

MC100LVEP210

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

Description

The MC100LVEP210 is a low skew 1-to-5 dual differential driver, designed with clock distribution in mind. The ECL/PECL input signals can be either differential or single-ended if the V_{BB} output is used. The signal is fanned out to 5 identical differential outputs. HSTL inputs can be used when the EP210 is operating in PECL mode.

The LVEP210 specifically guarantees low output-to-output skew. Optimal design, layout, and processing minimize skew within a device and from device to device.

To ensure the tight skew specification is realized, both sides of the differential output need to be terminated identically into $50\ \Omega$ 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 MC100LVEP210, as with most other ECL devices, can be operated from a positive V_{CC} supply in PECL mode. This allows the LVEP210 to be used for high performance clock distribution in +3.3 V or +2.5 V systems. Single-ended CLK input operation is limited to a $V_{CC} \geq 3.0\text{ V}$ in PECL mode, or $V_{EE} \leq -3.0\text{ V}$ in ECL mode.

Designers can take advantage of the LVEP210'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 more information on using PECL, designers should refer to Application Note AN1406/D.

Features

- 85 ps Typical Device-to-Device Skew
- 20 ps Typical Output-to-Output Skew
- V_{BB} Output
- Jitter Less than 1 ps RMS
- 350 ps Typical Propagation Delay
- Maximum Frequency > 3 GHz Typical
- The 100 Series Contains Temperature Compensation
- PECL and HSTL Mode Operating Range: $V_{CC} = 2.375\text{ V}$ to 3.8 V with $V_{EE} = 0\text{ V}$
- NECL Mode Operating Range: $V_{CC} = 0\text{ V}$ with $V_{EE} = -2.375\text{ V}$ to -3.8 V
- Open Input Default State
- LVDS Input Compatible
- Fully Compatible with MC100EP210
- Pb-Free Packages are Available*

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



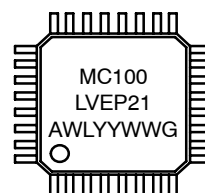
ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAM*



32-LEAD LQFP
FA SUFFIX
CASE 873A



A	= Assembly Location
WL	= Wafer Lot
YY	= Year
WW	= Work Week
G	= Pb-Free Package

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

ORDERING INFORMATION

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

MC100LVEP210

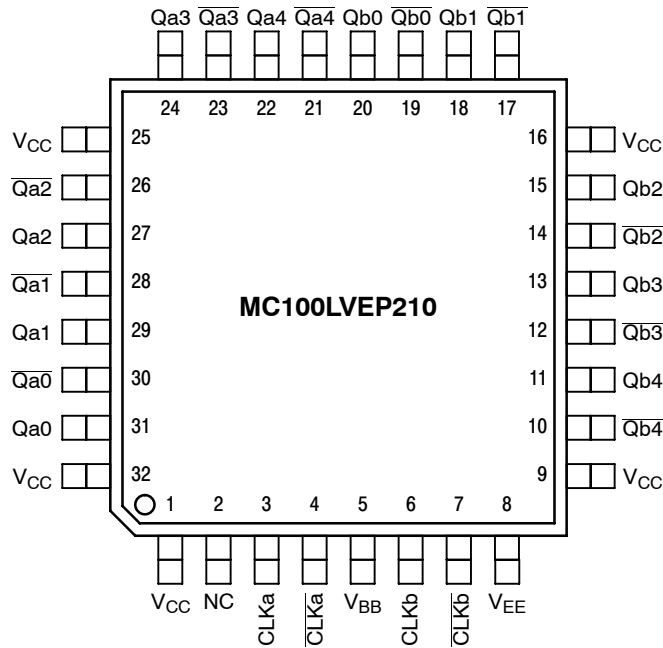


Table 1. PIN DESCRIPTION

PIN	FUNCTION
CLKn*, $\overline{\text{CLKn}}^{**}$	ECL/PECL/HSTL CLK Inputs
Qn0:4, $\overline{\text{Qn0:4}}$	ECL/PECL Outputs
V _{BB}	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.

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

Figure 1. LQFP-32 Pinout (Top View)

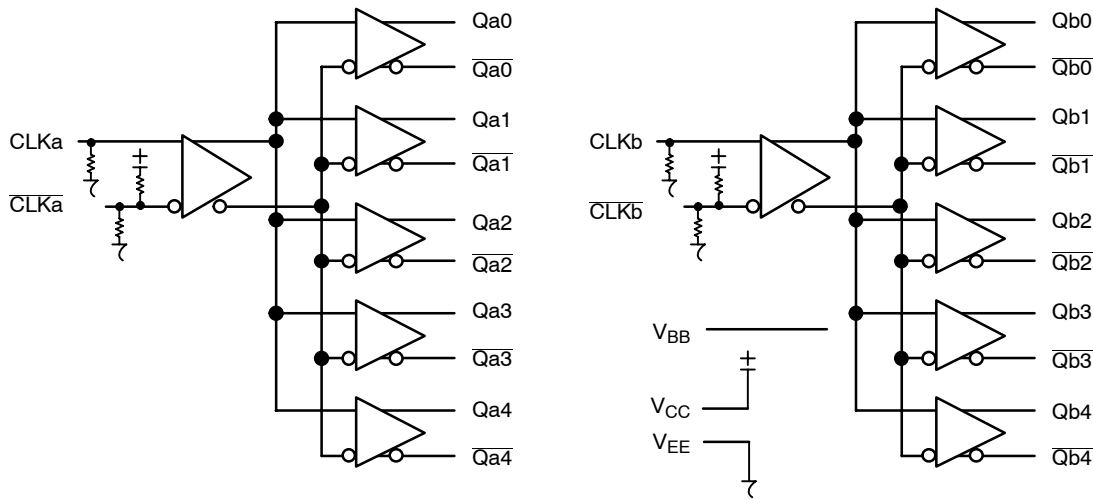


Figure 2. Logic Diagram

Table 2. ATTRIBUTES

Characteristics		Value
Internal Input Pulldown Resistor		75 kΩ
Internal Input Pull-up Resistor		37.5 kΩ
ESD Protection	Human Body Model	> 2 kV
	Machine Model	> 100 V
	Charged Device Model	> 2 kV
Moisture Sensitivity (Note 1)		Level 2
Flammability Rating Oxygen Index: 28 to 34		UL 94 V-0 @ 0.125 in
Transistor Count		461 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

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

MC100LVEP210

Table 3. 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 ≤ V _{CC} V _I ≥ 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
Q _{JA}	Thermal Resistance (Junction–to–Ambient)	0 lfpm 500 lfpm	LQFP–32 LQFP–32	80 55	°C/W °C/W
θ _{JC}	Thermal Resistance (Junction–to–Case)	Standard Board	LQFP–32	12 to 17	°C/W
T _{sol}	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.

Table 4. PECL DC CHARACTERISTICS V_{CC} = 2.5 V; V_{EE} = 0 V (Note 2)

Symbol	Characteristic	–40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I _{EE}	Power Supply Current	55	70	90	55	70	90	55	70	90	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)	555	680	900	555	680	900	555	680	900	mV
V _{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	1.2		2.5	1.2		2.5	1.2		2.5	V
V _{IL}	Input LOW Voltage (Single–Ended)	555		900	555		900	555		900	mV
I _{IH}	Input HIGH Current			150			150			150	μA
I _{IL}	Input LOW Current CLK 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.

- Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary + 0.125 V to –1.3 V.
- All loading with 50 Ω to V_{EE}.
- 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.

MC100LVEP210

Table 5. PECL DC CHARACTERISTICS $V_{CC} = 3.3\text{ V}$; $V_{EE} = 0\text{ V}$ (Note 5)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	55	70	90	55	70	90	55	70	90	mA
V_{OH}	Output HIGH Voltage (Note 6)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
V_{OL}	Output LOW Voltage (Note 6)	1355	1480	1700	1355	1480	1700	1355	1480	1700	mV
V_{IH}	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
V_{IL}	Input LOW Voltage (Single-Ended)	1355		1700	1355		1700	1355		1700	mV
V_{BB}	Output Reference Voltage (Note 7)	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 8)	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 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 lfm. 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_{CC} . V_{EE} can vary + 0.925 V to -0.5 V.
6. All loading with 50 Ω to $V_{CC} - 2.0\text{ V}$.
7. Single-ended input operation is limited $V_{CC} \geq 3.0\text{ V}$ in PECL mode.
8. 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 6. NECL DC CHARACTERISTICS $V_{CC} = 0\text{ V}$, $V_{EE} = -2.375\text{ V}$ to -3.8 V (Note 9)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I_{EE}	Power Supply Current	55	70	90	55	70	90	55	70	90	mA
V_{OH}	Output HIGH Voltage (Note 10)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
V_{OL}	Output LOW Voltage (Note 10)	-1945	-1820	-1600	-1945	-1820	-1600	-1945	-1820	-1600	mV
V_{IH}	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV
V_{IL}	Input LOW Voltage (Single-Ended)	-1945		-1600	-1945		-1600	-1945		-1600	mV
V_{BB}	Output Reference Voltage (Note 11)	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
V_{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 12)	$V_{EE} + 1.2$		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 CLK	0.5 -150			0.5 -150			0.5 -150		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 lfm. 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.

9. Input and output parameters vary 1:1 with V_{CC} .
10. All loading with 50 Ω to $V_{CC} - 2.0\text{ V}$.
11. Single-ended input operation is limited $V_{EE} \leq -3.0\text{ V}$ in NECL mode.
12. 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.

MC100LVEP210

Table 7. HSTL DC CHARACTERISTICS $V_{CC} = 2.375$ 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
V_{CM}	Input Crossover Voltage	680		900	680		900	680		900	mV
I_{CC}	Power Supply Current (Outputs Open)	55	70	90	55	70	90	55	70	90	mA

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 8. AC CHARACTERISTICS $V_{CC} = 0$ V; $V_{EE} = -2.375$ to -3.8 V or $V_{CC} = 2.375$ to 3.8 V; $V_{EE} = 0$ V (Note 13)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$f_{maxPECL/HSTL}$	Maximum Frequency (Figure 3)		3			3			3		GHz
t_{PLH} t_{PHL}	Propagation Delay Propagation Delay @ 2.5 V	220	300	380	270	350	430	300 330	500 410	750 490	ps
t_{skew}	Within-Device Skew (Note 14) Device-to-Device Skew (Note 15)		20 85	25 160		20 85	25 160		20 85	35 160	ps
t_{JITTER}	CLOCK Random Jitter (RMS) @ ≤ 0.5 GHz @ ≤ 1.0 GHz @ ≤ 1.5 GHz @ ≤ 2.0 GHz @ ≤ 2.5 GHz @ ≤ 3.0 GHz		0.184 0.190 0.178 0.196 0.239 0.336	0.3 0.3 0.3 0.3 0.4 0.5		0.207 0.200 0.197 0.233 0.301 0.422	0.3 0.3 0.3 0.4 0.4 0.5		0.271 0.252 0.259 0.308 0.399 0.572	0.4 0.4 0.4 0.5 0.5 0.9	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%)	100	170	250	120	190	270	150	280	350	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.

13. Measured with 750 mV source, 50% duty cycle clock source. All loading with $50\ \Omega$ to $V_{CC} - 2.0$ V.

14. Skew is measured between outputs under identical transitions of similar paths through a device.

15. Device-to-Device skew for identical transitions at identical V_{CC} levels.

MC100LVEP210

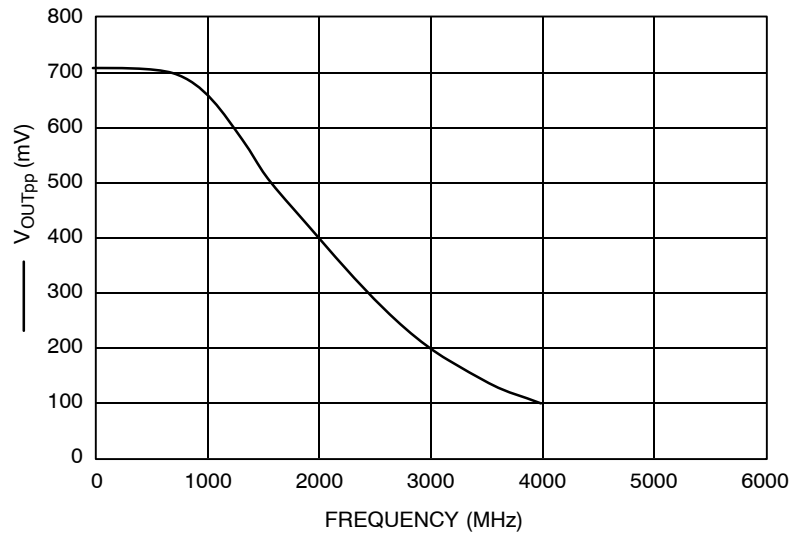
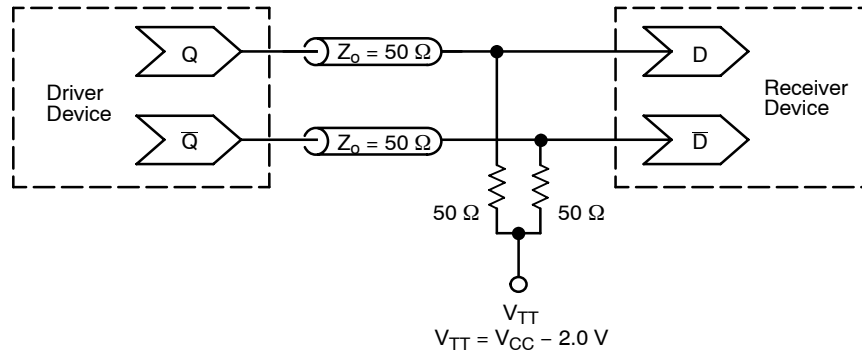


Figure 3. F_{max} Typical



**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 [†]
MC100LVEP210FA	LQFP	250 Units/Tray
MC100LVEP210FAG	LQFP (Pb-Free)	250 Units/Tray
MC100LVEP210FAR2	LQFP	2000 Tape & Reel
MC100LVEP210FARG	LQFP (Pb-Free)	2000 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.

MC100LVEP210

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
- AN1642/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

MC100LVEP210

ECLinPS is a trademark of Semiconductor Components Industries, LLC (SCILLC).

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. This literature is subject to all applicable copyright laws and is not for resale in any manner.

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: orderlit@onsemi.com

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

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

Japan Customer Focus Center
Phone: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative

MC100LVEP210/D