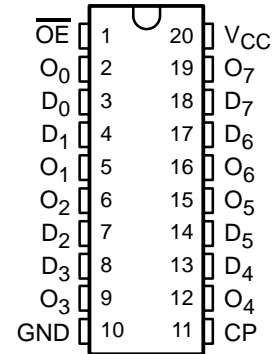


CY74FCT2374T 8-BIT REGISTER WITH 3-STATE OUTPUTS

SCCS040A – SEPTEMBER 1994 – REVISED OCTOBER 2001

- Function and Pinout Compatible With FCT and F Logic
- 25- Ω Output Series Resistors to Reduce Transmission-Line Reflection Noise
- Reduced V_{OH} (Typically = 3.3 V) Version of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- I_{off} Supports Partial-Power-Down Mode Operation
- Matched Rise and Fall Times
- Fully Compatible With TTL Input and Output Logic Levels
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)
- 3-State Outputs
- 12-mA Output Sink Current
15-mA Output Source Current
- Edge-Triggered D-Type Inputs
- 250-MHz Typical Switching Rate

SN74FCT2374T . . . Q OR SO PACKAGE
(TOP VIEW)



description

The CY74FCT2374T is a high-speed, low-power, octal D-type flip-flop featuring separate D-type inputs for each flip-flop. On-chip termination resistors at the outputs reduce system noise caused by reflections. The CY74FCT2374T can replace the CY74FCT374T to reduce noise in an existing design. The device has 3-state outputs for bus-oriented applications. A buffered clock (CP) and output-enable (\overline{OE}) inputs are common to all flip-flops. The flip-flops in the CY74FCT2374T store the state of their individual data (D) inputs that meet the setup-time and hold-time requirements on the low-to-high CP transition. When \overline{OE} is low, the contents of the flip-flops are available at the outputs. When \overline{OE} is high, the outputs are in the high-impedance state. The state of \overline{OE} does not affect the state of the flip-flops.

This device is fully specified for partial-power-down applications using I_{off} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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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CY74FCT2374T

8-BIT REGISTER

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ORDERING INFORMATION

TA	PACKAGE†		SPEED (ns)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QSOP – Q	Tape and reel	5.2	CY74FCT2374CTQCT	FCT2374C
	SOIC – SO	Tube	5.2	CY74FCT2374CTSOC	FCT2374C
		Tape and reel	5.2	CY74FCT2374CTSOCT	
	QSOP – Q	Tape and reel	6.5	CY74FCT2374ATQCT	FCT2374A
	SOIC – SO	Tube	6.5	CY74FCT2374ATSOC	FCT2374A
		Tape and reel	6.5	CY74FCT2374ATSOCT	
	SOIC – SO	Tube	10	CY74FCT2374TSOC	FCT2374
		Tape and reel	10	CY74FCT2374TSOCT	

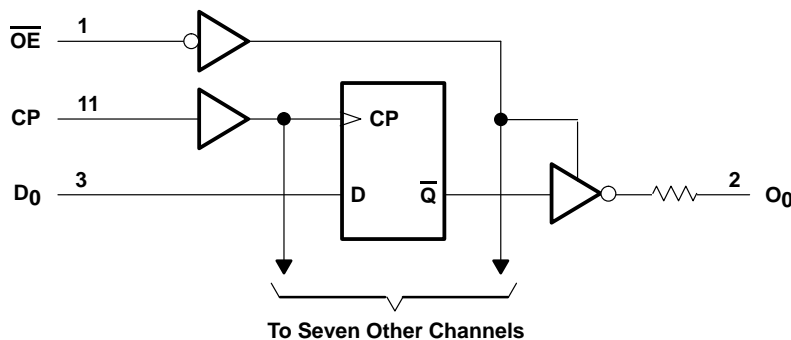
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

INPUTS			OUTPUT
D	CP	\overline{OE}	O
H	↑	L	H
L	↑	L	L
X	X	H	Z

H = High logic level, L = Low logic level,
 X = Don't care, Z = High-impedance state, ↑ = Low-to-high clock transition

logic diagram (positive logic)



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absolute maximum rating over operating free-air temperature range (unless otherwise noted)†

Supply voltage range to ground potential	–0.5 V to 7 V
DC input voltage range	–0.5 V to 7 V
DC output voltage range	–0.5 V to 7 V
DC output current (maximum sink current/pin)	120 mA
Package thermal impedance, θ_{JA} (see Note 1): Q package	68°C/W
SO package	58°C/W
Ambient temperature range with power applied, T_A	–65°C to 135°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.

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

recommended operating conditions (see Note 2)

	MIN	NOM	MAX	UNIT
V_{CC} Supply voltage	4.75	5	5.25	V
V_{IH} High-level input voltage	2			V
V_{IL} Low-level input voltage			0.8	V
I_{OH} High-level output current			–15	mA
I_{OL} Low-level output current			12	mA
T_A Operating free-air temperature	–40		85	°C

NOTE 2: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation.



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

PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}	$V_{CC} = 4.75\text{ V}$,	$I_{IN} = -18\text{ mA}$		-0.7	-1.2	V
V_{OH}	$V_{CC} = 4.75\text{ V}$,	$I_{OH} = -15\text{ mA}$	2.4	3.3		V
V_{OL}	$V_{CC} = 4.75\text{ V}$,	$I_{OL} = 12\text{ mA}$		0.3	0.55	V
R_{OUT}	$V_{CC} = 4.75\text{ V}$,	$I_{OL} = 12\text{ mA}$	20	25	40	Ω
V_{hys}	All inputs			0.2		V
I_I	$V_{CC} = 5.25\text{ V}$,	$V_{IN} = V_{CC}$			5	μA
I_{IH}	$V_{CC} = 5.25\text{ V}$,	$V_{IN} = 2.7\text{ V}$			± 1	μA
I_{IL}	$V_{CC} = 5.25\text{ V}$,	$V_{IN} = 0.5\text{ V}$			± 1	μA
I_{OZH}	$V_{CC} = 5.25\text{ V}$,	$V_{OUT} = 2.7\text{ V}$			10	μA
I_{OZL}	$V_{CC} = 5.25\text{ V}$,	$V_{OUT} = 0.5\text{ V}$			-10	μA
I_{OS}^\ddagger	$V_{CC} = 5.25\text{ V}$,	$V_{OUT} = 0\text{ V}$	-60	-120	-225	mA
I_{off}	$V_{CC} = 0\text{ V}$,	$V_{OUT} = 4.5\text{ V}$			± 1	μA
I_{CC}	$V_{CC} = 5.25\text{ V}$,	$V_{IN} \leq 0.2\text{ V}$, $V_{IN} \geq V_{CC} - 0.2\text{ V}$		0.1	0.2	mA
ΔI_{CC}	$V_{CC} = 5.25\text{ V}$, $V_{IN} = 3.4\text{ V}^\S$, $f_1 = 0$, Outputs open			0.5	2	mA
I_{CCD}^\parallel	$V_{CC} = 5.25\text{ V}$, Outputs open, One input switching at 50% duty cycle, $\overline{OE} = \text{GND}$, $V_{IN} \leq 0.2\text{ V}$ or $V_{IN} \geq V_{CC} - 0.2\text{ V}$			0.06	0.12	mA/MHz
$I_C^\#$	$V_{CC} = 5.25\text{ V}$, Outputs open, $f_0 = 10\text{ MHz}$, $\overline{OE} = \text{GND}$	One bit switching at $f_1 = 5\text{ MHz}$ at 50% duty cycle	$V_{IN} \leq 0.2\text{ V}$ or $V_{IN} \geq V_{CC} - 0.2\text{ V}$	0.7	1.4	mA
			$V_{IN} = 3.4\text{ V}$ or GND	1.2	3.4	
		Eight bits switching at $f_1 = 2.5\text{ MHz}$ at 50% duty cycle	$V_{IN} \leq 0.2\text{ V}$ or $V_{IN} \geq V_{CC} - 0.2\text{ V}$	1.6	3.2	
			$V_{IN} = 3.4\text{ V}$ or GND	3.9	12.2	
C_i				5	10	pF
C_o				9	12	pF

† Typical values are at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.

‡ Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample-and-hold techniques are preferable to minimize internal chip heating and more accurately reflect operational values. Otherwise, prolonged shorting of a high output can raise the chip temperature well above normal and cause invalid readings in other parametric tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

§ Per TTL-driven input ($V_{IN} = 3.4\text{ V}$); all other inputs at V_{CC} or GND

¶ This parameter is derived for use in total power-supply calculations.

$$\# I_C = I_{CC} + \Delta I_{CC} \times D_H \times N_T + I_{CCD} (f_0/2 + f_1 \times N_1)$$

Where:

I_C = Total supply current

I_{CC} = Power-supply current with CMOS input levels

ΔI_{CC} = Power-supply current for a TTL high input ($V_{IN} = 3.4\text{ V}$)

D_H = Duty cycle for TTL inputs high

N_T = Number of TTL inputs at D_H

I_{CCD} = Dynamic current caused by an input transition pair (HLH or LHL)

f_0 = Clock frequency for registered devices, otherwise zero

f_1 = Input signal frequency

N_1 = Number of inputs changing at f_1

All currents are in milliamperes and all frequencies are in megahertz.

|| Values for these conditions are examples of the I_{CC} formula.



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

		CY74FCT2374T		CY74FCT2374AT		CY74FCT2374CT		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, CP	7		5		4		ns
t_{su}	Setup time, data before CP \uparrow	2		2		1.5		ns
t_h	Hold time, data after CP \uparrow	1.5		1.5		1		ns

switching characteristics over operating free-air temperature range (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT2374T		CY74FCT2374AT		CY74FCT2374CT		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_{PLH}	CP	O	2	10	2	6.5	2	5.2	ns
t_{PHL}			2	10	2	6.5	2	5.2	
t_{PZH}	\overline{OE}	O	1.5	12.5	1.5	6.5	1.5	6.2	ns
t_{PZL}			1.5	12.5	1.5	6.5	1.5	6.2	
t_{PHZ}	\overline{OE}	O	1.5	8	1.5	5.5	1.5	5	ns
t_{PLZ}			1.5	8	1.5	5.5	1.5	5	

CY74FCT2374T
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PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS

LOAD CIRCUIT FOR 3-STATE OUTPUTS



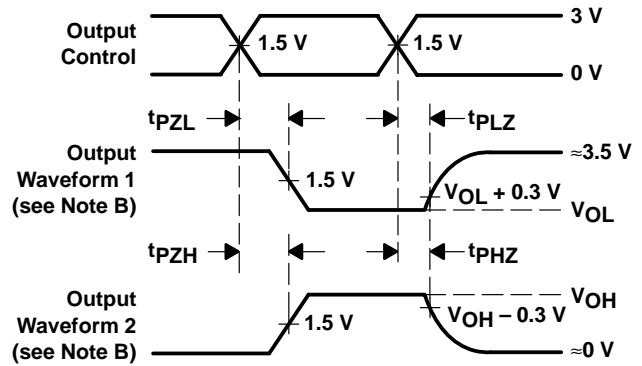
VOLTAGE WAVEFORMS PULSE DURATION



VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES LOW- AND HIGH-LEVEL ENABLING

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

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
CY74FCT2574ATQCT	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2574A	Samples
CY74FCT2574ATSOC	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2574A	Samples
CY74FCT2574CTQCT	ACTIVE	SSOP	DBQ	20	2500	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT2574C	Samples
CY74FCT2574CTSOC	ACTIVE	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT2574C	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.

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
CY74FCT2574ATQCT	SSOP	DBQ	20	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT2574CTQCT	SSOP	DBQ	20	2500	330.0	16.4	6.5	9.0	2.1	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)
CY74FCT2574ATQCT	SSOP	DBQ	20	2500	356.0	356.0	35.0
CY74FCT2574CTQCT	SSOP	DBQ	20	2500	356.0	356.0	35.0

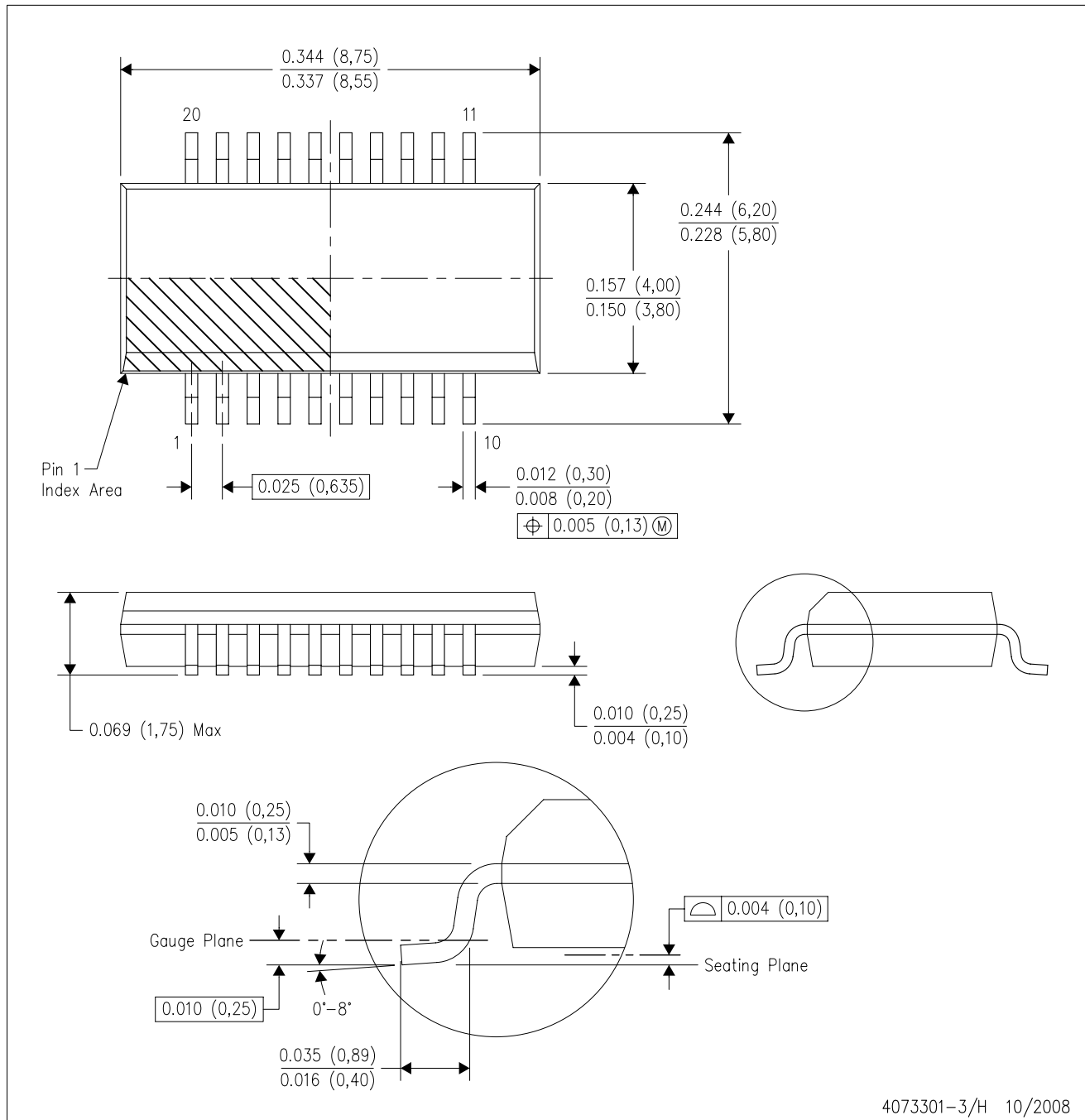
TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CY74FCT2574ATSOC	DW	SOIC	20	25	507	12.83	5080	6.6
CY74FCT2574CTSOC	DW	SOIC	20	25	507	12.83	5080	6.6

DBQ (R-PDSO-G20)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15) per side.
 - D. Falls within JEDEC MO-137 variation AD.

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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