

# MC10EP56

## Product Preview

# Dual Differential 2:1 Multiplexer

The MC10EP56 is a dual, fully differential 2:1 multiplexer. The differential data path makes the device ideal for multiplexing low skew clock or other skew sensitive signals. Multiple  $V_{BB}$  pins are provided to ease AC coupling of input signals. If used, the  $V_{BB}$  output should be bypassed to ground with a  $0.01\mu\text{F}$  capacitor.

The device features both individual and common select inputs to address both data path and random logic applications.

- 350ps Typical Propagation Delays
- Typical Frequency 3.0GHz
- 20-Lead TSSOP Package
- PECL mode: 3.0V to 5.5V  $V_{CC}$  with  $V_{EE} = 0\text{V}$
- ECL mode: 0V  $V_{CC}$  with  $V_{EE} = -3.0\text{V}$  to  $-5.5\text{V}$
- Separate and Common Select
- Internal Input Resistors: Pulldown on D,  $\bar{D}$
- Q Output will default LOW with inputs open or at  $V_{EE}$
- ESD Protection: >4KV HBM, >200V MM
- $V_{BB}$  Outputs
- New Differential Input Common Mode Range
- Moisture Sensitivity Level 1, Indefinite Time Out of Drypack.  
For Additional Information, See Application Note AND8003/D
- Flammability Rating: UL-94 code V-0 @ 1/8",  
Oxygen Index 28 to 34
- Transistor Count = 140 devices

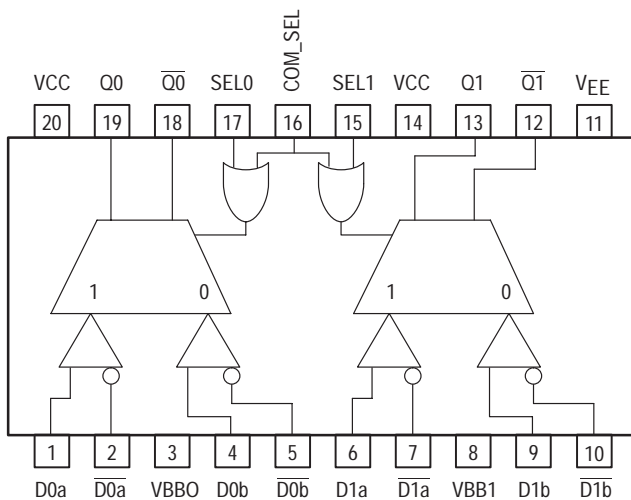


Figure 1. 20-Lead TSSOP (Top View) and Logic Diagram

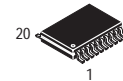
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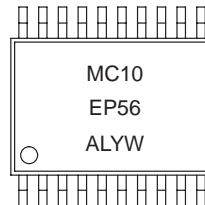
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**TSSOP-20  
DT SUFFIX  
CASE 948E**

### MARKING DIAGRAM\*



A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week

\*For additional information, see Application Note AND8002/D

| PIN DESCRIPTION           |                          |
|---------------------------|--------------------------|
| PIN                       | FUNCTION                 |
| D0a–D1a                   | ECL Input Data a         |
| $\bar{D}0a$ – $\bar{D}1a$ | ECL Input Data a Invert  |
| D0b–D1b                   | ECL Input Data b         |
| $\bar{D}0b$ – $\bar{D}1b$ | ECL Input Data b Invert  |
| SEL0–SEL1                 | ECL Indiv. Select Input  |
| COM_SEL                   | ECL Common Select Input  |
| $V_{BB0}$ , $V_{BB1}$     | Output Reference Voltage |
| Q0–Q1                     | ECL True Outputs         |
| $\bar{Q}0$ – $\bar{Q}1$   | ECL Inverted Outputs     |
| $V_{CC}$                  | Positive Supply          |
| $V_{EE}$                  | Negative, 0 Supply       |

### TRUTH TABLE

| SEL0 | SEL1 | COM_SEL | Q0,<br>$\bar{Q}0$ | Q1,<br>$\bar{Q}1$ |
|------|------|---------|-------------------|-------------------|
| X    | X    | H       | a                 | a                 |
| L    | L    | L       | b                 | b                 |
| L    | H    | L       | b                 | a                 |
| H    | H    | L       | a                 | a                 |
| H    | L    | L       | a                 | b                 |

### ORDERING INFORMATION

| Device       | Package | Shipping         |
|--------------|---------|------------------|
| MC10EP56DT   | TSSOP   | 75 Units/Rail    |
| MC10EP56DTR2 | TSSOP   | 2500 Tape & Reel |

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## MAXIMUM RATINGS\*

| Symbol        | Parameter   | Value              | Unit |
|---------------|---|--------------------|------|
| $V_{EE}$      | Power Supply ( $V_{CC} = 0V$ )  | -6.0 to 0          | VDC  |
| $V_{CC}$      | Power Supply ( $V_{EE} = 0V$ )  | 6.0 to 0           | VDC  |
| $V_I$         | Input Voltage ( $V_{CC} = 0V$ , $V_I$ not more negative than $V_{EE}$ ) | -6.0 to 0          | VDC  |
| $V_I$         | Input Voltage ( $V_{EE} = 0V$ , $V_I$ not more positive than $V_{CC}$ ) | 6.0 to 0           | VDC  |
| $I_{out}$     | Output Current<br>Continuous<br>Surge                                   | 50<br>100          | mA   |
| $I_{BB}$      | $V_{BB}$ Sink/Source Current†   | $\pm 0.5$          | mA   |
| $T_A$         | Operating Temperature Range   | -40 to +85         | °C   |
| $T_{stg}$     | Storage Temperature   | -65 to +150        | °C   |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient)<br>Still Air<br>500lfpm        | 140<br>100         | °C/W |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case)                                   | 23 to 41 $\pm 5\%$ | °C/W |
| $T_{sol}$     | Solder Temperature (<2 to 3 Seconds: 245°C desired)                     | 265                | °C   |

\* Maximum Ratings are those values beyond which damage to the device may occur.

† Use for inputs of same package only.

## DC CHARACTERISTICS, ECL/LVECL ( $V_{CC} = 0V$ ; $V_{EE} = -5.5V$ to $-3.0V$ ) (Note 4.)

| Symbol      | Characteristic  | -40°C        |       |       | 25°C         |       |       | 85°C         |       |       | Unit    |
|-------------|---|--------------|-------|-------|--------------|-------|-------|--------------|-------|-------|---------|
|             |   | Min          | Typ   | Max   | Min          | Typ   | Max   | Min          | Typ   | Max   |         |
| $I_{EE}$    | Power Supply Current<br>(Note 1.)                                   | 50           | 65    | 88    | 50           | 65    | 88    | 50           | 65    | 88    | mA      |
| $V_{OH}$    | Output HIGH Voltage<br>(Note 2.)                                    | -1135        | -1060 | -885  | -1070        | -945  | -820  | -1010        | -885  | -760  | mV      |
| $V_{OL}$    | Output LOW Voltage<br>(Note 2.)                                     | -1935        | -1810 | -1685 | -1870        | -1745 | -1620 | -1810        | -1685 | -1560 | mV      |
| $V_{IH}$    | Input HIGH Voltage<br>Single Ended                                  | -1210        |       | -885  | -1145        |       | -820  | -1085        |       | -760  | mV      |
| $V_{IL}$    | Input LOW Voltage<br>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<br>Range (Note 3.)                   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | $V_{EE}+2.0$ |       | 0.0   | V       |
| $I_{IH}$    | Input HIGH Current  |              |       | 150   |              |       | 150   |              |       | 150   | $\mu A$ |
| $I_{IL}$    | Input LOW Current<br>SEL, COM_SEL, $\overline{D}$<br>$\overline{D}$ | 0.5<br>-150  |       |       | 0.5<br>-150  |       |       | 0.5<br>-150  |       |       | $\mu A$ |

NOTE: 10EP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse airflow greater than 500lfpm is maintained.

1.  $V_{CC} = 0V$ ,  $V_{EE} = V_{EEmin}$  to  $V_{EEmax}$ , all other pins floating.
2. All loading with 50 ohms to  $V_{CC}-2.0$  volts.
3.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .
4. Input and output parameters vary 1:1 with  $V_{CC}$ .

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## DC CHARACTERISTICS, LVPECL ( $V_{CC} = 3.3V \pm 0.3V$ , $V_{EE} = 0V$ ) (Note 8.)

| Symbol          | Characteristic                                    | -40°C       |      |      | 25°C        |      |      | 85°C        |      |      | Unit |
|-----------------|---|-------------|------|------|-------------|------|------|-------------|------|------|------|
|                 |   | Min         | Typ  | Max  | Min         | Typ  | Max  | Min         | Typ  | Max  |      |
| IEE             | Power Supply Current<br>(Note 5.)                 | 50          | 65   | 88   | 50          | 65   | 88   | 50          | 65   | 88   | mA   |
| VOH             | Output HIGH Voltage<br>(Note 6.)                  | 2165        | 2240 | 2415 | 2230        | 2355 | 2480 | 2290        | 2415 | 2540 | mV   |
| VOL             | Output LOW Voltage<br>(Note 6.)                   | 1365        | 1490 | 1615 | 1430        | 1555 | 1680 | 1490        | 1615 | 1740 | mV   |
| VIH             | Input HIGH Voltage<br>Single Ended                | 2090        |      | 2415 | 2155        |      | 2480 | 2215        |      | 2540 | mV   |
| VIL             | Input LOW Voltage<br>Single Ended                 | 1365        |      | 1690 | 1430        |      | 1755 | 1490        |      | 1815 | mV   |
| VBB             | Output Voltage Reference                          | 1790        | 1890 | 1990 | 1855        | 1955 | 2055 | 1915        | 2015 | 2115 | mV   |
| VIHCMR          | Input HIGH Voltage Common Mode<br>Range (Note 7.) | 2.0         |      | 3.3  | 2.0         |      | 3.3  | 2.0         |      | 3.3  | V    |
| I <sub>IH</sub> | Input HIGH Current                                |             |      | 150  |             |      | 150  |             |      | 150  | μA   |
| I <sub>IL</sub> | Input LOW Current<br>SEL, COM_SEL, D<br>D         | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | μA   |

NOTE: 10EP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse airflow greater than 500lfpm is maintained.

5.  $V_{CC} = 3.3V$ ,  $V_{EE} = 0V$ , all other pins floating.

6. All loading with 50 ohms to  $V_{CC} - 2.0$  volts.

7.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

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

## DC CHARACTERISTICS, PECL ( $V_{CC} = 5.0V \pm 0.5V$ , $V_{EE} = 0V$ ) (Note 12.)

| Symbol          | Characteristic                                     | -40°C       |      |      | 25°C        |      |      | 85°C        |      |      | Unit |
|-----------------|--|-------------|------|------|-------------|------|------|-------------|------|------|------|
|                 |  | Min         | Typ  | Max  | Min         | Typ  | Max  | Min         | Typ  | Max  |      |
| IEE             | Power Supply Current<br>(Note 9.)                  | 50          | 65   | 88   | 50          | 65   | 88   | 50          | 65   | 88   | mA   |
| VOH             | Output HIGH Voltage<br>(Note 10.)                  | 3865        | 3940 | 4115 | 3930        | 4055 | 4180 | 3990        | 4115 | 4240 | mV   |
| VOL             | Output LOW Voltage<br>(Note 10.)                   | 3065        | 3190 | 3315 | 3130        | 3255 | 3380 | 3190        | 3315 | 3440 | mV   |
| VIH             | Input HIGH Voltage<br>Single Ended                 | 3790        |      | 4115 | 3855        |      | 4180 | 3915        |      | 4240 | mV   |
| VIL             | Input LOW Voltage<br>Single Ended                  | 3065        |      | 3390 | 3130        |      | 3455 | 3190        |      | 3515 | mV   |
| VBB             | Output Voltage Reference                           | 3490        | 3590 | 3690 | 3555        | 3655 | 3755 | 3615        | 3715 | 3815 | mV   |
| VIHCMR          | Input HIGH Voltage Common Mode<br>Range (Note 11.) | 2.0         |      | 5.0  | 2.0         |      | 5.0  | 2.0         |      | 5.0  | V    |
| I <sub>IH</sub> | Input HIGH Current                                 |             |      | 150  |             |      | 150  |             |      | 150  | μA   |
| I <sub>IL</sub> | Input LOW Current<br>SEL, COM_SEL, D<br>D          | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | 0.5<br>-150 |      |      | μA   |

NOTE: 10EP circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. The circuit is in a test socket or mounted on a printed circuit board and transverse airflow greater than 500lfpm is maintained.

9.  $V_{CC} = 5.0V$ ,  $V_{EE} = 0V$ , all other pins floating.

10. All loading with 50 ohms to  $V_{CC} - 2.0$  volts.

11.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ , max varies 1:1 with  $V_{CC}$ .

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

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**AC CHARACTERISTICS** ( $V_{CC} = 0V$ ;  $V_{EE} = -3.0V$  to  $-5.5V$ ) or ( $V_{CC} = 3.0V$  to  $5.5V$ ;  $V_{EE} = 0V$ )

| Symbol                   | Characteristic   | -40°C                    |                          |                          | 25°C                     |                          |                          | 85°C                     |                          |                          | Unit |
|--------------------------|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------|
|                          |  | Min                      | Typ                      | Max                      | Min                      | Typ                      | Max                      | Min                      | Typ                      | Max                      |      |
| $f_{max}$                | Maximum Toggle Frequency (Note 13.)  |                          |                          |                          |                          | 3.0                      |                          |                          |                          |                          | GHz  |
| $t_{PLH}$ ,<br>$t_{PHL}$ | Propagation Delay to Output Differential<br>D→Q, $\bar{Q}$ (Diff)<br>D→Q, $\bar{Q}$ (SE)<br>SEL→Q, $\bar{Q}$<br>COM_SEL→Q, $\bar{Q}$ | 250<br>250<br>200<br>200 | 340<br>340<br>340<br>350 | 480<br>480<br>550<br>580 | 250<br>250<br>200<br>200 | 360<br>360<br>340<br>360 | 480<br>480<br>550<br>580 | 300<br>300<br>200<br>200 | 400<br>400<br>390<br>400 | 520<br>520<br>650<br>675 | ps   |
| $t_{SKEW}$               | Within-Device Skew (Note 14.)<br>Duty Cycle Skew (Note 15.)  |                          | TBD<br>TBD               |                          |                          | TBD<br>TBD               |                          |                          | TBD<br>TBD               |                          | ps   |
| $t_{JITTER}$             | Cycle-to-Cycle Jitter  |                          | TBD                      |                          |                          | TBD                      |                          |                          | TBD                      |                          | ps   |
| $V_{PP}$                 | Input Voltage Swing (Diff.)  | 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                      | 150                      | 200                      | 100                      | 150                      | 200                      | 100                      | 160                      | 220                      | ps   |

13.  $F_{max}$  guaranteed for functionality only.

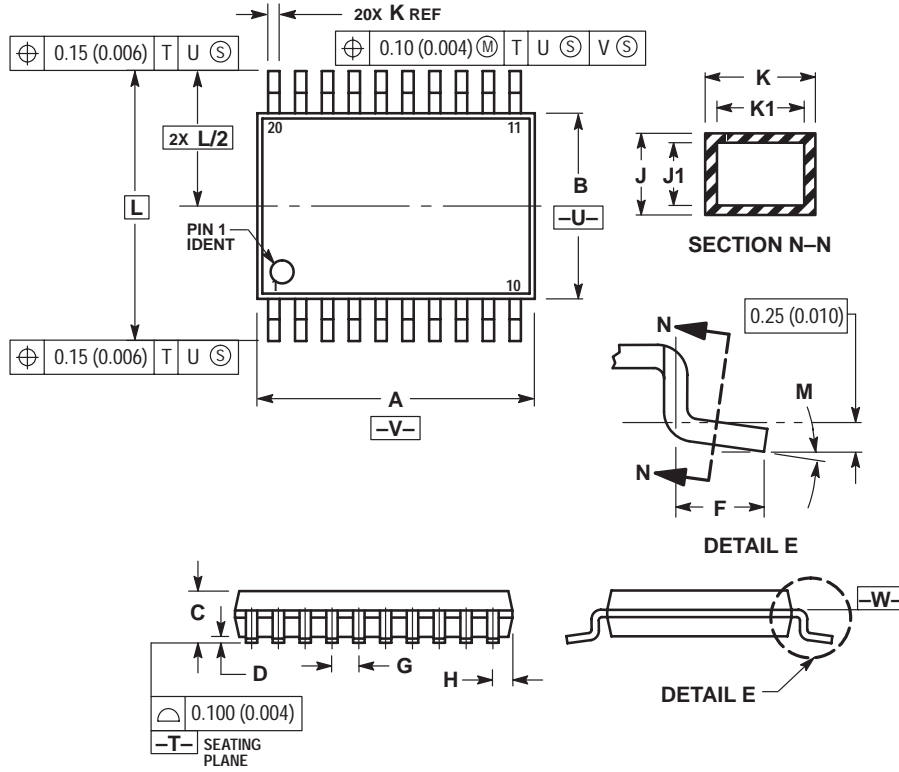
14. Within-Device Skew is defined as identical transitions on similar paths through a device.

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.

# MC10EP56

## PACKAGE DIMENSIONS

TSSOP-20  
DT SUFFIX  
20 PIN PLASTIC TSSOP PACKAGE  
CASE 948E-02  
ISSUE A



**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°    |

**Notes**

**Notes**

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