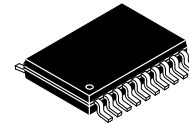


-3.3V / -5V Triple ECL Input to LVPECL/PECL Output Translator

MC10EP90, MC100EP90



TSSOP-20
DT SUFFIX
CASE 948E

Description

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

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

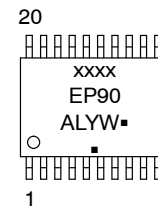
To accomplish the level translation the EP90 requires three power rails. The V_{CC} supply should be connected to the positive supply, and the V_{EE} connected to the negative supply.

The 100 Series contains temperature compensation.

Features

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

MARKING DIAGRAM



- xxxx = MC10 or 100
 - A = Assembly Location
 - L = Wafer Lot
 - Y = Year
 - W = Work Week
 - = Pb-Free Package
- (Note: Microdot may be in either location)

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

ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|--------------------|--------------------|
| MC100EP90DTG | TSSOP-20 (Pb-Free) | 75 Units / Tube |
| MC100EP90DTR2G | TSSOP-20 (Pb-Free) | 2500 / Tape & Reel |

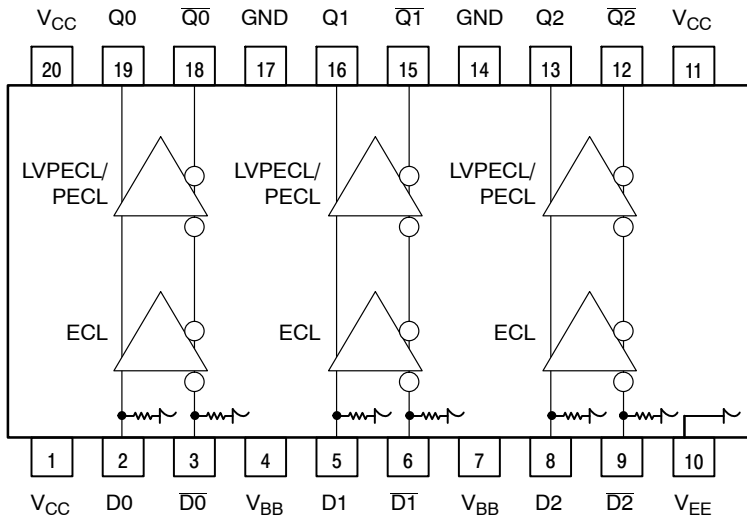
DISCONTINUED (Note 1)

| | | |
|---------------|--------------------|--------------------|
| MC10EP90DTG | TSSOP-20 (Pb-Free) | 75 Units / Tube |
| MC10EP90DTR2G | TSSOP-20 (Pb-Free) | 2500 / Tape & Reel |

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

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

MC10EP90, MC100EP90



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

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

Table 1. PIN DESCRIPTION

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

* Pins will default LOW when left open.

Table 2. FUNCTION TABLE

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

Table 3. ATTRIBUTES

| Characteristics | Value | |
|---|------------------------|----------------------|
| Internal Input Pulldown Resistor | 75 k Ω | |
| Internal Input Pullup Resistor | N/A | |
| ESD Protection | Human Body Model | > 2 kV |
| | Machine Model | > 200 V |
| | Charged Device Model | > 2 kV |
| Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1) | Pb Pkg | Pb-Free Pkg |
| | TSSOP-20 | Level 1 |
| | | Level 1 |
| Flammability Rating | Oxygen Index: 28 to 34 | UL 94 V-0 @ 0.125 in |
| Transistor Count | 350 Devices | |
| Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test | | |

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

MC10EP90, MC100EP90

Table 4. MAXIMUM RATINGS

| Symbol | Parameter | Condition 1 | Condition 2 | Rating | Unit |
|------------------|--|---------------------|----------------------------------|-------------|------|
| V _{CC} | PECL Mode Power Supply | GND = 0 V | | 6 | V |
| V _{EE} | NECL Mode Power Supply | GND = 0 V | | -6 | V |
| V _I | PECL Mode Input Voltage | GND = 0 V | V _I ≤ V _{CC} | 6 | V |
| | NECL Mode Input Voltage | GND = 0 V | V _I ≥ V _{EE} | -6 | V |
| I _{out} | Output Current | Continuous Surge | | 50 | mA |
| | | | | 100 | mA |
| I _{BB} | V _{BB} Sink/Source | | | ± 0.5 | mA |
| T _A | Operating Temperature Range | | | -40 to +85 | °C |
| T _{stg} | Storage Temperature Range | | | -65 to +150 | °C |
| θ _{JA} | Thermal Resistance (Junction-to-Ambient) | 0 lfpm | TSSOP-20 | 140 | °C/W |
| | | 500 lfpm | TSSOP-20 | 100 | °C/W |
| θ _{JC} | Thermal Resistance (Junction-to-Case) | Standard Board | TSSOP-20 | 23 to 41 | °C/W |
| T _{sol} | Wave Solder | Pb | <2 to 3 sec @ 248°C | 265 | °C |
| | | Pb-Free | <2 to 3 sec @ 260°C | 265 | |

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

MC10EP90, MC100EP90

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

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

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

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

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

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

Table 6. 10EP DC CHARACTERISTICS $V_{CC} = 5.0\text{ V}$, $V_{EE} = -5.5\text{ V}$ to -3.0 V ; $GND = 0\text{ V}$ (Note 5)

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

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

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

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

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

MC10EP90, MC100EP90

Table 7. 100EP DC CHARACTERISTICS $V_{CC} = 3.3\text{ V}$, $V_{EE} = -5.5\text{ V}$ to -3.0 V ; $GND = 0\text{ V}$ (Note 8)

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

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

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

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

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

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

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

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

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

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

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

MC10EP90, MC100EP90

Table 9. AC CHARACTERISTICS $V_{EE} = -3.0\text{ V to }-5.5\text{ V}$; $V_{CC} = 3.0\text{ V to }5.5\text{ V}$; $GND = 0\text{ V}$ (Note 14)

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

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 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.

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

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

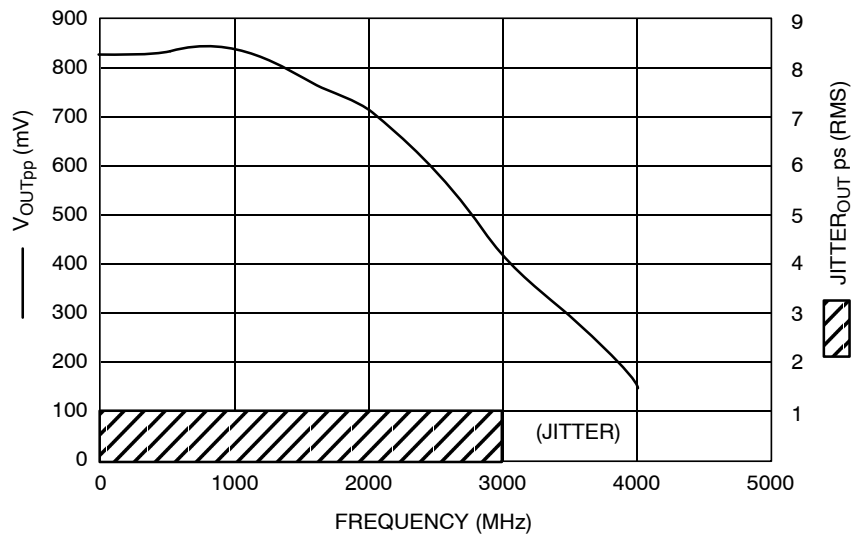
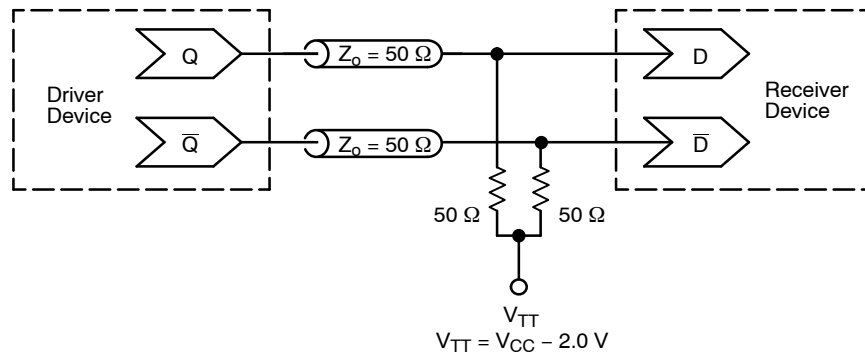


Figure 2. $F_{max}/Jitter$

MC10EP90, MC100EP90



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

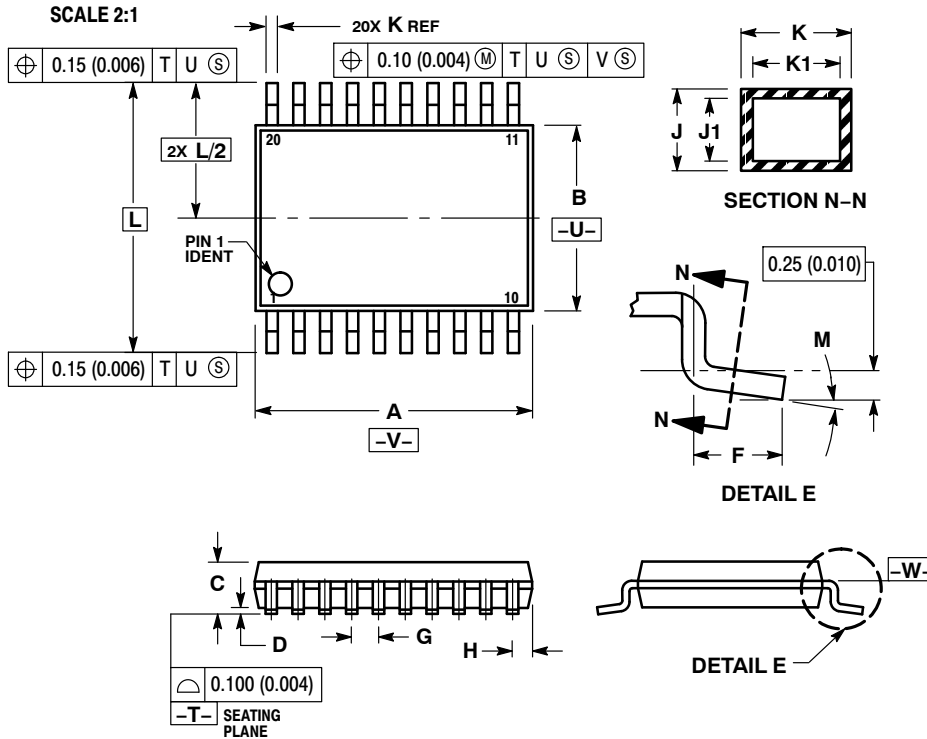
Resource Reference of Application Notes

- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPiCE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – Odd Number Counters Design
- AND8002/D** – Marking and Date Codes
- AND8020/D** – Termination of ECL Logic Devices
- AND8066/D** – Interfacing with ECLinPS
- AND8090/D** – AC Characteristics of ECL Devices



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-.

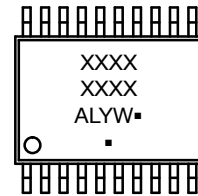
| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 6.40 | 6.60 | 0.252 | 0.260 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | --- | 1.20 | --- | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 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° |

RECOMMENDED
SOLDERING FOOTPRINT*



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

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. Some products may not follow the Generic Marking.

| | | |
|------------------|-------------|--|
| DOCUMENT NUMBER: | 98ASH70169A | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION: | TSSOP-20 WB | PAGE 1 OF 1 |

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales