# THE DATASHEET OF

# MC100EL31DR2

www.win-source.net 0086-755-83957316

# MC10EL31, MC100EL31

# 5 V ECL D Flip-Flop With Set and Reset

**ON Semiconductor®**

www.onsemi.com

**SOIC−8 NB**
**D SUFFIX**
**CASE 751−05**

**TSSOP−8**
**DT SUFFIX**
**CASE 948R−02**

### Description

The MC10EL/100EL31 is a D flip-flop with set and reset. The device is functionally equivalent to the E131 device with higher performance capabilities. With propagation delays and output transition times significantly faster than the E131, the EL31 is ideally suited for those applications which require the ultimate in AC performance.

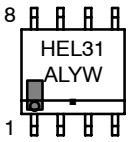
Both set and reset inputs are asynchronous, level triggered signals. Data enters the master portion of the flip-flop when clock is LOW and is transferred to the slave, and thus the outputs, upon a positive transition of the clock.

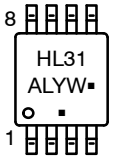
The 100 Series contains temperature compensation.

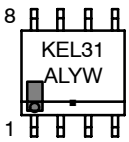
### Features

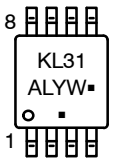
- 475 ps Propagation Delay
- 2.8 GHz Toggle Frequency
- ESD Protection:
  - > 1 kV Human Body Model
  - > 100 V Machine Model
- PECL Mode Operating Range: $V_{CC}$ = 4.2 V to 5.7 V with $V_{EE}$ = 0 V
- NECL Mode Operating Range: $V_{CC}$ = 0 V with $V_{EE}$ = −4.2 V to −5.7 V
- Internal Input Pulldown Resistors on D, CLK, S, and R
- Meets or Exceeds JEDEC Spec EIA/JESD78 IC Latchup Test
- Moisture Sensitivity:
  - Level 1 for SOIC−8 NB
  - Level 3 for TSSOP−8
  - For Additional Information, see Application Note AND8003/D
- Flammability Rating: UL 94 V−0 @ 0.125 in, Oxygen Index: 28 to 34
- Metastability 125 ps (see Application Note AN1504)
- Transistor Count = 79 Devices
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

### MARKING DIAGRAMS*




**SOIC−8 NB** **TSSOP−8**

H = MC10
K = MC100
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

See detailed ordering and shipping information on page 6 of this data sheet.

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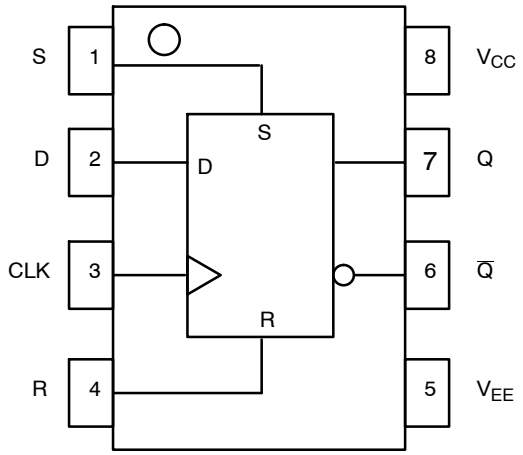



**Figure 1. Logic Diagram and Pinout Assignment**

**Table 1. TRUTH TABLE**

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

Z = LOW to HIGH Transition

* Pins will default low when left open.

**Table 2. PIN DESCRIPTION**

| PIN | FUNCTION |
|---|---|
| S | ECL Set Input |
| D | ECL Data Input |
| R | ECL Reset Input |
| CLK | ECL Clock Input |
| Q, $\overline{Q}$ | ECL Data Outputs |
| $V_{CC}$ | Positive Supply |
| $V_{EE}$ | Negative Supply |

**Table 3. MAXIMUM RATINGS**

| Symbol | Parameter | Condition 1 | Condition 2 | Rating | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | PECL Mode Power Supply- | $V_{EE}$ = 0 V | | 8 | V |
| $V_{EE}$ | NECL Mode Power Supply | $V_{CC}$ = 0 V | | −8 | V |
| $V_I$ | PECL Mode Input Voltage<br>NECL Mode Input Voltage | $V_{EE}$ = 0 V<br>$V_{CC}$ = 0 V | $V_I \le V_{CC}$<br>$V_I \ge V_{EE}$ | 6<br>−6 | V |
| $I_{out}$ | Output Current | Continuous<br>Surge | | 50<br>100 | mA |
| $T_A$ | Operating Temperature Range | | | −40 to +85 | °C |
| $T_{stg}$ | Storage Temperature Range | | | −65 to +150 | °C |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient) | 0 lfpm<br>500 lfpm | SOIC−8 NB<br>SOIC−8 NB | 190<br>130 | °C/W |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case) | Standard Board | SOIC−8 NB | 41 to 44 | °C/W |
| $\theta_{JA}$ | Thermal Resistance (Junction-to-Ambient) | 0 lfpm<br>500 lfpm | TSSOP−8<br>TSSOP−8 | 185<br>140 | °C/W |
| $\theta_{JC}$ | Thermal Resistance (Junction-to-Case) | Standard Board | TSSOP−8 | 41 to 44 ±5% | °C/W |
| $T_{sol}$ | Wave Solder (Pb-Free) | < 2 to 3 sec @ 260°C | | 265 | °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.

**Table 4. 10EL SERIES PECL DC CHARACTERISTICS** ($V_{CC}$ = 5.0 V; $V_{EE}$ = 0 V (Note 1))

| Symbol | Characteristic | −40°C | | | 25°C | | | 85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $I_{EE}$ | Power Supply Current | | 27 | 32 | | 27 | 32 | | 27 | 32 | mA |
| $V_{OH}$ | Output HIGH Voltage (Note 2) | 3920 | 4010 | 4110 | 4020 | 4105 | 4190 | 4090 | 4185 | 4280 | mV |
| $V_{OL}$ | Output LOW Voltage (Note 2) | 3050 | 3200 | 3350 | 3050 | 3210 | 3370 | 3050 | 3227 | 3405 | mV |
| $V_{IH}$ | Input HIGH Voltage | 3770 | | 4110 | 3870 | | 4190 | 3940 | | 4280 | mV |
| $V_{IL}$ | Input LOW Voltage | 3050 | | 3500 | 3050 | | 3520 | 3050 | | 3555 | mV |
| $I_{IH}$ | Input HIGH Current | | | 150 | | | 150 | | | 150 | μA |
| $I_{IL}$ | Input LOW Current | 0.5 | | | 0.5 | | | 0.3 | | | 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 $V_{CC}$. $V_{EE}$ can vary +0.25 V / −0.5 V.
2. Outputs are terminated through a 50 ohm resistor to $V_{CC}$−2 volts.

**Table 5. 10EL SERIES NECL DC CHARACTERISTICS** ($V_{CC}$ = 0 V; $V_{EE}$ = −5.0 V (Note 1))

| Symbol | Characteristic | −40°C | | | 25°C | | | 85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $I_{EE}$ | Power Supply Current | | 27 | 32 | | 27 | 32 | | 27 | 32 | mA |
| $V_{OH}$ | Output HIGH Voltage (Note 2) | −1080 | −990 | −890 | −980 | −895 | −810 | −910 | −815 | −720 | mV |
| $V_{OL}$ | Output LOW Voltage (Note 2) | −1950 | −1800 | −1650 | −1950 | −1790 | −1630 | −1950 | −1773 | −1595 | mV |
| $V_{IH}$ | Input HIGH Voltage | −1230 | | −890 | −1130 | | −810 | −1060 | | −720 | mV |
| $V_{IL}$ | Input LOW Voltage | −1950 | | −1500 | −1950 | | −1480 | −1950 | | −1445 | mV |
| $I_{IH}$ | Input HIGH Current | | | 150 | | | 150 | | | 150 | μA |
| $I_{IL}$ | Input LOW Current | 0.5 | | | 0.5 | | | 0.3 | | | 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 $V_{CC}$. $V_{EE}$ can vary +0.25 V / −0.5 V.
2. Outputs are terminated through a 50 ohm resistor to $V_{CC}$−2 volts.

**Table 6. 100EL SERIES PECL DC CHARACTERISTICS** ($V_{CC}$ = 5.0 V; $V_{EE}$ = 0 V (Note 1))

| Symbol | Characteristic | −40°C | | | 25°C | | | 85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $I_{EE}$ | Power Supply Current | | 27 | 32 | | 27 | 32 | | 31 | 37 | mA |
| $V_{OH}$ | Output HIGH Voltage (Note 2) | 3915 | 3995 | 4120 | 3975 | 4045 | 4120 | 3975 | 4050 | 4120 | mV |
| $V_{OL}$ | Output LOW Voltage (Note 2) | 3170 | 3305 | 3445 | 3190 | 3295 | 3380 | 3190 | 3295 | 3380 | mV |
| $V_{IH}$ | Input HIGH Voltage | 3835 | | 4120 | 3835 | | 4120 | 3835 | | 4120 | mV |
| $V_{IL}$ | Input LOW Voltage | 3190 | | 3525 | 3190 | | 3525 | 3190 | | 3525 | mV |
| $I_{IH}$ | 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 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 $V_{CC}$. $V_{EE}$ can vary +0.8 V / −0.5 V.
2. Outputs are terminated through a 50 ohm resistor to $V_{CC}$−2 volts.

**Table 7. 100EL SERIES NECL DC CHARACTERISTICS** ($V_{CC}$ = 0 V; $V_{EE}$ = −5.0 V (Note 1))

| Symbol | Characteristic | −40°C | | | 25°C | | | 85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $I_{EE}$ | Power Supply Current | | 27 | 32 | | 27 | 32 | | 31 | 37 | mA |
| $V_{OH}$ | Output HIGH Voltage (Note 2) | −1085 | −1005 | −880 | −1025 | −955 | −880 | −1025 | −955 | −880 | mV |
| $V_{OL}$ | Output LOW Voltage (Note 2) | −1830 | −1695 | −1555 | −1810 | −1705 | −1620 | −1810 | −1705 | −1620 | mV |
| $V_{IH}$ | Input HIGH Voltage | −1165 | | −880 | −1165 | | −880 | −1165 | | −880 | mV |
| $V_{IL}$ | Input LOW Voltage | −1810 | | −1475 | −1810 | | −1475 | −1810 | | −1475 | mV |
| $I_{IH}$ | 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 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 $V_{CC}$. $V_{EE}$ can vary +0.8 V / −0.5 V.
2. Outputs are terminated through a 50 ohm resistor to $V_{CC}$−2 volts.

**Table 8. AC CHARACTERISTICS** ($V_{CC}$ = 5.0 V; $V_{EE}$ = 0 V or $V_{CC}$ = 0 V; $V_{EE}$ = −5.0 V (Note 1))

| Symbol | Characteristic | −40°C | | | 25°C | | | 85°C | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| fmax | Maximum Toggle Frequency | 2.0 | 2.5 | | 2.2 | 2.8 | | 2.2 | 2.8 | | GHz |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>to Output CLK<br>S, R | <br>315<br>295 | <br>465<br>455 | <br>630<br>630 | <br>375<br>355 | <br>475<br>465 | <br>590<br>590 | <br>430<br>400 | <br>530<br>510 | <br>645<br>645 | ps |
| $t_S$<br>$t_H$ | Setup Time<br>Hold Time | 150<br>250 | 0<br>100 | | 150<br>250 | 0<br>100 | | 150<br>250 | 0<br>100 | | ps |
| $t_{RR}$ | Set/Reset Recovery | 400 | 200 | | 400 | 200 | | 400 | 200 | | ps |
| $t_{PW}$ | Minimum Pulse Width<br>CLK, Set, Reset | <br>400 | | | <br>400 | | | <br>400 | | | ps |
| tJITTER | Cycle-to-Cycle Jitter | | TBD | | | TBD | | | TBD | | ps |
| $t_r$<br>$t_f$ | Output Rise/Fall Times Q<br>(20% − 80%) | 100 | 225 | 350 | 100 | 225 | 350 | 100 | 225 | 350 | ps |

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

1. 10 Series: $V_{EE}$ can vary +0.25 V / −0.5 V.
   100 Series: $V_{EE}$ can vary +0.8 V / −0.5 V.

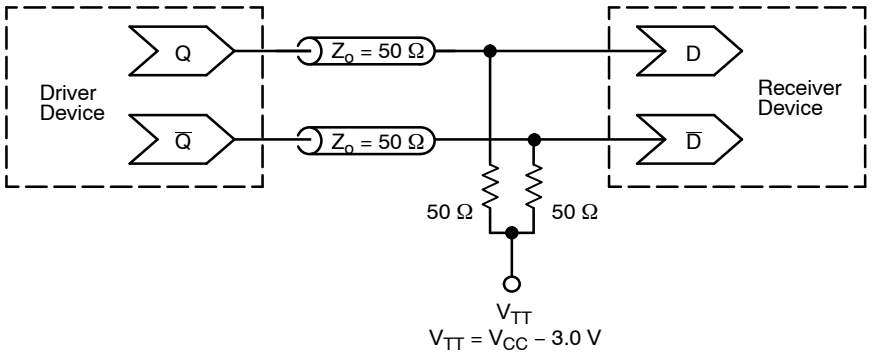



**Figure 2. Typical Termination for Output Driver and Device Evaluation**
**(See Application Note AND8020/D – Termination of ECL Logic Devices)**

## ORDERING INFORMATION

| Device | Package | Shipping† |
|---|---|---|
| MC10EL31DG | SOIC−8 NB (Pb-Free) | 98 Units / Tube |
| MC10EL31DR2G | SOIC−8 NB (Pb-Free) | 2500 / Tape & Reel |
| MC10EL31DTG | TSSOP−8 (Pb-Free) | 100 Units / Tube |
| MC100EL31DG | SOIC−8 NB (Pb-Free) | 98 Units / Tube |
| MC100EL31DR2G | SOIC−8 NB (Pb-Free) | 2500 / Tape & Reel |
| MC100EL31DTG | TSSOP−8 (Pb-Free) | 100 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.

### 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

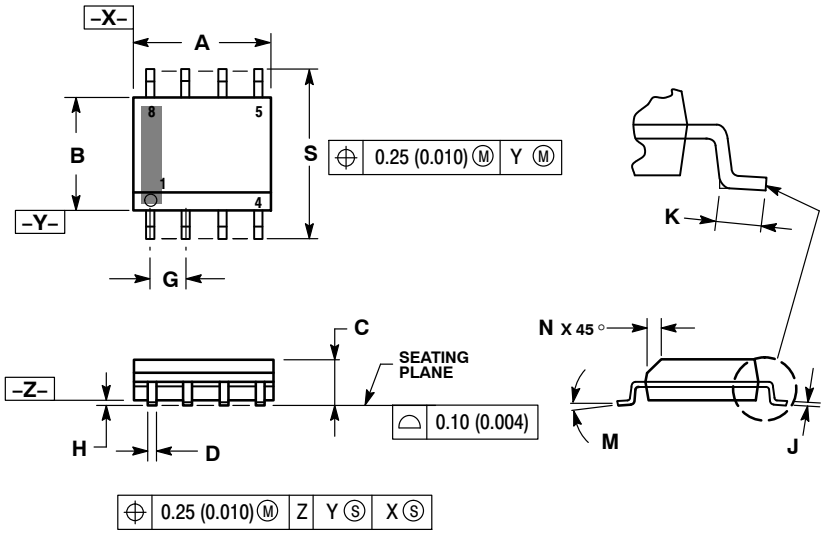
**AND8020/D** – Termination of ECL Logic Devices

**AND8066/D** – Interfacing with ECLinPS

**AND8090/D** – AC Characteristics of ECL Devices

## PACKAGE DIMENSIONS

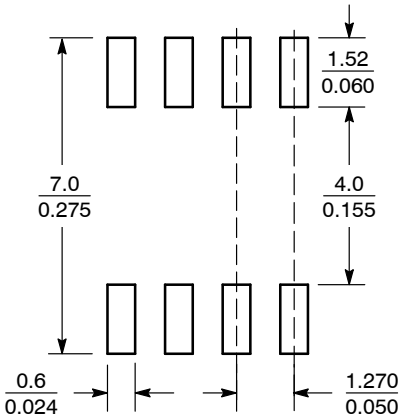
**SOIC−8 NB**
**D SUFFIX**
CASE 751−07
ISSUE AK




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751−01 THRU 751−06 ARE OBSOLETE. NEW STANDARD IS 751−07.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0 ° | 8 ° | 0 ° | 8 ° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

## SOLDERING FOOTPRINT*

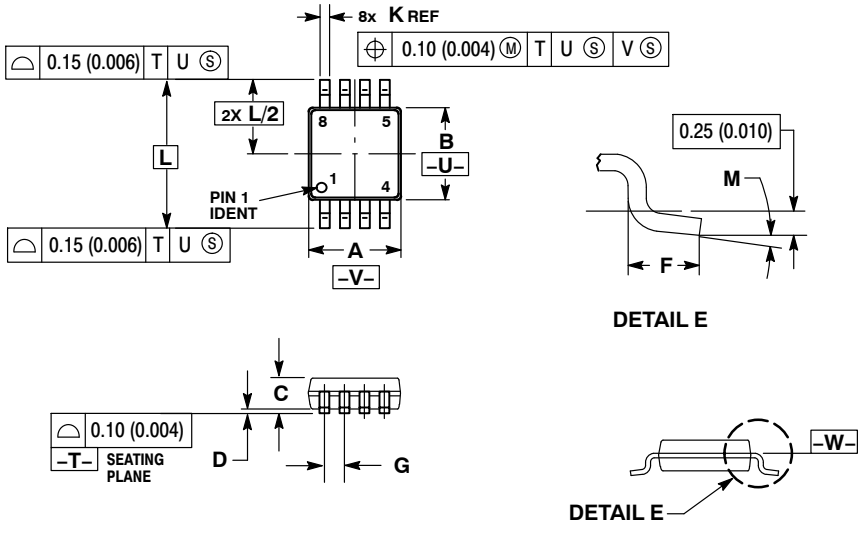



SCALE 6:1 (mm / inches)

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

## PACKAGE DIMENSIONS

**TSSOP−8**
**DT SUFFIX**
CASE 948R−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. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 2.90 | 3.10 | 0.114 | 0.122 |
| B | 2.90 | 3.10 | 0.114 | 0.122 |
| C | 0.80 | 1.10 | 0.031 | 0.043 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.40 | 0.70 | 0.016 | 0.028 |
| G | 0.65 BSC | | 0.026 BSC | |
| K | 0.25 | 0.40 | 0.010 | 0.016 |
| L | 4.90 BSC | | 0.193 BSC | |
| M | 0 ° | 6 ° | 0 ° | 6 ° |

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**MC10EL31/D**

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- Excess Inventory Management