

5-V PECL/ECL 1:2 Fanout Buffer

FEATURES

- 1:2 PECL/ECL Fanout Buffer
- Operating Range
 - PECL: $V_{CC} = 4.2\text{ V to }5.7\text{ V}$ With $V_{EE} = 0\text{ V}$
 - NECL: $V_{CC} = 0\text{ V}$ With $V_{EE} = -4.2\text{ V to }-5.7\text{ V}$
- 5-ps Skew Between Outputs
- Support for Clock Frequencies $>2.5\text{ GHz}$
- 265-ps Typical Propagation Delay
- Deterministic Output Value for Open Input Conditions
- Drop-In Compatible With MC10EL11, MC100EL11
- Built-In Input Pulldown Resistors
- Built-In Temperature Compensation

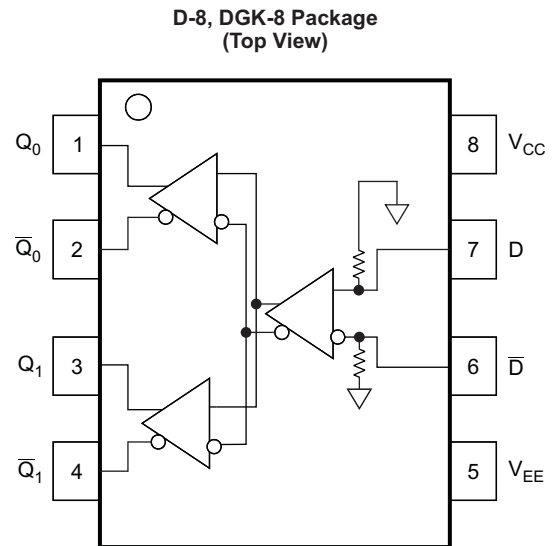
APPLICATIONS

- Data and Clock Transmission Over Backplane
- Signaling Level Conversion

DESCRIPTION

The SN65EL11 is a differential 1:2 PECL/ECL fanout buffer. The device includes circuitry to maintain a known logic level when inputs are in an open condition. The SN65EL11 is housed in an industry-standard SOIC-8 package and is also available in a TSSOP-8 package.

PINOUT ASSIGNMENT



P0065-02

Table 1. Pin Description

| PIN | FUNCTION |
|----------------------------------|----------------------|
| D, \bar{D} | PECL/ECL data inputs |
| $Q_0, \bar{Q}_0, Q_1, \bar{Q}_1$ | PECL/ECL outputs |
| V_{CC} | Positive supply |
| V_{EE} | Negative supply |

ORDERING INFORMATION⁽¹⁾

| PART NUMBER | PART MARKING | PACKAGE | LEAD FINISH |
|-------------|--------------|------------|-------------|
| SN65EL11D | SN65EL11 | SOIC | NiPdAu |
| SN65EL11DGK | SN65EL11 | SOIC-TSSOP | NiPdAu |

(1) Leaded device options not initially available; contact a sales representative for further details.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

| PARAMETER | CONDITIONS | VALUE | UNIT |
|---|--|------------|------|
| Absolute PECL-mode supply voltage, V_{CC} | $V_{EE} = 0\text{ V}$ | 6 | V |
| Absolute NECL-mode supply voltage, V_{EE} | $V_{CC} = 0\text{ V}$ | -6 | V |
| PECL-mode input voltage | $V_{EE} = 0\text{ V}; V_I \leq V_{CC}$ | 6 | V |
| NECL-mode input voltage | $V_{CC} = 0\text{ V}; V_I \geq V_{EE}$ | -6 | V |
| Output current | Continuous | 50 | mA |
| | Surge | 100 | mA |
| Operating temperature range | | -40 to 85 | °C |
| Storage temperature range | | -65 to 150 | °C |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

POWER DISSIPATION RATINGS

| PACKAGE | CIRCUIT BOARD MODEL | POWER RATING $T_A < 25^\circ\text{C}$ (mW) | THERMAL RESISTANCE, JUNCTION-TO-AMBIENT, NO AIRFLOW | DERATING FACTOR $T_A > 25^\circ\text{C}$ (mW/°C) | POWER RATING $T_A = 85^\circ\text{C}$ (mW) |
|------------|---------------------|---|---|--|--|
| SOIC | Low-K | 719 | 139 | 7 | 288 |
| | High-K | 840 | 119 | 8 | 336 |
| SOIC-TSSOP | Low-K | 469 | 213 | 5 | 188 |
| | High-K | 527 | 189 | 5 | 211 |

THERMAL CHARACTERISTICS

| PARAMETER | | PACKAGE | VALUE | UNIT |
|---------------|--------------------------------------|------------|-------|------|
| θ_{JB} | Junction-to-board thermal resistance | SOIC | 79 | °C/W |
| | | SOIC-TSSOP | 120 | |
| θ_{JC} | Junction-to-case thermal resistance | SOIC | 98 | °C/W |
| | | SOIC-TSSOP | 74 | |

KEY ATTRIBUTES

| CHARACTERISTICS | VALUE |
|---|-----------------------|
| Internal input pulldown resistor | 75 k Ω |
| Moisture sensitivity level | Level 1 |
| Flammability rating (oxygen index: 28 to 34) | UL 94 V-0 at 0.125 in |
| ESD-HBM | 4 kV |
| ESD-machine model | 200 V |
| Meets or exceeds JEDEC Spec EIA/JESD78 latchup test | |

PECL DC CHARACTERISTICS⁽¹⁾ ($V_{CC} = 5\text{ V}$; $V_{EE} = 0\text{ V}$)⁽²⁾

| PARAMETER | –40°C | | | 25°C | | | 85°C | | | UNIT |
|---|-------|-----|------|------|------|------|------|-----|------|------|
| | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| I_{CC} Power-supply current | | 18 | 26 | | 21 | 26 | | 23 | 26 | mA |
| V_{OH} Output HIGH voltage ⁽³⁾ | 3915 | | 4120 | 3915 | 4000 | 4120 | 3915 | | 4120 | mV |
| V_{OL} Output LOW voltage ⁽³⁾ | 3170 | | 3380 | 3170 | 3288 | 3380 | 3170 | | 3380 | mV |
| V_{IH} Input HIGH voltage (single-ended) | 3835 | | 4120 | 3835 | | 4120 | 3835 | | 4120 | mV |
| V_{IL} Input LOW voltage (single-ended) | 3190 | | 3525 | 3190 | | 3525 | 3190 | | 3525 | mV |
| V_{IHCMR} Input HIGH voltage, common-mode range (differential) ⁽⁴⁾ | 2.5 | | 4.6 | 2.5 | | 4.6 | 2.5 | | 4.6 | V |
| I_{IH} Input HIGH current | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} Input LOW current | 0.5 | | | 0.5 | | | 0.5 | | | μA |

(1) The device meets these specifications after thermal equilibrium has been established when mounted in a test socket or printed-circuit board with maintained transverse airflow greater than 500 lpm (2.54 m/s). Electrical parameters are assured 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} . V_{EE} can vary +0.25 V / –0.5 V.

(3) Outputs are terminated through a 50-Ω resistor to $V_{CC} - 2\text{ V}$.

(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 more-positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between V_{PP} min and 1 V.

NECL DC CHARACTERISTICS⁽¹⁾ ($V_{CC} = 0\text{ V}$; $V_{EE} = 5\text{ V}$)⁽²⁾

| PARAMETER | –40°C | | | 25°C | | | 85°C | | | UNIT |
|---|-------|-----|-------|-------|-------|-------|-------|-----|-------|------|
| | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| I_{EE} Power-supply current | | 19 | 26 | | 21 | 26 | | 23 | 26 | mA |
| V_{OH} Output HIGH voltage ⁽³⁾ | –1085 | | –880 | –1025 | –995 | –880 | –1025 | | –880 | mV |
| V_{OL} Output LOW voltage ⁽³⁾ | –1830 | | –1620 | –1810 | –1712 | –1620 | –1810 | | –1620 | mV |
| V_{IH} Input HIGH voltage (single-ended) | –1165 | | –880 | –1165 | | –880 | –1165 | | –880 | mV |
| V_{IL} Input LOW voltage (single-ended) | –1810 | | –1475 | –1810 | | –1475 | –1810 | | –1475 | mV |
| V_{IHCMR} Input HIGH voltage, common-mode range (differential) ⁽⁴⁾ | –2.5 | | –0.4 | –2.5 | | –0.4 | –2.5 | | –0.4 | V |
| I_{IH} Input HIGH current | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} Input LOW current | 0.5 | | | 0.5 | | | 0.5 | | | μA |

(1) The device meets these specifications after thermal equilibrium has been established when mounted in a test socket or printed-circuit board with maintained transverse airflow greater than 500 lpm (2.54 m/s). Electrical parameters are assured 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} . V_{EE} can vary +0.25 V / –0.5 V.

(3) Outputs are terminated through a 50-Ω resistor to $V_{CC} - 2\text{ V}$.

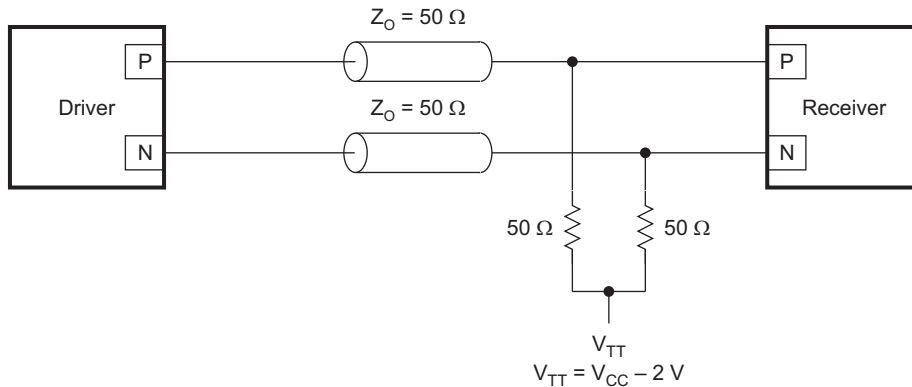
(4) V_{IHCMR} min varies 1:1 with V_{EE} ; V_{IHCMR} max varies 1:1 with V_{CC} . The V_{IHCMR} range is referenced to the more-positive side of the differential input signal. Normal operation is obtained if the HIGH level falls within the specified range and the peak-to-peak voltage lies between V_{PP} min and 1 V.

AC CHARACTERISTICS⁽¹⁾ ($V_{CC} = 5\text{ V}$; $V_{EE} = 0\text{ V}$ or $V_{CC} = 0\text{ V}$; $V_{EE} = -5\text{ V}$)⁽²⁾

| PARAMETER | | -40°C | | | 25°C | | | 85°C | | | UNIT |
|-------------------|---|-------|-----|------|------|-----|------|------|-----|------|------|
| | | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | |
| f_{MAX} | Maximum switching frequency ⁽³⁾ (see Figure 6) | 3.5 | | | 3.4 | | | 3.1 | | | GHz |
| t_{PLH}/t_{PHL} | Propagation delay to output (see Figure 2) | 200 | | 300 | 200 | | 300 | 200 | | 300 | ps |
| t_{SKEW} | Device skew ⁽⁴⁾ (see Figure 5) | 7 15 | | | 7 15 | | | 7 15 | | | ps |
| | Duty cycle skew ⁽⁵⁾ | 5 15 | | | 5 15 | | | 5 15 | | | |
| t_{JITTER} | Random clock jitter (RMS) | 0.2 | | | 0.2 | | | 0.2 | | | ps |
| V_{PP} | Input swing ⁽⁶⁾ (see Figure 3) | 150 | | 1000 | 150 | | 1000 | 150 | | 1000 | mV |
| t_r/t_f | Q-output rise/fall times (20%–80%) (see Figure 4) | 150 | | 250 | 150 | | 250 | 150 | | 250 | ps |

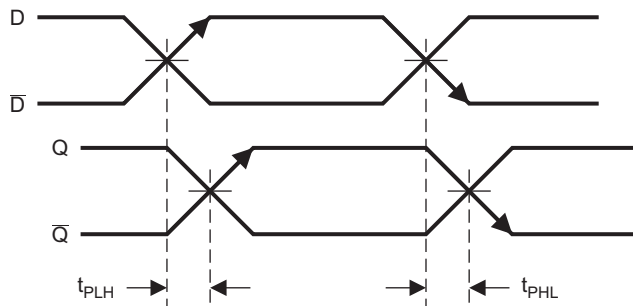
- (1) The device meets these specifications after thermal equilibrium has been established when mounted in a test socket or printed-circuit board with maintained transverse airflow greater than 500 lfpm (2.54 m/s). Electrical parameters are assured only over the declared operating temperature range. 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} . V_{EE} can vary +0.25 V / -0.5 V.
- (3) Maximum switching frequency is measured at an output amplitude of 300 mVpp.
- (4) Within-device skew defined as identical transitions on similar paths through a device.
- (5) Duty cycle skew is the difference between a t_{PLH} and t_{PHL} propagation delay through a device.
- (6) $V_{PP(min)}$ is the minimum input swing for which ac parameters are assured.

Typical Termination for Output Driver



S0078-02

Figure 1. Typical Termination for Output Driver



T0400-01

Figure 2. Propagation Delay

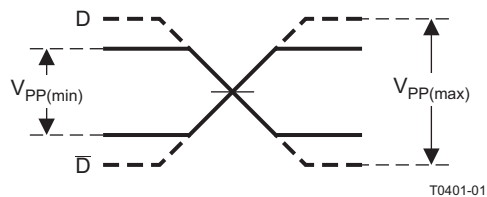


Figure 3. Input Voltage Swing

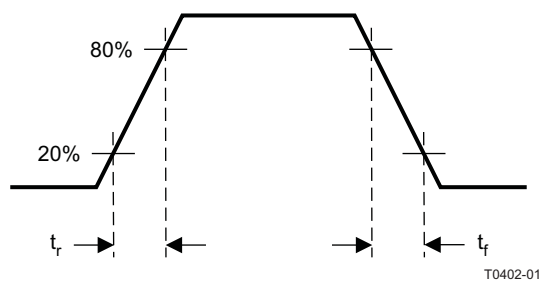
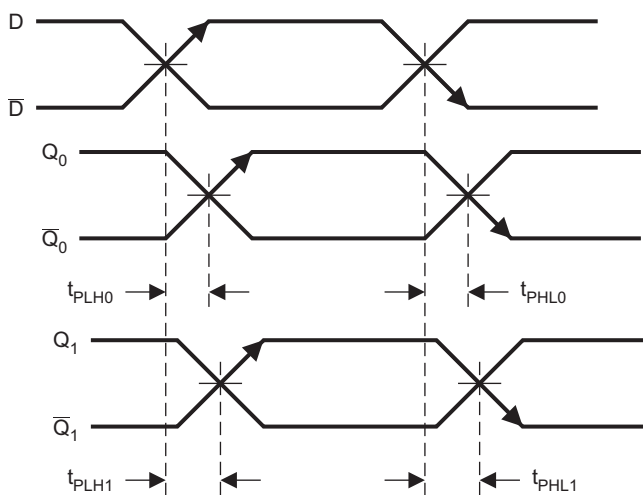


Figure 4. Output Rise and Fall Times



$$\text{Device Skew} = [(t_{PLH1} - t_{PLH0}), (t_{PHL1} - t_{PHL0})]$$

T0403-01

Figure 5. Device Skew

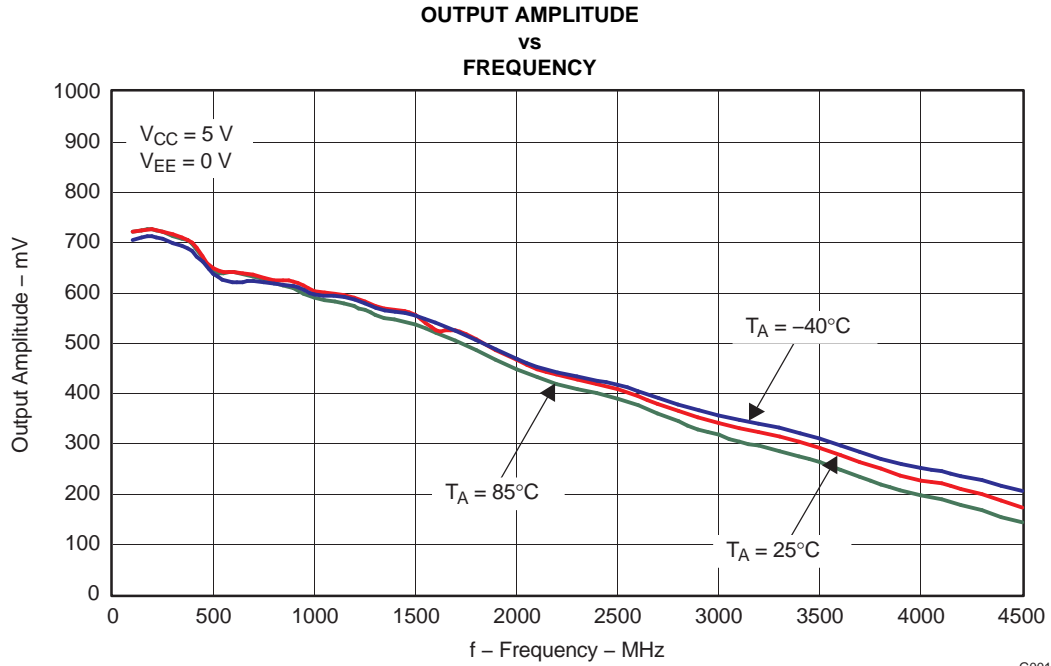


Figure 6.

G001

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN65EL11D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | EL11 | Samples |
| SN65EL11DGK | ACTIVE | VSSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | SILI | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

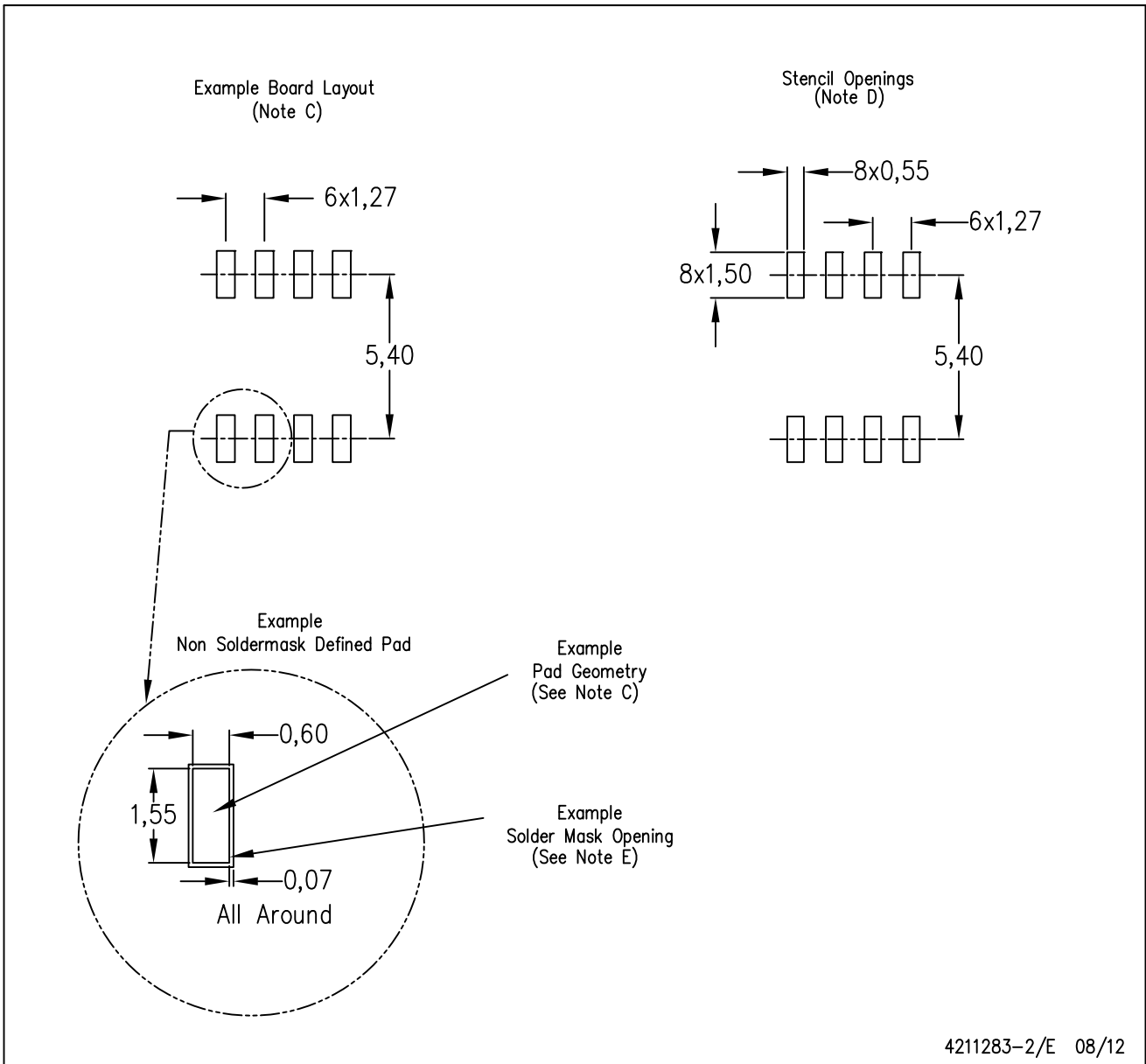
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

| | |
|------------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Applications Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community

e2e.ti.com