



# THE DATASHEET OF CY74FCT377CTSOC

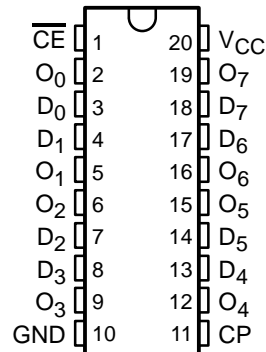


# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

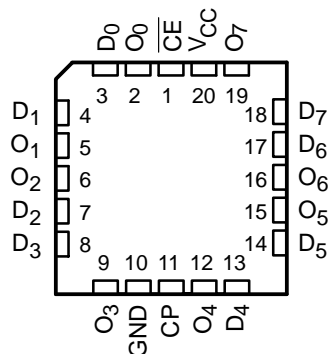
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- Function, Pinout, and Drive Compatible With FCT and F Logic
- Reduced  $V_{OH}$  (Typically = 3.3 V) Versions of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Matched Rise and Fall Times
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)
- Fully Compatible With TTL Input and Output Logic Levels
- Clock Enable for Address and Data Synchronization Application
- Eight Edge-Triggered D-Type Flip-Flops
- CY54FCT377T
  - 32-mA Output Sink Current
  - 12-mA Output Source Current
- CY74FCT377T
  - 64-mA Output Sink Current
  - 32-mA Output Source Current

SN74FCT377T . . . Q OR SO PACKAGE  
(TOP VIEW)



SN54FCT377T . . . L PACKAGE  
(TOP VIEW)



## description

The 'FCT377T devices have eight triggered D-type flip-flops with individual data (D) inputs. The common buffered clock (CP) inputs load all flip-flops simultaneously when the clock-enable ( $\overline{CE}$ ) input is low. The register is fully edge triggered. The state of each D input at one setup time before the low-to-high clock transition is transferred to the corresponding flip-flop output (O).  $\overline{CE}$  must be stable only one setup time prior to the low-to-high clock transition for predictable operation.

These devices are 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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# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

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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	5.2	CY74FCT377CTQCT	FCT377C	
	SOIC – SO	Tube	5.2	CY74FCT377CTSOC	FCT377C	
		Tape and reel	5.2	CY74FCT377CTSOCT		
	-40°C to 85°C	QSOP – Q	Tape and reel	7.2	CY74FCT377ATQCT	FCT377A
		SOIC – SO	Tube	7.2	CY74FCT377ATSOC	FCT377A
			Tape and reel	7.2	CY74FCT377ATSOCT	
QSOP – Q		Tape and reel	13	CY74FCT377TQCT	FCT377	
-55°C to 125°C	LCC – L	Tube	5.5	CY54FCT377CTLMB		
		Tube	8.3	CY54FCT377ATLMB		

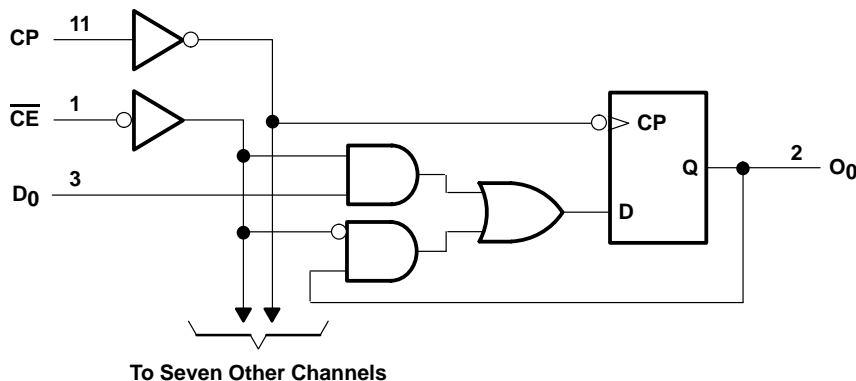
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

## FUNCTION TABLE

INPUTS			OUTPUT O	OPERATING MODE
CP	$\overline{CE}$	D		
↑	l	h	H	Load 1
↑	l	l	L	Load 0
↑	h	X	No change	Hold
X	H	X		

H = High logic level, h = High logic level one setup time prior to the low-to-high clock transition, L = Low logic level, l = Low logic level one setup time prior to the low-to-high clock transition, X = Don't care, ↑ = Low-to-high clock transition

## logic diagram



# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

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## absolute maximum ratings 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 .....	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)

	CY54FCT377T			CY74FCT377T			UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$ Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$ High-level input voltage	2			2			V
$V_{IL}$ Low-level input voltage	0.8			0.8			V
$I_{OH}$ High-level output current	–12			–32			mA
$I_{OL}$ Low-level output current	32			64			mA
$T_A$ Operating free-air temperature	–55		125	–40		85	°C

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

# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

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

PARAMETER	TEST CONDITIONS	CY54FCT377T			CY74FCT377T			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
V <sub>IK</sub>	V <sub>CC</sub> = 4.5 V, I <sub>IN</sub> = -18 mA	-0.7	-1.2					V
	V <sub>CC</sub> = 4.75 V, I <sub>IN</sub> = -18 mA				-0.7	-1.2		
V <sub>OH</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -12 mA	2.4	3.3					V
	V <sub>CC</sub> = 4.75 V	I <sub>OH</sub> = -32 mA			2			
		I <sub>OH</sub> = -15 mA			2.4	3.3		
V <sub>OL</sub>	V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 32 mA		0.3	0.55				V
	V <sub>CC</sub> = 4.75 V, I <sub>OL</sub> = 64 mA				0.3	0.55		
V <sub>hys</sub>	All inputs		0.2		0.2			V
I <sub>I</sub>	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = V <sub>CC</sub>			5				μA
	V <sub>CC</sub> = 5.25 V, V <sub>IN</sub> = V <sub>CC</sub>					5		
I <sub>IH</sub>	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 2.7 V			±1				μA
	V <sub>CC</sub> = 5.25 V, V <sub>IN</sub> = 2.7 V					±1		
I <sub>IL</sub>	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 0.5 V			±1				μA
	V <sub>CC</sub> = 5.25 V, V <sub>IN</sub> = 0.5 V					±1		
I <sub>OS</sub> ‡	V <sub>CC</sub> = 5.5 V, V <sub>OUT</sub> = 0 V	-60	-120	-225				mA
	V <sub>CC</sub> = 5.25 V, V <sub>OUT</sub> = 0 V				-60	-120	-225	
I <sub>off</sub>	V <sub>CC</sub> = 0 V, V <sub>OUT</sub> = 4.5 V			±1			±1	μA
I <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> ≤ 0.2 V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V		0.1	0.2				mA
	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		
ΔI <sub>CC</sub>	V <sub>CC</sub> = 5.5 V, V <sub>IN</sub> = 3.4 V§, f <sub>1</sub> = 0, Outputs open		0.5	2				mA
	V <sub>CC</sub> = 5.25 V, V <sub>IN</sub> = 3.4 V§, f <sub>1</sub> = 0, Outputs open				0.5	2		

† 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



# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

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

PARAMETER	TEST CONDITIONS		CY54FCT377T		CY74FCT377T		UNIT	
			MIN	TYP†	MAX	MIN		TYP†
$I_{CCD}^{\ddagger}$	$V_{CC} = 5.5$ V, Outputs open, One bit switching at 50% duty cycle, $\overline{CE} = GND$ , $V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V		0.06	0.12			mA/ MHz	
	$V_{CC} = 5.25$ V, Outputs open, One bit switching at 50% duty cycle, $\overline{CE} = GND$ , $V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V				0.06	0.12		
$I_C^{\#}$	$V_{CC} = 5.5$ V, Outputs open, $f_0 = 10$ MHz, $\overline{CE} = GND$	One bit switching at $f_1 = 5$ MHz at 50% duty cycle	$V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V	0.7	1.4		mA	
			$V_{IN} = 3.4$ V or GND	1.2	3.4			
		Eight bits switching at $f_1 = 2.5$ MHz at 50% duty cycle	$V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V	1.6	3.2			
			$V_{IN} = 3.4$ V or GND	3.9	12.2			
	$V_{CC} = 5.25$ V, Outputs open, $f_0 = 10$ MHz, $\overline{CE} = GND$	One bit switching at $f_1 = 5$ MHz at 50% duty cycle	$V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V			0.7		1.4
			$V_{IN} = 3.4$ V or GND			1.2		3.4
		Eight bits switching at $f_1 = 2.5$ MHz at 50% duty cycle	$V_{IN} \leq 0.2$ V or $V_{IN} \geq V_{CC} - 0.2$ V			1.6		3.2
			$V_{IN} = 3.4$ V or GND			3.9		12.2
$C_i$			5	10	5	10	pF	
$C_o$			9	12	9	12	pF	

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

‡ 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

$\Delta I_{CC}$  = Power-supply current for a TTL high input ( $V_{IN} = 3.4$  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.



# CY54FCT377T, CY74FCT377T 8-BIT REGISTERS

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

		CY54FCT377AT CY54FCT377CT		CY74FCT377T CY74FCT377AT CY74FCT377CT		UNIT
		MIN	MAX	MIN	MAX	
$t_w$	Pulse duration, CP high or low <sup>†</sup>	7		6		ns
$t_{su}$	Setup time, high or low	Data before CP $\uparrow$	2	2		ns
		$\overline{CE}$ before CP $\uparrow$	3.5	3.5		
$t_h$	Hold time, high or low	Data after CP $\uparrow$	1.5	1.5		ns
		$\overline{CE}$ after CP $\uparrow$	1.5	1.5		

<sup>†</sup> With one data channel switching,  $t_{w(L)} = t_{w(H)} = 4$  ns and  $t_r = t_f = 1$  ns.

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

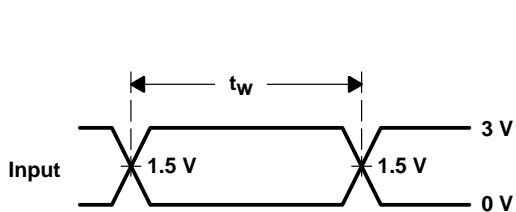
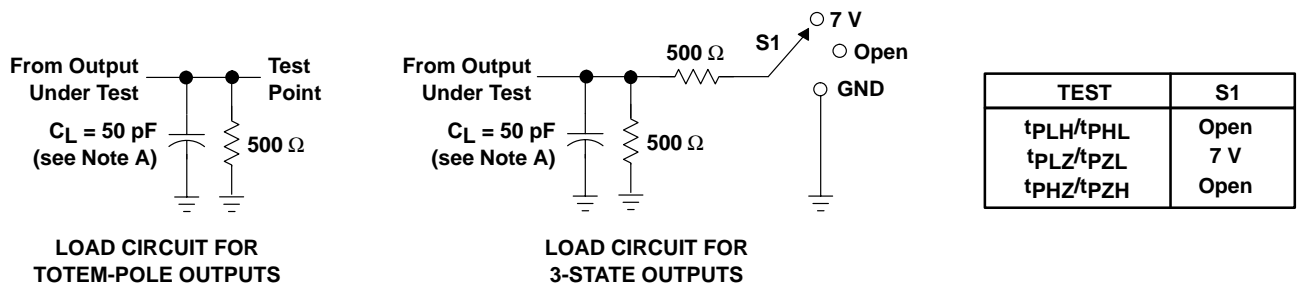
PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY54FCT377AT		CY54FCT377CT		UNIT
			MIN	MAX	MIN	MAX	
$t_{PLH}$	CP	O	2	8.3	2	5.5	ns
$t_{PHL}$			2	8.3	2	5.5	

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

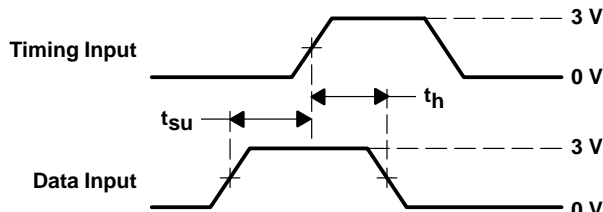
PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT377T		CY74FCT377AT		CY74FCT377CT		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	CP	O	2	13	2	7.2	2	5.2	ns
$t_{PHL}$			2	13	2	7.2	2	5.2	



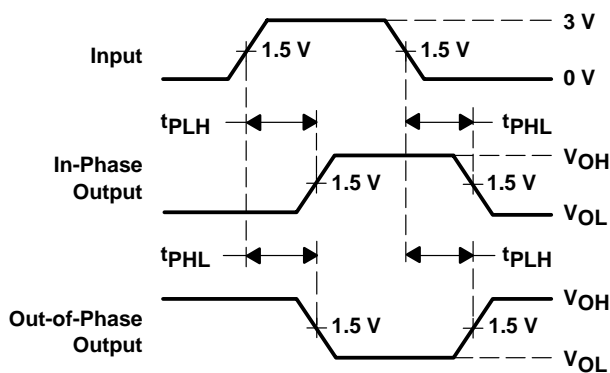
PARAMETER MEASUREMENT INFORMATION



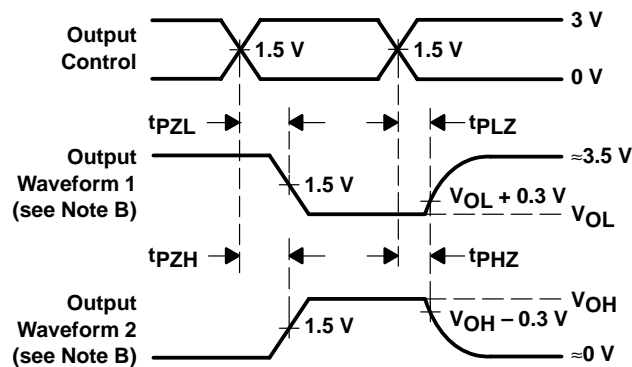
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS


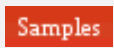





VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- 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/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-9221902M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9221902M2A	
5962-9221903M2A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9221903M2A CY54FCT 377CTLMB	
CY54FCT377CTLMB	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 9221903M2A CY54FCT 377CTLMB	
CY74FCT377ATQCT	ACTIVE	SSOP	DBQ	20	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	FCT377A	
CY74FCT377ATSOC	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	FCT377A	

(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) 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)

(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.

<sup>(5)</sup> 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.

<sup>(6)</sup> Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

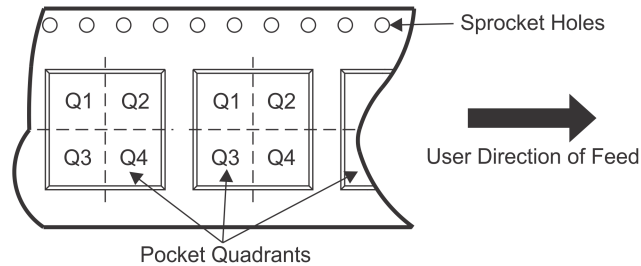
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## TAPE AND REEL INFORMATION



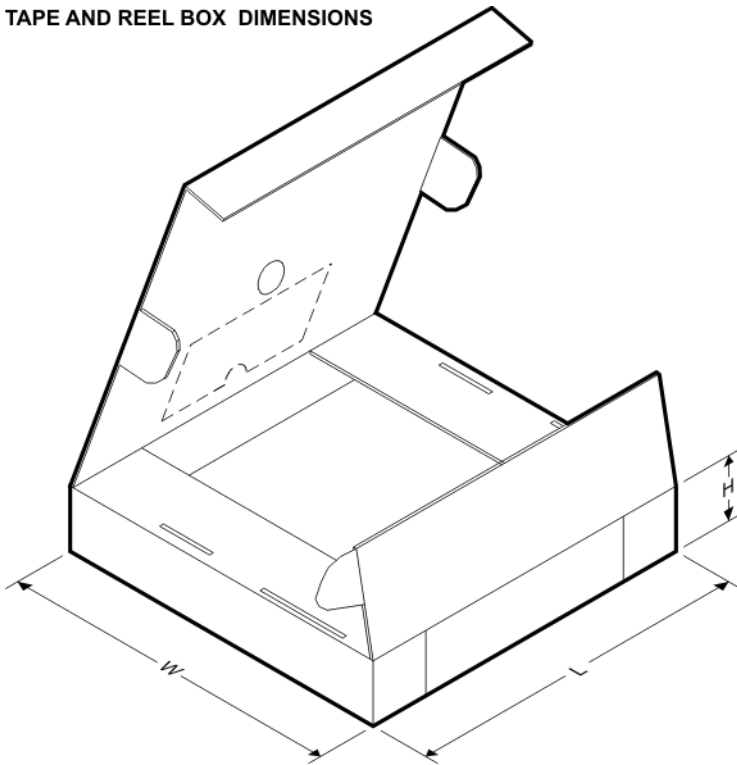
### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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
CY74FCT377ATQCT	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)
CY74FCT377ATQCT	SSOP	DBQ	20	2500	367.0	367.0	38.0

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