AND8009/D

ECLinPS Plus™ SPICE Modeling Kit

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APPLICATION NOTE

Objective

The objective of this kit is to provide customers with enough circuit schematic and SPICE parameter information to allow them to perform system level interconnect modeling for the current devices of the ECLinPS Plus logic line, ON Semiconductor's high performance ECL family. **The kit is not intended to provide information necessary to perform circuit level modeling on ECLinPS Plus devices.** With packaged gate delays of 160 ps and output edge rates as low as 80 ps, this family defines the state−of−the−artin ECL logic. The ECLinPS Plus line is one of ON Semiconductor's high performance ECL/PECL family of products.

Schematic Information

The kit contains representative input and output schematics, netlists, and waveform used for the ECLinPS Plus devices. This application note will be modified as new devices are added. The subcircuit models such as the input or output buffer, package, input ESD and output ESD may be interconnected as subcircuits to simulate specific device characteristics as shown in Figure 1 below. The block diagram in Figure 2 illustrates a typical situation which can be modeled using the information in this kit.

Subcircuit Interconnects for Input Pins

Subcircuit Interconnects for Output Pins
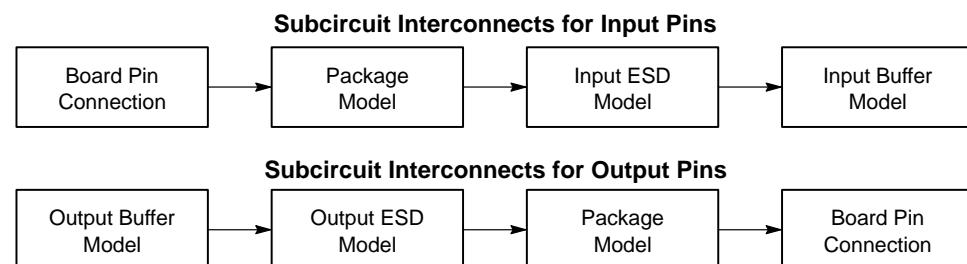
**Figure 1. Input and Output Pins Interconnects**
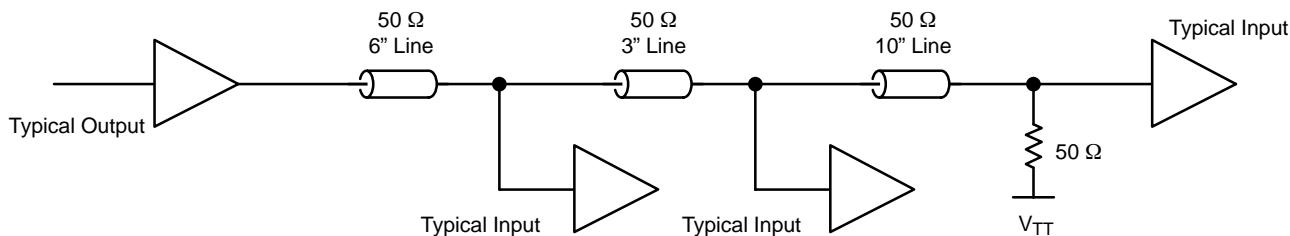
Figure 2. Typical Application for I/O SPICE Modeling Kit

There are four terminals on all transistor models: Emitter, Base, Collector, and Substrate (biased to V_{EE}). It should be noted that circuits can be used single ended by replacing INB with V_{BB}. Table 1 describes the nomenclature used in the schematics and netlists.

To simulate a different operating modes all levels, except V_{CS}, are adjusted with respect to V_{CC}. The V_{CS} is adjusted with respect to V_{EE} ($\approx V_{EE} + 1.1$ V $\pm$ 50 mV)

Table 1. Schematics and Netlist Nomenclature

Parameter	Function Description
V_{CC}	3.3 V FOR LVPECL OR (0 V) FOR LVECL
V_{CCO}	1.6 V – 2.0 V HSTL Output Positive Supply
V_{CS}	Internal Reference Voltage ($\approx$ VEE + 1.1 V $\pm$ 50 mV)
V_{HSTL}	HSTL Internal Constant Voltage Source
V_{EE}	–3.3 V FOR LVECL OR (0 V) FOR LVPECL
GND	0 V
V_{TT}	V_{CC} – 2 V TERMINATION PLANE
IN	TRUE INPUT TO CKT
INB or $\overline{IN}$	INVERTED INPUT TO CKT
Q	TRUE OUTPUT OF CKT
QB or $\overline{Q}$	INVERTED OUTPUT OF CKT

Input Buffer

The Typical Input Buffer schematic (see Table 2) and netlist are representing structure currently in use on the existing devices in this family. The schematics require the addition of ESD models (Figure 15) and package models (see Table 3) to more accurate model behavior. The internal input pulldown resistor is shown in the ESD network, Figure 15. Some devices may also display an internal pullup resistor to V_{CC}. Refer to specific device data sheet pinout and logic diagram. It is unnecessary to include an ESD or package model for the V_{BB} pins of the models because V_{BB} is intended as an internal node for most applications. If V_{BB} is modeled as an external node it is usually bypassed because it is a constant voltage, and adding ESD and Package parameters provide no additional benefit.

Output Buffer

The output buffer schematics (see Table 2) and netlists may contain the temperature compensation structure, so only the ESD and package models need to be added. Any input or output that is driving or being driven by an off chip signal should include the ESD and package models. The output buffers show differential inputs and outputs. When simulating a single ended output, the termination or load resistor, package model, ESD structure and output emitter follower, of the unused output, should not be eliminated to simplify the system model. The output buffer listing can be seen in Table 2.

Table 2. Buffer Model Figures

Buffer Model	Figure Number	Page Number
TYPICAL INBUF	3	6
OBUF01	4	7
OBUF02	5	8
OBUF03	6	9
OBUF04	7	10
OBUF05	8	11
OBUF06	9	12
OBUF07	10	13
OBUF08	11	14
OBUF09	12	15
OBUF10	13	16
OBUF11	14	17

Package

A case model for various package types is included to improve the accuracy of the system model (see Table 3). The .package model represents the parasitics as they are measured on a pin. The package pin model should be placed on each device input pin connecting to an input model, all device output pins connecting to an output model, V_{CC}, and V_{EE}. A model can be used at the V_{EE} pin: but is not necessary since the current in the V_{EE} pin is a constant. Explanations of the Package Model modes can be found in Appendix A.

Table 3. Available Packages

Package Model	Page Number
8–Lead SO	22
8–Lead TSSOP	24
20–Lead SO	26
20–Lead TSSOP	32
24–Lead QFN	37
32–Lead TQFP	43
52–Lead LQFP	51
64–Lead LQFP	58

EP16 Buffer Model

The EP16 interconnect has been completely modeled to provide a working schematic and output waveforms as examples of the ECLinPS Plus line. The typical input buffer may be driven with the output buffer, OBUF01. (See Figure 17, simplified EP16 SPICE model and Figure 18 typical output waveform.)

SPICE Netlists

The netlists are organized as a group of subcircuits. In each subcircuit model netlist, the model name is followed by a list of external node interconnects.

Temperature Compensation Network for 100EP

The output netlists include temperature compensation network circuitry for 100EP style output buffers. The circuit components of the temperature compensation networks are shown in Figure 18. For simulating 10EP style outputs these components should either be deleted or commented out of the subcircuit netlists. Subcircuit models such as the Input or Output Buffer, Package, Input ESD and Output ESD should connect to supplies through hierarchical, passed parameters such as V_{CC}, V_{EE}, etc., for proper simulation and not separately attached to independent power supplies.

SPICE Parameter Information

In addition to the schematics and netlists is a listing of the SPICE parameters for the transistors referenced in the schematics and netlists. These parameters represent a typical device of a given transistor. Varying the typical parameters will affect the DC and AC performance of the structures; but for the type of modeling intended by this note, the actual delay times are not necessary and are not modeled, as a result variation of the device parameters are meaningless. The performance levels are more easily varied by other methods and will be discussed in the next section. The resistors referenced in the schematics are polysilicon and have no parasitic capacitance in the real circuit and none is required in the model. The schematics display the only devices needed in the SPICE netlists.

Modeling Information

The bias drivers for the devices are not detailed since their circuitry would result in a substantial increase of model complexity and simulation time. Instead, these internal reference voltages (V_{BB}, V_{CS}, V_{HSTL}, etc.) should be driven with ideal constant voltage sources.

The schematics and SPICE parameters will provide a typical output waveshape, which can be seen in Figures 18, 19, and 20. Simple adjustments can be made to the models allowing output characteristics to simulate conditions at or near the corners of the data book specifications. Consistent cross−point voltages need to be maintained.

- To adjust rise and fall times:

  Produce the desired rise and fall times output slew rates by adjusting collector load resistors to change the gates tail current. The V_{CS} voltage will affect the tail current in the output differential, which will interact with the load resistor and collector resistor to determine t_r and t_f at the output.

- To adjust the V_{OH}:

  Adjust the V_{OH} and V_{OL} level by the same amount by varying V_{CC}. The output levels will follow changes in V_{CC} at a 1:1 ratio.

- To adjust the V_{OL} only:

  Adjust the V_{OL} level independently of the V_{OH} level by increasing or decreasing the collector load resistance. Note that the VOH level will also change slightly due to a $I_{BASE}R$ drop across the collector load resistor. V_{OL} can be changed by varying the VCS supply, and therefore the gate current through the current source resistor.

Summary

The information included in this kit provides adequate information to run a SPICE level system interconnect simulation. Device input or output models are presented in Table 4. For EP and LVEP series devices not listed in Table 4, consult www.onsemi.com (Tech Support).

Table 4. ECLinPS Plus Input/Output Selection Table

Device	Package A	Package B	Input ESD	Input Buffer	Output Buffer	Output ESD
EP01	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP05	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP08	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP11	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP14	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
EP16	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP17	20–lead SO	20–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF06	OUT_ESD
EP29	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
EP31	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP32	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP33	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF02	OUT_ESD
EP35	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP40	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF09	OUT_ESD
EP51	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP52	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP56	20–lead SO	20–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP57	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP58	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
EP89	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF05	OUT_ESD
EP90	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP016	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF02	OUT_ESD
EP016A	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF02	OUT_ESD
EP101	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF06	OUT_ESD
EP105	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF06	OUT_ESD
EP116	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF06	OUT_ESD
EP131	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF02	OUT_ESD
EP139	20–lead SO	20–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF07	OUT_ESD
EP140	8–lead SO	N/A	IN_ESD	TYPICAL INBUF	OBUF09	OUT_ESD
EP142	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
EP195	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP196	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP210S	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF10	OUT_ESD
EP223	64–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF11	OUT_ESD
EP445	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
EP446	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF04	OUT_ESD
EP451	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
EP809	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF11	OUT_ESD

Table 4. ECLinPS Plus Input/Output Selection Table (continued)

LVEP11	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF08	OUT_ESD
LVEP14	20–lead TSSOP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP16	8–lead SO	8–lead TSSOP	IN_ESD	TYPICAL INBUF	OBUF08	OUT_ESD
LVEP17	20–lead TSSOP	24–lead QFN	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP34	16–lead SO*	16–lead TSSOP*	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP56	20–lead TSSOP	24–lead QFN	IN_ESD	TYPICAL INBUF	OBUF01	OUT_ESD
LVEP111	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP210	32–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP221	52–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP222	52–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD
LVEP224	64–lead LQFP	N/A	IN_ESD	TYPICAL INBUF	OBUF03	OUT_ESD

*For package model, please consult manufacturer at www.onsemi.com (Tech Support).

Netlists and Schematics
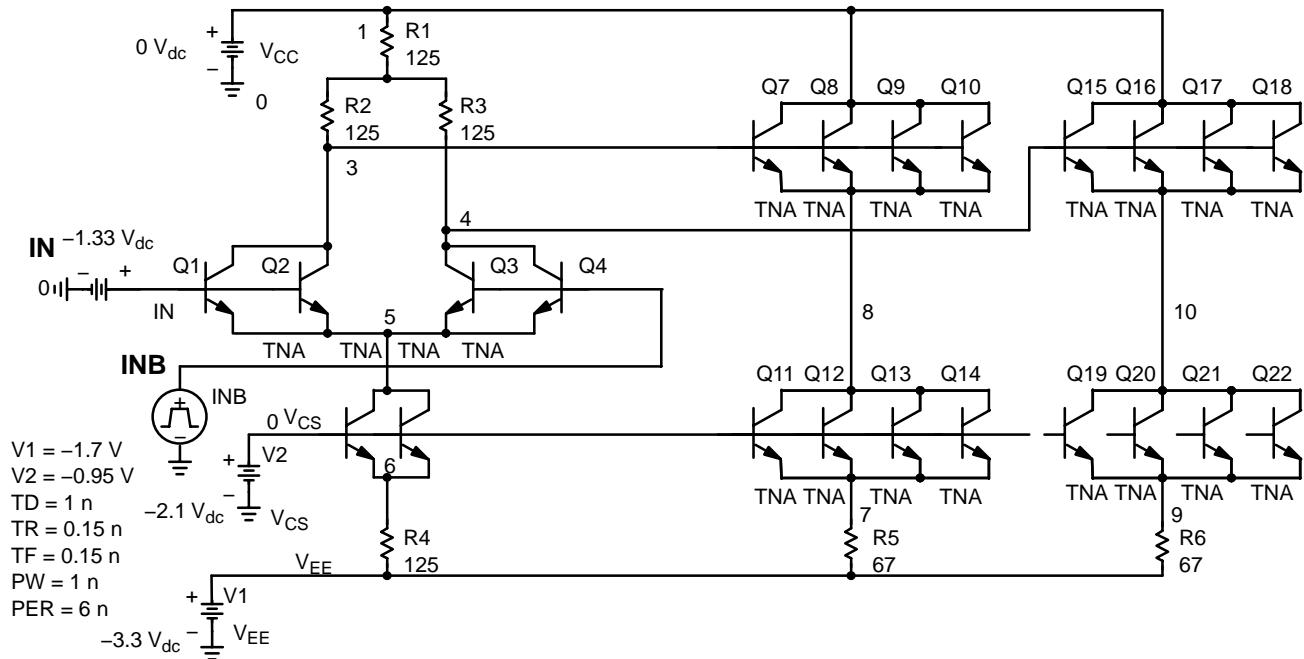

Figure 3. Typical INBUF

```
.SUBCKT TYPICAL INBUF IN INB VCS VEE
Q_Q1        3 IN 5 TNA
Q_Q2        3 IN 5 TNA
Q_Q3        4 INB 5 TNA
Q_Q4        4 INB 5 TNA
Q_Q5        5 VCS 6 TNA
Q_Q6        5 VCS 6 TNA
Q_Q7        1 3 8 TNA
Q_Q8        1 3 8 TNA
Q_Q9        1 3 8 TNA
Q_Q10       1 3 8 TNA
Q_Q11       8 VCS 7 TNA
Q_Q12       8 VCS 7 TNA
Q_Q13       8 VCS 7 TNA
Q_Q14       8 VCS 7 TNA
Q_Q15       1 4 10 TNA
Q_Q16       1 4 10 TNA
Q_Q17       1 4 10 TNA
Q_Q18       1 4 10 TNA
Q_Q19       10 VCS 9 TNA
Q_Q20       10 VCS 9 TNA
Q_Q21       10 VCS 9 TNA
Q_Q22       10 VCS 9 TNA
R_R1        2 1  125
R_R2        3 2  125
R_R3        4 2  125
R_R4        VEE 6  125
R_R5        VEE 7  67
R_R6        VEE 9  67
V_V1        VEE 0 -3.3Vdc
V_V2        VCS 0 -2.1Vdc
V_IN        IN 0 -1.33Vdc
V_VCC       1 0 0Vdc
V_INB       INB 0
+PULSE -1.7V -0.95V 1n 0.15n 0.15n 1n 6n
.END TYPICAL INBUF
```
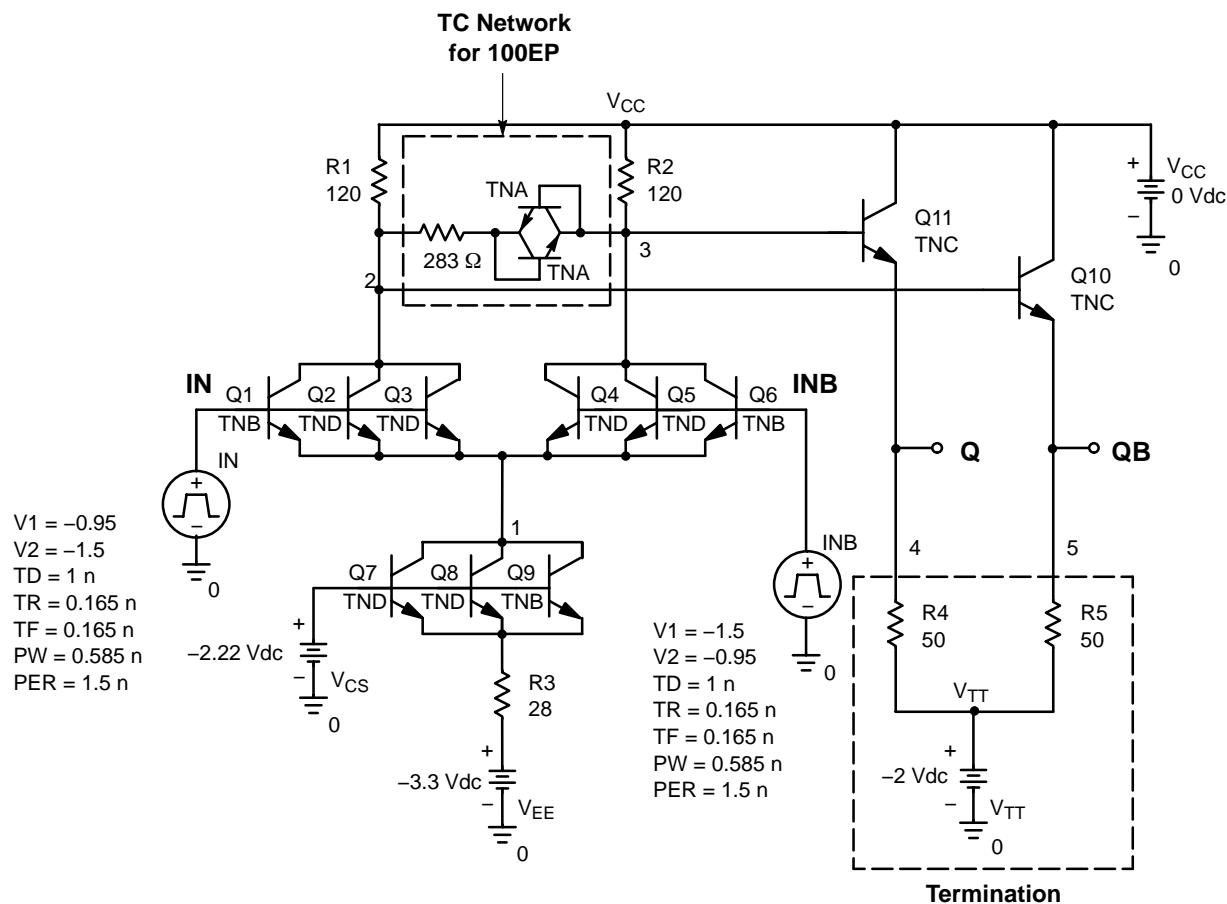
Figure 4. OBUF01

```
.SUBCKT OBUF01 IN INB VCS VCC VEE VTT
Q_Q1      2 IN 1 TNB
Q_Q2      2 IN 1 TND
Q_Q3      2 IN 1 TND
Q_Q4      3 INB 1 TND
Q_Q5      3 INB 1 TND
Q_Q6      3 INB 1 TNB
Q_Q7      1 VCS 10 TND
Q_Q8      1 VCS 10 TND
Q_Q9      1 VCS 10 TNB
Q_Q10     VCC 2 5 TNC
Q_Q11     VCC 3 4 TNC
R_R1      2 VCC  120
R_R2      3 VCC  120
R_R3      VEE 10  28
R_R4      VTT 4  50
R_R5      VTT 5  50
V_IN      IN 0
+PULSE -0.95 -1.5 1n 0.165n 0.165n 0.585n 1.5n
V_INB     INB 0
+PULSE -1.5 -0.95 1n 0.165n 0.165n 0.585n 1.5n
V_VCC     VCC 0 0Vdc
V_VEE     VEE 0 -3.3Vdc
V_VTT     VTT 0 -2Vdc
V_VCS     VCS 0 -2.22Vdc
.END OBUF01
```
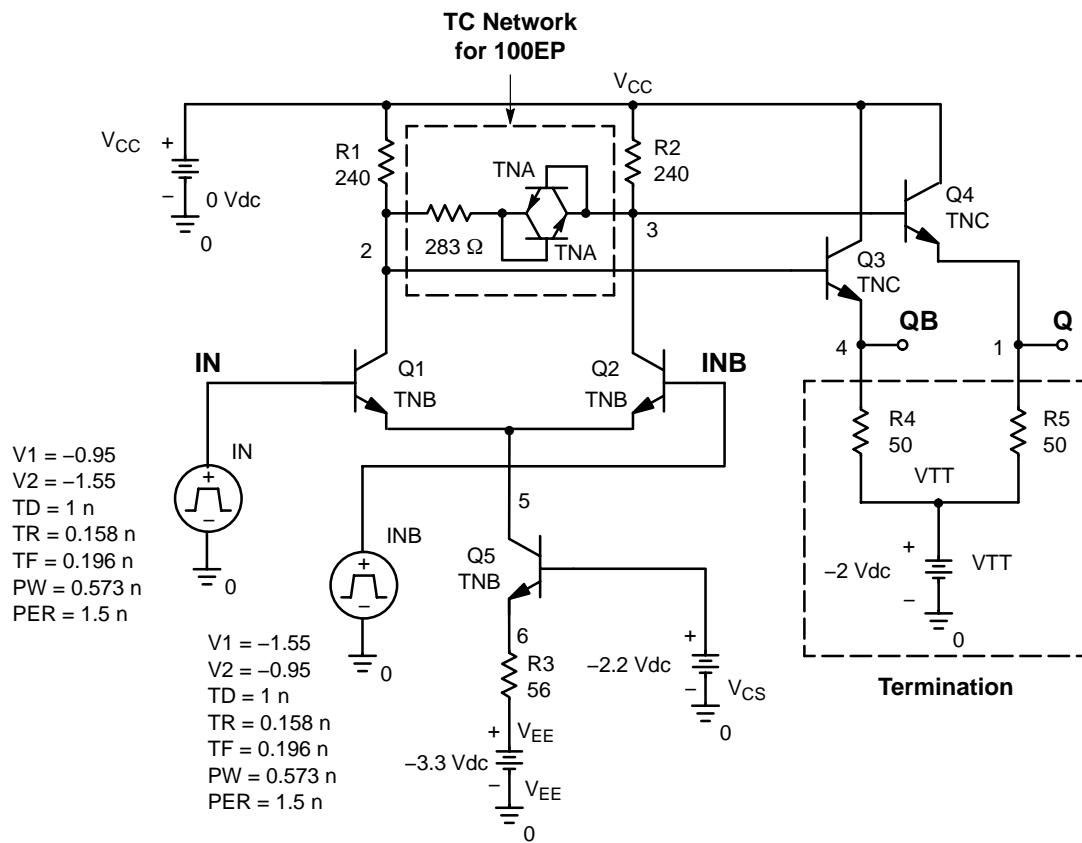
Figure 5. OBUF02

```
.SUBCKT OBUF02 IN INB VCC VCS VEE VTT
Q_Q1        2 IN 5 TNB
Q_Q2        3 INB 5 TNB
Q_Q3        VCC 2 4 TNC
Q_Q4        VCC 3 1 TNC
Q_Q5        5 VCS 6 TNB
R_R1        2 VCC  240
R_R2        3 VCC  240
R_R3        VEE 6  56
R_R4        VTT 4  50
R_R5        VTT 1  50
V_IN        IN 0
+PULSE −0.95 −1.55 1n 0.158n 0.196n 0.573n 1.5n
V_INB       INB 0
+PULSE −1.55 −0.95 1n 0.158n 0.196n 0.573n 1.5n
V_VCC       VCC 0 0Vdc
V_VEE       VEE 0 −3.3Vdc
V_VTT       VTT 0 −2Vdc
V_VCS       VCS 0 −2.2Vdc
.END OBUF02
```

**TC Network
for 100EP**
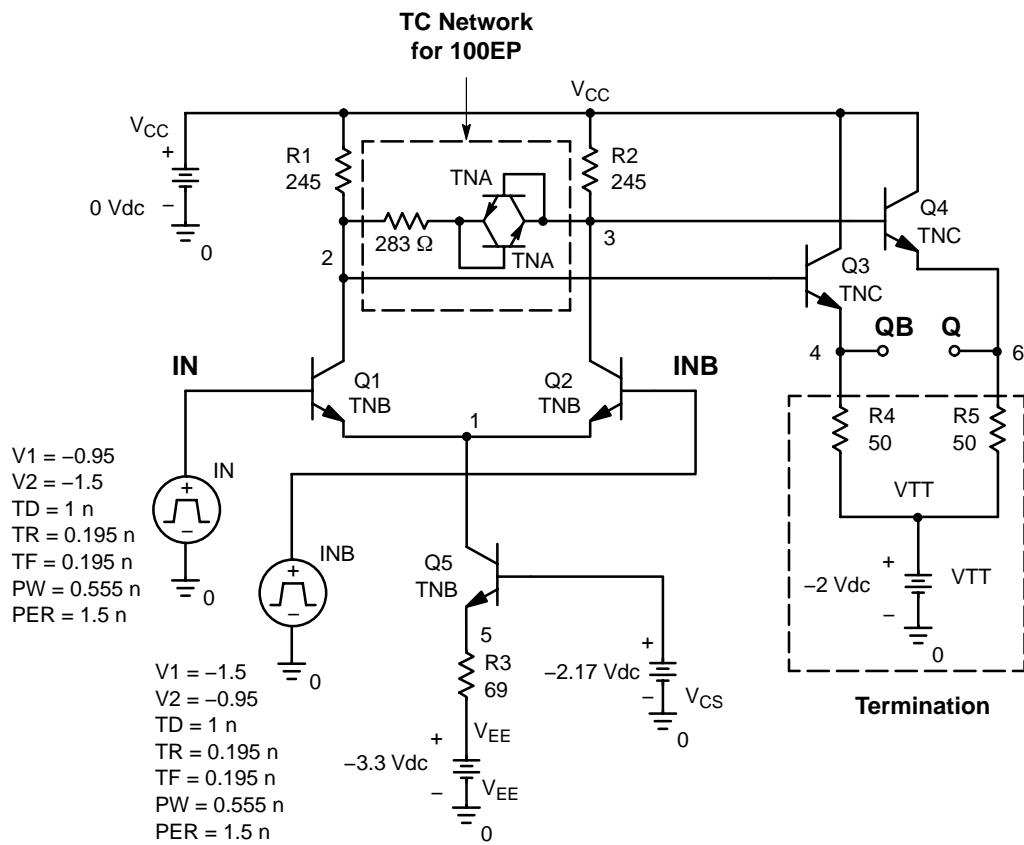

Figure 6. OBUF03

```
.SUBCKT OBUF03 IN INB VCC VCS VEE VTT
Q_Q1        2 IN 1 TNB
Q_Q2        3 INB 1 TNB
Q_Q3        VCC 2 4 TNC
Q_Q4        VCC 3 6 TNC
Q_Q5        1 VCS 5 TNB
R_R1        2 VCC   245
R_R2        3 VCC   245
R_R3        VEE 5  69
R_R4        VTT 4  50
R_R5        VTT 6  50
V_IN        IN 0
+PULSE −0.95 −1.5 1n 0.195n 0.195n 0.555n 1.5n
V_INB       INB 0
+PULSE −1.5 −0.95 1n 0.195n 0.195n 0.555n 1.5n
V_VCC       VCC 0 0Vdc
V_VEE       VEE 0 −3.3Vdc
V_VTT       VTT 0 −2Vdc
V_VCS       VCS 0 −2.17Vdc
.END OBUF03
```
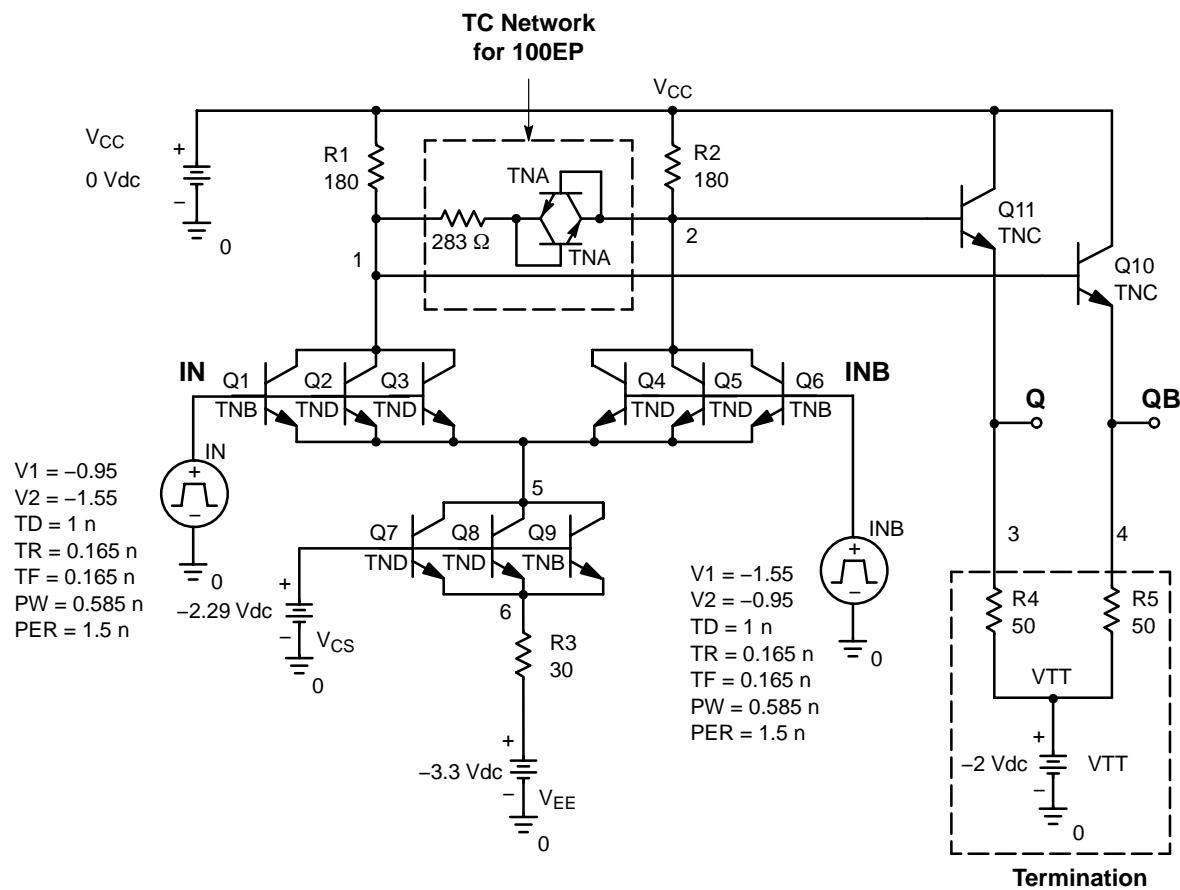
Figure 7. OBUF04

```
.SUBCKT OBUF04 IN INB VCS VCC VEE VTT
Q_Q1      1 IN 5 TNB
Q_Q2      1 IN 5 TND
Q_Q3      1 IN 5 TND
Q_Q4      2 INB 5 TND
Q_Q5      2 INB 5 TND
Q_Q6      2 INB 5 TNB
Q_Q7      5 VCS 6 TND
Q_Q8      5 VCS 6 TND
Q_Q9      5 VCS 6 TNB
Q_Q10     VCC 1 4 TNC
Q_Q11     VCC 2 3 TNC
R_R1      1 VCC  180
R_R2      2 VCC  180
R_R3      VEE 6  20
R_R4      VTT 3  50
R_R5      VTT 4  50
V_IN      IN 0
+PULSE -0.95 -1.55 1n 0.165n 0.165n 0.585n 1.5n
V_INB     INB 0
+PULSE -1.55 -0.95 1n 0.165n 0.165n 0.585n 1.5n
V_VCC     VCC 0 0Vdc
V_VEE     VEE 0 -3.3Vdc
V_VTT     VTT 0 -2Vdc
V_VCS     VCS 0 -2.29Vdc
.END OBUF04
```

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for 100EP**
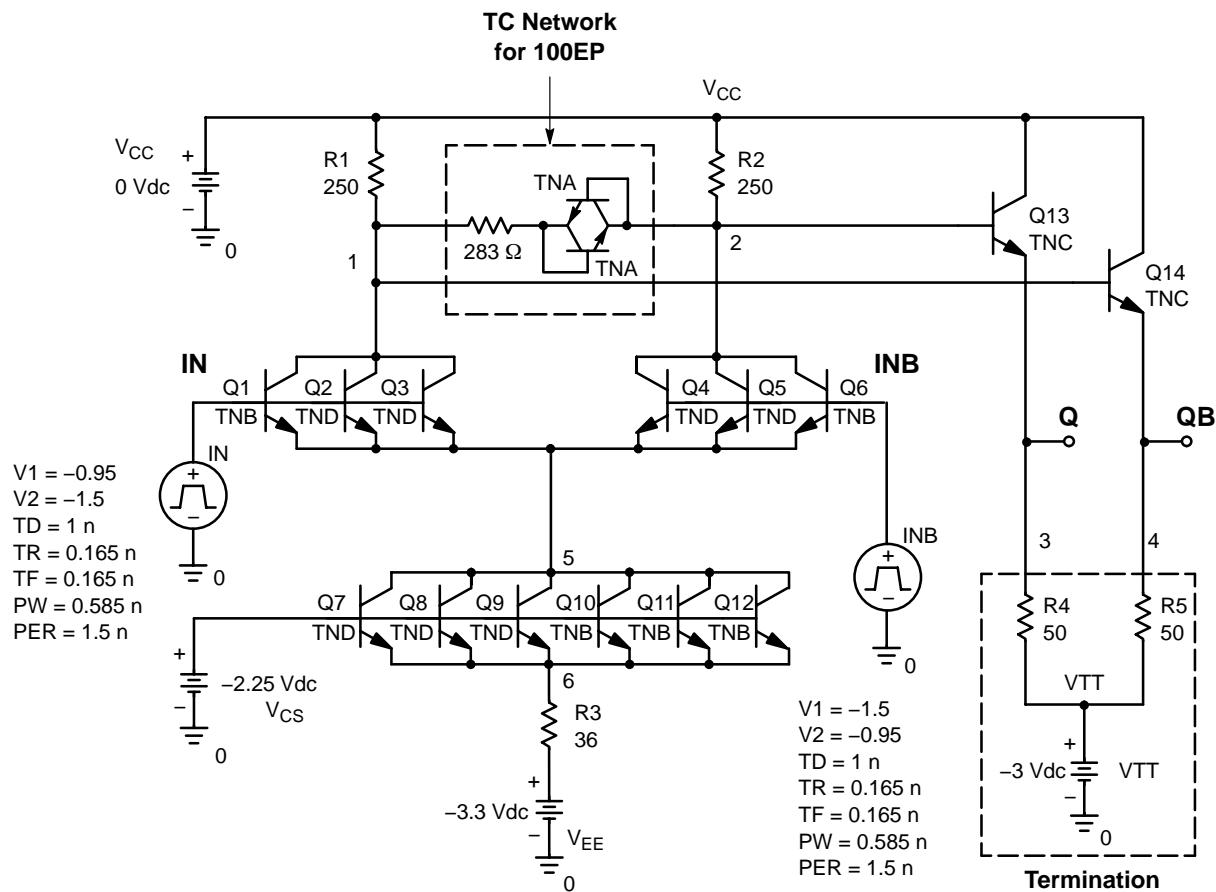
Figure 8. OBUF05

```
.SUBCKT OBUF05 IN INB VCS VCC VTT VEE
Q_Q1      1 IN 5 TNB
Q_Q2      1 IN 5 TND
Q_Q3      1 IN 5 TND
Q_Q4      2 INB 5 TND
Q_Q5      2 INB 5 TND
Q_Q6      2 INB 5 TNB
Q_Q7      5 VCS 6 TND
Q_Q8      5 VCS 6 TND
Q_Q9      5 VCS 6 TND
Q_Q10     5 VCS 6 TNB
Q_Q11     5 VCS 6 TNB
Q_Q12     5 VCS 6 TNB
Q_Q13     VCC 2 3 TNC
Q_Q14     VCC 1 4 TNC
R_R1      1 VCC 285
R_R2      2 VCC 285
R_R3      VEE 6 38
R_R4      VTT 3 50
R_R5      VTT 4 50
V_IN      IN 0 −1.33Vdc
+PULSE −0.95 −1.5 1n 0.165n 0.165n 0.585n 1.5n
V_INB     INB 0
+PULSE −1.5 −0.95 1n 0.165n 0.165n 0.585n 1.5n
V_VEE     VEE 0 −3.3Vdc
V_VCC     VCC 0 0Vdc
V_VTT     VTT 0 −3Vdc
V_VCS     VCS 0 −2.25Vdc
.END OBUF05
```

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for 100EP**
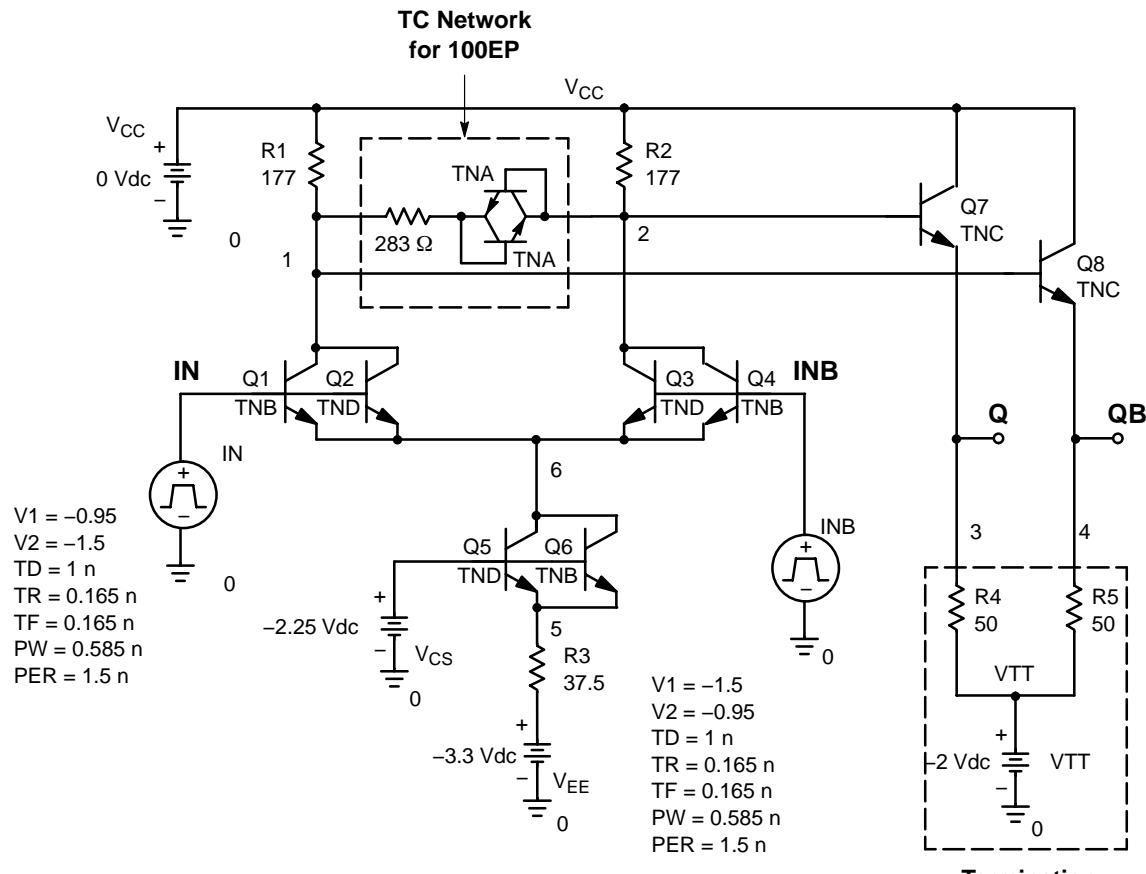
**Figure 9. OBUF06**

```
.SUBCKT OBUF06 IN INB VCC VCS VEE VTT
Q_Q1        1 IN 6 TNB
Q_Q2        1 IN 6 TND
Q_Q3        2 INB 6 TND
Q_Q4        2 INB 6 TNB
Q_Q5        6 VCS 5 TND
Q_Q6        6 VCS 5 TNB
Q_Q7        VCC 2 3 TNC
Q_Q8        VCC 1 4 TNC
R_R1        1 VCC  177
R_R2        2 VCC  177
R_R3        VEE 5  37.5
R_R4        VTT 3  50
R_R5        VTT 4  50
V_IN        IN 0
+PULSE −0.95 −1.5 1n 0.165n 0.165n 0.585n 1.5n
V_INB       INB 0
+PULSE −1.5 −0.95 1n 0.165n 0.165n 0.585n 1.5n
V_VEE       VEE 0 −3.3Vdc
V_VCC       VCC 0 0Vdc
V_VTT       VTT 0 −2Vdc
V_VCS       VCS 0 −2.25Vdc
.END OBUF06
```

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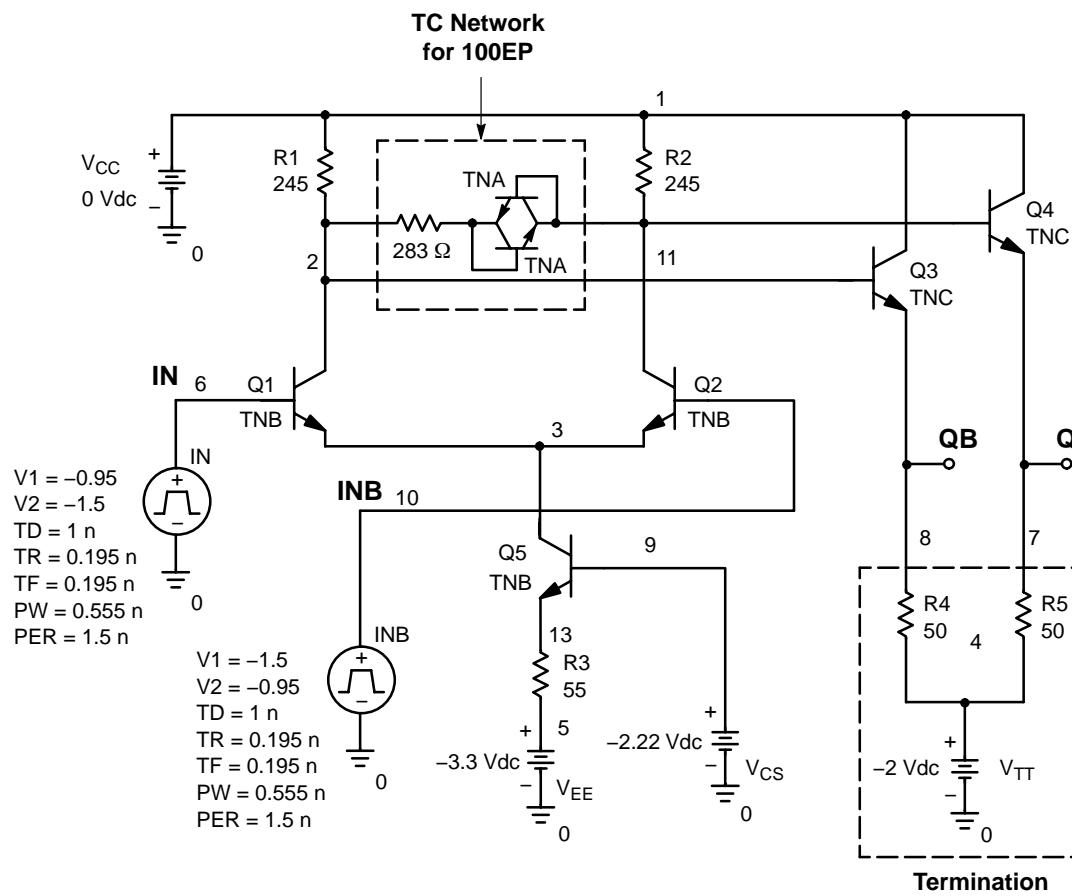
Figure 10. OBUF07

```
.SUBCKT OBUF07
Q_Q1        2 6 3 TNB
Q_Q2        11 10 3 TNB
Q_Q3        1 2 8 TNC
Q_Q4        1 11 7 TNC
Q_Q5        3 9 13 TNB
R_R1        2 1  245
R_R2        11 1  245
R_R3        5 13  55
R_R4        4 8   50
R_R5        4 7   50
V_IN        6 0
+PULSE −0.95 −1.5 1n 0.195n 0.195n 0.555n 1.5n
V_INB       10 0
+PULSE −1.5 −0.95 1n 0.195n 0.195n 0.555n 1.5n
V_VEE       5 0 −3.3Vdc
V_VCC       1 0 0Vdc
V_VTT       4 0 −2Vdc
V_VCS       9 0 −2.22Vdc
.END OBUF07
```

**TC Network
for 100EP**
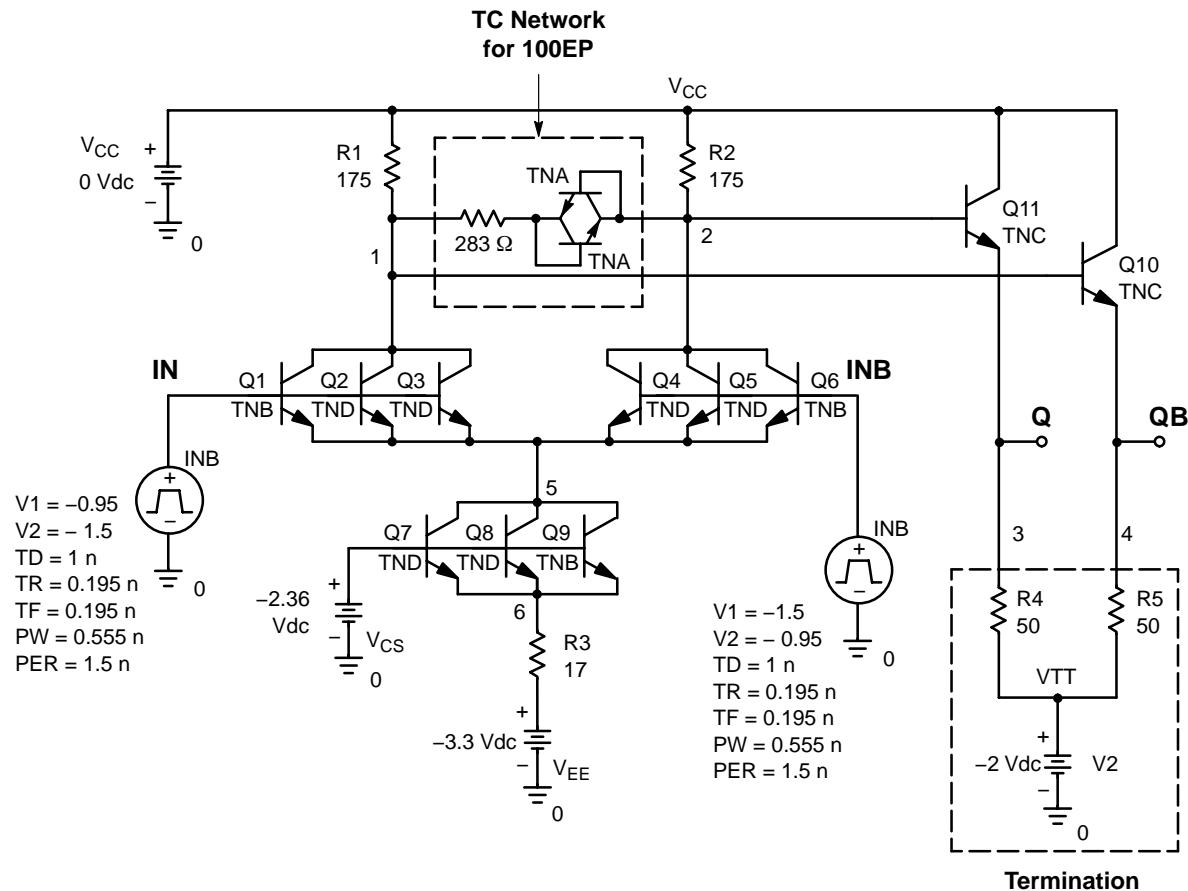
Figure 11. OBUF08

```
.SUBCKT OBUF08 IN INB VCC VCS VEE VTT
Q_Q1      1 IN 5 TNB
Q_Q2      1 IN 5 TND
Q_Q3      1 IN 5 TND
Q_Q4      2 INB 5 TND
Q_Q5      2 INB 5 TND
Q_Q6      2 INB 5 TNB
Q_Q7      5 VCS 6 TND
Q_Q8      5 VCS 6 TND
Q_Q9      5 VCS 6 TNB
Q_Q10     VCC 1 4 TNC
Q_Q11     VCC 2 3 TNC
R_R1      1 VCC  175
R_R2      2 VCC  175
R_R3      VEE 6  17
R_R4      VTT 3  50
R_R5      VTT 4  50
V_INB     INB 0
+PULSE −1.5 −0.95 1n 0.195n 0.195n 0.555n 1.5n
V_IN      IN 0
+PULSE −0.95 −1.5 1n 0.195n 0.195n 0.555n 1.5n
V_VEE     VEE 0 −3.3Vdc
V_VTT     VTT 0 −2Vdc
V_VCS     VCS 0 −2.36Vdc
V_VCC     VCC 0 0Vdc
.END OBUF08
```

**TC Network
for 100EP**
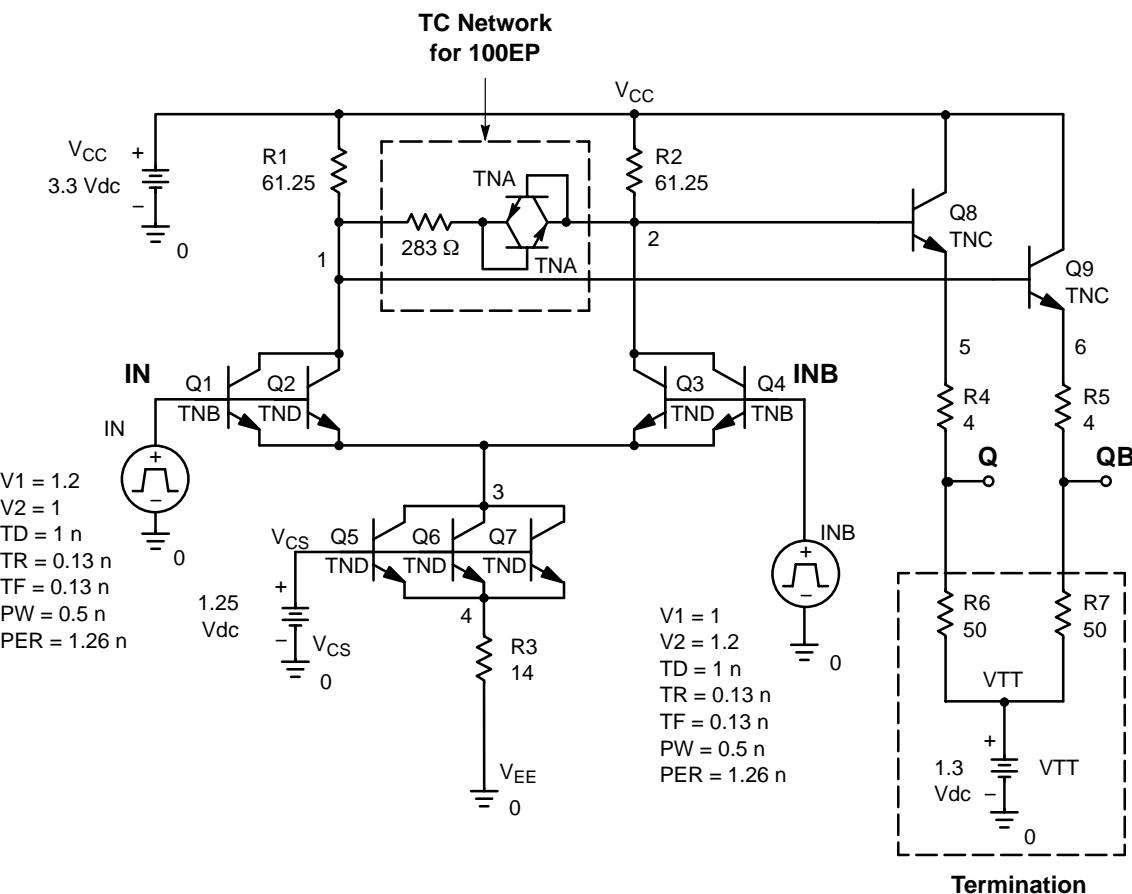
Figure 12. OBUF09

```
.SUBCKT OBUF09 IN INB VCC VCS VTT VEE Q QB
Q_Q1      1 IN 3 TNB
Q_Q2      1 IN 3 TND
Q_Q3      2 INB 3 TND
Q_Q4      2 INB 3 TNB
Q_Q5      3 VCS 4 TND
Q_Q6      3 VCS 4 TND
Q_Q7      3 VCS 4 TND
Q_Q8      VCC 2 5 TNC
Q_Q9      VCC 1 6 TNC
R_R1      1 VCC  61.25
R_R2      2 VCC  61.25
R_R3      VEE 4  14
R_R4      Q 5  4
R_R5      QB 6  4
R_R6      VTT Q  50
R_R7      VTT QB  50
V_INB     INB 0
+PULSE 1 1.2 1n 0.13n 0.13n 0.5n 1.26n
V_IN      IN 0
+PULSE 1.2 1 1n 0.13n 0.13n 0.5n 1.26n
V_VCS     VCS 0 1.25Vdc
V_VCC     VCC 0 3.3Vdc
V_VTT     VTT 0 1.3Vdc
.END OBUF09
```
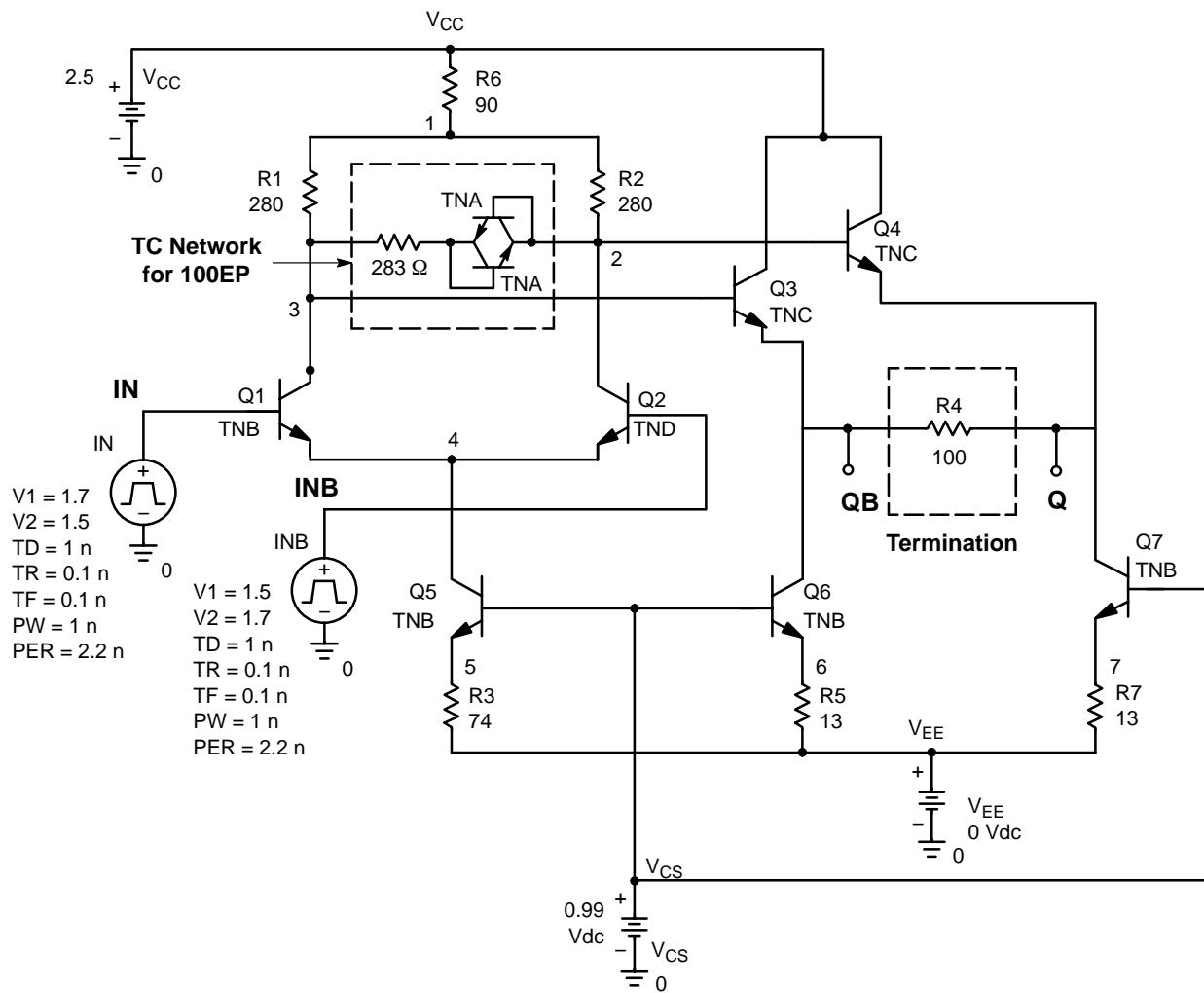
Figure 13. OBUF10

```
.SUBCKT OBUF10 IN INB VCC VCS VEE Q QB
Q_Q1      3 IN 4 TNB
Q_Q2      2 INB 4 TNB
Q_Q3      VCC 3 QB TNC
Q_Q4      VCC 2 Q TNC
Q_Q5      4 VCS 5 TNB
Q_Q6      QB VCS 6 TNB
Q_Q7      Q VCS 7 TNB
R_R1      3 1  295
R_R2      2 1  295
R_R3      VEE 5  64.3
R_R4      QB Q  100
R_R5      VEE 6  10
R_R6      1 VCC  61.25
R_R7      VEE 7  10
V_IN      IN 0
+PULSE 1.5 1.7 1n 0.1n 0.1n 1n 2.6n
V_INB     INB 0
+PULSE 1.7 1.5 1n 0.1n 0.1n 1n 2.6n
V_VCC     VCC 0 2.5
V_VEE     VEE 0 0Vdc
V_VCS     VCS 0 0.99Vdc
.END OBUF10
```
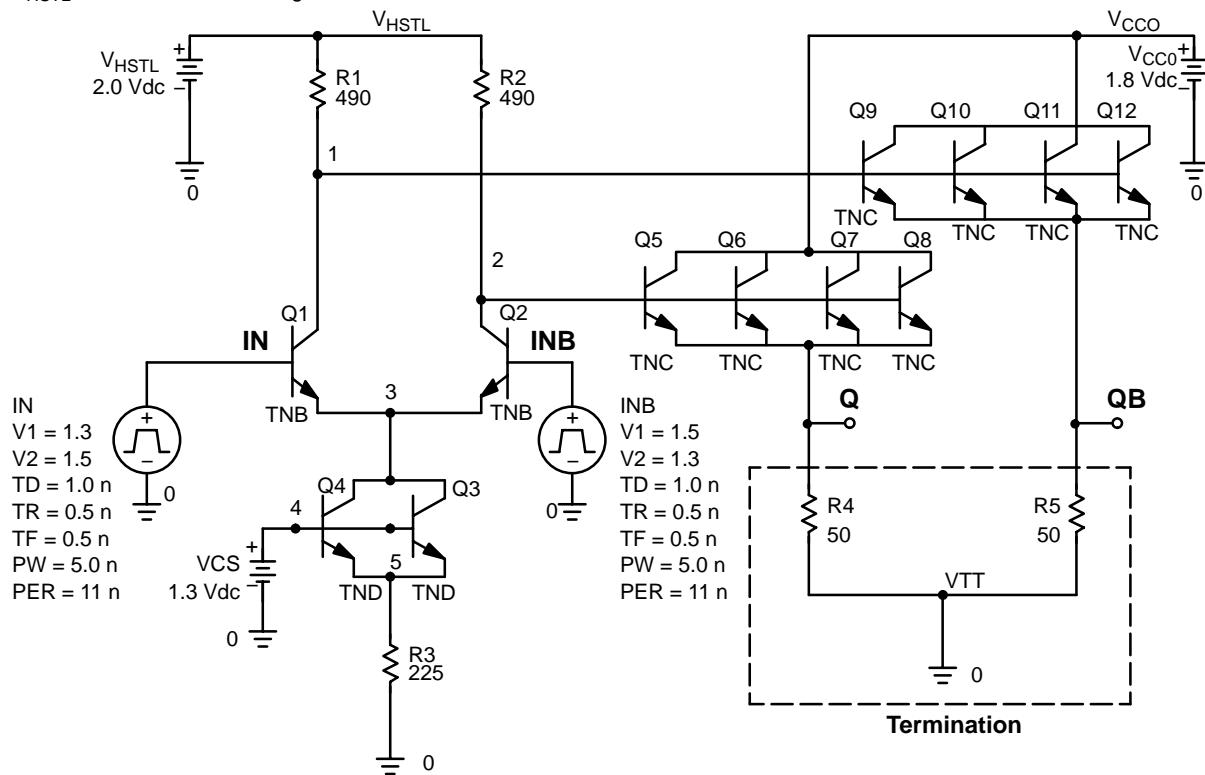
Figure 14. OBUF11

```
.SUBCKT OBUF11 IN INB VCCO VHSTL Q QB
Q_Q1        1 IN 3 TNB
Q_Q2        2 INB 3 TNB
Q_Q3        3 4 5 TND
Q_Q4        3 4 5 TND
Q_Q5        VCCO 2 Q TNC
Q_Q6        VCCO 2 Q TNC
Q_Q7        VCCO 2 Q TNC
Q_Q8        VCCO 2 Q TNC
Q_Q9        VCCO 1 QB TNC
Q_Q10       VCCO 1 QB TNC
Q_Q11       VCCO 1 QB TNC
Q_Q12       VCCO 1 QB TNC
R_R1        1 VHSTL  490
R_R2        2 VHSTL  490
R_R3        0 5  225
R_R4        0 Q  50
R_R5        0 QB  50
V_IN        IN 0
+PULSE 1.3 1.5 1n 0.5n 0.5n 5n 11n
V_INB       INB 0
+PULSE 1.5 1.3 1n 0.5n 0.5n 5n 11n
V_VCCO      VCCO 0 1.8Vdc
V_VHSTL     VHSTL 0 2.0Vdc
V_VCS       4 0 1.3Vdc
.END OBUF11
```
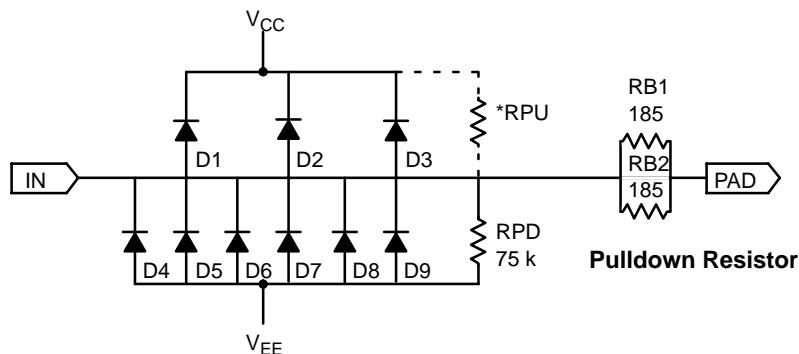
Figure 15. Input ESD

```
.SUBCKT  IN_ESD VCC VEE  IN PAD
D1        IN       VCC       ESDM
D2        IN       VCC       ESDM
D3        IN       VCC       ESDM
D4        VEE      IN        ESDM
D5        VEE      IN        ESDS
D6        VEE      IN        ESDM
D7        VEE      IN        ESDS
D8        VEE      IN        ESDM
D9        VEE      IN        ESDS
RPD       IN       VEE       75K
RPU       IN       VCC       36.5K
RB1       IN       PAD       185
RB2       IN       PAD       185
.ENDS IN_ESD
```
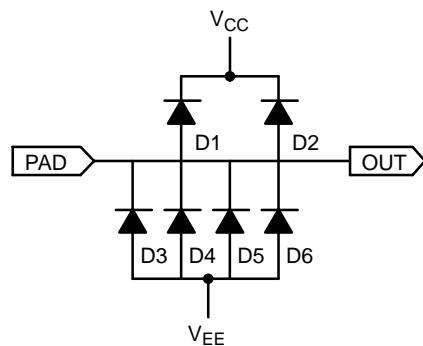

Figure 16. Output ESD

```
.SUBCKT  OUT_ESD VCC VEE  OUT
D1        OUT       VCC       ESDM
D2        OUT       VCC       ESDM
D3        VEE       OUT       ESDM
D4        VEE       OUT       ESDS
D5        VEE       OUT       ESDM
D6        VEE       OUT       ESDS
.ENDS OUT_ESD
```

The following is an example of a typical run–deck file which might be used to simulate Figure 17 to produce output waveform shown in Figure 18.

TYPICAL TEST CIRCUIT

```
VCC       VCC      0       0V
VEE       VEE      0       −3.3V
VCS       VCS      0       −2.2V
VTT       VTT      0       −2.0V
VIN       IN       0       PULSE(−1.7 −0.95 5NS 5NS 5NS 50NS 110NS)
VINB      INB      0       PULSE(−0.95 −1.7 5NS 5NS 5NS 50NS 110NS)
.GROUND 0
.TRAN  0.2NS   120NS
```
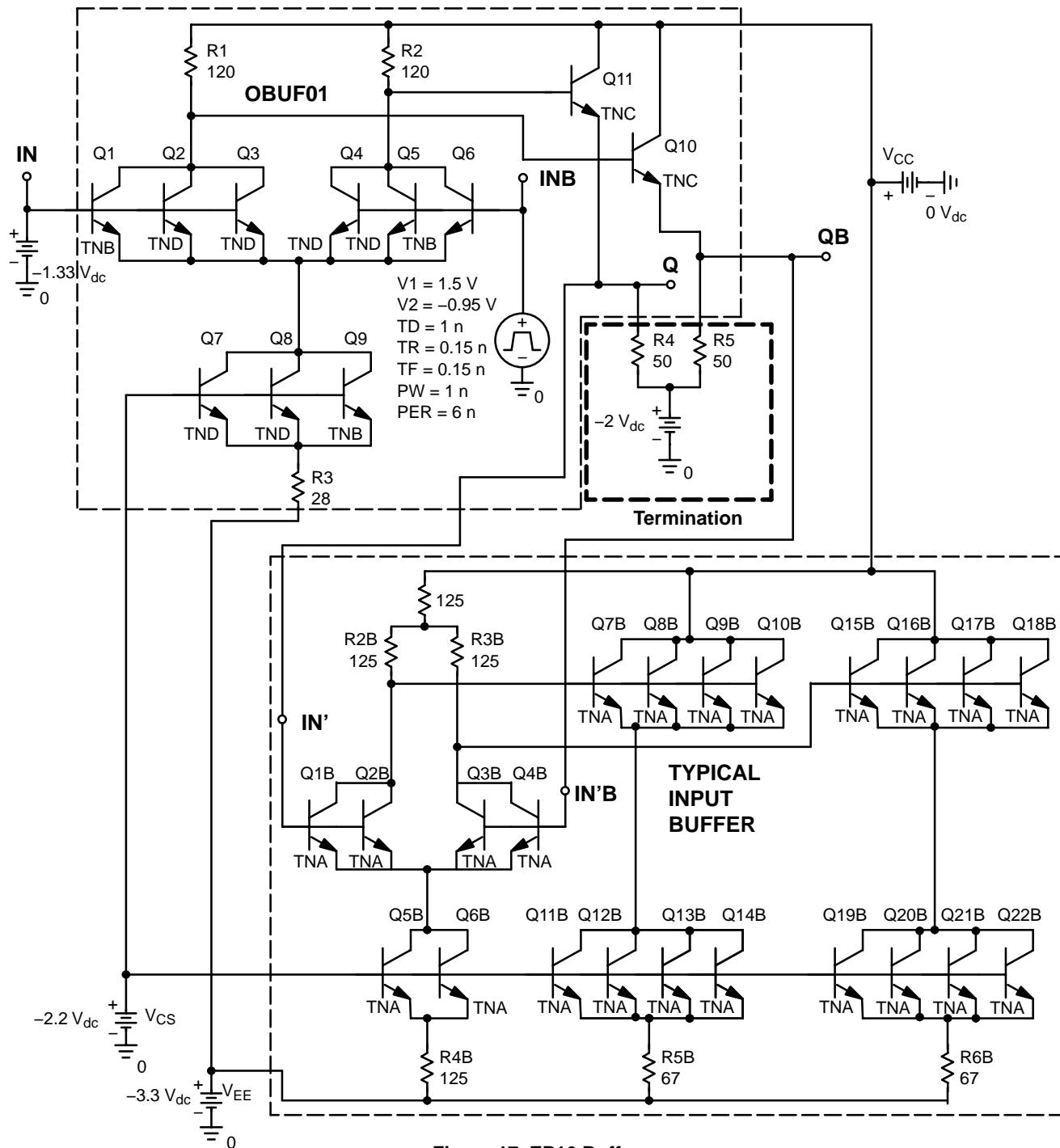

Figure 17. EP16 Buffer
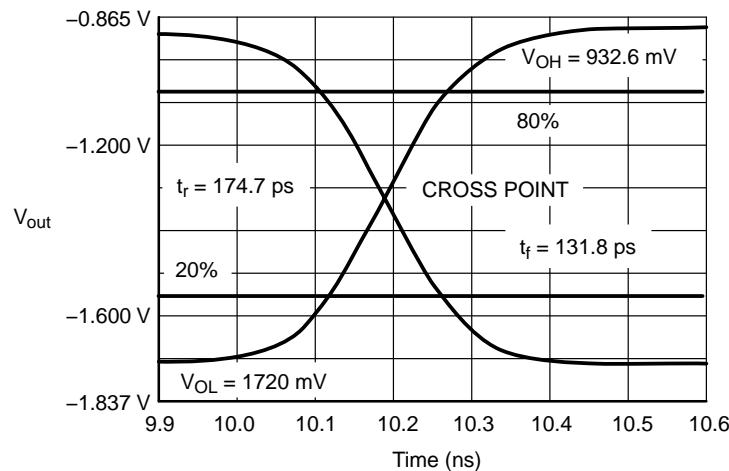
Figure 18. Typical Generic Output Waveform
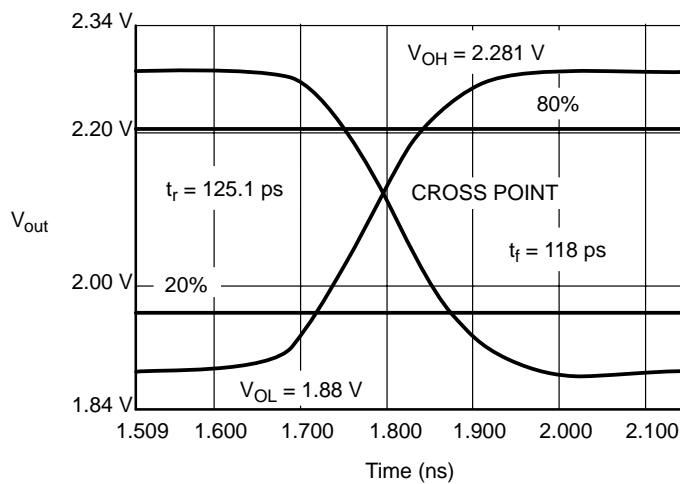
**Figure 19. OBUF09 Reduced Swing Output
Waveform (EP40/140)**
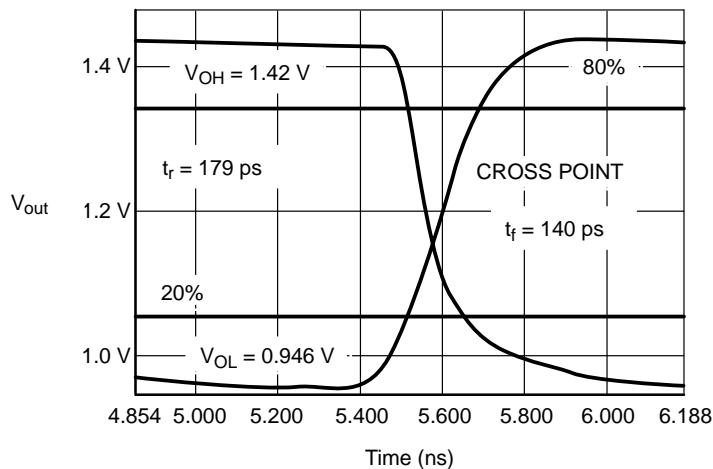
Figure 20. LVDS Output Waveform (EP210's)

```
******************     Transistor and Diodes Nominal SPICE Models*      ******************

*************************************************************************
.MODEL TNA NPN (IS=8.12e-18 BF=192 NF=1 VAF=75.6 IKF=1.49e-02
+ ISE=9.14e-17 NE=2 BR=15.8 VAR=2.76 IKR=2.2e-03 ISC=2.62e-16
+ NC=1.578 RB=327 IRB=4.8e-05 RBM=0.001 RE=10 RC=15 CJE=2.0e-14
+ VJE=.8867 MJE=.2868 TF=9.02e-12 ITF=7.6e-03 XTF=2.8 VTF=3.4 PTF=41.56 TR=1NS
+ CJC=5.6e-15 VJC=.6324 MJC=.3006 XCJC=.3 CJS=4.8e-15 VJS=.4193 MJS=.2563
+ EG=1.119 XTI=3.999 XTB=0.8826 FC=0.9)
*************************************************************************
.MODEL TNB NPN (IS=2.71e-17 BF=172 NF=1 VAF=71.4 IKF=4.38e-02
+ ISE=1.33e-15 NE=2 BR=17.9 VAR=2.76 IKR=3.0e-03 ISC=2.22e-16
+ NC=1.578 RB=67 IRB=6.47e-05 RBM=0.001 RE=3 RC=4 CJE=5.09e-14
+ VJE=.8867 MJE=.2868 TF=9.02e-12 ITF=2.53e-02 XTF=2.8 VTF=3.4 PTF=41.56 TR=1NS
+ CJC=20.6e-15 VJC=.6324 MJC=.3006 XCJC=.3 CJS=1.7e-14 VJS=.4193 MJS=.2563
+ EG=1.119 XTI=3.999 XTB=0.8826 FC=0.9)
*************************************************************************
.MODEL TNC NPN (IS=6.55e-17 BF=103 NF=1 VAF=90 IKF=2.91e-01
+ ISE=8.85e-15 NE=2 BR=15.7 NR=1 VAR=3.82 IKR=2.01e-02 ISC=1.48e-15
+ NC=2 RB=10.5 IRB=4.39e-04 RBM=0.29 RE=0.351 RC=9 CJE=3.5e-13
+ VJE=.8167 MJE=.1973 TF=8.99e-12 ITF=1.3e-01 XTF=5.67 VTF=1.86 PTF=41.43 TR=6.405e-10
+ CJC=1.4e-13 VJC=.6401 MJC=.2674 XCJC=1 CJS=9.3e-14 VJS=.5002 MJS=.1706
+ EG=1.135 XTI=4.177 XTB=0.6322 FC=0.961)
*************************************************************************
.MODEL TND NPN (IS=1.36e-17 BF=180 NF=1 VAF=87.6 IKF=2.19e-02
+ ISE=6.65e-16 NE=2 BR=16.9 VAR=2.76 IKR=1.5e-03 ISC=1.11e-16
+ NC=1.578 RB=136 IRB=3.24e-05 RBM=0.001 RE=6 RC=8 CJE=1.02e-13
+ VJE=.8867 MJE=.2868 TF=9.02e-12 ITF=1.27e-02 XTF=2.8 VTF=3.4 PTF=41.56 TR=1NS
+ CJC=10.3e-15 VJC=.6324 MJC=.3006 XCJC=.3 CJS=9.94e-15 VJS=.4193 MJS=.2563
+ EG=1.119 XTI=3.999 XTB=0.8826 FC=0.9)
*************************************************************************
.MODEL TNE NPN (IS=2.68e-18 BF=223 NF=1 VAF=56.0 IKF=3.96e-03
+ ISE=3.07e-17 NE=2 BR=13.9 VAR=2.76 IKR=7.23e-04 ISC=6.08e-17
+ NC=1.578 RB=386 IRB=1.3e-05 RBM=0.001 RE=26 RC=28 CJE=6.0e-15
+ VJE=.8867 MJE=.2868 TF=9.02PS ITF=2.6e-03 XTF=2.8 VTF=3.4 PTF=41.56 TR=1NS
+ CJC=3.4e-15 VJC=.6324 MJC=.3006 XCJC=.3 CJS=3.4e-15 VJS=.4193 MJS=.2563
+ EG=1.119 XTI=3.999 XTB=0.8826 FC=0.9)
*************************************************************************
.MODEL ESDM D (IS=1.55E-14 CJO=160fF RS=12 VJ=.58 M=.25 BV=9)
*************************************************************************
.MODEL ESDS D (IS=1.55E-14 CJO=29fF VJ=.624 M=.571)
*************************************************************************
*SPICE MODELS 4.5
```

Package: SO-8


```
* SPICE subcircuit file of coupled transmission lines
*
* Transmission line model
*
* Conductor number-pin designation cross reference:
*    Conductor     Pin
*       1            1
*       2            2
*       3            3
*       4            4
*       5            5
*       6            6
*       7            7
*       8            8
*
* number of lumps:      1
* FASTEST APPLICABLE EDGE RATE:          0.076 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
* Connect chip side to N**I and board side to N**O
*
.SUBCKT LINES N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O
L01WB    N01I    N01M    1.367e-09
L01      N01M    N01O    7.794e-10
C01      N01M    0       2.445e-13
L02WB    N02I    N02M    1.287e-09
L02      N02M    N02O    5.473e-10
C02      N02M    0       1.888e-13
L03WB    N03I    N03M    1.287e-09
L03      N03M    N03O    5.473e-10
C03      N03M    0       1.901e-13
L04WB    N04I    N04M    1.367e-09
L04      N04M    N04O    7.723e-10
C04      N04M    0       2.443e-13
L05WB    N05I    N05M    1.367e-09
L05      N05M    N05O    7.710e-10
C05      N05M    0       2.478e-13
L06WB    N06I    N06M    1.287e-09
L06      N06M    N06O    5.489e-10
C06      N06M    0       1.916e-13
L07WB    N07I    N07M    1.287e-09
L07      N07M    N07O    5.495e-10
C07      N07M    0       1.930e-13
L08WB    N08I    N08M    1.367e-09
L08      N08M    N08O    7.786e-10
C08      N08M    0       2.451e-13
K0102    L01     L02     0.1687
K0102WB  L01WB   L02WB   0.3400
C0102    N01O    N02O    3.674e-14
K0103    L01     L03     0.0702
K0103WB  L01WB   L03WB   0.1847
K0203    L02     L03     0.1822
K0203WB  L02WB   L03WB   0.3505
C0203    N02O    N03O    3.521e-14
K0204    L02     L04     0.0682
K0204WB  L02WB   L04WB   0.1847
K0304    L03     L04     0.1694
K0304WB  L03WB   L04WB   0.3400
```

```
C0304     N03O     N04O     3.675e-14
K0305WB L03WB     L05WB     0.1847
K0405WB L04WB     L05WB     0.3455
K0406WB L04WB     L06WB     0.1847
K0506     L05      L06      0.1697
K0506WB L05WB     L06WB     0.3400
C0506     N05O     N06O     3.720e-14
K0507     L05      L07      0.0682
K0507WB L05WB     L07WB     0.1847
K0607     L06      L07      0.1824
K0607WB L06WB     L07WB     0.3505
C0607     N06O     N07O     3.570e-14
K0608     L06      L08      0.0702
K0608WB L06WB     L08WB     0.1847
K0708     L07      L08      0.1691
K0708WB L07WB     L08WB     0.3400
C0708     N07O     N08O     3.632e-14
.ENDS LINES
----------------------------------------------------------------
```

Package: TSSOP-8


```
* SPICE subcircuit file of coupled transmission lines
*
* Transmission line model
*
* Conductor number-pin designation cross reference:
* counter-clockwise
*    Conductor      Pin
*        1            1
*        2            2
*        3            3
*        4            4
*        5            5
*        6            6
*        7            7
*        8            8
*
* number of lumps:       1
* FASTEST APPLICABLE EDGE RATE:          0.048 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
R_SHORT 0 GND 0.0001
*
X_777 N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O GND PACKAGE
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O GND
R01WB    N01I     N01W    4.727e-02
L01WB    N01W     N01R    1.158e-09
R01      N01R     N01C    9.680e-04
C01      N01C     GND     8.978e-14
L01      N01C     N01O    7.466e-10
R02WB    N02I     N02W    3.815e-02
L02WB    N02W     N02R    9.835e-10
R02      N02R     N02C    9.680e-04
C02      N02C     GND     7.711e-14
L02      N02C     N02O    7.466e-10
R03WB    N03I     N03W    3.815e-02
L03WB    N03W     N03R    9.835e-10
R03      N03R     N03C    9.680e-04
C03      N03C     GND     7.704e-14
L03      N03C     N03O    7.465e-10
R04WB    N04I     N04W    4.727e-02
L04WB    N04W     N04R    1.158e-09
R04      N04R     N04C    9.680e-04
C04      N04C     GND     8.983e-14
L04      N04C     N04O    7.460e-10
R05WB    N05I     N05W    4.727e-02
L05WB    N05W     N05R    1.158e-09
R05      N05R     N05C    9.680e-04
C05      N05C     GND     8.983e-14
L05      N05C     N05O    7.460e-10
R06WB    N06I     N06W    3.815e-02
L06WB    N06W     N06R    9.835e-10
R06      N06R     N06C    9.680e-04
C06      N06C     GND     7.704e-14
L06      N06C     N06O    7.465e-10
R07WB    N07I     N07W    3.815e-02
```

```
L07WB    N07W    N07R    9.835e-10
R07      N07R    N07C    9.680e-04
C07      N07C    GND     7.711e-14
L07      N07C    N07O    7.466e-10
R08WB    N08I    N08W    4.727e-02
L08WB    N08W    N08R    1.158e-09
R08      N08R    N08C    9.680e-04
C08      N08C    GND     8.978e-14
L08      N08C    N08O    7.466e-10
K0102    L01     L02     0.2481
K0102WB  L01WB   L02WB   0.1729
C0102    N01C    N02C    2.283e-14
K0103    L01     L03     0.1067
K0103WB  L01WB   L03WB   0.0598
K0104    L01     L04     0.0593
K0203    L02     L03     0.2479
K0203WB  L02WB   L03WB   0.1463
C0203    N02C    N03C    2.136e-14
K0204    L02     L04     0.1068
K0204WB  L02WB   L04WB   0.0598
K0304    L03     L04     0.2481
K0304WB  L03WB   L04WB   0.1729
C0304    N03C    N04C    2.279e-14
K0506    L05     L06     0.2481
K0506WB  L05WB   L06WB   0.1513
C0506    N05C    N06C    2.279e-14
K0507    L05     L07     0.1068
K0507WB  L05WB   L07WB   0.0615
K0508    L05     L08     0.0593
K0607    L06     L07     0.2479
K0607WB  L06WB   L07WB   0.1729
C0607    N06C    N07C    2.136e-14
K0608    L06     L08     0.1067
K0608WB  L06WB   L08WB   0.0615
K0708    L07     L08     0.2481
K0708WB  L07WB   L08WB   0.1513
C0708    N07C    N08C    2.283e-14
.ENDS PACKAGE
----------------------------------------------------------------
```

Package: SO-20


```
* SPICE subcircuit file of coupled transmission lines
*
* Transmission line model
*
* Conductor number-pin designation cross reference:
*     Conductor       Pin
*         1             1
*         2             2
*         3             3
*         4             4
*         5             5
*         6             6
*         7             7
*         8             8
*         9             9
*        10            10
*        11            11
*        12            12
*        13            13
*        14            14
*        15            15
*        16            16
*        17            17
*        18            18
*        19            19
*        20            20
*
* number of lumps:       1
* FASTEST APPLICABLE EDGE RATE:          0.275 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O BD_GND
R01WB    N01I     N01W     3.732e-02
L01WB    N01W     N01R     9.678e-10
R01      N01R     N01C     1.700e-02
C01      N01C     BD_GND   4.680e-13
L01      N01C     N01O     3.814e-09
R02WB    N02I     N02W     8.086e-02
L02WB    N02W     N02R     1.822e-09
R02      N02R     N02C     1.300e-02
C02      N02C     BD_GND   1.924e-13
L02      N02C     N02O     2.724e-09
R03WB    N03I     N03W     9.122e-02
L03WB    N03W     N03R     2.033e-09
R03      N03R     N03C     9.000e-02
C03      N03C     BD_GND   1.377e-13
L03      N03C     N03O     1.814e-09
R04WB    N04I     N04W     7.878e-02
L04WB    N04W     N04R     1.780e-09
R04      N04R     N04C     8.000e-02
C04      N04C     BD_GND   1.484e-13
L04      N04C     N04O     1.551e-09
R05WB    N05I     N05W     6.634e-02
L05WB    N05W     N05R     1.531e-09
R05      N05R     N05C     7.000e-02
```

```
C05      N05C      BD_GND    1.635e-13
L05      N05C      N05O      1.508e-09
R06WB    N06I      N06W      6.634e-02
L06WB    N06W      N06R      1.531e-09
R06      N06R      N06C      7.000e-02
C06      N06C      BD_GND    1.584e-13
L06      N06C      N06O      1.508e-09
R07WB    N07I      N07W      7.878e-02
L07WB    N07W      N07R      1.780e-09
R07      N07R      N07C      8.000e-02
C07      N07C      BD_GND    1.476e-13
L07      N07C      N07O      1.553e-09
R08WB    N08I      N08W      4.976e-02
L08WB    N08W      N08R      1.206e-09
R08      N08R      N08C      9.000e-02
C08      N08C      BD_GND    1.322e-13
L08      N08C      N08O      1.820e-09
R09WB    N09I      N09W      8.086e-02
L09WB    N09W      N09R      1.822e-09
R09      N09R      N09C      1.300e-02
C09      N09C      BD_GND    1.864e-13
L09      N09C      N09O      2.725e-09
R10WB    N10I      N10W      7.256e-02
L10WB    N10W      N10R      1.655e-09
R10      N10R      N10C      1.700e-02
C10      N10C      BD_GND    4.681e-13
L10      N10C      N10O      3.814e-09
R11WB    N11I      N11W      3.732e-02
L11WB    N11W      N11R      9.678e-10
R11      N11R      N11C      1.700e-02
C11      N11C      BD_GND    4.761e-13
L11      N11C      N11O      3.795e-09
R12WB    N12I      N12W      8.086e-02
L12WB    N12W      N12R      1.822e-09
R12      N12R      N12C      1.300e-02
C12      N12C      BD_GND    1.888e-13
L12      N12C      N12O      2.745e-09
R13WB    N13I      N13W      9.122e-02
L13WB    N13W      N13R      2.033e-09
R13      N13R      N13C      9.000e-02
C13      N13C      BD_GND    1.346e-13
L13      N13C      N13O      1.879e-09
R14WB    N14I      N14W      7.878e-02
L14WB    N14W      N14R      1.780e-09
R14      N14R      N14C      8.000e-02
C14      N14C      BD_GND    1.496e-13
L14      N14C      N14O      1.436e-09
R15WB    N15I      N15W      6.634e-02
L15WB    N15W      N15R      1.531e-09
R15      N15R      N15C      7.000e-02
C15      N15C      BD_GND    1.550e-13
L15      N15C      N15O      1.464e-09
R16WB    N16I      N16W      6.634e-02
L16WB    N16W      N16R      1.531e-09
R16      N16R      N16C      7.000e-02
C16      N16C      BD_GND    1.568e-13
L16      N16C      N16O      1.465e-09
R17WB    N17I      N17W      7.878e-02
L17WB    N17W      N17R      1.780e-09
R17      N17R      N17C      8.000e-02
C17      N17C      BD_GND    1.492e-13
L17      N17C      N17O      1.437e-09
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R18WB    N18I    N18W     9.122e-02
L18WB    N18W    N18R     2.033e-09
R18      N18R    N18C     9.000e-02
C18      N18C    BD_GND   1.346e-13
L18      N18C    N18O     1.892e-09
R19WB    N19I    N19W     8.086e-02
L19WB    N19W    N19R     1.822e-09
R19      N19R    N19C     1.300e-02
C19      N19C    BD_GND   1.880e-13
L19      N19C    N19O     2.767e-09
R20WB    N20I    N20W     7.256e-02
L20WB    N20W    N20R     1.655e-09
R20      N20R    N20C     1.700e-02
C20      N20C    BD_GND   4.712e-13
L20      N20C    N20O     3.825e-09
K0102    L01     L02      0.4539
K0102WB  L01WB   L02WB    0.1239
C0102    N01C    N02C     2.674e-13
K0103    L01     L03      0.2557
K0104    L01     L04      0.1742
K0105    L01     L05      0.1290
K0106    L01     L06      0.1011
K0107    L01     L07      0.0834
K0108    L01     L08      0.0636
K0111    L01     L11      -0.0789
K0112    L01     L12      -0.0755
K0113    L01     L13      -0.0716
K0114    L01     L14      -0.0594
K0115    L01     L15      -0.0669
K0116    L01     L16      -0.0657
K0117    L01     L17      -0.0672
K0118    L01     L18      -0.0625
K0203    L02     L03      0.3964
K0203WB  L02WB   L03WB    0.1239
C0203    N02C    N03C     1.529e-13
K0204    L02     L04      0.2341
K0205    L02     L05      0.1587
K0206    L02     L06      0.1206
K0207    L02     L07      0.0974
K0208    L02     L08      0.0760
K0209    L02     L09      0.0554
K0211    L02     L11      -0.0743
K0212    L02     L12      -0.0723
K0213    L02     L13      -0.0707
K0214    L02     L14      -0.0604
K0215    L02     L15      -0.0678
K0216    L02     L16      -0.0677
K0217    L02     L17      -0.0685
K0218    L02     L18      -0.0682
K0304    L03     L04      0.3767
K0304WB  L03WB   L04WB    0.1239
C0304    N03C    N04C     1.006e-13
K0305    L03     L05      0.2211
K0306    L03     L06      0.1564
K0307    L03     L07      0.1219
K0308    L03     L08      0.0956
K0309    L03     L09      0.0762
K0310    L03     L10      0.0639
K0311    L03     L11      -0.0654
K0312    L03     L12      -0.0662
K0313    L03     L13      -0.0688
K0314    L03     L14      -0.0614
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K0315    L03      L15      -0.0683
K0316    L03      L16      -0.0692
K0317    L03      L17      -0.0684
K0318    L03      L18      -0.0730
K0319    L03      L19      -0.0609
K0320    L03      L20      -0.0501
K0405    L04      L05       0.3731
K0405WB  L04WB    L05WB     0.1239
C0405    N04C     N05C      8.137e-14
K0406    L04      L06       0.2290
K0407    L04      L07       0.1637
K0408    L04      L08       0.1218
K0409    L04      L09       0.0976
K0410    L04      L10       0.0836
K0411    L04      L11      -0.0645
K0412    L04      L12      -0.0673
K0413    L04      L13      -0.0722
K0414    L04      L14      -0.0658
K0415    L04      L15      -0.0724
K0416    L04      L16      -0.0733
K0417    L04      L17      -0.0708
K0418    L04      L18      -0.0763
K0419    L04      L19      -0.0673
K0420    L04      L20      -0.0597
K0506    L05      L06       0.3775
K0506WB  L05WB    L06WB     0.1239
C0506    N05C     N06C      8.844e-14
K0507    L05      L07       0.2293
K0508    L05      L08       0.1565
K0509    L05      L09       0.1208
K0510    L05      L10       0.1013
K0511    L05      L11      -0.0636
K0512    L05      L12      -0.0679
K0513    L05      L13      -0.0742
K0514    L05      L14      -0.0683
K0515    L05      L15      -0.0737
K0516    L05      L16      -0.0741
K0517    L05      L17      -0.0704
K0518    L05      L18      -0.0760
K0519    L05      L19      -0.0684
K0520    L05      L20      -0.0622
K0607    L06      L07       0.3743
K0607WB  L06WB    L07WB     0.1239
C0607    N06C     N07C      7.898e-14
K0608    L06      L08       0.2214
K0609    L06      L09       0.1591
K0610    L06      L10       0.1293
K0611    L06      L11      -0.0607
K0612    L06      L12      -0.0668
K0613    L06      L13      -0.0752
K0614    L06      L14      -0.0700
K0615    L06      L15      -0.0741
K0616    L06      L16      -0.0742
K0617    L06      L17      -0.0690
K0618    L06      L18      -0.0754
K0619    L06      L19      -0.0697
K0620    L06      L20      -0.0652
K0708    L07      L08       0.3762
K0708WB  L07WB    L08WB     0.1239
C0708    N07C     N08C      1.016e-13
K0709    L07      L09       0.2343
K0710    L07      L10       0.1746
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K0711   L07     L11     -0.0581
K0712   L07     L12     -0.0657
K0713   L07     L13     -0.0756
K0714   L07     L14     -0.0707
K0715   L07     L15     -0.0736
K0716   L07     L16     -0.0730
K0717   L07     L17     -0.0667
K0718   L07     L18     -0.0735
K0719   L07     L19     -0.0692
K0720   L07     L20     -0.0661
K0809   L08     L09     0.3970
K0809WB L08WB   L09WB   0.1239
C0809   N08C    N09C    1.545e-13
K0810   L08     L10     0.2564
K0812   L08     L12     -0.0591
K0813   L08     L13     -0.0723
K0814   L08     L14     -0.0685
K0815   L08     L15     -0.0698
K0816   L08     L16     -0.0693
K0817   L08     L17     -0.0624
K0818   L08     L18     -0.0702
K0819   L08     L19     -0.0681
K0820   L08     L20     -0.0670
K0910   L09     L10     0.4542
K0910WB L09WB   L10WB   0.1239
C0910   N09C    N10C    2.677e-13
K0913   L09     L13     -0.0675
K0914   L09     L14     -0.0688
K0915   L09     L15     -0.0687
K0916   L09     L16     -0.0693
K0917   L09     L17     -0.0618
K0918   L09     L18     -0.0723
K0919   L09     L19     -0.0742
K0920   L09     L20     -0.0759
K1011WB L10WB   L11WB   0.1239
K1013   L10     L13     -0.0616
K1014   L10     L14     -0.0675
K1015   L10     L15     -0.0668
K1016   L10     L16     -0.0685
K1017   L10     L17     -0.0609
K1018   L10     L18     -0.0731
K1019   L10     L19     -0.0773
K1020   L10     L20     -0.0803
K1112   L11     L12     0.4562
K1112WB L11WB   L12WB   0.1239
C1112   N11C    N12C    2.679e-13
K1113   L11     L13     0.2725
K1114   L11     L14     0.1533
K1115   L11     L15     0.1161
K1116   L11     L16     0.0901
K1117   L11     L17     0.0702
K1118   L11     L18     0.0567
K1213   L12     L13     0.4103
K1213WB L12WB   L13WB   0.1239
C1213   N12C    N13C    1.538e-13
K1214   L12     L14     0.2091
K1215   L12     L15     0.1398
K1216   L12     L16     0.1055
K1217   L12     L17     0.0812
K1218   L12     L18     0.0684
K1314   L13     L14     0.3577
K1314WB L13WB   L14WB   0.1239
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C1314    N13C    N14C    1.026e-13
K1315    L13     L15     0.2088
K1316    L13     L16     0.1474
K1317    L13     L17     0.1074
K1318    L13     L18     0.0930
K1319    L13     L19     0.0693
K1320    L13     L20     0.0578
K1415    L14     L15     0.3383
K1415WB  L14WB   L15WB   0.1239
C1415    N14C    N15C    7.843e-14
K1416    L14     L16     0.1987
K1417    L14     L17     0.1302
K1418    L14     L18     0.1078
K1419    L14     L19     0.0825
K1420    L14     L20     0.0715
K1516    L15     L16     0.3631
K1516WB  L15WB   L16WB   0.1239
C1516    N15C    N16C    9.179e-14
K1517    L15     L17     0.1988
K1518    L15     L18     0.1480
K1519    L15     L19     0.1072
K1520    L15     L20     0.0918
K1617    L16     L17     0.3380
K1617WB  L16WB   L17WB   0.1239
C1617    N16C    N17C    7.810e-14
K1618    L16     L18     0.2096
K1619    L16     L19     0.1419
K1620    L16     L20     0.1183
K1718    L17     L18     0.3595
K1718WB  L17WB   L18WB   0.1239
C1718    N17C    N18C    1.034e-13
K1719    L17     L19     0.2122
K1720    L17     L20     0.1565
K1819    L18     L19     0.4140
K1819WB  L18WB   L19WB   0.1239
C1819    N18C    N19C    1.536e-13
K1820    L18     L20     0.2766
K1920    L19     L20     0.4603
K1920WB  L19WB   L20WB   0.1239
C1920    N19C    N20C    2.679e-13
.ENDS PACKAGE
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--------------------------------------------------------------------
```
Package: TSSOP-20


```
* SPICE subcircuit file of coupled transmission lines
*
* Transmission line model
*
* Conductor number-pin designation cross reference:
*    Conductor      Pin
*        1            1
*        2            2
*        3            3
*        4            4
*        5            5
*        6            6
*        7            7
*        8            8
*        9            9
*       10           10
*       11           11
*       12           12
*       13           13
*       14           14
*       15           15
*       16           16
*       17           17
*       18           18
*       19           19
*       20           20
*
* number of lumps: 1
* FASTEST APPLICABLE EDGE RATE:  0.114 ns
* Equivalent bandwidth:                  3.07GHz
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
**CONNECT CHIP SIDE TO N**I AND BOARD SIDE TO N**O
* ECLinPS PLUS usage requires the input nodes used in the subcircuit call
* statement(X_777) that are tied to global ports(VCC, VCCO, and VEE internal
* to the die) to have the same global names in the subcircuit call statement(X_777) .
* For example, if VCC is wirebonded to pin 20 for a certain design, then N20I
* should be relabeled to VCC.  Again, the change needs only to be incorporated
* in the X_777 subcircuit callout statement.  Since this requires a change to
* the netlist below, it is necessary for each design to have a copy of this file with
* the appropriate changes made that are required for that design.
*
R_SHORT 0 GND 0.0001
X_777 N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O GND PACKAGE
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O GND
R01WB N01I N01W 5.225e-02
L01WB N01W N01R 1.254e-09
R01 N01R N01C 2.100e-03
C01 N01C GND 1.840e-13
L01 N01C N01O 1.603e-09
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R02WB N02I N02W 5.473e-02
L02WB N02W N02R 1.303e-09
R02 N02R N02C 2.500e-03
C02 N02C GND 8.995e-14
L02 N02C N02O 1.187e-09
R03WB N03I N03W 5.266e-02
L03WB N03W N03R 1.262e-09
R03 N03R N03C 2.500e-03
C03 N03C GND 7.204e-14
L03 N03C N03O 9.073e-10
R04WB N04I N04W 3.690e-02
L04WB N04W N04R 9.599e-10
R04 N04R N04C 2.100e-03
C04 N04C GND 8.838e-14
L04 N04C N04O 9.053e-10
R05WB N05I N05W 3.151e-02
L05WB N05W N05R 8.581e-10
R05 N05R N05C 1.700e-03
C05 N05C GND 9.879e-14
L05 N05C N05O 9.065e-10
R06WB N06I N06W 3.151e-02
L06WB N06W N06R 8.581e-10
R06 N06R N06C 1.700e-03
C06 N06C GND 9.879e-14
L06 N06C N06O 9.065e-10
R07WB N07I N07W 3.690e-02
L07WB N07W N07R 9.599e-10
R07 N07R N07C 2.100e-03
C07 N07C GND 8.838e-14
L07 N07C N07O 9.053e-10
R08WB N08I N08W 5.266e-02
L08WB N08W N08R 1.262e-09
R08 N08R N08C 2.500e-03
C08 N08C GND 7.204e-14
L08 N08C N08O 9.073e-10
R09WB N09I N09W 5.473e-02
L09WB N09W N09R 1.303e-09
R09 N09R N09C 2.500e-03
C09 N09C GND 8.995e-14
L09 N09C N09O 1.187e-09
R10WB N10I N10W 5.225e-02
L10WB N10W N10R 1.254e-09
R10 N10R N10C 2.100e-03
C10 N10C GND 1.840e-13
L10 N10C N10O 1.603e-09
R11WB N11I N11W 5.225e-02
L11WB N11W N11R 1.254e-09
R11 N11R N11C 2.100e-03
C11 N11C GND 1.840e-13
L11 N11C N11O 1.603e-09
R12WB N12I N12W 5.473e-02
L12WB N12W N12R 1.303e-09
R12 N12R N12C 2.500e-03
C12 N12C GND 8.995e-14
L12 N12C N12O 1.187e-09
R13WB N13I N13W 5.266e-02
L13WB N13W N13R 1.262e-09
R13 N13R N13C 2.500e-03
C13 N13C GND 7.204e-14
L13 N13C N13O 9.073e-10
R14WB N14I N14W 3.690e-02
L14WB N14W N14R 9.599e-10
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```
R14 N14R N14C 2.100e-03
C14 N14C GND 8.838e-14
L14 N14C N14O 9.053e-10
R15WB N15I N15W 3.151e-02
L15WB N15W N15R 8.581e-10
R15 N15R N15C 1.700e-03
C15 N15C GND 9.879e-14
L15 N15C N15O 9.065e-10
R16WB N16I N16W 3.151e-02
L16WB N16W N16R 8.581e-10
R16 N16R N16C 1.700e-03
C16 N16C GND 9.879e-14
L16 N16C N16O 9.065e-10
R17WB N17I N17W 3.690e-02
L17WB N17W N17R 9.599e-10
R17 N17R N17C 2.100e-03
C17 N17C GND 8.838e-14
L17 N17C N17O 9.053e-10
R18WB N18I N18W 5.266e-02
L18WB N18W N18R 1.262e-09
R18 N18R N18C 2.500e-03
C18 N18C GND 7.204e-14
L18 N18C N18O 9.073e-10
R19WB N19I N19W 5.473e-02
L19WB N19W N19R 1.303e-09
R19 N19R N19C 2.500e-03
C19 N19C GND 8.995e-14
L19 N19C N19O 1.187e-09
R20WB N20I N20W 5.225e-02
L20WB N20W N20R 1.254e-09
R20 N20R N20C 2.100e-03
C20 N20C GND 1.840e-13
L20 N20C N20O 1.603e-09
K0102 L01 L02 0.2780
K0102WB L01WB L02WB 0.2168
C0102 N01C N02C 1.222e-13
K0103 L01 L03 0.1016
K0103WB L01WB L03WB 0.0788
K0104 L01 L04 0.0559
K0120WB L01WB L20WB 0.1061
K0119WB L01WB L19WB 0.0542
K0203 L02 L03 0.2333
K0203WB L02WB L03WB 0.1970
C0203 N02C N03C 7.150e-14
K0204 L02 L04 0.1006
K0204WB L02WB L04WB 0.0729
K0205 L02 L05 0.0577
K0220WB L02WB L20WB 0.0542
K0304 L03 L04 0.2384
K0304WB L03WB L04WB 0.1787
C0304 N03C N04C 5.860e-14
K0305 L03 L05 0.1055
K0305WB L03WB L05WB 0.0542
K0306 L03 L06 0.0577
K0405 L04 L05 0.2370
K0405WB L04WB L05WB 0.1281
C0405 N04C N05C 5.812e-14
K0406 L04 L06 0.0939
K0407 L04 L07 0.0583
K0506 L05 L06 0.1951
K0506WB L05WB L06WB 0.0908
C0506 N05C N06C 3.558e-14
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K0507 L05 L07 0.0939
K0508 L05 L08 0.0577
K0607 L06 L07 0.2370
K0607WB L06WB L07WB 0.1281
C0607 N06C N07C 5.812e-14
K0608 L06 L08 0.1055
K0608WB L06WB L08WB 0.0542
K0609 L06 L09 0.0577
K0708 L07 L08 0.2384
K0708WB L07WB L08WB 0.1787
C0708 N07C N08C 5.860e-14
K0709 L07 L09 0.1006
K0709WB L07WB L09WB 0.0729
K0710 L07 L10 0.0559
K0809 L08 L09 0.2333
K0809WB L08WB L09WB 0.1970
C0809 N08C N09C 7.150e-14
K0810 L08 L10 0.1016
K0810WB L08WB L10WB 0.0788
K0910 L09 L10 0.2780
K0910WB L09WB L10WB 0.2168
C0910 N09C N10C 1.222e-13
K0911WB L09WB L11WB 0.0542
K1011WB L10WB L11WB 0.1061
K1012WB L10WB L12WB 0.0542
K1112 L11 L12 0.2780
K1112WB L11WB L12WB 0.2168
C1112 N11C N12C 1.222e-13
K1113 L11 L13 0.1016
K1113WB L11WB L13WB 0.0788
K1114 L11 L14 0.0559
K1213 L12 L13 0.2333
K1213WB L12WB L13WB 0.1970
C1213 N12C N13C 7.150e-14
K1214 L12 L14 0.1006
K1214WB L12WB L14WB 0.0729
K1215 L12 L15 0.0577
K1314 L13 L14 0.2384
K1314WB L13WB L14WB 0.1787
C1314 N13C N14C 5.860e-14
K1315 L13 L15 0.1055
K1315WB L13WB L15WB 0.0542
K1316 L13 L16 0.0577
K1415 L14 L15 0.2370
K1415WB L14WB L15WB 0.1281
C1415 N14C N15C 5.812e-14
K1416 L14 L16 0.0939
K1417 L14 L17 0.0583
K1516 L15 L16 0.1951
K1516WB L15WB L16WB 0.0908
C1516 N15C N16C 3.558e-14
K1517 L15 L17 0.0939
K1518 L15 L18 0.0577
K1617 L16 L17 0.2370
K1617WB L16WB L17WB 0.1281
C1617 N16C N17C 5.812e-14
K1618 L16 L18 0.1055
K1618WB L16WB L18WB 0.0542
K1619 L16 L19 0.0577
K1718 L17 L18 0.2384
K1718WB L17WB L18WB 0.1787
C1718 N17C N18C 5.860e-14
```

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K1719 L17 L19 0.1006
K1719WB L17WB L19WB 0.0729
K1720 L17 L20 0.0559
K1819 L18 L19 0.2333
K1819WB L18WB L19WB 0.1970
C1819 N18C N19C 7.150e-14
K1820 L18 L20 0.1016
K1820WB L18WB L20WB 0.0788
K1920 L19 L20 0.2780
K1920WB L19WB L20WB 0.2168
C1920 N19C N20C 1.222e-13
.ENDS PACKAGE
----------------------------------------------------------------
```

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Package:24 Lead QFN

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*
*
**************************************************************
* Note:
* 1. The model assume ground plane is 15 mil below package
* 2. The model assume flag is grounded
* 3. the model assume single wires are used for each pin.
**************************************************************
* Lead Frame drawing: 4 x 4 mm QFN
* Case Outline  :
**************************************************************
*
* Package:  24 pin QFN
* Model for 24 pins
*
*
* Conductor number-pin designation cross reference:
*
*    Conductor      Pin
*        1           1
*        2           2
*        3           3
*        4           4
*        5           5
*        6           6
*        7           7
*        8           8
*        9           9
*       10          10
*       11          11
*       12          12
*       13          13
*       14          14
*       15          15
*       16          16
*       17          17
*       18          18
*       19          19
*       20          20
*       21          21
*       22          22
*       23          23
*       24          24
*
* number of lumps:      1
* FASTEST APPLICABLE EDGE RATE:          0.005 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O N21I N21O N22I N22O N23I N23O N24I N24O BD_GND
R01WB   N01I    N01W    5.556e-02
L01WB   N01W    N01R    1.319e-09
R01     N01R    N01C    5.000e-03
C01     N01C    BD_GND  5.826e-14
L01     N01C    N01O    1.349e-11
```

```
R02WB    N02I    N02W     4.976e-02
L02WB    N02W    N02R     1.206e-09
R02      N02R    N02C     5.000e-03
C02      N02C    BD_GND   4.590e-14
L02      N02C    N02O     1.328e-11
R03WB    N03I    N03W     4.665e-02
L03WB    N03W    N03R     1.146e-09
R03      N03R    N03C     5.000e-03
C03      N03C    BD_GND   4.486e-14
L03      N03C    N03O     1.329e-11
R04WB    N04I    N04W     4.665e-02
L04WB    N04W    N04R     1.146e-09
R04      N04R    N04C     5.000e-03
C04      N04C    BD_GND   4.453e-14
L04      N04C    N04O     1.328e-11
R05WB    N05I    N05W     4.976e-02
L05WB    N05W    N05R     1.206e-09
R05      N05R    N05C     5.000e-03
C05      N05C    BD_GND   4.608e-14
L05      N05C    N05O     1.324e-11
R06WB    N06I    N06W     5.556e-02
L06WB    N06W    N06R     1.319e-09
R06      N06R    N06C     5.000e-03
C06      N06C    BD_GND   5.836e-14
L06      N06C    N06O     1.342e-11
R07WB    N07I    N07W     5.556e-02
L07WB    N07W    N07R     1.319e-09
R07      N07R    N07C     5.000e-03
C07      N07C    BD_GND   5.857e-14
L07      N07C    N07O     1.339e-11
R08WB    N08I    N08W     4.976e-02
L08WB    N08W    N08R     1.206e-09
R08      N08R    N08C     5.000e-03
C08      N08C    BD_GND   4.581e-14
L08      N08C    N08O     1.324e-11
R09WB    N09I    N09W     4.665e-02
L09WB    N09W    N09R     1.146e-09
R09      N09R    N09C     5.000e-03
C09      N09C    BD_GND   4.446e-14
L09      N09C    N09O     1.328e-11
R10WB    N10I    N10W     4.665e-02
L10WB    N10W    N10R     1.146e-09
R10      N10R    N10C     5.000e-03
C10      N10C    BD_GND   4.450e-14
L10      N10C    N10O     1.331e-11
R11WB    N11I    N11W     4.976e-02
L11WB    N11W    N11R     1.206e-09
R11      N11R    N11C     5.000e-03
C11      N11C    BD_GND   4.587e-14
L11      N11C    N11O     1.329e-11
R12WB    N12I    N12W     5.556e-02
L12WB    N12W    N12R     1.319e-09
R12      N12R    N12C     5.000e-03
C12      N12C    BD_GND   5.815e-14
L12      N12C    N12O     1.345e-11
R13WB    N13I    N13W     5.556e-02
L13WB    N13W    N13R     1.319e-09
R13      N13R    N13C     5.000e-03
C13      N13C    BD_GND   5.840e-14
L13      N13C    N13O     1.344e-11
R14WB    N14I    N14W     4.976e-02
L14WB    N14W    N14R     1.206e-09
```

```
R14       N14R    N14C    5.000e-03
C14       N14C    BD_GND  4.612e-14
L14       N14C    N14O    1.329e-11
R15WB     N15I    N15W    4.665e-02
L15WB     N15W    N15R    1.146e-09
R15       N15R    N15C    5.000e-03
C15       N15C    BD_GND  4.473e-14
L15       N15C    N15O    1.332e-11
R16WB     N16I    N16W    4.665e-02
L16WB     N16W    N16R    1.146e-09
R16       N16R    N16C    5.000e-03
C16       N16C    BD_GND  4.464e-14
L16       N16C    N16O    1.328e-11
R17WB     N17I    N17W    4.976e-02
L17WB     N17W    N17R    1.206e-09
R17       N17R    N17C    5.000e-03
C17       N17C    BD_GND  4.582e-14
L17       N17C    N17O    1.325e-11
R18WB     N18I    N18W    5.556e-02
L18WB     N18W    N18R    1.319e-09
R18       N18R    N18C    5.000e-03
C18       N18C    BD_GND  5.818e-14
L18       N18C    N18O    1.343e-11
R19WB     N19I    N19W    5.556e-02
L19WB     N19W    N19R    1.319e-09
R19       N19R    N19C    5.000e-03
C19       N19C    BD_GND  5.829e-14
L19       N19C    N19O    1.343e-11
R20WB     N20I    N20W    4.976e-02
L20WB     N20W    N20R    1.206e-09
R20       N20R    N20C    5.000e-03
C20       N20C    BD_GND  4.615e-14
L20       N20C    N20O    1.332e-11
R21WB     N21I    N21W    4.665e-02
L21WB     N21W    N21R    1.146e-09
R21       N21R    N21C    5.000e-03
C21       N21C    BD_GND  4.467e-14
L21       N21C    N21O    1.336e-11
R22WB     N22I    N22W    4.665e-02
L22WB     N22W    N22R    1.146e-09
R22       N22R    N22C    5.000e-03
C22       N22C    BD_GND  4.476e-14
L22       N22C    N22O    1.340e-11
R23WB     N23I    N23W    4.976e-02
L23WB     N23W    N23R    1.206e-09
R23       N23R    N23C    5.000e-03
C23       N23C    BD_GND  4.582e-14
L23       N23C    N23O    1.340e-11
R24WB     N24I    N24W    5.556e-02
L24WB     N24W    N24R    1.319e-09
R24       N24R    N24C    5.000e-03
C24       N24C    BD_GND  5.872e-14
L24       N24C    N24O    1.347e-11
K0102     L01     L02     0.2857
K0102WB   L01WB   L02WB   0.2034
C0102     N01C    N02C    1.685e-14
K0103     L01     L03     0.1556
K0103WB   L01WB   L03WB   0.0777
K0104     L01     L04     0.1042
K0105     L01     L05     0.0778
K0106     L01     L06     0.0624
K0121     L01     L21     0.0549
```

```
K0122    L01      L22      0.0661
K0123    L01      L23      0.0819
K0124    L01      L24      0.1047
K0203    L02      L03      0.2817
K0203WB  L02WB    L03WB    0.2034
C0203    N02C     N03C     1.681e-14
K0204    L02      L04      0.1540
K0204WB  L02WB    L04WB    0.0777
K0205    L02      L05      0.1042
K0206    L02      L06      0.0778
K0221    L02      L21      0.0503
K0222    L02      L22      0.0584
K0223    L02      L23      0.0691
K0224    L02      L24      0.0832
K0304    L03      L04      0.2838
K0304WB  L03WB    L04WB    0.2034
C0304    N03C     N04C     1.690e-14
K0305    L03      L05      0.1553
K0305WB  L03WB    L05WB    0.0777
K0306    L03      L06      0.1051
K0307    L03      L07      0.0550
K0308    L03      L08      0.0504
K0322    L03      L22      0.0514
K0323    L03      L23      0.0585
K0324    L03      L24      0.0670
K0405    L04      L05      0.2816
K0405WB  L04WB    L05WB    0.2034
C0405    N04C     N05C     1.695e-14
K0406    L04      L06      0.1555
K0406WB  L04WB    L06WB    0.0777
K0407    L04      L07      0.0679
K0408    L04      L08      0.0596
K0409    L04      L09      0.0525
K0424    L04      L24      0.0542
K0506    L05      L06      0.2840
K0506WB  L05WB    L06WB    0.2034
C0506    N05C     N06C     1.698e-14
K0507    L05      L07      0.0843
K0507WB  L05WB    L07WB    0.0563
K0508    L05      L08      0.0706
K0509    L05      L09      0.0597
K0510    L05      L10      0.0505
K0607    L06      L07      0.1065
K0607WB  L06WB    L07WB    0.1166
K0608    L06      L08      0.0843
K0608WB  L06WB    L08WB    0.0563
K0609    L06      L09      0.0681
K0610    L06      L10      0.0550
K0708    L07      L08      0.2837
K0708WB  L07WB    L08WB    0.2034
C0708    N07C     N08C     1.663e-14
K0709    L07      L09      0.1556
K0709WB  L07WB    L09WB    0.0777
K0710    L07      L10      0.1047
K0711    L07      L11      0.0781
K0712    L07      L12      0.0625
K0809    L08      L09      0.2826
K0809WB  L08WB    L09WB    0.2034
C0809    N08C     N09C     1.677e-14
K0810    L08      L10      0.1556
K0810WB  L08WB    L10WB    0.0777
K0811    L08      L11      0.1052
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K0812    L08       L12       0.0781
K0910    L09       L10       0.2843
K0910WB  L09WB     L10WB     0.2034
C0910    N09C      N10C      1.677e-14
K0911    L09       L11       0.1562
K0911WB  L09WB     L11WB     0.0777
K0912    L09       L12       0.1047
K0913    L09       L13       0.0546
K1011    L10       L11       0.2846
K1011WB  L10WB     L11WB     0.2034
C1011    N10C      N11C      1.684e-14
K1012    L10       L12       0.1555
K1012WB  L10WB     L12WB     0.0777
K1013    L10       L13       0.0674
K1014    L10       L14       0.0588
K1015    L10       L15       0.0518
K1112    L11       L12       0.2838
K1112WB  L11WB     L12WB     0.2034
C1112    N11C      N12C      1.695e-14
K1113    L11       L13       0.0836
K1113WB  L11WB     L13WB     0.0563
K1114    L11       L14       0.0696
K1115    L11       L15       0.0589
K1213    L12       L13       0.1064
K1213WB  L12WB     L13WB     0.1166
K1214    L12       L14       0.0836
K1214WB  L12WB     L14WB     0.0563
K1215    L12       L15       0.0674
K1216    L12       L16       0.0546
K1314    L13       L14       0.2838
K1314WB  L13WB     L14WB     0.2034
C1314    N13C      N14C      1.687e-14
K1315    L13       L15       0.1558
K1315WB  L13WB     L15WB     0.0777
K1316    L13       L16       0.1050
K1317    L13       L17       0.0784
K1318    L13       L18       0.0626
K1415    L14       L15       0.2849
K1415WB  L14WB     L15WB     0.2034
C1415    N14C      N15C      1.673e-14
K1416    L14       L16       0.1564
K1416WB  L14WB     L16WB     0.0777
K1417    L14       L17       0.1054
K1418    L14       L18       0.0780
K1516    L15       L16       0.2845
K1516WB  L15WB     L16WB     0.2034
C1516    N15C      N16C      1.684e-14
K1517    L15       L17       0.1559
K1517WB  L15WB     L17WB     0.0777
K1518    L15       L18       0.1047
K1519    L15       L19       0.0543
K1617    L16       L17       0.2828
K1617WB  L16WB     L17WB     0.2034
C1617    N16C      N17C      1.678e-14
K1618    L16       L18       0.1557
K1618WB  L16WB     L18WB     0.0777
K1619    L16       L19       0.0674
K1620    L16       L20       0.0591
K1621    L16       L21       0.0521
K1718    L17       L18       0.2843
K1718WB  L17WB     L18WB     0.2034
C1718    N17C      N18C      1.690e-14
```

```
K1719    L17      L19      0.0838
K1719WB  L17WB    L19WB    0.0563
K1720    L17      L20      0.0702
K1721    L17      L21      0.0595
K1722    L17      L22      0.0503
K1819    L18      L19      0.1062
K1819WB  L18WB    L19WB    0.1166
K1820    L18      L20      0.0841
K1820WB  L18WB    L20WB    0.0563
K1821    L18      L21      0.0679
K1822    L18      L22      0.0549
K1920    L19      L20      0.2849
K1920WB  L19WB    L20WB    0.2034
C1920    N19C     N20C     1.688e-14
K1921    L19      L21      0.1568
K1921WB  L19WB    L21WB    0.0777
K1922    L19      L22      0.1059
K1923    L19      L23      0.0792
K1924    L19      L24      0.0638
K2021    L20      L21      0.2853
K2021WB  L20WB    L21WB    0.2034
C2021    N20C     N21C     1.689e-14
K2022    L20      L22      0.1589
K2022WB  L20WB    L22WB    0.0777
K2023    L20      L23      0.1074
K2024    L20      L24      0.0799
K2122    L21      L22      0.2877
K2122WB  L21WB    L22WB    0.2034
C2122    N21C     N22C     1.678e-14
K2123    L21      L23      0.1591
K2123WB  L21WB    L23WB    0.0777
K2124    L21      L24      0.1072
K2223    L22      L23      0.2878
K2223WB  L22WB    L23WB    0.2034
C2223    N22C     N23C     1.690e-14
K2224    L22      L24      0.1588
K2224WB  L22WB    L24WB    0.0777
K2324    L23      L24      0.2873
K2324WB  L23WB    L24WB    0.2034
K2301WB  L23WB    L01WB    0.0563
C2324    N23C     N24C     1.693e-14
K2401WB  L24WB    L01WB    0.1166
K2402WB  L24WB    L02WB    0.0563
.ENDS PACKAGE
*
*
```

```
--------------------------------------------------------------------
```
Package: 32-TQFP

```
* SPICE subcircuit file of coupled transmission lines
*
* Transmission line model
*
* Conductor number-pin designation cross reference:
*    Conductor     Pin
*        1           1
*        2           2
*        3           3
*        4           4
*        5           5
*        6           6
*        7           7
*        8           8
*        9           9
*       10          10
*       11          11
*       12          12
*       13          13
*       14          14
*       15          15
*       16          16
*       17          17
*       18          18
*       19          19
*       20          20
*       21          21
*       22          22
*       23          23
*       24          24
*       25          25
*       26          26
*       27          27
*       28          28
*       29          29
*       30          30
*       31          31
*       32          32
*
* number of lumps: 1
* FASTEST APPLICABLE EDGE RATE:  0.135 ns
* Equivalent bandwidth:                2.6   GHz
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
**CONNECT CHIP SIDE TO N**I AND BOARD SIDE TO N**O
* ECLinPS PLUS usage requires the input nodes used in the subcircuit call
* statement(X_777) that are tied to global ports(VCC, VCCO, and VEE internal
* to the die) to have the same global names in the subcircuit call statement(X_777).
* For example, if VCC is wirebonded to pin 1, 9, 16, and 32 for a certain design, then
* N01I, N09I, N16I, and N32I should be relabeled to VCC.  Again, the change needs only to
* be incorporated in the X_777 subcircuit callout statement.  Since this requires a change
* to the netlist below, it is necessary for each design to have a copy of this file with
* the appropriate changes made that are required for that design.
*
R_SHORT 0 ground 0.0001
*
X_777 N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
```

```
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O N21I N21O N22I N22O N23I N23O N24I N24O
+ N25I N25O N26I N26O N27I N27O N28I N28O N29I N29O
+ N30I N30O N31I N31O N32I N32O ground PACKAGE
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O N21I N21O N22I N22O N23I N23O N24I N24O
+ N25I N25O N26I N26O N27I N27O N28I N28O N29I N29O
+ N30I N30O N31I N31O N32I N32O ground
*
R01WB N01I N01W 5.432e-02
L01WB N01W N01R 1.295e-09
R01 N01R N01C 1.560e-03
C01 N01C ground 2.813e-13
L01 N01C N01O 1.584e-09
R02WB N02I N02W 4.976e-02
L02WB N02W N02R 1.206e-09
R02 N02R N02C 1.330e-03
C02 N02C ground 1.308e-13
L02 N02C N02O 1.437e-09
R03WB N03I N03W 4.810e-02
L03WB N03W N03R 1.174e-09
R03 N03R N03C 1.170e-03
C03 N03C ground 1.235e-13
L03 N03C N03O 1.321e-09
R04WB N04I N04W 4.561e-02
L04WB N04W N04R 1.126e-09
R04 N04R N04C 1.100e-03
C04 N04C ground 1.207e-13
L04 N04C N04O 1.259e-09
R05WB N05I N05W 4.561e-02
L05WB N05W N05R 1.126e-09
R05 N05R N05C 1.100e-03
C05 N05C ground 1.207e-13
L05 N05C N05O 1.259e-09
R06WB N06I N06W 4.810e-02
L06WB N06W N06R 1.174e-09
R06 N06R N06C 1.170e-03
C06 N06C ground 1.235e-13
L06 N06C N06O 1.321e-09
R07WB N07I N07W 4.976e-02
L07WB N07W N07R 1.206e-09
R07 N07R N07C 1.330e-03
C07 N07C ground 1.308e-13
L07 N07C N07O 1.437e-09
R08WB N08I N08W 5.432e-02
L08WB N08W N08R 1.295e-09
R08 N08R N08C 1.560e-03
C08 N08C ground 2.813e-13
L08 N08C N08O 1.584e-09
R09WB N09I N09W 5.432e-02
L09WB N09W N09R 1.295e-09
R09 N09R N09C 1.560e-03
C09 N09C ground 2.813e-13
L09 N09C N09O 1.584e-09
R10WB N10I N10W 4.976e-02
L10WB N10W N10R 1.206e-09
R10 N10R N10C 1.330e-03
C10 N10C ground 1.308e-13
```

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L10 N10C N10O 1.437e-09
R11WB N11I N11W 4.810e-02
L11WB N11W N11R 1.174e-09
R11 N11R N11C 1.170e-03
C11 N11C ground 1.235e-13
L11 N11C N11O 1.321e-09
R12WB N12I N12W 4.561e-02
L12WB N12W N12R 1.126e-09
R12 N12R N12C 1.100e-03
C12 N12C ground 1.207e-13
L12 N12C N12O 1.259e-09
R13WB N13I N13W 4.561e-02
L13WB N13W N13R 1.126e-09
R13 N13R N13C 1.100e-03
C13 N13C ground 1.207e-13
L13 N13C N13O 1.259e-09
R14WB N14I N14W 4.810e-02
L14WB N14W N14R 1.174e-09
R14 N14R N14C 1.170e-03
C14 N14C ground 1.235e-13
L14 N14C N14O 1.321e-09
R15WB N15I N15W 4.976e-02
L15WB N15W N15R 1.206e-09
R15 N15R N15C 1.330e-03
C15 N15C ground 1.308e-13
L15 N15C N15O 1.437e-09
R16WB N16I N16W 5.432e-02
L16WB N16W N16R 1.295e-09
R16 N16R N16C 1.560e-03
C16 N16C ground 2.813e-13
L16 N16C N16O 1.584e-09
R17WB N17I N17W 5.432e-02
L17WB N17W N17R 1.295e-09
R17 N17R N17C 1.560e-03
C17 N17C ground 2.813e-13
L17 N17C N17O 1.584e-09
R18WB N18I N18W 4.976e-02
L18WB N18W N18R 1.206e-09
R18 N18R N18C 1.330e-03
C18 N18C ground 1.308e-13
L18 N18C N18O 1.437e-09
R19WB N19I N19W 4.810e-02
L19WB N19W N19R 1.174e-09
R19 N19R N19C 1.170e-03
C19 N19C ground 1.235e-13
L19 N19C N19O 1.321e-09
R20WB N20I N20W 4.561e-02
L20WB N20W N20R 1.126e-09
R20 N20R N20C 1.100e-03
C20 N20C ground 1.207e-13
L20 N20C N20O 1.259e-09
R21WB N21I N21W 4.561e-02
L21WB N21W N21R 1.126e-09
R21 N21R N21C 1.100e-03
C21 N21C ground 1.207e-13
L21 N21C N21O 1.259e-09
R22WB N22I N22W 4.810e-02
L22WB N22W N22R 1.174e-09
R22 N22R N22C 1.170e-03
C22 N22C ground 1.235e-13
L22 N22C N22O 1.321e-09
R23WB N23I N23W 4.976e-02
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L23WB N23W N23R 1.206e-09
R23 N23R N23C 1.330e-03
C23 N23C ground 1.308e-13
L23 N23C N23O 1.437e-09
R24WB N24I N24W 5.432e-02
L24WB N24W N24R 1.295e-09
R24 N24R N24C 1.560e-03
C24 N24C ground 2.813e-13
L24 N24C N24O 1.584e-09
R25WB N25I N25W 5.432e-02
L25WB N25W N25R 1.295e-09
R25 N25R N25C 1.560e-03
C25 N25C ground 2.813e-13
L25 N25C N25O 1.584e-09
R26WB N26I N26W 4.976e-02
L26WB N26W N26R 1.206e-09
R26 N26R N26C 1.330e-03
C26 N26C ground 1.308e-13
L26 N26C N26O 1.437e-09
R27WB N27I N27W 4.810e-02
L27WB N27W N27R 1.174e-09
R27 N27R N27C 1.170e-03
C27 N27C ground 1.235e-13
L27 N27C N27O 1.321e-09
R28WB N28I N28W 4.561e-02
L28WB N28W N28R 1.126e-09
R28 N28R N28C 1.100e-03
C28 N28C ground 1.207e-13
L28 N28C N28O 1.259e-09
R29WB N29I N29W 4.561e-02
L29WB N29W N29R 1.126e-09
R29 N29R N29C 1.100e-03
C29 N29C ground 1.207e-13
L29 N29C N29O 1.259e-09
R30WB N30I N30W 4.810e-02
L30WB N30W N30R 1.174e-09
R30 N30R N30C 1.170e-03
C30 N30C ground 1.235e-13
L30 N30C N30O 1.321e-09
R31WB N31I N31W 4.976e-02
L31WB N31W N31R 1.206e-09
R31 N31R N31C 1.330e-03
C31 N31C ground 1.308e-13
L31 N31C N31O 1.437e-09
R32WB N32I N32W 5.432e-02
L32WB N32W N32R 1.295e-09
R32 N32R N32C 1.560e-03
C32 N32C ground 2.813e-13
L32 N32C N32O 1.584e-09
K0102 L01 L02 0.3413
K0102WB L01WB L02WB 0.2544
C0102 N01C N02C 1.426e-13
K0103 L01 L03 0.1426
K0103WB L01WB L03WB 0.1061
K0104 L01 L04 0.0720
K0104WB L01WB L04WB 0.0674
K0130 L01 L30 0.0607
K0131 L01 L31 0.1053
K0131WB L01WB L31WB 0.0799
K0132 L01 L32 0.1899
K0132WB L01WB L32WB 0.1729
K0203 L02 L03 0.3211
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K0203WB L02WB L03WB 0.2628
C0203 N02C N03C 1.205e-13
K0204 L02 L04 0.1333
K0204WB L02WB L04WB 0.1162
K0205 L02 L05 0.0701
K0205WB L02WB L05WB 0.0697
K0231 L02 L31 0.0706
K0232 L02 L32 0.1053
K0232WB L02WB L32WB 0.0799
K0304 L03 L04 0.3070
K0304WB L03WB L04WB 0.2809
C0304 N03C N04C 1.038e-13
K0305 L03 L05 0.1301
K0305WB L03WB L05WB 0.1200
K0306 L03 L06 0.0683
K0306WB L03WB L06WB 0.0719
K0332 L03 L32 0.0607
K0405 L04 L05 0.3070
K0405WB L04WB L05WB 0.2717
C0405 N04C N05C 1.041e-13
K0406 L04 L06 0.1301
K0406WB L04WB L06WB 0.1200
K0407 L04 L07 0.0701
K0407WB L04WB L07WB 0.0697
K0506 L05 L06 0.3070
K0506WB L05WB L06WB 0.2809
C0506 N05C N06C 1.038e-13
K0507 L05 L07 0.1333
K0507WB L05WB L07WB 0.1162
K0508 L05 L08 0.0720
K0508WB L05WB L08WB 0.0674
K0607 L06 L07 0.3211
K0607WB L06WB L07WB 0.2628
C0607 N06C N07C 1.205e-13
K0608 L06 L08 0.1426
K0608WB L06WB L08WB 0.1061
K0609 L06 L09 0.0607
K0708 L07 L08 0.3413
K0708WB L07WB L08WB 0.2544
C0708 N07C N08C 1.426e-13
K0709 L07 L09 0.1053
K0709WB L07WB L09WB 0.0799
K0710 L07 L10 0.0706
K0809 L08 L09 0.1899
K0809WB L08WB L09WB 0.1729
K0810 L08 L10 0.1053
K0810WB L08WB L10WB 0.0799
K0811 L08 L11 0.0607
K0910 L09 L10 0.3413
K0910WB L09WB L10WB 0.2544
C0910 N09C N10C 1.426e-13
K0911 L09 L11 0.1426
K0911WB L09WB L11WB 0.1061
K0912 L09 L12 0.0720
K0912WB L09WB L12WB 0.0674
K1011 L10 L11 0.3211
K1011WB L10WB L11WB 0.2628
C1011 N10C N11C 1.205e-13
K1012 L10 L12 0.1333
K1012WB L10WB L12WB 0.1162
K1013 L10 L13 0.0701
K1013WB L10WB L13WB 0.0697
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K1112 L11 L12 0.3070
K1112WB L11WB L12WB 0.2809
C1112 N11C N12C 1.038e-13
K1113 L11 L13 0.1301
K1113WB L11WB L13WB 0.1200
K1114 L11 L14 0.0683
K1114WB L11WB L14WB 0.0719
K1213 L12 L13 0.3070
K1213WB L12WB L13WB 0.2717
C1213 N12C N13C 1.041e-13
K1214 L12 L14 0.1301
K1214WB L12WB L14WB 0.1200
K1215 L12 L15 0.0701
K1215WB L12WB L15WB 0.0697
K1314 L13 L14 0.3070
K1314WB L13WB L14WB 0.2809
C1314 N13C N14C 1.038e-13
K1315 L13 L15 0.1333
K1315WB L13WB L15WB 0.1162
K1316 L13 L16 0.0720
K1316WB L13WB L16WB 0.0674
K1415 L14 L15 0.3211
K1415WB L14WB L15WB 0.2628
C1415 N14C N15C 1.205e-13
K1416 L14 L16 0.1426
K1416WB L14WB L16WB 0.1061
K1417 L14 L17 0.0607
K1516 L15 L16 0.3413
K1516WB L15WB L16WB 0.2544
C1516 N15C N16C 1.426e-13
K1517 L15 L17 0.1053
K1517WB L15WB L17WB 0.0799
K1518 L15 L18 0.0706
K1617 L16 L17 0.1899
K1617WB L16WB L17WB 0.1729
K1618 L16 L18 0.1053
K1618WB L16WB L18WB 0.0799
K1619 L16 L19 0.0607
K1718 L17 L18 0.3413
K1718WB L17WB L18WB 0.2544
C1718 N17C N18C 1.426e-13
K1719 L17 L19 0.1426
K1719WB L17WB L19WB 0.1061
K1720 L17 L20 0.0720
K1720WB L17WB L20WB 0.0674
K1819 L18 L19 0.3211
K1819WB L18WB L19WB 0.2628
C1819 N18C N19C 1.205e-13
K1820 L18 L20 0.1333
K1820WB L18WB L20WB 0.1162
K1821 L18 L21 0.0701
K1821WB L18WB L21WB 0.0697
K1920 L19 L20 0.3070
K1920WB L19WB L20WB 0.2809
C1920 N19C N20C 1.038e-13
K1921 L19 L21 0.1301
K1921WB L19WB L21WB 0.1200
K1922 L19 L22 0.0683
K1922WB L19WB L22WB 0.0719
K2021 L20 L21 0.3070
K2021WB L20WB L21WB 0.2717
C2021 N20C N21C 1.041e-13
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K2022 L20 L22 0.1301
K2022WB L20WB L22WB 0.1200
K2023 L20 L23 0.0701
K2023WB L20WB L23WB 0.0697
K2122 L21 L22 0.3070
K2122WB L21WB L22WB 0.2809
C2122 N21C N22C 1.038e-13
K2123 L21 L23 0.1333
K2123WB L21WB L23WB 0.1162
K2124 L21 L24 0.0720
K2124WB L21WB L24WB 0.0674
K2223 L22 L23 0.3211
K2223WB L22WB L23WB 0.2628
C2223 N22C N23C 1.205e-13
K2224 L22 L24 0.1426
K2224WB L22WB L24WB 0.1061
K2225 L22 L25 0.0607
K2324 L23 L24 0.3413
K2324WB L23WB L24WB 0.2544
C2324 N23C N24C 1.426e-13
K2325 L23 L25 0.1053
K2325WB L23WB L25WB 0.0799
K2326 L23 L26 0.0706
K2425 L24 L25 0.1899
K2425WB L24WB L25WB 0.1729
K2426 L24 L26 0.1053
K2426WB L24WB L26WB 0.0799
K2427 L24 L27 0.0607
K2526 L25 L26 0.3413
K2526WB L25WB L26WB 0.2544
C2526 N25C N26C 1.426e-13
K2527 L25 L27 0.1426
K2527WB L25WB L27WB 0.1061
K2528 L25 L28 0.0720
K2528WB L25WB L28WB 0.0674
K2627 L26 L27 0.3211
K2627WB L26WB L27WB 0.2628
C2627 N26C N27C 1.205e-13
K2628 L26 L28 0.1333
K2628WB L26WB L28WB 0.1162
K2629 L26 L29 0.0701
K2629WB L26WB L29WB 0.0697
K2728 L27 L28 0.3070
K2728WB L27WB L28WB 0.2809
C2728 N27C N28C 1.038e-13
K2729 L27 L29 0.1301
K2729WB L27WB L29WB 0.1200
K2730 L27 L30 0.0683
K2730WB L27WB L30WB 0.0719
K2829 L28 L29 0.3070
K2829WB L28WB L29WB 0.2717
C2829 N28C N29C 1.041e-13
K2830 L28 L30 0.1301
K2830WB L28WB L30WB 0.1200
K2831 L28 L31 0.0701
K2831WB L28WB L31WB 0.0697
K2930 L29 L30 0.3070
K2930WB L29WB L30WB 0.2809
C2930 N29C N30C 1.038e-13
K2931 L29 L31 0.1333
K2931WB L29WB L31WB 0.1162
K2932 L29 L32 0.0720
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K2932WB L29WB L32WB 0.0674
K3031 L30 L31 0.3211
K3031WB L30WB L31WB 0.2628
C3031 N30C N31C 1.205e-13
K3032 L30 L32 0.1426
K3032WB L30WB L32WB 0.1061
K3132 L31 L32 0.3413
K3132WB L31WB L32WB 0.2544
C3132 N31C N32C 1.426e-13
.ENDS PACKAGE
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Package: LQFP–52
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*********************************************************
* Note:
* 1. The model assume ground plane is 15 mil below package
*********************************************************
* Transmission line model
*
* Package: 52 pin LQFP
* Model for 52 pins
*
* Conductor number-pin designation cross reference:
*
*     Conductor      Pin
*         1            1
*         2            2
*         3            3
*         4            4
*         5            5
*         6            6
*         7            7
*         8            8
*         9            9
*        10           10
*        11           11
*        12           12
*        13           13
*        14           14
*        15           15
*        16           16
*        17           17
*        18           18
*        19           19
*        20           20
*        21           21
*        22           22
*        23           23
*        24           24
*        25           25
*        26           26
*        27           27
*        28           28
*        29           29
*        30           30
*        31           31
*        32           32
*        33           33
*        34           34
*        35           35
*        36           36
*        37           37
*        38           38
*        39           39
*        40           40
*        41           41
*        42           42
*        43           43
*        44           44
*        45           45
*        46           46
*        47           47
*        48           48
*        49           49
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*        50          50
*        51          51
*        52          52
*
* number of lumps: 1
* FASTEST APPLICABLE EDGE RATE: 0.160 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O N21I N21O N22I N22O N23I N23O N24I N24O
+ N25I N25O N26I N26O N27I N27O N28I N28O N29I N29O
+ N30I N30O N31I N31O N32I N32O N33I N33O N34I N34O
+ N35I N35O N36I N36O N37I N37O N38I N38O N39I N39O
+ N40I N40O N41I N41O N42I N42O N43I N43O N44I N44O
+ N45I N45O N46I N46O N47I N47O N48I N48O N49I N49O
+ N50I N50O N51I N51O N52I N52O BD_GND
R01WB  N01I   N01W   8.625e-02
L01WB  N01W   N01R   1.931e-09
R01    N01R   N01M   1.650e-02
L01l   N01M   N01C   1.113e-09
C01    N01C   BD_GND 2.107e-13
L01r   N01C   N01O   1.113e-09
R02WB  N02I   N02W   8.376e-02
L02WB  N02W   N02R   1.880e-09
R02    N02R   N02M   1.680e-02
L02l   N02M   N02C   1.063e-09
C02    N02C   BD_GND 6.598e-14
L02r   N02C   N02O   1.063e-09
R03WB  N03I   N03W   7.878e-02
L03WB  N03W   N03R   1.780e-09
R03    N03R   N03M   1.570e-02
L03l   N03M   N03C   9.940e-10
C03    N03C   BD_GND 5.694e-14
L03r   N03C   N03O   9.940e-10
R04WB  N04I   N04W   7.630e-02
L04WB  N04W   N04R   1.730e-09
R04    N04R   N04M   1.460e-02
L04l   N04M   N04C   9.368e-10
C04    N04C   BD_GND 5.233e-14
L04r   N04C   N04O   9.368e-10
R05WB  N05I   N05W   7.422e-02
L05WB  N05W   N05R   1.688e-09
R05    N05R   N05M   1.380e-02
L05l   N05M   N05C   8.830e-10
C05    N05C   BD_GND 4.810e-14
L05r   N05C   N05O   8.830e-10
R06WB  N06I   N06W   7.381e-02
L06WB  N06W   N06R   1.680e-09
R06    N06R   N06M   1.330e-02
L06l   N06M   N06C   8.557e-10
C06    N06C   BD_GND 4.665e-14
L06r   N06C   N06O   8.557e-10
R07WB  N07I   N07W   7.298e-02
L07WB  N07W   N07R   1.663e-09
R07    N07R   N07M   1.290e-02
L07l   N07M   N07C   8.187e-10
C07    N07C   BD_GND 4.714e-14
L07r   N07C   N07O   8.187e-10
R08WB  N08I   N08W   7.464e-02
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L08WB  N08W   N08R  1.696e-09
R08    N08R   N08M  1.330e-02
L08l   N08M   N08C  8.557e-10
C08    N08C   BD_GND 4.665e-14
L08r   N08C   N08O  8.557e-10
R09WB  N09I   N09W  7.422e-02
L09WB  N09W   N09R  1.688e-09
R09    N09R   N09M  1.380e-02
L09l   N09M   N09C  8.830e-10
C09    N09C   BD_GND 4.810e-14
L09r   N09C   N09O  8.830e-10
R10WB  N10I   N10W  7.630e-02
L10WB  N10W   N10R  1.730e-09
R10    N10R   N10M  1.460e-02
L10l   N10M   N10C  9.368e-10
C10    N10C   BD_GND 5.233e-14
L10r   N10C   N10O  9.368e-10
R11WB  N11I   N11W  7.878e-02
L11WB  N11W   N11R  1.780e-09
R11    N11R   N11M  1.570e-02
L11l   N11M   N11C  9.940e-10
C11    N11C   BD_GND 5.694e-14
L11r   N11C   N11O  9.940e-10
R12WB  N12I   N12W  8.376e-02
L12WB  N12W   N12R  1.880e-09
R12    N12R   N12M  1.680e-02
L12l   N12M   N12C  1.063e-09
C12    N12C   BD_GND 6.598e-14
L12r   N12C   N12O  1.063e-09
R13WB  N13I   N13W  8.998e-02
L13WB  N13W   N13R  2.008e-09
R13    N13R   N13M  1.650e-02
L13l   N13M   N13C  1.113e-09
C13    N13C   BD_GND 2.107e-13
L13r   N13C   N13O  1.113e-09
R14WB  N14I   N14W  8.625e-02
L14WB  N14W   N14R  1.931e-09
R14    N14R   N14M  1.650e-02
L14l   N14M   N14C  1.113e-09
C14    N14C   BD_GND 2.107e-13
L14r   N14C   N14O  1.113e-09
R15WB  N15I   N15W  8.086e-02
L15WB  N15W   N15R  1.822e-09
R15    N15R   N15M  1.680e-02
L15l   N15M   N15C  1.063e-09
C15    N15C   BD_GND 6.598e-14
L15r   N15C   N15O  1.063e-09
R16WB  N16I   N16W  7.671e-02
L16WB  N16W   N16R  1.738e-09
R16    N16R   N16M  1.570e-02
L16l   N16M   N16C  9.940e-10
C16    N16C   BD_GND 5.694e-14
L16r   N16C   N16O  9.940e-10
R17WB  N17I   N17W  7.422e-02
L17WB  N17W   N17R  1.688e-09
R17    N17R   N17M  1.460e-02
L17l   N17M   N17C  9.368e-10
C17    N17C   BD_GND 5.233e-14
L17r   N17C   N17O  9.368e-10
R18WB  N18I   N18W  7.298e-02
L18WB  N18W   N18R  1.663e-09
R18    N18R   N18M  1.380e-02
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L18l    N18M    N18C    8.830e-10
C18     N18C    BD_GND  4.810e-14
L18r    N18C    N18O    8.830e-10
R19WB   N19I    N19W    7.381e-02
L19WB   N19W    N19R    1.680e-09
R19     N19R    N19M    1.330e-02
L19l    N19M    N19C    8.557e-10
C19     N19C    BD_GND  4.665e-14
L19r    N19C    N19O    8.557e-10
R20WB   N20I    N20W    7.298e-02
L20WB   N20W    N20R    1.663e-09
R20     N20R    N20M    1.290e-02
L20l    N20M    N20C    8.187e-10
C20     N20C    BD_GND  4.714e-14
L20r    N20C    N20O    8.187e-10
R21WB   N21I    N21W    7.464e-02
L21WB   N21W    N21R    1.696e-09
R21     N21R    N21M    1.330e-02
L21l    N21M    N21C    8.557e-10
C21     N21C    BD_GND  4.665e-14
L21r    N21C    N21O    8.557e-10
R22WB   N22I    N22W    7.588e-02
L22WB   N22W    N22R    1.721e-09
R22     N22R    N22M    1.380e-02
L22l    N22M    N22C    8.830e-10
C22     N22C    BD_GND  4.810e-14
L22r    N22C    N22O    8.830e-10
R23WB   N23I    N23W    7.630e-02
L23WB   N23W    N23R    1.730e-09
R23     N23R    N23M    1.460e-02
L23l    N23M    N23C    9.368e-10
C23     N23C    BD_GND  5.233e-14
L23r    N23C    N23O    9.368e-10
R24WB   N24I    N24W    7.878e-02
L24WB   N24W    N24R    1.780e-09
R24     N24R    N24M    1.570e-02
L24l    N24M    N24C    9.940e-10
C24     N24C    BD_GND  5.694e-14
L24r    N24C    N24O    9.940e-10
R25WB   N25I    N25W    8.376e-02
L25WB   N25W    N25R    1.880e-09
R25     N25R    N25M    1.680e-02
L25l    N25M    N25C    1.063e-09
C25     N25C    BD_GND  6.598e-14
L25r    N25C    N25O    1.063e-09
R26WB   N26I    N26W    8.998e-02
L26WB   N26W    N26R    2.008e-09
R26     N26R    N26M    1.650e-02
L26l    N26M    N26C    1.113e-09
C26     N26C    BD_GND  2.107e-13
L26r    N26C    N26O    1.113e-09
R27WB   N27I    N27W    8.625e-02
L27WB   N27W    N27R    1.931e-09
R27     N27R    N27M    1.650e-02
L27l    N27M    N27C    1.113e-09
C27     N27C    BD_GND  2.107e-13
L27r    N27C    N27O    1.113e-09
R28WB   N28I    N28W    8.086e-02
L28WB   N28W    N28R    1.822e-09
R28     N28R    N28M    1.680e-02
L28l    N28M    N28C    1.063e-09
C28     N28C    BD_GND  6.598e-14
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L28r   N28C  N28O  1.063e-09
R29WB  N29I  N29W  7.671e-02
L29WB  N29W  N29R  1.738e-09
R29    N29R  N29M  1.570e-02
L29l   N29M  N29C  9.940e-10
C29    N29C  BD_GND 5.694e-14
L29r   N29C  N29O  9.940e-10
R30WB  N30I  N30W  7.422e-02
L30WB  N30W  N30R  1.688e-09
R30    N30R  N30M  1.460e-02
L30l   N30M  N30C  9.368e-10
C30    N30C  BD_GND 5.233e-14
L30r   N30C  N30O  9.368e-10
R31WB  N31I  N31W  7.298e-02
L31WB  N31W  N31R  1.663e-09
R31    N31R  N31M  1.380e-02
L31l   N31M  N31C  8.830e-10
C31    N31C  BD_GND 4.810e-14
L31r   N31C  N31O  8.830e-10
R32WB  N32I  N32W  7.381e-02
L32WB  N32W  N32R  1.680e-09
R32    N32R  N32M  1.330e-02
L32l   N32M  N32C  8.557e-10
C32    N32C  BD_GND 4.665e-14
L32r   N32C  N32O  8.557e-10
R33WB  N33I  N33W  7.298e-02
L33WB  N33W  N33R  1.663e-09
R33    N33R  N33M  1.290e-02
L33l   N33M  N33C  8.187e-10
C33    N33C  BD_GND 4.714e-14
L33r   N33C  N33O  8.187e-10
R34WB  N34I  N34W  7.464e-02
L34WB  N34W  N34R  1.696e-09
R34    N34R  N34M  1.330e-02
L34l   N34M  N34C  8.557e-10
C34    N34C  BD_GND 4.665e-14
L34r   N34C  N34O  8.557e-10
R35WB  N35I  N35W  7.588e-02
L35WB  N35W  N35R  1.721e-09
R35    N35R  N35M  1.380e-02
L35l   N35M  N35C  8.830e-10
C35    N35C  BD_GND 4.810e-14
L35r   N35C  N35O  8.830e-10
R36WB  N36I  N36W  7.630e-02
L36WB  N36W  N36R  1.730e-09
R36    N36R  N36M  1.460e-02
L36l   N36M  N36C  9.368e-10
C36    N36C  BD_GND 5.233e-14
L36r   N36C  N36O  9.368e-10
R37WB  N37I  N37W  7.878e-02
L37WB  N37W  N37R  1.780e-09
R37    N37R  N37M  1.570e-02
L37l   N37M  N37C  9.940e-10
C37    N37C  BD_GND 5.694e-14
L37r   N37C  N37O  9.940e-10
R38WB  N38I  N38W  8.376e-02
L38WB  N38W  N38R  1.880e-09
R38    N38R  N38M  1.680e-02
L38l   N38M  N38C  1.063e-09
C38    N38C  BD_GND 6.598e-14
L38r   N38C  N38O  1.063e-09
R39WB  N39I  N39W  8.998e-02
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L39WB  N39W   N39R   2.008e-09
R39    N39R   N39M   1.650e-02
L39l   N39M   N39C   1.113e-09
C39    N39C   BD_GND 2.107e-13
L39r   N39C   N39O   1.113e-09
R40WB  N40I   N40W   8.625e-02
L40WB  N40W   N40R   1.931e-09
R40    N40R   N40M   1.650e-02
L40l   N40M   N40C   1.113e-09
C40    N40C   BD_GND 2.107e-13
L40r   N40C   N40O   1.113e-09
R41WB  N41I   N41W   8.086e-02
L41WB  N41W   N41R   1.822e-09
R41    N41R   N41M   1.680e-02
L41l   N41M   N41C   1.063e-09
C41    N41C   BD_GND 6.598e-14
L41r   N41C   N41O   1.063e-09
R42WB  N42I   N42W   7.671e-02
L42WB  N42W   N42R   1.738e-09
R42    N42R   N42M   1.570e-02
L42l   N42M   N42C   9.940e-10
C42    N42C   BD_GND 5.694e-14
L42r   N42C   N42O   9.940e-10
R43WB  N43I   N43W   7.422e-02
L43WB  N43W   N43R   1.688e-09
R43    N43R   N43M   1.460e-02
L43l   N43M   N43C   9.368e-10
C43    N43C   BD_GND 5.233e-14
L43r   N43C   N43O   9.368e-10
R44WB  N44I   N44W   7.298e-02
L44WB  N44W   N44R   1.663e-09
R44    N44R   N44M   1.380e-02
L44l   N44M   N44C   8.830e-10
C44    N44C   BD_GND 4.810e-14
L44r   N44C   N44O   8.830e-10
R45WB  N45I   N45W   7.381e-02
L45WB  N45W   N45R   1.680e-09
R45    N45R   N45M   1.330e-02
L45l   N45M   N45C   8.557e-10
C45    N45C   BD_GND 4.665e-14
L45r   N45C   N45O   8.557e-10
R46WB  N46I   N46W   7.298e-02
L46WB  N46W   N46R   1.663e-09
R46    N46R   N46M   1.290e-02
L46l   N46M   N46C   8.187e-10
C46    N46C   BD_GND 4.714e-14
L46r   N46C   N46O   8.187e-10
R47WB  N47I   N47W   7.464e-02
L47WB  N47W   N47R   1.696e-09
R47    N47R   N47M   1.330e-02
L47l   N47M   N47C   8.557e-10
C47    N47C   BD_GND 4.665e-14
L47r   N47C   N47O   8.557e-10
R48WB  N48I   N48W   7.588e-02
L48WB  N48W   N48R   1.721e-09
R48    N48R   N48M   1.380e-02
L48l   N48M   N48C   8.830e-10
C48    N48C   BD_GND 4.810e-14
L48r   N48C   N48O   8.830e-10
R49WB  N49I   N49W   7.630e-02
L49WB  N49W   N49R   1.730e-09
R49    N49R   N49M   1.460e-02
```

```
L49l    N49M    N49C   9.368e-10
C49     N49C    BD_GND 5.233e-14
L49r    N49C    N49O   9.368e-10
R50WB   N50I    N50W   7.878e-02
L50WB   N50W    N50R   1.780e-09
R50     N50R    N50M   1.570e-02
L50l    N50M    N50C   9.940e-10
C50     N50C    BD_GND 5.694e-14
L50r    N50C    N50O   9.940e-10
R51WB   N51I    N51W   8.376e-02
L51WB   N51W    N51R   1.880e-09
R51     N51R    N51M   1.680e-02
L51l    N51M    N51C   1.063e-09
C51     N51C    BD_GND 6.598e-14
L51r    N51C    N51O   1.063e-09
R52WB   N52I    N52W   8.998e-02
L52WB   N52W    N52R   2.008e-09
R52     N52R    N52M   1.650e-02
L52l    N52M    N52C   1.113e-09
C52     N52C    BD_GND 2.107e-13
L52r    N52C    N52O   1.113e-09
.ENDS PACKAGE
*
*
```

Package: LQFP-64
```
***********************************************************
* Note:
* 1. The model assume ground plane is 15 mil below package
***********************************************************
* Transmission line model
*
* Package: 64 pins LQFP
* Model for 64 pins
*
*
* Conductor number-pin designation cross reference:
*
*     Conductor      Pin
*         1            1
*         2            2
*         3            3
*         4            4
*         5            5
*         6            6
*         7            7
*         8            8
*         9            9
*        10           10
*        11           11
*        12           12
*        13           13
*        14           14
*        15           15
*        16           16
*        17           17
*        18           18
*        19           19
*        20           20
*        21           21
*        22           22
*        23           23
*        24           24
*        25           25
*        26           26
*        27           27
*        28           28
*        29           29
*        30           30
*        31           31
*        32           32
*        33           33
*        34           34
*        35           35
*        36           36
*        37           37
*        38           38
*        39           39
*        40           40
*        41           41
*        42           42
*        43           43
*        44           44
*        45           45
*        46           46
*        47           47
*        48           48
```

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*        49        49
*        50        50
*        51        51
*        52        52
*        53        53
*        54        54
*        55        55
*        56        56
*        57        57
*        58        58
*        59        59
*        60        60
*        61        61
*        62        62
*        63        63
*        64        64
*
* number of lumps:        1
* FASTEST APPLICABLE EDGE RATE:          0.153 ns
* COMPRESSION OF SUBCIRCUITS PERFORMED: discard ratio is 0.050
*
.SUBCKT PACKAGE N01I N01O N02I N02O N03I N03O N04I N04O
+ N05I N05O N06I N06O N07I N07O N08I N08O N09I N09O
+ N10I N10O N11I N11O N12I N12O N13I N13O N14I N14O
+ N15I N15O N16I N16O N17I N17O N18I N18O N19I N19O
+ N20I N20O N21I N21O N22I N22O N23I N23O N24I N24O
+ N25I N25O N26I N26O N27I N27O N28I N28O N29I N29O
+ N30I N30O N31I N31O N32I N32O N33I N33O N34I N34O
+ N35I N35O N36I N36O N37I N37O N38I N38O N39I N39O
+ N40I N40O N41I N41O N42I N42O N43I N43O N44I N44O
+ N45I N45O N46I N46O N47I N47O N48I N48O N49I N49O
+ N50I N50O N51I N51O N52I N52O N53I N53O N54I N54O
+ N55I N55O N56I N56O N57I N57O N58I N58O N59I N59O
+ N60I N60O N61I N61O N62I N62O N63I N63O N64I N64O VEE_EXT
R01WB    N01I     N01W     1.053e-01
L01WB    N01W     N01R     2.326e-09
R01      N01R     N01C     1.650e-02
C01      N01C     VEE_EXT  2.653e-13
L01      N01C     N01O     1.921e-09
R02WB    N02I     N02W     9.827e-02
L02WB    N02W     N02R     2.179e-09
R02      N02R     N02C     1.690e-02
C02      N02C     VEE_EXT  1.034e-13
L02      N02C     N02O     1.801e-09
R03WB    N03I     N03W     9.288e-02
L03WB    N03W     N03R     2.067e-09
R03      N03R     N03C     1.660e-02
C03      N03C     VEE_EXT  8.350e-14
L03      N03C     N03O     1.765e-09
R04WB    N04I     N04W     8.874e-02
L04WB    N04W     N04R     1.982e-09
R04      N04R     N04C     1.600e-02
C04      N04C     VEE_EXT  8.115e-14
L04      N04C     N04O     1.705e-09
R05WB    N05I     N05W     8.708e-02
L05WB    N05W     N05R     1.948e-09
R05      N05R     N05C     1.560e-02
C05      N05C     VEE_EXT  7.954e-14
L05      N05C     N05O     1.650e-09
R06WB    N06I     N06W     8.583e-02
L06WB    N06W     N06R     1.923e-09
R06      N06R     N06C     1.520e-02
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C06     N06C    VEE_EXT 7.774e-14
L06     N06C    N06O    1.613e-09
R07WB   N07I    N07W    8.500e-02
L07WB   N07W    N07R    1.906e-09
R07     N07R    N07C    1.470e-02
C07     N07C    VEE_EXT 7.184e-14
L07     N07C    N07O    1.550e-09
R08WB   N08I    N08W    8.583e-02
L08WB   N08W    N08R    1.923e-09
R08     N08R    N08C    1.420e-02
C08     N08C    VEE_EXT 7.198e-14
L08     N08C    N08O    1.566e-09
R09WB   N09I    N09W    8.583e-02
L09WB   N09W    N09R    1.923e-09
R09     N09R    N09C    1.420e-02
C09     N09C    VEE_EXT 7.198e-14
L09     N09C    N09O    1.566e-09
R10WB   N10I    N10W    8.500e-02
L10WB   N10W    N10R    1.906e-09
R10     N10R    N10C    1.470e-02
C10     N10C    VEE_EXT 7.184e-14
L10     N10C    N10O    1.550e-09
R11WB   N11I    N11W    8.583e-02
L11WB   N11W    N11R    1.923e-09
R11     N11R    N11C    1.520e-02
C11     N11C    VEE_EXT 7.774e-14
L11     N11C    N11O    1.613e-09
R12WB   N12I    N12W    8.708e-02
L12WB   N12W    N12R    1.948e-09
R12     N12R    N12C    1.560e-02
C12     N12C    VEE_EXT 7.954e-14
L12     N12C    N12O    1.650e-09
R13WB   N13I    N13W    8.874e-02
L13WB   N13W    N13R    1.982e-09
R13     N13R    N13C    1.600e-02
C13     N13C    VEE_EXT 8.115e-14
L13     N13C    N13O    1.705e-09
R14WB   N14I    N14W    9.288e-02
L14WB   N14W    N14R    2.067e-09
R14     N14R    N14C    1.660e-02
C14     N14C    VEE_EXT 8.350e-14
L14     N14C    N14O    1.765e-09
R15WB   N15I    N15W    9.827e-02
L15WB   N15W    N15R    2.179e-09
R15     N15R    N15C    1.690e-02
C15     N15C    VEE_EXT 1.034e-13
L15     N15C    N15O    1.801e-09
R16WB   N16I    N16W    1.053e-01
L16WB   N16W    N16R    2.326e-09
R16     N16R    N16C    1.650e-02
C16     N16C    VEE_EXT 2.653e-13
L16     N16C    N16O    1.921e-09
R17WB   N17I    N17W    1.053e-01
L17WB   N17W    N17R    2.326e-09
R17     N17R    N17C    1.650e-02
C17     N17C    VEE_EXT 2.653e-13
L17     N17C    N17O    1.921e-09
R18WB   N18I    N18W    9.827e-02
L18WB   N18W    N18R    2.179e-09
R18     N18R    N18C    1.690e-02
C18     N18C    VEE_EXT 1.034e-13
L18     N18C    N18O    1.801e-09
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R19WB    N19I     N19W     9.288e-02
L19WB    N19W     N19R     2.067e-09
R19      N19R     N19C     1.660e-02
C19      N19C     VEE_EXT  8.350e-14
L19      N19C     N19O     1.765e-09
R20WB    N20I     N20W     8.874e-02
L20WB    N20W     N20R     1.982e-09
R20      N20R     N20C     1.600e-02
C20      N20C     VEE_EXT  8.115e-14
L20      N20C     N20O     1.705e-09
R21WB    N21I     N21W     8.708e-02
L21WB    N21W     N21R     1.948e-09
R21      N21R     N21C     1.560e-02
C21      N21C     VEE_EXT  7.954e-14
L21      N21C     N21O     1.650e-09
R22WB    N22I     N22W     8.583e-02
L22WB    N22W     N22R     1.923e-09
R22      N22R     N22C     1.520e-02
C22      N22C     VEE_EXT  7.774e-14
L22      N22C     N22O     1.613e-09
R23WB    N23I     N23W     8.500e-02
L23WB    N23W     N23R     1.906e-09
R23      N23R     N23C     1.470e-02
C23      N23C     VEE_EXT  7.184e-14
L23      N23C     N23O     1.550e-09
R24WB    N24I     N24W     8.583e-02
L24WB    N24W     N24R     1.923e-09
R24      N24R     N24C     1.420e-02
C24      N24C     VEE_EXT  7.198e-14
L24      N24C     N24O     1.566e-09
R25WB    N25I     N25W     8.583e-02
L25WB    N25W     N25R     1.923e-09
R25      N25R     N25C     1.420e-02
C25      N25C     VEE_EXT  7.198e-14
L25      N25C     N25O     1.566e-09
R26WB    N26I     N26W     8.500e-02
L26WB    N26W     N26R     1.906e-09
R26      N26R     N26C     1.470e-02
C26      N26C     VEE_EXT  7.184e-14
L26      N26C     N26O     1.550e-09
R27WB    N27I     N27W     8.583e-02
L27WB    N27W     N27R     1.923e-09
R27      N27R     N27C     1.520e-02
C27      N27C     VEE_EXT  7.774e-14
L27      N27C     N27O     1.613e-09
R28WB    N28I     N28W     8.708e-02
L28WB    N28W     N28R     1.948e-09
R28      N28R     N28C     1.560e-02
C28      N28C     VEE_EXT  7.954e-14
L28      N28C     N28O     1.650e-09
R29WB    N29I     N29W     8.874e-02
L29WB    N29W     N29R     1.982e-09
R29      N29R     N29C     1.600e-02
C29      N29C     VEE_EXT  8.115e-14
L29      N29C     N29O     1.705e-09
R30WB    N30I     N30W     9.288e-02
L30WB    N30W     N30R     2.067e-09
R30      N30R     N30C     1.660e-02
C30      N30C     VEE_EXT  8.350e-14
L30      N30C     N30O     1.765e-09
R31WB    N31I     N31W     9.827e-02
L31WB    N31W     N31R     2.179e-09
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R31      N31R    N31C      1.690e-02
C31      N31C    VEE_EXT   1.034e-13
L31      N31C    N31O      1.801e-09
R32WB    N32I    N32W      1.053e-01
L32WB    N32W    N32R      2.326e-09
R32      N32R    N32C      1.650e-02
C32      N32C    VEE_EXT   2.653e-13
L32      N32C    N32O      1.921e-09
R33WB    N33I    N33W      1.053e-01
L33WB    N33W    N33R      2.326e-09
R33      N33R    N33C      1.650e-02
C33      N33C    VEE_EXT   2.653e-13
L33      N33C    N33O      1.921e-09
R34WB    N34I    N34W      9.827e-02
L34WB    N34W    N34R      2.179e-09
R34      N34R    N34C      1.690e-02
C34      N34C    VEE_EXT   1.034e-13
L34      N34C    N34O      1.801e-09
R35WB    N35I    N35W      9.288e-02
L35WB    N35W    N35R      2.067e-09
R35      N35R    N35C      1.660e-02
C35      N35C    VEE_EXT   8.350e-14
L35      N35C    N35O      1.765e-09
R36WB    N36I    N36W      8.874e-02
L36WB    N36W    N36R      1.982e-09
R36      N36R    N36C      1.600e-02
C36      N36C    VEE_EXT   8.115e-14
L36      N36C    N36O      1.705e-09
R37WB    N37I    N37W      8.708e-02
L37WB    N37W    N37R      1.948e-09
R37      N37R    N37C      1.560e-02
C37      N37C    VEE_EXT   7.954e-14
L37      N37C    N37O      1.650e-09
R38WB    N38I    N38W      8.583e-02
L38WB    N38W    N38R      1.923e-09
R38      N38R    N38C      1.520e-02
C38      N38C    VEE_EXT   7.774e-14
L38      N38C    N38O      1.613e-09
R39WB    N39I    N39W      8.500e-02
L39WB    N39W    N39R      1.906e-09
R39      N39R    N39C      1.470e-02
C39      N39C    VEE_EXT   7.184e-14
L39      N39C    N39O      1.550e-09
R40WB    N40I    N40W      8.583e-02
L40WB    N40W    N40R      1.923e-09
R40      N40R    N40C      1.420e-02
C40      N40C    VEE_EXT   7.198e-14
L40      N40C    N40O      1.566e-09
R41WB    N41I    N41W      8.583e-02
L41WB    N41W    N41R      1.923e-09
R41      N41R    N41C      1.420e-02
C41      N41C    VEE_EXT   7.198e-14
L41      N41C    N41O      1.566e-09
R42WB    N42I    N42W      8.500e-02
L42WB    N42W    N42R      1.906e-09
R42      N42R    N42C      1.470e-02
C42      N42C    VEE_EXT   7.184e-14
L42      N42C    N42O      1.550e-09
R43WB    N43I    N43W      8.583e-02
L43WB    N43W    N43R      1.923e-09
R43      N43R    N43C      1.520e-02
C43      N43C    VEE_EXT   7.774e-14
```

```
L43      N43C    N43O    1.613e-09
R44WB    N44I    N44W    8.708e-02
L44WB    N44W    N44R    1.948e-09
R44      N44R    N44C    1.560e-02
C44      N44C    VEE_EXT 7.954e-14
L44      N44C    N44O    1.650e-09
R45WB    N45I    N45W    8.874e-02
L45WB    N45W    N45R    1.982e-09
R45      N45R    N45C    1.600e-02
C45      N45C    VEE_EXT 8.115e-14
L45      N45C    N45O    1.705e-09
R46WB    N46I    N46W    9.288e-02
L46WB    N46W    N46R    2.067e-09
R46      N46R    N46C    1.660e-02
C46      N46C    VEE_EXT 8.350e-14
L46      N46C    N46O    1.765e-09
R47WB    N47I    N47W    9.827e-02
L47WB    N47W    N47R    2.179e-09
R47      N47R    N47C    1.690e-02
C47      N47C    VEE_EXT 1.034e-13
L47      N47C    N47O    1.801e-09
R48WB    N48I    N48W    1.053e-01
L48WB    N48W    N48R    2.326e-09
R48      N48R    N48C    1.650e-02
C48      N48C    VEE_EXT 2.653e-13
L48      N48C    N48O    1.921e-09
R49WB    N49I    N49W    1.053e-01
L49WB    N49W    N49R    2.326e-09
R49      N49R    N49C    1.650e-02
C49      N49C    VEE_EXT 2.653e-13
L49      N49C    N49O    1.921e-09
R50WB    N50I    N50W    9.827e-02
L50WB    N50W    N50R    2.179e-09
R50      N50R    N50C    1.690e-02
C50      N50C    VEE_EXT 1.034e-13
L50      N50C    N50O    1.801e-09
R51WB    N51I    N51W    9.288e-02
L51WB    N51W    N51R    2.067e-09
R51      N51R    N51C    1.660e-02
C51      N51C    VEE_EXT 8.350e-14
L51      N51C    N51O    1.765e-09
R52WB    N52I    N52W    8.874e-02
L52WB    N52W    N52R    1.982e-09
R52      N52R    N52C    1.600e-02
C52      N52C    VEE_EXT 8.115e-14
L52      N52C    N52O    1.705e-09
R53WB    N53I    N53W    8.708e-02
L53WB    N53W    N53R    1.948e-09
R53      N53R    N53C    1.560e-02
C53      N53C    VEE_EXT 7.954e-14
L53      N53C    N53O    1.650e-09
R54WB    N54I    N54W    8.583e-02
L54WB    N54W    N54R    1.923e-09
R54      N54R    N54C    1.520e-02
C54      N54C    VEE_EXT 7.774e-14
L54      N54C    N54O    1.613e-09
R55WB    N55I    N55W    8.500e-02
L55WB    N55W    N55R    1.906e-09
R55      N55R    N55C    1.470e-02
C55      N55C    VEE_EXT 7.184e-14
L55      N55C    N55O    1.550e-09
R56WB    N56I    N56W    8.583e-02
```

```
L56WB    N56W    N56R    1.923e-09
R56      N56R    N56C    1.420e-02
C56      N56C    VEE_EXT 7.198e-14
L56      N56C    N56O    1.566e-09
R57WB    N57I    N57W    8.583e-02
L57WB    N57W    N57R    1.923e-09
R57      N57R    N57C    1.420e-02
C57      N57C    VEE_EXT 7.198e-14
L57      N57C    N57O    1.566e-09
R58WB    N58I    N58W    8.500e-02
L58WB    N58W    N58R    1.906e-09
R58      N58R    N58C    1.470e-02
C58      N58C    VEE_EXT 7.184e-14
L58      N58C    N58O    1.550e-09
R59WB    N59I    N59W    8.583e-02
L59WB    N59W    N59R    1.923e-09
R59      N59R    N59C    1.520e-02
C59      N59C    VEE_EXT 7.774e-14
L59      N59C    N59O    1.613e-09
R60WB    N60I    N60W    8.708e-02
L60WB    N60W    N60R    1.948e-09
R60      N60R    N60C    1.560e-02
C60      N60C    VEE_EXT 7.954e-14
L60      N60C    N60O    1.650e-09
R61WB    N61I    N61W    8.874e-02
L61WB    N61W    N61R    1.982e-09
R61      N61R    N61C    1.600e-02
C61      N61C    VEE_EXT 8.115e-14
L61      N61C    N61O    1.705e-09
R62WB    N62I    N62W    9.288e-02
L62WB    N62W    N62R    2.067e-09
R62      N62R    N62C    1.660e-02
C62      N62C    VEE_EXT 8.350e-14
L62      N62C    N62O    1.765e-09
R63WB    N63I    N63W    9.827e-02
L63WB    N63W    N63R    2.179e-09
R63      N63R    N63C    1.690e-02
C63      N63C    VEE_EXT 1.034e-13
L63      N63C    N63O    1.801e-09
R64WB    N64I    N64W    1.053e-01
L64WB    N64W    N64R    2.326e-09
R64      N64R    N64C    1.650e-02
C64      N64C    VEE_EXT 2.653e-13
L64      N64C    N64O    1.921e-09
.ENDS PACKAGE
*
*
```

APPENDIX A

Package Models Help

In the SPICE netlist, X_777 is a circuit element (black box) with connections to a subcircuit:

```
circuit element   connections                                   subcircuit
X_777             N01I N01O N02I N02O N03I N03O N04I N04O
                  +N05I N05O N06I N06O N07I N07O N08I N08O GND     PACKAGE
```

The defined connection nodes of the circuit element are declared as:

```
                  N01I N01O N02I N02O N03I N03O N04I N04O
                  N05I N05O N06I N06O N07I N07O N08I N08O GND
```

The subcircuit PACKAGE is connected to these same nodes:

```
.SUBCKT PACKAGE   N01I N01O N02I N02O N03I N03O N04I N04O
                  +N05I N05O N06I N06O N07I N07O N08I N08O GND
```

where:

```
                  N01I is the PACKAGE pin #1 internal node connection to the chip pad
                  N01O is the PACKAGE pin #1 external node connecting to the lead
```

Internal to the subcircuit PACKAGE are several nodes for each pin (See Figure 7). For pin 2, of the 8 pin TSSOP, the netlist:

```
R02WB     N02I     N02W     3.815e-02
L02WB     N02W     N02R     9.835e-10
R02       N02R     N02C     9.680e-04
C02       N02C     GND      7.711e-14
L02       N02C     N02O     7.466e-10
```
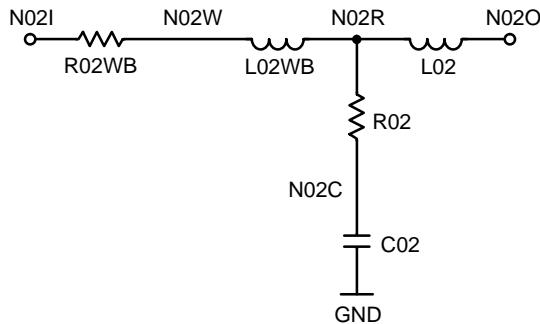

Figure 21.

Parasitic Mutual inductance, K, and capacitance, C, is also represented. Such as "K0102", where inductance from Lead #1 (L01) to Lead #2 (L02) is indicated.

```
K0102     L01      L02      0.2481
K0102WB   L01WB    L02WB    0.1729
C0102     N01C     N02C     2.283e-14
K0103     L01      L03      0.1067
K0103WB   L01WB    L03WB    0.0598
K0104     L01      L04      0.0593
K0203     L02      L03      0.2479
K0203WB   L02WB    L03WB    0.1463
C0203     N02C     N03C     2.136e-14
K0204     L02      L04      0.1068
K0204WB   L02WB    L04WB    0.0598
```
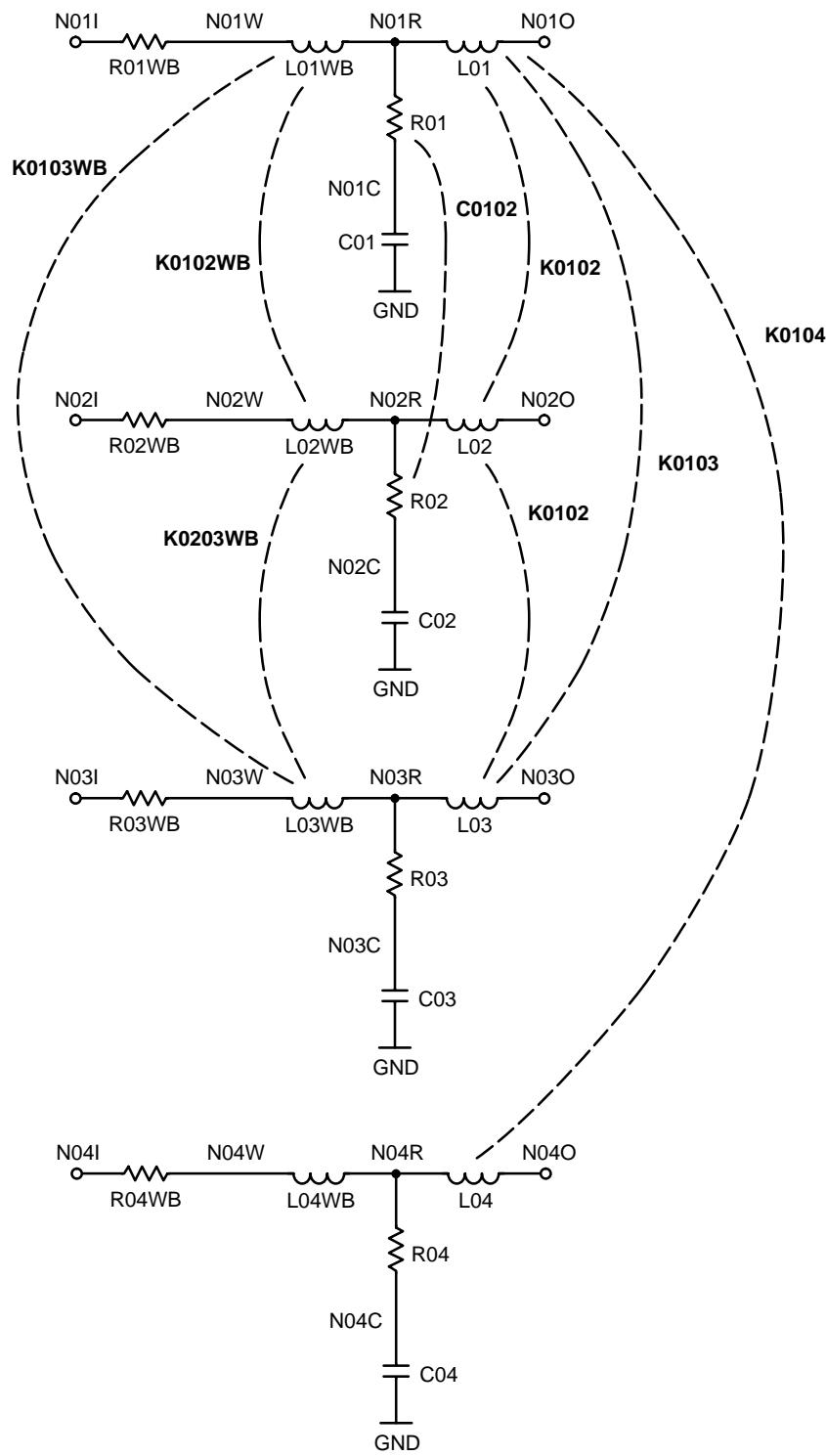
Figure 22.

<u>Notes</u>

ECLinPS Plus is a trademark of Semiconductor Components Industries, LLC.