

SN74S1051

12-BIT SCHOTTKY BARRIER DIODE BUS-TERMINATION ARRAY

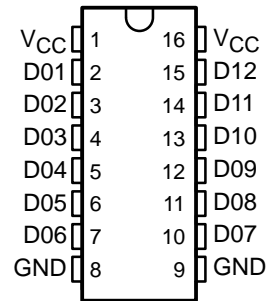
SDLS018B – SEPTEMBER 1990 – REVISED MARCH 2003

- Designed to Reduce Reflection Noise
- Repetitive Peak Forward Current to 200 mA
- 12-Bit Array Structure Suited for Bus-Oriented Systems

description/ordering information

This Schottky barrier diode bus-termination array is designed to reduce reflection noise on memory bus lines. This device consists of a 12-bit high-speed Schottky diode array suitable for clamping to V_{CC} and/or GND.

D, N, NS, OR PW PACKAGE (TOP VIEW)

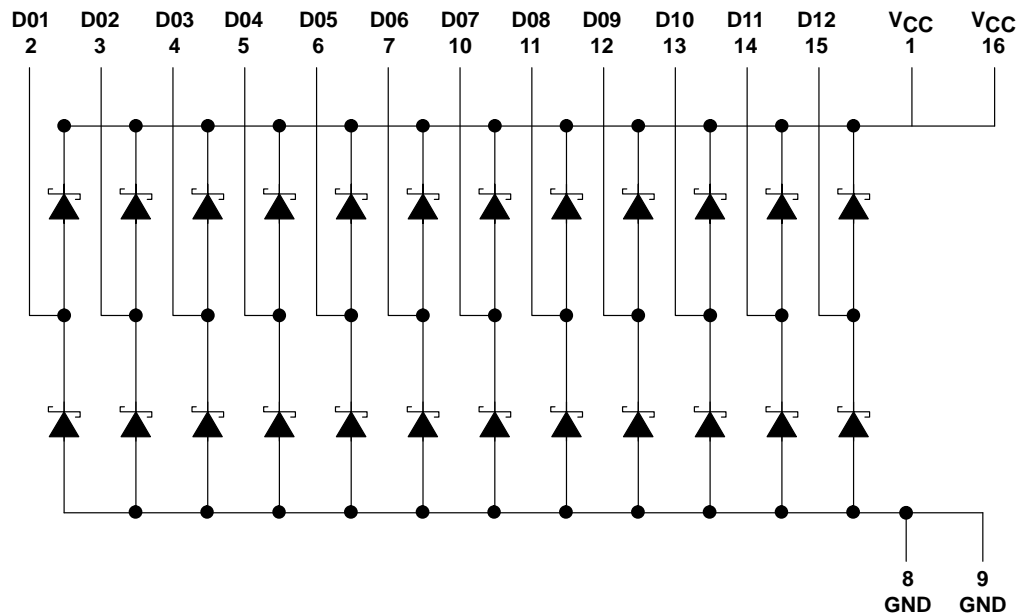


ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – N	Tube	SN74S1051N	SN74S1051N
	SOIC – D	Tube	SN74S1051D	S1051
		Tape and reel	SN74S1051DR	
	SOP – NS	Tape and reel	SN74S1051NSR	74S1051
	TSSOP – PW	Tape and reel	SN74S1051PWR	S1051

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

schematic diagrams



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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12-BIT SCHOTTKY BARRIER DIODE

BUS-TERMINATION ARRAY

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Steady-state reverse voltage, V_R	7 V
Continuous forward current, I_F : Any D terminal from GND or to V_{CC}	50 mA
Total through all GND or V_{CC} terminals	170 mA
Repetitive peak forward current [‡] , I_{FRM} : Any D terminal from GND or V_{CC}	200 mA
Total through all GND or V_{CC} terminals	1 A
Package thermal impedance, θ_{JA} (see Note 1): D package	73°C/W
N package	67°C/W
NS package	64°C/W
PW package	108°C/W
Operating free-air temperature range	0°C to 70°C
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

[‡] These values apply for $t_W \leq 100 \mu s$, duty cycle $\leq 20\%$.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51-7.

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

single-diode operation (see Note 2)

PARAMETER	TEST CONDITIONS	MIN	TYP [§]	MAX	UNIT
V_F Static forward voltage	To V_{CC}	$I_F = 18 \text{ mA}$	0.85	1.05	V
			1.05	1.3	
	From GND	$I_F = 18 \text{ mA}$	0.75	0.95	
			0.95	1.2	
V_{FM} Peak forward voltage		$I_F = 200 \text{ mA}$	1.45		V
I_R Static reverse current	To V_{CC}	$V_R = 7 \text{ V}$		5	μA
	From GND			5	
C_t Total capacitance	$V_R = 0 \text{ V}$, $f = 1 \text{ MHz}$		8	16	pF
	$V_R = 2 \text{ V}$, $f = 1 \text{ MHz}$		4	8	

[§] All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

NOTE 2: Test conditions and limits apply separately to each of the diodes. The diodes not under test are open-circuited during the measurement of these characteristics.

multiple-diode operation

PARAMETER	TEST CONDITIONS	MIN	TYP [§]	MAX	UNIT
I_X Internal crosstalk current	Total I_F current = 1 A, See Note 3		0.8	2	mA
	Total I_F current = 198 mA, See Note 3		0.02	0.2	

[§] All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^\circ\text{C}$.

NOTE 3: I_X is measured under the following conditions with one diode static, all others switching:

Switching diodes: $t_W = 100 \mu s$, duty cycle = 20%

Static diode: $V_R = 5 \text{ V}$

The static diode input current is the internal crosstalk current, I_X .

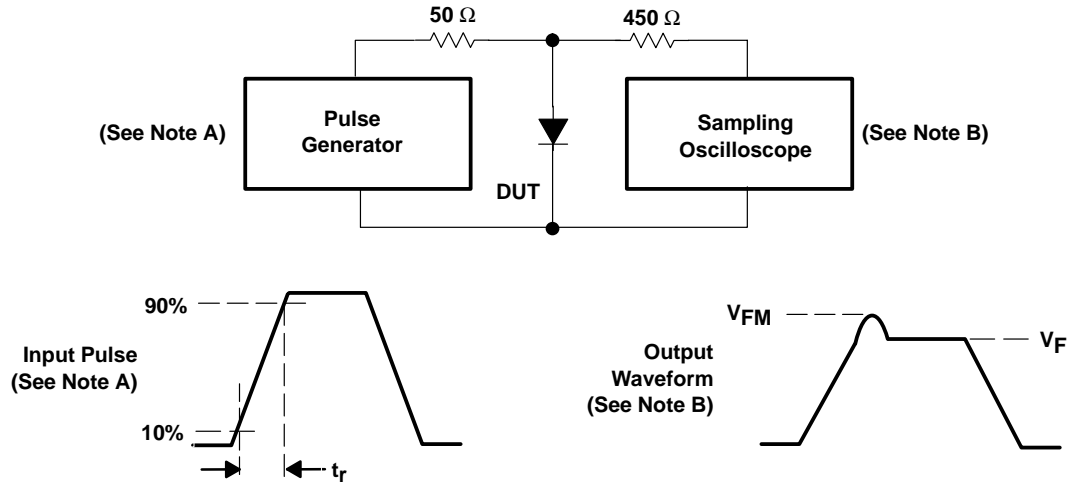
switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 1 and 2)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{rr} Reverse recovery time	$I_F = 10 \text{ mA}$, $I_{RM(REC)} = 10 \text{ mA}$, $I_{R(REC)} = 1 \text{ mA}$, $R_L = 100 \Omega$		8	16	ns



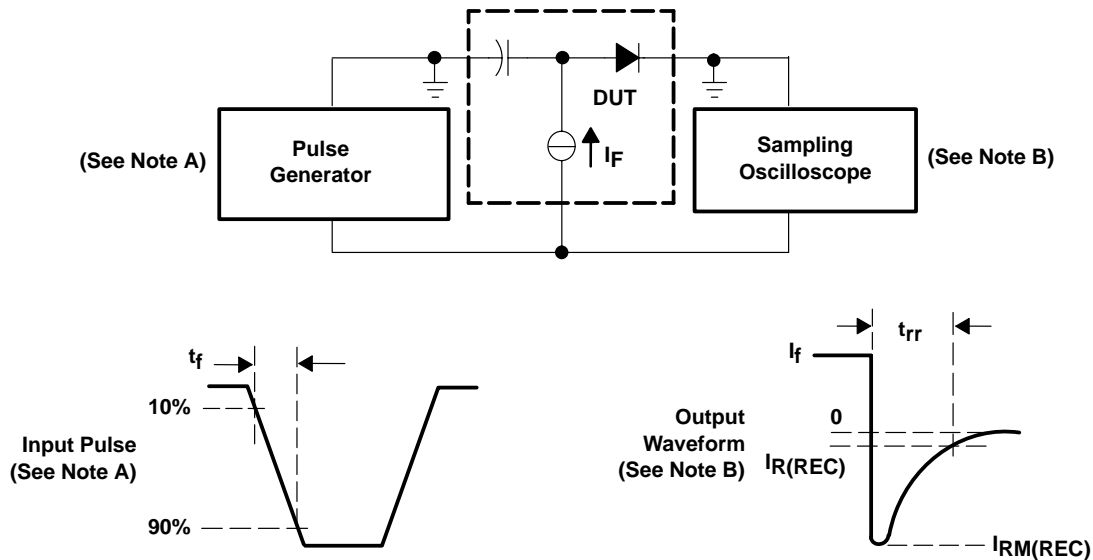
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PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The input pulse is supplied by a pulse generator having the following characteristics: $t_r = 20$ ns, $Z_O = 50$ Ω, freq = 500 Hz, duty cycle = 1%.
B. The output waveform is monitored by an oscilloscope having the following characteristics: $t_r \leq 350$ ps, $R_i = 50$ Ω, $C_i \leq 5$ pF.

Figure 1. Forward Recovery Voltage



- NOTES: A. The input pulse is supplied by a pulse generator having the following characteristics: $t_f = 0.5$ ns, $Z_O = 50$ Ω, $t_w \geq 50$ ns, duty cycle = 1%.
B. The output waveform is monitored by an oscilloscope having the following characteristics: $t_r \leq 350$ ps, $R_i = 50$ Ω, $C_i \leq 5$ pF.

Figure 2. Reverse Recovery Time

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BUS-TERMINATION ARRAY

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APPLICATION INFORMATION

Large negative transients at the inputs of memory devices (DRAMs, SRAMs, EPROMs, etc.) or on the CLOCK lines of many clocked devices can result in improper operation of the devices. The SN74S1051 diode termination array helps suppress negative transients caused by transmission-line reflections, crosstalk, and switching noise.

Diode terminations have several advantages when compared to resistor termination schemes. Split-resistor or Thevenin-equivalent termination can cause a substantial increase in power consumption. The use of a single resistor to ground to terminate a line usually results in degradation of the output high level, resulting in reduced noise immunity. Series damping resistors placed on the outputs of the driver reduce negative transients, but they also can increase propagation delays down the line because a series resistor reduces the output drive capability of the driving device. Diode terminations have none of these drawbacks.

The operation of the diode arrays in reducing negative transients is explained in the following figures. The diode conducts current when the voltage reaches a negative value large enough for the diode to turn on. Suppression of negative transients is tracked by the current-voltage characteristic curve for that diode. Typical current-versus-voltage curves for the SN74S1051 are shown in Figures 3 and 4.

To illustrate how the diode arrays act to reduce negative transients at the end of a transmission line, the test setup in Figure 5 was evaluated. The resulting waveforms with and without the diode are shown in Figure 6.

The maximum effectiveness of the diode arrays in suppressing negative transients occurs when the diode arrays are placed at the end of a line and/or the end of a long stub branching off a main transmission line. The diodes can also reduce the negative transients that occur due to discontinuities in the middle of a line. An example of this is a slot in a backplane that is provided for an add-on card.

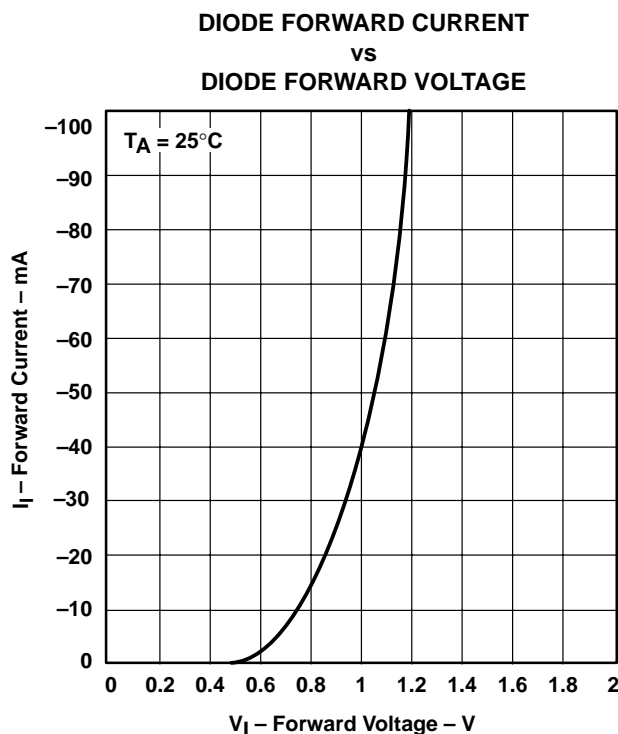


Figure 3. Typical Input Current vs Input Voltage
(Lower Diode)

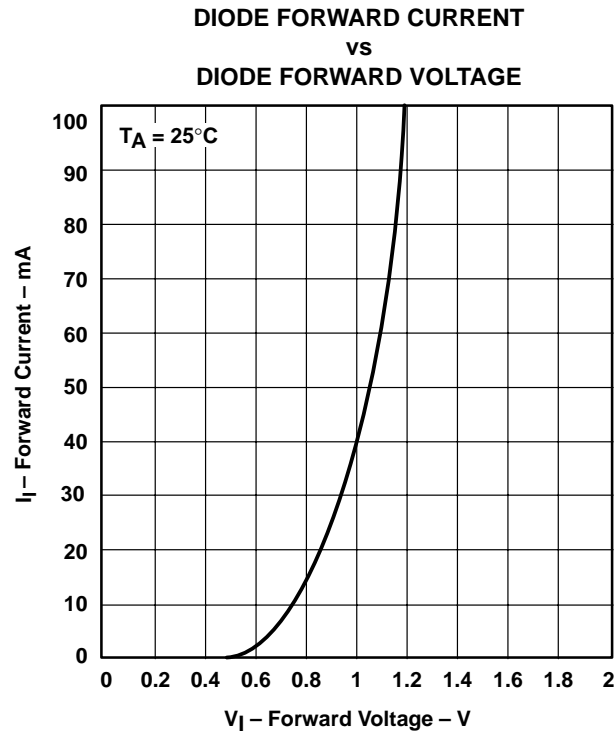
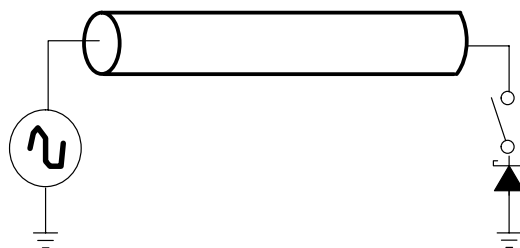


Figure 4. Typical Input Current vs Input Voltage
(Upper Diode)

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$Z_0 = 50 \, \Omega$
Length = 36 in.



31.500 ns 56.500 ns 81.500 ns

End-of-Line Without Diode

End-of-Line With Diode

Vmarker 1

Vmarker 2

Ch 2 = 1.880 V/div

Timebase = 5.00 ns/V

Memory 1 = 1.880 V/div

Vmarker 1 = -1.353 V

Vmarker 2 = -3.647 V

Offset = 0.000 V

Delay = 56.500 ns

Delta V = -2.293 V

Figure 6. Reduction of Negative Transients at the End of a Transmission Line

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
SN74S1051D	Obsolete	Production	SOIC (D) 16	-	-	Call TI	Call TI	0 to 70	S1051
SN74S1051DR	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	S1051
SN74S1051DR.A	Active	Production	SOIC (D) 16	2500 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	S1051
SN74S1051N	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74S1051N
SN74S1051N.A	Active	Production	PDIP (N) 16	25 TUBE	Yes	NIPDAU	N/A for Pkg Type	0 to 70	SN74S1051N
SN74S1051NSR	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	74S1051
SN74S1051NSR.A	Active	Production	SOP (NS) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	74S1051
SN74S1051PW	Obsolete	Production	TSSOP (PW) 16	-	-	Call TI	Call TI	0 to 70	S1051
SN74S1051PWR	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	S1051
SN74S1051PWR.A	Active	Production	TSSOP (PW) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	S1051

⁽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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TAPE AND REEL INFORMATION



*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
SN74S1051DR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
SN74S1051NSR	SOP	NS	16	2000	330.0	16.4	8.1	10.4	2.5	12.0	16.0	Q1
SN74S1051PWR	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)
SN74S1051DR	SOIC	D	16	2500	353.0	353.0	32.0
SN74S1051NSR	SOP	NS	16	2000	353.0	353.0	32.0
SN74S1051PWR	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)
SN74S1051N	N	PDIP	16	25	506	13.97	11230	4.32
SN74S1051N	N	PDIP	16	25	506	13.97	11230	4.32
SN74S1051N.A	N	PDIP	16	25	506	13.97	11230	4.32
SN74S1051N.A	N	PDIP	16	25	506	13.97	11230	4.32



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



SOLDER MASK DETAILS

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.



SOP - 2.00 mm max height

[illegible]

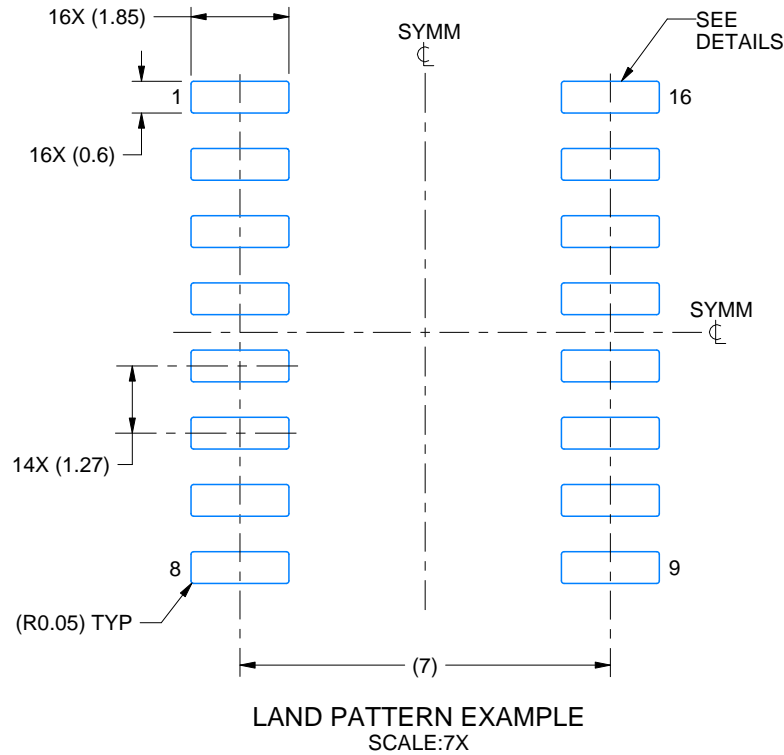
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate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

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.

N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
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	AA	BB	AC	AD



4040049/E 12/2002

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

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