



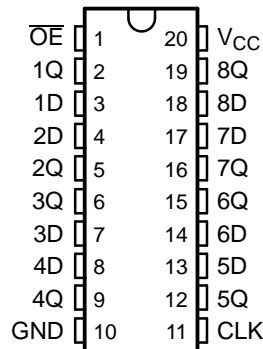
# THE DATASHEET OF SN74ALVCH374NG4



## FEATURES

- Operates From 1.65 V to 3.6 V
- Max  $t_{pd}$  of 3.6 ns at 3.3 V
- $\pm 24$ -mA Output Drive at 3.3 V
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

DB, DGV, DW, N, OR PW PACKAGE  
(TOP VIEW)



## DESCRIPTION/ORDERING INFORMATION

This octal edge-triggered D-type flip-flop is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

The SN74ALVCH374 is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels at the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without interface or pullup components.

$\overline{OE}$  does not affect internal operations of the latch. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Active bus-hold circuitry holds unused or undriven inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

## ORDERING INFORMATION

$T_A$	PACKAGE <sup>(1)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	PDIP - N	Tube	SN74ALVCH374N	SN74ALVCH374N
	SOIC - DW	Tube	SN74ALVCH374DW	ALVCH374
		Tape and reel	SN74ALVCH374DWR	
	SSOP - DB	Tape and reel	SN74ALVCH374DBR	VB374
	TSSOP - PW	Tube	SN74ALVCH374PW	VB374
		Tape and reel	SN74ALVCH374PWR	
TVSOP - DGV	Tape and reel	SN74ALVCH374DGVR	VB374	

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



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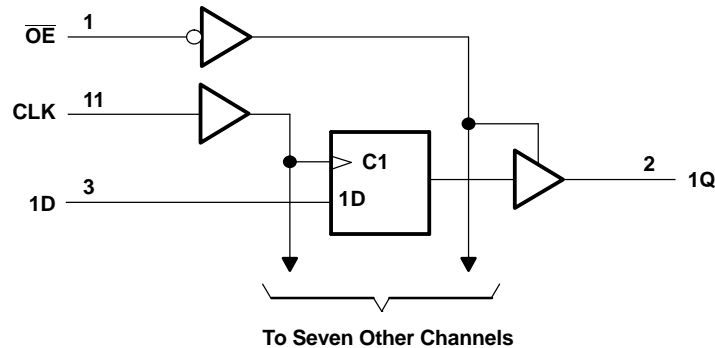
**SN74ALVCH374**  
**OCTAL POSITIVE EDGE-TRIGGERED D-TYPE FLIP-FLOP**  
**WITH 3-STATE OUTPUTS**

SCES118G—JULY 1997—REVISED OCTOBER 2004

**FUNCTION TABLE**

INPUTS			OUTPUT Q
$\overline{OE}$	CLK	D	
L	↑	H	H
L	↑	L	L
L	H or L	X	$Q_0$
H	X	X	Z

**LOGIC DIAGRAM (POSITIVE LOGIC)**



**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

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

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage range	-0.5	4.6	V
$V_I$	Input voltage range <sup>(2)</sup>	-0.5	4.6	V
$V_O$	Output voltage range <sup>(2)(3)</sup>	-0.5	$V_{CC} + 0.5$	V
$I_{IK}$	Input clamp current		-50	mA
$I_{OK}$	Output clamp current		-50	mA
$I_O$	Continuous output current		±50	mA
	Continuous current through $V_{CC}$ or GND		±100	mA
$\theta_{JA}$	Package thermal impedance <sup>(4)</sup>	DB package	70	°C/W
		DGV package	92	
		DW package	58	
		N package	69	
		PW package	83	
$T_{stg}$	Storage temperature range	-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 negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) This value is limited to 4.6 V maximum.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.

**RECOMMENDED OPERATING CONDITIONS<sup>(1)</sup>**

		MIN	MAX	UNIT
$V_{CC}$	Supply voltage	1.65	3.6	V
$V_{IH}$	High-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	2	
$V_{IL}$	Low-level input voltage	$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.7	
		$V_{CC} = 2.7\text{ V to }3.6\text{ V}$	0.8	
$V_I$	Input voltage	0	$V_{CC}$	V
$V_O$	Output voltage	0	$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 1.65\text{ V}$	-4	mA
		$V_{CC} = 2.3\text{ V}$	-12	
		$V_{CC} = 2.7\text{ V}$	-12	
		$V_{CC} = 3\text{ V}$	-24	
$I_{OL}$	Low-level output current	$V_{CC} = 1.65\text{ V}$	4	mA
		$V_{CC} = 2.3\text{ V}$	12	
		$V_{CC} = 2.7\text{ V}$	12	
		$V_{CC} = 3\text{ V}$	24	
$\Delta t/\Delta v$	Input transition rise or fall rate		5	ns/V
$T_A$	Operating free-air temperature	-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 CMOS Inputs*, literature number SCBA004.

# SN74ALVCH374

## OCTAL POSITIVE EDGE-TRIGGERED D-TYPE FLIP-FLOP WITH 3-STATE OUTPUTS

SCES118G–JULY 1997–REVISED OCTOBER 2004

### ELECTRICAL CHARACTERISTICS

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
V <sub>OH</sub>	I <sub>OH</sub> = -100 μA	1.65 V to 3.6 V	V <sub>CC</sub> - 0.2			V	
	I <sub>OH</sub> = -4 mA	1.65 V	1.2				
	I <sub>OH</sub> = -6 mA	2.3 V	2				
	I <sub>OH</sub> = -12 mA	2.3 V	1.7				
		2.7 V	2.2				
		3 V	2.4				
I <sub>OH</sub> = -24 mA	3 V	2					
V <sub>OL</sub>	I <sub>OL</sub> = 100 μA	1.65 V to 3.6 V	0.2			V	
	I <sub>OL</sub> = 4 mA	1.65 V	0.45				
	I <sub>OL</sub> = 6 mA	2.3 V	0.4				
	I <sub>OL</sub> = 12 mA	2.3 V	0.7				
		2.7 V	0.4				
	I <sub>OL</sub> = 24 mA	3 V	0.55				
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	3.6 V	±5			μA	
I <sub>I(hold)</sub>	V <sub>I</sub> = 0.58 V	1.65 V	25			μA	
	V <sub>I</sub> = 1.07 V	1.65 V	-25				
	V <sub>I</sub> = 0.7 V	2.3 V	45				
	V <sub>I</sub> = 1.7 V	2.3 V	-45				
	V <sub>I</sub> = 0.8 V	3 V	75				
	V <sub>I</sub> = 2 V	3 V	-75				
	V <sub>I</sub> = 0 to 3.6 V <sup>(2)</sup>	3.6 V	±500				
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	3.6 V	±10			μA	
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	3.6 V	10			μA	
ΔI <sub>CC</sub>	One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND	3 V to 3.6 V	750			μA	
C <sub>i</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND	3.3 V			5	pF
	Data inputs						
C <sub>o</sub>	Outputs	V <sub>O</sub> = V <sub>CC</sub> or GND	3.3 V			7.5	pF

 (1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

(2) This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

### TIMING REQUIREMENTS

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

		V <sub>CC</sub> = 1.8 V ± 0.15 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		V <sub>CC</sub> = 2.7 V		V <sub>CC</sub> = 3.3 V ± 0.3 V		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
f <sub>clock</sub>	Clock frequency			100		100		150		MHz
t <sub>w</sub>	Pulse duration, CLK high or low	3.8		3.3		3.3		3.3		ns
t <sub>su</sub>	Setup time, data before CLK↑	3		1.8		2.1		1.8		ns
t <sub>h</sub>	Hold time, data after CLK↑	1		0.5		0.5		0.5		ns

**SWITCHING CHARACTERISTICS**

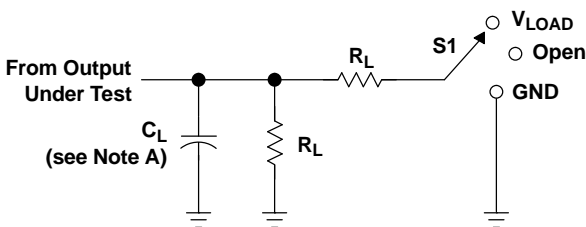
over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 1.8\text{ V}$ $\pm 0.15\text{ V}$		$V_{CC} = 2.5\text{ V}$ $\pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V}$ $\pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$f_{max}$					100		100		150		MHz
$t_{pd}$	CLK	Q	1.5	6.4	1	3.9	3.6		1.1	3.6	ns
$t_{en}$	$\overline{OE}$	Q	3.6	8.1	2.1	5.6	5.3		1.6	5.2	ns
$t_{dis}$	$\overline{OE}$	Q	2.7	7.9	0.9	4.5	4.4		1.2	4.5	ns

**OPERATING CHARACTERISTICS**
 $T_A = 25^\circ\text{C}$ 

PARAMETER		TEST CONDITIONS	$V_{CC} = 1.8\text{ V}$	$V_{CC} = 2.5\text{ V}$	$V_{CC} = 3.3\text{ V}$	UNIT
			TYP	TYP	TYP	
$C_{pd}$	Power dissipation capacitance per flip-flop	Outputs enabled	44	46	50	pF
		Outputs disabled	24	26	29.5	

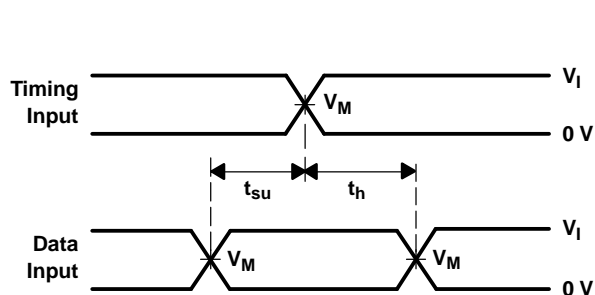
**PARAMETER MEASUREMENT INFORMATION**



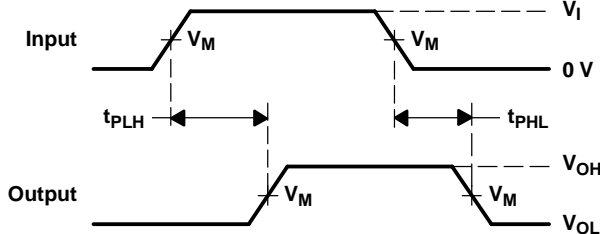
**LOAD CIRCUIT**

TEST	S1
$t_{pd}$ $t_{PLZ}/t_{PZL}$ $t_{PHZ}/t_{PZH}$	Open $V_{LOAD}$ GND

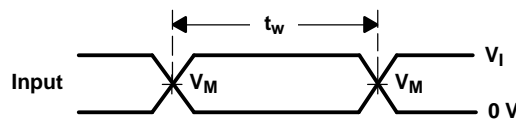
$V_{CC}$	INPUT		$V_M$	$V_{LOAD}$	$C_L$	$R_L$	$V_{\Delta}$
	$V_I$	$t_r/t_f$					
$1.8\text{ V} \pm 0.15\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	1 k $\Omega$	0.15 V
$2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC}$	$\leq 2\text{ ns}$	$V_{CC}/2$	$2 \times V_{CC}$	30 pF	500 $\Omega$	0.15 V
2.7 V	2.7 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V
$3.3\text{ V} \pm 0.3\text{ V}$	2.7 V	$\leq 2.5\text{ ns}$	1.5 V	6 V	50 pF	500 $\Omega$	0.3 V



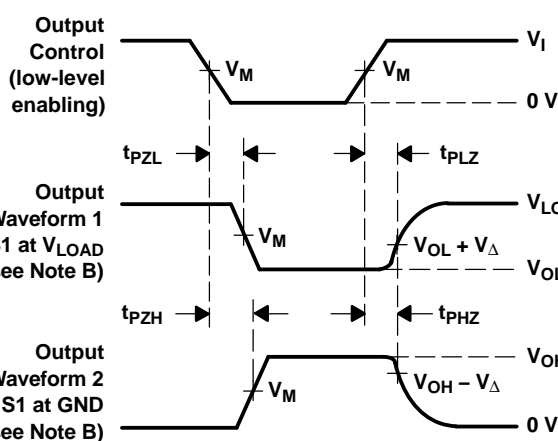
**VOLTAGE WAVEFORMS**  
**SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS**  
**PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS**  
**PULSE DURATION**



**VOLTAGE WAVEFORMS**  
**ENABLE AND DISABLE TIMES**

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ .  
D. The outputs are measured one at a time, with one transition per measurement.  
E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .  
F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .  
G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .  
H. All parameters and waveforms are not applicable to all devices.

**Figure 1. Load Circuit and Voltage Waveforms**

**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
SN74ALVCH374DGVR	ACTIVE	TVSOP	DGV	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VB374	<a href="#">Samples</a>
SN74ALVCH374DW	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	ALVCH374	<a href="#">Samples</a>
SN74ALVCH374PW	ACTIVE	TSSOP	PW	20	70	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VB374	<a href="#">Samples</a>
SN74ALVCH374PWR	ACTIVE	TSSOP	PW	20	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	VB374	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** 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.

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**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
SN74ALVCH374DGVR	TVSOP	DGV	20	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74ALVCH374PWR	TSSOP	PW	20	2000	330.0	16.4	6.95	7.0	1.4	8.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74ALVCH374DGVR	TVSOP	DGV	20	2000	356.0	356.0	35.0
SN74ALVCH374PWR	TSSOP	PW	20	2000	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
SN74ALVCH374DW	DW	SOIC	20	25	507	12.83	5080	6.6
SN74ALVCH374PW	PW	TSSOP	20	70	530	10.2	3600	3.5

PW0020A



# PACKAGE OUTLINE

## TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4220206/A 02/2017

### 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

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

4220206/A 02/2017

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

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



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

4220206/A 02/2017

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.

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DGV (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- 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 per side.  
 D. Falls within JEDEC: 24/48 Pins – MO-153  
 14/16/20/56 Pins – MO-194

# DW0020A



# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

### NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

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

# EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



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

4220724/A 05/2016

NOTES: (continued)

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

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