

# CY54FCT827T, CY74FCT827T 10-BIT BUFFERS WITH 3-STATE OUTPUTS

SCCS034A – SEPTEMBER 1994 – REVISED OCTOBER 2001

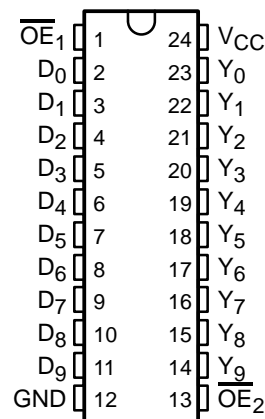
- Function, Pinout, and Drive Compatible With FCT, F, and AM29827 Logic
- Reduced  $V_{OH}$  (Typically = 3.3 V) Versions of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- ESD Protection 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
- Matched Rise and Fall Times
- Fully Compatible With TTL Input and Output Logic Levels
- CY54FCT827T
  - 32-mA Output Sink Current
  - 12-mA Output Source Current
- CY74FCT827T
  - 64-mA Output Sink Current
  - 32-mA Output Source Current

## description

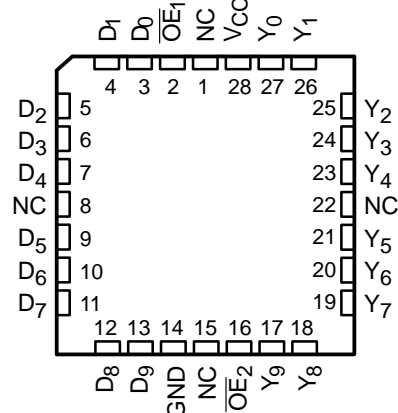
The 'FCT827T devices are 10-bit bus drivers that provide high-performance bus-interface buffering for wide data/address paths or buses carrying parity. The 10-bit buffers have NANDed output enables for maximum control flexibility. The 'FCT827T devices are designed for high-capacitance-load drive capability, while providing low-capacitance bus loading at both inputs and outputs. All outputs are designed for low-capacitance bus loading in the high-impedance state.

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.

CY74FCT827T . . . Q OR SO PACKAGE  
(TOP VIEW)



CY74FCT827T . . . L PACKAGE  
(TOP VIEW)



NC – No internal connection



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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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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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	4.4	CY74FCT827CTQCT	FCT827C
	SOIC – SO	Tube	4.4	CY74FCT827CTSOC	FCT827C
		Tape and reel	4.4	CY74FCT827CTSOCT	
	QSOP – Q	Tape and reel	8	CY74FCT827ATQCT	FCT827A
		SOIC – SO	Tube	8	CY74FCT827ATSOC
	Tape and reel		8	CY74FCT827ATSOCT	
–55°C to 125°C	LCC – L	Tube	9	CY54FCT827ATLMB	

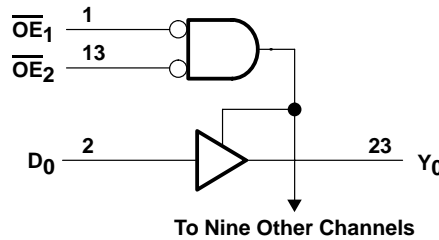
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

**FUNCTION TABLE**

INPUTS			OUTPUT Y	FUNCTION
$\overline{OE}_1$	$\overline{OE}_2$	D		
L	L	L	L	Transparent
L	L	H	H	
H	X	X	Z	3-state
X	H	X	Z	

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

**logic diagram (positive logic)**



Pin numbers shown are for the Q and SO packages.

**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	61°C/W
SO package	46°C/W
Ambient temperature range with power applied, T <sub>A</sub>	–65°C to 135°C
Storage temperature range, T <sub>stg</sub>	–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.



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## recommended operating conditions (see Note 2)

		CY54FCT827T			CY74FCT827T			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
V <sub>IH</sub>	High-level input voltage	2			2			V
V <sub>IL</sub>	Low-level input voltage				0.8			V
I <sub>OH</sub>	High-level output current				-12			mA
I <sub>OL</sub>	Low-level output current				32			mA
T <sub>A</sub>	Operating free-air temperature	-55			125			°C

NOTE 2: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation.

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

PARAMETER	TEST CONDITIONS	CY54FCT827T			CY74FCT827T			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			
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			
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>OZH</sub>	V <sub>CC</sub> = 5.5 V, V <sub>OUT</sub> = 2.7 V	10						μA
	V <sub>CC</sub> = 5.25 V, V <sub>OUT</sub> = 2.7 V				10			
I <sub>OZL</sub>	V <sub>CC</sub> = 5.5 V, V <sub>OUT</sub> = 0.5 V	-10						μA
	V <sub>CC</sub> = 5.25 V, V <sub>OUT</sub> = 0.5 V				-10			
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			
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			

† 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



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

PARAMETER	TEST CONDITIONS		CY54FCT827T		CY74FCT827T		UNIT	
			MIN	TYP†	MAX	MIN		TYP†
I <sub>CCD</sub> ††	V <sub>CC</sub> = 5.5 V, One input switching at 50% duty cycle, Outputs open, $\overline{OE}_1$ or $\overline{OE}_2 = \text{GND}$ , 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	
	V <sub>CC</sub> = 5.25 V, One input switching at 50% duty cycle, Outputs open, $\overline{OE}_1$ or $\overline{OE}_2 = \text{GND}$ , V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2 V				0.06	0.12		
I <sub>C</sub> #	V <sub>CC</sub> = 5.5 V, Outputs open, $\overline{OE}_1$ or $\overline{OE}_2 = \text{GND}$	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			
		10 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	1.6	3.2			
	V <sub>IN</sub> = 3.4 V or GND		4.1	13.2				
	V <sub>CC</sub> = 5.25 V, Outputs open, $\overline{OE}_1$ or $\overline{OE}_2 = \text{GND}$	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
			V <sub>IN</sub> = 3.4 V or GND			1		2.4
10 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			1.6	3.2		
		V <sub>IN</sub> = 3.4 V or GND			4.1	13.2		
C <sub>i</sub>			5	10	5	10	pF	
C <sub>o</sub>			9	12	9	12	pF	

†† 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>CC</sub> formula.



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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST LOAD	CY54FCT827AT		CY74FCT827AT		CY74FCT827CT		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	D	Y	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	1.5	9	1.5	8	1.5	4.4	ns
t <sub>PHL</sub>				1.5	9	1.5	8	1.5	4.4	
t <sub>PLH</sub>	D	Y	C <sub>L</sub> = 300 pF, R <sub>L</sub> = 500 Ω	1.5	17	1.5	15	1.5	10	ns
t <sub>PHL</sub>				1.5	17	1.5	15	1.5	10	
t <sub>PZH</sub>	$\overline{OE}$	Y	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	1.5	13	1.5	12	1.5	7	ns
t <sub>PZL</sub>				1.5	13	1.5	12	1.5	7	
t <sub>PZH</sub>	$\overline{OE}$	Y	C <sub>L</sub> = 300 pF, R <sub>L</sub> = 500 Ω	1.5	25	1.5	23	1.5	14	ns
t <sub>PZL</sub>				1.5	25	1.5	23	1.5	14	
t <sub>PHZ</sub>	$\overline{OE}$	Y	C <sub>L</sub> = 5 pF, R <sub>L</sub> = 500 Ω	1.5	9	1.5	9	1.5	5.7	ns
t <sub>PHL</sub>				1.5	9	1.5	9	1.5	5.7	
t <sub>PHZ</sub>	$\overline{OE}$	Y	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	1.5	10	1.5	10	1.5	6	ns
t <sub>PHL</sub>				1.5	10	1.5	10	1.5	6	

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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 <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
5962-9224701M3A	ACTIVE	LCCC	FK	28	1	TBD	POST-PLATE	N / A for Pkg Type
CY74FCT827ATQCT	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827ATQCTE4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827ATQCTG4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827ATSOC	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827ATSOCE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827ATSOCG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827ATSOCT	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827ATSOCTE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827ATSOCTG4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTQCT	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827CTQCTE4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827CTQCTG4	ACTIVE	SSOP/ QSOP	DBQ	24	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
CY74FCT827CTSOC	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTSOCE4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTSOCG4	ACTIVE	SOIC	DW	24	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTSOCT	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTSOCTE4	ACTIVE	SOIC	DW	24	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
CY74FCT827CTSOCTG4	ACTIVE	SOIC	DW	24	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**



**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
CY74FCT827ATQCT	SSOP/QSOP	DBQ	24	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT827ATSOCT	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CY74FCT827CTQCT	SSOP/QSOP	DBQ	24	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
CY74FCT827CTSOCT	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CY74FCT827ATQCT	SSOP/QSOP	DBQ	24	2500	346.0	346.0	33.0
CY74FCT827ATSOCT	SOIC	DW	24	2000	346.0	346.0	41.0
CY74FCT827CTQCT	SSOP/QSOP	DBQ	24	2500	346.0	346.0	33.0
CY74FCT827CTSOCT	SOIC	DW	24	2000	346.0	346.0	41.0

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