

# MC10E404, MC100E404

## 5 V ECL Quad Differential AND/NAND

### Description

The MC10E404/100E404 is a 4-bit differential AND/NAND device. The differential operation of the device makes it ideal for pulse shaping applications where duty cycle skew is critical. Special design techniques were incorporated to minimize the skew between the upper and lower level gate inputs.

Because a negative 2-input NAND function is equivalent to a 2-input OR function, the differential inputs and outputs of the device also allow for its use as a fully differential 2 input OR/NOR function.

The output RISE/FALL times of this device are significantly faster than most other standard ECLinPS™ devices resulting in an increased bandwidth.

The differential inputs have clamp structures which will force the Q output of a gate in an open input condition to go to a LOW state. Thus, inputs of unused gates can be left open and will not affect the operation of the rest of the device. Note that the input clamp will take affect only if both inputs fall 2.5 V below  $V_{CC}$ .

The 100 Series contains temperature compensation.

### Features

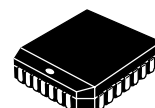
- Differential D and Q
  - 700 ps Max. Propagation Delay
  - High Frequency Outputs
  - PECL Mode Operating Range:  $V_{CC} = 4.2\text{ V}$  to  $5.7\text{ V}$  with  $V_{EE} = 0\text{ V}$
  - NECL Mode Operating Range:  $V_{CC} = 0\text{ V}$  with  $V_{EE} = -4.2\text{ V}$  to  $-5.7\text{ V}$
  - Internal Input  $50\text{ k}\Omega$  Pulldown Resistors
  - ESD Protection: Human Body Model;  $> 2\text{ kV}$ ,  
Machine Model;  $> 200\text{ V}$   
Charged Device Model;  $> 2\text{ kV}$
  - Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test
  - Moisture Sensitivity Level:  
Pb = 1  
Pb-Free = 3
- For Additional Information, see Application Note AND8003/D
- Flammability Rating: UL 94 V-0 @ 0.125 in, Oxygen Index: 28 to 34
  - Transistor Count = 274 devices
  - 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.



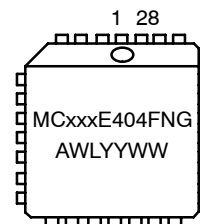
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**PLCC-28  
FN SUFFIX  
CASE 776**

### MARKING DIAGRAM\*



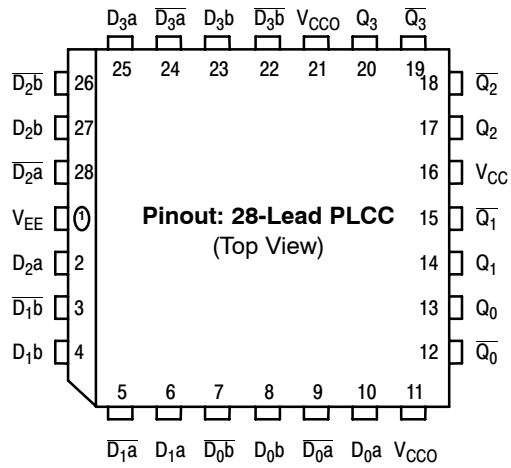
|     |                     |
|-----|---------------------|
| xxx | = 10 or 100         |
| A   | = Assembly Location |
| WL  | = Wafer Lot         |
| YY  | = Year              |
| WW  | = Work Week         |
| G   | = Pb-Free Package   |

\*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.

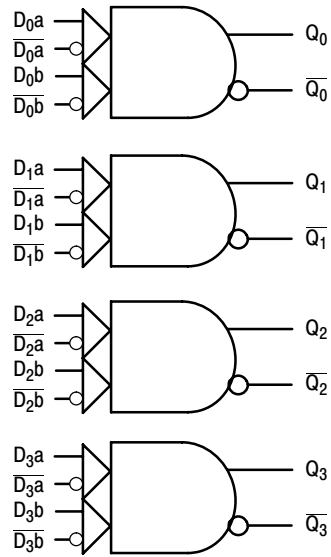
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\* All V<sub>CC</sub> and V<sub>CCO</sub> pins are tied together on the die.

Warning: All V<sub>CC</sub>, V<sub>CCO</sub>, and V<sub>EE</sub> pins must be externally connected to Power Supply to guarantee proper operation.

**Figure 1. 28-Lead Pinout Assignment**



**Figure 2. Logic Diagram**

**Table 1. PIN DESCRIPTION**

| PIN                                | FUNCTION                      |
|------------------------------------|-------------------------------|
| D[0:4], $\overline{D}$ [0:4]       | ECL Differential Data Inputs  |
| Q[0:4], $\overline{Q}$ [0:4]       | ECL Differential Data Outputs |
| V <sub>CC</sub> , V <sub>CCO</sub> | Positive Supply               |
| V <sub>EE</sub>                    | Negative Supply               |

**Table 2. One-Column Numbered Table**

| Da | Db | Q | $\overline{D}$ a | $\overline{D}$ b | $\overline{Q}$ |
|----|----|---|------------------|------------------|----------------|
| L  | L  | L | L                | L                | L              |
| L  | H  | L | L                | H                | H              |
| H  | L  | L | H                | L                | H              |
| H  | H  | H | H                | H                | H              |

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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                          |                                                                      | 8            | V            |
| V <sub>I</sub>   | PECL Mode Input Voltage<br>NECL Mode Input Voltage | V <sub>EE</sub> = 0 V<br>V <sub>CC</sub> = 0 V | V <sub>I</sub> ≤ V <sub>CC</sub><br>V <sub>I</sub> ≥ V <sub>EE</sub> | 6<br>-6      | V<br>V       |
| I <sub>out</sub> | Output Current                                     | Continuous<br>Surge                            |                                                                      | 50<br>100    | mA<br>mA     |
| T <sub>A</sub>   | Operating Temperature Range                        |                                                |                                                                      | 0 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<br>500 lfpm                             | PLCC-28<br>PLCC-28                                                   | 63.5<br>43.5 | °C/W<br>°C/W |
| θ <sub>JC</sub>  | Thermal Resistance (Junction-to-Case)              | Standard Board                                 | PLCC-28                                                              | 22 to 26     | °C/W         |
| T <sub>sol</sub> | Wave Solder<br>Pb<br>Pb-Free                       |                                                |                                                                      | 265<br>265   | °C           |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

**Table 4. 10E SERIES PECL DC CHARACTERISTICS** V<sub>CCx</sub> = 5.0 V, V<sub>EE</sub> = 0.0 V (Note 1)

| Symbol          | Characteristic               | 0°C  |      |      | 25°C |      |      | 85°C |      |      | Unit |
|-----------------|------------------------------|------|------|------|------|------|------|------|------|------|------|
|                 |                              | Min  | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |      |
| I <sub>EE</sub> | Power Supply Current         |      | 106  | 127  |      | 106  | 127  |      | 106  | 127  | mA   |
| V <sub>OH</sub> | Output HIGH Voltage (Note 2) | 3980 | 4070 | 4160 | 4020 | 4105 | 4190 | 4090 | 4185 | 4280 | mV   |
| V <sub>OL</sub> | Output LOW Voltage (Note 2)  | 3050 | 3210 | 3370 | 3050 | 3210 | 3370 | 3050 | 3227 | 3405 | mV   |
| V <sub>IH</sub> | Input HIGH Voltage           | 3830 | 3995 | 4160 | 3870 | 4030 | 4190 | 3940 | 4110 | 4280 | mV   |
| V <sub>IL</sub> | Input LOW Voltage            | 3050 | 3285 | 3520 | 3050 | 3285 | 3520 | 3050 | 3302 | 3555 | mV   |
| I <sub>IH</sub> | Input HIGH Current           |      |      | 150  |      |      | 150  |      |      | 150  | μA   |
| I <sub>IL</sub> | Input LOW Current            | 0.5  | 0.3  |      | 0.5  | 0.25 |      | 0.3  | 0.2  |      | 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.

1. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary -0.46 V / +0.06 V.
2. Outputs are terminated through a 50 Ω resistor to V<sub>CC</sub> - 2.0 V.

**Table 5. 10E SERIES NECL DC CHARACTERISTICS** V<sub>CCx</sub> = 0.0 V; V<sub>EE</sub> = -5.0 V (Note 3)

| Symbol          | Characteristic               | 0°C   |       |       | 25°C  |       |       | 85°C  |       |       | Unit |
|-----------------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
|                 |                              | Min   | Typ   | Max   | Min   | Typ   | Max   | Min   | Typ   | Max   |      |
| I <sub>EE</sub> | Power Supply Current         |       | 106   | 127   |       | 106   | 127   |       | 106   | 127   | mA   |
| V <sub>OH</sub> | Output HIGH Voltage (Note 4) | -1020 | -930  | -840  | -980  | -895  | -810  | -910  | -815  | -720  | mV   |
| V <sub>OL</sub> | Output LOW Voltage (Note 4)  | -1950 | -1790 | -1630 | -1950 | -1790 | -1630 | -1950 | -1773 | -1595 | mV   |
| V <sub>IH</sub> | Input HIGH Voltage           | -1170 | -1005 | -840  | -1130 | -970  | -810  | -1060 | -890  | -720  | mV   |
| V <sub>IL</sub> | Input LOW Voltage            | -1950 | -1715 | -1480 | -1950 | -1715 | -1480 | -1950 | -1698 | -1445 | mV   |
| I <sub>IH</sub> | Input HIGH Current           |       |       | 150   |       |       | 150   |       |       | 150   | μA   |
| I <sub>IL</sub> | Input LOW Current            | 0.5   | 0.3   |       | 0.5   | 0.065 |       | 0.3   | 0.2   |       | 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.

3. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary -0.46 V / +0.06 V.
4. Outputs are terminated through a 50 Ω resistor to V<sub>CC</sub> - 2.0 V.

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**Table 6. 100E SERIES PECL DC CHARACTERISTICS**  $V_{CCx} = 5.0 \text{ V}$ ;  $V_{EE} = 0.0 \text{ V}$  (Note 5)

| Symbol   | Characteristic               | 0°C  |      |      | 25°C |      |      | 85°C |      |      | Unit          |
|----------|------------------------------|------|------|------|------|------|------|------|------|------|---------------|
|          |                              | Min  | Typ  | Max  | Min  | Typ  | Max  | Min  | Typ  | Max  |               |
| $I_{EE}$ | Power Supply Current         |      | 106  | 127  |      | 106  | 127  |      | 122  | 146  | mA            |
| $V_{OH}$ | Output HIGH Voltage (Note 6) | 3975 | 4050 | 4120 | 3975 | 4050 | 4120 | 3975 | 4050 | 4120 | mV            |
| $V_{OL}$ | Output LOW Voltage (Note 6)  | 3190 | 3295 | 3380 | 3190 | 3255 | 3380 | 3190 | 3260 | 3380 | mV            |
| $V_{IH}$ | Input HIGH Voltage           | 3835 | 3975 | 4120 | 3835 | 3975 | 4120 | 3835 | 3975 | 4120 | mV            |
| $V_{IL}$ | Input LOW Voltage            | 3190 | 3355 | 3525 | 3190 | 3355 | 3525 | 3190 | 3355 | 3525 | mV            |
| $I_{IH}$ | Input HIGH Current           |      |      | 150  |      |      | 150  |      |      | 150  | $\mu\text{A}$ |
| $I_{IL}$ | Input LOW Current            | 0.5  | 0.3  |      | 0.5  | 0.25 |      | 0.5  | 0.2  |      | $\mu\text{A}$ |

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  $-0.46 \text{ V} / +0.8 \text{ V}$ .

6. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .

**Table 7. 100E SERIES NECL DC CHARACTERISTICS**  $V_{CCx} = 0 \text{ V}$ ;  $V_{EE} = -5.0 \text{ V}$  (Note 7)

| Symbol   | Characteristic               | 0°C   |       |       | 25°C  |       |       | 85°C  |       |       | Unit          |
|----------|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|
|          |                              | Min   | Typ   | Max   | Min   | Typ   | Max   | Min   | Typ   | Max   |               |
| $I_{EE}$ | Power Supply Current         |       | 106   | 127   |       | 106   | 127   |       | 122   | 146   | mA            |
| $V_{OH}$ | Output HIGH Voltage (Note 8) | -1025 | -950  | -880  | -1025 | -950  | -880  | -1025 | -950  | -880  | mV            |
| $V_{OL}$ | Output LOW Voltage (Note 8)  | -1810 | -1705 | -1620 | -1810 | -1745 | -1620 | -1810 | -1740 | -1620 | mV            |
| $V_{IH}$ | Input HIGH Voltage           | -1165 | -1025 | -880  | -1165 | -1025 | -880  | -1165 | -1025 | -880  | mV            |
| $V_{IL}$ | Input LOW Voltage            | -1810 | -1645 | -1475 | -1810 | -1645 | -1475 | -1810 | -1645 | -1475 | mV            |
| $I_{IH}$ | Input HIGH Current           |       |       | 150   |       |       | 150   |       |       | 150   | $\mu\text{A}$ |
| $I_{IL}$ | Input LOW Current            | 0.5   | 0.3   |       | 0.5   | 0.25  |       | 0.5   | 0.2   |       | $\mu\text{A}$ |

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.

7. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary  $-0.46 \text{ V} / +0.8 \text{ V}$ .

8. Outputs are terminated through a  $50 \Omega$  resistor to  $V_{CC} - 2.0 \text{ V}$ .

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**Table 8. AC CHARACTERISTICS**  $V_{CCx} = 5.0\text{ V}$ ;  $V_{EE} = 0.0\text{ V}$  or  $V_{CCx} = 0.0\text{ V}$ ;  $V_{EE} = -5.0\text{ V}$  (Note 9)

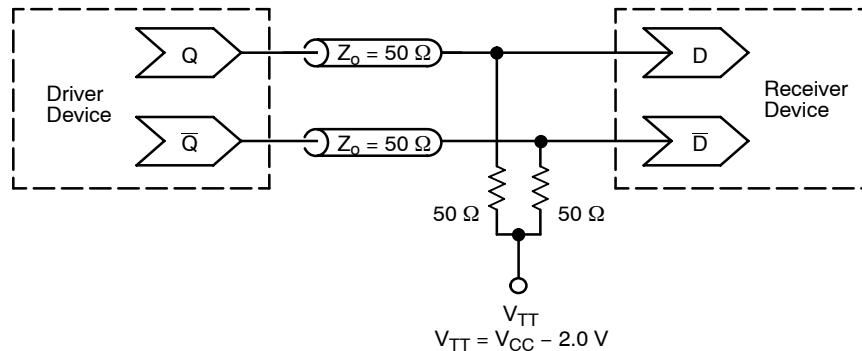
| Symbol                 | Characteristic                                                              | 0°C                      |                          |                          | 25°C                     |                          |                          | 85°C                     |                          |                          | Unit |
|------------------------|-----------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|------|
|                        |                                                                             | Min                      | Typ                      | Max                      | Min                      | Typ                      | Max                      | Min                      | Typ                      | Max                      |      |
| $f_{MAX}$              | Maximum Toggle Frequency                                                    |                          | 900                      |                          |                          | 900                      |                          |                          | 900                      |                          | MHz  |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay to Output<br>Da (Diff)<br>Da (SE)<br>Db (Diff)<br>Db (SE) | 350<br>300<br>375<br>325 | 475<br>475<br>500<br>500 | 650<br>700<br>675<br>725 | 350<br>300<br>375<br>325 | 475<br>475<br>500<br>500 | 650<br>700<br>675<br>725 | 350<br>300<br>375<br>325 | 475<br>475<br>500<br>500 | 650<br>700<br>675<br>725 | ps   |
| $t_{SKEW}$             | Within-Device Skew (Note 10)                                                |                          | 50                       |                          |                          | 50                       |                          |                          | 50                       |                          | ps   |
| $t_{JITTER}$           | Random Clock Jitter (RMS)                                                   |                          | < 1                      |                          |                          | < 1                      |                          |                          | < 1                      |                          | ps   |
| $V_{PP(AC)}$           | Input Voltage Swing<br>(Differential Configuration)                         | 150                      |                          |                          | 150                      |                          |                          | 150                      |                          |                          | mV   |
| $t_r$<br>$t_f$         | Rise/Fall Time<br>(20 - 80%)                                                | 150                      |                          | 400                      | 150                      |                          | 400                      | 150                      |                          | 400                      | 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.

9. 10 Series:  $V_{EE}$  can vary  $-0.46\text{ V} / +0.06\text{ V}$ .

100 Series:  $V_{EE}$  can vary  $-0.46\text{ V} / +0.8\text{ V}$ .

10. Within-device skew is defined as identical transitions on similar paths through a device.



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

## MC10E404, MC100E404

### ORDERING INFORMATION

| Device         | Package              | Shipping <sup>†</sup> |
|----------------|----------------------|-----------------------|
| MC10E404FN     | PLCC-28              | 37 Units / Rail       |
| MC10E404FNG    | PLCC-28<br>(Pb-Free) | 37 Units / Rail       |
| MC10E404FNR2   | PLCC-28              | 500 / Tape & Reel     |
| MC10E404FNR2G  | PLCC-28<br>(Pb-Free) | 500 / Tape & Reel     |
| MC100E404FN    | PLCC-28              | 37 Units / Rail       |
| MC100E404FNG   | PLCC-28<br>(Pb-Free) | 37 Units / Rail       |
| MC100E404FNR2  | PLCC-28              | 500 / Tape & Reel     |
| MC100E404FNR2G | PLCC-28<br>(Pb-Free) | 500 / 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.

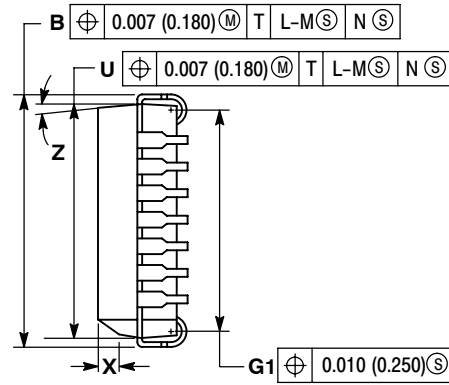
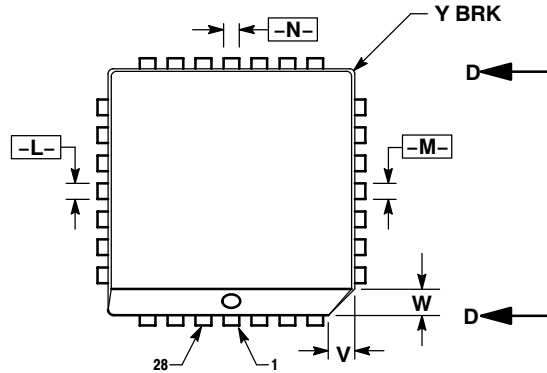
### Resource Reference of Application Notes

- 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

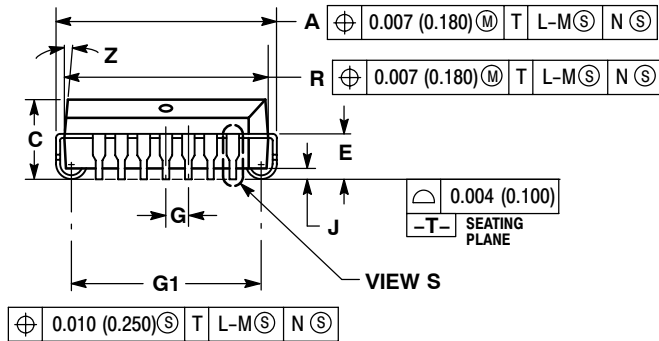
# MC10E404, MC100E404

## PACKAGE DIMENSIONS

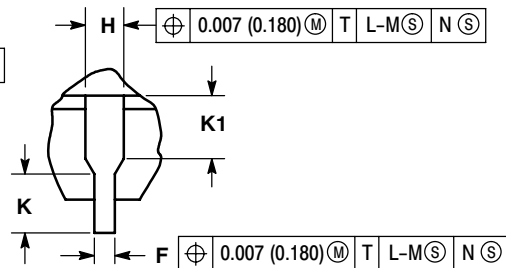
PLCC-28  
FN SUFFIX  
PLASTIC PLCC PACKAGE  
CASE 776-02  
ISSUE E



VIEW D-D



VIEW S



VIEW S

### NOTES:

- DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
- DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
- DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
- DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.485     | 0.495 | 12.32       | 12.57 |
| B   | 0.485     | 0.495 | 12.32       | 12.57 |
| C   | 0.165     | 0.180 | 4.20        | 4.57  |
| E   | 0.090     | 0.110 | 2.29        | 2.79  |
| F   | 0.013     | 0.019 | 0.33        | 0.48  |
| G   | 0.050 BSC |       | 1.27 BSC    |       |
| H   | 0.026     | 0.032 | 0.66        | 0.81  |
| J   | 0.020     | ---   | 0.51        | ---   |
| K   | 0.025     | ---   | 0.64        | ---   |
| R   | 0.450     | 0.456 | 11.43       | 11.58 |
| U   | 0.450     | 0.456 | 11.43       | 11.58 |
| V   | 0.042     | 0.048 | 1.07        | 1.21  |
| W   | 0.042     | 0.048 | 1.07        | 1.21  |
| X   | 0.042     | 0.056 | 1.07        | 1.42  |
| Y   | ---       | 0.020 | ---         | 0.50  |
| Z   | 2°        | 10°   | 2°          | 10°   |
| G1  | 0.410     | 0.430 | 10.42       | 10.92 |
| K1  | 0.040     | ---   | 1.02        | ---   |

# MC10E404, MC100E404

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