# **3.3V ECL 1:9 Differential Clock Driver**

The MC100LVE111 is a low skew 1-to-9 differential driver, designed with clock distribution in mind. The MC100LVE111's function and performance are similar to the popular MC100E111, with the added feature of low voltage operation. It accepts one signal input, which can be either differential or single-ended if the V<sub>BB</sub> output is used. The signal is fanned out to 9 identical differential outputs.

The LVE111 is specifically designed, modeled and produced with low skew as the key goal. Optimal design and layout serve to minimize gate to gate skew within a device, and empirical modeling is used to determine process control limits that ensure consistent  $t_{pd}$  distributions from lot to lot. The net result is a dependable, guaranteed low skew device.

To ensure that the tight skew specification is met it is necessary that both sides of the differential output are terminated into 50  $\Omega$ , even if only one side is being used. In most applications, all nine differential pairs will be used and therefore terminated. In the case where fewer than nine pairs are used, it is necessary to terminate at least the output pairs on the same package side as the pair(s) being used on that side, in order to maintain minimum skew. Failure to do this will result in small degradations of propagation delay (on the order of 10–20 ps) of the output(s) being used which, while not being catastrophic to most designs, will mean a loss of skew margin.

The MC100LVE111, as with most other ECL devices, can be operated from a positive V<sub>CC</sub> supply in PECL mode. This allows the LVE111 to be used for high performance clock distribution in +3.3 V systems. Designers can take advantage of the LVE111's performance to distribute low skew clocks across the backplane or the board. In a PECL environment, series or Thevenin line terminations are typically used as they require no additional power supplies. For systems incorporating GTL, parallel termination offers the lowest power by taking advantage of the 1.2 V supply as a terminating voltage. For more information on using PECL, designers should refer to Application Note AN1406/D.

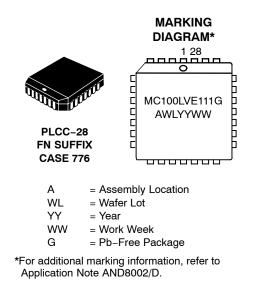
The V<sub>BB</sub> pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to V<sub>BB</sub> as a switching reference voltage. V<sub>BB</sub> may also rebias AC coupled inputs. When used, decouple V<sub>BB</sub> and V<sub>CC</sub> via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used, V<sub>BB</sub> should be left open. **Features** 

- 200 ps Part-to-Part Skew
- 50 ps Output-to-Output Skew
- The 100 Series Contains Temperature Compensation
- PECL Mode Operating Range:  $V_{CC} = 3.0 \text{ V}$  to 3.8 V with  $V_{EE} = 0 \text{ V}$
- NECL Mode Operating Range:  $V_{CC} = 0 V$  with  $V_{EE} = -3.0 V$  to -3.8 V
- Internal Input Pulldown Resistors
- Q Output will Default LOW with Inputs Open or at VEE
- Pb-Free Packages are Available\*



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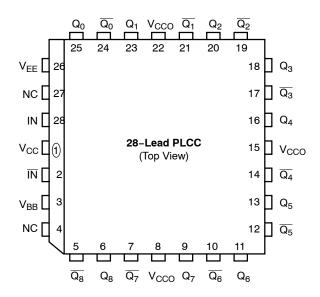
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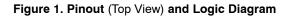
### **ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

\*For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



Warning: All  $V_{CC},\,V_{CCO},\,$  and  $V_{EE}$  pins must be externally connected to Power Supply to guarantee proper operation.



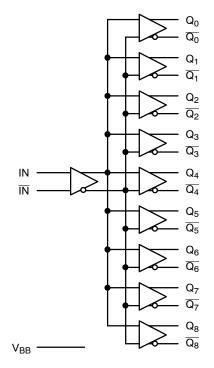


Figure 2. Logic Symbol

#### Table 1. PIN DESCRIPTION

Pin	Function
$ \begin{array}{c} \text{IN, IN} \\ \text{Q}_0, \ \overline{\text{Q}_0} - \text{Q}_8, \ \overline{\text{Q}_8} \\ \text{V}_{\text{BB}} \\ \text{V}_{\text{CC}}, \ \text{V}_{\text{CCO}} \\ \text{V}_{\text{EE}} \\ \text{NC} \end{array} $	ECL Differential Input Pair ECL Differential Outputs Reference Voltage Output Positive Supply Negative Supply No Connect

### Table 2. ATTRIBUTES

Characterist	Value	
Internal Input Pulldown Resistor	75 kΩ	
Internal Input Pullup Resistor	N/A	
ESD Protection	Human Body Model Machine Model	> 2 kV > 200 V
Moisture Sensitivity, Indefinite Time	Out of Drypack (Note 1)	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count		250
Meets or exceeds JEDEC Spec EIA	JESD78 IC Latchup Test	

1. For additional information, see Application Note AND8003/D.

### Table 3. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	PECL Mode Power Supply	V <sub>EE</sub> = 0 V		8 to 0	V
$V_{EE}$	NECL Mode Power Supply	$V_{CC} = 0 V$		–8 to 0	V
VI	PECL Mode Input Voltage NECL Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	$\begin{array}{c} V_{I} \leq V_{CC} \\ V_{I} \geq V_{EE} \end{array}$	6 to 0 -6 to 0	V V
l <sub>out</sub>	Output Current	Continuous Surge		50 100	mA mA
I <sub>BB</sub>	V <sub>BB</sub> Sink/Source			± 0.5	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	PLCC-28 PLCC-28	63.5 43.5	°C/W °C/W
θJC	Thermal Resistance (Junction-to-Case)	Standard Board	PLCC-28	22 to 26 ± 5%	°C/W
T <sub>sol</sub>	Wave Solder Pb Pb-Free	<2 to 3 sec @ 248°C <2 to 3 sec @ 260°C		265 265	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

	Characteristic Power Supply Current	–40°C			25°C			85°C			
Symbol		Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
$I_{EE}$			55	66		55	66		65	78	mA
V <sub>OH</sub> Output HIGH Voltage (Note 3)		2215	2345	2420	2275	2345	2420	2275	2345	2420	mV
V <sub>OL</sub>	DL Output LOW Voltage (Note 3)		1595	1680	1490	1595	1680	1490	1595	1680	mV
VIH	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
VIL	Input LOW Voltage (Single-Ended)	1490		1825	1490		1825	1490		1825	mV
$V_{BB}$	Output Voltage Reference	1.92		2.04	1.92		2.04	1.92		2.04	V
VIHCMR	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	1.8		2.9	1.8		2.9	1.8		2.9	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μA
I <sub>IL</sub>	Input LOW Current	0.5			0.5			0.5			μA

### Table 4. LVPECL DC CHARACTERISTICS V<sub>CC</sub> = 3.3 V; V<sub>EE</sub> = 0 V (Note 2)

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

2. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary ±0.3 V.

3. Outputs are terminated through a 50  $\Omega$  resistor to V<sub>CC</sub> – 2.0 V.

4. V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, maximum varies 1:1 with V<sub>CC</sub>. V<sub>IHCMR</sub> is defined as the range within which the V<sub>IH</sub> level may vary, with the device still meeting the propagation delay specification. The V<sub>IL</sub> level must be such that the peak to peak voltage is less than 1.0 V and greater than or equal to V<sub>PP</sub>(min).

			-40°C		25°C						
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
I <sub>EE</sub>	Power Supply Current		55	66		55	66		65	78	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 6)		-955	-880	-1025	-955	-880	-1025	-955	-880	mV
V <sub>OL</sub>	Output LOW Voltage (Note 6)		-1705	-1620	-1810	-1705	-1620	-1810	-1705	-1620	mV
VIH	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	-1810		-1475	-1810		-1475	-1810		-1475	mV
V <sub>BB</sub>	Output Voltage Reference	-1.38		-1.26	-1.38		-1.26	-1.38		-1.26	V
VIHCMR	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7)	-1.5		-0.4	-1.5		-0.4	-1.5		-0.4	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μΑ
I <sub>IL</sub>	Input LOW Current	0.5			0.5			0.5			μΑ

#### Table 5. LVNECL DC CHARACTERISTICS $V_{CC} = 0 V$ ; $V_{EE} = -3.3 V$ (Note 5)

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

5. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary ±0.3 V.

6. Outputs are terminated through a 50  $\Omega$  resistor to V<sub>CC</sub> – 2.0 V.

V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, maximum varies 1:1 with V<sub>CC</sub>. V<sub>IHCMR</sub> is defined as the range within which the V<sub>IH</sub> level may vary, with the device still meeting the propagation delay specification. The V<sub>IL</sub> level must be such that the peak to peak voltage is less than 1.0 V and greater than or equal to V<sub>PP</sub>(min).

		-40°C			25°C			85°C			
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
f <sub>max</sub>	Maximum Toggle Frequency		> 1.5			> 1.5			> 1.5		GHz
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay to Output IN (Differential Configuration) (Note 9) sIN (Single-Ended) (Note 10)			650 700	440 390		630 680	445 395		635 685	ps
t <sub>skew</sub>	Within-Device Skew (Note 11) Part-to-Part Skew (Differential Configuration)			50 250			50 200			50 200	ps
t <sub>JITTER</sub>	Cycle-to-Cycle Jitter		0.2	< 1		0.2	< 1		0.2	< 1	ps
V <sub>PP</sub>	Input Swing (Note 12)	500		1000	500		1000	500		1000	mV
t <sub>r</sub> /t <sub>f</sub>	Output Rise/Fall Time (20%-80%)	200		600	200		600	200		600	ps

### Table 6. AC CHARACTERISTICS $V_{CC} = 3.3 \text{ V}$ ; $V_{EE} = 0 \text{ V}$ or $V_{CC} = 0 \text{ V}$ ; $V_{EE} = -3.3 \text{ V}$ (Note 8)

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

 V<sub>EE</sub> can vary ±0.3 V.
The differential propagation delay is defined as the delay from the crossing points of the differential input signals to the crossing point of the differential output signals.

10. The single-ended propagation delay is defined as the delay from the 50% point of the input signal to the 50% point of the output signal.

11. The within-device skew is defined as the worst case difference between any two similar delay paths within a single device.

12. VPP (min) is defined as the minimum input differential voltage which will cause no increase in the propagation delay. The VPP (min) is AC limited for the E111 as a differential input as low as 50 mV will still produce full ECL levels at the output.

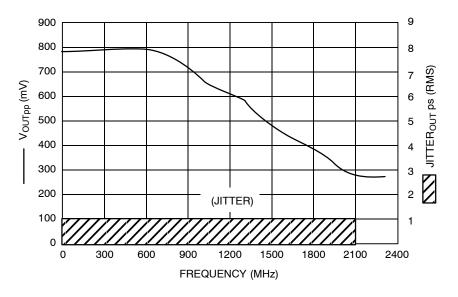


Figure 3. F<sub>max</sub>/Jitter

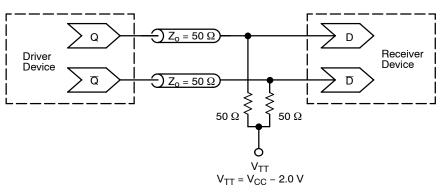


Figure 4. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D – Termination of ECL Logic Devices.)

### **ORDERING INFORMATION**

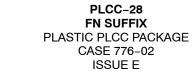
Device	Package	Shipping <sup>†</sup>
MC100LVE111FN	PLCC-28	37 Units / Rail
MC100LVE111FNG	PLCC-28 (Pb-Free)	37 Units / Rail
MC100LVE111FNR2	PLCC-28	500 / Tape & Reel
MC100LVE111FNR2G	PLCC-28 (Pb-Free)	500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

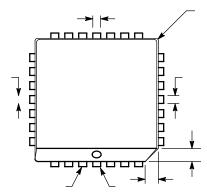
#### **Resource Reference of Application Notes**

AN1405/D	-	ECL Clock Distribution Techniques
AN1406/D	-	Designing with PECL (ECL at +5.0 V)
AN1503/D	-	ECLinPS <sup>™</sup> I/O SPiCE Modeling Kit
AN1504/D	-	Metastability and the ECLinPS Family
AN1568/D	-	Interfacing Between LVDS and ECL
AN1672/D	-	The ECL Translator Guide
AND8001/D	-	Odd Number Counters Design
AND8002/D	-	Marking and Date Codes
AND8020/D	-	Termination of ECL Logic Devices
AND8066/D	_	Interfacing with ECLinPS
AND8090/D	-	AC Characteristics of ECL Devices

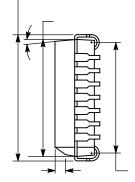
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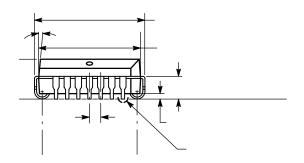


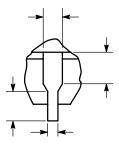




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