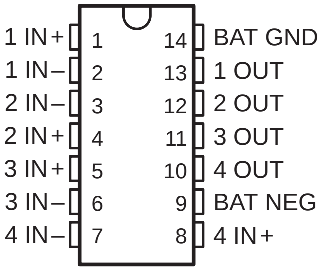
# DS3680
# QUAD TELEPHONE RELAY DRIVER

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 μA3680**

**D OR N PACKAGE**
**(TOP VIEW)**

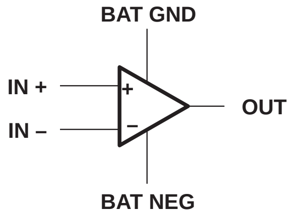


## description

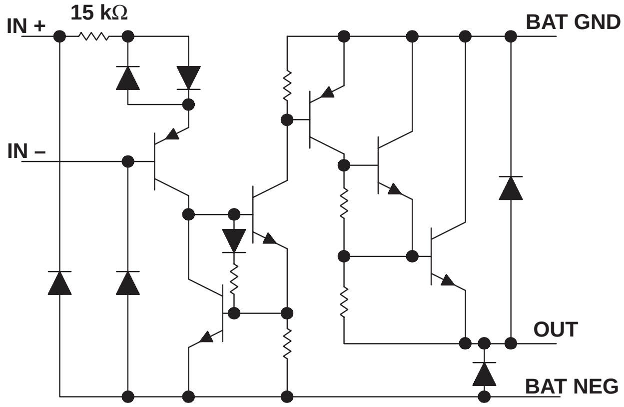
The DS3680 telephone relay driver is a monolithic integrated circuit designed to interface −48-V relay systems to TTL or other systems in telephone applications. It is capable of sourcing up to 50 mA from standard −52-V battery power. To reduce the effects of noise and IR drop between logic ground and battery ground, these drivers are designed to operate with a common-mode input range of ±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.

## 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) | | ±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 | $T_A \le 25°C$ POWER RATING | DERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ 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† | 20 | V |
| High-level differential input voltage, $V_{IDH}$ | 2 | 20 | V |
| Low-level differential input voltage, $V_{IDL}$ | –20† | 0.8 | V |
| Operating free-air temperature, $T_A$ | 0 | 70 | °C |

† 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‡ | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{IH}$ | High-level input current (into IN+) | $V_{ID} = 2$ V | | | 40 | 100 | µA |
| | | $V_{ID} = 7$ V | | | 375 | 1000 | |
| $I_{IL}$ | Low-level input current (into IN+) | $V_{ID} = 0.4$ V | | | 0.01 | 5 | µA |
| | | $V_{ID} = -7$ 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 | µA |
| | | | Inputs open | | –2 | –100 | |
| $I_R$ | Clamp diode reverse current | $V_O = 0$ | | | 2 | 100 | µA |
| $V_{OK}$ | 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 | µA |

‡ All typical values are at $T_A = 25°C$.

## switching characteristics $V_{BAT-} = -52$ V, $T_A = 25°C$

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

## PARAMETER MEASUREMENT INFORMATION

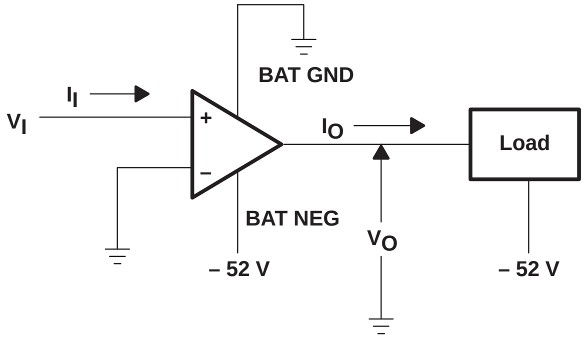
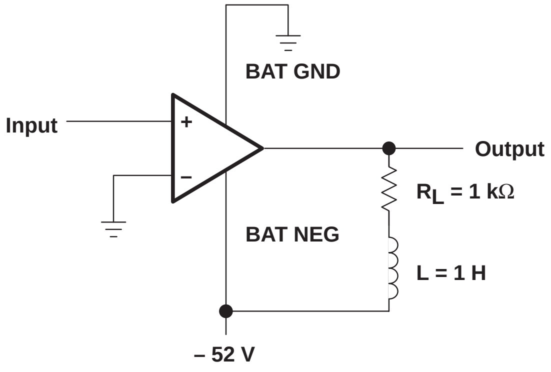
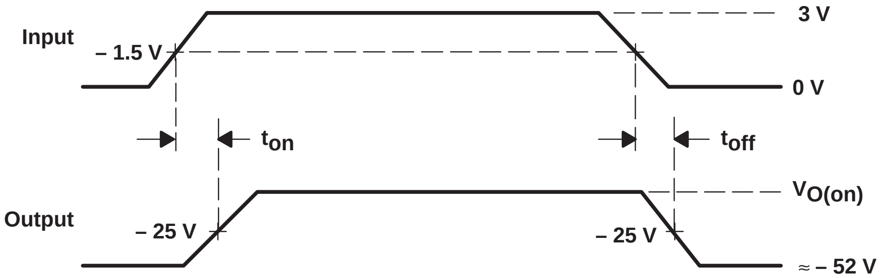


Figure 1. Generalized Test Circuit, Each Driver



TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 2. Test Circuit and Voltage Waveforms, Each Driver

## APPLICATION INFORMATION

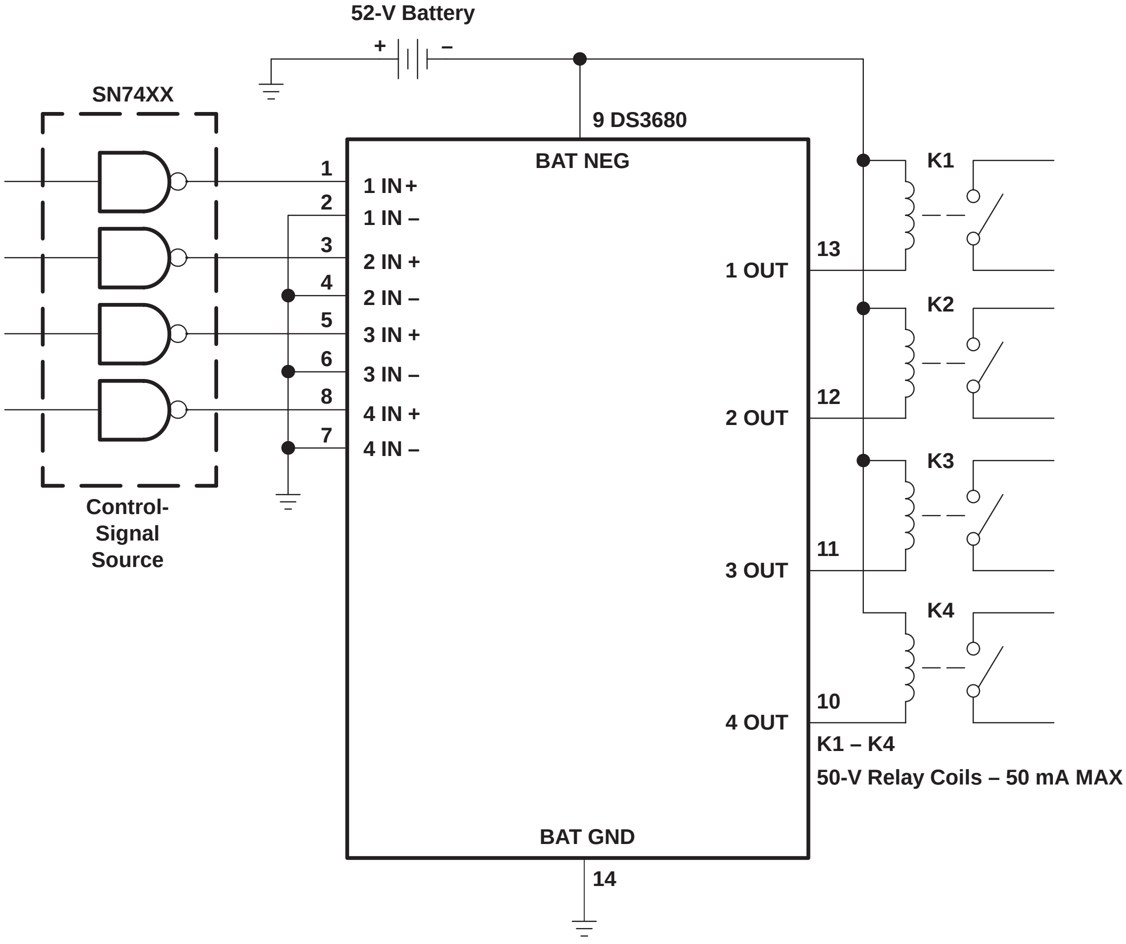


Figure 3. Relay Driver

## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| DS3680D | 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 |
| DS3680N | 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 |

(1) **Status:** For more details on status, see our product life cycle.

(2) **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.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **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.

(5) **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.

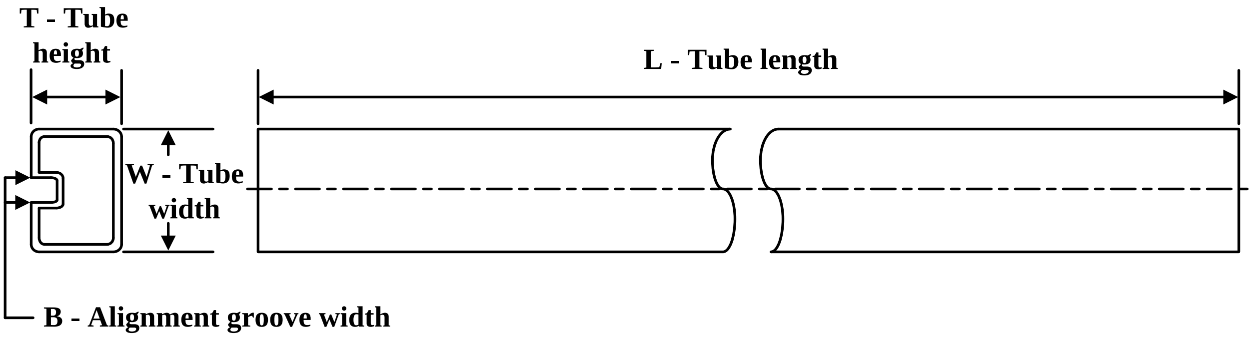
(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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.

**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.

## TUBE



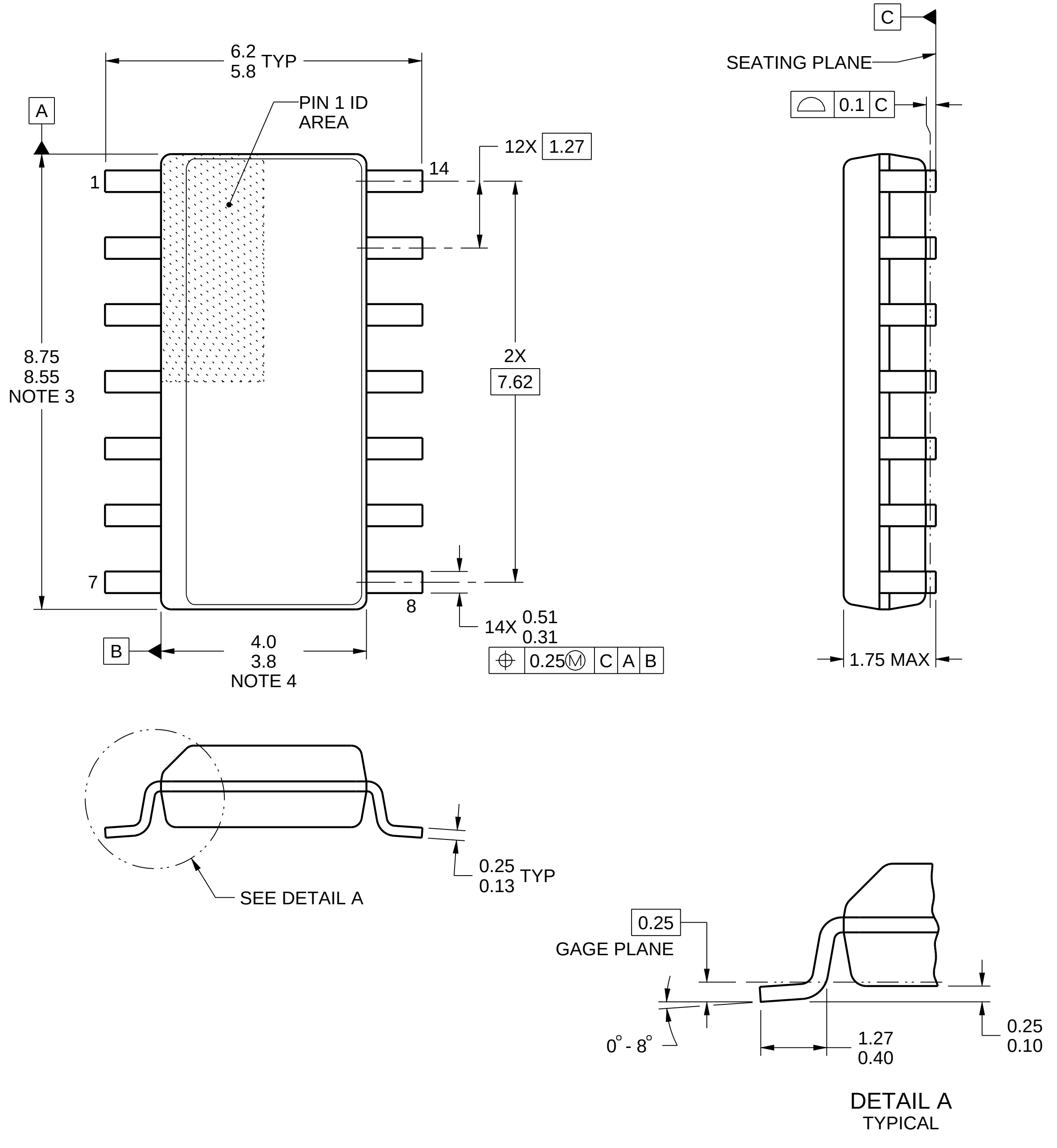
*All dimensions are nominal

| 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 |

# PACKAGE OUTLINE

## SOIC - 1.75 mm max height

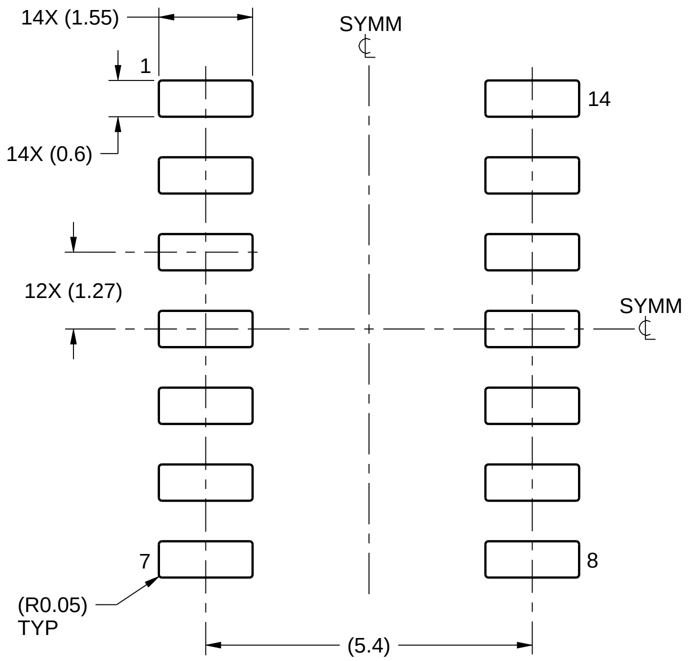
SMALL OUTLINE INTEGRATED CIRCUIT



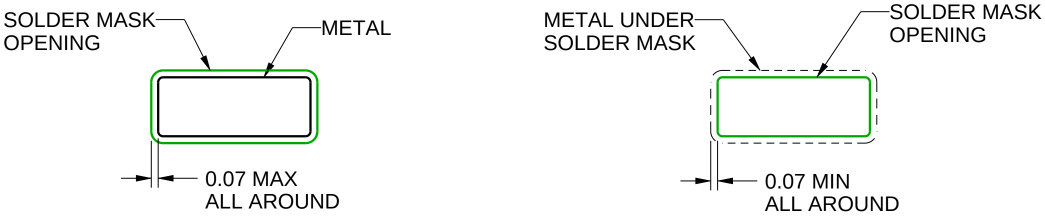
4220718/A 09/2016

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.



LAND PATTERN EXAMPLE
SCALE:8X



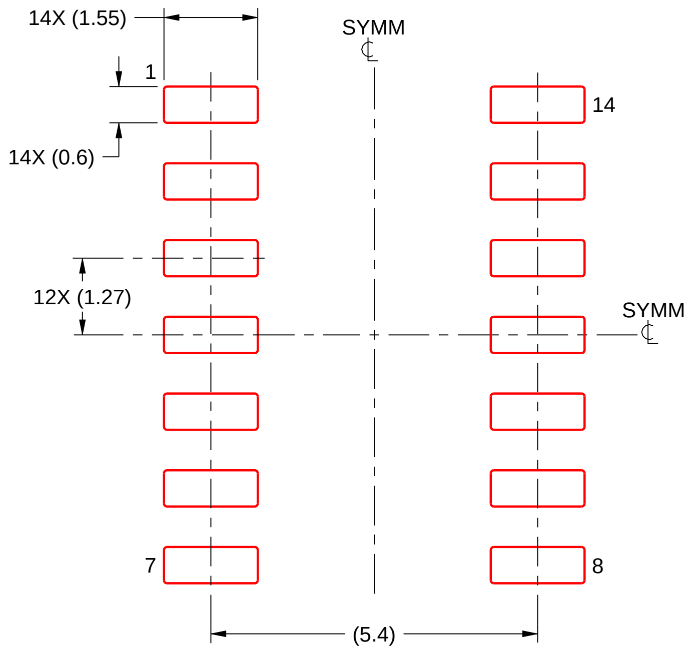
NON SOLDER MASK
DEFINED

SOLDER MASK
DEFINED

SOLDER MASK DETAILS

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.



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

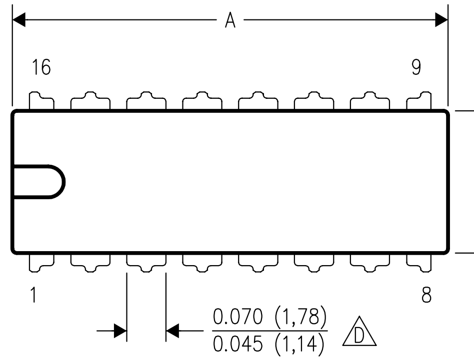
4220718/A 09/2016

NOTES: (continued)

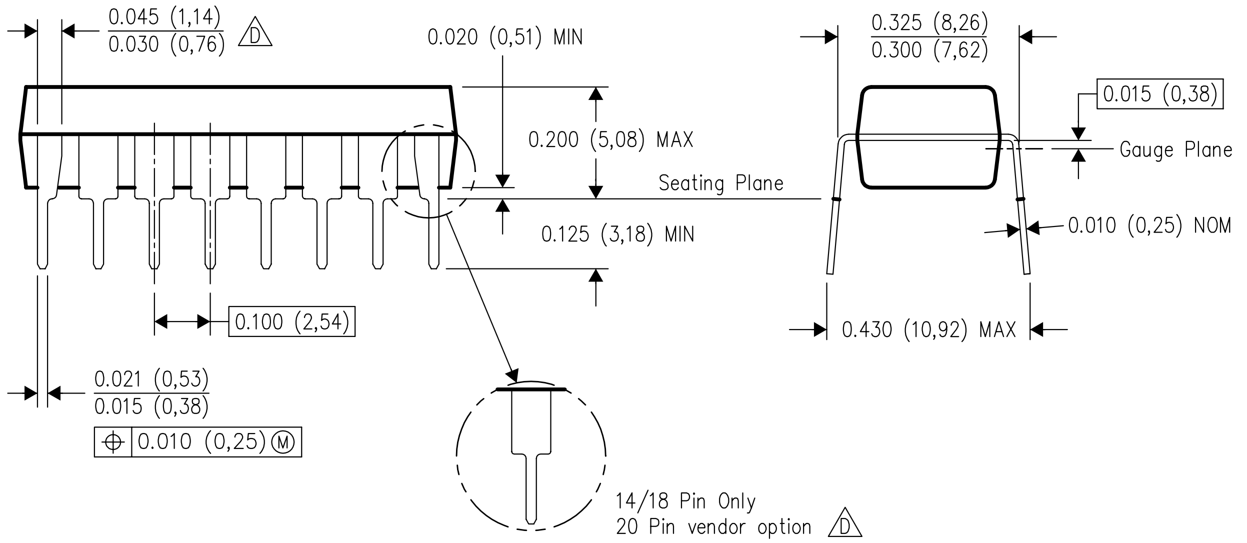
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

## N (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



| PINS ** / 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) |
| △C MS–001 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.
- △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.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale, TI’s General Quality Guidelines, or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.

Copyright © 2025, Texas Instruments Incorporated

Last updated 10/2025