

# 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 pair 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  $3.8\text{ V}$  with  $V_{EE} = 0\text{ V}$
- NECL Mode Operating Range:  $V_{CC} = 0\text{ V}$  with  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$
- Open Input Default State
- LVDS Input Compatible
- Fully Compatible with MC100EP210
- Pb-Free Packages are Available\*

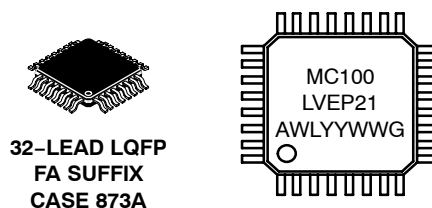
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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### MARKING DIAGRAM\*



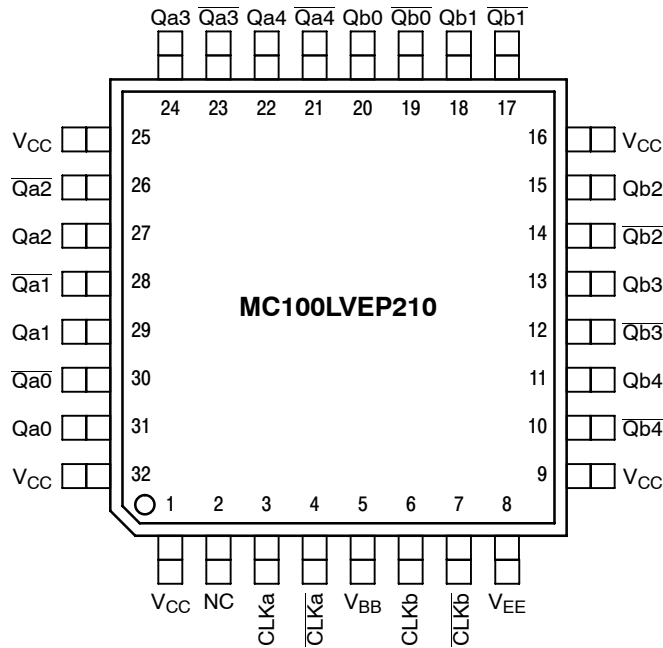
|    |                     |
|----|---------------------|
| A  | = Assembly Location |
| WL | = Wafer Lot         |
| YY | = Year              |
| WW | = Work Week         |
| G  | = Pb-Free Package   |

\*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.

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**Table 1. PIN DESCRIPTION**

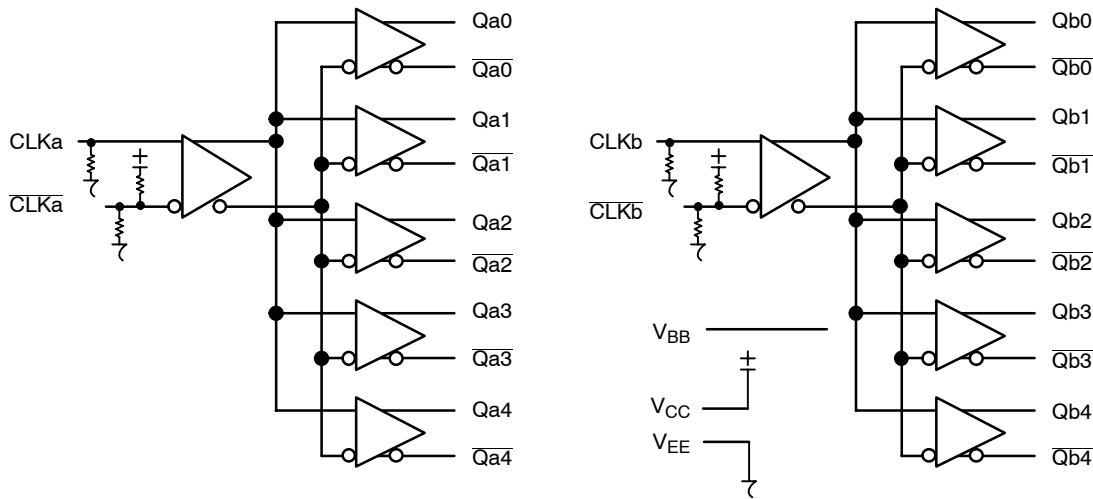
| PIN                                  | FUNCTION                 |
|--------------------------------------|--------------------------|
| CLKn*, $\overline{\text{CLKn}}^{**}$ | ECL/PECL/HSTL CLK Inputs |
| Qn0:4, $\overline{\text{Qn0:4}}$     | ECL/PECL Outputs         |
| V <sub>BB</sub>                      | Reference Voltage Output |
| V <sub>CC</sub>                      | Positive Supply          |
| V <sub>EE</sub>                      | Negative Supply          |

\* Pins will default LOW when left open.

\*\* Pins will default to V<sub>CC</sub>/2 when left open.

Warning: All V<sub>CC</sub> and V<sub>EE</sub> 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 |
| Transistor Count                                       |                      | 461 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 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                      |                                  | 6           | V    |
| V <sub>EE</sub>  | NECL Mode Power Supply                   | V <sub>CC</sub> = 0 V                      |                                  | –6          | V    |
| V <sub>I</sub>   | PECL Mode Input Voltage                  | V <sub>EE</sub> = 0 V                      | V <sub>I</sub> ≤ V <sub>CC</sub> | 6           | V    |
|                  | NECL Mode Input Voltage                  | V <sub>CC</sub> = 0 V                      | V <sub>I</sub> ≥ V <sub>EE</sub> | –6          | V    |
| I <sub>out</sub> | Output Current                           | Continuous<br>Surge                        |                                  | 50          | mA   |
|                  |                                          |                                            |                                  | 100         | 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   |
| Q <sub>JA</sub>  | Thermal Resistance (Junction–to–Ambient) | 0 lfpm                                     | LQFP–32                          | 80          | °C/W |
|                  |                                          | 500 lfpm                                   | LQFP–32                          | 55          | °C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction–to–Case)    | Standard Board                             | LQFP–32                          | 12 to 17    | °C/W |
| T <sub>sol</sub> | Wave Solder                              | <2 to 3 sec @ 248°C<br><2 to 3 sec @ 260°C |                                  | 265         | °C   |
|                  | Pb<br>Pb–Free                            |                                            |                                  | 265         |      |

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<sub>CC</sub> = 2.5 V; V<sub>EE</sub> = 0 V (Note 2)

| Symbol             | Characteristic                                                             | –40°C       |      |      | 25°C        |      |      | 85°C        |      |      | Unit |
|--------------------|----------------------------------------------------------------------------|-------------|------|------|-------------|------|------|-------------|------|------|------|
|                    |                                                                            | Min         | Typ  | Max  | Min         | Typ  | Max  | Min         | Typ  | Max  |      |
| I <sub>EE</sub>    | Power Supply Current                                                       | 55          | 70   | 90   | 55          | 70   | 90   | 55          | 70   | 90   | mA   |
| V <sub>OH</sub>    | Output HIGH Voltage (Note 3)                                               | 1355        | 1480 | 1605 | 1355        | 1480 | 1605 | 1355        | 1480 | 1605 | mV   |
| V <sub>OL</sub>    | Output LOW Voltage (Note 3)                                                | 555         | 680  | 900  | 555         | 680  | 900  | 555         | 680  | 900  | mV   |
| V <sub>IHCMR</sub> | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4) | 1.2         |      | 2.5  | 1.2         |      | 2.5  | 1.2         |      | 2.5  | V    |
| V <sub>IL</sub>    | Input LOW Voltage (Single–Ended)                                           | 555         |      | 900  | 555         |      | 900  | 555         |      | 900  | mV   |
| I <sub>IH</sub>    | Input HIGH Current                                                         |             |      | 150  |             |      | 150  |             |      | 150  | μA   |
| I <sub>IL</sub>    | Input LOW Current                                                          | CLK<br>–150 |      |      | 0.5<br>–150 |      |      | 0.5<br>–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<sub>CC</sub>. V<sub>EE</sub> can vary + 0.125 V to –1.3 V.
- All loading with 50 Ω to V<sub>EE</sub>.
- V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>. V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

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**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  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current<br>CLK<br>CLK                                            | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | $\mu\text{A}$ |

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  $\Omega$  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  $-3.8\text{ V}$  (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   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current<br>CLK<br>CLK                                             | 0.5<br>-150    |       |       | 0.5<br>-150    |       |       | 0.5<br>-150    |       | 150   | $\mu\text{A}$ |

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  $\Omega$  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.

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**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  |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Propagation Delay @ 2.5 V                                                                                                    | 220   | 300                                                | 380                                    | 270  | 350                                                | 430                                    | 300<br>330 | 500<br>410                                         | 750<br>490                             | ps   |
| $t_{skew}$             | Within-Device Skew (Note 14)<br>Device-to-Device Skew (Note 15)                                                                                   |       | 20<br>85                                           | 25<br>160                              |      | 20<br>85                                           | 25<br>160                              |            | 20<br>85                                           | 35<br>160                              | ps   |
| $t_{JITTER}$           | CLOCK Random Jitter (RMS)<br>@ $\leq 0.5$ GHz<br>@ $\leq 1.0$ GHz<br>@ $\leq 1.5$ GHz<br>@ $\leq 2.0$ GHz<br>@ $\leq 2.5$ GHz<br>@ $\leq 3.0$ GHz |       | 0.184<br>0.190<br>0.178<br>0.196<br>0.239<br>0.336 | 0.3<br>0.3<br>0.3<br>0.3<br>0.4<br>0.5 |      | 0.207<br>0.200<br>0.197<br>0.233<br>0.301<br>0.422 | 0.3<br>0.3<br>0.3<br>0.4<br>0.4<br>0.5 |            | 0.271<br>0.252<br>0.259<br>0.308<br>0.399<br>0.572 | 0.4<br>0.4<br>0.4<br>0.5<br>0.5<br>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   |

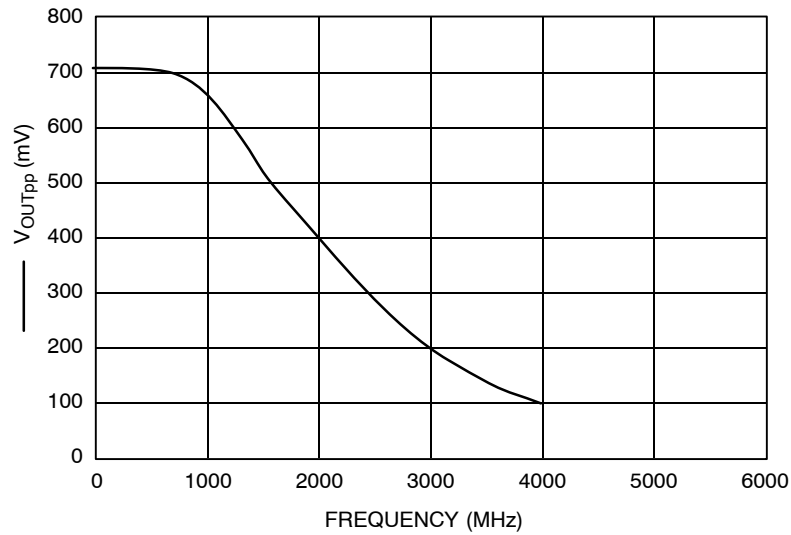
NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional 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.

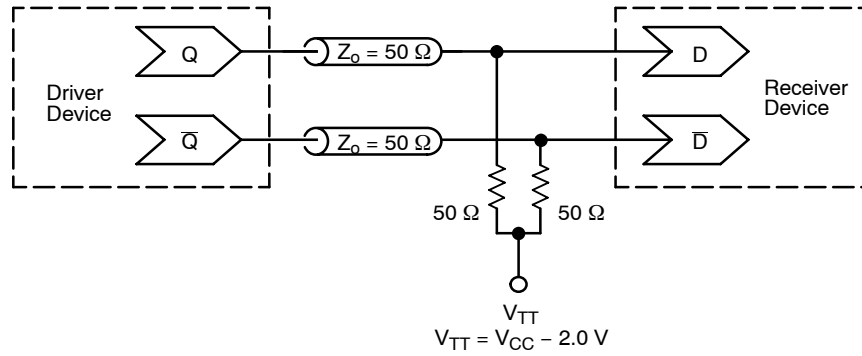
14. Skew is measured between outputs under identical transitions of similar paths through a device.

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

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**Figure 3. F<sub>max</sub> 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 <sup>†</sup> |
|------------------|-------------------|-----------------------|
| MC100LVEP210FA   | LQFP              | 250 Units/Tray        |
| MC100LVEP210FAG  | LQFP<br>(Pb-Free) | 250 Units/Tray        |
| MC100LVEP210FAR2 | LQFP              | 2000 Tape & Reel      |
| MC100LVEP210FARG | LQFP<br>(Pb-Free) | 2000 Tape & Reel      |

<sup>†</sup>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



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**MC100LVEP210/D**

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Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

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