

# -3.3V / -5V Triple ECL Input to LVPECL/PECL Output Translator

## MC10EP90, MC100EP90

### Description

The MC10/100EP90 is a TRIPLE ECL TO LVPECL/PECL translator. The device receives differential LVECL or ECL signals and translates them to differential LVPECL or PECL output signals.

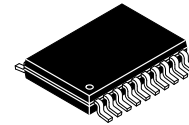
A  $V_{BB}$  output is provided for interfacing with Single-Ended LVECL or ECL signals at the input. If a Single-Ended input is to be used the  $V_{BB}$  output should be connected to the  $\bar{D}$  input. The active signal would then drive the D input. When used the  $V_{BB}$  output should be bypassed to ground by a 0.01  $\mu$ F capacitor. The  $V_{BB}$  output is designed to act as the switching reference for the EP90 under Single-Ended input switching conditions, as a result this pin can only source/sink up to 0.5 mA of current.

To accomplish the level translation the EP90 requires three power rails. The  $V_{CC}$  supply should be connected to the positive supply, and the  $V_{EE}$  connected to the negative supply.

The 100 Series contains temperature compensation.

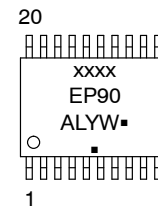
### Features

- 260 ps Typical Propagation Delay
- Maximum Frequency > 3 GHz Typical
- Voltage Supplies  $V_{CC} = 3.0$  V to 5.5 V,  $V_{EE} = -3.0$  V to -5.5 V,  $GND = 0$  V
- Open Input Default State
- Safety Clamp on Inputs
- Fully Differential Design
- Q Output Will Default LOW with Inputs Open or at  $V_{EE}$
- $V_{BB}$  Output
- These are Pb-Free Devices\*



TSSOP-20  
DT SUFFIX  
CASE 948E

### MARKING DIAGRAM



xxxx = MC10 or 100  
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†             |
|----------------|-----------------------|-----------------------|
| MC100EP90DTG   | TSSOP-20<br>(Pb-Free) | 75 Units /<br>Tube    |
| MC100EP90DTR2G | TSSOP-20<br>(Pb-Free) | 2500 /<br>Tape & Reel |

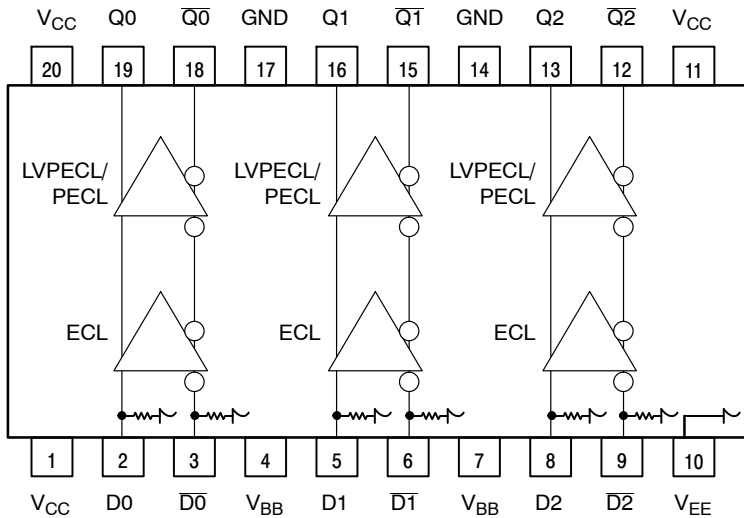
### DISCONTINUED (Note 1)

|               |                       |                       |
|---------------|-----------------------|-----------------------|
| MC10EP90DTG   | TSSOP-20<br>(Pb-Free) | 75 Units /<br>Tube    |
| MC10EP90DTR2G | TSSOP-20<br>(Pb-Free) | 2500 /<br>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](#).

1. **DISCONTINUED:** This device is not recommended for new design. Please contact your onsemi representative for information. The most current information on this device may be available on [www.onsemi.com](http://www.onsemi.com).

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

**Figure 1. TSSOP-20 (Top View) and Logic Diagram**

**Table 1. PIN DESCRIPTION**

| PIN                       | FUNCTION                            |
|---------------------------|-------------------------------------|
| Q(0:2), $\bar{Q}$ (0:2)   | Differential LVPECL or PECL Outputs |
| D(0:2)*, $\bar{D}$ (0:2)* | Differential LVECL or ECL Inputs    |
| $V_{CC}$                  | Positive Supply                     |
| GND                       | Ground                              |
| $V_{EE}$                  | Negative Supply                     |
| $V_{BB}$                  | Output Reference Supply             |

\* Pins will default LOW when left open.

**Table 2. FUNCTION TABLE**

| Function               | $V_{CC}$ | GND | $V_{EE}$ |
|------------------------|----------|-----|----------|
| -5V ECL to 5V PECL     | 5 V      | 0 V | -5 V     |
| -5V ECL to 3.3V PECL   | 3.3 V    | 0 V | -5 V     |
| -3.3V ECL to 5V PECL   | 5 V      | 0 V | -3.3 V   |
| -3.3V ECL to 3.3V PECL | 3.3 V    | 0 V | -3.3 V   |

**Table 3. ATTRIBUTES**

| Characteristics                                               | Value                                                     |                             |
|---------------------------------------------------------------|-----------------------------------------------------------|-----------------------------|
| Internal Input Pulldown Resistor                              | 75 kΩ                                                     |                             |
| Internal Input Pullup Resistor                                | N/A                                                       |                             |
| ESD Protection                                                | Human Body Model<br>Machine Model<br>Charged Device Model | > 2 kV<br>> 200 V<br>> 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                                              | 350 Devices                                               |                             |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test        |                                                           |                             |

1. For additional information, refer to Application Note AND8003/D.

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**Table 4. MAXIMUM RATINGS**

| Symbol           | Parameter                                | Condition 1         | Condition 2       | Rating      | Unit |
|------------------|------------------------------------------|---------------------|-------------------|-------------|------|
| V <sub>CC</sub>  | PECL Mode Power Supply                   | GND = 0 V           |                   | 6           | V    |
| V <sub>EE</sub>  | NECL Mode Power Supply                   | GND = 0 V           |                   | –6          | V    |
| V <sub>I</sub>   | PECL Mode Input Voltage                  | GND = 0 V           | $V_I \leq V_{CC}$ | 6           | V    |
|                  | NECL Mode Input Voltage                  | GND = 0 V           | $V_I \geq V_{EE}$ | –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   |
| θ <sub>JA</sub>  | Thermal Resistance (Junction–to–Ambient) | 0 lfpm              | TSSOP–20          | 140         | °C/W |
|                  |                                          | 500 lfpm            | TSSOP–20          | 100         | °C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction–to–Case)    | Standard Board      | TSSOP–20          | 23 to 41    | °C/W |
| T <sub>sol</sub> | Wave Solder                              | Pb                  |                   | 265         | °C   |
|                  |                                          | 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.

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**Table 5. 10EP DC CHARACTERISTICS**  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$ ;  $GND = 0\text{ V}$  (Note 2)

| Symbol      | Characteristic                                                             | -40°C        |       |       | 25°C         |       |       | 85°C         |       |       | Unit |
|-------------|----------------------------------------------------------------------------|--------------|-------|-------|--------------|-------|-------|--------------|-------|-------|------|
|             |                                                                            | Min          | Typ   | Max   | Min          | Typ   | Max   | Min          | Typ   | Max   |      |
| $I_{EE}$    | Negative Power Supply Current                                              | 5            | 13    | 20    | 5            | 13    | 20    | 5            | 13    | 20    | mA   |
| $I_{CC}$    | Positive Power Supply Current                                              | 43           | 55    | 67    | 43           | 55    | 67    | 43           | 55    | 67    | mA   |
| $V_{OH}$    | Output HIGH Voltage (Note 3)                                               | 2165         | 2290  | 2415  | 2230         | 2355  | 2480  | 2290         | 2415  | 2540  | mV   |
| $V_{OL}$    | Output LOW Voltage (Note 3)                                                | 1365         | 1490  | 1615  | 1430         | 1555  | 1680  | 1490         | 1615  | 1740  | mV   |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                          | -1210        |       | -885  | -1145        |       | -820  | -1085        |       | -760  | mV   |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | -1935        |       | -1610 | -1870        |       | -1545 | -1810        |       | -1485 | mV   |
| $V_{BB}$    | Output Voltage Reference                                                   | -1510        | -1410 | -1310 | -1445        | -1345 | -1245 | -1385        | -1285 | -1185 | mV   |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4) | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | V    |
| $I_{IH}$    | Input HIGH Current                                                         |              |       | 150   |              |       | 150   |              |       | 150   | μA   |
| $I_{IL}$    | Input LOW Current                                                          | 0.5          |       |       | 0.5          |       |       | 0.5          |       |       | 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.

2. Input and output parameters vary 1:1 with  $V_{CC}$ .

3. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .

4.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , 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. 10EP DC CHARACTERISTICS**  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$ ;  $GND = 0\text{ V}$  (Note 5)

| Symbol      | Characteristic                                                             | -40°C        |       |       | 25°C         |       |       | 85°C         |       |       | Unit |
|-------------|----------------------------------------------------------------------------|--------------|-------|-------|--------------|-------|-------|--------------|-------|-------|------|
|             |                                                                            | Min          | Typ   | Max   | Min          | Typ   | Max   | Min          | Typ   | Max   |      |
| $I_{EE}$    | Negative Power Supply Current                                              | 5            | 13    | 20    | 5            | 13    | 20    | 5            | 13    | 20    | mA   |
| $I_{CC}$    | Positive Power Supply Current                                              | 43           | 55    | 67    | 43           | 55    | 67    | 43           | 55    | 67    | mA   |
| $V_{OH}$    | Output HIGH Voltage (Note 6)                                               | 3865         | 3990  | 4115  | 3930         | 4055  | 4180  | 3990         | 4115  | 4240  | mV   |
| $V_{OL}$    | Output LOW Voltage (Note 6)                                                | 3065         | 3190  | 3315  | 3130         | 3255  | 3380  | 3190         | 3315  | 3440  | mV   |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                          | -1210        |       | -885  | -1145        |       | -820  | -1085        |       | -760  | mV   |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | -1935        |       | -1610 | -1870        |       | -1545 | -1810        |       | -1485 | mV   |
| $V_{BB}$    | Output Voltage Reference                                                   | -1510        | -1410 | -1310 | -1445        | -1345 | -1245 | -1385        | -1285 | -1185 | mV   |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7) | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | V    |
| $I_{IH}$    | Input HIGH Current                                                         |              |       | 150   |              |       | 150   |              |       | 150   | μA   |
| $I_{IL}$    | Input LOW Current                                                          | 0.5          |       |       | 0.5          |       |       | 0.5          |       |       | 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  $V_{CC}$ .

6. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .

7.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , 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. 100EP DC CHARACTERISTICS**  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$ ; GND = 0 V (Note 8)

| Symbol      | Characteristic                                                              | -40°C        |       |       | 25°C         |       |       | 85°C         |       |       | Unit |
|-------------|-----------------------------------------------------------------------------|--------------|-------|-------|--------------|-------|-------|--------------|-------|-------|------|
|             |                                                                             | Min          | Typ   | Max   | Min          | Typ   | Max   | Min          | Typ   | Max   |      |
| $I_{EE}$    | Negative Power Supply Current                                               | 5            | 13    | 20    | 5            | 13    | 20    | 5            | 13    | 20    | mA   |
| $I_{CC}$    | Positive Power Supply Current                                               | 45           | 58    | 70    | 50           | 62    | 75    | 53           | 65    | 78    | mA   |
| $V_{OH}$    | Output HIGH Voltage (Note 9)                                                | 2155         | 2280  | 2405  | 2155         | 2280  | 2405  | 2155         | 2280  | 2405  | mV   |
| $V_{OL}$    | Output LOW Voltage (Note 9)                                                 | 1305         | 1480  | 1605  | 1305         | 1480  | 1605  | 1305         | 1480  | 1605  | mV   |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | -1225        |       | -885  | -1225        |       | -885  | -1225        |       | -885  | mV   |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                            | -1995        |       | -1625 | -1995        |       | -1625 | -1995        |       | -1625 | mV   |
| $V_{BB}$    | Output Voltage Reference                                                    | -1525        | -1425 | -1325 | -1525        | -1425 | -1325 | -1525        | -1425 | -1325 | mV   |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 10) | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | V    |
| $I_{IH}$    | Input HIGH Current                                                          |              |       | 150   |              |       | 150   |              |       | 150   | μA   |
| $I_{IL}$    | Input LOW Current                                                           | 0.5          |       |       | 0.5          |       |       | 0.5          |       |       | 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.

8. Input and output parameters vary 1:1 with  $V_{CC}$ .

9. All loading with 50 Ω to  $V_{CC} - 2.0\text{ V}$ .

10.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

**Table 8. 100EP DC CHARACTERISTICS**  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$ ; GND = 0 V (Note 11)

| Symbol      | Characteristic                                                              | -40°C        |       |       | 25°C         |       |       | 85°C         |       |       | Unit |
|-------------|-----------------------------------------------------------------------------|--------------|-------|-------|--------------|-------|-------|--------------|-------|-------|------|
|             |                                                                             | Min          | Typ   | Max   | Min          | Typ   | Max   | Min          | Typ   | Max   |      |
| $I_{EE}$    | Negative Power Supply Current                                               | 5            | 13    | 20    | 5            | 13    | 20    | 5            | 13    | 20    | mA   |
| $I_{CC}$    | Positive Power Supply Current                                               | 45           | 58    | 70    | 50           | 62    | 75    | 53           | 65    | 78    | mA   |
| $V_{OH}$    | Output HIGH Voltage (Note 12)                                               | 3855         | 3980  | 4105  | 3855         | 3980  | 4105  | 3855         | 3980  | 4105  | mV   |
| $V_{OL}$    | Output LOW Voltage (Note 12)                                                | 3005         | 3180  | 3305  | 3005         | 3180  | 3305  | 3005         | 3180  | 3305  | mV   |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | -1225        |       | -885  | -1225        |       | -885  | -1225        |       | -885  | mV   |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                            | -1995        |       | -1625 | -1995        |       | -1625 | -1995        |       | -1625 | mV   |
| $V_{BB}$    | Output Voltage Reference                                                    | -1525        | -1425 | -1325 | -1525        | -1425 | -1325 | -1525        | -1425 | -1325 | mV   |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13) | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | V    |
| $I_{IH}$    | Input HIGH Current                                                          |              |       | 150   |              |       | 150   |              |       | 150   | μA   |
| $I_{IL}$    | Input LOW Current                                                           | 0.5          |       |       | 0.5          |       |       | 0.5          |       |       | 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.

11. Input and output parameters vary 1:1 with  $V_{CC}$ .

12. All loading with 50 Ω to  $V_{CC} - 2.0\text{ V}$ .

13.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , 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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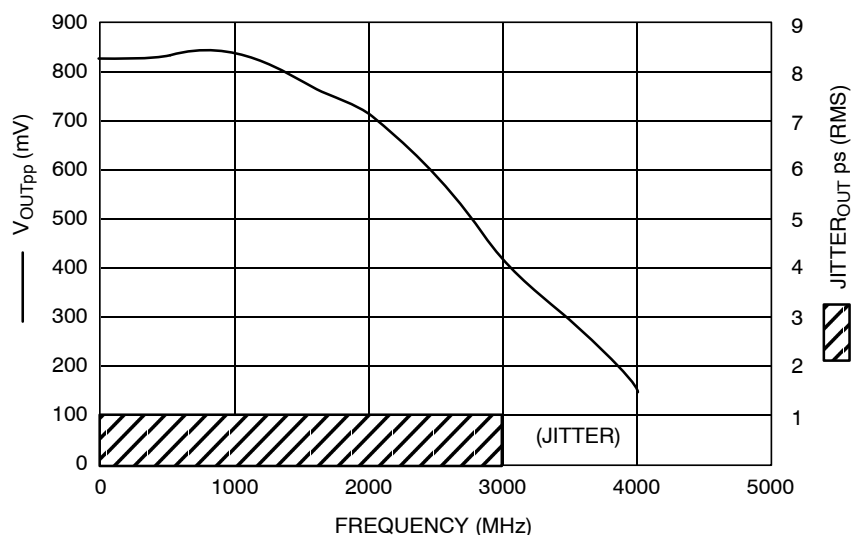
**Table 9. AC CHARACTERISTICS**  $V_{EE} = -3.0\text{ V to }-5.5\text{ V}$ ;  $V_{CC} = 3.0\text{ V to }5.5\text{ V}$ ;  $GND = 0\text{ V}$  (Note 14)

| Symbol                   | Characteristic                                                     | -40°C |     |           | 25°C |     |           | 85°C |     |           | Unit |
|--------------------------|--------------------------------------------------------------------|-------|-----|-----------|------|-----|-----------|------|-----|-----------|------|
|                          |                                                                    | Min   | Typ | Max       | Min  | Typ | Max       | Min  | Typ | Max       |      |
| $f_{\max}$               | Maximum Frequency<br>(See Figure 2 $F_{\max}/\text{JITTER}$ )      |       | > 3 |           |      | > 3 |           |      | > 3 |           | GHz  |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay to<br>Output Differential                        | 170   | 240 | 310       | 200  | 260 | 340       | 230  | 300 | 370       | ps   |
| $t_{\text{SKEW}}$        | Duty Cycle Skew (Note 15)                                          |       | 5.0 | 20        |      | 5.0 | 20        |      | 5.0 | 20        | ps   |
|                          | Within Device Skew $Q, \bar{Q}$<br>Device to Device Skew (Note 15) |       |     | 80<br>140 |      |     | 80<br>140 |      |     | 80<br>140 |      |
| $t_{\text{JITTER}}$      | Cycle-to-Cycle Jitter<br>(See Figure 2 $F_{\max}/\text{JITTER}$ )  |       | 0.2 | < 1       |      | 0.2 | < 1       |      | 0.2 | < 1       | ps   |
| $V_{PP}$                 | Input Voltage<br>Swing (Differential Configuration)                | 150   | 800 | 1200      | 150  | 800 | 1200      | 150  | 800 | 1200      | mV   |
| $t_r$ ,<br>$t_f$         | Output Rise/Fall Times $Q, \bar{Q}$<br>(20% – 80%)                 | 70    | 120 | 170       | 80   | 130 | 180       | 100  | 150 | 230       | 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 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.

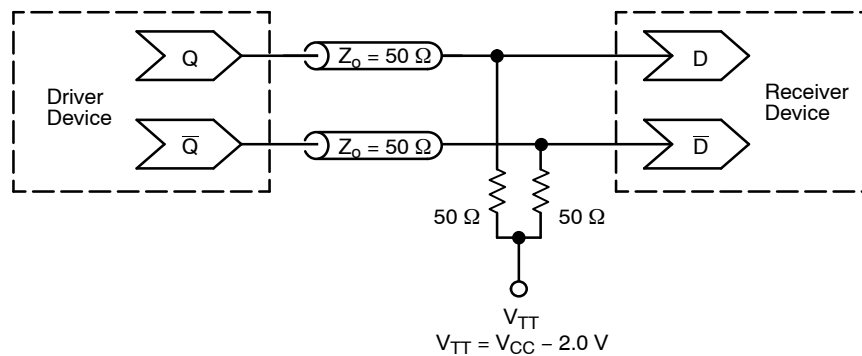
14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC}-2.0\text{ V}$ .

15. Skew is measured between outputs under identical transitions. Duty cycle skew is defined only for differential operation when the delays are measured from the cross point of the inputs to the cross point of the outputs.



**Figure 2.  $F_{\max}/\text{Jitter}$**

## MC10EP90, MC100EP90



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

### 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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