4728	D1N4729
D1N4730	D1N4731	D1N4732	D1N4733	D1N4734
D1N4735	D1N4736	D1N4737	D1N4738	D1N4739
D1N4740	D1N4741	D1N4742	D1N4743	D1N4744
D1N4745	D1N4746	D1N4747	D1N4748	D1N4749
D1N4750	D1N4751	D1N4752	D1N4753	D1N4754
D1N4755	D1N4756	D1N4757	D1N4758	D1N4759
D1N4760	D1N4761	D1N4762	D1N4763	D1N4764
D1N5221	D1N5222	D1N5223	D1N5224	D1N5225
D1N5226	D1N5227	D1N5228	D1N5229	D1N5230
D1N5231	D1N5232	D1N5233	D1N5234	D1N5235
D1N5236	D1N5237	D1N5238	D1N5239	D1N5240
D1N5241	D1N5242	D1N5243	D1N5244	D1N5245
D1N5246	D1N5247	D1N5248	D1N5249	D1N5250
D1N5251	D1N5252	D1N5253	D1N5254	D1N5255
D1N5256	D1N5257	D1N5258	D1N5259	D1N5260
D1N5261	D1N5262	D1N5263	D1N5264	D1N5265
D1N5266	D1N5267	D1N5268	D1N5269	D1N5270
D1N5271	D1N5272	D1N5333	D1N5334	D1N5335
D1N5336	D1N5337	D1N5338	D1N5339	D1N5340
D1N5341	D1N5342	D1N5343	D1N5344	D1N5345
D1N5346	D1N5347	D1N5348	D1N5349	D1N5350
D1N5351	D1N5352	D1N5353	D1N5354	D1N5355
D1N5356	D1N5357	D1N5358	D1N5359	D1N5360
D1N5361	D1N5362	D1N5363	D1N5364	D1N5365
D1N5366	D1N5367	D1N5368	D1N5369	D1N5370
D1N5371	D1N5372	D1N5373	D1N5374	D1N5375
D1N5376	D1N5377	D1N5378	D1N5379	D1N5380

D1N5381	D1N5382	D1N5383	D1N5384	D1N5385
D1N5386	D1N5387	D1N5388	D1N5817	D1N5818
D1N5819	D1N5913	D1N5914	D1N5915	D1N5916
D1N5917	D1N5918	D1N5919	D1N5920	D1N5921
D1N5922	D1N5923	D1N5924	D1N5925	D1N5926
D1N5927	D1N5928	D1N5929	D1N5930	D1N5931
D1N5932	D1N5933	D1N5934	D1N5935	D1N5936
D1N5937	D1N5938	D1N5939	D1N5940	D1N5941
D1N5942	D1N5943	D1N5944	D1N5945	D1N5946
D1N5947	D1N5948	D1N5949	D1N5950	D1N5951
D1N5952	D1N5953	D1N5954	D1N5955	D1N5956
D1N746	D1N747	D1N748	D1N749	D1N750
D1N751	D1N752	D1N753	D1N754	D1N755
D1N756	D1N757	D1N758	D1N759	D1N914
D1N957	D1N958	D1N959	D1N960	D1N961
D1N962	D1N963	D1N964	D1N965	D1N966
D1N967	D1N968	D1N969	D1N970	D1N971
D1N972	D1N973	D1N974	D1N975	D1N976
D1N977	D1N978	D1N979	D1N980	D1N981
D1N982	D1N983	D1N984	D1N985	D1N986
D1S1585	D1S1586	D1S1587	D1S1588	D1SV147
D1SV149	DMBR115P	DMBR120P	DMBR130P	DMBR140P
DSK4A3				

FET Models

Required element syntax: Xyyyy drain gate source modelname

Search path: *$installdir/parts/fet*

Optional parameters: vt = value, betaf = value

Model names:

J108	J109	J110	J111	J112
J113	J2N3330	J2N3460	J2N3824	J2N4391
J2N4392	J2N4393	J2N4856	J2N4857	J2N5457
J2N5458	J2N5459	J2N5460	J2N5461	J2N5462
J2N5463	J2N5465	J309	J511	J557
JSJ74	JSK170	M2N6755	M2N6756	M2N6757
M2N6758	M2N6759	M2N6760	M2N6761	M2N6762
M2N6763	M2N6764	M2N6765	M2N6766	M2N6767
M2N6768	M2N6769	M2N6770	M2N6787	M2N6788
M2N6789	M2N6790	M2N6791	M2N6792	M2N6793
M2N6794	M2N6795	M2N6796	M2N6797	M2N6798
M2N6799	M2N6800	M2N6801	M2N6802	MBUZ10
MBUZ20	MBUZ23	MBUZ24	MBUZ32	MBUZ35
MBUZ36	MBUZ42	MBUZ45	MBUZ46	MBUZ60
MBUZ63	MBUZ64	MBUZ71	MBUZ72A	MBUZ74
MBUZ76	MIRF120	MIRF121	MIRF122	MIRF123
MIRF130	MIRF131	MIRF132	MIRF133	MIRF140
MIRF141	MIRF142	MIRF143	MIRF150	MIRF151
MIRF152	MIRF153	MIRF220	MIRF221	MIRF222
MIRF223	MIRF230	MIRF231	MIRF232	MIRF233
MIRF240	MIRF241	MIRF242	MIRF243	MIRF250
MIRF251	MIRF252	MIRF253	MIRF320	MIRF321
MIRF322	MIRF323	MIRF330	MIRF331	MIRF332
MIRF333	MIRF340	MIRF341	MIRF342	MIRF343
MIRF350	MIRF351	MIRF352	MIRF353	MIRF420
MIRF421	MIRF422	MIRF423	MIRF430	MIRF431
MIRF432	MIRF433	MIRF440	MIRF441	MIRF442
MIRF443	MIRF450	MIRF451	MIRF452	MIRF453

MIRF510	MIRF511	MIRF512	MIRF513	MIRF520
MIRF521	MIRF522	MIRF523	MIRF530	MIRF531
MIRF532	MIRF533	MIRF540	MIRF541	MIRF542
MIRF543	MIRF610	MIRF611	MIRF612	MIRF613
MIRF620	MIRF621	MIRF622	MIRF623	MIRF630
MIRF631	MIRF632	MIRF633	MIRF640	MIRF641
MIRF642	MIRF643	MIRF710	MIRF711	MIRF712
MIRF713	MIRF720	MIRF721	MIRF722	MIRF723
MIRF730	MIRF731	MIRF732	MIRF733	MIRF740
MIRF741	MIRF742	MIRF743	MIRF810	MIRF811
MIRF812	MIRF813	MIRF820	MIRF821	MIRF822
MIRF823	MIRF830	MIRF831	MIRF832	MIRF833
MIRF840	MIRF841	MIRF842	MIRF843	MIRF9020
MIRFF110	MIRFF111	MIRFF112	MIRFF113	MIRFF120
MIRFF121	MIRFF122	MIRFF123	MIRFF130	MIRFF131
MIRFF132	MIRFF133	MIRFF210	MIRFF211	MIRFF212
MIRFF213	MIRFF220	MIRFF221	MIRFF222	MIRFF223
MIRFF230	MIRFF231	MIRFF232	MIRFF233	MIRFF310
MIRFF311	MIRFF312	MIRFF313	MIRFF320	MIRFF321
MIRFF322	MIRFF323	MIRFF330	MIRFF331	MIRFF332
MIRFF333	MIRFF430	MIRFF431	MIRFF432	MIRFF433

Linear Technology Device Models

Search path: *$installdir/parts/lin_tech*

Model names:

113090	LF155	LF155A	LF156	LF156A
LF355	LF355A	LF356	LF356A	LF412
LF412A	LM101A	LM107	LM108	LM108A
LM10C	LM118	LM301A	LM307	LM308
LM308A	LM318	LT1001	LT1001A	LT1006
LT1006A	LT1006S8	LT1007	LT1007A	LT1008
LT1012	LT1012A	LT1012D	LT1012S8	LT1013
LT1013A	LT1013D	LT1022	LT1022A	LT1028

113090	LF155	LF155A	LF156	LF156A
LT1028A	LT1037	LT1037A	LT1055	LT1055A
LT1055S8	LT1056	LT1056A	LT1056S8	LT1057
LT1057A	LT1057S	LT1078	LT1078A	LT1097
LT1101	LT1115	LT1122	LT1178	LT1178A
LT118A	LT1220	LTC1049	LTC1050	LTC1050A
LTC1051	LTC1052	LTC1150	OP05	OP05A
OP05C	OP05E	OP07	OP07A	OP07C
OP07E	OP15A	OP15B	OP15C	OP16A
OP16B	OP16C	OP215A	OP215C	OP27A
OP27C	OP37A	OP37C	OP97	

Intel PCI Speedway Models

Search path: *$installdir/parts/pci*

Model names:

PCI_II_B	PCI_II_T	PCI_II_W	PCI_IN_W	PCI_II_B

Signetics Device Models

Search path: *$installdir/parts/signet*

Model names:

AC109EQ	AC240EQ	AC833OD	AC86EQ	ACTINPUT
CL10X10	CL30X10	DIP14	DIP16	DIP20
DIP24	DIP28	DIP8	DIP80001	SO16
SO20	SO24	SO28	SO8	

Texas Instruments Device Models

Search path: *$installdir/parts/ti*

Model names:

ICL7652	LF347	LF351	LF353	LF411C
LF412C	LM101A	LM107	LM301A	LM307
LM308	LM318	LM324	LM348	LM358
LT1001	LT1008	LT1012	LT1013	LT1028
LT1037	LTC1052	MC1458	MC3403	NE5534
OP-07C	OP-07D	OP-07E	OP-27C	OP-27E
OP-27G	OP-37A	RC4136	RC4558	RC4559
TL022C	TL031	TL032	TL034	TL044C
TL051	TL052	TL054	TL060	TL061
TL062	TL064	TL066	TL070	TL071
TL072	TL074	TL075	TL080	TL081
TL082	TL083	TL084	TL085	TL087
TL088	TL136	TL287	TL288	TL321
TL322	TLC1078	TLC1079	TLC2201	TLC251H
TLC251L	TLC251M	TLC252C	TLC254C	TLC25L2C
TLC25L4C	TLC25M2C	TLC25M4C	TLC2652	TLC2654
TLC271H	TLC271L	TLC271M	TLC272	TLC274
TLC277	TLC279	TLC27L2	TLC27L4	TLC27L7
TLC27L9	TLC27M2	TLC27M4	TLC27M7	TLC27M9
TLE2021	TLE2022	TLE2024	TLE2061	TLE2062
TLE2064	TLE2161	UA741	UA747	UA748

Transmission Line Models

Search path: *$installdir/parts/tline*

Model names:

RCFILT	RG11_U	RG11A_U	RG15_U	RG180B_U
RG188A_U	RG53_U	RG54A_U	RG58A_U	RG58C_U
RG59B_U	RG62_U	RG62B_U	RG71_U	RG71B_U
RG9_U	RG9B_U	TW_SH_U	TW_UN_U	

Xilinx Device Models

Search path: *$installdir/parts/xilinx*

Model names:

FOUTPUT	OUTPUT	XC7236A	XC7272A	XC7336A
XIL_IOB	XIL_IOB4			