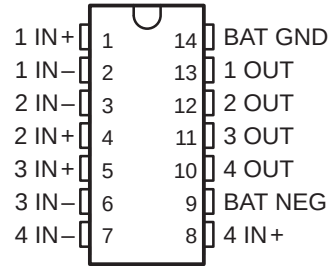


# DS3680 QUAD TELEPHONE RELAY DRIVER

SLRS014C – MARCH 1986 – REVISED SEPTEMBER 1995

- Designed for –52-V Battery Operation
- 50-mA Output Current Capability
- Input Compatible With TTL and CMOS
- High Common-Mode Input Voltage Range
- Very Low Input Current
- Fail-Safe Disconnect Feature
- Built-in Output Clamp Diode
- Direct Replacement for National DS3680 and Fairchild  $\mu$ A3680

D OR N PACKAGE  
(TOP VIEW)

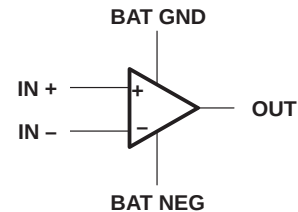


## description

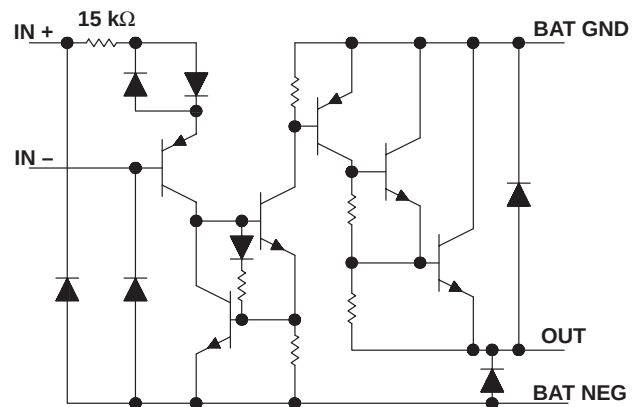
The DS3680 telephone relay driver is a monolithic integrated circuit designed to interface –48-V relay systems to TTL or other systems in telephone applications. It is capable of sourcing up to 50 mA from standard –52-V battery power. To reduce the effects of noise and IR drop between logic ground and battery ground, these drivers are designed to operate with a common-mode input range of  $\pm 20$  V referenced to battery ground. The common-mode input voltages for the four drivers can be different, so a wide range of input elements can be accommodated. The high-impedance inputs are compatible with positive TTL and CMOS levels or negative logic levels. A clamp network is included in the driver outputs to limit high-voltage transients generated by the relay coil during switching. The complementary inputs ensure that the driver output is off as a fail-safe condition when either output is open.

The DS3680 is characterized for operation from 0°C to 70°C.

## symbol (each driver)



## schematic diagram (each driver)



All resistor values shown are nominal.

# DS3680

## QUAD TELEPHONE RELAY DRIVER

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### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|                                                              |                              |
|--------------------------------------------------------------|------------------------------|
| Supply voltage range at BAT NEG, $V_{BAT-}$ (see Note 1)     | –70 V to 0.5 V               |
| Input voltage range with respect to BAT GND                  | –70 V to 20 V                |
| Input voltage range with respect to BAT NEG                  | –0.5 V to 70 V               |
| Differential input voltage, $V_{ID}$ (see Note 2)            | $\pm 20$ V                   |
| Output current, $I_O$ : Resistive load                       | –100 mA                      |
| Inductive load                                               | –50 mA                       |
| Inductive output load                                        | 5 H                          |
| Continuous total dissipation                                 | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$                  | 0°C to 70°C                  |
| Storage temperature range, $T_{stg}$                         | –65°C to 150°C               |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds | 260°C                        |

- NOTES: 1. All voltages are with respect to BAT GND, unless otherwise specified.  
2. Differential input voltages are at the noninverting input terminal IN+ with respect to the inverting input terminal IN–.

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|---------------------------------------------------|------------------------------------------|
| D       | 950 mW                                      | 7.6 mW/°C                                         | 608 mW                                   |
| N       | 1150 mW                                     | 9.2 mW/°C                                         | 736 mW                                   |

### recommended operating conditions

|                                                  | MIN              | MAX | UNIT |
|--------------------------------------------------|------------------|-----|------|
| Supply voltage, $V_{BAT-}$                       | –10              | –60 | V    |
| Input voltage, either input                      | –20 <sup>†</sup> | 20  | V    |
| High-level differential input voltage, $V_{IDH}$ | 2                | 20  | V    |
| Low-level differential input voltage, $V_{IDL}$  | –20 <sup>†</sup> | 0.8 | V    |
| Operating free-air temperature, $T_A$            | 0                | 70  | °C   |

<sup>†</sup> The algebraic convention, in which the less positive (more negative) limit is designated minimum, is used in this data sheet for input voltage levels.

### electrical characteristics over recommended operating free-air temperature range, $V_{BAT-} = -52$ V (unless otherwise noted)

| PARAMETER                                    | TEST CONDITIONS                     | MIN  | TYP <sup>‡</sup> | MAX  | UNIT          |
|----------------------------------------------|-------------------------------------|------|------------------|------|---------------|
| $I_{IH}$ High-level input current (into IN+) | $V_{ID} = 2$ V                      |      | 40               | 100  | $\mu\text{A}$ |
|                                              | $V_{ID} = 7$ V                      |      | 375              | 1000 |               |
| $I_{IL}$ Low-level input current (into IN+)  | $V_{ID} = 0.4$ V                    |      | 0.01             | 5    | $\mu\text{A}$ |
|                                              | $V_{ID} = -7$ V                     |      | –1               | –100 |               |
| $V_{O(on)}$ On-stage output voltage          | $I_O = 50$ mA, $V_{ID} = 2$ V       | –1.6 |                  | –2.1 | V             |
| $I_{O(off)}$ Off-stage output current        | $V_O = V_{BAT-}$ , $V_{ID} = 0.8$ V | –2   |                  | –100 | $\mu\text{A}$ |
|                                              | Inputs open                         | –2   |                  | –100 |               |
| $I_R$ Clamp diode reverse current            | $V_O = 0$                           |      | 2                | 100  | $\mu\text{A}$ |
| $V_{OK}$ Output clamp voltage                | $I_O = 50$ mA                       |      | 0.9              | 1.2  | V             |
|                                              | $I_O = -50$ mA, $V_{BAT-} = 0$      |      | –0.9             | –1.2 |               |
| $I_{BAT(on)}$ On-state battery current       | All drivers on                      | –2   |                  | –4.4 | mA            |
| $I_{BAT(off)}$ Off-state battery current     | All drivers off                     | –1   |                  | –100 | $\mu\text{A}$ |

<sup>‡</sup> All typical values are at  $T_A = 25^\circ\text{C}$ .



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switching characteristics  $V_{BAT-} = -52\text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER               | TEST CONDITIONS                                                                             | MIN | TYP | MAX | UNIT          |
|-------------------------|---------------------------------------------------------------------------------------------|-----|-----|-----|---------------|
| $t_{on}$ Turn-on time   | $V_{ID} = 3\text{-V pulse}$ , $R_L = 1\text{ k}\Omega$ ,<br>$L = 1\text{ H}$ , See Figure 2 |     | 1   | 10  | $\mu\text{s}$ |
| $t_{off}$ Turn-off time |                                                                                             |     | 1   | 10  | $\mu\text{s}$ |

## PARAMETER MEASUREMENT INFORMATION

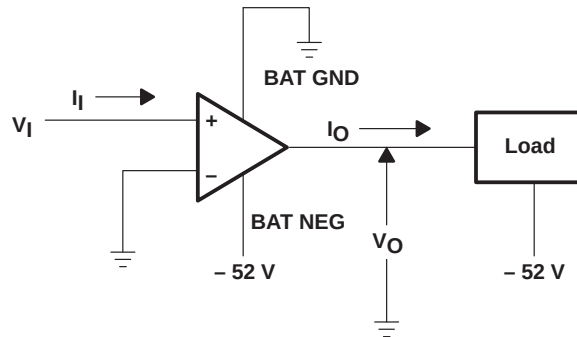


Figure 1. Generalized Test Circuit, Each Driver

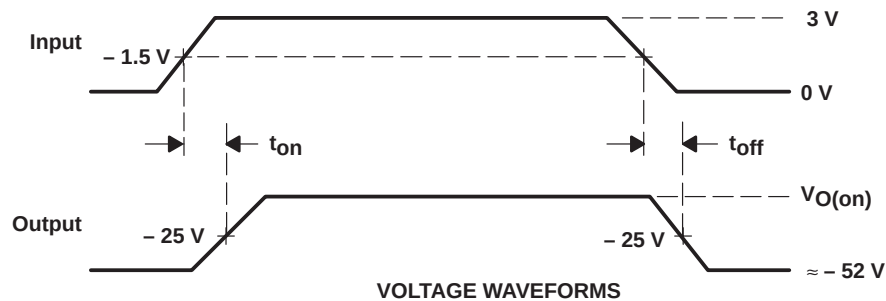
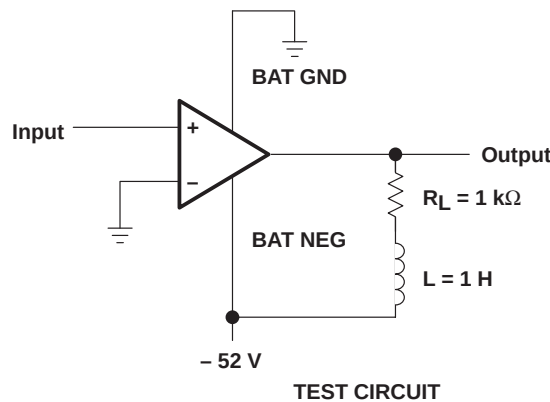


Figure 2. Test Circuit and Voltage Waveforms, Each Driver

# DS3680 QUAD TELEPHONE RELAY DRIVER

SLRS014C – MARCH 1986 – REVISED SEPTEMBER 1995

## APPLICATION INFORMATION

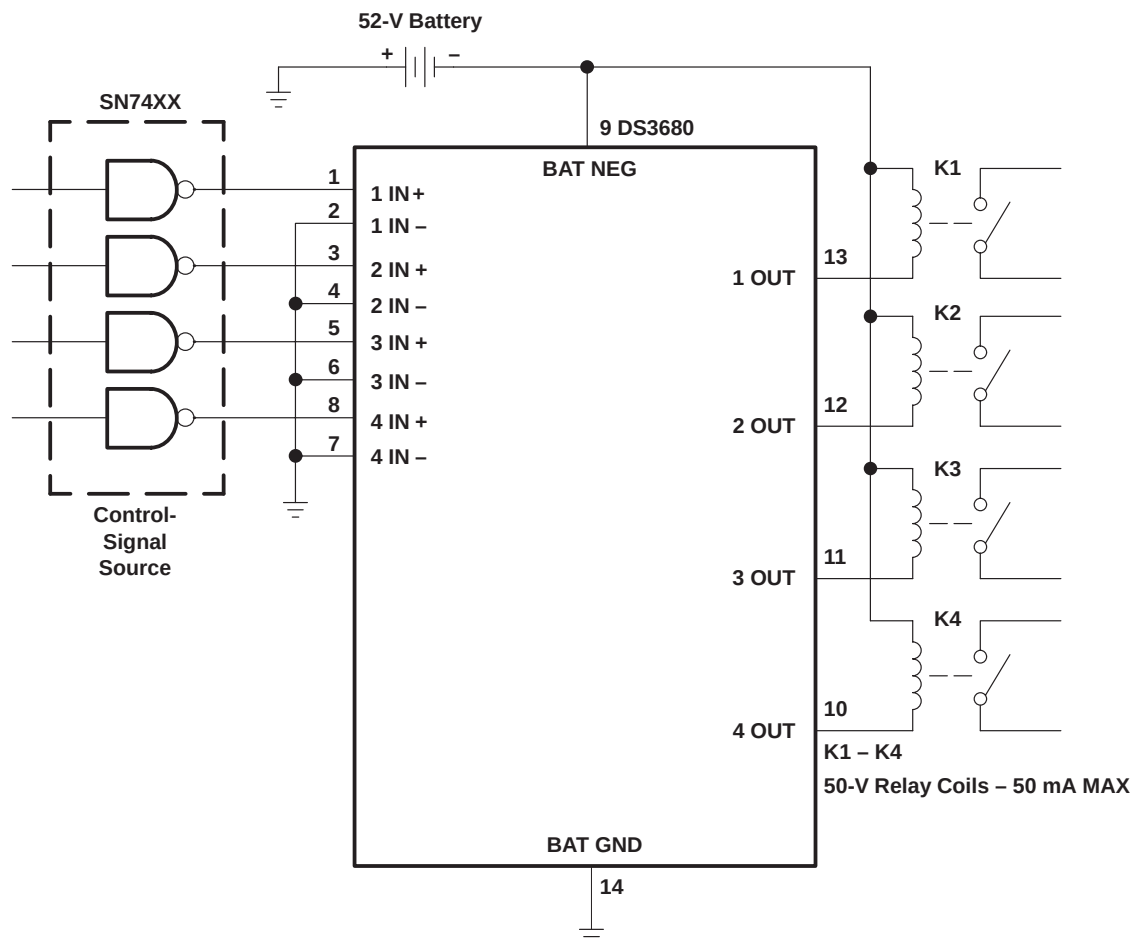


Figure 3. Relay Driver

## PACKAGING INFORMATION

| Orderable part number   | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">DS3680D</a> | Active        | Production           | SOIC (D)   14  | 50   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | DS3680              |
| DS3680D.A               | Active        | Production           | SOIC (D)   14  | 50   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | DS3680              |
| DS3680DE4               | Active        | Production           | SOIC (D)   14  | 50   TUBE             | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | 0 to 70      | DS3680              |
| <a href="#">DS3680N</a> | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | DS3680N             |
| DS3680N.A               | Active        | Production           | PDIP (N)   14  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | DS3680N             |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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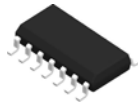
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## TUBE

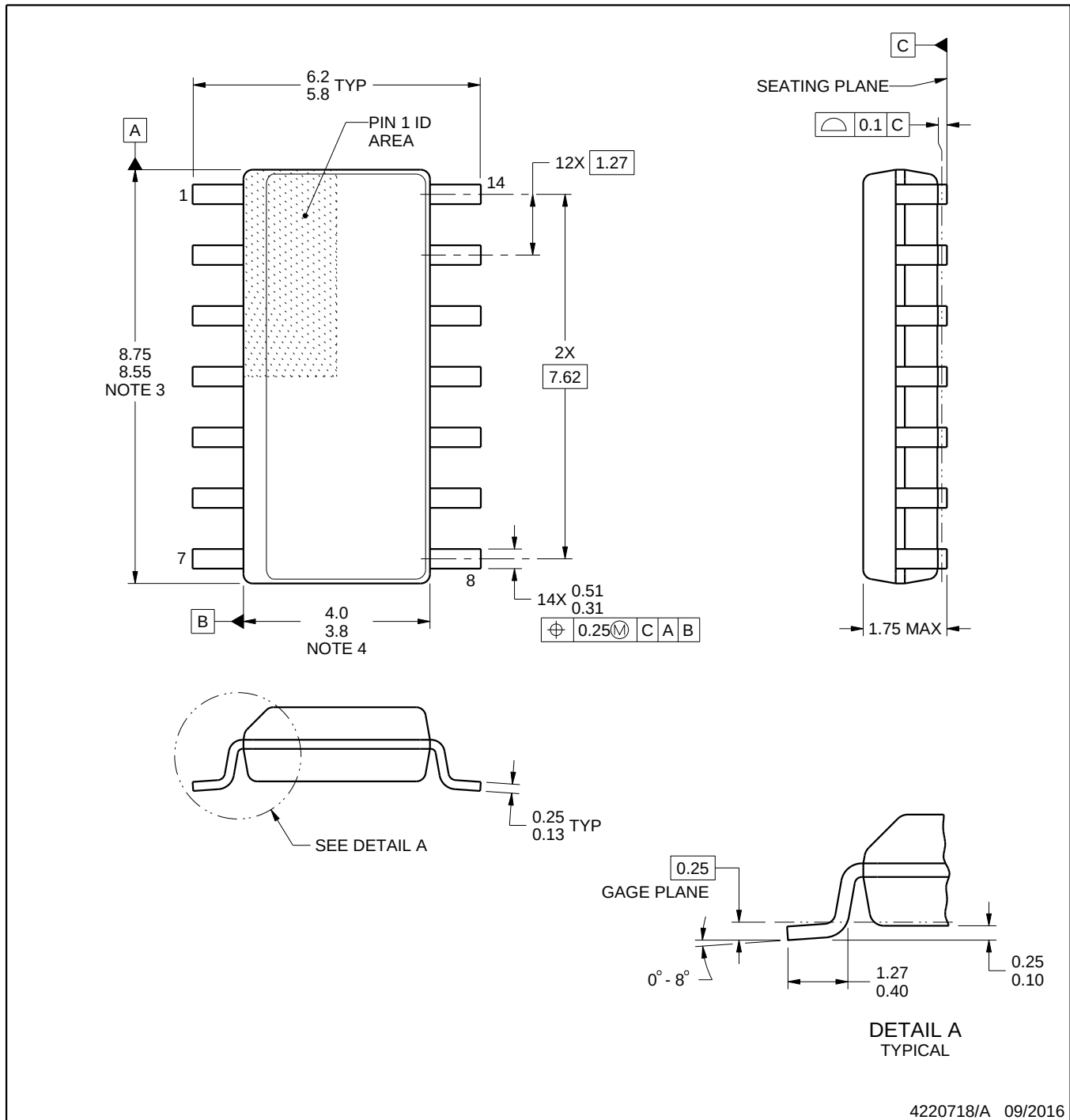


\*All dimensions are nominal

| Device    | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|-----------|--------------|--------------|------|-----|--------|--------|--------|--------|
| DS3680D   | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| DS3680D.A | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| DS3680DE4 | D            | SOIC         | 14   | 50  | 506.6  | 8      | 3940   | 4.32   |
| DS3680N   | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |
| DS3680N.A | N            | PDIP         | 14   | 25  | 506    | 13.97  | 11230  | 4.32   |

**D0014A****PACKAGE OUTLINE****SOIC - 1.75 mm max height**

SMALL OUTLINE INTEGRATED CIRCUIT



4220718/A 09/2016

**NOTES:**

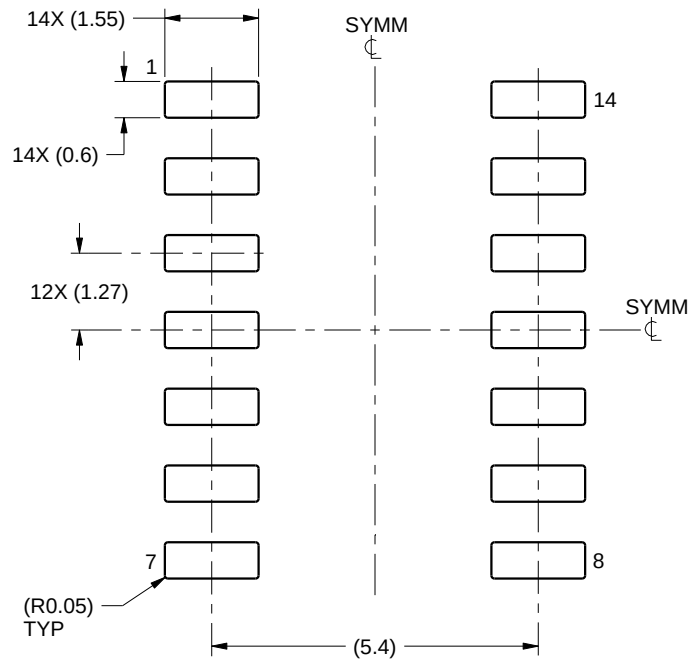
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.

# EXAMPLE BOARD LAYOUT

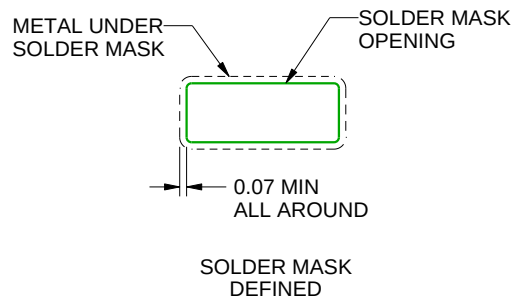
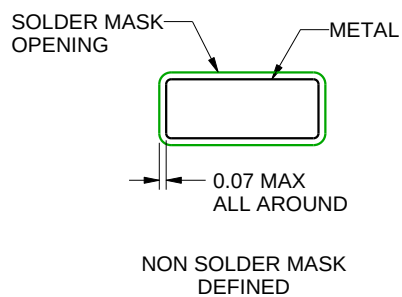
D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



LAND PATTERN EXAMPLE  
SCALE:8X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

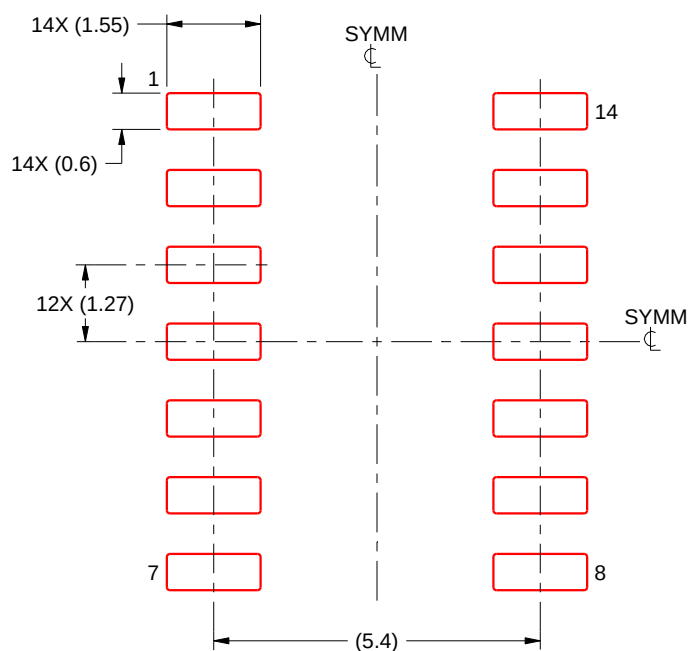


## EXAMPLE STENCIL DESIGN

D0014A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:8X

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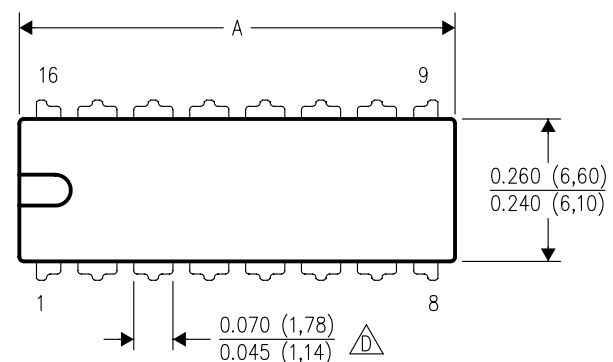
NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

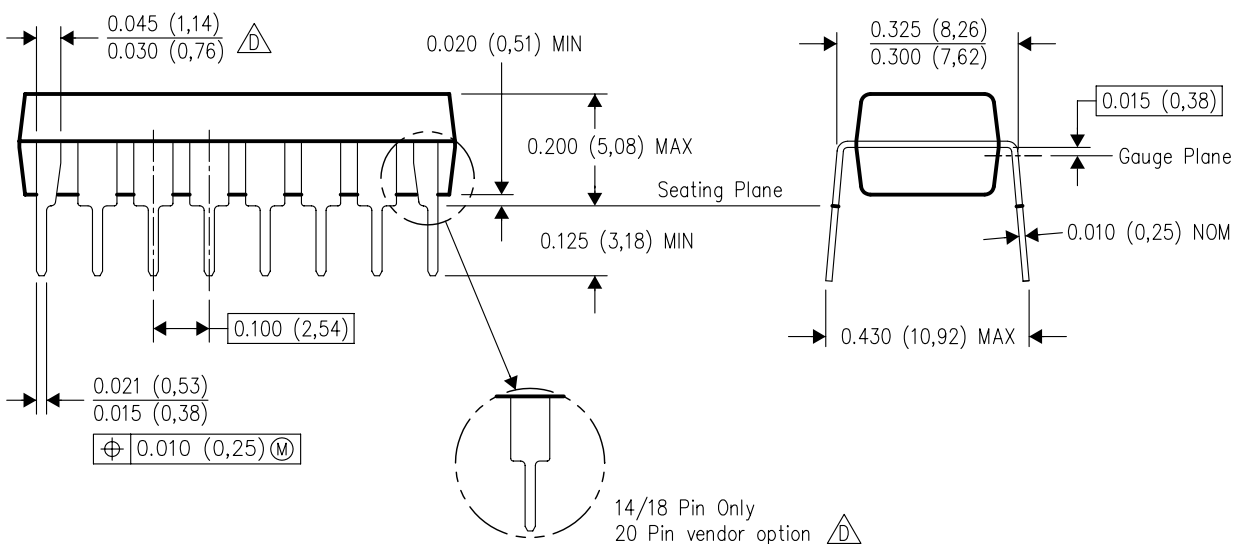
N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **<br>DIM      | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| A MAX               | 0.775<br>(19,69) | 0.775<br>(19,69) | 0.920<br>(23,37) | 1.060<br>(26,92) |
| A MIN               | 0.745<br>(18,92) | 0.745<br>(18,92) | 0.850<br>(21,59) | 0.940<br>(23,88) |
| MS-001<br>VARIATION | 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.
-  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).  
 The 20 pin end lead shoulder width is a vendor option, either half or full width.

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