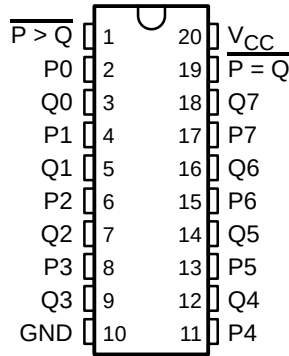


# SN54HC684, SN74HC684 8-BIT MAGNITUDE COMPARATORS

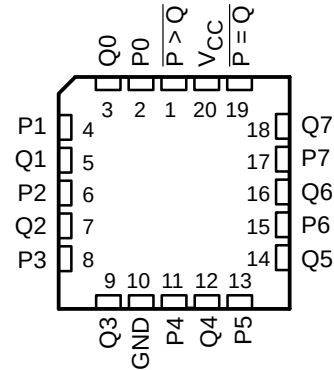
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- Wide Operating Voltage Range of 2 V to 6 V
- High-Current Outputs Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Max  $I_{CC}$
- Typical  $t_{pd} = 22$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1  $\mu$ A Max
- Compare Two 8-Bit Words

SN54HC684 . . . J OR W PACKAGE  
SN74HC684 . . . DW OR N PACKAGE  
(TOP VIEW)



SN54HC684 . . . FK PACKAGE  
(TOP VIEW)



## description/ordering information

These magnitude comparators perform comparisons of two 8-bit binary or BCD words. These devices provide  $P = Q$  and  $P > Q$  outputs.

## ORDERING INFORMATION

| $T_A$          | PACKAGE <sup>†</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------------------|---------------|-----------------------|------------------|
| -40°C to 85°C  | PDIP – N             | Tube          | SN74HC684N            | HC684            |
|                | SOIC – DW            | Tube          | SN74HC684DW           |                  |
|                |                      | Tape and reel | SN74HC684DWR          |                  |
| -55°C to 125°C | CDIP – J             | Tube          | SNJ54HC684J           | SNJ54HC684J      |
|                | CFP – W              | Tube          | SNJ54HC684W           | SNJ54HC684W      |
|                | LCCC – FK            | Tube          | SNJ54HC684FK          | SNJ54HC684FK     |

<sup>†</sup> Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

| DATA INPUTS<br>P, Q | OUTPUTS            |                    |
|---------------------|--------------------|--------------------|
|                     | $\overline{P = Q}$ | $\overline{P > Q}$ |
| $P = Q$             | L                  | H                  |
| $P > Q$             | H                  | L                  |
| $P < Q$             | H                  | H                  |

The  $P < Q$  function can be generated by applying  $\overline{P = Q}$  and  $\overline{P > Q}$  to a 2-input NAND gate.



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**TEXAS  
INSTRUMENTS**

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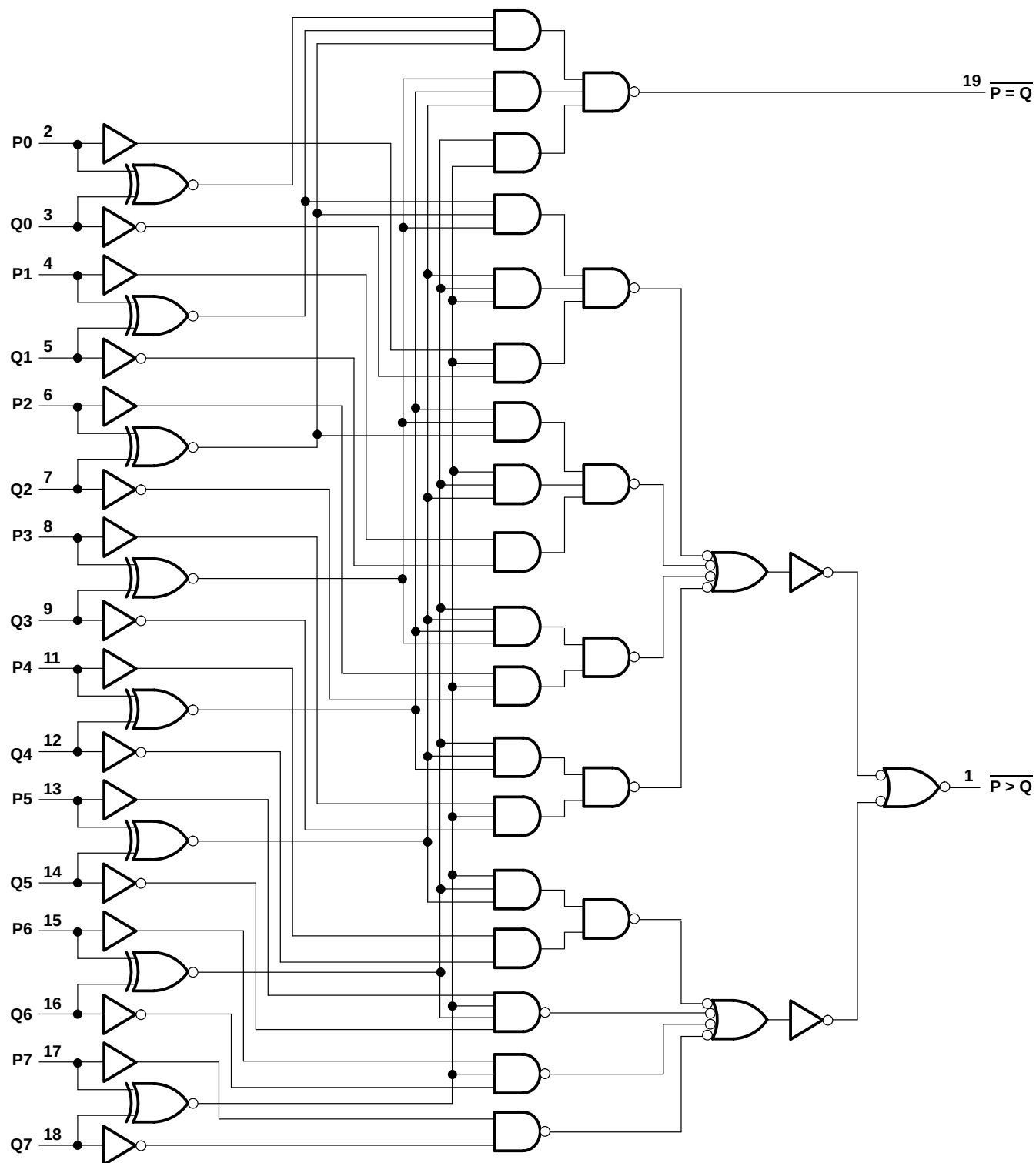
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# SN54HC684, SN74HC684

## 8-BIT MAGNITUDE COMPARATORS

SCLS340B – MARCH 1996 – REVISED MARCH 2003

### logic diagram (positive logic)



**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>**

|                                                                   |                            |
|-------------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                    | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)                           | –0.5 V to 7 V              |
| Output voltage range, $V_O$ (see Note 1)                          | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )     | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ )    | ±20 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )        | ±25 mA                     |
| Continuous current through $V_{CC}$ or GND                        | ±50 mA                     |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package | 58°C/W                     |
| N package                                                         | 69°C/W                     |
| Storage temperature range, $T_{stg}$                              | –65°C to 150°C             |

<sup>†</sup> 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.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The package thermal impedance is calculated in accordance with JESD 51-7.

**recommended operating conditions (see Note 3)**

|                 |                                        |                         | SN54HC684 |                 |     | SN74HC684 |                 |     | UNIT |
|-----------------|----------------------------------------|-------------------------|-----------|-----------------|-----|-----------|-----------------|-----|------|
|                 |                                        |                         | MIN       | NOM             | MAX | MIN       | NOM             | MAX |      |
| V <sub>CC</sub> | Supply voltage                         |                         | 2         | 5               | 6   | 2         | 5               | 6   | V    |
| V <sub>IH</sub> | High-level input voltage               | V <sub>CC</sub> = 2 V   | 1.5       |                 |     | 1.5       |                 |     | V    |
|                 |                                        | V <sub>CC</sub> = 4.5 V | 3.15      |                 |     | 3.15      |                 |     |      |
|                 |                                        | V <sub>CC</sub> = 6 V   | 4.2       |                 |     | 4.2       |                 |     |      |
| V <sub>IL</sub> | Low-level input voltage                | V <sub>CC</sub> = 2 V   | 0.5       |                 |     | 0.5       |                 |     | V    |
|                 |                                        | V <sub>CC</sub> = 4.5 V | 1.35      |                 |     | 1.35      |                 |     |      |
|                 |                                        | V <sub>CC</sub> = 6 V   | 1.8       |                 |     | 1.8       |                 |     |      |
| V <sub>I</sub>  | Input voltage                          |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| V <sub>O</sub>  | Output voltage                         |                         | 0         | V <sub>CC</sub> |     | 0         | V <sub>CC</sub> |     | V    |
| t <sub>t</sub>  | Input transition (rise and fall) times | V <sub>CC</sub> = 2 V   | 1000      |                 |     | 1000      |                 |     | ns   |
|                 |                                        | V <sub>CC</sub> = 4.5 V | 500       |                 |     | 500       |                 |     |      |
|                 |                                        | V <sub>CC</sub> = 6 V   | 400       |                 |     | 400       |                 |     |      |
| T <sub>A</sub>  | Operating free-air temperature         |                         | −55       | 125             |     | −40       | 85              |     | °C   |

NOTE 3: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

# SN54HC684, SN74HC684

## 8-BIT MAGNITUDE COMPARATORS

SCLS340B – MARCH 1996 – REVISED MARCH 2003

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

| PARAMETER       | TEST CONDITIONS                                           |                           | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | SN54HC684 |       | SN74HC684 |       | UNIT |
|-----------------|-----------------------------------------------------------|---------------------------|-----------------|-----------------------|-------|------|-----------|-------|-----------|-------|------|
|                 |                                                           |                           |                 | MIN                   | TYP   | MAX  | MIN       | MAX   | MIN       | MAX   |      |
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OH</sub> = –20 µA  | 2 V             | 1.9                   | 1.998 |      | 1.9       |       | 1.9       |       | V    |
|                 |                                                           |                           | 4.5 V           | 4.4                   | 4.499 |      | 4.4       |       | 4.4       |       |      |
|                 |                                                           |                           | 6 V             | 5.9                   | 5.999 |      | 5.9       |       | 5.9       |       |      |
|                 |                                                           | I <sub>OH</sub> = –4 mA   | 4.5 V           | 3.98                  | 4.30  |      | 3.7       |       | 3.84      |       |      |
|                 |                                                           | I <sub>OH</sub> = –5.2 mA | 6 V             | 5.48                  | 5.80  |      | 5.2       |       | 5.34      |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>       | I <sub>OL</sub> = 20 µA   | 2 V             |                       | 0.002 | 0.1  |           | 0.1   |           | 0.1   | V    |
|                 |                                                           |                           | 4.5 V           |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |                                                           |                           | 6 V             |                       | 0.001 | 0.1  |           | 0.1   |           | 0.1   |      |
|                 |                                                           | I <sub>OL</sub> = 4 mA    | 4.5 V           |                       | 0.17  | 0.26 |           | 0.4   |           | 0.33  |      |
|                 |                                                           | I <sub>OL</sub> = 5.2 mA  | 6 V             |                       | 0.15  | 0.26 |           | 0.4   |           | 0.33  |      |
| I <sub>IH</sub> | V <sub>I</sub> = V <sub>CC</sub>                          |                           | 6 V             |                       | 0.1   | 100  |           | 1000  |           | 1000  | nA   |
| I <sub>IL</sub> | V <sub>I</sub> = 0                                        |                           | 6 V             |                       | –0.1  | –100 |           | –1000 |           | –1000 | nA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0 |                           | 6 V             |                       |       | 8    |           | 160   |           | 80    | µA   |
| C <sub>i</sub>  |                                                           |                           | 2 V to 6 V      |                       | 3     | 10   |           | 10    |           | 10    | pF   |

switching characteristics over recommended operating free-air temperature range, C<sub>L</sub> = 50 pF (unless otherwise noted) (see Figure 1)

| PARAMETER       | FROM (INPUT) | TO (OUTPUT) | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | SN54HC684 |     | SN74HC684 |     | UNIT |
|-----------------|--------------|-------------|-----------------|-----------------------|-----|-----|-----------|-----|-----------|-----|------|
|                 |              |             |                 | MIN                   | TYP | MAX | MIN       | MAX | MIN       | MAX |      |
| t <sub>pd</sub> | P or Q       | Any         | 2 V             |                       | 130 | 275 |           | 413 |           | 344 | ns   |
|                 |              |             | 4.5 V           |                       | 26  | 55  |           | 88  |           | 69  |      |
|                 |              |             | 6 V             |                       | 22  | 47  |           | 70  |           | 58  |      |
| t <sub>t</sub>  |              | Any         | 2 V             |                       | 38  | 75  |           | 110 |           | 95  | ns   |
|                 |              |             | 4.5 V           |                       | 8   | 15  |           | 22  |           | 19  |      |
|                 |              |             | 6 V             |                       | 6   | 13  |           | 19  |           | 16  |      |

operating characteristics, T<sub>A</sub> = 25°C

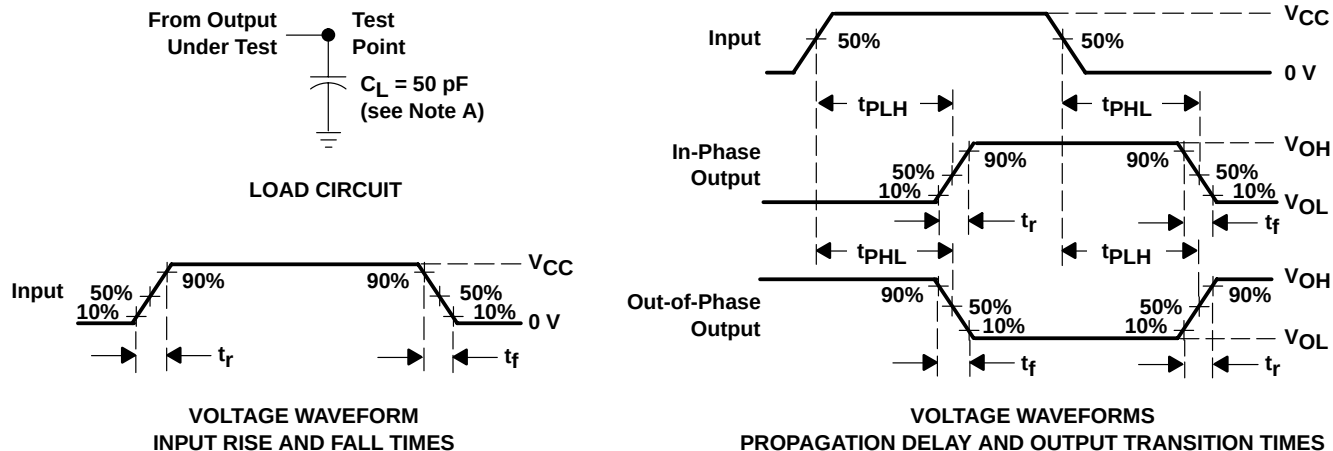
| PARAMETER       |                               | TEST CONDITIONS | TYP | UNIT |
|-----------------|-------------------------------|-----------------|-----|------|
| C <sub>pd</sub> | Power dissipation capacitance | No load         | 40  | pF   |

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## PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and test-fixture capacitance.
  - B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - C. The outputs are measured one at a time with one input transition per measurement.
  - D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74HC684DW      | ACTIVE        | SOIC         | DW                 | 20   | 25             | Green (RoHS<br>& no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | -40 to 85    | HC684                   | <a href="#">Samples</a> |
| SN74HC684N       | ACTIVE        | PDIP         | N                  | 20   | 20             | Pb-Free<br>(RoHS)          | NIPDAU                  | N / A for Pkg Type   | -40 to 85    | SN74HC684N              | <a href="#">Samples</a> |
| SN74HC684NE4     | ACTIVE        | PDIP         | N                  | 20   | 20             | Pb-Free<br>(RoHS)          | NIPDAU                  | N / A for Pkg Type   | -40 to 85    | SN74HC684N              | <a href="#">Samples</a> |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

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(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.

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## PACKAGE OPTION ADDENDUM

6-Feb-2020

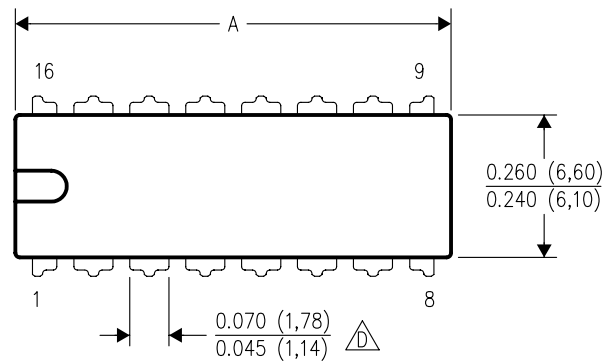
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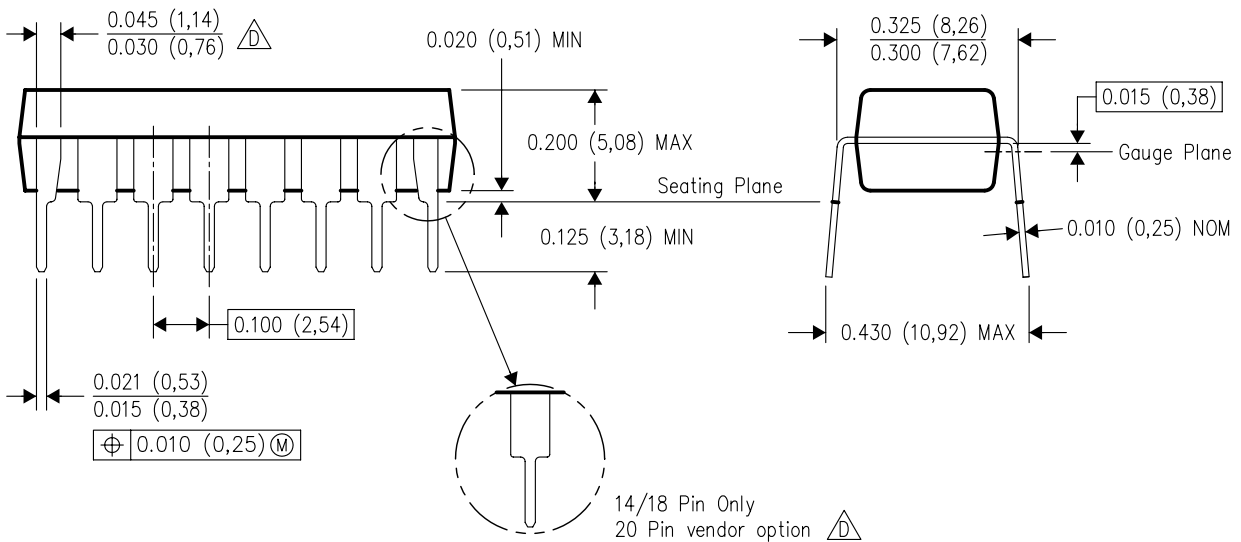
## N (R-PDIP-T\*\*)

16 PINS SHOWN

## PLASTIC DUAL-IN-LINE PACKAGE



| PINS **             | 14               | 16               | 18               | 20               |
|---------------------|------------------|------------------|------------------|------------------|
| DIM                 |                  |                  |                  |                  |
| 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               |

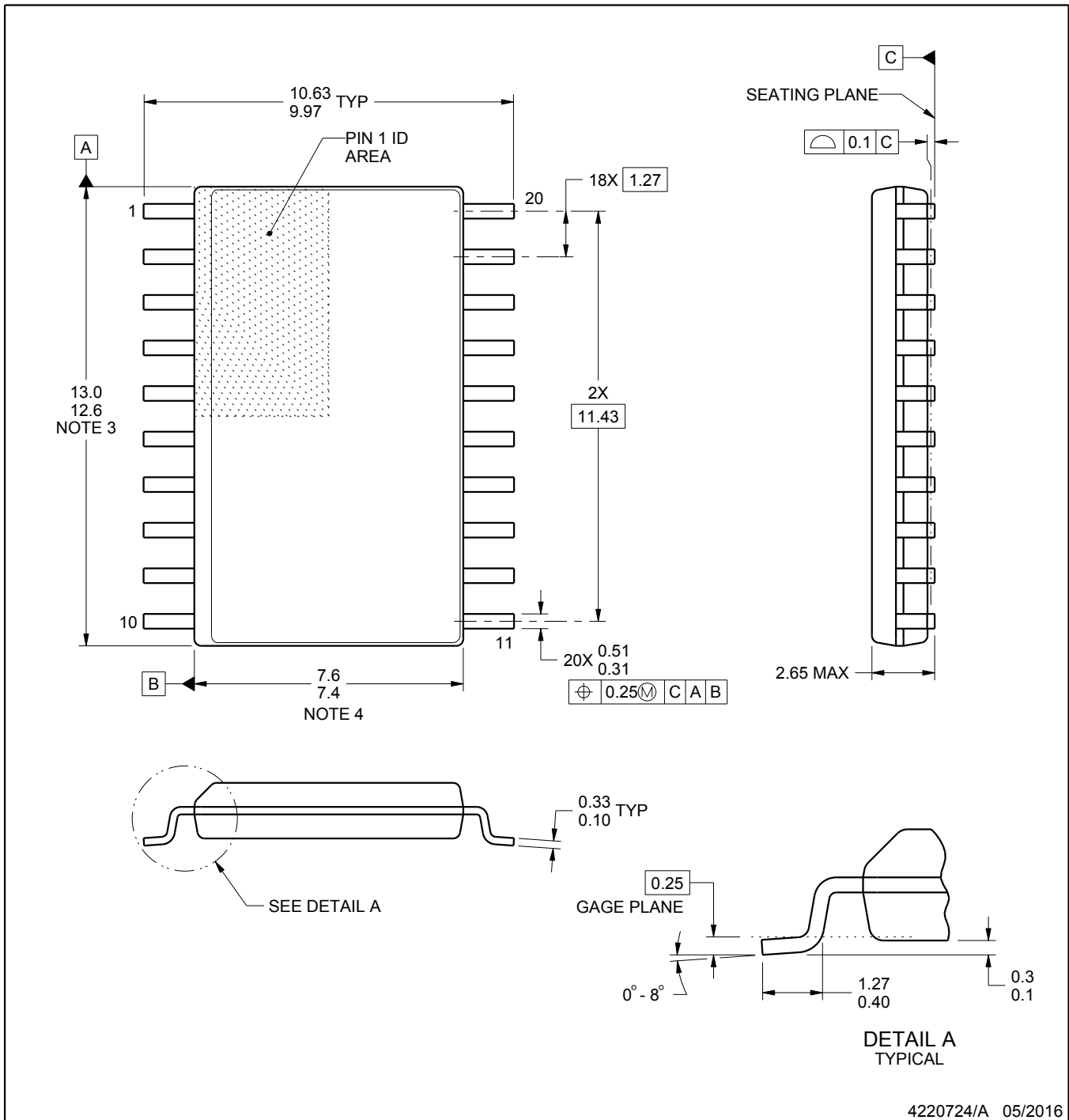
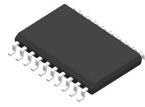


14/18 Pin Only  
20 Pin vendor option

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.





## NOTES:

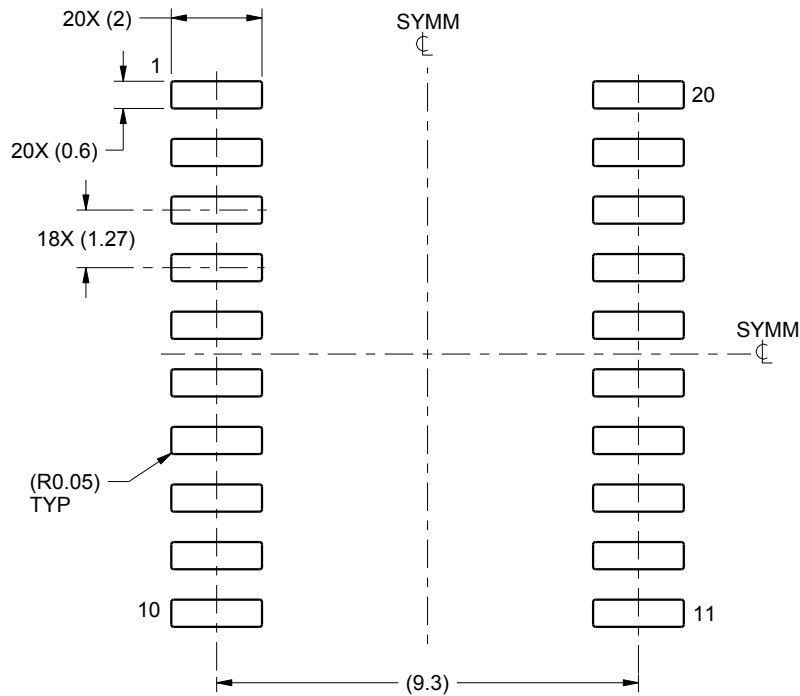
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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-013.

# EXAMPLE BOARD LAYOUT

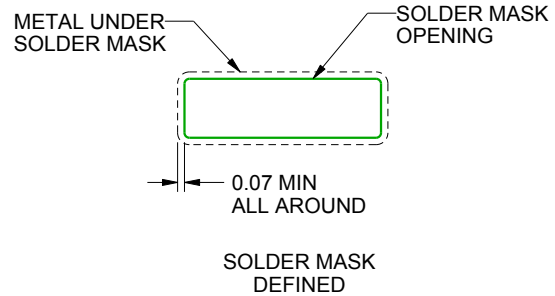
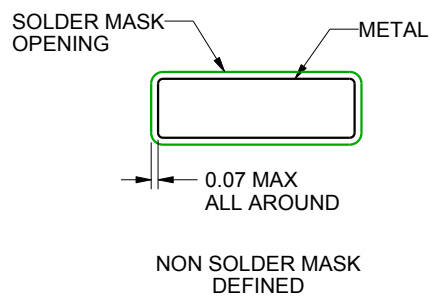
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

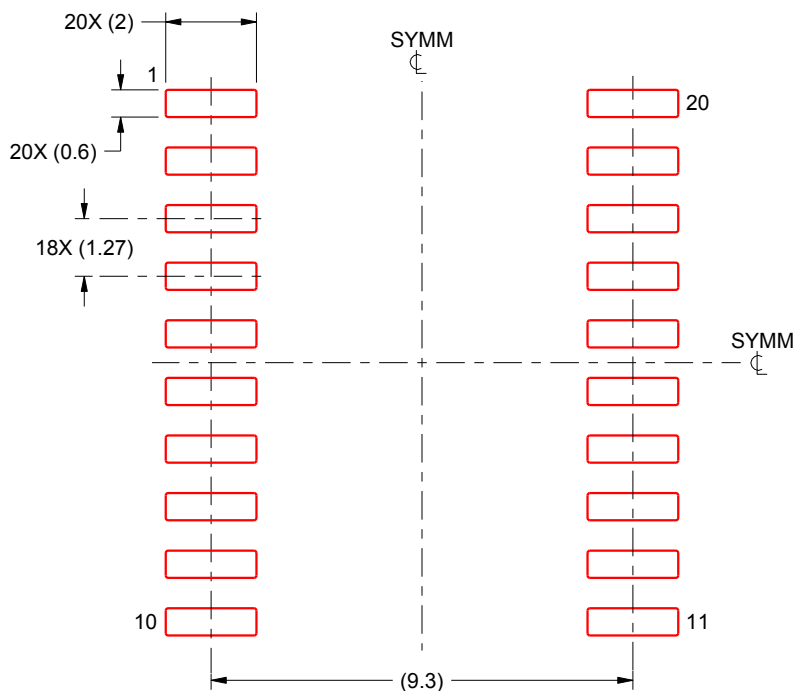
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.

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