# CD40106B CMOS Hex Schmitt-Trigger Inverters

## 1 Features

- Schmitt-Trigger Action With No External Components
- Hysteresis Voltage (Typical):
  - 0.9 V at $V_{DD}$ = 5 V
  - 2.3 V at $V_{DD}$ = 10 V
  - 3.5 V at $V_{DD}$ = 15 V
- Noise Immunity Greater Than 50%
- No Limit On Input Rise and Fall Times
- Standardized, Symmetrical Output Characteristics
- 100% Tested For Quiescent Current at 20 V
- Maximum Input Current Of 1 µA at 18 V Over Full Package Temperature Range:
  - 100 nA at 18 V and 25°C
- Low $V_{DD}$ and $V_{SS}$ Current During Slow Input Ramp
- 5-V, 10-V, and 15-V Parametric Ratings
- Meets All JEDEC Tentative Standard Requirements

## 2 Applications

- Wave and Pulse Shapers
- High-Noise-Environment Systems
- Monostable Multivibrators
- Astable Multivibrators

## 3 Description

The CD40106B device consists of six Schmitt-Trigger circuits. Each circuit functions as an inverter with Schmitt-Trigger action on the input. The trigger switches at different points for positive- and negative-going signals. The difference between the positive-going voltage ($V_P$) and the negative-going voltages ($V_N$) is defined as hysteresis voltage ($V_H$).

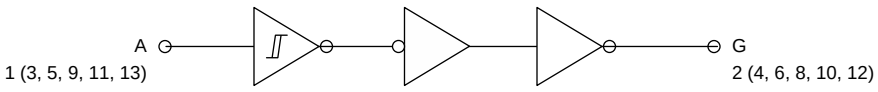
The CD40106B device is supplied in ceramic packaging (J) as well as standard packaging (D, N, NS, PW). All CD40106B devices are rated for –55°C to 125°C ambient temperature operation.

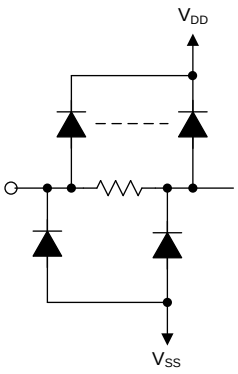
**Device Information(1)**

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| CD40106BF | CDIP (14) | 6.92 mm x 19.94 mm |
| CD40106BE | PDIP (14) | 6.30 mm x 19.31 mm |
| CD40106BM | SOIC (14) | 3.90 mm x 8.65 mm |
| CD40106BNSR | SO (14) | 5.30 mm x 10.20 mm |
| CD40106BPWR | TSSOP (14) | 4.40 mm x 5.00 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

**Logic Diagram**

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## Table of Contents

**1 Features** ... 1
**2 Applications** ... 1
**3 Description** ... 1
**4 Revision History** ... 2
**5 Pin Configuration and Functions** ... 3
**6 Specifications** ... 4
6.1 Absolute Maximum Ratings ... 4
6.2 ESD Ratings ... 4
6.3 Recommended Operating Conditions ... 4
6.4 Thermal Information ... 4
6.5 Electrical Characteristics: Dynamic ... 5
6.6 Electrical Characteristics: Static ... 5
6.7 Typical Characteristics ... 9
**7 Parameter Measurement Information** ... 11
**8 Detailed Description** ... 13
8.1 Overview ... 13
8.2 Functional Block Diagram ... 13
8.3 Feature Description ... 13
8.4 Device Functional Modes ... 13
**9 Application and Implementation** ... 14
9.1 Application Information ... 14
9.2 Typical Applications ... 14
**10 Power Supply Recommendations** ... 16
**11 Layout** ... 16
11.1 Layout Guidelines ... 16
11.2 Layout Example ... 16
**12 Device and Documentation Support** ... 18
12.1 Receiving Notification of Documentation Updates 18
12.2 Community Resources ... 18
12.3 Trademarks ... 18
12.4 Electrostatic Discharge Caution ... 18
12.5 Glossary ... 18
**13 Mechanical, Packaging, and Orderable Information** ... 18

## 4 Revision History

**Changes from Revision D (August 2003) to Revision E** **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Added *Thermal Information* table ... 4


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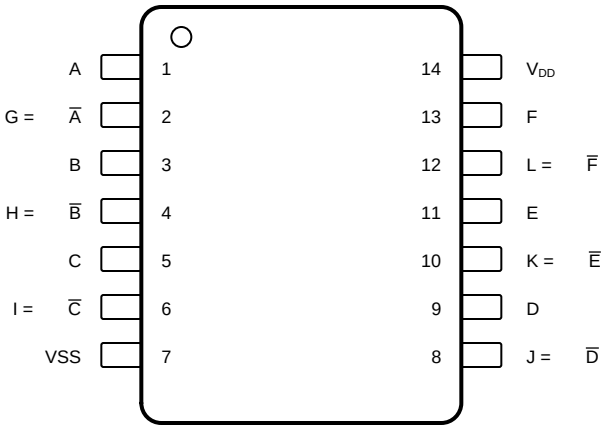
# 5 Pin Configuration and Functions

**D, J, N, NS, PW Packages**
**14-Pin SOIC, CDIP, PDIP, SO, TSSOP**
**Top View**




Not to scale

**Pin Functions**

| PIN | | I/O | DESCRIPTION |
|---|---|---|---|
| NO. | NAME | | |
| 1 | A | I | Channel A Input |
| 2 | G = $\overline{A}$ | O | Channel A Output |
| 3 | B | I | Channel B Input |
| 4 | H = $\overline{B}$ | O | Channel B Input |
| 5 | C | I | Channel B Input |
| 6 | I = $\overline{C}$ | O | Channel B Input |
| 7 | $V_{SS}$ | — | Ground |
| 8 | J = $\overline{D}$ | O | Channel D Output |
| 9 | D | I | Channel D Input |
| 10 | K = $\overline{E}$ | O | Channel E Output |
| 11 | E | I | Channel E Input |
| 12 | L = $\overline{F}$ | O | Channel F Output |
| 13 | F | I | Channel F Input |
| 14 | $V_{DD}$ | — | Power supply |

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# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| DC supply voltage, $V_{DD}$(2) | | –0.5 | 20 | V |
| Input voltage, all inputs | | –0.5 | $V_{DD}$ + 0.5 | V |
| DC input current, any one input | | | ±10 | mA |
| Power dissipation, $P_D$ | $T_A$ = –55°C to 100°C | | 500 | mW |
| | $T_A$ = 100°C to 125°C(3) | | 200 | |
| Device dissipation per output transistor | | | 100 | mW |
| Operating temperature, $T_A$ | | –55 | 125 | °C |
| Maximum junction temperature, $T_J$ | | | 150 | °C |
| Storage temperature, $T_{stg}$ | | –65 | 150 | °C |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) Voltages reference to $V_{SS}$ terminal
(3) Derate linearity at 12 mW/°C

## 6.2 ESD Ratings

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1) | 2000 | V |
| | | Charged-device model (CDM), per JEDEC specification JESD22-C101(2) | 1000 | |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | MIN | MAX | UNIT |
|---|---|---|---|
| Supply voltage | 3 | 18 | V |

## 6.4 Thermal Information

| THERMAL METRIC(1) | | CD40106B | | | | UNIT |
|---|---|---|---|---|---|---|
| | | D (SOIC) | N (PDIP) | NS (SO) | PW (TSSOP) | |
| | | 14 PINS | 14 PINS | 14 PINS | 14 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 86.1 | 51.3 | 83.5 | 114.1 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 44.3 | 38.6 | 41.5 | 39.1 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 40.6 | 31.2 | 42.2 | 56.9 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 11.6 | 23.4 | 13.1 | 3.1 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 40.3 | 31.3 | 41.8 | 56.2 | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report.


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## 6.5 Electrical Characteristics: Dynamic

at $T_A$ = 25°C, input $t_r$, $t_f$ = 20 ns, $C_L$ = 50 pF, and $R_L$ = 200 kΩ (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_{PHL}$, $t_{PLH}$ | Propagation delay time | $V_{DD}$ = 5 | | 140 | 280 | ns |
| | | $V_{DD}$ = 10 | | 70 | 140 | |
| | | $V_{DD}$ = 15 | | 60 | 120 | |
| $t_{THL}$, $t_{TLH}$ | Transition time | $V_{DD}$ = 5 | | 100 | 200 | ns |
| | | $V_{DD}$ = 10 | | 50 | 100 | |
| | | $V_{DD}$ = 15 | | 40 | 80 | |
| $C_{IN}$ | Input capacitance | Any input | | 5 | 7.5 | pF |

## 6.6 Electrical Characteristics: Static

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{DD}$max | Quiescent device current | $V_{IN}$ = 0 or 5, $V_{DD}$ = 5 | $T_A$ = –55°C | | | 1 | µA |
| | | | $T_A$ = –40°C | | | 1 | |
| | | | $T_A$ = 25°C | | 0.02 | 1 | |
| | | | $T_A$ = 85°C | | | 30 | |
| | | | $T_A$ = 125°C | | | 30 | |
| | | $V_{IN}$ = 0 or 10, $V_{DD}$ = 10 | $T_A$ = –55°C | | | 2 | |
| | | | $T_A$ = –40°C | | | 2 | |
| | | | $T_A$ = 25°C | | 0.02 | 2 | |
| | | | $T_A$ = 85°C | | | 60 | |
| | | | $T_A$ = 125°C | | | 60 | |
| | | $V_{IN}$ = 0 or 15, $V_{DD}$ = 15 | $T_A$ = –55°C | | | 4 | |
| | | | $T_A$ = –40°C | | | 4 | |
| | | | $T_A$ = 25°C | | 0.02 | 4 | |
| | | | $T_A$ = 85°C | | | 120 | |
| | | | $T_A$ = 125°C | | | 120 | |
| | | $V_{IN}$ = 0 or 20, $V_{DD}$ = 20 | $T_A$ = –55°C | | | 20 | |
| | | | $T_A$ = –40°C | | | 20 | |
| | | | $T_A$ = 25°C | | 0.04 | 20 | |
| | | | $T_A$ = 85°C | | | 600 | |
| | | | $T_A$ = 125°C | | | 600 | |
| $V_P$min | Positive trigger threshold voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | 2.2 | | | V |
| | | | $T_A$ = –40°C | 2.2 | | | |
| | | | $T_A$ = 25°C | 2.2 | 2.9 | | |
| | | | $T_A$ = 85°C | 2.2 | | | |
| | | | $T_A$ = 125°C | 2.2 | | | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | 4.6 | | | |
| | | | $T_A$ = –40°C | 4.6 | | | |
| | | | $T_A$ = 25°C | 4.6 | 5.9 | | |
| | | | $T_A$ = 85°C | 4.6 | | | |
| | | | $T_A$ = 125°C | 4.6 | | | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | 6.8 | | | |
| | | | $T_A$ = –40°C | 6.8 | | | |
| | | | $T_A$ = 25°C | 6.8 | 8.8 | | |
| | | | $T_A$ = 85°C | 6.8 | | | |
| | | | $T_A$ = 125°C | 6.8 | | | |

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## Electrical Characteristics: Static (continued)

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_P$max | Positive trigger threshold voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | | | 3.6 | V |
| | | | $T_A$ = –40°C | | | 3.6 | |
| | | | $T_A$ = 25°C | | 2.9 | 3.6 | |
| | | | $T_A$ = 85°C | | | 3.6 | |
| | | | $T_A$ = 125°C | | | 3.6 | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | | | 7.1 | |
| | | | $T_A$ = –40°C | | | 7.1 | |
| | | | $T_A$ = 25°C | | 5.9 | 7.1 | |
| | | | $T_A$ = 85°C | | | 7.1 | |
| | | | $T_A$ = 125°C | | | 7.1 | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | | | 10.8 | |
| | | | $T_A$ = –40°C | | | 10.8 | |
| | | | $T_A$ = 25°C | | 8.8 | 10.8 | |
| | | | $T_A$ = 85°C | | | 10.8 | |
| | | | $T_A$ = 125°C | | | 10.8 | |
| $V_N$min | Negative trigger threshold voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | 0.9 | | | V |
| | | | $T_A$ = –40°C | 0.9 | | | |
| | | | $T_A$ = 25°C | 0.9 | 1.9 | | |
| | | | $T_A$ = 85°C | 0.9 | | | |
| | | | $T_A$ = 125°C | 0.9 | | | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | 2.5 | | | |
| | | | $T_A$ = –40°C | 2.5 | | | |
| | | | $T_A$ = 25°C | 2.5 | 3.9 | | |
| | | | $T_A$ = 85°C | 2.5 | | | |
| | | | $T_A$ = 125°C | 2.5 | | | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | 4 | | | |
| | | | $T_A$ = –40°C | 4 | | | |
| | | | $T_A$ = 25°C | 4 | 5.8 | | |
| | | | $T_A$ = 85°C | 4 | | | |
| | | | $T_A$ = 125°C | 4 | | | |
| $V_N$max | Negative trigger threshold voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | | | 2.8 | V |
| | | | $T_A$ = –40°C | | | 2.8 | |
| | | | $T_A$ = 25°C | | 1.9 | 2.8 | |
| | | | $T_A$ = 85°C | | | 2.8 | |
| | | | $T_A$ = 125°C | | | 2.8 | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | | | 5.2 | |
| | | | $T_A$ = –40°C | | | 5.2 | |
| | | | $T_A$ = 25°C | | 3.9 | 5.2 | |
| | | | $T_A$ = 85°C | | | 5.2 | |
| | | | $T_A$ = 125°C | | | 5.2 | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | | | 7.4 | |
| | | | $T_A$ = –40°C | | | 7.4 | |
| | | | $T_A$ = 25°C | | 5.8 | 7.4 | |
| | | | $T_A$ = 85°C | | | 7.4 | |
| | | | $T_A$ = 125°C | | | 7.4 | |


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## Electrical Characteristics: Static (continued)

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_H$min | Hysteresis voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | 0.3 | | | V |
| | | | $T_A$ = –40°C | 0.3 | | | |
| | | | $T_A$ = 25°C | 0.3 | 0.9 | | |
| | | | $T_A$ = 85°C | 0.3 | | | |
| | | | $T_A$ = 125°C | 0.3 | | | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | 1.2 | | | |
| | | | $T_A$ = –40°C | 1.2 | | | |
| | | | $T_A$ = 25°C | 1.2 | 2.3 | | |
| | | | $T_A$ = 85°C | 1.2 | | | |
| | | | $T_A$ = 125°C | 1.2 | | | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | 1.6 | | | |
| | | | $T_A$ = –40°C | 1.6 | | | |
| | | | $T_A$ = 25°C | 1.6 | 3.5 | | |
| | | | $T_A$ = 85°C | 1.6 | | | |
| | | | $T_A$ = 125°C | 1.6 | | | |
| $V_H$max | Hysteresis voltage | $V_{DD}$ = 5 | $T_A$ = –55°C | | | 1.6 | V |
| | | | $T_A$ = –40°C | | | 1.6 | |
| | | | $T_A$ = 25°C | | 0.9 | 1.6 | |
| | | | $T_A$ = 85°C | | | 1.6 | |
| | | | $T_A$ = 125°C | | | 1.6 | |
| | | $V_{DD}$ = 10 | $T_A$ = –55°C | | | 3.4 | |
| | | | $T_A$ = –40°C | | | 3.4 | |
| | | | $T_A$ = 25°C | | 2.3 | 3.4 | |
| | | | $T_A$ = 85°C | | | 3.4 | |
| | | | $T_A$ = 125°C | | | 3.4 | |
| | | $V_{DD}$ = 15 | $T_A$ = –55°C | | | 5 | |
| | | | $T_A$ = –40°C | | | 5 | |
| | | | $T_A$ = 25°C | | 3.5 | 5 | |
| | | | $T_A$ = 85°C | | | 5 | |
| | | | $T_A$ = 125°C | | | 5 | |
| $I_{OL}$min | Output low (sink) current | $V_O$ = 0.4, $V_{IN}$ = 0 or 5, $V_{DD}$ = 5 | $T_A$ = –55°C | 0.64 | | | mA |
| | | | $T_A$ = –40°C | 0.61 | | | |
| | | | $T_A$ = 25°C | 0.51 | 1 | | |
| | | | $T_A$ = 85°C | 0.42 | | | |
| | | | $T_A$ = 125°C | 0.36 | | | |
| | | $V_O$ = 0.5, $V_{IN}$ = 0 or 10, $V_{DD}$ = 10 | $T_A$ = –55°C | 1.6 | | | |
| | | | $T_A$ = –40°C | 1.5 | | | |
| | | | $T_A$ = 25°C | 1.3 | 2.6 | | |
| | | | $T_A$ = 85°C | 1.1 | | | |
| | | | $T_A$ = 125°C | 0.9 | | | |
| | | $V_O$ = 1.5, $V_{IN}$ = 0 or 15, $V_{DD}$ = 15 | $T_A$ = –55°C | 4.2 | | | |
| | | | $T_A$ = –40°C | 4 | | | |
| | | | $T_A$ = 25°C | 3.4 | 6.8 | | |
| | | | $T_A$ = 85°C | 2.8 | | | |
| | | | $T_A$ = 125°C | 2.4 | | | |

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## Electrical Characteristics: Static (continued)

over operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{OH}$min | Output high (source) current | $V_O$ = 4.6, $V_{IN}$ = 0 or 5, $V_{DD}$ = 5 | $T_A$ = –55°C | –0.64 | | | mA |
| | | | $T_A$ = –40°C | –0.61 | | | |
| | | | $T_A$ = 25°C | –0.51 | –1 | | |
| | | | $T_A$ = 85°C | –0.42 | | | |
| | | | $T_A$ = 125°C | –0.36 | | | |
| | | $V_O$ = 2.5, $V_{IN}$ = 0 or 5, $V_{DD}$ = 5 | $T_A$ = –55°C | –2 | | | |
| | | | $T_A$ = –40°C | –1.8 | | | |
| | | | $T_A$ = 25°C | –1.6 | –3.2 | | |
| | | | $T_A$ = 85°C | –1.3 | | | |
| | | | $T_A$ = 125°C | –1.15 | | | |
| | | $V_O$ = 9.5, $V_{IN}$ = 0 or 10, $V_{DD}$ = 10 | $T_A$ = –55°C | –1.6 | | | |
| | | | $T_A$ = –40°C | –1.5 | | | |
| | | | $T_A$ = 25°C | –1.3 | –2.6 | | |
| | | | $T_A$ = 85°C | –1.1 | | | |
| | | | $T_A$ = 125°C | –0.9 | | | |
| | | $V_O$ = 13.5, $V_{IN}$ = 0 or 15, $V_{DD}$ = 15 | $T_A$ = –55°C | –4.2 | | | |
| | | | $T_A$ = –40°C | –4 | | | |
| | | | $T_A$ = 25°C | –3.4 | –6.8 | | |
| | | | $T_A$ = 85°C | –2.8 | | | |
| | | | $T_A$ = 125°C | –2.4 | | | |
| $V_{OL}$max | Low-level output voltage | $V_{IN}$ = 5, $V_{DD}$ = 5 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | | 0 | 0.05 | V |
| | | $V_{IN}$ = 10, $V_{DD}$ = 10 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | | 0 | 0.05 | |
| | | $V_{IN}$ = 15, $V_{DD}$ = 15 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | | 0 | 0.05 | |
| $V_{OH}$min | High-level output voltage | $V_{IN}$ = 0, $V_{DD}$ = 5 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | 4.95 | 5 | | V |
| | | $V_{IN}$ = 0, $V_{DD}$ = 10 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | 9.95 | 10 | | |
| | | $V_{IN}$ = 0, $V_{DD}$ = 15 | $T_A$ = –55°C, –40°C, 25°C, 85°C, and 125°C | 14.95 | 15 | | |
| $I_{IN}$max | Input current | $V_{IN}$ = 0 or 18, $V_{DD}$ = 18 | $T_A$ = –55°C | | | ±0.1 | µA |
| | | | $T_A$ = –40°C | | | ±0.1 | |
| | | | $T_A$ = 25°C | | ±0.00001 | ±0.1 | |
| | | | $T_A$ = 85°C | | | ±1 | |
| | | | $T_A$ = 125°C | | | ±1 | |


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## 6.7 Typical Characteristics

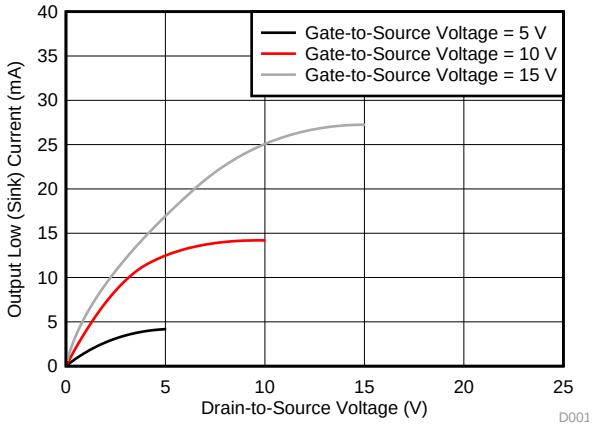


**Figure 1. Typical Output Low (Sink) Current Characteristics**

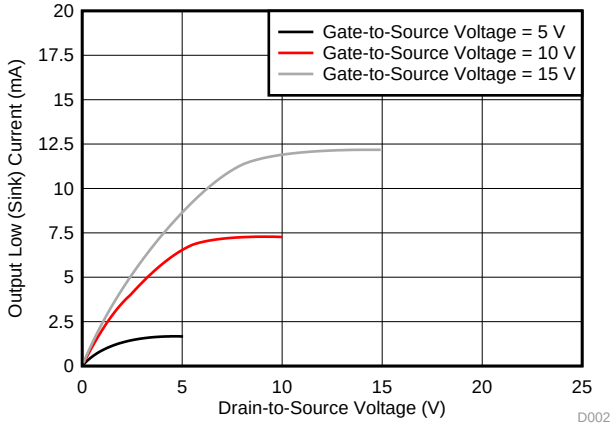


**Figure 2. Minimum Output Low (Sink) Current Characteristics**

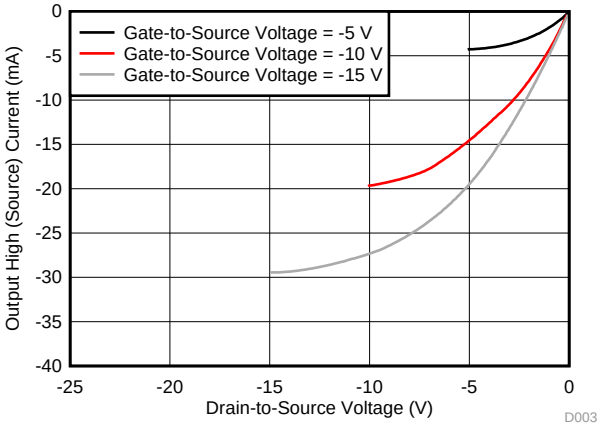


**Figure 3. Typical Output High (Source) Current Characteristics**

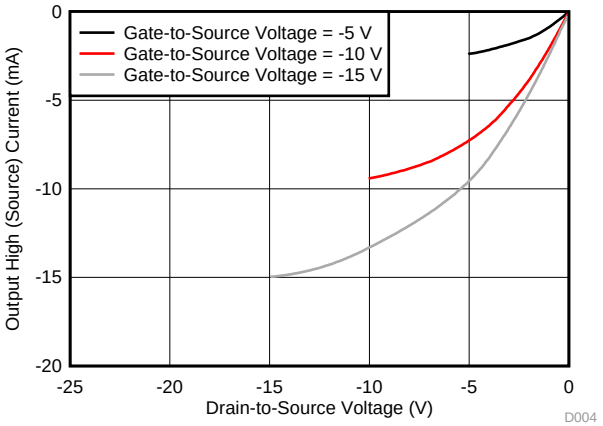


**Figure 4. Minimum Output High (Source) Current Characteristics**

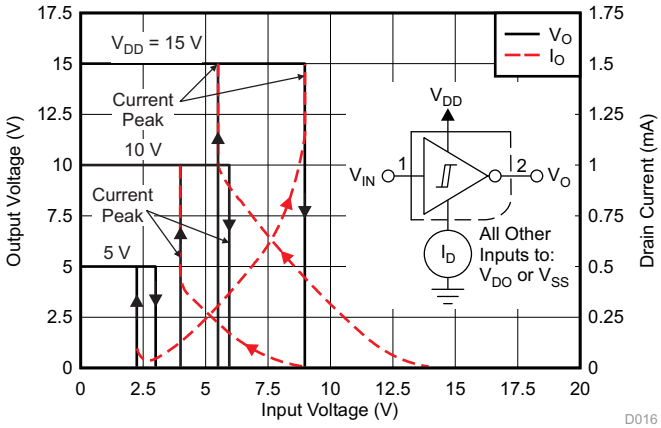


**Figure 5. Typical Current and Voltage Transfer Characteristics**

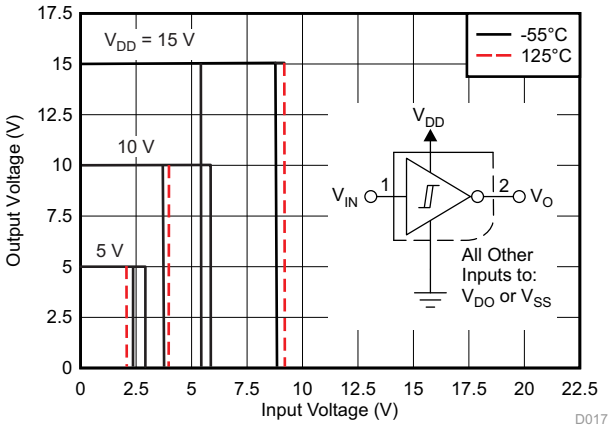


**Figure 6. Typical Voltage Transfer Characteristics as a Function of Temperature**

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## Typical Characteristics (continued)

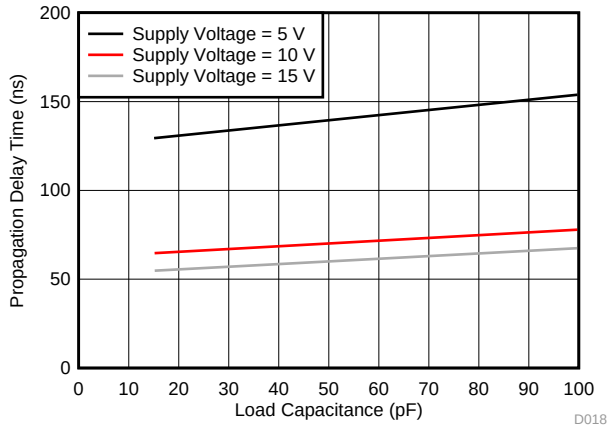


**Figure 7. Typical Propagation Delay Time as a Function of Load Capacitance**

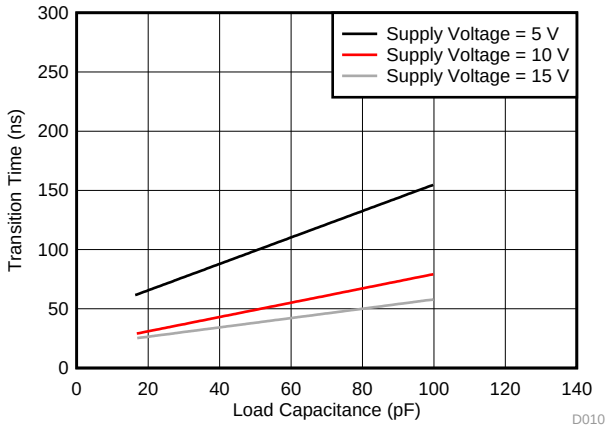


**Figure 8. Typical Transition Time as a Function of Load Capacitance**

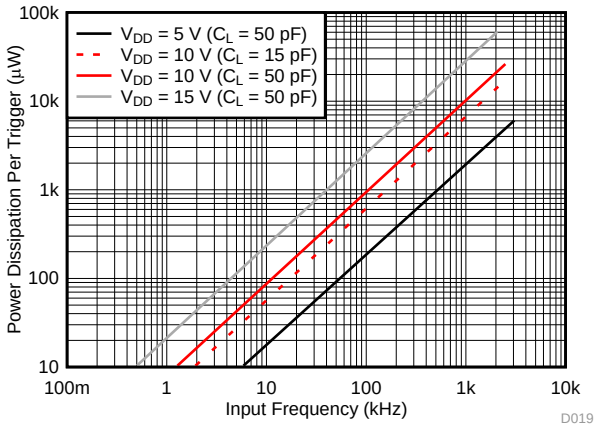


**Figure 9. Typical Power Dissipation Per Trigger as a Function of Input Frequency**

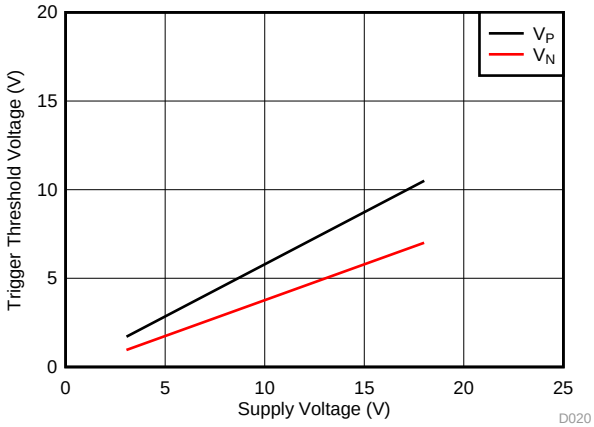


**Figure 10. Typical Trigger Threshold Voltage as a Function of Supply Voltage**

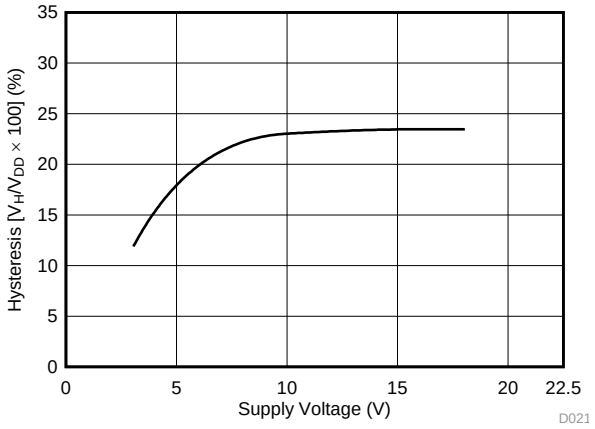


**Figure 11. Typical Percent Hysteresis as a Function of Supply Voltage**


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# 7 Parameter Measurement Information

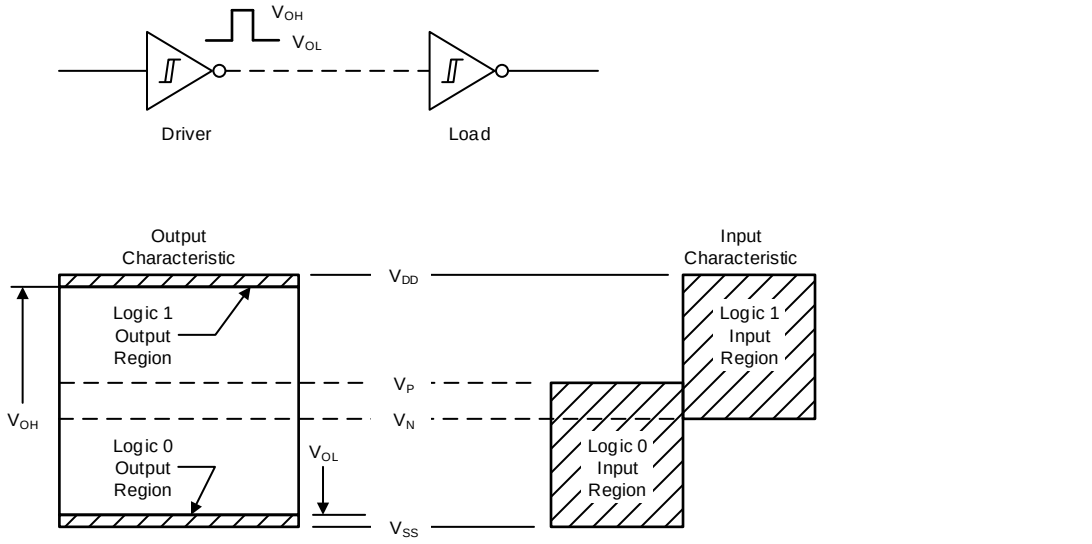
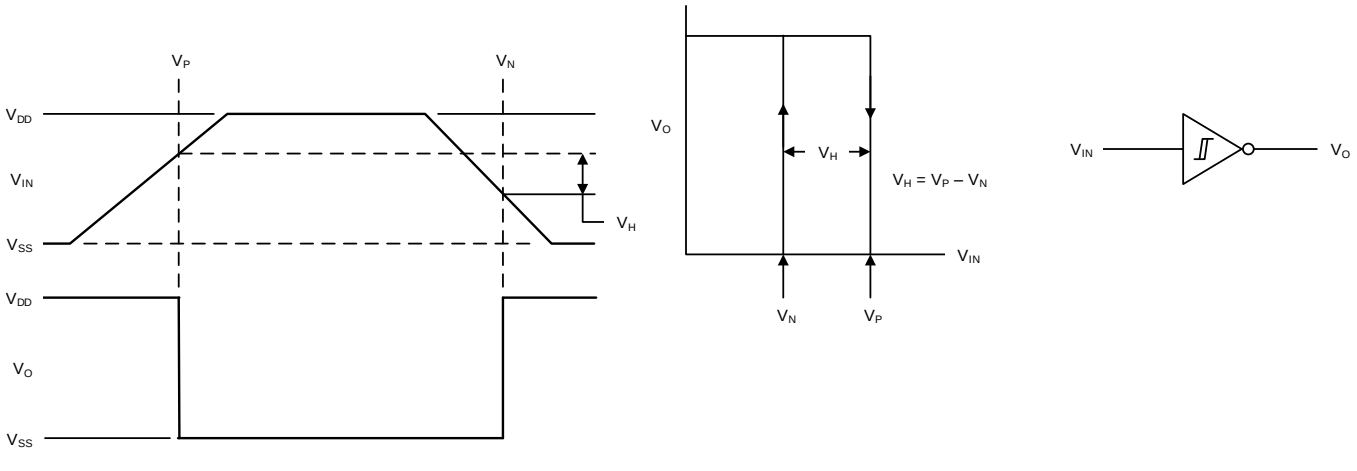



**Figure 12. Input and Output Characteristics**




a) Definition of $V_P$, $V_N$, and $V_H$

b) Transfer Characteristics of 1 of 6 Gates

**Figure 13. Hysteresis Definition, Characteristics, and Test Set-Up**

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## Parameter Measurement Information (continued)

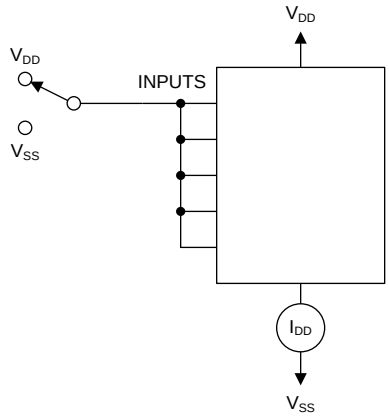


**Figure 14. Quiescent Device Current Test Circuit**

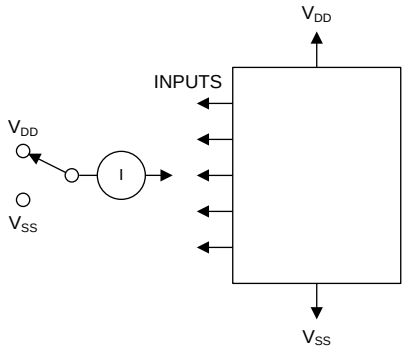


**Figure 15. Input Current Test Circuit**

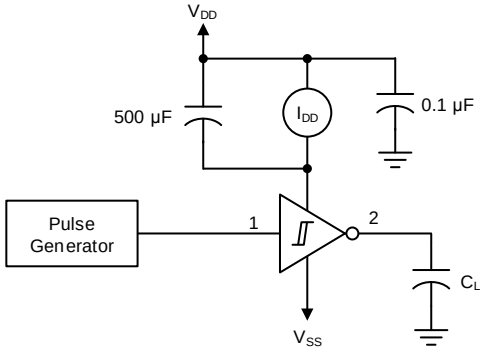


**Figure 16. Dynamic Power Dissipation Test Circuit**


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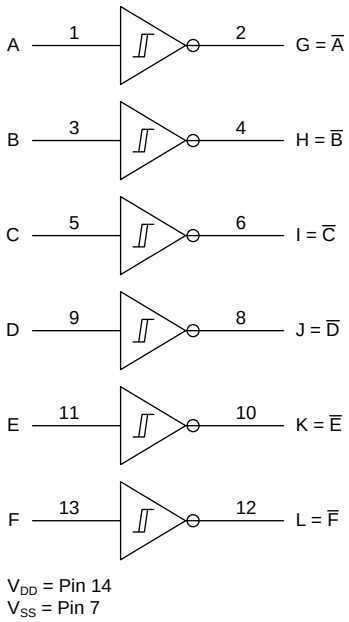
# 8 Detailed Description

## 8.1 Overview

The CD40106B device consists of Schmitt-Trigger devices that contain six independent inverters. They perform the Boolean function $Y = \overline{A}$ in positive logic.

Schmitt-Trigger inputs are designed to provide a minimum separation between positive and negative switching thresholds. This allows for noisy or slow inputs that would cause problems such as oscillation or excessive current draw.

## 8.2 Functional Block Diagram

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## 8.3 Feature Description

The CD40106B has standardized symmetrical output characteristics and a wide operating voltage from 3 V to 18 V with quiescent current of 20 µA tested at 20 V. These devices have transition times of $t_{TLH} = t_{THL} = 50$ ns (typical) at 10 V. The operating temperature is from –55°C to 125°C.

## 8.4 Device Functional Modes

Table 1 lists the functional modes of the CD40106B.

**Table 1. Function Table**

| INPUT | OUTPUT |
|---|---|
| H | L |
| L | H |

# 9 Application and Implementation

**NOTE**

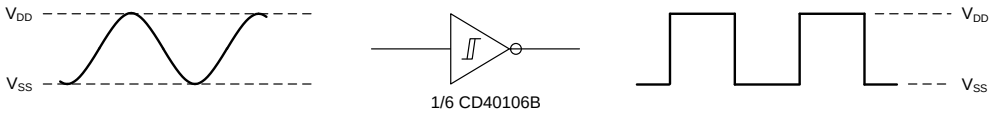
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

## 9.1 Application Information

The CD40106B device is a Schmitt-Trigger input device that can be used for a multitude of inverting buffer type functions. The application shown here takes advantage of the Schmitt-Trigger inputs to produce a square wave output from a sine wave input.

## 9.2 Typical Applications

### 9.2.1 Wave Shaper




Frequency Range of Wave Shape
is from DC to 1 MHz.

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**Figure 17. Wave Shaper Schematic**

#### *9.2.1.1 Design Requirements*

Take care to avoid bus contention, because it can drive currents that would exceed maximum limits. Parallel output drive can create fast edges into light loads so consider routing and load conditions to prevent ringing.

#### *9.2.1.2 Detailed Design Procedure*

The recommended input conditions for Figure 17 includes specified high and low levels (see $V_P$ and $V_N$ in *Electrical Characteristics: Static*). Inputs are not overvoltage tolerant and must be below $V_{CC}$ level because of the presence of input clamp diodes to VCC.

The recommended output condition for the CD40106B application includes specific load currents. Load currents must be limited so as to not exceed the total power (continuous current through VCC or GND) for the device. These limits are in the *Absolute Maximum Ratings*. Outputs must not be pulled above $V_{CC}$.

#### *9.2.1.3 Application Curve*

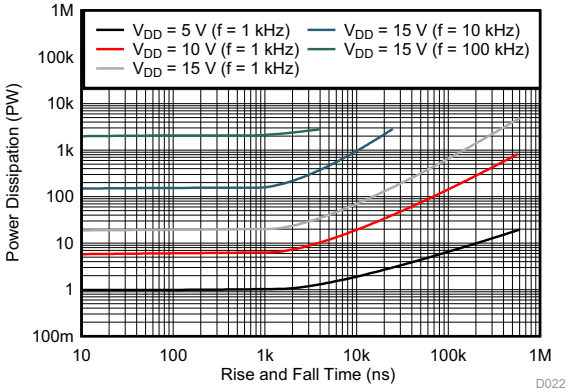


**Figure 18. Typical Power Dissipation as a Function of Rise and Fall Times**


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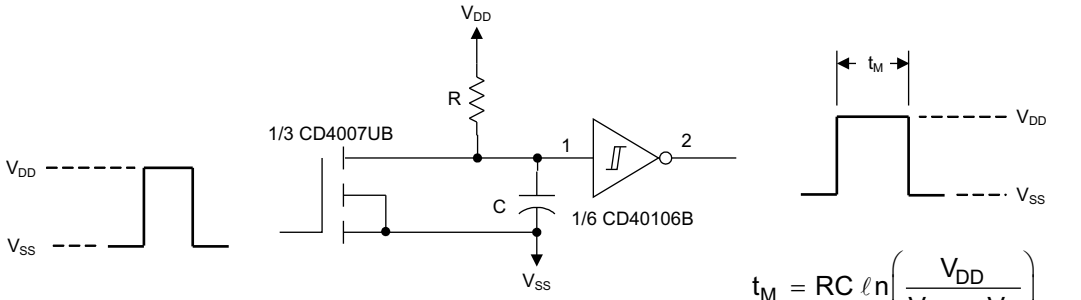
## Typical Applications (continued)

### 9.2.2 Monostable Multivibrator

The timing of the monostable multivibrator circuit can be set by following the equations shown in Figure 19.




$$t_M = RC\,\ell n\left(\frac{V_{DD}}{V_{DD} - V_P}\right)$$

$50\ k\Omega \le R \le 1\ M\Omega$

$100\ pF \le C \le 1\ \mu F$

For the Range of R and C
Given $5\ \mu s < t_M < 1\ s$

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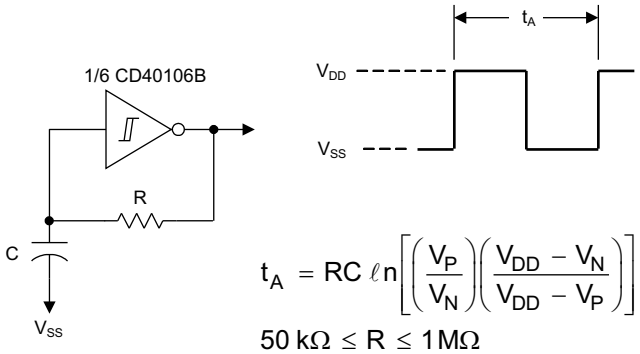
**Figure 19. Monostable Multivibrator Schematic and Equations**

### 9.2.3 Astable Multivibrator

The timing of the astable multivibrator circuit can be set by following the equations shown in Figure 20.




$$t_A = RC\,\ell n\left[\left(\frac{V_P}{V_N}\right)\left(\frac{V_{DD} - V_N}{V_{DD} - V_P}\right)\right]$$

$50\ k\Omega \le R \le 1\ M\Omega$

$100\ pF \le C \le 1\ \mu F$

For the Range of R and C
Given $2\ \mu s < t_A < 0.4\ s$

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**Figure 20. Astable Multivibrator Schematic and Equations**

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*. The $V_{CC}$ terminal must have a good bypass capacitor to prevent power disturbance. A 0.1-µF capacitor is recommended to be used on the $V_{CC}$ terminal, and it must be placed as close as possible to the pin for best results.

## 11 Layout

### 11.1 Layout Guidelines

When using multiple bit logic devices, inputs must never float. In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only three of the four buffer gates are used. Such inputs must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally they are tied to GND or $V_{CC}$, whichever makes more sense or is more convenient. Floating outputs are generally acceptable, unless the part is a transceiver.

### 11.2 Layout Example

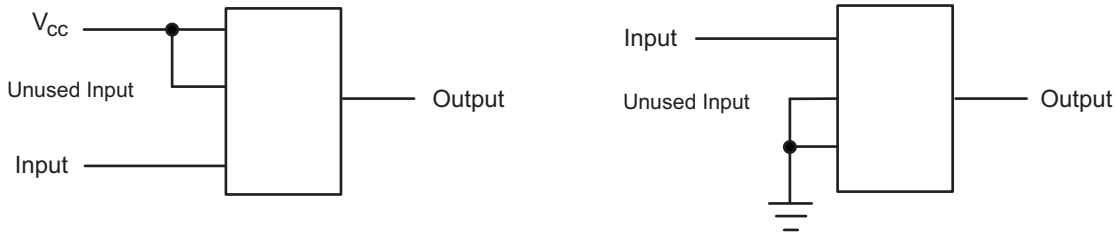


**Figure 21. Layout Diagram**


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## Layout Example (continued)

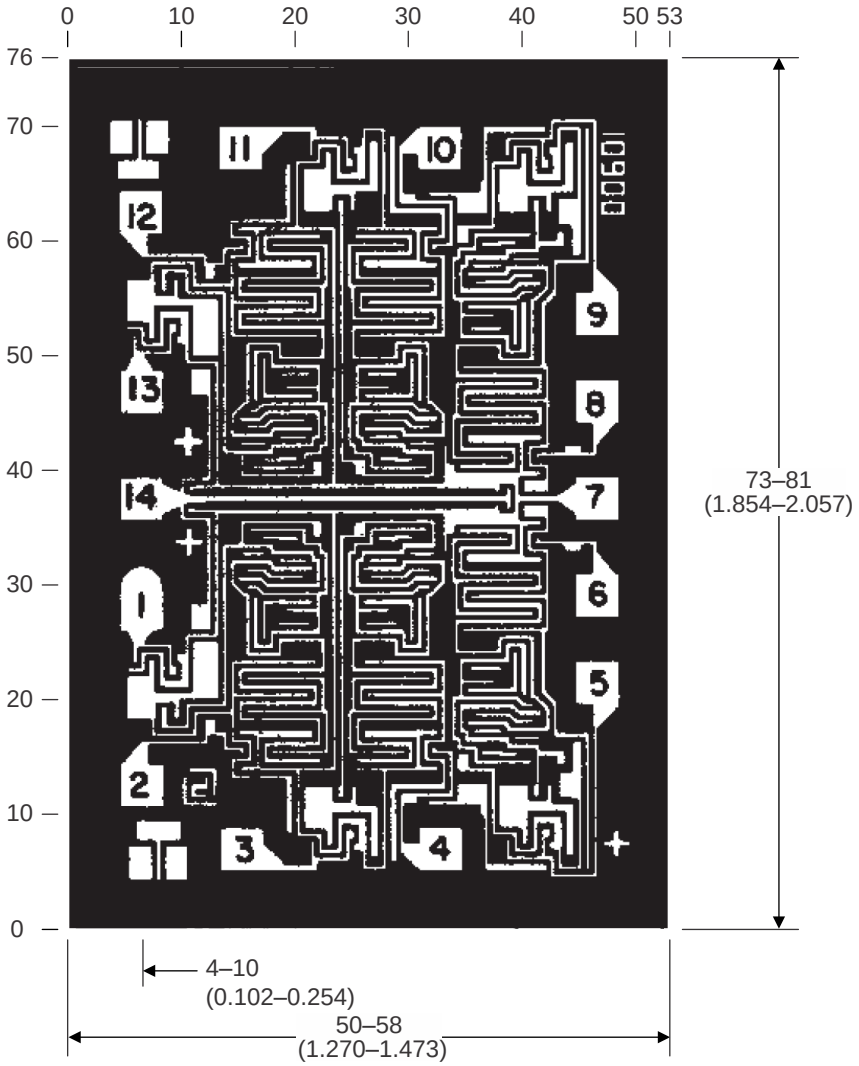


**Figure 22. Dimensions and Pad Layout for CD40106BH**

# 12 Device and Documentation Support

## 12.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

## 12.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

**TI E2E™ Online Community** ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

## 12.3 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

## 12.4 Electrostatic Discharge Caution

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.

## 12.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

# 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.


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## 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| CD40106BE | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD40106BE |
| CD40106BEE4 | ACTIVE | PDIP | N | 14 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -55 to 125 | CD40106BE |
| CD40106BF | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD40106BF |
| CD40106BF3A | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | CD40106BF3A |
| CD40106BK | OBSOLETE | CFP | WR | 14 | | TBD | Call TI | Call TI | | |
| CD40106BM | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BM96 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BM96E4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BM96G4 | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BMG4 | ACTIVE | SOIC | D | 14 | 50 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BMT | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BMTG4 | ACTIVE | SOIC | D | 14 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106BM |
| CD40106BNSR | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106B |
| CD40106BNSRG4 | ACTIVE | SO | NS | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CD40106B |
| CD40106BPW | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM0106B |
| CD40106BPWG4 | ACTIVE | TSSOP | PW | 14 | 90 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM0106B |
| CD40106BPWR | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM0106B |
| CD40106BPWRE4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM0106B |

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|
| CD40106BPWRG4 | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -55 to 125 | CM0106B |

**(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.

**OTHER QUALIFIED VERSIONS OF CD40106B, CD40106B-MIL :**

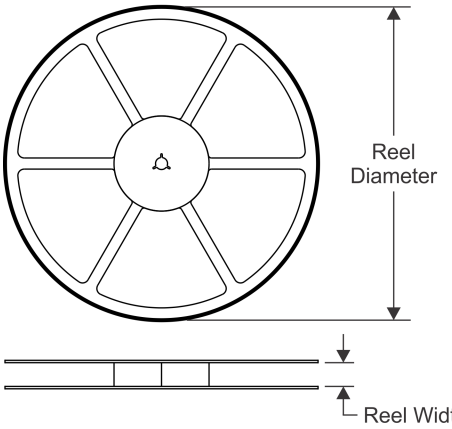
- Catalog: CD40106B
- Military: CD40106B-MIL

NOTE: Qualified Version Definitions:

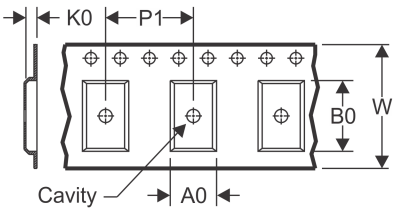
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

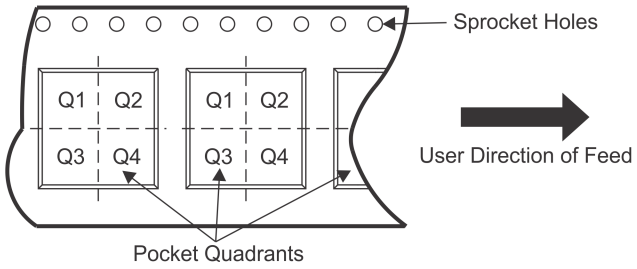



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

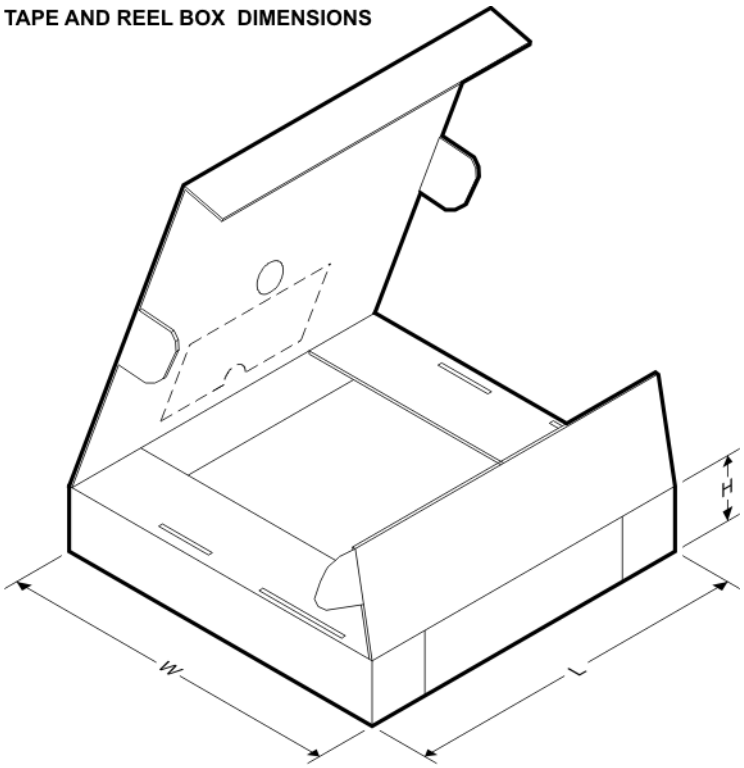
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CD40106BM96 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| CD40106BM96G4 | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| CD40106BMT | SOIC | D | 14 | 250 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| CD40106BNSR | SO | NS | 14 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |
| CD40106BPWR | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



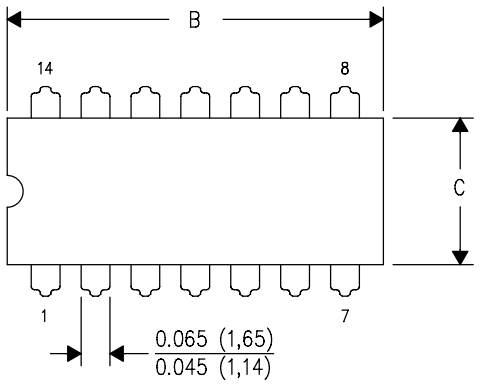

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| CD40106BM96 | SOIC | D | 14 | 2500 | 367.0 | 367.0 | 38.0 |
| CD40106BM96G4 | SOIC | D | 14 | 2500 | 367.0 | 367.0 | 38.0 |
| CD40106BMT | SOIC | D | 14 | 250 | 367.0 | 367.0 | 38.0 |
| CD40106BNSR | SO | NS | 14 | 2000 | 367.0 | 367.0 | 38.0 |
| CD40106BPWR | TSSOP | PW | 14 | 2000 | 367.0 | 367.0 | 35.0 |

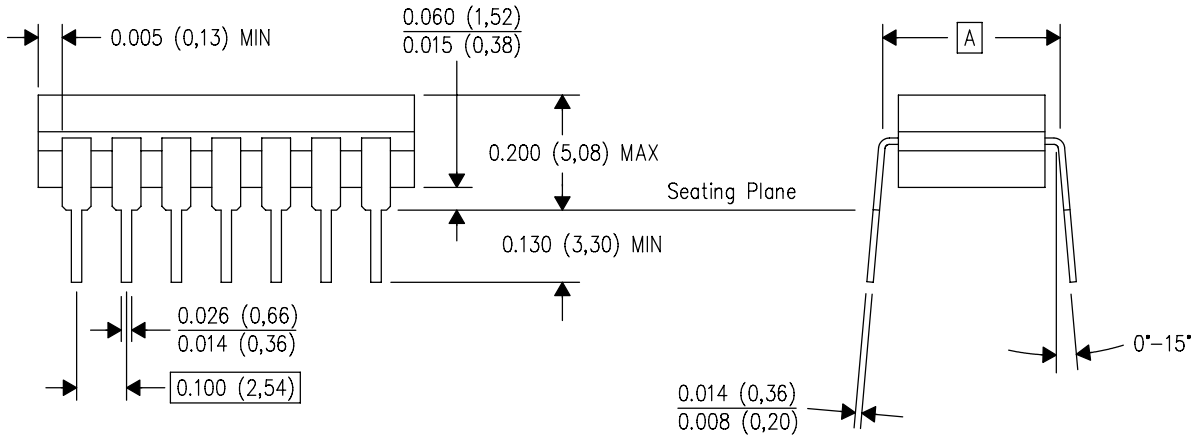
J (R–GDIP–T**)

14 LEADS SHOWN

# CERAMIC DUAL IN–LINE PACKAGE




| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC | 0.300 (7,62) BSC |
| B MAX | 0.785 (19,94) | .840 (21,34) | 0.960 (24,38) | 1.060 (26,92) |
| B MIN | — | — | — | — |
| C MAX | 0.300 (7,62) | 0.300 (7,62) | 0.310 (7,87) | 0.300 (7,62) |
| C MIN | 0.245 (6,22) | 0.245 (6,22) | 0.220 (5,59) | 0.245 (6,22) |



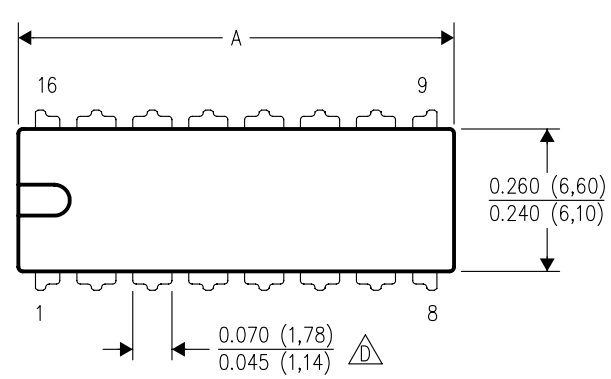

4040083/F 03/03

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls within MIL STD 1835 GDIP1–T14, GDIP1–T16, GDIP1–T18 and GDIP1–T20.

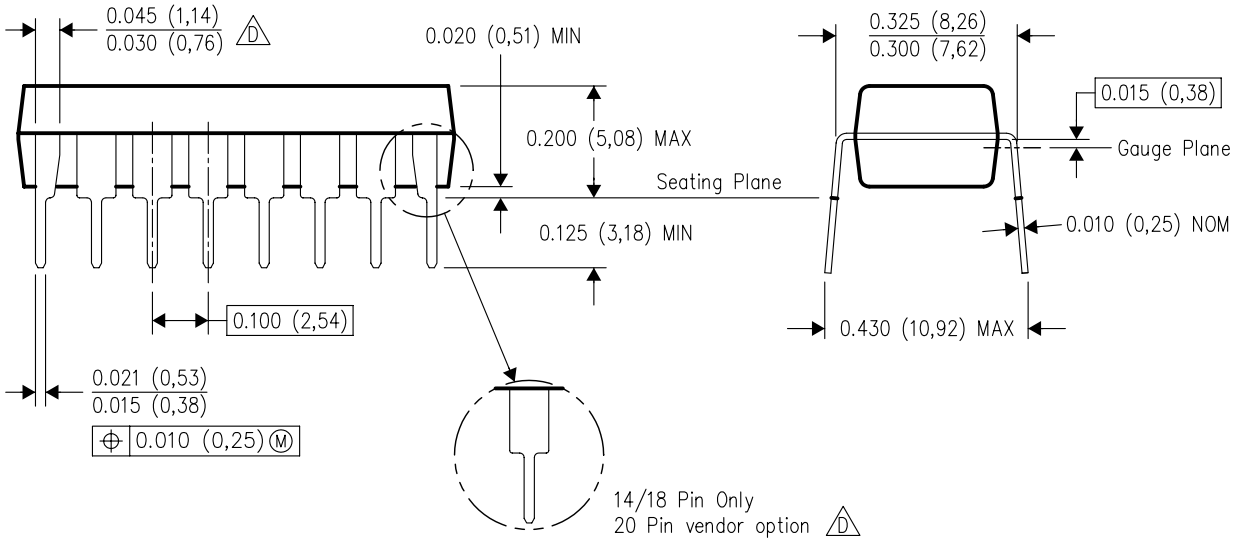
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



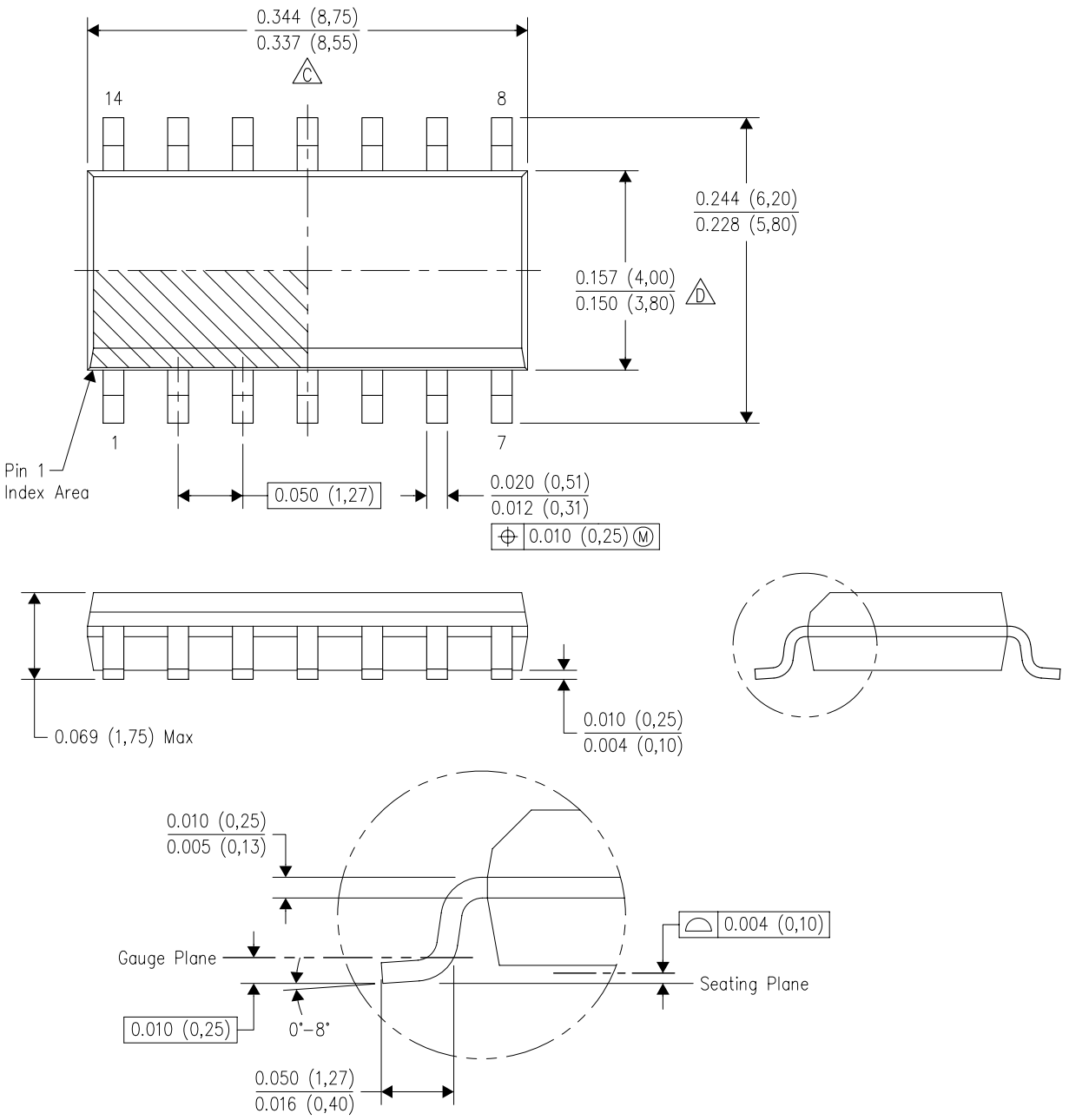

| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |




4040049/E 12/2002

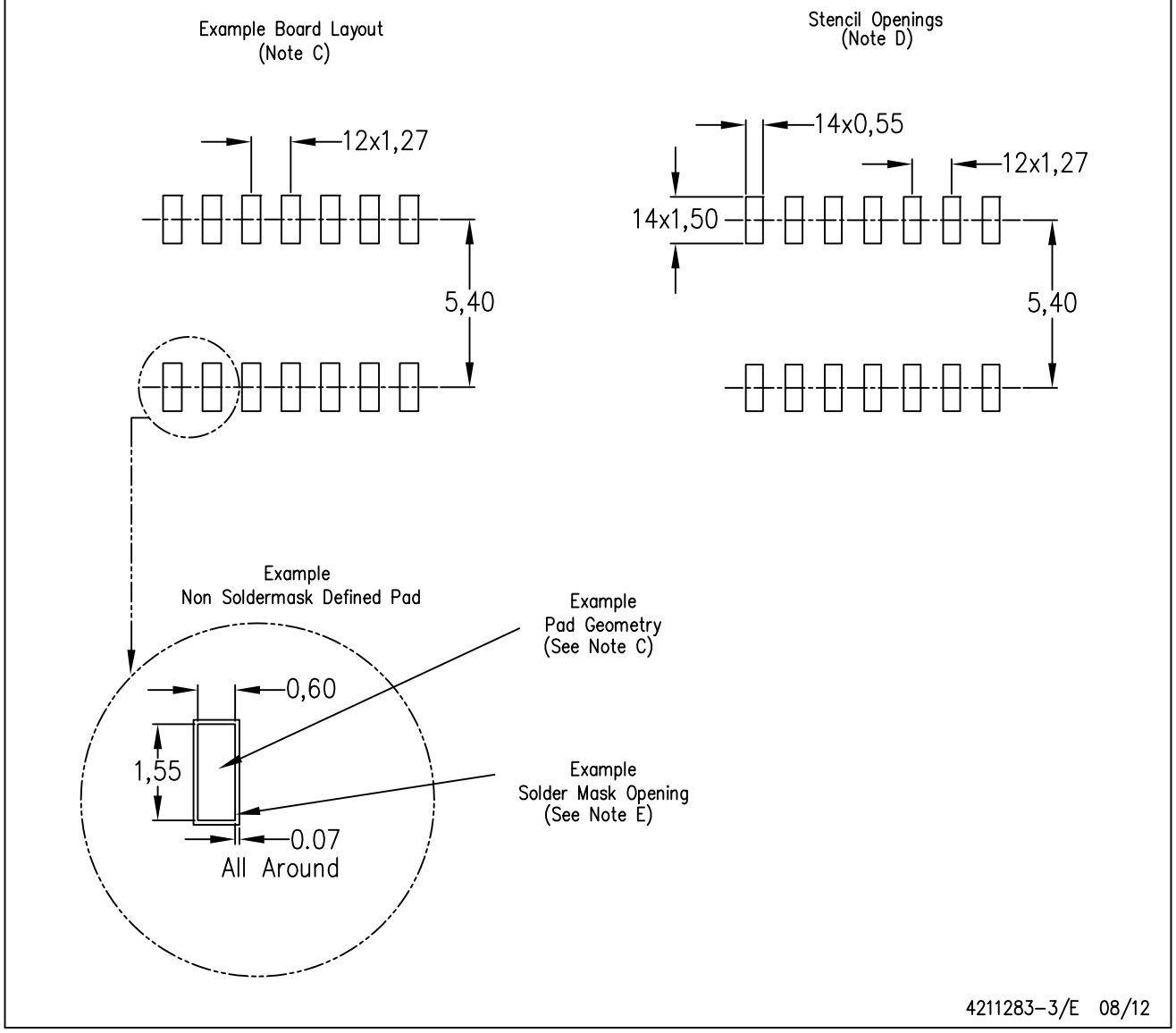
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R–PDSO–G14) PLASTIC SMALL OUTLINE



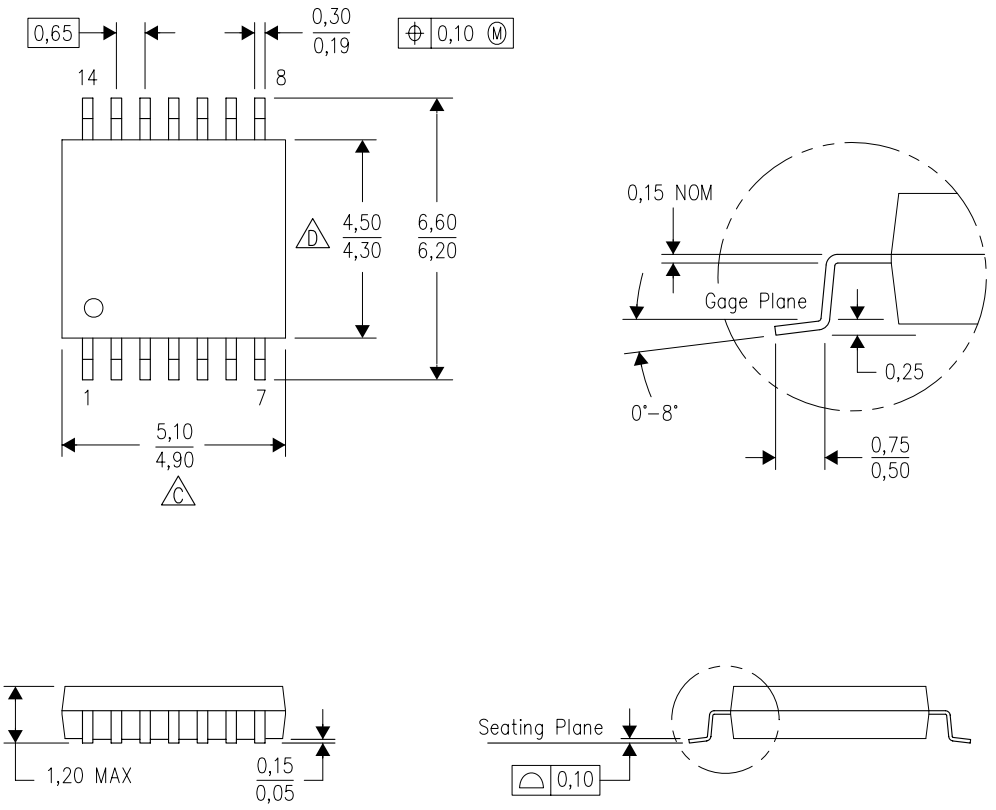

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AB.

D (R–PDSO–G14) 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.

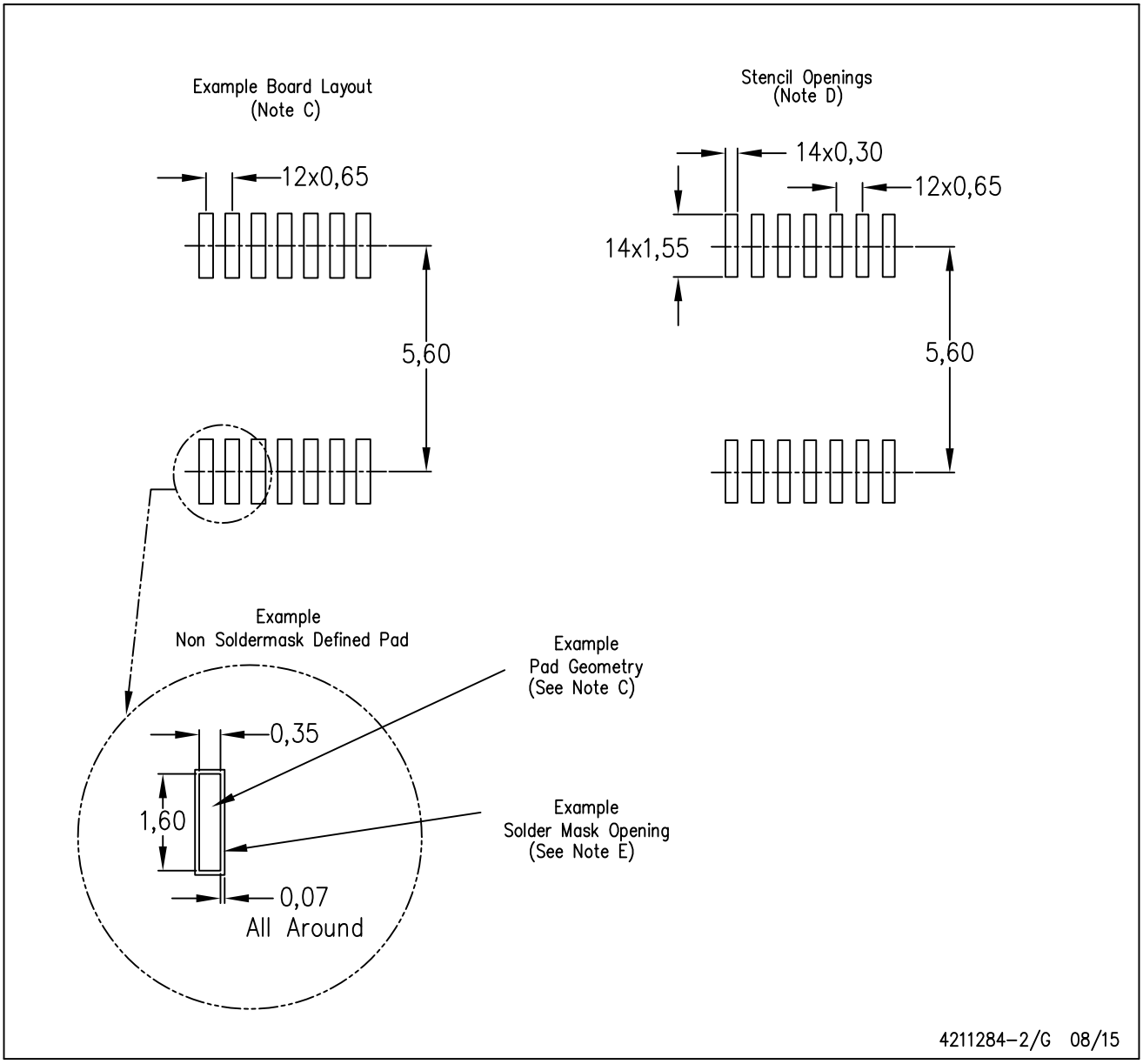
PW (R–PDSO–G14) PLASTIC SMALL OUTLINE




4040064–3/G 02/11

NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
E. Falls within JEDEC MO–153

PW (R–PDSO–G14) PLASTIC SMALL OUTLINE

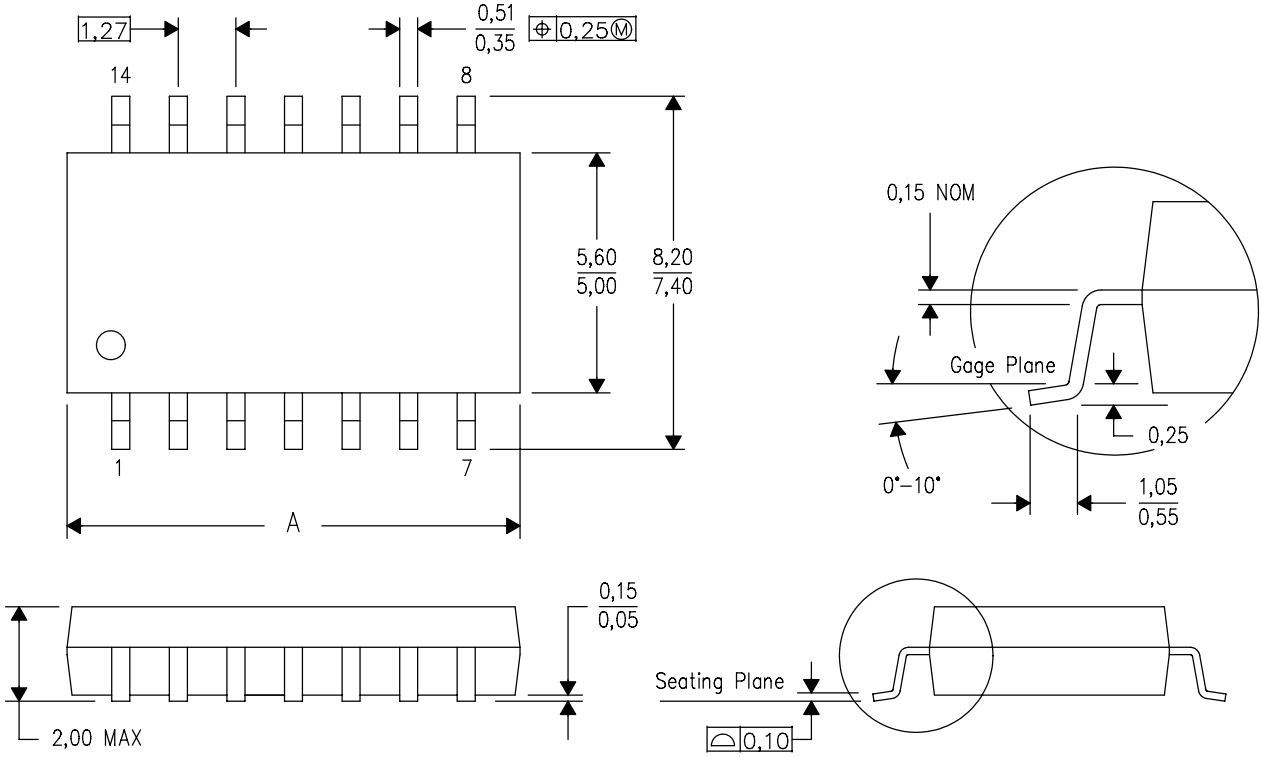



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact 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.

## MECHANICAL DATA

**NS (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14-PINS SHOWN**




| DIM \ PINS ** | 14 | 16 | 20 | 24 |
|---|---|---|---|---|
| A MAX | 10,50 | 10,50 | 12,90 | 15,30 |
| A MIN | 9,90 | 9,90 | 12,30 | 14,70 |

4040062/C 03/03

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

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