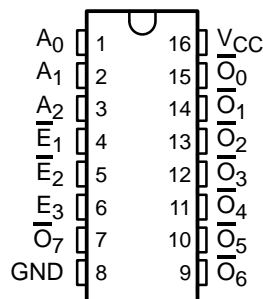


# CY54FCT138T, CY74FCT138T 1-OF-8 DECODERS

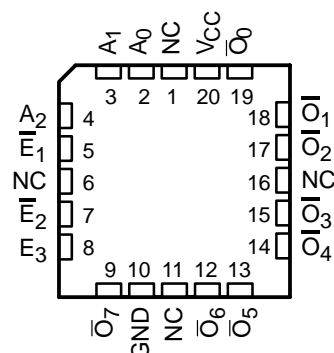
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- Function, Pinout, and Drive Compatible With FCT and F Logic
- Reduced  $V_{OH}$  (Typically = 3.3 V) Versions of Equivalent FCT Functions
- Edge-Rate Control Circuitry for Significantly Improved Noise Characteristics
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Matched Rise and Fall Times
- Fully Compatible With TTL Input and Output Logic Levels
- Dual 1-of-8 Decoder With Enables
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)
- CY54FCT138T
  - 32-mA Output Sink Current
  - 12-mA Output Source Current
- CY74FCT138T
  - 64-mA Output Sink Current
  - 32-mA Output Source Current

CY54FCT138T . . . D PACKAGE  
CY74FCT138T . . . Q OR SO PACKAGE  
(TOP VIEW)



CY54FCT138T . . . L PACKAGE  
(TOP VIEW)



NC – No internal connection

## description

The 'FCT138T devices are 1-of-8 decoders. These devices accept three binary weighted inputs ( $A_0$ ,  $A_1$ ,  $A_2$ ) and, when enabled, provide eight mutually exclusive active-low outputs ( $\overline{O}_0$ – $\overline{O}_7$ ). The 'FCT138T devices feature three enable inputs: two active low ( $\overline{E}_1$ ,  $\overline{E}_2$ ) and one active high ( $E_3$ ).

All outputs are high unless  $\overline{E}_1$  and  $\overline{E}_2$  are low and  $E_3$  is high. This multiple-enable function allows easy parallel expansion of the device to a 1-of-32 (five lines to 32 lines) decoder with just four 'FCT138T devices and one inverter.

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.

### PIN DESCRIPTION

NAME	DESCRIPTION
A	Address inputs
$\overline{E}_1$ , $\overline{E}_2$	Enable inputs (active low)
$E_3$	Enable input (active high)
$\overline{O}$	Outputs



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 **TEXAS  
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# CY54FCT138T, CY74FCT138T 1-OF-8 DECODERS

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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	CY74FCT138CTQCT	FT138-3
	SOIC – SO	Tube	5	CY74FCT138CTSOC	FCT138C
		Tape and reel	5	CY74FCT138CTSOCT	
	QSOP – Q	Tape and reel	5.8	CY74FCT138ATQCT	FT138-1
		SOIC – SO	Tube	5.8	CY74FCT138ATSOC
	Tape and reel		5.8	CY74FCT138ATSOCT	
-55°C to 125°C	QSOP – Q	Tape and reel	9	CY74FCT138TQCT	FT138
	LCC – L	Tube	6	CY54FCT138CTLMB	
	LCC – L	Tube	12	CY54FCT138TLMB	
	CDIP – D	Tube	12	CY54FCT138TDMB	

† 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).

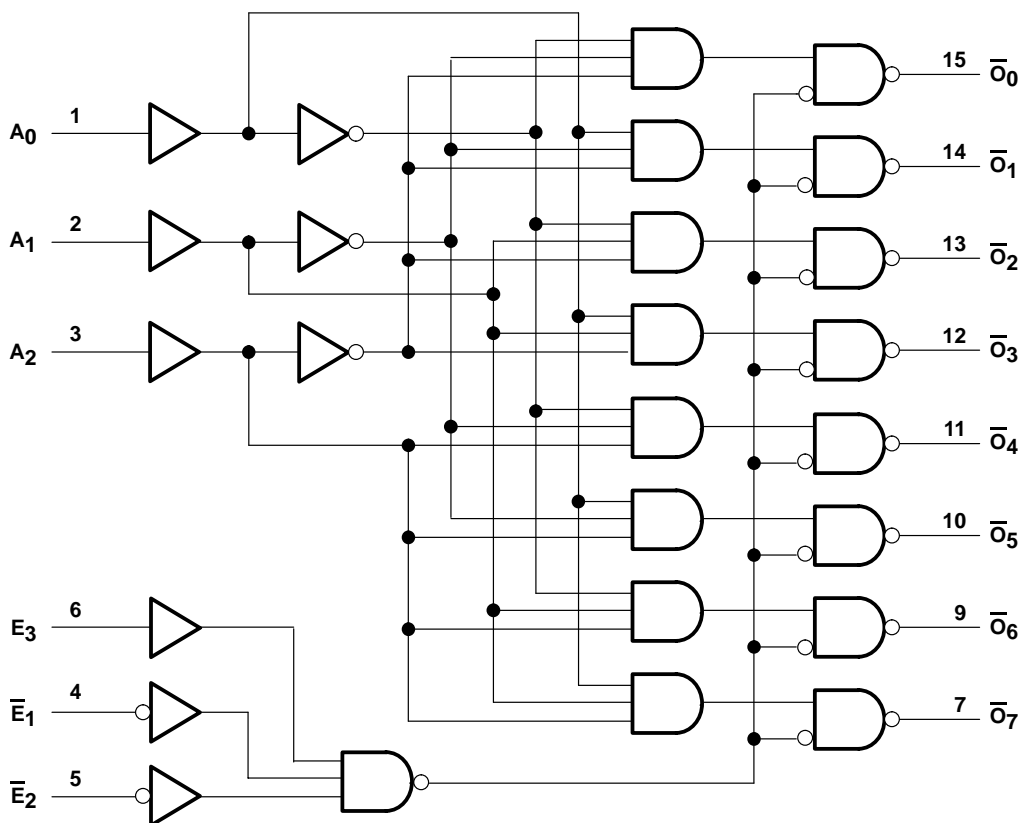
## FUNCTION TABLE

INPUTS						OUTPUTS							
$\bar{E}_1$	$\bar{E}_2$	E <sub>3</sub>	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	H	L	H	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = High logic level, L = Low logic level, X = Don't care



logic diagram (positive logic)



Pin numbers shown are for the D, Q, and SO packages.

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 .....	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.

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

# CY54FCT138T, CY74FCT138T 1-OF-8 DECODERS

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## recommended operating conditions (see Note 2)

		CY54FCT138T			CY74FCT138T			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.

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

PARAMETER	TEST CONDITIONS	CY54FCT138T			CY74FCT138T			UNIT
		MIN	TYP†	MAX	MIN	TYP†	MAX	
$V_{IK}$	$V_{CC} = 4.5\text{ V}$ , $I_{IN} = -18\text{ mA}$		-0.7	-1.2				V
	$V_{CC} = 4.75\text{ V}$ , $I_{IN} = -18\text{ mA}$				-0.7	-1.2		
$V_{OH}$	$V_{CC} = 4.5\text{ V}$ , $I_{OH} = -12\text{ mA}$	2.4	3.3					V
	$V_{CC} = 4.75\text{ V}$				2			
		$I_{OH} = -15\text{ mA}$				2.4	3.3	
$V_{OL}$	$V_{CC} = 4.5\text{ V}$ , $I_{OL} = 32\text{ mA}$		0.3	0.55				V
	$V_{CC} = 4.75\text{ V}$ , $I_{OL} = 64\text{ mA}$				0.3	0.55		
$V_{hys}$	All inputs		0.2		0.2			V
$I_I$	$V_{CC} = 5.5\text{ V}$ , $V_{IN} = V_{CC}$			5				$\mu\text{A}$
	$V_{CC} = 5.25\text{ V}$ , $V_{IN} = V_{CC}$					5		
$I_{IH}$	$V_{CC} = 5.5\text{ V}$ , $V_{IN} = 2.7\text{ V}$			$\pm 1$				$\mu\text{A}$
	$V_{CC} = 5.25\text{ V}$ , $V_{IN} = 2.7\text{ V}$					$\pm 1$		
$I_{IL}$	$V_{CC} = 5.5\text{ V}$ , $V_{IN} = 0.5\text{ V}$			$\pm 1$				$\mu\text{A}$
	$V_{CC} = 5.25\text{ V}$ , $V_{IN} = 0.5\text{ V}$					$\pm 1$		
$I_{OS}‡$	$V_{CC} = 5.5\text{ V}$ , $V_{OUT} = 0\text{ V}$	-60	-120	-225				mA
	$V_{CC} = 5.25\text{ V}$ , $V_{OUT} = 0\text{ V}$				-60	-120	-225	
$I_{off}$	$V_{CC} = 0\text{ V}$ , $V_{OUT} = 4.5\text{ V}$			$\pm 1$			$\pm 1$	$\mu\text{A}$
$I_{CC}$	$V_{CC} = 5.5\text{ V}$ , $V_{IN} \leq 0.2\text{ V}$ , $V_{IN} \geq V_{CC} - 0.2\text{ V}$		0.1	0.2				mA
	$V_{CC} = 5.25\text{ V}$ , $V_{IN} \leq 0.2\text{ V}$ , $V_{IN} \geq V_{CC} - 0.2\text{ V}$				0.1	0.2		
$\Delta I_{CC}$	$V_{CC} = 5.5\text{ V}$ , $V_{IN} = 3.4\text{ V}§$ , $f_1 = 0$ , Outputs open		0.5	2				mA
	$V_{CC} = 5.25\text{ V}$ , $V_{IN} = 3.4\text{ V}§$ , $f_1 = 0$ , Outputs open				0.5	2		
$I_{CCD}¶$	$V_{CC} = 5.5\text{ V}$ , Outputs open, One bit switching at 50% duty cycle, $V_{IN} \leq 0.2\text{ V}$ or $V_{IN} \geq V_{CC} - 0.2\text{ V}$		0.06	0.12				mA/ MHz
	$V_{CC} = 5.25\text{ V}$ , Outputs open, One bit switching at 50% duty cycle, $V_{IN} \leq 0.2\text{ V}$ or $V_{IN} \geq V_{CC} - 0.2\text{ V}$				0.06	0.12		

† 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.



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

PARAMETER	TEST CONDITIONS			CY54FCT138T		CY74FCT138T		UNIT
				MIN	TYP†	MAX	MIN	
I <sub>C</sub> #	V <sub>CC</sub> = 5.5 V, Outputs open, Switch $\bar{E}_1$ , $\bar{E}_2$ , or E <sub>3</sub>	One output 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			
	V <sub>CC</sub> = 5.25 V, Outputs open, Switch $\bar{E}_1$ , $\bar{E}_2$ , or E <sub>3</sub>	One output 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	
C <sub>i</sub>				5	10	5	10	pF
C <sub>O</sub>				9	12	9	12	pF

† Typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

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

Where:

I<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.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY54FCT138T		CY54FCT138CT		UNIT
			MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A	$\bar{O}$	1.5	12	1.5	6	ns
t <sub>PHL</sub>			1.5	12	1.5	6	
t <sub>PLH</sub>	$\bar{E}_1$ or $\bar{E}_2$	$\bar{O}$	1.5	12.5	1.5	6.1	ns
t <sub>PHL</sub>			1.5	12.5	1.5	6.1	
t <sub>PLH</sub>	E <sub>3</sub>	$\bar{O}$	1.5	12.5	1.5	6.1	ns
t <sub>PHL</sub>			1.5	12.5	1.5	6.1	

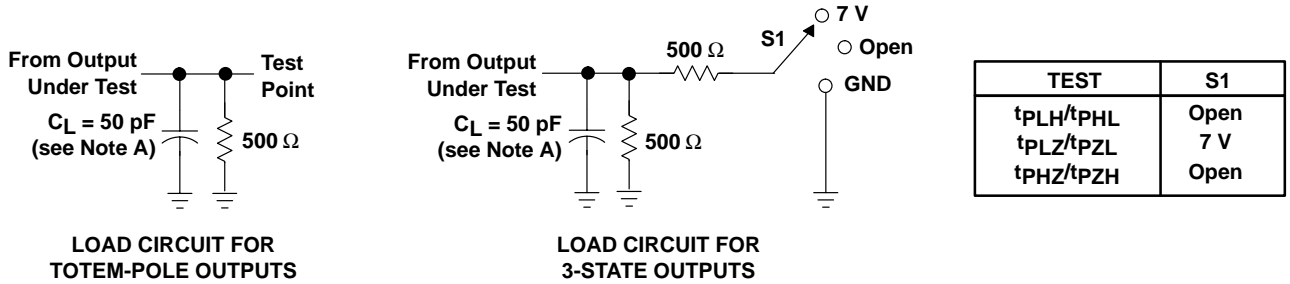
switching characteristics over operating free-air temperature range (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	CY74FCT138T		CY74FCT138AT		CY74FCT138CT		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A	$\bar{O}$	1.5	9	1.5	5.8	1.5	5	ns
t <sub>PHL</sub>			1.5	9	1.5	5.8	1.5	5	
t <sub>PLH</sub>	$\bar{E}_1$ or $\bar{E}_2$	$\bar{O}$	1.5	9	1.5	5.9	1.5	5	ns
t <sub>PHL</sub>			1.5	9	1.5	5.9	1.5	5	
t <sub>PLH</sub>	E <sub>3</sub>	$\bar{O}$	1.5	9	1.5	5.9	1.5	5	ns
t <sub>PHL</sub>			1.5	9	1.5	5.9	1.5	5	

# CY54FCT138T, CY74FCT138T 1-OF-8 DECODERS

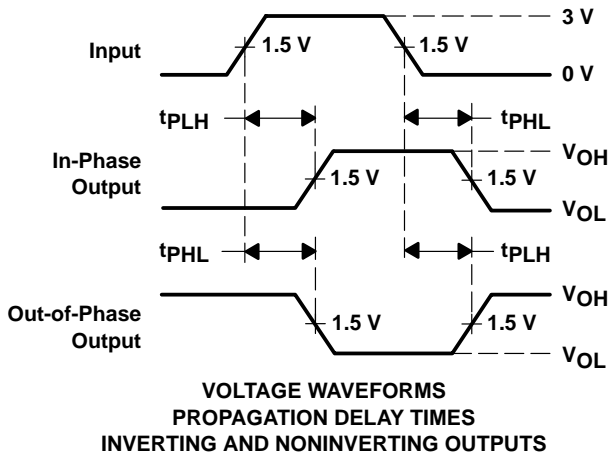
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## PARAMETER MEASUREMENT INFORMATION



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

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