# SNx4HC377 Octal D-Type Flip-Flops With Clock Enable

## 1 Features

- Wide operating voltage range of 2 V to 6 V
- Outputs can drive up to 10 LSTTL loads
- Low power consumption, 80-µA max $I_{CC}$
- Typical $t_{pd}$ = 12 ns
- ±4-mA output drive at 5 V
- Low input current of 1 µA max
- Eight flip-flops with single-rail outputs
- Clock enable latched to avoid false clocking

## 2 Applications

- Buffer/storage registers
- Shift registers
- Pattern generators

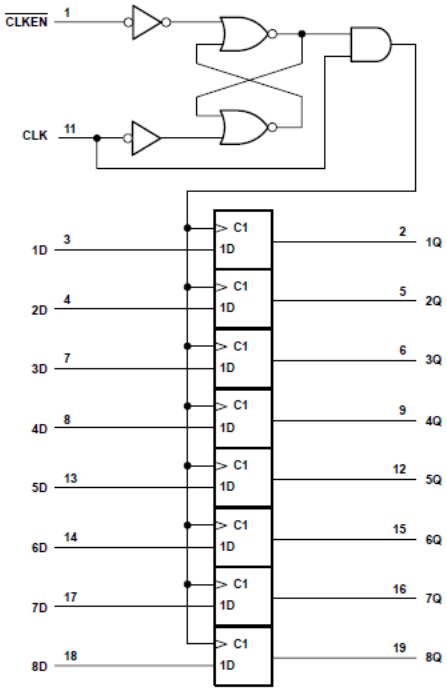
## 3 Description

These devices are positive-edge-triggered octal D-type flip-flops with an enable input. The ’HC377 devices are similar to the ’HC273 devices, but feature a latched clock-enable ($\overline{\text{CLKEN}}$) input instead of a common clear.

**Device Information**

| PART NUMBER | PACKAGE(1) | BODY SIZE (NOM) |
|---|---|---|
| SN74HC377DW | SOIC (20) | 12.80 mm × 7.50 mm |
| SN74HC377N | PDIP (20) | 25.40 mm × 6.35 mm |
| SN74HC377NS | SO (20) | 15.00 mm × 5.30 mm |
| SN54HC377J | CDIP (20) | 26.92 mm × 6.92 mm |
| SNJ54HC377FK | LCCC (20) | 8.89 mm × 8.45 mm |

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




**Functional Block Diagram**

## Table of Contents



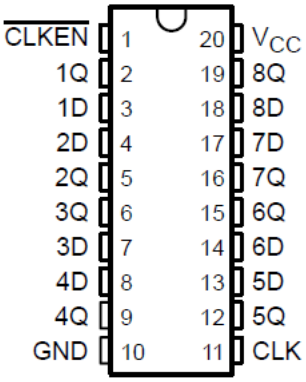
## 4 Revision History

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

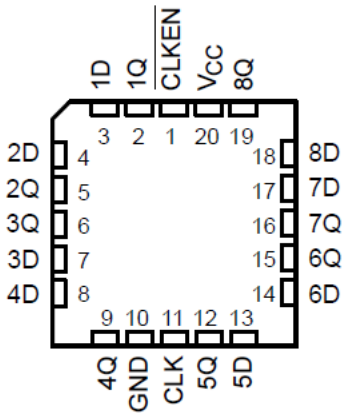
| Changes from Revision C (January 2022) to Revision D (May 2022) | Page |
|---|---|
| • Junction-to-ambient thermal resistance values increased. DW was 58 is now 109.1, N was 69 is now 84.6, NS was 60 is now 113.4 | 4 |

| Changes from Revision B (January 2003) to Revision C (January 2022) | Page |
|---|---|
| • Updated the numbering, formatting, tables, figures, and cross-references throughout the document to reflect modern data sheet standards | 1 |

## 5 Pin Configuration and Functions




**J, DW, N, or NS package**
**20-Pin CDIP, SOIC, PDIP, SO**
**Top View**




**FK package**
**20-Pin LCCC**
**Top View**

# 6 Specifications

## 6.1 Absolute Maximum Ratings

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

| | | | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage range | | -0.5 | 7 | V |
| $I_{IK}$ | Input clamp current(2) | ($V_I$ < 0 or $V_I$ > $V_{CC}$) | | ±20 | mA |
| $I_{OK}$ | Output clamp current(2) | ($V_O$ < 0 or $V_O$ > $V_{CC}$) | | ±20 | mA |
| $I_O$ | Continuous output current | ($V_O$ = 0 to $V_{CC}$) | | ±25 | mA |
| | Continuous current through $V_{CC}$ or GND | | | ±50 | mA |
| $T_J$ | Junction temperature | | | 150 | °C |
| $T_{stg}$ | 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 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.
(2) The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## 6.2 Recommended Operating Conditions(1)

| | | | SN54HC377 | | | SN74HC377 | | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | NOM | MAX | MIN | NOM | MAX | |
| $V_{CC}$ | Supply voltage | | 2 | 5 | 6 | 2 | 5 | 6 | V |
| $V_{IH}$ | High-level input voltage | $V_{CC}$ = 2 V | 1.5 | | | 1.5 | | | V |
| | | $V_{CC}$ = 4.5 V | 3.15 | | | 3.15 | | | |
| | | $V_{CC}$ = 6 V | 4.2 | | | 4.2 | | | |
| $V_{IL}$ | Low-level input voltage | $V_{CC}$ = 2 V | | | 0.5 | | | 0.5 | V |
| | | $V_{CC}$ = 4.5 V | | | 1.35 | | | 1.35 | |
| | | $V_{CC}$ = 6 V | | | 1.8 | | | 1.8 | |
| $V_I$ | Input voltage | | 0 | | $V_{CC}$ | 0 | | $V_{CC}$ | V |
| $V_O$ | Output voltage | | 0 | | $V_{CC}$ | 0 | | $V_{CC}$ | V |
| $t_t$ | Input transition rise/fall time | $V_{CC}$ = 2 V | | | 1000 | | | 1000 | ns |
| | | $V_{CC}$ = 4.5 V | | | 500 | | | 500 | |
| | | $V_{CC}$ = 6 V | | | 400 | | | 400 | |
| $T_A$ | Operating free-air temperature | | – 55 | | 125 | – 40 | | 85 | °C |

(1) 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 SMOS Inputs, literature number SCBA004.

## 6.3 Thermal Information

| THERMAL METRIC | | DW (SOIC) 20 PINS | N (PDIP) 20 PINS | NS (SO) 20 PINS | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance(1) | 109.1 | 84.6 | 113.4 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 76 | 72.5 | 78.6 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 77.6 | 65.3 | 78.4 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 51.5 | 55.3 | 47.1 | °C/W |
| $\psi_{JB}$ | Junction-to-top characterization parameter | 77.1 | 65.2 | 78.1 | °C/W |

## 6.3 Thermal Information (continued)

| THERMAL METRIC | | DW (SOIC) 20 PINS | N (PDIP) 20 PINS | NS (SO) 20 PINS | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | N/A | N/A | N/A | °C/W |

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

## 6.4 Electrical Characteristics

| PARAMETER | TEST CONDITIONS(1) | $V_{CC}$ (V) | $T_A$ = 25°C | | | SN74HC377 | | SN74HC377 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $V_{OH}$ | $I_{OH}$ = –20 µA | 2 | 1.9 | 1.998 | | 1.9 | | 1.9 | | V |
| | | 4.5 | 4.4 | 4.499 | | 4.4 | | 4.4 | | |
| | | 6 | 5.9 | 5.999 | | 5.9 | | 5.9 | | |
| | $I_{OH}$ = –4 mA | 4.5 | 3.98 | 4.3 | | 3.7 | | 3.84 | | |
| | $I_{OH}$ = – 5.2 mA | 6 | 5.48 | 5.8 | | 5.2 | | 5.34 | | |
| $V_{OL}$ | $I_{OL}$ = 20 µA | 2 | | 0.002 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | 6 | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | $I_{OL}$ = 4 mA | 4.5 | | 0.17 | 0.26 | | 0.4 | | 0.33 | |
| | $I_{OL}$ = 5.2 mA | 6 | | 0.15 | 0.26 | | 0.4 | | 0.33 | |
| $I_I$ | $V_I$ = $V_{CC}$ or 0 | 6 | | | ±0.1 | | ±1000 | | ±1000 | nA |
| $I_{CC}$ | $V_I$ = $V_{CC}$ or 0. $I_O$ = 0 | 6 | | | 8 | | 160 | | 80 | µA |
| $C_i$ | | 2 to 6 | | 3 | 10 | | 10 | | 10 | pF |

(1) $V_I$ = $V_{IH}$ or $V_{IL}$, unless otherwise noted.

## 6.5 Timing Requirements

| | | | $V_{CC}$ | $T_A$ = 25°C | | SN54HC377 | | SN74HC377 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $f_{clock}$ | Clock frequency | | 2 | | 5 | | 3 | | 4 | MHz |
| | | | 4.5 | | 25 | | 16 | | 20 | |
| | | | 6 | | 29 | | 19 | | 23 | |
| $t_W$ | Pulse duration, CLK high or low | | 2 | 100 | | 150 | | 125 | | ns |
| | | | 4.5 | 20 | | 30 | | 25 | | |
| | | | 6 | 17 | | 25 | | 21 | | |
| $t_{su}$ | Setup time, data before CLK↑ | D | 2 | 100 | | 150 | | 125 | | ns |
| | | | 4.5 | 20 | | 30 | | 25 | | |
| | | | 6 | 17 | | 25 | | 21 | | |
| | | $\overline{CLKEN}$ high or low | 2 | 100 | | 150 | | 125 | | |
| | | | 4.5 | 20 | | 30 | | 25 | | |
| | | | 6 | 17 | | 25 | | 21 | | |
| $t_h$ | Hold time, data after LE↑ | $\overline{CLKEN}$ inactive or active, data | 2 | 5 | | 5 | | 5 | | ns |
| | | | 4.5 | 5 | | 5 | | 5 | | |
| | | | 6 | 5 | | 5 | | 5 | | |

## 6.6 Switching Characteristics

over recommended operating free-air temperature range, $C_L$ = 50 pF (unless otherwise noted) See Parameter Measurement Information

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC}$ (V) | $T_A$ = 25°C | | | SN54HC377 | | SN74HC377 | | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| $f_{max}$ | | | 2 | 5 | 11 | | 3 | | 4 | | MHz |
| | | | 4.5 | 25 | 54 | | 16 | | 20 | | |
| | | | 6 | 29 | 64 | | 19 | | 23 | | |
| $t_{pd}$ | $\overline{CLK}$ | Any | 2 | | 56 | 160 | | 240 | | 200 | ns |
| | | | 4.5 | | 15 | 32 | | 48 | | 40 | |
| | | | 6 | | 12 | 27 | | 41 | | 34 | |
| $t_t$ | | Any | 2 | | 38 | 75 | | 110 | | 95 | ns |
| | | | 4.5 | | 8 | 15 | | 22 | | 19 | |
| | | | 6 | | 6 | 13 | | 19 | | 16 | |

## 6.7 Operating Characteristics

$T_A$ = 25°C

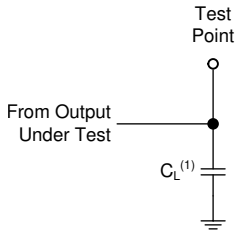
| | | Test Conditions | TYP | UNIT |
|---|---|---|---|---|
| $C_{pd}$ | Power dissipation capacitance per flip-flop | No load | 30 | pF |

## 7 Parameter Measurement Information

Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, $Z_O$ = 50 Ω, $t_t$ < 2.5 ns.

For clock inputs, $f_{max}$ is measured when the input duty cycle is 50%.

The outputs are measured one at a time with one input transition per measurement.




(1) $C_L$ includes probe and test-fixture capacitance.

**Figure 7-1. Load Circuit for Push-Pull Outputs**

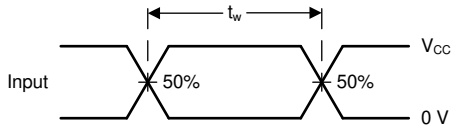



**Figure 7-2. Voltage Waveforms, Standard CMOS Inputs Pulse Duration**

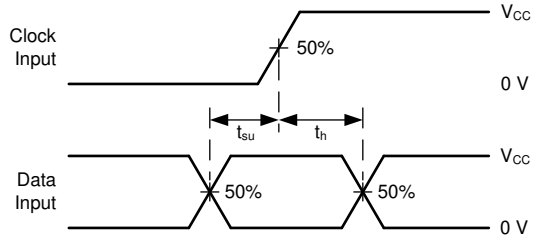
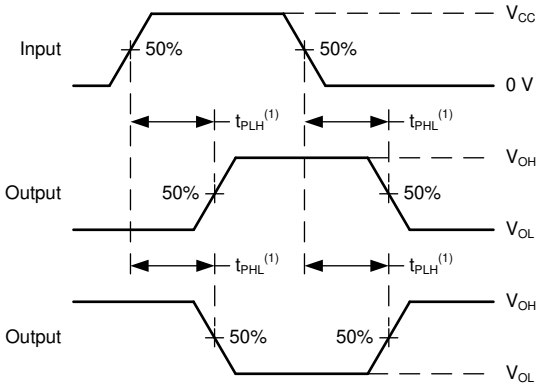
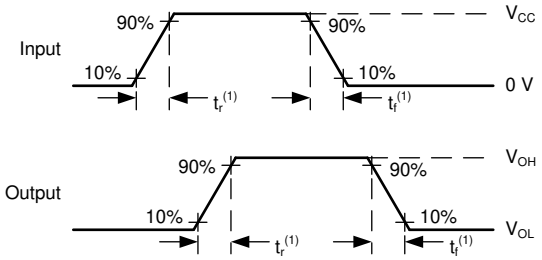



**Figure 7-3. Voltage Waveforms, Standard CMOS Inputs Setup and Hold Times**




(1) The greater between $t_{PLH}$ and $t_{PHL}$ is the same as $t_{pd}$.

**Figure 7-4. Voltage Waveforms, Propagation Delays for Standard CMOS Inputs**




(1) The greater between $t_r$ and $t_f$ is the same as $t_t$.

**Figure 7-5. Voltage Waveforms, Input and Output Transition Times for Standard CMOS Inputs**

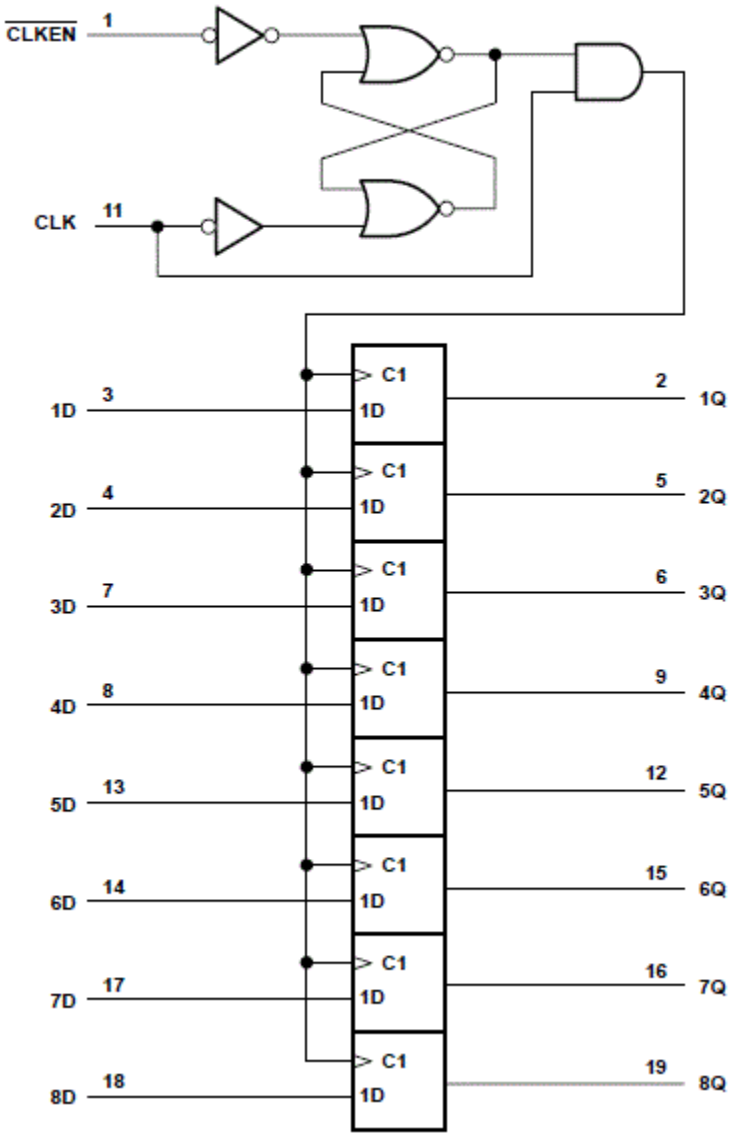
# 8 Detailed Description

## 8.1 Overview

These devices are positive-edge-triggered octal D-type flip-flops with an enable input. The ’HC377 devices are similar to the ’HC273 devices, but feature a latched clock-enable ($\overline{\text{CLKEN}}$) input instead of a common clear.

Information at the data (D) inputs meeting the setup time requirements is transferred to the Q outputs on the positive-going edge of the clock (CLK) pulse, if $\overline{\text{CLKEN}}$ is low. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When CLK is at either the high or low level, the D input has no effect at the output. These devices are designed to prevent false clocking by transitions at $\overline{\text{CLKEN}}$.

## 8.2 Functional Block Diagram



## 8.3 Device Functional Modes

**Function Table**
**(Each Flip-Flop)**

| INPUTS | | | OUTPUT Q |
|---|---|---|---|
| $\overline{\text{CLKEN}}$ | CLK | D | |
| H | X | X | $Q_0$ |
| L | ↑ | H | H |
| L | ↑ | L | L |
| X | L | X | $Q_0$ |

## 9 Power Supply Recommendations

The power supply can be any voltage between the minimum and maximum supply voltage rating located in the *Recommended Operating Conditions*. Each $V_{CC}$ terminal should have a good bypass capacitor to prevent power disturbance. A 0.1-µF capacitor is recommended for this device. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. The 0.1-µF and 1-µF capacitors are commonly used in parallel. The bypass capacitor should be installed as close to the power terminal as possible for best results.

## 10 Layout

### 10.1 Layout Guidelines

When using multiple-input and multiple-channel logic devices inputs must not ever be left floating. In many cases, functions or parts of functions of digital logic devices are unused; for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such unused input pins must not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. All unused inputs of digital logic devices must be connected to a logic high or logic low voltage, as defined by the input voltage specifications, to prevent them from floating. The logic level that must be applied to any particular unused input depends on the function of the device. Generally, the inputs are tied to GND or $V_{CC}$, whichever makes more sense for the logic function or is more convenient.

# 11 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

## 11.1 Documentation Support

### 11.1.1 Related Documentation

## 11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* 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.

## 11.3 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.

## 11.4 Trademarks

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

## 11.5 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.

## 11.6 Glossary

| | |
|---|---|
| TI Glossary | This glossary lists and explains terms, acronyms, and definitions. |

# 12 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 Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5962-87807012A | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-87807012A SNJ54HC 377FK | Samples |
| 5962-8780701RA | ACTIVE | CDIP | J | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-8780701RA SNJ54HC377J | Samples |
| SN54HC377J | ACTIVE | CDIP | J | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | SN54HC377J | Samples |
| SN74HC377DW | ACTIVE | SOIC | DW | 20 | 25 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC377 | Samples |
| SN74HC377DWR | ACTIVE | SOIC | DW | 20 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC377 | Samples |
| SN74HC377N | ACTIVE | PDIP | N | 20 | 20 | RoHS & Green | NIPDAU | N / A for Pkg Type | -40 to 85 | SN74HC377N | Samples |
| SN74HC377NE4 | ACTIVE | PDIP | N | 20 | 20 | RoHS & Green | NIPDAU | N / A for Pkg Type | -40 to 85 | SN74HC377N | Samples |
| SN74HC377NSR | ACTIVE | SO | NS | 20 | 2000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | HC377 | Samples |
| SNJ54HC377FK | ACTIVE | LCCC | FK | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-87807012A SNJ54HC 377FK | Samples |
| SNJ54HC377J | ACTIVE | CDIP | J | 20 | 1 | Non-RoHS & Green | SNPB | N / A for Pkg Type | -55 to 125 | 5962-8780701RA SNJ54HC377J | Samples |

(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".
**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

**(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 finish/Ball material - Orderable Devices 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.



**OTHER QUALIFIED VERSIONS OF SN54HC377, SN74HC377 :**

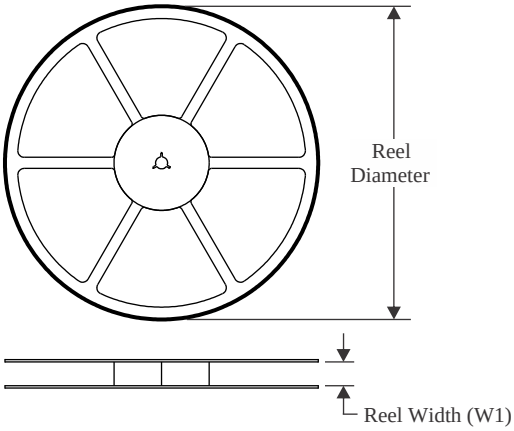
- Catalog : SN74HC377
- Military : SN54HC377

NOTE: Qualified Version Definitions:

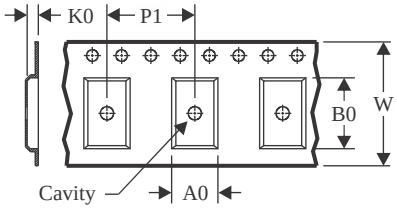
- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

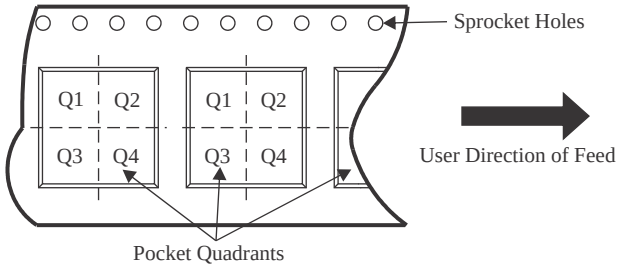



**TAPE DIMENSIONS**




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

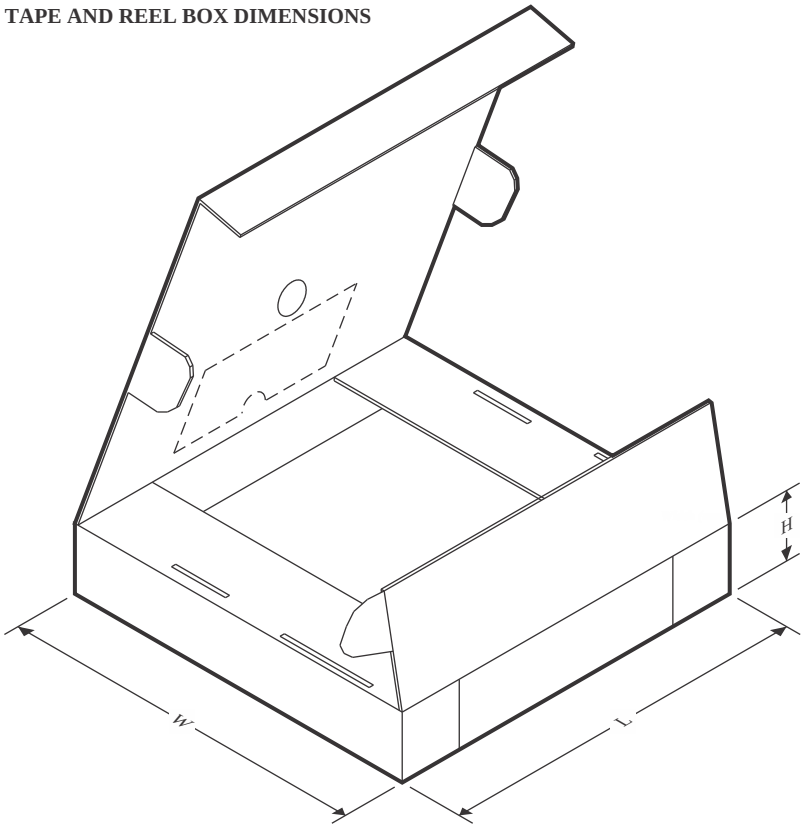
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SN74HC377DWR | SOIC | DW | 20 | 2000 | 330.0 | 24.4 | 10.8 | 13.3 | 2.7 | 12.0 | 24.0 | Q1 |
| SN74HC377NSR | SO | NS | 20 | 2000 | 330.0 | 24.4 | 8.4 | 13.0 | 2.5 | 12.0 | 24.0 | Q1 |
| SN74HC377NSR | SO | NS | 20 | 2000 | 330.0 | 24.4 | 8.4 | 13.0 | 2.5 | 12.0 | 24.0 | Q1 |

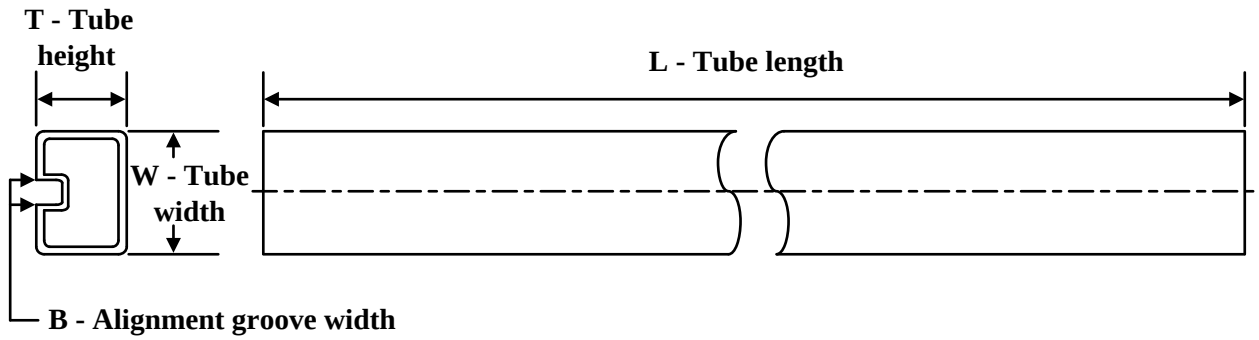
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN74HC377DWR | SOIC | DW | 20 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74HC377NSR | SO | NS | 20 | 2000 | 367.0 | 367.0 | 45.0 |
| SN74HC377NSR | SO | NS | 20 | 2000 | 367.0 | 367.0 | 45.0 |

## TUBE

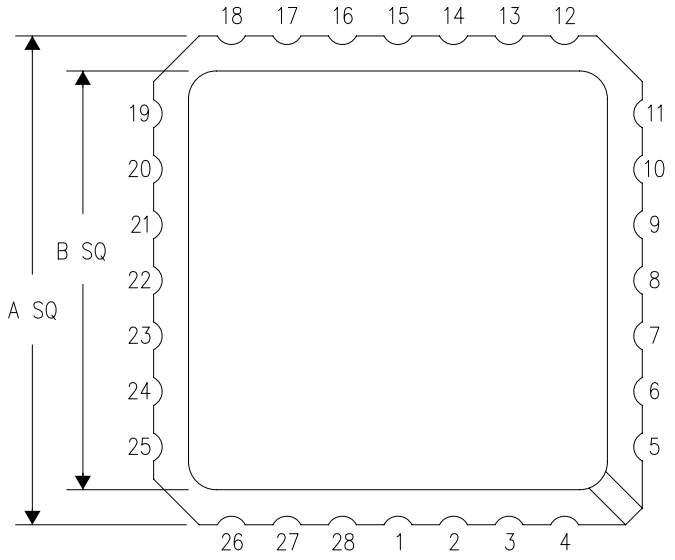



*All dimensions are nominal

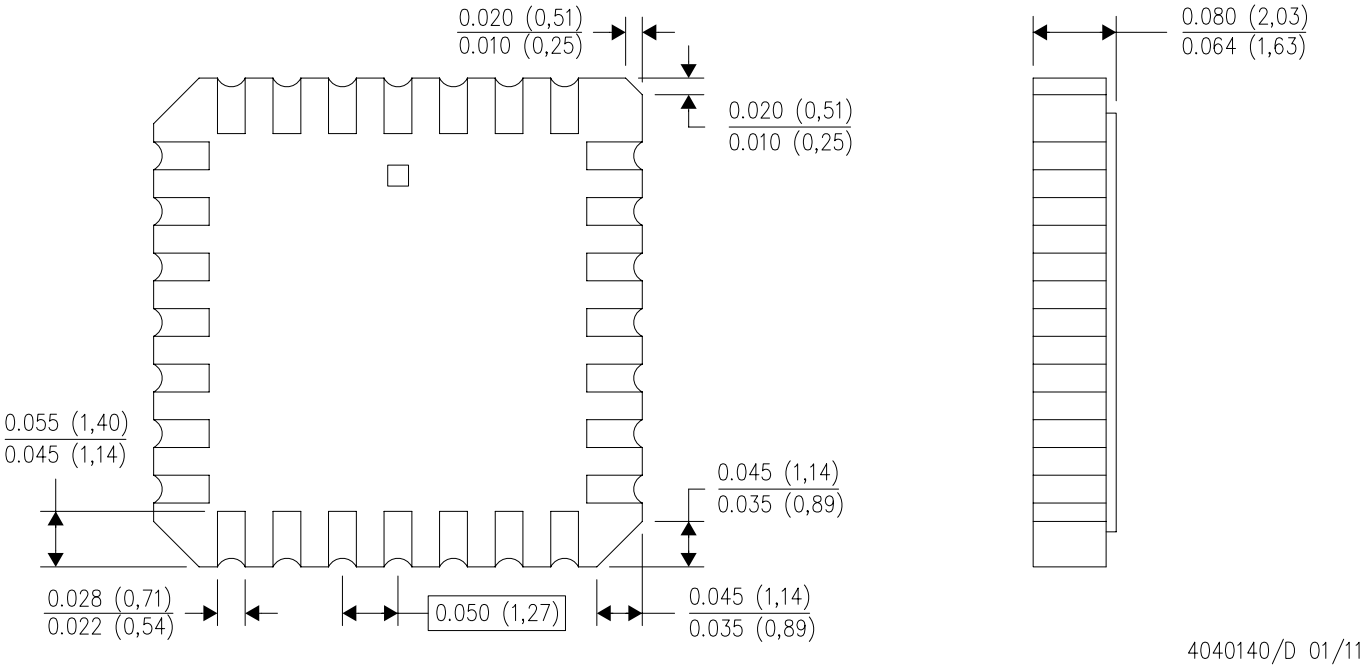
| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| 5962-87807012A | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |
| SN74HC377DW | DW | SOIC | 20 | 25 | 507 | 12.83 | 5080 | 6.6 |
| SN74HC377N | N | PDIP | 20 | 20 | 506 | 13.97 | 11230 | 4.32 |
| SN74HC377NE4 | N | PDIP | 20 | 20 | 506 | 13.97 | 11230 | 4.32 |
| SNJ54HC377FK | FK | LCCC | 20 | 1 | 506.98 | 12.06 | 2030 | NA |

FK (S–CQCC–N**) LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN




| NO. OF TERMINALS ** | A | | B | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| 20 | 0.342 (8,69) | 0.358 (9,09) | 0.307 (7,80) | 0.358 (9,09) |
| 28 | 0.442 (11,23) | 0.458 (11,63) | 0.406 (10,31) | 0.458 (11,63) |
| 44 | 0.640 (16,26) | 0.660 (16,76) | 0.495 (12,58) | 0.560 (14,22) |
| 52 | 0.740 (18,78) | 0.761 (19,32) | 0.495 (12,58) | 0.560 (14,22) |
| 68 | 0.938 (23,83) | 0.962 (24,43) | 0.850 (21,6) | 0.858 (21,8) |
| 84 | 1.141 (28,99) | 1.165 (29,59) | 1.047 (26,6) | 1.063 (27,0) |



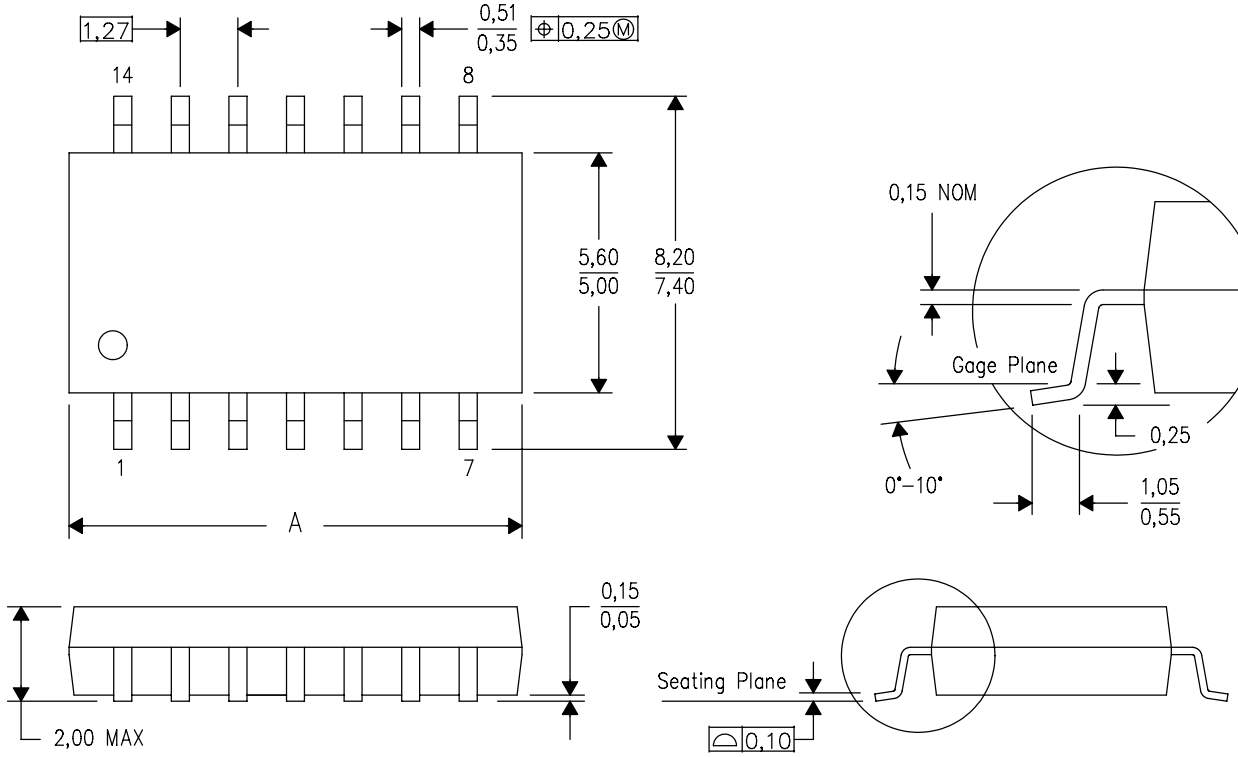

4040140/D 01/11

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 metal lid.
D. Falls within JEDEC MS–004

## MECHANICAL DATA

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

**14-PINS SHOWN**




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

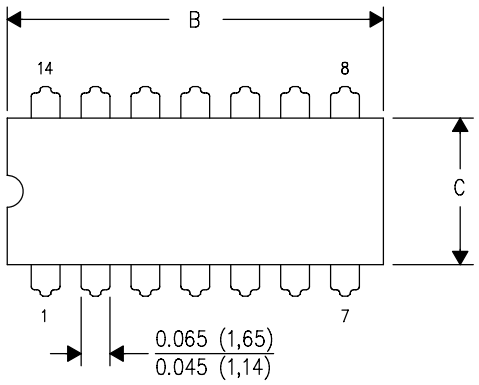
4040062/C 03/03

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

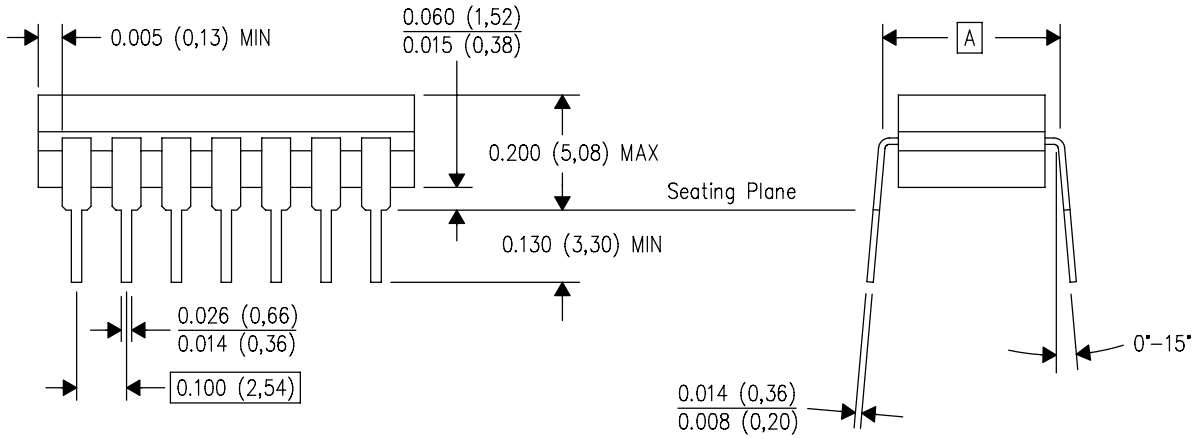
J (R–GDIP–T**)

14 LEADS SHOWN

# CERAMIC DUAL IN–LINE PACKAGE




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



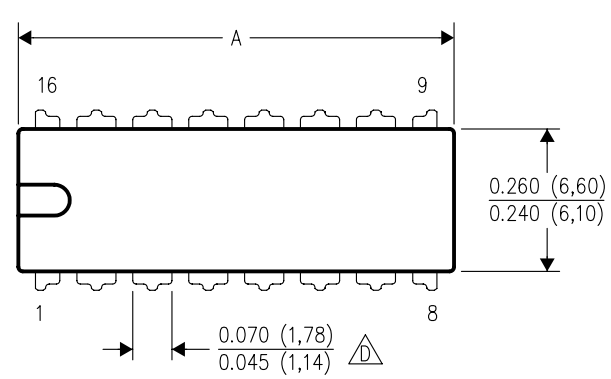

4040083/F 03/03

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

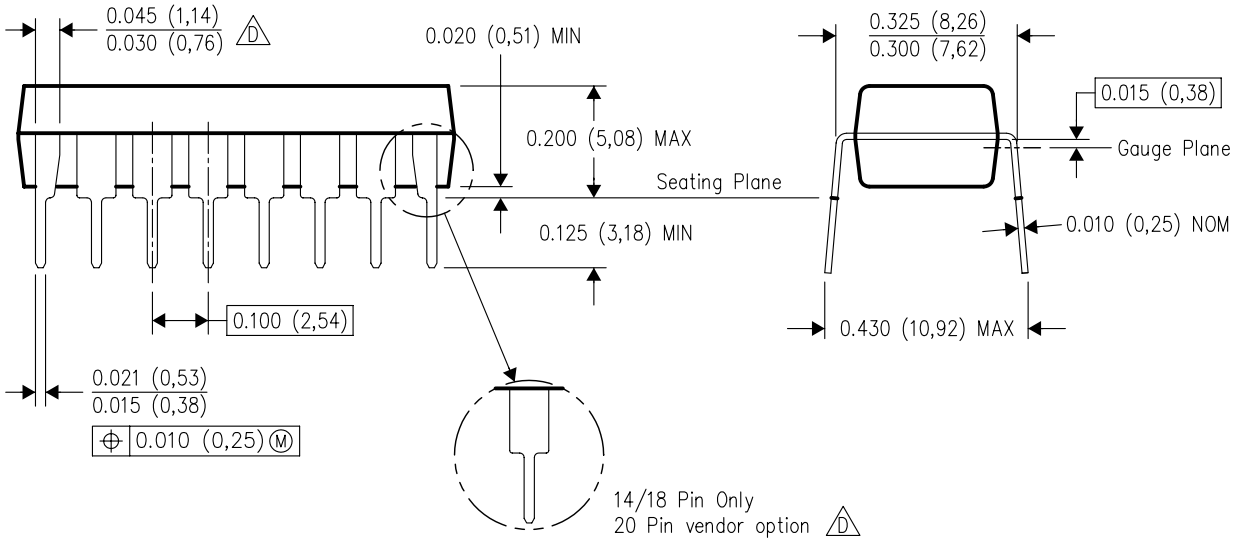
## N (R–PDIP–T**)

## PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN

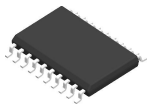



| DIM \ PINS ** | 14 | 16 | 18 | 20 |
|---|---|---|---|---|
| A MAX | 0.775 (19,69) | 0.775 (19,69) | 0.920 (23,37) | 1.060 (26,92) |
| A MIN | 0.745 (18,92) | 0.745 (18,92) | 0.850 (21,59) | 0.940 (23,88) |
| MS–001 VARIATION (C) | AA | BB | AC | AD |




4040049/E 12/2002

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

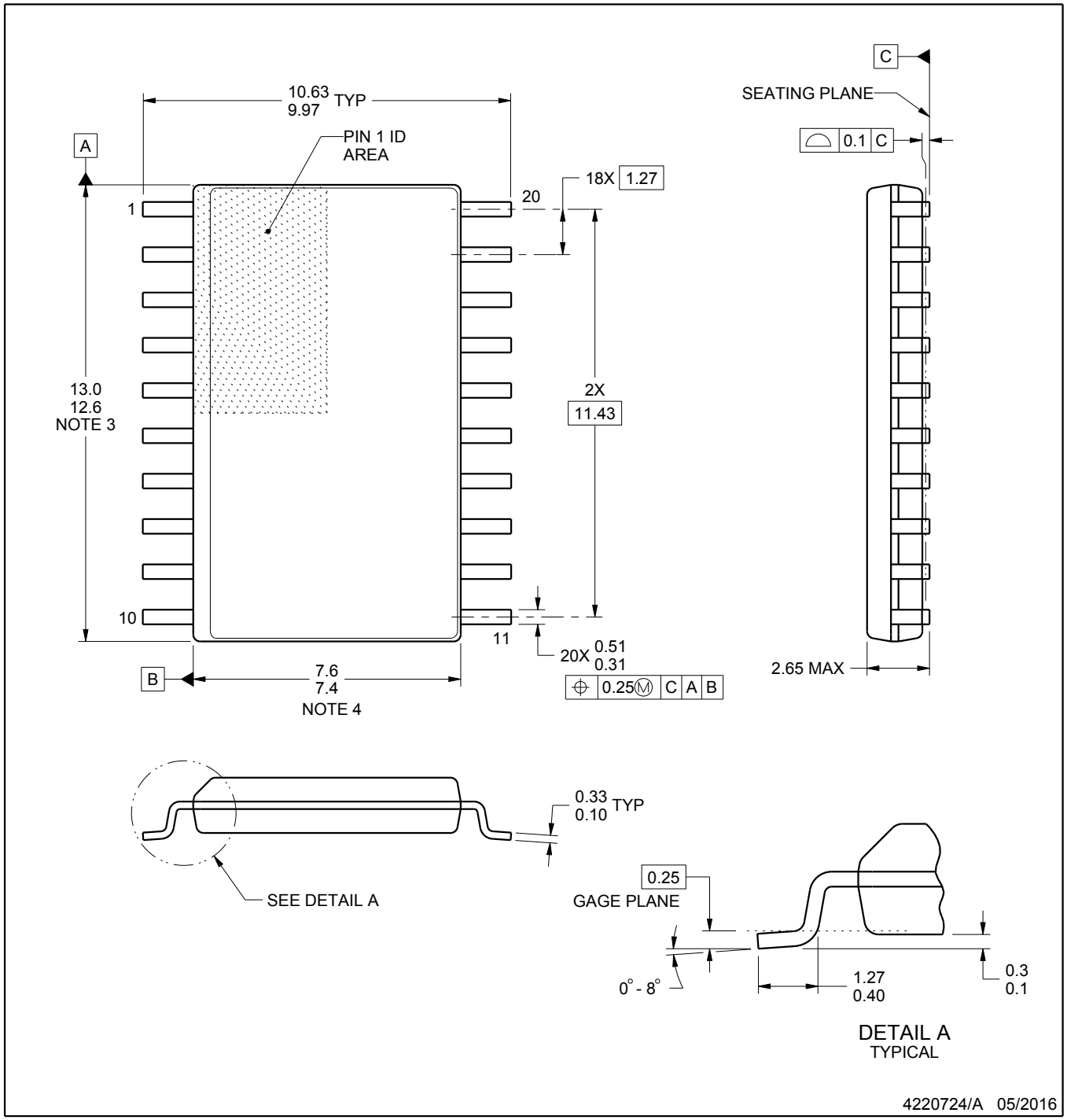


# PACKAGE OUTLINE

## DW0020A

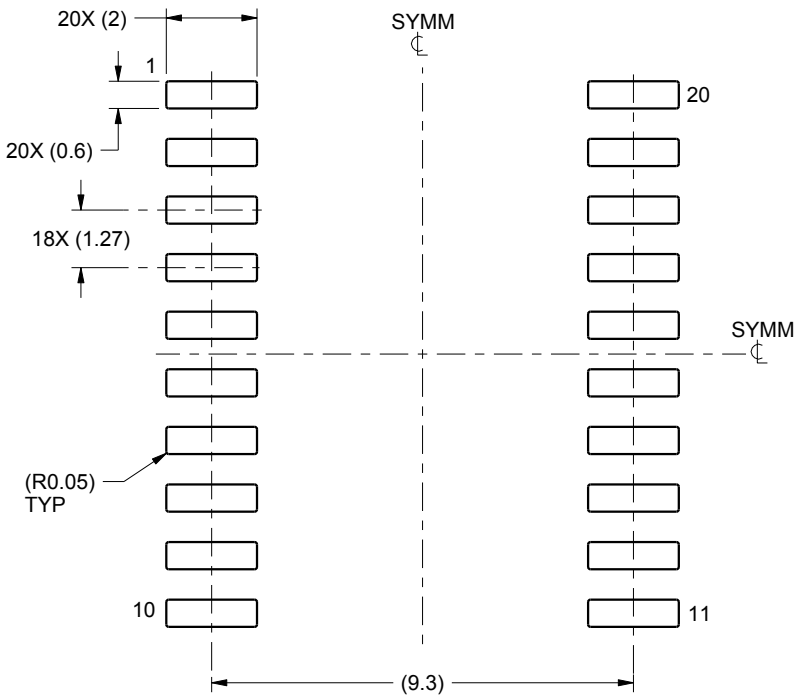
## SOIC - 2.65 mm max height

SOIC

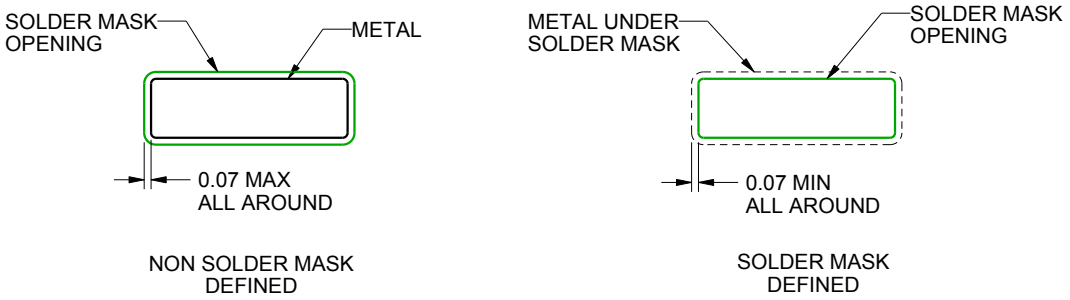



NOTES:

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.




LAND PATTERN EXAMPLE
SCALE:6X

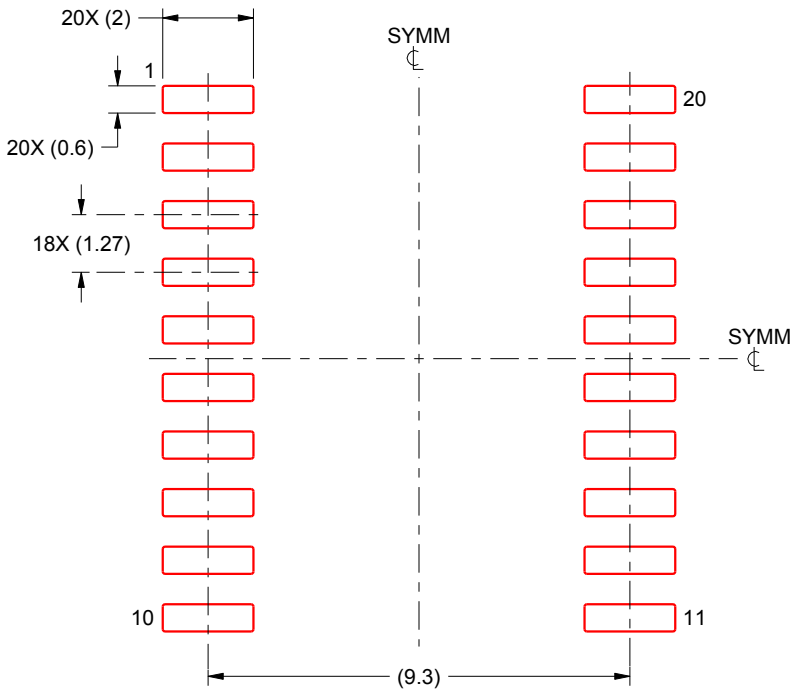



SOLDER MASK DETAILS

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.




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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