

# ON Semiconductor

## Is Now

# onsemi™

To learn more about onsemi™, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

---

**onsemi** and **onsemi** and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi** product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.



## ECLinPS Lite™ MC100LVELT22 SPICE Model Kit

Prepared by  
Paul Shockman

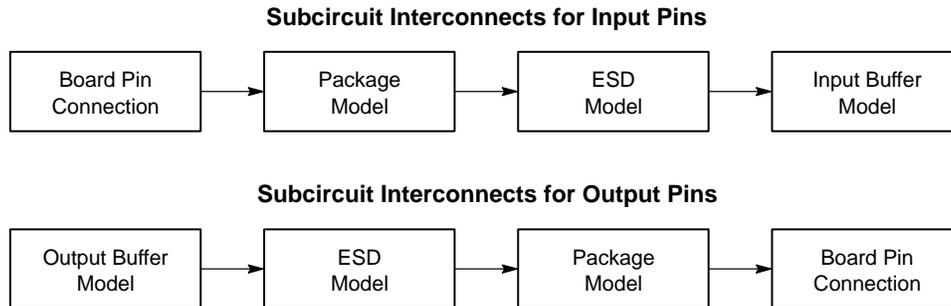
ON Semiconductor Logic Applications Engineering

### APPLICATION NOTE

#### Introduction

The objective of this kit is to provide schematic and SPICE parameter information for performing system level interconnect modeling with the Low Voltage ECLinPS Lite Translator TTL to PECL “LVELT22” device. The LVELT22 device is a dual 1 Bit translator from LVTTTL/LVCMOS levels to PECL levels. This kit contains model netlists and

transistor parameter descriptions for the Input and Output buffers, package models, and ESD protection networks for Input and Output circuits used by the LVELT22 device. These may be interconnected as subcircuits to simulate buffer signals.



**Figure 1. Input and Output Models**

#### Input and Output Buffers

The LVTTTL–LVPECL Translator subcircuits use SPICE level 3 netlists in circuit buffer models LVTTTLIN and LVTTTLOUT. All inputs and outputs are protected by ESD “Electro Static Discharge” protection circuitry. If the user would like to just simulate the output behavior, LVTTTLOUT circuit can be stimulated with internal signals levels:

Voltage Internal Input Low	VIII	VCC–1.1
Voltage Internal Input High	VIIH	VCC–0.8

#### Package

The MC100LVELT22 is only packaged in the 8 pin SOIC case outline. The coupled transmission line package model, LINES, may be added to all external pins. In this subcircuit model, all external board side connections of input, output, and supply pins are called N\*\*O and all internal chip side connections of input, output, and supply pins are referred to as N\*\*I as shown in Table 1.

**Table 1.**

8 Pin SOIC Package Model		
Pin Connection	Outside to Board	Internal to Chip
1	N01O	N01I
2	N02O	N02I
3	N03O	N03I
4	N04O	N04I
5	N05O	N05I
6	N06O	N06I
7	N07O	N07I
8	N08O	N08I

The LINES model considers the capacitance to be lumped. Minimum (fastest) useable edge rate is 0.076 NS.

## AND8010/D

### Modeling

The bias driver schematics for VCS and V1 generation are not included in this kit, as they are unnecessary for interconnection simulation. In addition their detailed netlist modeling would result in a relatively large increase in simulation time. Alternatively the internal reference voltages should be driven with ideal constant voltage sources. This model kit is intended for simulations within the specified power supply range. If supply voltages drop below minimum specification, VCS and V1 can no longer be assumed to be constant. Thus, this model kit should not be used for power up or power down simulations. LVPECL outputs should be terminated properly, such as through ohms to  $V_{TT}=V_{CC}-2V$ .

The common global nodes are as follows:

```
*100 VCC
*200 VEE
*300 VCS internal TTL reference = VEE+1.3V
*400 V1 internal TTL reference = 1.5
*10 IN
*5 QI VCC-1.1 TO VCC-0.8
*6 QIB VCC-0.8 TO VCC-1.1
*20 D
*21 DB
*60 Q
*62 QB
*1 to external PIN
*2 to internal chip CKT
*3 external PIN and internal chip CKT node
```

```
*LVTTLIN
.SUBCKT LVTTLIN 100 200 300 400 10 5 6
Q1 1 10 3 200 TN6
Q2 2 400 3 200 TN6
Q3 100 1 6 200 TN6
Q4 100 2 5 200 TN6
Q5 3 300 7 200 TN6
Q6 6 300 8 200 TN6
Q7 5 300 9 200 TN6
R1 100 1 266
* TC=0.26M, 0.9U
R2 100 1 266
* TC=0.26M, 0.9U
R3 7 200 42
* TC=0.26M, 0.9U
R4 8 200 42
* TC=0.26M, 0.9U
R5 9 200 42
* TC=0.26M, 0.9U
.ENDS LVTTLIN

.SUBCKT LVTTLOUT 100 200 300 20 21 60 62
Q1 62 20 1 200 TRANA
Q2 60 21 1 200 TRANA
Q3 1 300 2 200 TRANA
R1 100 60 269
* TC=0.26M, 0.9U
R2 100 62 269
* TC=0.26M, 0.9U
R3 2 200 112
* TC=0.26M, 0.9U
.ENDS LVTTLOUT
```

### ESD

The ESD protection for the inputs pins D0 and D1 uses the subcircuit model ESDIN. In the ESDIN model, a diode (CBVCC) goes to  $V_{CC}$  with a parallel resistor of high value (75 k $\Omega$ ) and a diode pair (CBSUB devices) go to  $V_{EE}$ . The input has a series resistor.

```
.SUBCKT ESDIN 100 200 1 2
D1 1 100 CBVCC
D2 1 200 CBSUB
```

## AND8010/D

```
D3 1 200 CBSUB
R1 1 VCC 75K
* TC=0.26M, 0.9U
R2 1 2 93
.END ESDIN
```

The ESD model for the PECL output pins (Q0, Q0bar, Q1, Q1bar) use subcircuit model ESDOUT. The ESDOUT is modeled as diode (CBVCC) to V<sub>CC</sub> and a diode pair (CBSUB devices) to V<sub>EE</sub>.

```
.SUBCKT ESDOUT 100 200 1
D1 1 100 CBVCC
D2 1 200 CBSUB
D3 1 200 CBSUB
.END ESDOUT

.MODEL CBVCC D
+ ( IS = 1.00E15 CJO = 527fF Vj = 0.545 M = 0.32 BV = 14.5
+ IBV = 0.1E6 XTI = 5 TT = 1nS )
.MODEL CBSUB D
+ ( IS = 1.00E15 CJO = 453fF TT = 1nS )

.MODEL TN6 NPN
+(IS = 8.56E-18 BF = 120 NF = 1 VAF = 30 IKF = 10.5mA
+ ISE = 4.48E-16 BR = 10 NE = 2 VAR = 5 IKR = 922uA
+ IRB = 13.2uA RB = 291.4 RBM = 95.0 RE = 13.3 RC = 62.7
+ CJE = 29.9fF VJE = .9 MJE = .4 XTB = 0.73
+ CJC = 31.2fF VJC = .67 MJC = .32 XCJC= .3
+ CJS = 60.9fF VJS = .6 MJS = .4 FC = .9
+ TF = 8pS TR = 1nS XTF = 10 VTF = 1.4V ITF = 27.6mA
+ ISC=0 EG=1.11 XTI=5.2 PTF=0 KF=0 AF=1 NR=1 NC=2)
*

.MODEL TRANA NPN
+(IS = 2.09E-17 BF = 120 NF = 1 VAF = 30 IKF = 25.7mA
+ ISE = 1.09E-15 BR = 10 NE = 2 VAR = 5 IKR = 2.25mA
+ IRB = 32.2uA RB = 122.6 RBM = 42.2 RE = 5.44 RC = 32.8
+ CJE = 67.4fF VJE = .9 MJE = .4 XTB = 0.73
+ CJC = 53.8fF VJC = .67 MJC = .32 XCJC= .3
+ CJS = 103fF VJS = .6 MJS = .4 FC = .9
+ TF = 8pS TR = 1nS XTF = 10 VTF = 1.4V ITF = 67.5mA
+ ISC=0 EG=1.11 XTI=5.2 PTF=0 KF=0 AF=1 NR=1 NC=2)
* 1.75 x 13.50 emitter (2 emitters)
```

### PACKAGE MODEL TRANSMISSION LINES

```
* 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
```

## AND8010/D

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

ECLinPS Lite and ECLinPS Plus are trademarks of Semiconductor Components Industries, LLC.

**ON Semiconductor** and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

### PUBLICATION ORDERING INFORMATION

#### Literature Fulfillment:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** ONlit@hibbertco.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada

**JAPAN:** ON Semiconductor, Japan Customer Focus Center  
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031  
**Phone:** 81-3-5740-2700  
**Email:** r14525@onsemi.com

**ON Semiconductor Website:** <http://onsemi.com>

For additional information, please contact your local  
Sales Representative.