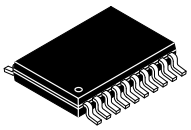
2.5V / 3.3V 1:5 Differential ECL/PECL/HSTL Clock Driver

MC100LVEP14



TSSOP−20
DT SUFFIX
CASE 948E

Description

The MC100LVEP14 is a low skew 1−to−5 differential driver, designed with clock distribution in mind, accepting two clock sources into an input multiplexer. The ECL/PECL input signals can be either differential or single−ended (if the V_{BB} output is used). HSTL inputs can be used when the LVEP14 is operating under PECL conditions.

The LVEP14 specifically guarantees low output−to−output skew. Optimal design, layout, and processing minimize skew within a device and from device to device.

To ensure that the tight skew specification is realized, both sides of any differential output need to be terminated identically into 50 Ω even if only one output is being used. If an output pair is unused, both outputs may be left open (unterminated) without affecting skew.

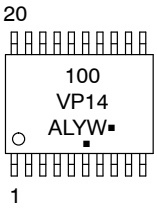
The common enable ($\overline{EN}$) is synchronous, outputs are enabled/disabled in the LOW state. This avoids a runt clock pulse when the device is enabled/disabled as can happen with an asynchronous control. The internal flip flop is clocked on the falling edge of the input clock; therefore, all associated specification limits are referenced to the negative edge of the clock input.

The MC100LVEP14, as with most other ECL devices, can be operated from a positive V_{CC} supply in PECL mode. This allows the LVEP14 to be used for high performance clock distribution in +3.3 V or +2.5 V systems. Single−ended CLK input pin operation is limited to a $V_{CC} \geq 3.0$ V in PECL mode, or $V_{EE} \leq -3.0$ V in NECL mode. Designers can take advantage of the LVEP14's performance to distribute low skew clocks across the backplane or the board.

Features

- 100 ps Device−to−Device Skew
- 25 ps Within Device Skew
- 400 ps Typical Propagation Delay
- Maximum Frequency > 2 GHz Typical
- The 100 Series Contains Temperature Compensation
- PECL and HSTL Mode:
  V_{CC} = 2.375 V to 3.8 V with V_{EE} = 0 V
- NECL Mode:
  V_{CC} = 0 V with V_{EE} = −2.375 V to −3.8 V
- LVDS Input Compatible
- Open Input Default State
- These Devices are Pb−Free and are RoHS Compliant

MARKING DIAGRAM



A	= Assembly Location
L	= Wafer Lot
Y	= Year
W	= Work Week
▪	= Pb−Free Package

(Note: Microdot may be in either location)

*For additional marking information, refer to Application Note AND8002/D.

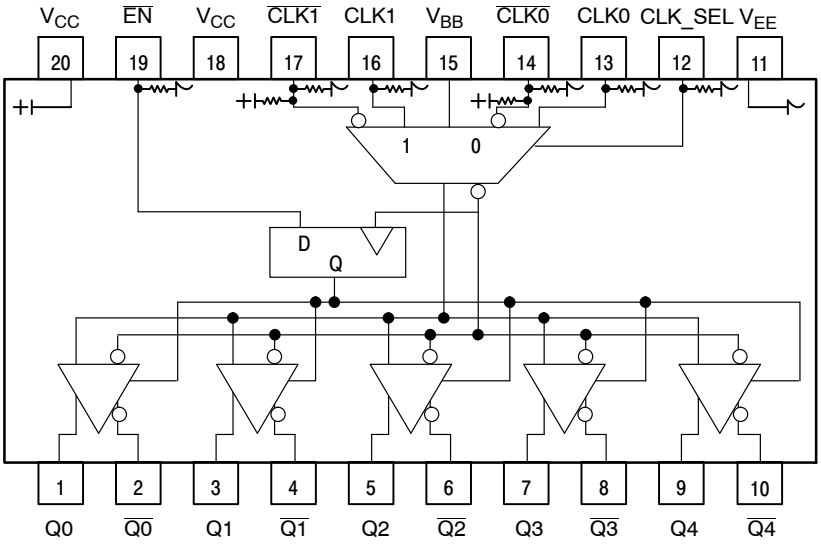
ORDERING INFORMATION

Device	Package	Shipping†
MC100LVEP14DTG	TSSOP−20 (Pb-Free)	75 Units / Tube
MC100LVEP14DTR2G	TSSOP−20 (Pb-Free)	2500 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.

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

Figure 1. 20–Lead Pinout (Top View) **and Logic Diagram**

Table 1. PIN DESCRIPTION

Pin	Type	Function
CLK0*, $\overline{CLK0}$**	LVECL/LVPECL/ HSTL	ECL/PECL/HSTL CLK Input
CLK1*, $\overline{CLK1}$**	LVECL/LVPECL/ HSTL	ECL/PECL/HSTL CLK Input
Q0:4, $\overline{Q0:4}$	LVECL/LVPECL	ECL/PECL Outputs
CLK_SEL*	LVECL/LVPECL	ECL/PECL Active Clock Select Input
$\overline{EN}$*	LVECL/LVPECL	ECL Sync Enable
V_{BB}	LVECL/LVPECL	Reference Voltage Output
V_{CC}		Positive Supply
V_{EE}		Negative Supply

* Pins will default low when left open.
**Pins will default to $V_{CC}/2$ when left open.

Table 2. FUNCTION TABLE

CLK0	CLK1	CLK_SEL	$\overline{EN}$	Q
L	X	L	L	L
H	X	L	L	H
X	L	H	L	L
X	H	H	L	H
X	X	X	H	L*

*On next negative transition of CLK0 or CLK1

Table 3. ATTRIBUTES

Characteristics		Value	
Internal Input Pulldown Resistor		75 kΩ	
Internal Input Pullup Resistor		37.5 kΩ	
ESD Protection	Human Body Model Machine Model Charged Device Model	> 2 kV > 100 V > 2 kV	
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)		Pb Pkg	Pb–Free Pkg
	TSSOP–20	Level 1	Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V–0 @ 0.125 in	
Transistor Count		357 Devices	
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test			

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

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Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V_{CC}	PECL Mode Power Supply	V_{EE} = 0 V		6	V
V_{EE}	NECL Mode Power Supply	V_{CC} = 0 V		−6	V
V_I	PECL Mode Input Voltage NECL Mode Input Voltage	V_{EE} = 0 V V_{CC} = 0 V	$V_I \leq V_{CC}$ $V_I \geq V_{EE}$	6 −6	V V
I_{out}	Output Current	Continuous Surge		50 100	mA mA
I_{BB}	V_{BB} Sink/Source			± 0.5	mA
T_A	Operating Temperature Range			−40 to +85	°C
T_{stg}	Storage Temperature Range			−65 to +150	°C
θ_{JA}	Thermal Resistance (Junction−to−Ambient)	0 lfpm 500 lfpm	TSSOP−20 TSSOP−20	140 100	°C/W °C/W
θ_{JC}	Thermal Resistance (Junction−to−Case)	Standard Board	TSSOP−20	23 to 41	°C/W
T_{sol}	Wave Solder Pb Pb−Free			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.

Table 5. 100LVEP DC CHARACTERISTICS, PECL V_{CC} = 2.5 V, V_{EE} = 0 V (Note 2)

		−40°C			25°C			85°C			
Symbol	Characteristic	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
I_{EE}	Power Supply Current	45	60	75	45	60	75	45	60	75	mA
V_{OH}	Output HIGH Voltage (Note 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
V_{OL}	Output LOW Voltage (Note 3)	505	730	900	505	730	900	505	730	900	mV
V_{IH}	Input HIGH Voltage (Single−Ended) (Note 4)	1335		1620	1335		1620	1275		1620	mV
V_{IL}	Input LOW Voltage (Single−Ended) (Note 4)	505		900	505		900	505		900	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current CLK $\overline{CLK}$	0.5 −150			0.5 −150			0.5 −150			μA

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_{CC}. V_{EE} can vary +0.125 V to −1.3 V.
3. All loading with 50 Ω to V_{CC} − 2.0 V.
4. Do not use V_{BB} at V_{CC} < 3.0 V.
5. V_{IHCMR} min varies 1:1 with V_{EE}, V_{IHCMR} max varies 1:1 with V_{CC}. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

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Table 6. 100LVEP DC CHARACTERISTICS, PECL V_{CC} = 3.3 V, V_{EE} = 0 V (Note 6)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	45	60	75	45	60	75	45	60	75	mA
V_{OH}	Output HIGH Voltage (Note 7)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
V_{OL}	Output LOW Voltage (Note 7)	1305	1530	1700	1305	1530	1700	1305	1530	1700	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	2135		2420	2135		2420	2135		2420	mV
V_{IL}	Input LOW Voltage (Single−Ended)	1305		1700	1305		1700	1305		1700	mV
V_{BB}	Output Reference Voltage (Note 8)	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9)	1.2		3.3	1.2		3.3	1.2		3.3	V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current CLK $\overline{CLK}$	0.5 −150			0.5 −150			0.5 −150			μA

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.

6. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary +0.925 V to −0.5 V.
7. All loading with 50 Ω to V_{CC} − 2.0 V.
8. Single−ended input operation is limited to $V_{CC} \geq$ 3.0 V in PECL mode.
9. V_{IHCMR} min varies 1:1 with V_{EE}, V_{IHCMR} max varies 1:1 with V_{CC}. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

Table 7. 100LVEP DC CHARACTERISTICS, NECL V_{CC} = 0 V, V_{EE} = −3.8 V to −2.375 V (Note 10)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	45	60	75	45	60	75	45	60	75	mA
V_{OH}	Output HIGH Voltage (Note 11)	−1145	−1020	−895	−1145	−1020	−895	−1145	−1020	−895	mV
V_{OL}	Output LOW Voltage (Note 11)	−1995	−1770	−1600	−1995	−1770	−1600	−1995	−1770	−1600	mV
V_{IH}	Input HIGH Voltage (Single−Ended)	−1165		−880	−1165		−880	−1165		−880	mV
V_{IL}	Input LOW Voltage (Single−Ended)	−1995		−1600	−1995		−1600	−1995		−1600	mV
V_{BB}	Output Reference Voltage (Note 12)	−1525	−1425	−1325	−1525	−1425	−1325	−1525	−1425	−1325	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13)	V_{EE} + 1.2		0.0	V_{EE} + 1.2		0.0	V_{EE} + 1.2		0.0	V
I_{IH}	Input HIGH Current			150			150			150	μA
I_{IL}	Input LOW Current CLK $\overline{CLK}$	0.5 −150			0.5 −150			0.5 −150			μA

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.

10. Input and output parameters vary 1:1 with V_{CC}.
11. All loading with 50 Ω to V_{CC} − 2.0 V.
12. Single−ended input operation is limited to $V_{EE} \leq$ 3.0 V in NECL mode.
13. V_{IHCMR} min varies 1:1 with V_{EE}, V_{IHCMR} max varies 1:1 with V_{CC}. The V_{IHCMR} range is referenced to the most positive side of the differential input signal.

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Table 8. DC CHARACTERISTICS, HSTL V_{CC} = 2.375 V to 3.8 V, V_{EE} = 0 V

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{IH}	Input HIGH Voltage	1200			1200			1200			mV
V_{IL}	Input LOW Voltage			400			400			400	mV

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.

Table 9. AC CHARACTERISTICS V_{CC} = 0 V, V_{EE} = −2.375 V to −3.8 V or V_{CC} = 2.375 V to 3.8 V; V_{EE} = 0 V (Note 14)

Symbol	Characteristic	−40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{OUTPP}	Output Voltage Amplitude @ 2.5 GHz (Figure 2)	330	425		280	375		230	295		mV
t_{PLH} t_{PHL}	Propagation Delay to Output Differential	300	375	425	300	400	475	300	430	525	ps
t_{skew}	Within−Device Skew (Note 15) Device−to−Device Skew (Note 15)		10 100	25 125		15 150	25 175		15 200	25 225	ps
t_s t_h	Setup Time $\overline{EN}$ Hold Time $\overline{EN}$	100 200	50 140		100 200	50 140		100 200	50 140		ps
t_{JITTER}	CLOCK Random Jitter (RMS) @ ≤ 1.0 GHz @ ≤ 1.5 GHz @ ≤ 2.0 GHz @ ≤ 2.5 GHz		 0.157 0.163 0.180 0.179	 0.3 0.2 0.3 0.3		 0.181 0.176 0.201 0.208	 0.3 0.3 0.3 0.3		 0.212 0.218 0.235 0.253	 0.3 0.3 0.3 0.4	ps
V_{PP}	Minimum Input Swing	150	800	1200	150	800	1200	150	800	1200	mV
t_r/t_f	Output Rise/Fall Time (20%−80%)	125	165	225	125	180	250	125	200	275	ps

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.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω to V_{CC} − 2.0 V.
15. Skew is measured between outputs under identical transitions.

Resource Reference of Application Notes

AN1405/D – ECL Clock Distribution Techniques

AN1406/D – Designing with PECL (ECL at +5.0 V)

AN1503/D – ECLinPS™ 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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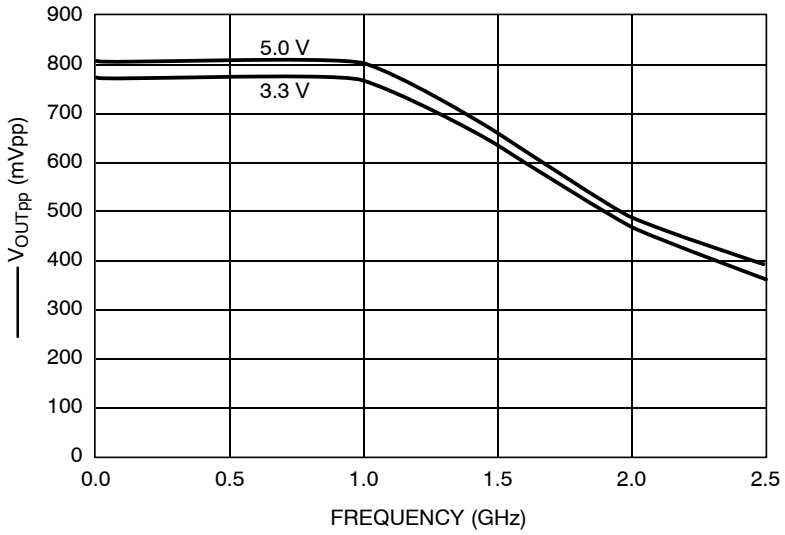


Figure 2. Typical V_{OUTPP} (mVpp) versus Frequency (GHz) @ 25°C

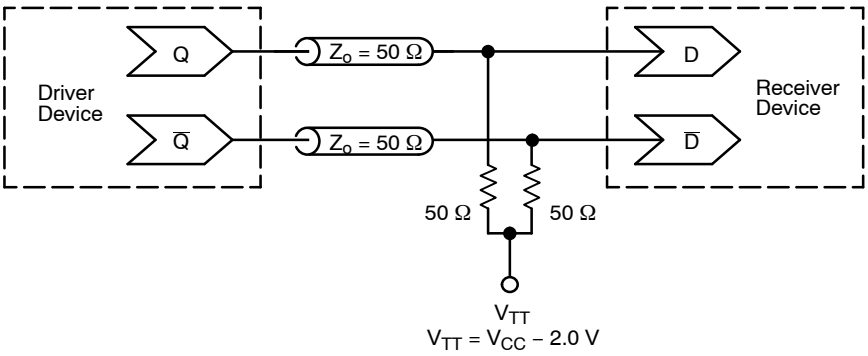


Figure 3. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D – Termination of ECL Logic Devices.)

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