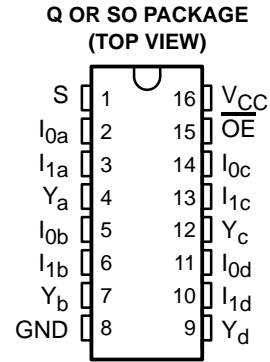


# CY74FCT2257T QUAD 2-INPUT MULTIPLEXER WITH 3-STATE OUTPUTS

SCCS038B – SEPTEMBER 1994 – REVISED OCTOBER 2001

- Function and Pinout Compatible With FCT and F Logic
- 25- $\Omega$  Output Series Resistors to Reduce Transmission-Line Reflection Noise
- TTL Output Level Versions of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- 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)
- 12-mA Output Sink Current  
15-mA Output Source Current
- 3-State Outputs



## description

The CY74FCT2257T has four identical two-input multiplexers that select four bits of data from two sources under the control of a common data-select (S) input. The  $I_0$  inputs are selected when S is low, and the  $I_1$  inputs are selected when S is high. Data appears at the output in noninverted form for the CY74FCT2257T. On-chip termination resistors at the outputs reduce system noise caused by reflections. The CY74FCT2257T can replace the FCT257T to reduce noise in an existing design.

The CY74FCT2257T is a logic implementation of a four-pole, two-position switch, in which the position of the switch is determined by the logic levels supplied to S. Outputs are forced to the high-impedance off state when the output-enable ( $\overline{OE}$ ) input is high.

All but one device must be in the high-impedance state to prevent currents from exceeding the maximum ratings if outputs are tied together. Design of the  $\overline{OE}$  signals must ensure that there is no overlap when outputs of 3-state devices are tied together.

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.

### PIN DESCRIPTION

NAME	DESCRIPTION
I	Data inputs
S	Common data-select input
$\overline{OE}$	Output-enable input (active low)
Y	Data outputs



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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# CY74FCT2257T QUAD 2-INPUT MULTIPLEXER WITH 3-STATE OUTPUTS

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## ORDERING INFORMATION

T <sub>A</sub>	PACKAGE†		SPEED (ns)	ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 85°C	QSOP – Q	Tape and reel	4.3	CY74FCT2257CTQCT	FR257-3
	SOIC – SO	Tube	4.3	CY74FCT2257CTSOC	FCT2257C
		Tape and reel	4.3	CY74FCT2257CTSOCT	
	QSOP – Q	Tape and reel	5	CY74FCT2257ATQCT	FR257-1

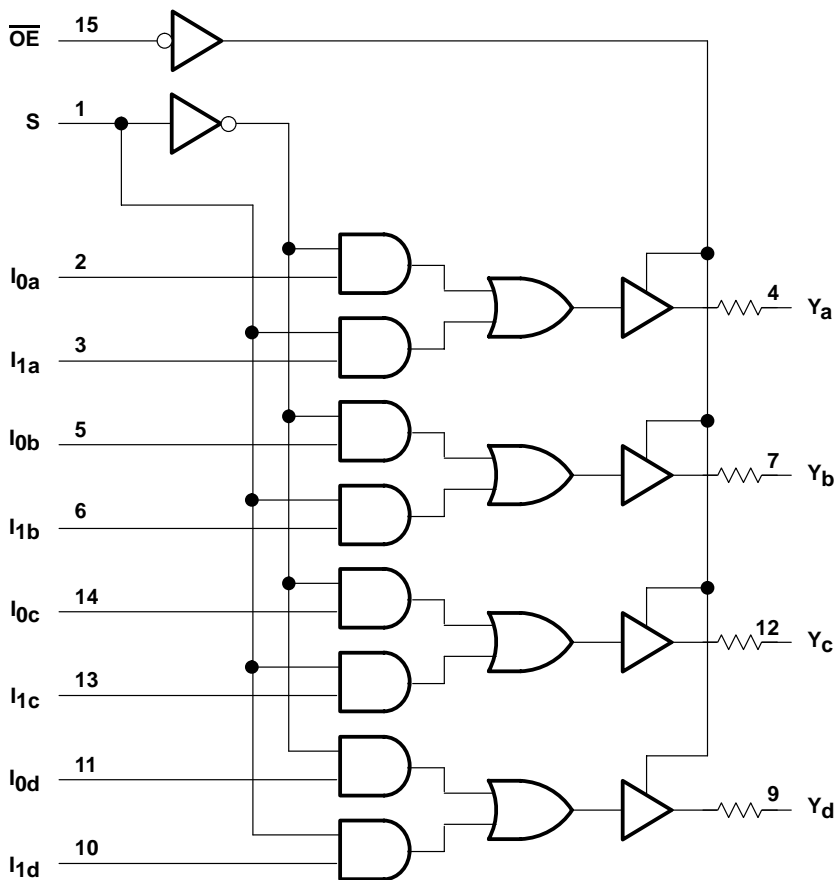
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

$\overline{OE}$	INPUTS			OUTPUT
	S	I <sub>0</sub>	I <sub>1</sub>	Y
H	X	X	X	Z
L	H	X	L	L
L	H	X	H	H
L	L	L	X	L
L	L	H	X	H

H = High logic level, L = Low logic level, X = Don't care, Z = High-impedance (off) state

## 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, $\theta_{JA}$ (see Note 1): Q package .....	90°C/W
SO package .....	57°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.

NOTES: 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.



# CY74FCT2257T

## QUAD 2-INPUT MULTIPLEXER

### WITH 3-STATE OUTPUTS

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

PARAMETER	TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V <sub>IK</sub>	V <sub>CC</sub> = 4.75 V,	I <sub>IN</sub> = -18 mA		-0.7	-1.2	V
V <sub>OH</sub>	V <sub>CC</sub> = 4.75 V,	I <sub>OH</sub> = -15 mA	2.4	3.3		V
V <sub>OL</sub>	V <sub>CC</sub> = 4.75 V,	I <sub>OL</sub> = 12 mA		0.3	0.55	V
R <sub>out</sub>	V <sub>CC</sub> = 4.75 V,	I <sub>OL</sub> = 12 mA	20	25	40	Ω
V <sub>hys</sub>	All inputs			0.2		V
I <sub>IH</sub>	V <sub>CC</sub> = 5.25 V,	V <sub>IN</sub> = 2.7 V			±1	μA
I <sub>IL</sub>	V <sub>CC</sub> = 5.25 V,	V <sub>IN</sub> = 0.5 V			±1	μA
I <sub>OZH</sub>	V <sub>CC</sub> = 5.25 V,	V <sub>OUT</sub> = 2.7 V			10	μA
I <sub>OZL</sub>	V <sub>CC</sub> = 5.25 V,	V <sub>OUT</sub> = 0.5 V			-10	μA
I <sub>OS</sub> ‡	V <sub>CC</sub> = 5.25 V,	V <sub>OUT</sub> = 0 V	-60	-120	-225	mA
I <sub>off</sub>	V <sub>CC</sub> = 0 V,	V <sub>OUT</sub> = 4.5 V			±1	μA
I <sub>CC</sub>	V <sub>CC</sub> = 5.25 V,	V <sub>IN</sub> ≤ 0.2 V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V		0.1	0.2	mA
ΔI <sub>CC</sub>	V <sub>CC</sub> = 5.25 V, V <sub>IN</sub> = 3.4 V§, f <sub>1</sub> = 0, Outputs open			0.5	2	mA
I <sub>CCD</sub> ¶	V <sub>CC</sub> = 5.25 V, One input switching at 50% duty cycle, Outputs open, OE = GND, V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V			0.06	0.12	mA/MHz
I <sub>C</sub> #	V <sub>CC</sub> = 5.25 V, Outputs open, OE = GND	One bit switching at f <sub>1</sub> = 10 MHz at 50% duty cycle	V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V	0.7	1.4	mA
			V <sub>IN</sub> = 3.4 V or GND	1	2.4	
		Four bits switching at f <sub>1</sub> = 2.5 MHz at 50% duty cycle	V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V	0.7	1.4	
			V <sub>IN</sub> = 3.4 V or GND	1.7	5.4	
C <sub>i</sub>				5	10	pF
C <sub>o</sub>				9	12	pF

† Typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°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<sub>OS</sub> tests should be performed last.

§ Per TTL-driven input (V<sub>IN</sub> = 3.4 V); all other inputs at V<sub>CC</sub> or GND

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

# I<sub>C</sub> = I<sub>CC</sub> + ΔI<sub>CC</sub> × D<sub>H</sub> × N<sub>T</sub> + I<sub>CCD</sub> (f<sub>0</sub>/2 + f<sub>1</sub> × N<sub>1</sub>)

Where:

I<sub>C</sub> = Total supply current

I<sub>CC</sub> = Power-supply current with CMOS input levels

ΔI<sub>CC</sub> = Power-supply current for a TTL high input (V<sub>IN</sub> = 3.4 V)

D<sub>H</sub> = Duty cycle for TTL inputs high

N<sub>T</sub> = Number of TTL inputs at D<sub>H</sub>

I<sub>CCD</sub> = Dynamic current caused by an input transition pair (HLH or LHL)

f<sub>0</sub> = Clock frequency for registered devices, otherwise zero

f<sub>1</sub> = Input signal frequency

N<sub>1</sub> = Number of inputs changing at f<sub>1</sub>

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

|| Values for these conditions are examples of the I<sub>C</sub> formula.



**CY74FCT2257T**  
**QUAD 2-INPUT MULTIPLEXER**  
**WITH 3-STATE OUTPUTS**

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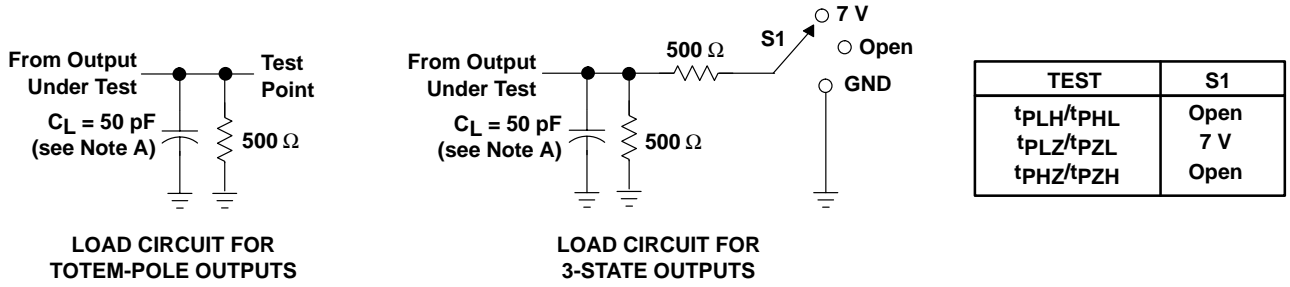
switching characteristics over operating free-air temperature range (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT2257AT		CY74FCT2257CT		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	I <sub>a</sub> or I <sub>b</sub>	Y	1.5	5	1.5	4.7	ns
t <sub>PHL</sub>			1.5	5	1.5	4.7	
t <sub>PLH</sub>	S	Y	1.5	7	1.5	5.2	ns
t <sub>PHL</sub>			1.5	7	1.5	5.2	
t <sub>PZH</sub>	$\overline{OE}$	Y	1.5	7	1.5	6	ns
t <sub>PZL</sub>			1.5	7	1.5	6	
t <sub>PHZ</sub>	$\overline{OE}$	Y	1.5	5.5	1.5	5	ns
t <sub>PLZ</sub>			1.5	5.5	1.5	5	

**CY74FCT2257T**  
**QUAD 2-INPUT MULTIPLEXER**  
**WITH 3-STATE OUTPUTS**

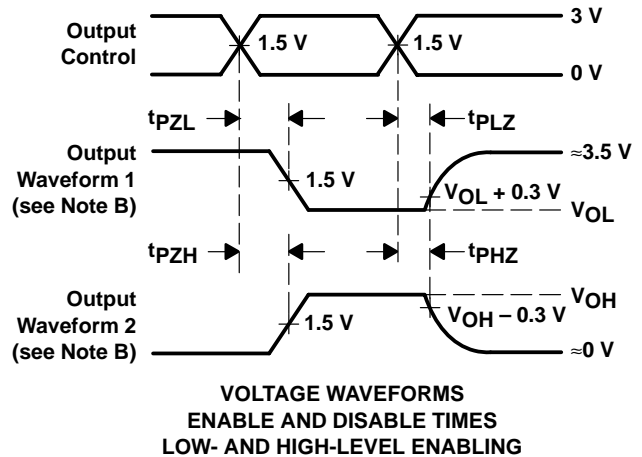
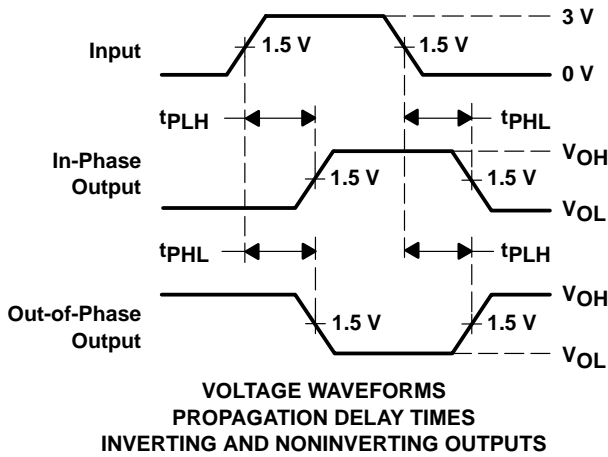
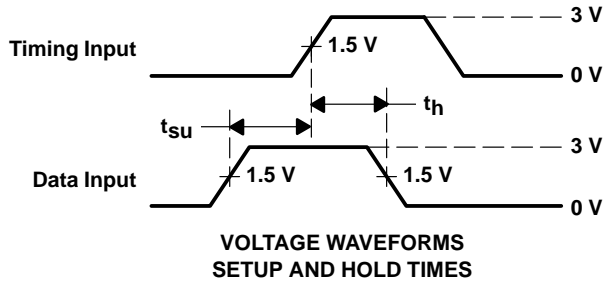
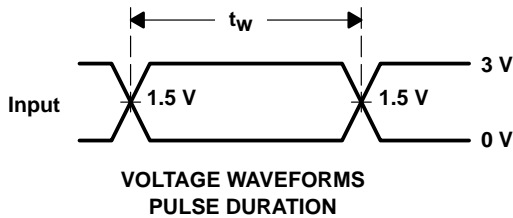
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**PARAMETER MEASUREMENT INFORMATION**



**LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS**

**LOAD CIRCUIT FOR 3-STATE OUTPUTS**



- 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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
74FCT2257CTSOCTE4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
74FCT2257CTSOCTG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	
CY74FCT2257ATQCT	ACTIVE	SSOP/QSOP	DBQ	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
CY74FCT2257ATQCTE4	ACTIVE	SSOP/QSOP	DBQ	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
CY74FCT2257ATQCTG4	ACTIVE	SSOP/QSOP	DBQ	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
CY74FCT2257CTSOCT	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

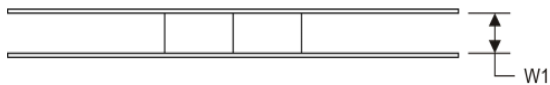
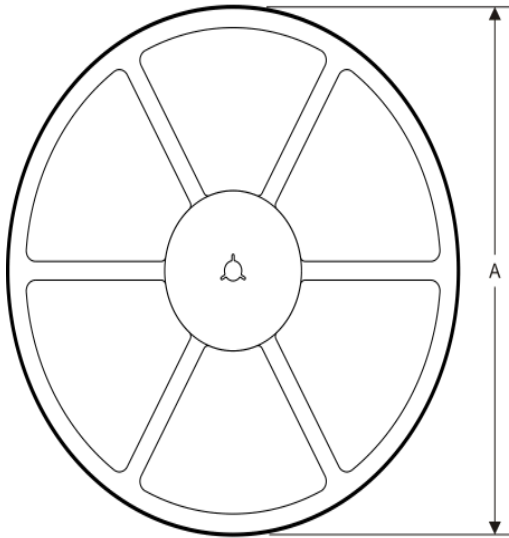
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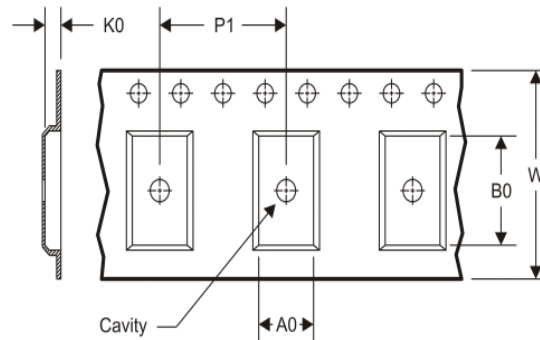


**TAPE AND REEL INFORMATION**

**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

**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
CY74FCT2257CTSOCT	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1

**TAPE AND REEL BOX DIMENSIONS**

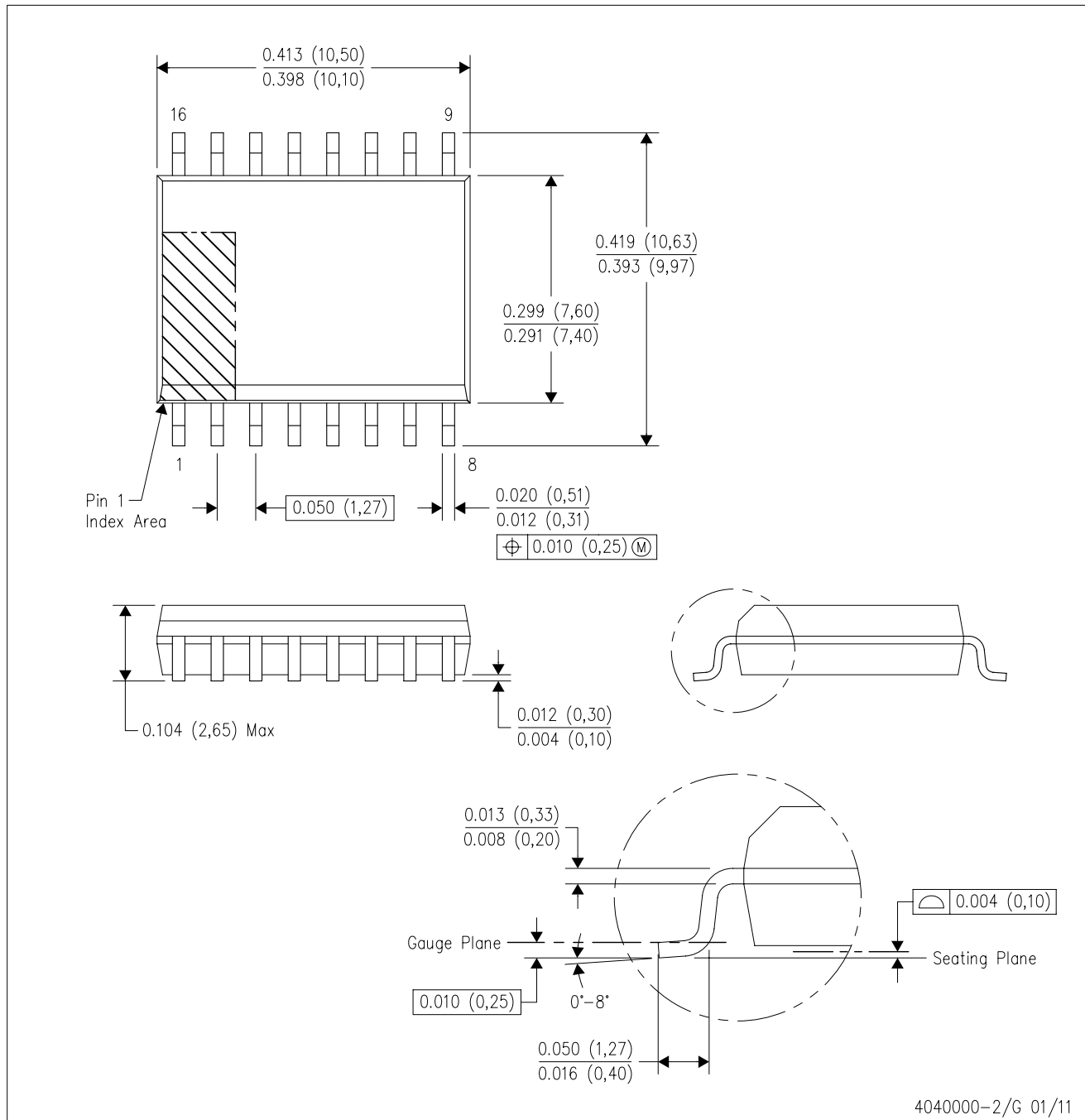


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CY74FCT2257CTSOCT	SOIC	DW	16	2000	367.0	367.0	38.0

DW (R-PDSO-G16)

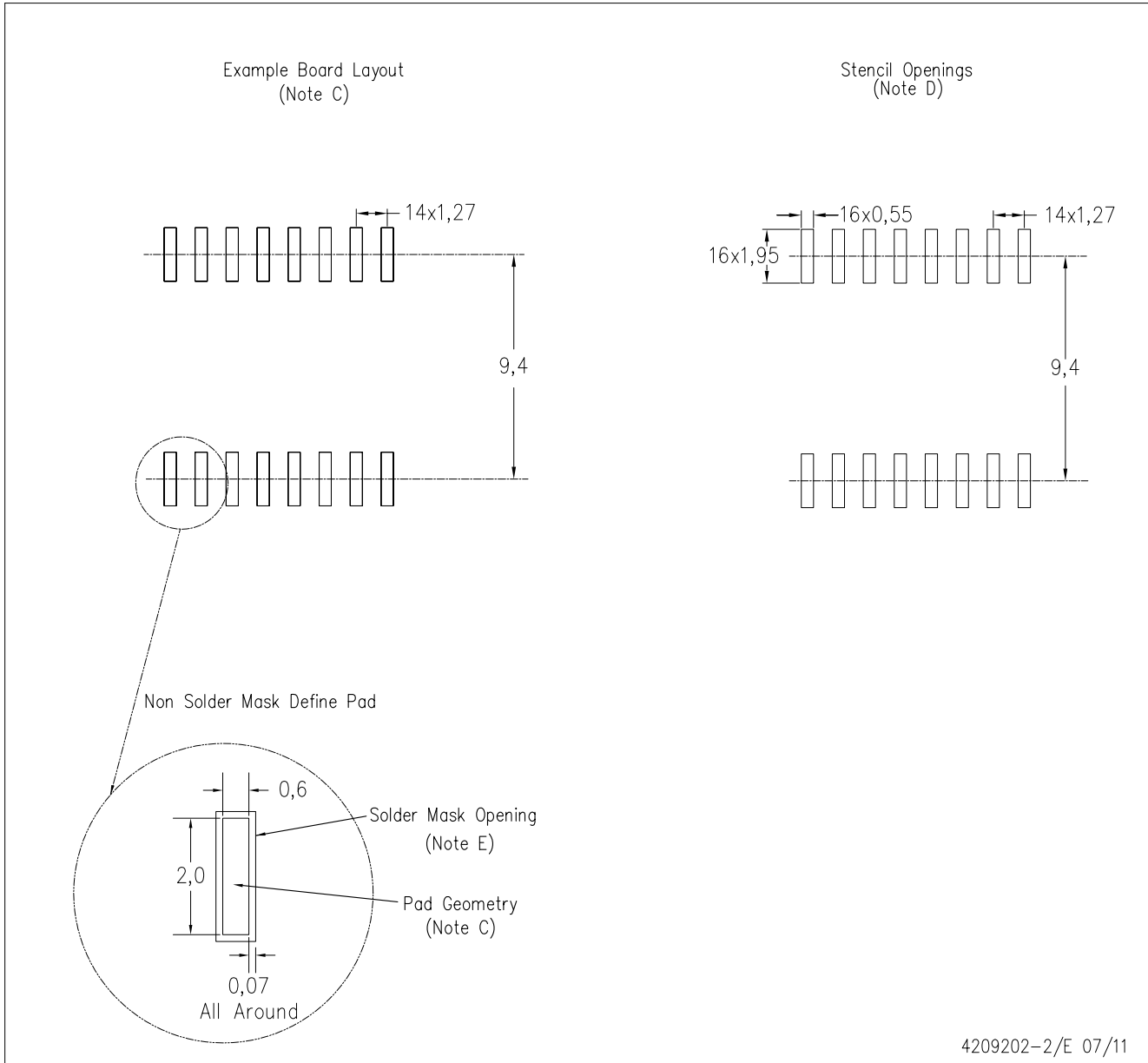
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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).
  - D. Falls within JEDEC MS-013 variation AA.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

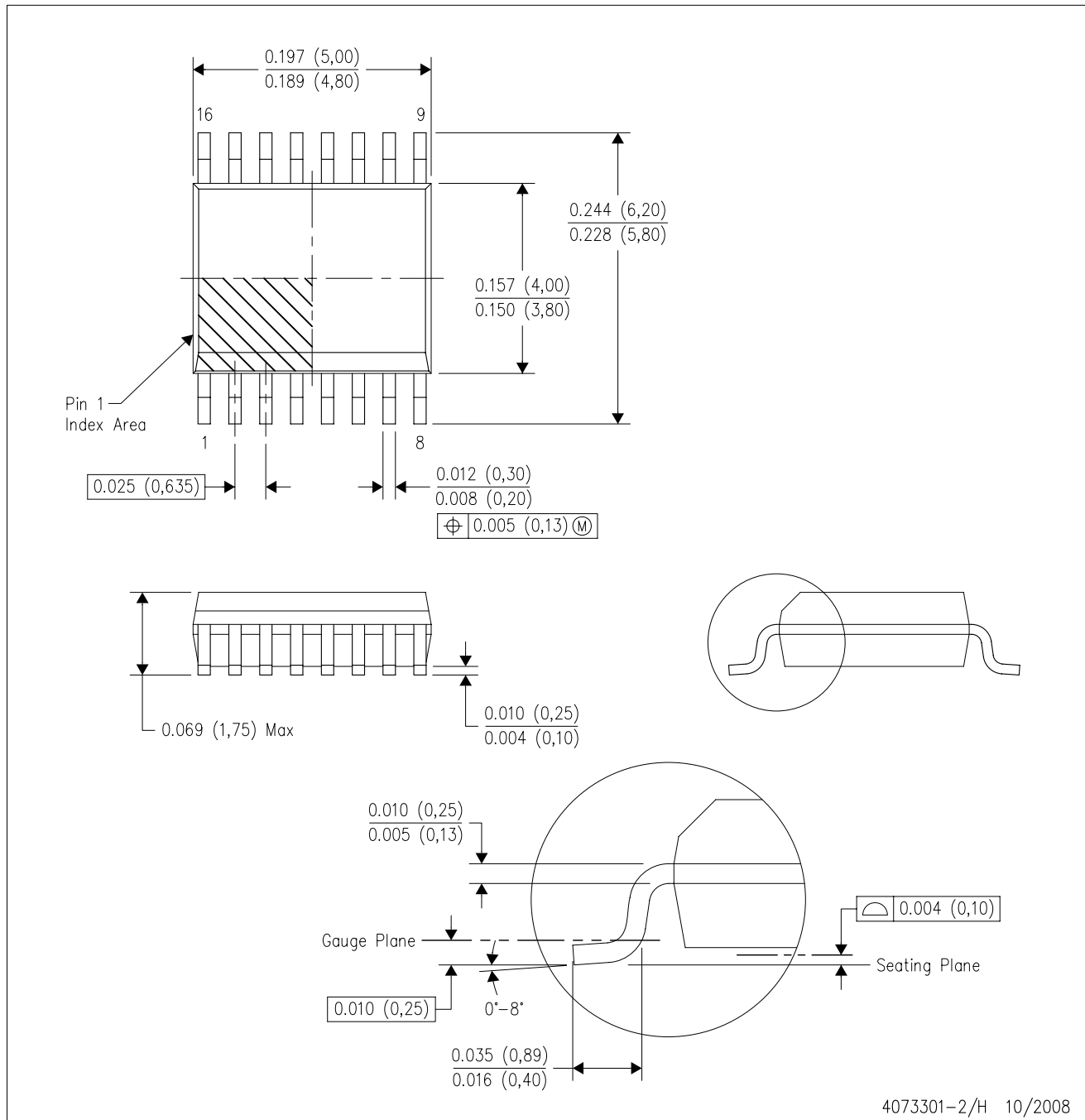


4209202-2/E 07/11

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board 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
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DBQ (R-PDSO-G16)

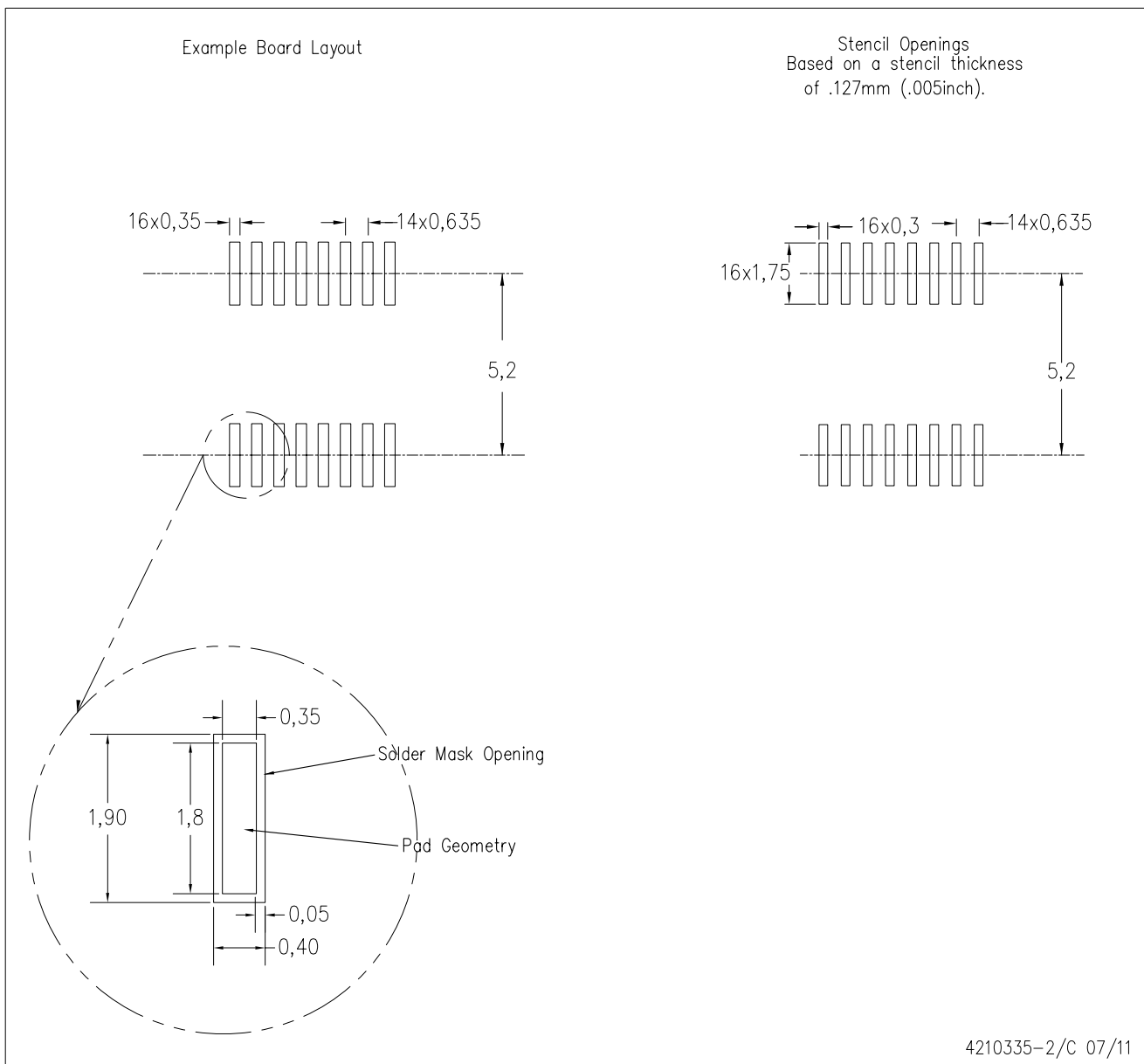
PLASTIC SMALL-OUTLINE PACKAGE



- 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 AB.

DBQ (R-PDSO-G16)

PLASTIC SMALL OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

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### Products

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Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
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### Applications

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