

### 3.3 V/5 V ECL Dual Differential Data and Clock D Flip-Flop With Set and Reset

## MC10EP29, MC100EP29

#### Description

The MC10/100EP29 is a dual master-slave flip-flop. The device features fully differential Data and Clock inputs as well as outputs. The MC10/100EP29 is functionally equivalent to the MC10/100EL29. Data enters the master latch when the clock is LOW and transfers to the slave upon a positive transition on the clock input.

The differential inputs have special circuitry which ensures device stability under open input conditions. When both differential inputs are left open the D input will pull down to  $V_{EE}$  and the  $\bar{D}$  input will bias around  $V_{CC}/2$ . The outputs will go to a defined state, however the state will be random based on how the flip flop powers up.

Both flip flops feature asynchronous, overriding Set and Reset inputs. Note that the Set and Reset inputs cannot both be HIGH simultaneously.

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

The 100 Series contains temperature compensation.

#### Features

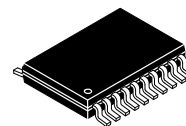
- Maximum Frequency > 3 GHz Typical
- 500 ps Typical Propagation Delays
- PECL Mode Operating Range:  $V_{CC} = 3.0$  V to 5.5 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -3.0$  V to -5.5 V
- Open Input Default State
- Safety Clamp on Inputs
- These are Pb-Free Devices



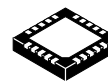
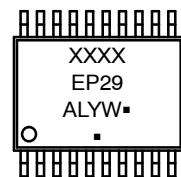
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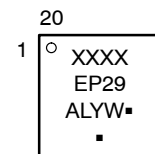
#### MARKING DIAGRAM\*



TSSOP-20  
DT SUFFIX  
CASE 948E



QFN-20  
MN SUFFIX  
CASE 485E



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)

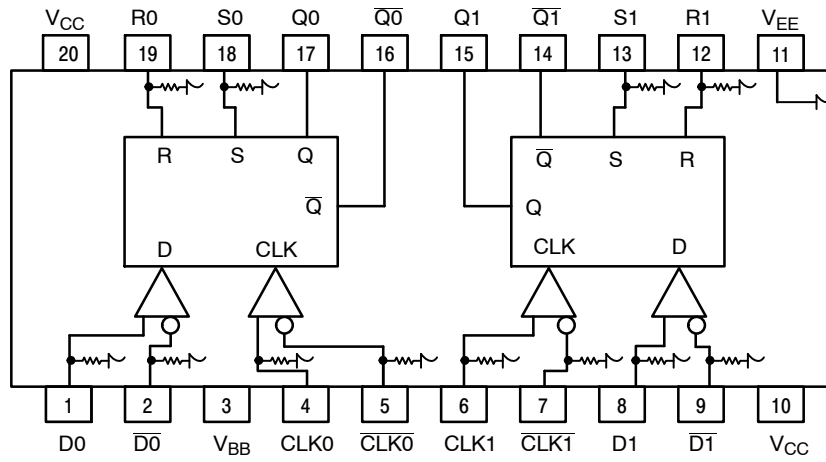
\*For additional marking information, refer to Application Note [AND8002/D](#).

#### ORDERING INFORMATION

| Device         | Package            | Shipping†          |
|----------------|--------------------|--------------------|
| MC10EP29DTG    | TSSOP-20 (Pb-Free) | 75 Units / Tube    |
| MC100EP29DTG   | TSSOP-20 (Pb-Free) | 75 Units / Tube    |
| MC100EP29DTR2G | TSSOP-20 (Pb-Free) | 2500 / Tape & Reel |
| MC100EP29MNG   | QFN-20 (Pb-Free)   | 92 Units / Tube    |

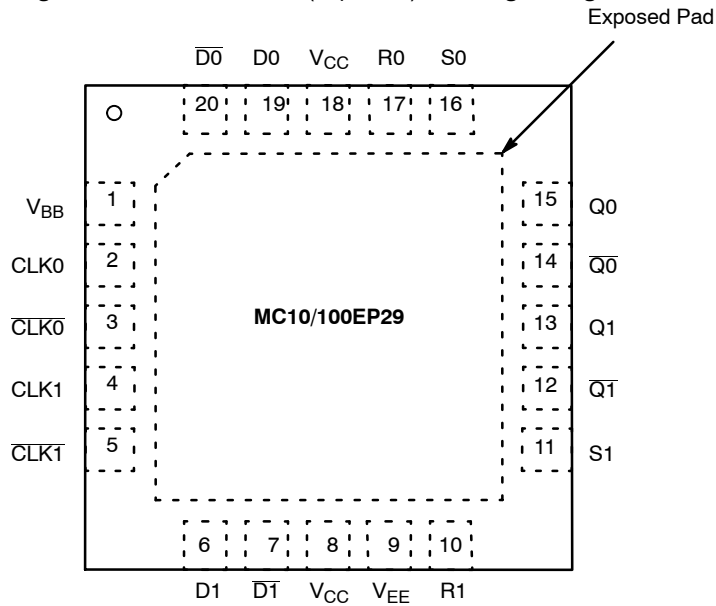
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

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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**



NOTE: The Exposed Pad (EP) on package bottom must be attached to a heat-sinking conduit.  
The Exposed Pad may only be electrically connected to  $V_{EE}$ .

**Figure 1. QFN-20 Pinout (Top View)**

**Table 1. PIN DESCRIPTION**

| Pin                        | Function                      |
|----------------------------|-------------------------------|
| D0*, D0-bar*; D1*, D1-bar* | ECL Differential Data Inputs  |
| R0*, R1*                   | ECL Reset Inputs              |
| CLK0*, CLK0-bar*           | ECL Differential Clock Inputs |
| CLK1*, CLK1-bar*           | ECL Differential Clock Inputs |
| S0*, S1*                   | ECL Set Inputs                |
| Q0, Q0-bar; Q1, Q1-bar     | ECL Differential Data Outputs |
| $V_{BB}$                   | Reference Voltage Output      |
| $V_{CC}$                   | Positive Supply               |
| $V_{EE}$                   | Negative Supply               |
| EP                         | Exposed Pad                   |

\*Pins will default LOW when left open.

**Table 2. TRUTH TABLE**

| R | S | D | CLK | Q     | Q-bar |
|---|---|---|-----|-------|-------|
| L | L | L | Z   | L     | H     |
| L | L | H | Z   | H     | L     |
| H | L | X | X   | L     | H     |
| L | H | X | X   | H     | L     |
| H | H | X | X   | Undef | Undef |

Z = LOW to HIGH Transition  
X = Don't Care

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**Table 3. ATTRIBUTES**

| Characteristics                                                             | Value                       |
|-----------------------------------------------------------------------------|-----------------------------|
| Internal Input Pulldown Resistor                                            | 75 k $\Omega$               |
| Internal Input Pullup Resistor                                              | N/A                         |
| ESD Protection<br>Human Body Model<br>Machine Model<br>Charged Device Model | > 2 kV<br>> 100 V<br>> 2 kV |
| Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)               | Pb-Free Pkg                 |
| TSSOP-20<br>QFN-20                                                          | Level 3<br>Level 1          |
| Flammability Rating<br>Oxygen Index: 28 to 34                               | UL 94 V-0 @ 0.125 in        |
| Transistor Count                                                            | 383 Devices                 |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test                      |                             |

1. For additional information, see Application Note [AND8003/D](#).

**Table 4. MAXIMUM RATINGS**

| Symbol        | Parameter                                          | Condition 1                                    | Condition 2                            | Rating      | Unit                                         |
|---------------|----------------------------------------------------|------------------------------------------------|----------------------------------------|-------------|----------------------------------------------|
| $V_{CC}$      | PECL Mode Power Supply                             | $V_{EE} = 0\text{ V}$                          |                                        | 6           | V                                            |
| $V_{EE}$      | NECL Mode Power Supply                             | $V_{CC} = 0\text{ V}$                          |                                        | -6          | V                                            |
| $V_I$         | PECL Mode Input Voltage<br>NECL Mode Input Voltage | $V_{EE} = 0\text{ V}$<br>$V_{CC} = 0\text{ V}$ | $V_I \leq V_{CC}$<br>$V_I \geq V_{EE}$ | 6<br>-6     | V<br>V                                       |
| $I_{out}$     | Output Current                                     | Continuous<br>Surge                            |                                        | 50<br>100   | mA<br>mA                                     |
| $I_{BB}$      | $V_{BB}$ Sink/Source                               |                                                |                                        | $\pm 0.5$   | mA                                           |
| $T_A$         | Operating Temperature Range                        |                                                |                                        | -40 to +85  | $^{\circ}\text{C}$                           |
| $T_{stg}$     | Storage Temperature Range                          |                                                |                                        | -65 to +150 | $^{\circ}\text{C}$                           |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient)           | 0 lfpm<br>500 lfpm                             | 20 TSSOP<br>20 TSSOP                   | 140<br>100  | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$ |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)              | Standard Board                                 | 20 TSSOP                               | 23 to 41    | $^{\circ}\text{C/W}$                         |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient)           | 0 lfpm<br>500 lfpm                             | QFN-20<br>QFN-20                       | 47<br>33    | $^{\circ}\text{C/W}$<br>$^{\circ}\text{C/W}$ |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)              | Standard Board                                 | QFN-20                                 | 18          | $^{\circ}\text{C/W}$                         |
| $T_{sol}$     | Wave Solder (Pb-Free)                              |                                                |                                        | 265         | $^{\circ}\text{C}$                           |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

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**Table 5. 10EP DC CHARACTERISTICS, PECL  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 2)**

| Symbol      | Characteristic                                                             | -40°C |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|-------------|----------------------------------------------------------------------------|-------|------|------|------|------|------|------|------|------|---------------|
|             |                                                                            | Min   | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$    | Power Supply Current                                                       | 35    | 46   | 55   | 37   | 48   | 57   | 40   | 49   | 60   | 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)                                          | 2090  |      | 2415 | 2155 |      | 2480 | 2215 |      | 2540 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | 1365  |      | 1690 | 1460 |      | 1755 | 1490 |      | 1815 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                   | 1790  | 1890 | 1990 | 1855 | 1955 | 2055 | 1915 | 2015 | 2115 | mV            |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4) | 2.0   |      | 3.3  | 2.0  |      | 3.3  | 2.0  |      | 3.3  | V             |
| $I_{IH}$    | Input HIGH Current                                                         |       |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                          | 0.5   |      |      | 0.5  |      |      | 0.5  |      |      | $\mu\text{A}$ |

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.

2. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.3 V to -2.2 V.

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

4.  $V_{IHCMR}$  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. 10EP DC CHARACTERISTICS, PECL  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (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                                                       | 35    | 46   | 55   | 37   | 48   | 57   | 40   | 49   | 60   | 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)                                          | 3790  |      | 4115 | 3855 |      | 4180 | 3915 |      | 4240 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                           | 3065  |      | 3390 | 3130 |      | 3455 | 3190 |      | 3515 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                   | 3490  | 3590 | 3690 | 3555 | 3655 | 3755 | 3615 | 3715 | 3815 | mV            |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7) | 2.0   |      | 5.0  | 2.0  |      | 5.0  | 2.0  |      | 5.0  | V             |
| $I_{IH}$    | Input HIGH Current                                                         |       |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                          | 0.5   |      |      | 0.5  |      |      | 0.5  |      |      | $\mu\text{A}$ |

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.

5. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +2.0 V to -0.5 V.

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

7.  $V_{IHCMR}$  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. 10EP DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$  (Note 8)

| Symbol      | Characteristic                                                              | -40°C          |       |       | 25°C           |       |       | 85°C           |       |       | Unit          |
|-------------|-----------------------------------------------------------------------------|----------------|-------|-------|----------------|-------|-------|----------------|-------|-------|---------------|
|             |                                                                             | Min            | Typ   | Max   | Min            | Typ   | Max   | Min            | Typ   | Max   |               |
| $I_{EE}$    | Power Supply Current                                                        | 35             | 46    | 55    | 37             | 48    | 57    | 40             | 49    | 60    | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 9)                                                | -1135          | -1010 | -885  | -1070          | -945  | -820  | -1010          | -885  | -760  | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 9)                                                 | -1935          | -1810 | -1685 | -1870          | -1745 | -1620 | -1810          | -1685 | -1560 | 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 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   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                           | 0.5            |       |       | 0.5            |       |       | 0.5            |       |       | $\mu\text{A}$ |

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.

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

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

10.  $V_{IHCMR}$  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 8. 100EP DC CHARACTERISTICS, PECL**  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 11)

| Symbol      | Characteristic                                                              | -40°C |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|-------------|-----------------------------------------------------------------------------|-------|------|------|------|------|------|------|------|------|---------------|
|             |                                                                             | Min   | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$    | Power Supply Current                                                        | 35    | 46   | 55   | 37   | 48   | 57   | 40   | 49   | 60   | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 12)                                               | 2155  | 2280 | 2405 | 2155 | 2280 | 2405 | 2155 | 2280 | 2405 | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 12)                                                | 1305  | 1480 | 1605 | 1305 | 1480 | 1605 | 1305 | 1480 | 1605 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | 2075  |      | 2420 | 2075 |      | 2420 | 2075 |      | 2420 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                            | 1305  |      | 1675 | 1305 |      | 1675 | 1305 |      | 1675 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                    | 1775  | 1875 | 1975 | 1775 | 1875 | 1975 | 1775 | 1875 | 1975 | mV            |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13) | 2.0   |      | 3.3  | 2.0  |      | 3.3  | 2.0  |      | 3.3  | V             |
| $I_{IH}$    | Input HIGH Current                                                          |       |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                           | 0.5   |      |      | 0.5  |      |      | 0.5  |      |      | $\mu\text{A}$ |

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.

11. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $+0.3\text{ V}$  to  $-2.2\text{ V}$ .

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

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 9. 100EP DC CHARACTERISTICS, PECL**  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 14)

| Symbol      | Characteristic                                                              | -40°C |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|-------------|-----------------------------------------------------------------------------|-------|------|------|------|------|------|------|------|------|---------------|
|             |                                                                             | Min   | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$    | Power Supply Current                                                        | 35    | 46   | 55   | 37   | 48   | 57   | 40   | 49   | 60   | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 15)                                               | 3855  | 3980 | 4105 | 3855 | 3980 | 4105 | 3855 | 3980 | 4105 | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 15)                                                | 3005  | 3180 | 3305 | 3005 | 3180 | 3305 | 3005 | 3180 | 3305 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | 3775  |      | 4120 | 3775 |      | 4120 | 3775 |      | 4120 | mV            |
| $V_{IL}$    | Input LOW Voltage (Single-Ended)                                            | 3005  |      | 3375 | 3005 |      | 3375 | 3005 |      | 3375 | mV            |
| $V_{BB}$    | Output Voltage Reference                                                    | 3475  | 3575 | 3675 | 3475 | 3575 | 3675 | 3475 | 3575 | 3675 | mV            |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 16) | 2.0   |      | 5.0  | 2.0  |      | 5.0  | 2.0  |      | 5.0  | V             |
| $I_{IH}$    | Input HIGH Current                                                          |       |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                           | 0.5   |      |      | 0.5  |      |      | 0.5  |      |      | $\mu\text{A}$ |

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.

14. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +2.0 V to -0.5 V.

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

16.  $V_{IHCMR}$  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 10. 100EP DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$  (Note 17)

| Symbol      | Characteristic                                                              | -40°C          |       |       | 25°C           |       |       | 85°C           |       |       | Unit          |
|-------------|-----------------------------------------------------------------------------|----------------|-------|-------|----------------|-------|-------|----------------|-------|-------|---------------|
|             |                                                                             | Min            | Typ   | Max   | Min            | Typ   | Max   | Min            | Typ   | Max   |               |
| $I_{EE}$    | Power Supply Current                                                        | 35             | 46    | 55    | 37             | 48    | 57    | 40             | 49    | 60    | mA            |
| $V_{OH}$    | Output HIGH Voltage (Note 18)                                               | -1145          | -1020 | -895  | -1145          | -1020 | -895  | -1145          | -1020 | -895  | mV            |
| $V_{OL}$    | Output LOW Voltage (Note 18)                                                | -1995          | -1820 | -1695 | -1995          | -1820 | -1695 | -1995          | -1820 | -1695 | mV            |
| $V_{IH}$    | Input HIGH Voltage (Single-Ended)                                           | -1225          |       | -880  | -1225          |       | -880  | -1225          |       | -880  | 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 19) | $V_{EE} + 2.0$ |       | 0.0   | $V_{EE} + 2.0$ |       | 0.0   | $V_{EE} + 2.0$ |       | 0.0   | V             |
| $I_{IH}$    | Input HIGH Current                                                          |                |       | 150   |                |       | 150   |                |       | 150   | $\mu\text{A}$ |
| $I_{IL}$    | Input LOW Current                                                           | 0.5            |       |       | 0.5            |       |       | 0.5            |       |       | $\mu\text{A}$ |

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.

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

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

19.  $V_{IHCMR}$  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 11. AC CHARACTERISTICS**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.0\text{ V}$  to  $-5.5\text{ V}$  or  $V_{CC} = 3.0\text{ V}$  to  $5.5\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 20)

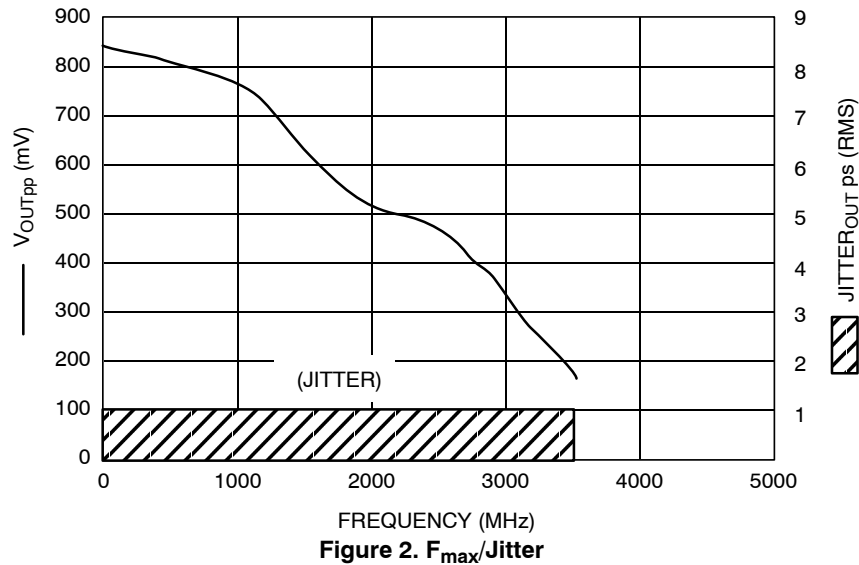
| Symbol                   | Characteristic                                                    | -40°C             |                   |                   | 25°C              |                   |                   | 85°C              |                   |                   | Unit |
|--------------------------|-------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|
|                          |                                                                   | Min               | Typ               | Max               | Min               | Typ               | Max               | Min               | Typ               | Max               |      |
| $f_{\max}$               | Maximum Frequency<br>(See Figure 2 $F_{\max}/\text{JITTER}$ )     |                   | > 3.0             |                   |                   | > 3.0             |                   |                   | > 3.0             |                   | GHz  |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay to<br>Output Differential S<br>R                | 300<br>275<br>300 | 380<br>380<br>400 | 450<br>475<br>500 | 350<br>300<br>325 | 420<br>400<br>420 | 500<br>500<br>525 | 400<br>350<br>375 | 470<br>450<br>470 | 550<br>550<br>575 | ps   |
| $t_S$<br>$t_H$           | Setup Time<br>Hold Time                                           | 100<br>100        | 20<br>20          |                   | 100<br>100        | 20<br>20          |                   | 100<br>100        | 20<br>20          |                   | ps   |
| $t_{RR}/t_{RR2}$         | Set/Reset Recovery                                                | 150               | 80                |                   | 150               | 80                |                   | 150               | 80                |                   | ps   |
| $t_{PW}$                 | Minimum Pulse Width<br>Set, Reset                                 | 500               | 300               |                   | 500               | 300               |                   | 500               | 300               |                   | ps   |
| $t_{\text{JITTER}}$      | 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 Swing (Note 21)                                     | 150               | 800               | 1200              | 150               | 800               | 1200              | 150               | 800               | 1200              | mV   |
| $t_r$<br>$t_f$           | Output Rise/Fall Times<br>(20% – 80%) Q, $\bar{Q}$                | 100               | 180               | 250               | 150               | 210               | 300               | 175               | 230               | 325               | 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.

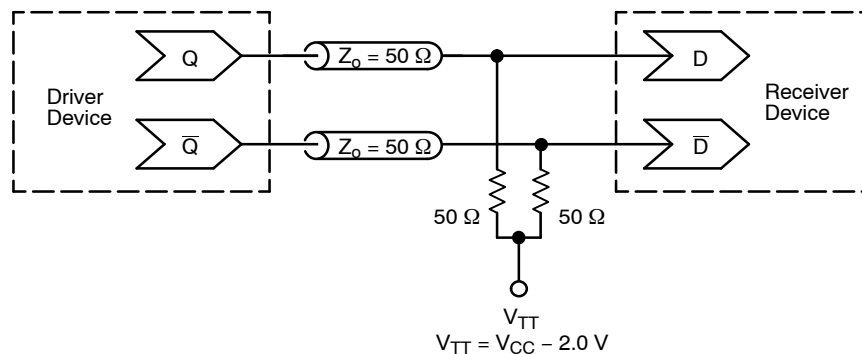
20. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .

21.  $V_{PP}(\text{min})$  is the minimum input swing for which AC parameters are guaranteed.

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.



## MC10EP29, MC100EP29



**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

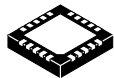
- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPiCE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – 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

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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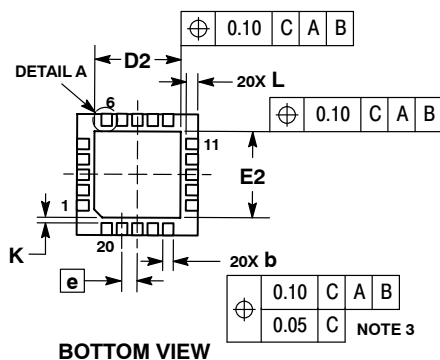
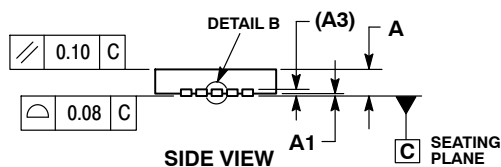
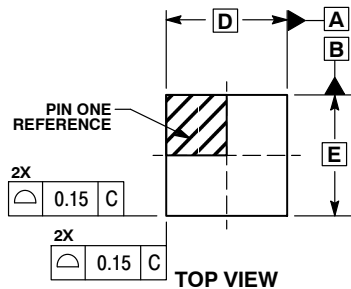
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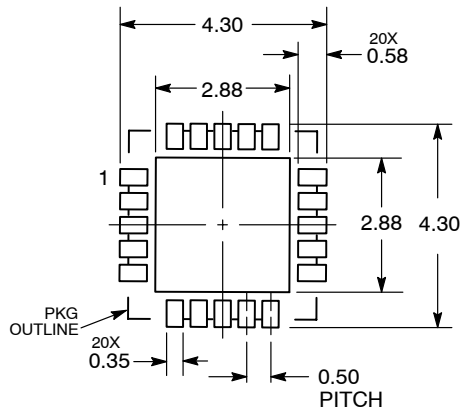
SCALE 2:1

QFN20, 4x4, 0.5P  
CASE 485E  
ISSUE C

DATE 13 FEB 2018

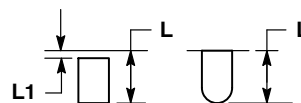
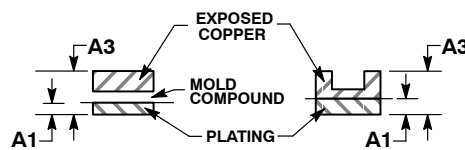


### SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

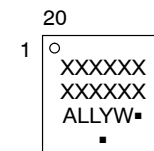


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |          |      |
|-------------|----------|------|
| DIM         | MIN      | MAX  |
| A           | 0.80     | 1.00 |
| A1          | ---      | 0.05 |
| A3          | 0.20 REF |      |
| b           | 0.20     | 0.30 |
| D           | 4.00 BSC |      |
| D2          | 2.60     | 2.90 |
| E           | 4.00 BSC |      |
| E2          | 2.60     | 2.90 |
| e           | 0.50 BSC |      |
| K           | 0.20 REF |      |
| L           | 0.35     | 0.45 |
| L1          | 0.00     | 0.15 |

### GENERIC MARKING DIAGRAM\*



XXXXXX= Specific Device Code  
A = Assembly Location  
LL = Wafer Lot  
Y = Year  
W = Work Week  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present. Some products may not follow the Generic Marking.

|                         |                         |                                                                                                                                                                                  |
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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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ON



SCALE 2:1

TSSOP-20 WB  
CASE 948E  
ISSUE D

DATE 17 FEB 2016



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 6.40        | 6.60 | 0.252     | 0.260 |
| B   | 4.30        | 4.50 | 0.169     | 0.177 |
| C   | ---         | 1.20 | ---       | 0.047 |
| D   | 0.05        | 0.15 | 0.002     | 0.006 |
| F   | 0.50        | 0.75 | 0.020     | 0.030 |
| G   | 0.65 BSC    |      | 0.026 BSC |       |
| H   | 0.27        | 0.37 | 0.011     | 0.015 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0°          | 8°   | 0°        | 8°    |

### GENERIC MARKING DIAGRAM\*



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

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

|                  |             |                                                                                                                                                                                  |
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| DESCRIPTION:     | TSSOP-20 WB | PAGE 1 OF 1                                                                                                                                                                      |

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