

## SNx4HC138 3-Line To 8-Line Decoders/Demultiplexers

### 1 Features

- Targeted Specifically for High-Speed Memory Decoders and Data-Transmission Systems
- Wide Operating Voltage Range (2 V to 6 V)
- Outputs Can Drive Up To 10 LSTTL Loads
- Low Power Consumption, 80- $\mu$ A Maximum  $I_{CC}$
- Typical  $t_{pd} = 15$  ns
- $\pm 4$ -mA Output Drive at 5 V
- Low Input Current of 1- $\mu$ A Maximum
- Active Low Outputs ( Selected Output is Low)
- Incorporate Three Enable Inputs to Simplify Cascading or Data Reception

### 2 Applications

- LED Displays
- Servers
- White Goods
- Power Infrastructure
- Building Automation
- Factory Automation

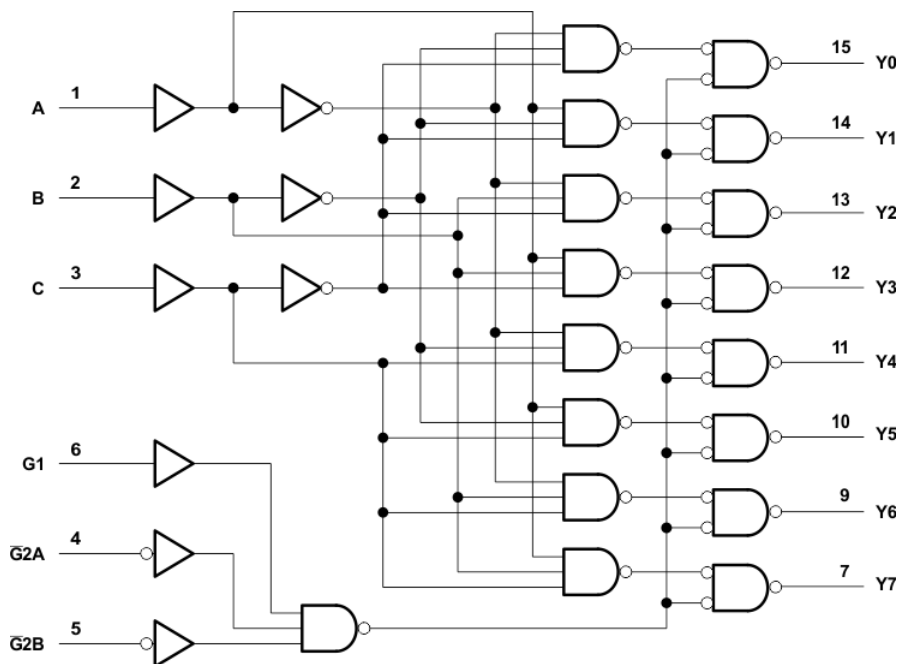
### 3 Description

The SNx4HC138 devices are designed to be used in high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high-performance memory systems, these decoders can be used to minimize the effects of system decoding. When employed with high-speed memories using a fast enable circuit, the delay times of these decoders and the enable time of the memory are usually less than the typical access time of the memory. This means that the effective system delay introduced by the decoders is negligible.

#### Device Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM)    |
|-------------|------------------------|--------------------|
| SN74HC138D  | SOIC (16)              | 9.90 mm x 3.90 mm  |
| SN74HC138DB | SSOP (16)              | 6.20 mm x 5.30 mm  |
| SN74HC138N  | PDIP (16)              | 19.32 mm x 6.35 mm |
| SN74HC138NS | SO (16)                | 10.20 mm x 5.30 mm |
| SN74HC138PW | TSSOP (16)             | 5.00 mm x 4.40 mm  |
| SN54HC138J  | CDIP (16)              | 21.34 mm x 6.92 mm |
| SN54HC138W  | CFP (16)               | 10.16 mm x 6.73 mm |
| SN54HC138FK | LCCC (20)              | 8.89 mm x 8.89 mm  |

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



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Pin numbers shown are for the D, DB, J, N, NS, PW, and W packages.

#### Functional Block Diagram



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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## 4 Revision History

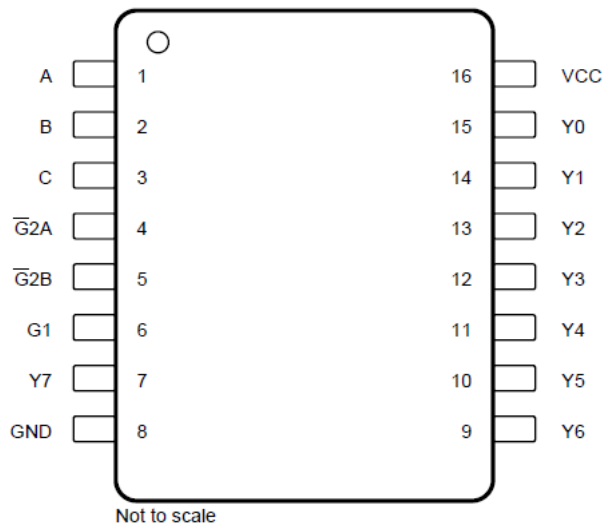
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| <b>Changes from Revision E (September 2003) to Revision F (September 2016)</b>  | <b>Page</b> |
|---|-------------|
| • Added <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section..... | 1           |
| • Deleted Ordering Information table; see POA at the end of the data sheet.....   | 1           |
| • Changed R <sub>θJA</sub> values from 73 to 87.3 (D), from 82 to 104.3 (DB), from 67 to 54.8 (N), from 64 to 91.1 (NS), and from 108 to 114.6 (PW).....  | 5           |

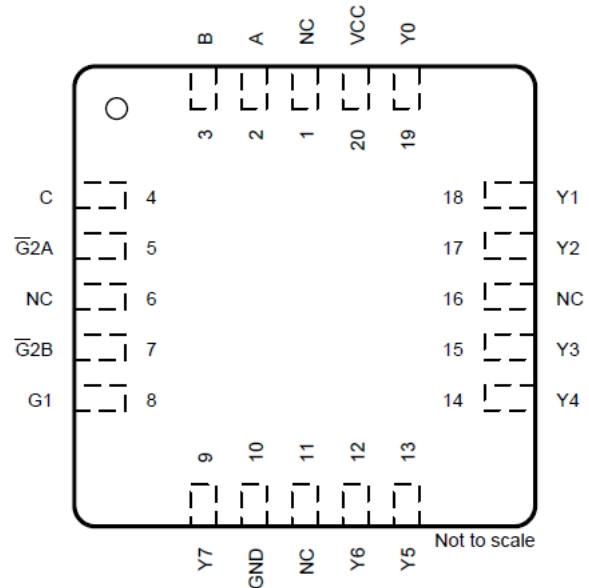
  

| <b>Changes from Revision F (September 2016) to Revision G (October 2021)</b> | <b>Page</b> |
|--|-------------|
| • Updated the ESD ratings table to fit modern data sheet standards.....      | 4           |

## 5 Pin Configuration and Functions



**SOIC, SSOP, PDIP, SO, TSSOP, CDIP, or CFP  
Package**  
**16-Pin D, DB, N, NS, PW, J or W  
Top View**



NC: No internal connection  
**LCCC Package**  
**20-Pin FK  
Top View**

## Pin Functions

| NAME             | PIN                                    |              | I/O <sup>(1)</sup> | DESCRIPTION                            |
|------------------|--|--------------|--------------------|--|
|                  | SOIC, SSOP, PDIP, SO, TSSOP, CDIP, CFP | LCCC         |                    |  |
| A                | 1                                      | 2            | I                  | Select input A (least significant bit) |
| B                | 2                                      | 3            | I                  | Select input B                         |
| C                | 3                                      | 4            | I                  | Select input C (most significant bit)  |
| $\overline{G2A}$ | 4                                      | 5            | I                  | Active low enable A                    |
| $\overline{G2B}$ | 5                                      | 7            | I                  | Active low enable B                    |
| G1               | 6                                      | 8            | I                  | Active high enable                     |
| GND              | 8                                      | 10           | —                  | Ground                                 |
| NC               | —                                      | 1, 6, 11, 16 | —                  | No internal connection                 |
| V <sub>CC</sub>  | 16                                     | 20           | —                  | Supply voltage                         |
| Y0               | 15                                     | 19           | O                  | Output 0 (least significant bit)       |
| Y1               | 14                                     | 18           | O                  | Output 1                               |
| Y2               | 13                                     | 17           | O                  | Output 2                               |
| Y3               | 12                                     | 15           | O                  | Output 3                               |
| Y4               | 11                                     | 14           | O                  | Output 4                               |
| Y5               | 10                                     | 13           | O                  | Output 5                               |
| Y6               | 9                                      | 12           | O                  | Output 6                               |
| Y7               | 7                                      | 9            | O                  | Output 7 (most significant bit)        |

(1) Signal Types: I = Input, O = Output, I/O = Input or Output.

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

|                  |   | MIN  | MAX | UNIT      |
|------------------|---|--|-----|-----------|
| V <sub>CC</sub>  | Supply voltage range                              | −0.5   | 7   | V         |
| I <sub>IK</sub>  | Input clamp current <sup>(2)</sup>                | V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>CC</sub> |     | ±20<br>mA |
| I <sub>OK</sub>  | Output clamp current <sup>(2)</sup>               | V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub> |     | ±20<br>mA |
| I <sub>O</sub>   | Continuous output current                         | V <sub>O</sub> = 0 to V <sub>CC</sub>                  |     | ±25<br>mA |
|                  | Continuous current through V <sub>CC</sub> or GND |  |     | ±50<br>mA |
| T <sub>J</sub>   | Junction temperature                              |  |     | 150<br>°C |
| T <sub>stg</sub> | Storage temperature                               | −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) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### 6.2 ESD Ratings: SN74HC138

|                    |                         | VALUE   | UNIT  |
|--------------------|-------------------------|---|-------|
| V <sub>(ESD)</sub> | Electrostatic discharge | Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>     | ±2000 |
|                    |                         | Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup> | ±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)<sup>(1)</sup>

|                 |   | MIN                     | NOM  | MAX             | UNIT |
|-----------------|---|-------------------------|------|-----------------|------|
| V <sub>CC</sub> | Supply voltage                          | 2                       | 5    | 6               | V    |
| V <sub>IH</sub> | High-level input voltage                | V <sub>CC</sub> = 2 V   | 1.5  |                 | V    |
|                 |   | V <sub>CC</sub> = 4.5 V | 3.15 |                 |      |
|                 |   | V <sub>CC</sub> = 6 V   | 4.2  |                 |      |
| V <sub>IL</sub> | Low-level input voltage                 | V <sub>CC</sub> = 2 V   |      | 0.5             | V    |
|                 |   | V <sub>CC</sub> = 4.5 V |      | 1.35            |      |
|                 |   | V <sub>CC</sub> = 6 V   |      | 1.8             |      |
| V <sub>I</sub>  | Input voltage                           | 0                       |      | V <sub>CC</sub> | V    |
| V <sub>O</sub>  | Output voltage                          | 0                       |      | V <sub>CC</sub> | V    |
| Δt/Δv           | Input transition rise or fall time      | V <sub>CC</sub> = 2 V   |      | 1000            | ns   |
|                 |   | V <sub>CC</sub> = 4.5 V |      | 500             |      |
|                 |   | V <sub>CC</sub> = 6 V   |      | 400             |      |
| C <sub>pd</sub> | Power dissipation capacitance (no load) |                         | 85   |                 | pF   |
| T <sub>A</sub>  | Operating free-air temperature          | SN54HC138               | −55  | 125             | °C   |
|                 |   | SN74HC138               | −40  | 85              |      |

(1) All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. See TI application report, *Implications of Slow or Floating CMOS Inputs* (SCBA004).

## 6.4 Thermal Information: SN74HC138

| THERMAL METRIC <sup>(1)</sup> | SN74HC138                                    |           |          |         |            | UNIT  |      |
|-------------------------------|--|-----------|----------|---------|------------|-------|------|
|                               | D (SOIC)                                     | DB (SSOP) | N (PDIP) | NS (SO) | PW (TSSOP) |       |      |
|                               | 16 PINS                                      | 16 PINS   | 16 PINS  | 16 PINS | 16 PINS    |       |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | 87.3      | 104.3    | 54.8    | 91.1       | 141.6 | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 45.8      | 54.7     | 42.1    | 49.5       | 49.5  | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | 44.8      | 54.9     | 34.8    | 51.5       | 59.6  | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 14.2      | 17.7     | 27      | 17.8       | 6.9   | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 44.5      | 54.4     | 34.7    | 51.2       | 59.1  | °C/W |

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

## 6.5 Thermal Information: SN54HC138

| THERMAL METRIC <sup>(1)</sup> | SN54HC138 <sup>(2)</sup>                     |         |           | UNIT |      |
|-------------------------------|--|---------|-----------|------|------|
|                               | J (CDIP)                                     | W (CFP) | FK (LCCC) |      |      |
|                               | 16 PINS                                      | 16 PINS | 20 PINS   |      |      |
| R <sub>θJA</sub>              | Junction-to-ambient thermal resistance       | —       | —         | —    | °C/W |
| R <sub>θJC(top)</sub>         | Junction-to-case (top) thermal resistance    | 45.4    | 68.1      | 49   | °C/W |
| R <sub>θJB</sub>              | Junction-to-board thermal resistance         | —       | 118.4     | 47.7 | °C/W |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | —       | —         | 7.2  | °C/W |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 62.5    | —         | —    | °C/W |
| R <sub>θJC(bot)</sub>         | Junction-to-case (bottom) thermal resistance | 17.7    | 9         | —    | °C/W |

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

(2) R<sub>θJC</sub> follows MIL-STD-883, and R<sub>θJB</sub> follows JESD51.

## 6.6 Electrical Characteristics

T<sub>A</sub> = 25°C (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS  |  | MIN                     | TYP   | MAX   | UNIT |
|-----------------|--|--|-------------------------|-------|-------|------|
| V <sub>OH</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                              | I <sub>OH</sub> = -20 μA                         | V <sub>CC</sub> = 2 V   | 1.9   | 1.998 | V    |
|                 |  |  | V <sub>CC</sub> = 4.5 V | 4.4   | 4.499 |      |
|                 |  |  | V <sub>CC</sub> = 6 V   | 5.9   | 5.999 |      |
|                 |  | I <sub>OH</sub> = -4 mA, V <sub>CC</sub> = 4.5 V | 3.98                    | 4.3   |       |      |
|                 |  | I <sub>OH</sub> = -5.2 mA, V <sub>CC</sub> = 6 V | 5.48                    | 5.8   |       |      |
| V <sub>OL</sub> | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>                              | I <sub>OL</sub> = 20 μA                          | V <sub>CC</sub> = 2 V   | 0.002 | 0.1   | V    |
|                 |  |  | V <sub>CC</sub> = 4.5 V | 0.001 | 0.1   |      |
|                 |  |  | V <sub>CC</sub> = 6 V   | 0.001 | 0.1   |      |
|                 |  | I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = 4.5 V  | 0.17                    | 0.26  |       |      |
|                 |  | I <sub>OL</sub> = 5.2 mA, V <sub>CC</sub> = 6 V  | 0.15                    | 0.26  |       |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or 0, V <sub>CC</sub> = 6 V                     |  |                         | ±0.1  | ±100  | nA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0, V <sub>CC</sub> = 6 V |  |                         |       | 8     | μA   |
| C <sub>i</sub>  | V <sub>CC</sub> = 2 V to 6 V   |  |                         | 3     | 10    | pF   |

## 6.7 Electrical Characteristics: SN74HC138

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

| PARAMETER | TEST CONDITIONS                              |                                  | MIN              | TYP  | MAX        | UNIT    |
|-----------|--|----------------------------------|------------------|------|------------|---------|
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$                   | $I_{OH} = -20 \mu A$             | $V_{CC} = 2 V$   |      | 1.9        | V       |
|           |  |                                  | $V_{CC} = 4.5 V$ |      | 4.4        |         |
|           |  |                                  | $V_{CC} = 6 V$   |      | 5.9        |         |
|           |  | $I_{OH} = -4 mA, V_{CC} = 4.5 V$ |                  |      | 3.84       |         |
|           |  | $I_{OH} = -5.2 mA, V_{CC} = 6 V$ |                  | 5.34 |            |         |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$                   | $I_{OL} = 20 \mu A$              | $V_{CC} = 2 V$   |      | 0.1        | V       |
|           |  |                                  | $V_{CC} = 4.5 V$ |      | 0.1        |         |
|           |  |                                  | $V_{CC} = 6 V$   |      | 0.1        |         |
|           |  | $I_{OL} = 4 mA, V_{CC} = 4.5 V$  |                  |      | 0.33       |         |
|           |  | $I_{OL} = 5.2 mA, V_{CC} = 6 V$  |                  | 0.33 |            |         |
| $I_I$     | $V_I = V_{CC}$ or 0, $V_{CC} = 6 V$          |                                  |                  |      | $\pm 1000$ | nA      |
| $I_{CC}$  | $V_I = V_{CC}$ or 0, $I_O = 0, V_{CC} = 6 V$ |                                  |                  |      | 80         | $\mu A$ |
| $C_i$     | $V_{CC} = 2 V$ to $6 V$                      |                                  |                  |      | 10         | pF      |

## 6.8 Electrical Characteristics: SN54HC138

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

| PARAMETER | TEST CONDITIONS                              |                                  | $V_{CC}$         | MIN | TYP        | MAX     | UNIT |
|-----------|--|----------------------------------|------------------|-----|------------|---------|------|
| $V_{OH}$  | $V_I = V_{IH}$ or $V_{IL}$                   | $I_{OH} = -20 \mu A$             | $V_{CC} = 2 V$   |     | 1.9        | V       |      |
|           |  |                                  | $V_{CC} = 4.5 V$ |     | 4.4        |         |      |
|           |  |                                  | $V_{CC} = 6 V$   |     | 5.9        |         |      |
|           |  | $I_{OH} = -4 mA, V_{CC} = 4.5 V$ |                  |     | 3.7        |         |      |
|           |  | $I_{OH} = -5.2 mA, V_{CC} = 6 V$ |                  | 5.2 |            |         |      |
| $V_{OL}$  | $V_I = V_{IH}$ or $V_{IL}$                   | $I_{OL} = 20 \mu A$              | $V_{CC} = 2 V$   |     | 0.1        | V       |      |
|           |  |                                  | $V_{CC} = 4.5 V$ |     | 0.1        |         |      |
|           |  |                                  | $V_{CC} = 6 V$   |     | 0.1        |         |      |
|           |  | $I_{OL} = 4 mA, V_{CC} = 4.5 V$  |                  |     | 0.4        |         |      |
|           |  | $I_{OL} = 5.2 mA, V_{CC} = 6 V$  |                  | 0.4 |            |         |      |
| $I_I$     | $V_I = V_{CC}$ or 0, $V_{CC} = 6 V$          |                                  |                  |     | $\pm 1000$ | nA      |      |
| $I_{CC}$  | $V_I = V_{CC}$ or 0, $I_O = 0, V_{CC} = 6 V$ |                                  |                  |     | 160        | $\mu A$ |      |
| $C_i$     | $V_{CC} = 2 V$ to $6 V$                      |                                  |                  |     | 10         | pF      |      |

## 6.9 Switching Characteristics

$T_A = 25^\circ C$  and  $C_L = 50 pF$  (unless otherwise noted; see [Section 7](#))

| PARAMETER | TEST CONDITIONS                           |                  | MIN | TYP | MAX | UNIT |
|-----------|---|------------------|-----|-----|-----|------|
| $t_{pd}$  | From A, B, or C (input) to any Y (output) | $V_{CC} = 2 V$   |     | 67  | 180 | ns   |
|           |   | $V_{CC} = 4.5 V$ |     | 18  | 36  |      |
|           |   | $V_{CC} = 6 V$   |     | 15  | 31  |      |
|           | From enable (input) to any Y (output)     | $V_{CC} = 2 V$   |     | 66  | 155 |      |
|           |   | $V_{CC} = 4.5 V$ |     | 18  | 31  |      |
|           |   | $V_{CC} = 6 V$   |     | 15  | 26  |      |
| $t_t$     | To any output                             | $V_{CC} = 2 V$   |     | 38  | 75  | ns   |
|           |   | $V_{CC} = 4.5 V$ |     | 8   | 15  |      |
|           |   | $V_{CC} = 6 V$   |     | 6   | 13  |      |

### 6.10 Switching Characteristics: SN74HC138

over recommended operating free-air temperature range and  $C_L = 50 \text{ pF}$  (unless otherwise noted; see [Section 7](#))

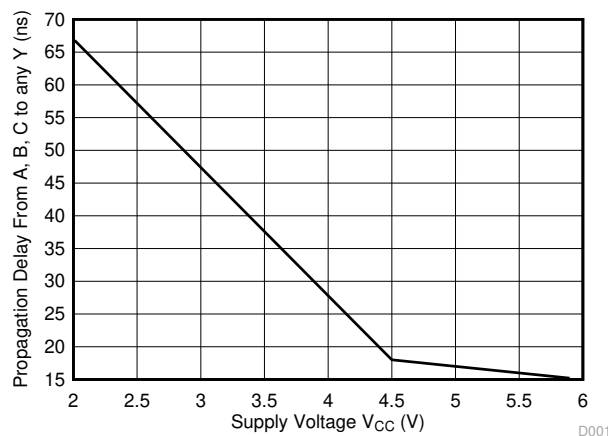
| PARAMETER | TEST CONDITIONS                           | MIN                      | TYP | MAX | UNIT |
|-----------|---|--------------------------|-----|-----|------|
| $t_{pd}$  | From A, B, or C (input) to any Y (output) | $V_{CC} = 2 \text{ V}$   |     | 225 | ns   |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 45  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 38  |      |
|           | From enable (input) to any Y (output)     | $V_{CC} = 2 \text{ V}$   |     | 195 |      |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 39  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 33  |      |
| $t_t$     | To any output                             | $V_{CC} = 2 \text{ V}$   |     | 95  | ns   |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 19  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 16  |      |

### 6.11 Switching Characteristics: SN54HC138

over recommended operating free-air temperature range and  $C_L = 50 \text{ pF}$  (unless otherwise noted; see [Section 7](#))

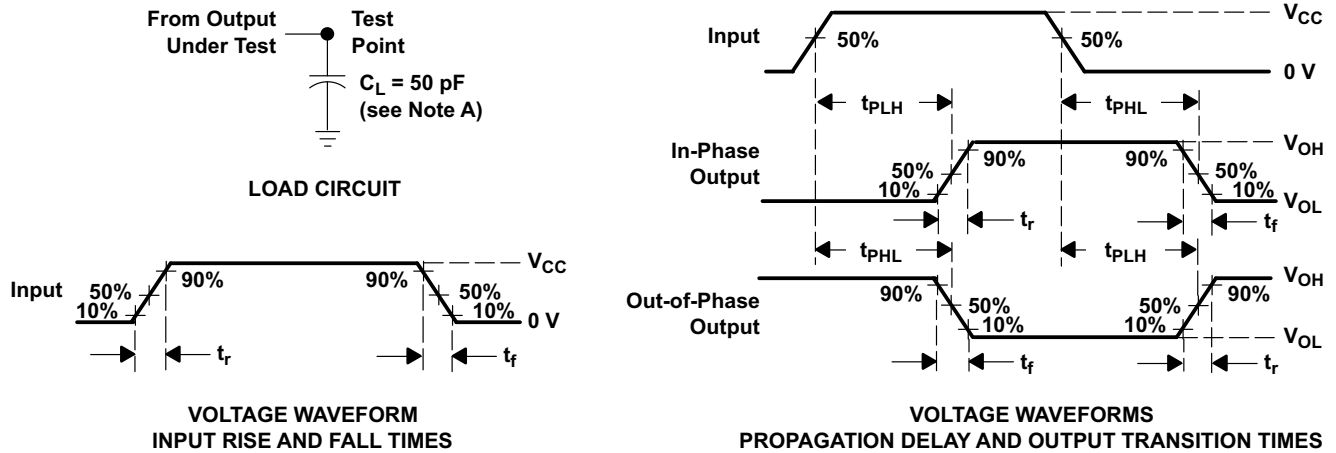
| PARAMETER | TEST CONDITIONS                           | MIN                      | TYP | MAX | UNIT |
|-----------|---|--------------------------|-----|-----|------|
| $t_{pd}$  | From A, B, or C (input) to any Y (output) | $V_{CC} = 2 \text{ V}$   |     | 270 | ns   |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 54  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 46  |      |
|           | From enable (input) to any Y (output)     | $V_{CC} = 2 \text{ V}$   |     | 235 |      |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 47  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 40  |      |
| $t_t$     | To any output                             | $V_{CC} = 2 \text{ V}$   |     | 110 | ns   |
|           |   | $V_{CC} = 4.5 \text{ V}$ |     | 22  |      |
|           |   | $V_{CC} = 6 \text{ V}$   |     | 19  |      |

### 6.12 Typical Characteristic



**Figure 6-1. Typical Propagation Delay vs Supply Voltage**

## 7 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:  $\text{PRR} \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = 6 \text{ ns}$ ,  $t_f = 6 \text{ ns}$ .
  - 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 7-1. Load Circuit and Voltage Waveforms**

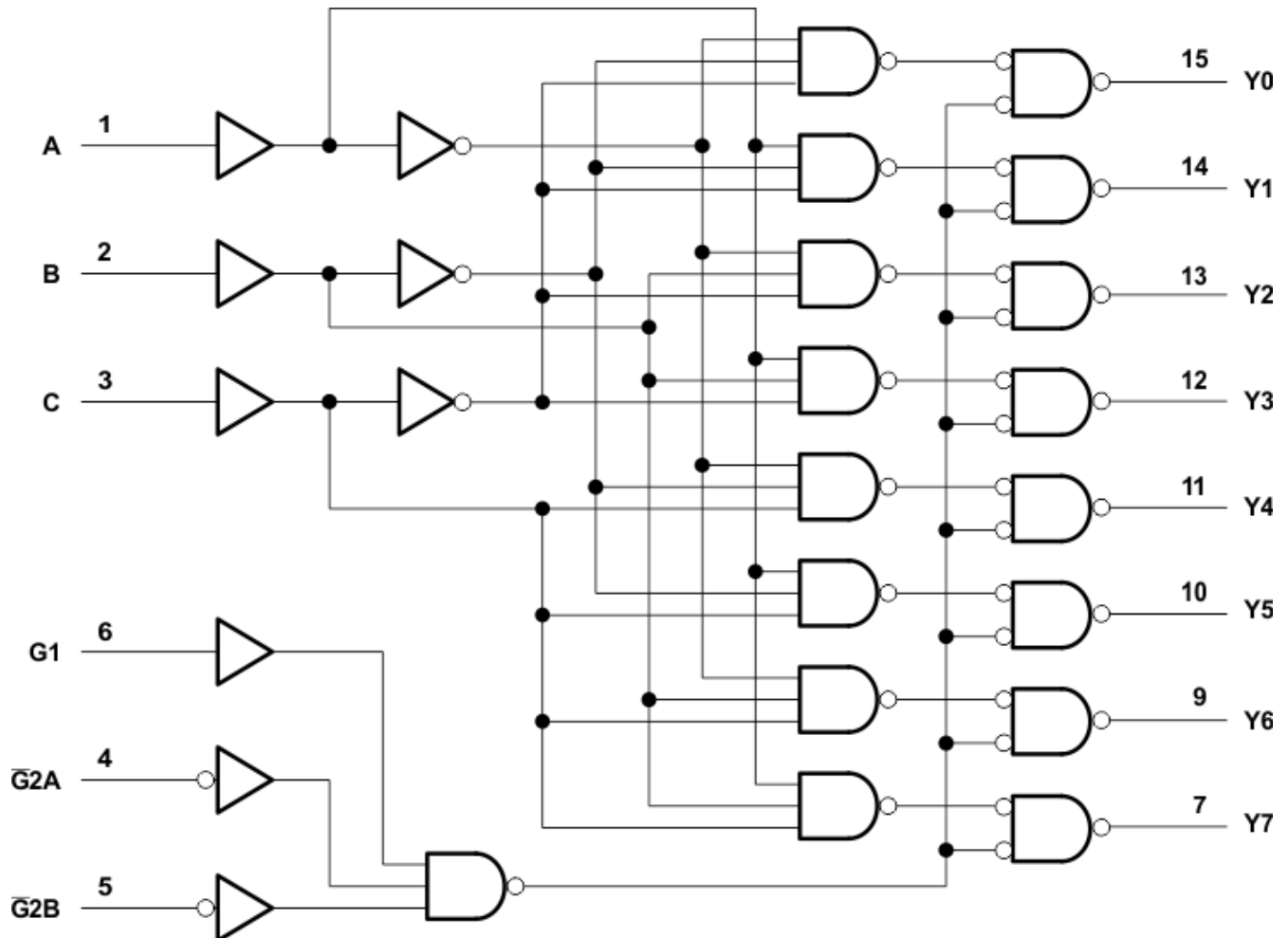


## 8 Detailed Description

### 8.1 Overview

The SNx4HC138 devices are 3-to-8 decoders and demultiplexers. The three input pins, A, B, and C, select which output is active. The selected output is pulled LOW, while the remaining outputs are all HIGH. The conditions at the binary-select inputs at the three enable inputs select one of eight output lines. Two active-low and one active-high enable inputs reduce the requirement for external gates or inverters when expanding. A 24-line decoder can be implemented without external inverters, and a 32-line decoder requires only one inverter. An enable input can be used as a data input for demultiplexing applications.

### 8.2 Functional Block Diagram



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Pin numbers shown are for the D, DB, J, N, NS, PW, and W packages.

### 8.3 Feature Description

This device features three binary inputs to select a single active-low output. Three enable pins are also available to enable or disable the outputs. One active high enable and two active low enable pins are available, and any enable pin can be deactivated to force all outputs high. All three enable pins must be active for the output to be enabled.

## 8.4 Device Functional Modes

Table 8-1 lists the functions of the SNx4HC138 devices.

**Table 8-1. Function Table**

| INPUTS |                  |                  |        |   |   | OUTPUTS |    |    |    |    |    |    |    |
|--------|------------------|------------------|--------|---|---|---------|----|----|----|----|----|----|----|
| ENABLE |                  |                  | SELECT |   |   | Y0      | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| G1     | $\overline{G2A}$ | $\overline{G2B}$ | C      | B | A |         |    |    |    |    |    |    |    |
| X      | H                | X                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| X      | X                | H                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| L      | X                | X                | X      | X | X | H       | H  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | L | L | L       | H  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | L | H | H       | L  | H  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | H | L | H       | H  | L  | H  | H  | H  | H  | H  |
| H      | L                | L                | L      | H | H | H       | H  | H  | L  | H  | H  | H  | H  |
| H      | L                | L                | H      | L | L | H       | H  | H  | H  | L  | H  | H  | H  |
| H      | L                | L                | H      | H | L | H       | H  | H  | H  | H  | H  | L  | H  |
| H      | L                | L                | H      | H | H | H       | H  | H  | H  | H  | H  | H  | L  |

## 9 Application and Implementation

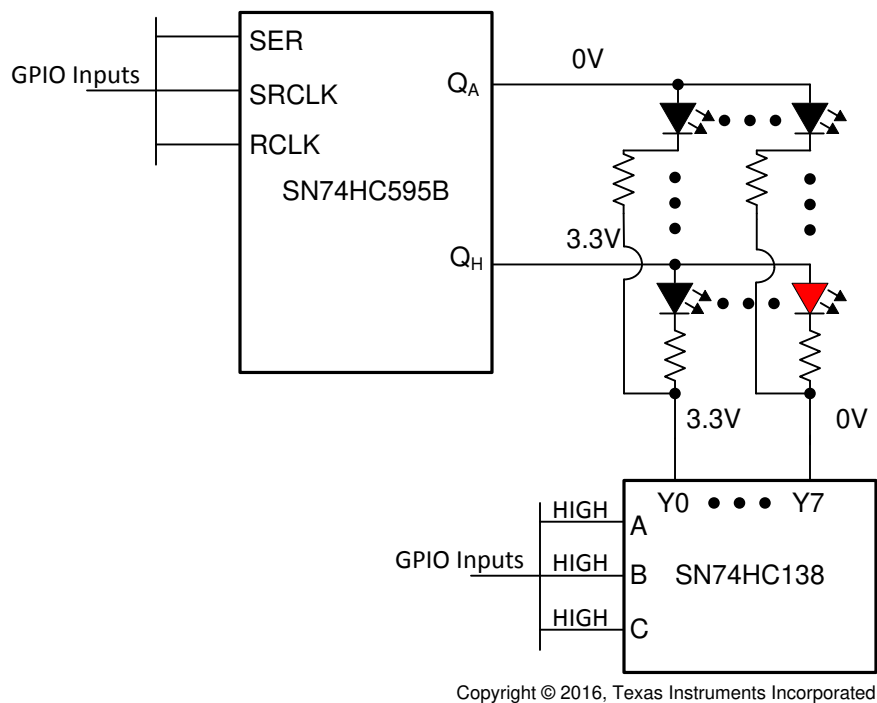
### Note

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, as well as validating and testing their design implementation to confirm system functionality.

### 9.1 Application Information

The SN74HC138 is useful as a scanning column selector for an LED Matrix display as it can be used for the low side drive of the LED string. The decoder functionality ensures that no more than one output is pulled to a low-level logic voltage so that only a single column is enabled at any point in time.

### 9.2 Typical Application



**Figure 9-1. LED Matrix Driver Application**

#### 9.2.1 Design Requirements

These devices use CMOS technology and have balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive also creates fast edges into light loads, so routing and load conditions must be considered to prevent ringing.

#### 9.2.2 Detailed Design Procedure

1. Recommended Input Conditions
  - For switch time specifications, see propagation delay times in [Section 6.9](#).
  - For input voltage level specifications for control inputs, see  $V_{IH}$  and  $V_{IL}$  in [Section 6.6](#).
2. Recommended Output Conditions
  - Outputs must not be pulled above  $V_{CC}$  or below GND.

### 9.2.3 Application Curve

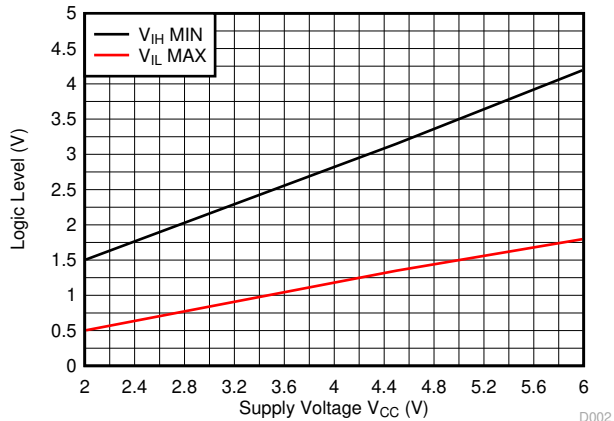


Figure 9-2. Input High and Input Low Thresholds vs Supply Voltage

## 10 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the [Section 6.3](#).

Each  $V_{CC}$  terminal must have a good bypass capacitor to prevent power disturbance. A 0.1- $\mu$ F bypass capacitor is recommended to be placed close to the  $V_{CC}$  terminal. It is acceptable to parallel multiple bypass capacitors to reject different frequencies of noise; 0.1- $\mu$ F and 1- $\mu$ F capacitors are commonly used in parallel. The bypass capacitor must be installed as close to the power terminal as possible for best results.

## 11 Layout

### 11.1 Layout Guidelines

Reflections and matching are closely related to loop antenna theory, but different enough to warrant their own discussion. When a PCB trace turns a corner at a 90° angle, a reflection can occur. This is primarily due to the change of width of the trace. At the apex of the turn, the trace width is increased to 1.414 times its width. This upsets the transmission line characteristics, especially the distributed capacitance and self-inductance of the trace (resulting in the reflection). It is a given that not all PCB traces can be straight, and so they have to turn corners. [Figure 11-1](#) shows progressively better techniques of rounding corners. Only the last example maintains constant trace width and minimizes reflections.

### 11.2 Layout Example

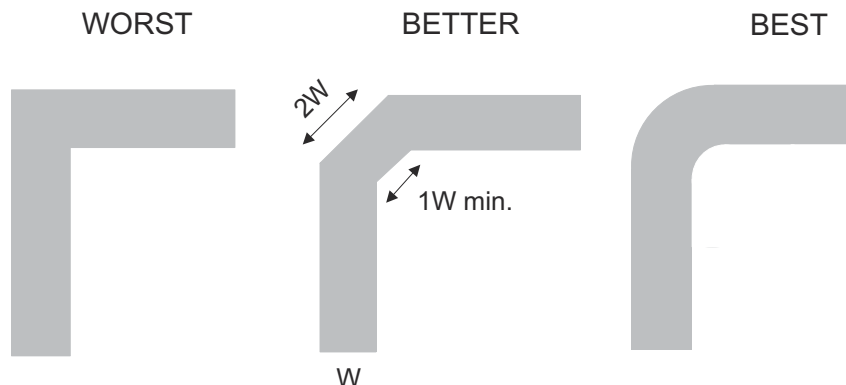


Figure 11-1. Trace Example

## 12 Device and Documentation Support

### 12.1 Documentation Support

#### 12.1.1 Related Documentation

For related documentation see the following:

[Implications of Slow or Floating CMOS Inputs](#) (SCBA004)

#### 12.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 12-1. Related Links**

| PARTS     | PRODUCT FOLDER             | SAMPLE & BUY               | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|-----------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| SN54HC138 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| SN74HC138 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

#### 12.3 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.

#### 12.4 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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](#).

#### 12.5 Trademarks

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All trademarks are the property of their respective owners.

#### 12.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

#### 12.7 Glossary

[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.

**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="#">5962-8406201VEA</a>  | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8406201VE<br>A<br>SNV54HC138J |
| 5962-8406201VEA.A                | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8406201VE<br>A<br>SNV54HC138J |
| <a href="#">5962-8406201VFA</a>  | Active        | Production           | CFP (W)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8406201VF<br>A<br>SNV54HC138W |
| 5962-8406201VFA.A                | Active        | Production           | CFP (W)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 5962-8406201VF<br>A<br>SNV54HC138W |
| <a href="#">84062012A</a>        | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 84062012A<br>SNJ54HC<br>138FK      |
| <a href="#">8406201EA</a>        | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201EA<br>SNJ54HC138J           |
| <a href="#">8406201FA</a>        | Active        | Production           | CFP (W)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201FA<br>SNJ54HC138W           |
| <a href="#">JM38510/65802B2A</a> | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802B2A               |
| JM38510/65802B2A.A               | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802B2A               |
| <a href="#">JM38510/65802BEA</a> | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802BEA               |
| JM38510/65802BEA.A               | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802BEA               |
| <a href="#">M38510/65802B2A</a>  | Active        | Production           | LCCC (FK)   20 | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802B2A               |
| <a href="#">M38510/65802BEA</a>  | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | JM38510/<br>65802BEA               |
| <a href="#">SN54HC138J</a>       | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN54HC138J                         |
| SN54HC138J.A                     | Active        | Production           | CDIP (J)   16  | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | SN54HC138J                         |
| <a href="#">SN74HC138D</a>       | Obsolete      | Production           | SOIC (D)   16  | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | HC138                              |

| 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="#">SN74HC138DBR</a>   | Active        | Production           | SSOP (DB)   16  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138DBR.A                 | Active        | Production           | SSOP (DB)   16  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138DR</a>    | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138DR.A                  | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138DRE4                  | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138DRG4</a>  | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138DRG4.A                | Active        | Production           | SOIC (D)   16   | 2500   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138DT</a>    | Obsolete      | Production           | SOIC (D)   16   | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | HC138                         |
| <a href="#">SN74HC138N</a>     | Active        | Production           | PDIP (N)   16   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | SN74HC138N                    |
| SN74HC138N.A                   | Active        | Production           | PDIP (N)   16   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | SN74HC138N                    |
| SN74HC138NE4                   | Active        | Production           | PDIP (N)   16   | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | -40 to 85    | SN74HC138N                    |
| <a href="#">SN74HC138NSR</a>   | Active        | Production           | SOP (NS)   16   | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138NSR.A                 | Active        | Production           | SOP (NS)   16   | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138PW</a>    | Obsolete      | Production           | TSSOP (PW)   16 | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | HC138                         |
| <a href="#">SN74HC138PWR</a>   | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138PWR.A                 | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138PWRG4</a> | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| SN74HC138PWRG4.A               | Active        | Production           | TSSOP (PW)   16 | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | HC138                         |
| <a href="#">SN74HC138PWT</a>   | Obsolete      | Production           | TSSOP (PW)   16 | -                     | -           | Call TI                              | Call TI                           | -40 to 85    | HC138                         |
| <a href="#">SNJ54HC138FK</a>   | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 84062012A<br>SNJ54HC<br>138FK |
| SNJ54HC138FK.A                 | Active        | Production           | LCCC (FK)   20  | 55   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 84062012A<br>SNJ54HC<br>138FK |
| <a href="#">SNJ54HC138J</a>    | Active        | Production           | CDIP (J)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201EA<br>SNJ54HC138J      |
| SNJ54HC138J.A                  | Active        | Production           | CDIP (J)   16   | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201EA<br>SNJ54HC138J      |
| <a href="#">SNJ54HC138W</a>    | Active        | Production           | CFP (W)   16    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201FA<br>SNJ54HC138W      |
| SNJ54HC138W.A                  | Active        | Production           | CFP (W)   16    | 25   TUBE             | No          | SNPB                                 | N/A for Pkg Type                  | -55 to 125   | 8406201FA<br>SNJ54HC138W      |

- (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.

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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 SN54HC138, SN54HC138-SP, SN74HC138 :**

- Catalog : [SN74HC138](#), [SN54HC138](#)
- Automotive : [SN74HC138-Q1](#), [SN74HC138-Q1](#)
- Military : [SN54HC138](#)
- Space : [SN54HC138-SP](#)

NOTE: Qualified Version Definitions:



- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

**TAPE AND REEL INFORMATION**

**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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74HC138DBR   | SSOP         | DB              | 16   | 2000 | 330.0              | 16.4               | 8.35    | 6.6     | 2.4     | 12.0    | 16.0   | Q1            |
| SN74HC138DR    | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC138DR    | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC138DRG4  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| SN74HC138NSR   | SOP          | NS              | 16   | 2000 | 330.0              | 16.4               | 8.45    | 10.55   | 2.5     | 12.0    | 16.2   | Q1            |
| SN74HC138PWR   | TSSOP        | PW              | 16   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |
| SN74HC138PWRG4 | TSSOP        | PW              | 16   | 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) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74HC138DBR   | SSOP         | DB              | 16   | 2000 | 353.0       | 353.0      | 32.0        |
| SN74HC138DR    | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74HC138DR    | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74HC138DRG4  | SOIC         | D               | 16   | 2500 | 340.5       | 336.1      | 32.0        |
| SN74HC138NSR   | SOP          | NS              | 16   | 2000 | 353.0       | 353.0      | 32.0        |
| SN74HC138PWR   | TSSOP        | PW              | 16   | 2000 | 356.0       | 356.0      | 35.0        |
| SN74HC138PWRG4 | TSSOP        | PW              | 16   | 2000 | 353.0       | 353.0      | 32.0        |

**TUBE**


\*All dimensions are nominal

| Device             | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|--------------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| 5962-8406201VFA    | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 5962-8406201VFA.A  | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |
| 84062012A          | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| 8406201FA          | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |
| JM38510/65802B2A   | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| JM38510/65802B2A.A | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| M38510/65802B2A    | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| SN74HC138N         | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC138N         | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC138N.A       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC138N.A       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC138NE4       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SN74HC138NE4       | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| SNJ54HC138FK       | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| SNJ54HC138FK.A     | FK           | LCCC         | 20   | 55  | 506.98 | 12.06  | 2030   | NA     |
| SNJ54HC138W        | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |
| SNJ54HC138W.A      | W            | CFP          | 16   | 25  | 506.98 | 26.16  | 6220   | NA     |

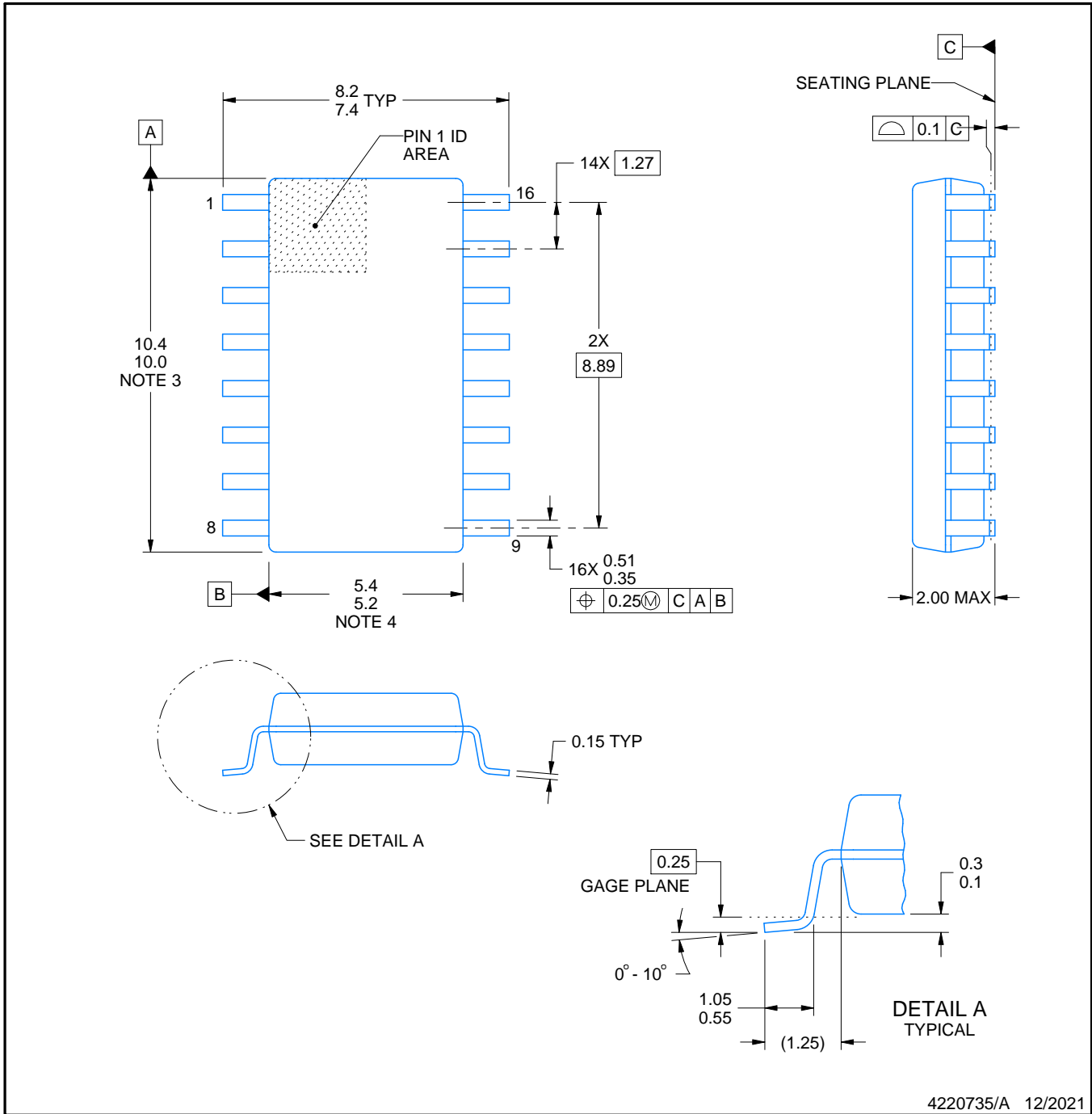


# PACKAGE OUTLINE

## NS0016A

### SOP - 2.00 mm max height

SOP



#### 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 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

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

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220735/A 12/2021

NOTES: (continued)



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

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- 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 AC.



# DB0016A



# PACKAGE OUTLINE

## SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



4220763/A 05/2022

### NOTES:

- All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
- This drawing is subject to change without notice.
- 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.
- Reference JEDEC registration MO-150.

# EXAMPLE BOARD LAYOUT

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220763/A 05/2022

NOTES: (continued)

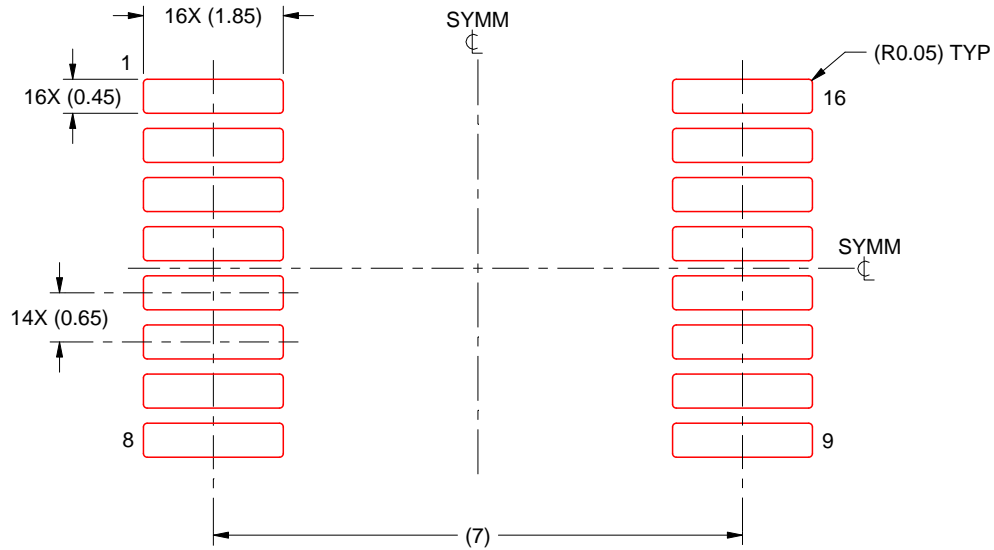
- 5. Publication IPC-7351 may have alternate designs.
- 6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220763/A 05/2022

NOTES: (continued)

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

W (R-GDFP-F16)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP2-F16

## GENERIC PACKAGE VIEW

**FK 20**

**LCCC - 2.03 mm max height**

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.



4229370VA\

J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE

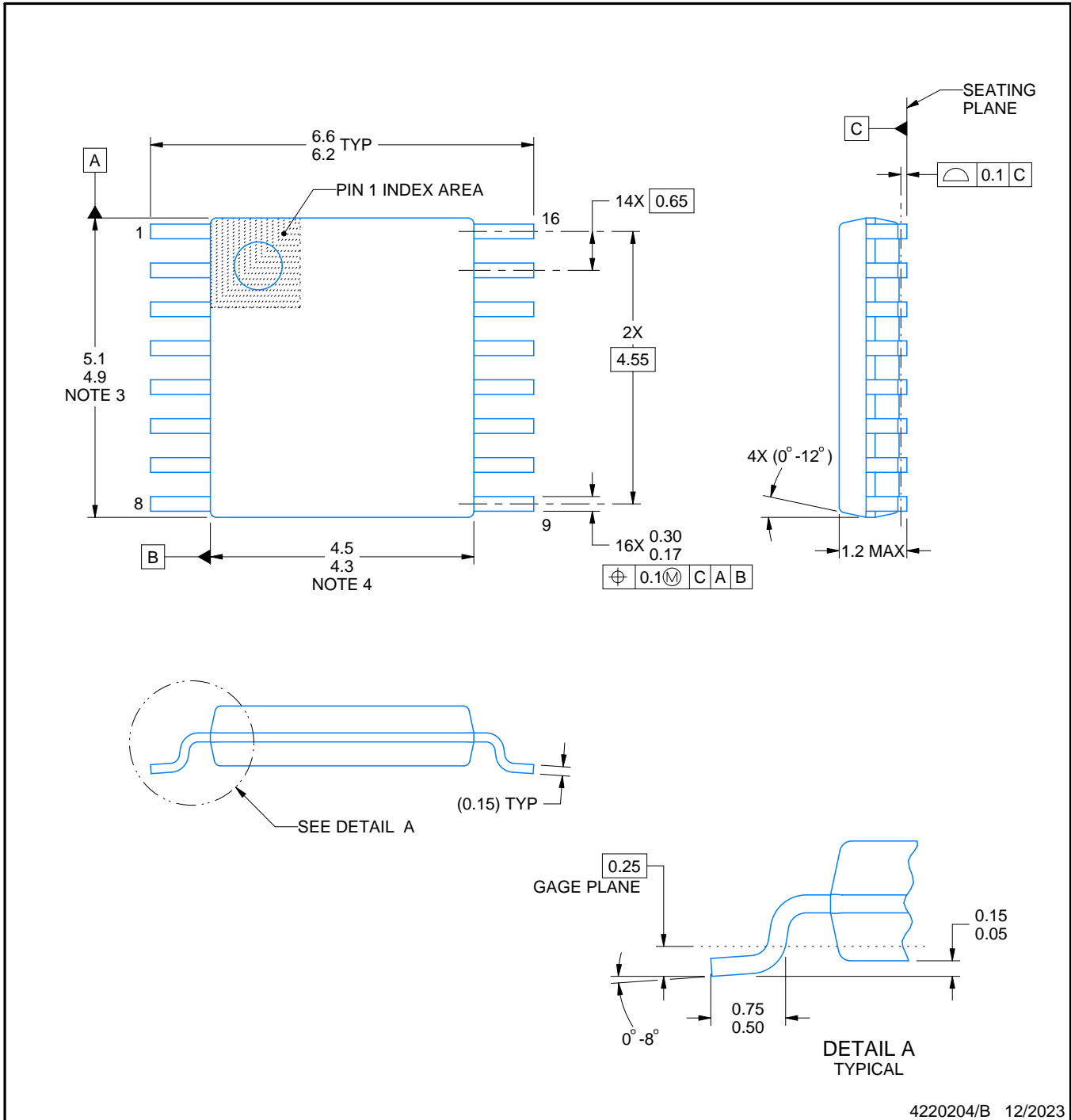
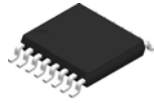


| DIM \ PINS ** | 14                     | 16                     | 18                     | 20                     |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A             | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC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



4040083/F 03/03

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



4220204/B 12/2023

NOTES:

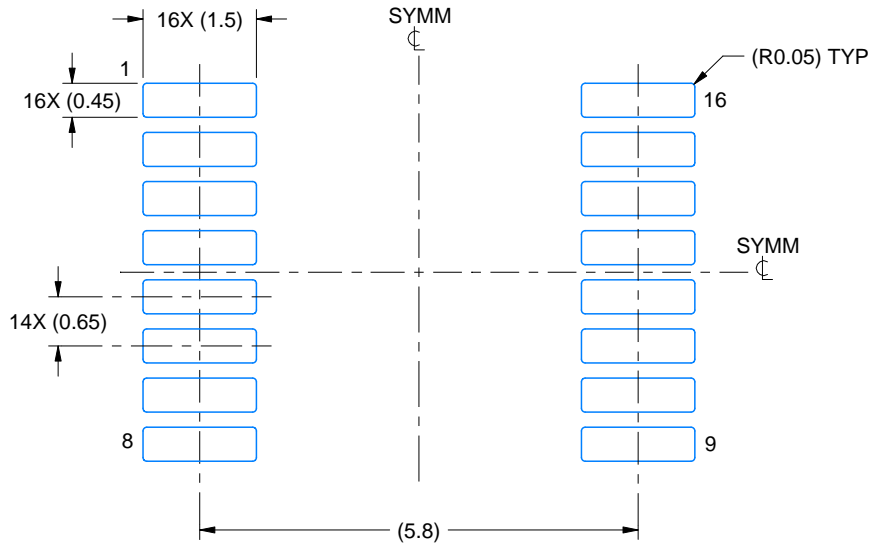
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

# EXAMPLE BOARD LAYOUT

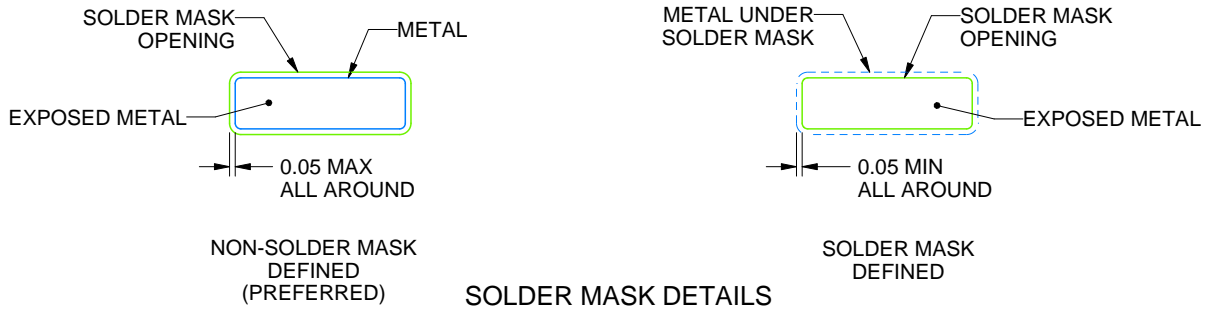
PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220204/B 12/2023

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.

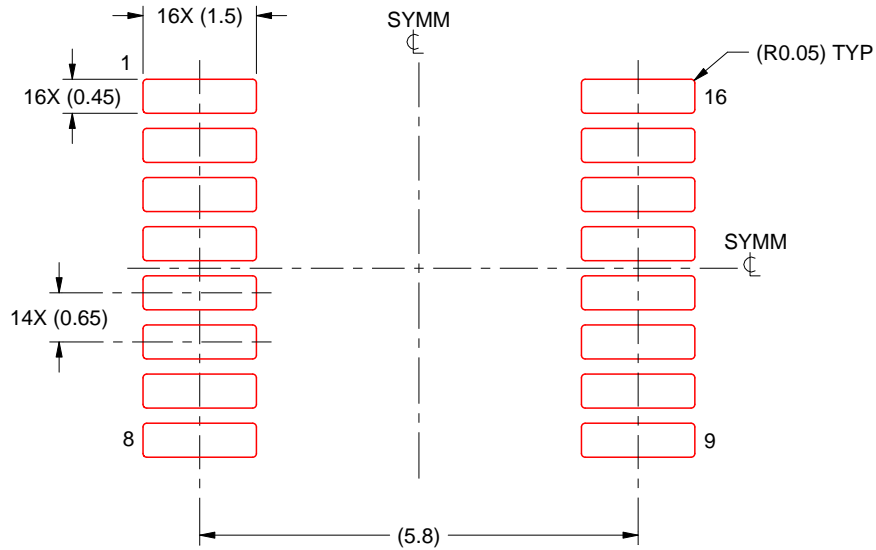


# EXAMPLE STENCIL DESIGN

PW0016A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

4220204/B 12/2023

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



- 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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