National Semiconductor

54AC/74AC374 • 54ACT/74ACT374
Octal D Flip-Flop with TRI-STATE® Outputs

General Description

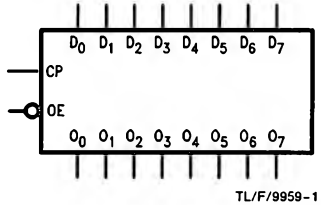
The 'AC/'ACT374 is a high-speed, low-power octal D-type flip-flop featuring separate D-type inputs for each flip-flop and TRI-STATE outputs for bus-oriented applications. A buffered Clock (CP) and Output Enable ($\overline{OE}$) are common to all flip-flops.

Features

- Buffered positive edge-triggered clock
- TRI-STATE outputs for bus-oriented applications
- Outputs source/sink 24 mA
- See '273 for reset version
- See '377 for clock enable version
- See '373 for transparent latch version
- See '574 for broadside pinout version
- See '564 for broadside pinout version with inverted outputs
- 'ACT374 has TTL-compatible inputs
- Standard Military Drawing (SMD)
  - — 'AC374: 5962-87694
  - — 'ACT374: 5962-87631

Ordering Code: See Section 8

Logic Symbols



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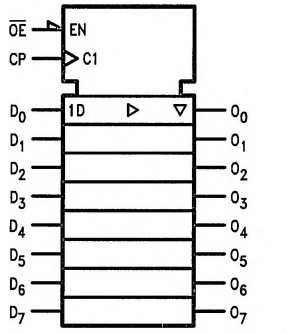
IEEE/IEC



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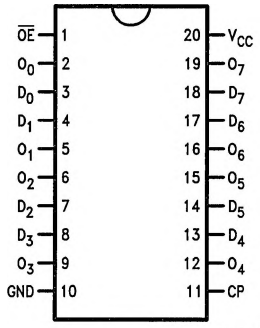
Pin Names	Description
D_0–D_7	Data Inputs
CP	Clock Pulse Input
$\overline{OE}$	TRI-STATE Output Enable Input
O_0–O_7	TRI-STATE Outputs

Connection Diagrams

Pin Assignment for DIP, Flatpak and SOIC



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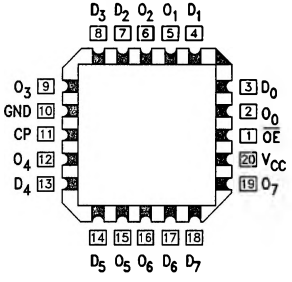
Pin Assignment for LCC and PCC



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Functional Description

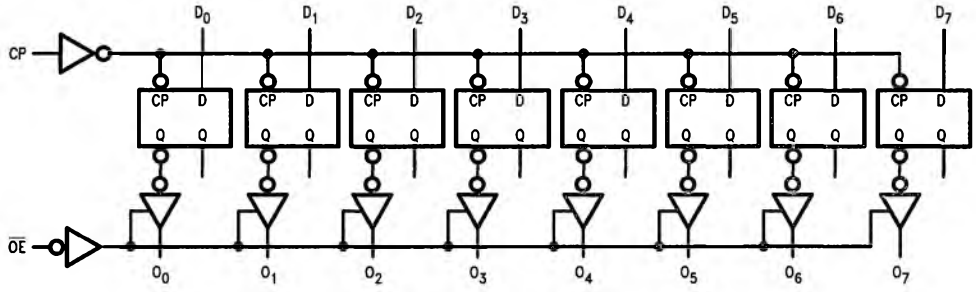
The 'AC/'ACT374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ($\overline{OE}$) LOW, the contents of the eight flip-flops are available at the outputs. When the $\overline{OE}$ is HIGH, the outputs go to the high impedance state. Operation of the $\overline{OE}$ input does not affect the state of the flip-flops.

Truth Table

Inputs			Outputs
D_n	CP	$\overline{OE}$	O_n
H	⌐	L	H
L	⌐	L	L
X	X	H	Z

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance
⌐ = LOW-to-HIGH Transition

Logic Diagram



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Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Rating (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
V_I = −0.5V	−20 mA
V_I = V_{CC} + 0.5V	+20 mA
DC Input Voltage (V_I)	−0.5V to V_{CC} + 0.5V
DC Output Diode Current (I_{OK})	
V_O = −0.5V	−20 mA
V_O = V_{CC} + 0.5V	+20 mA
DC Output Voltage (V_O)	−0.5V to V_{CC} + 0.5V
DC Output Source or Sink Current (I_O)	±50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	
CDIP	175°C
PDIP	140°C

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'AC	2.0V to 6.0V
'ACT	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	
74AC/ACT	−40°C to +85°C
54AC/ACT	−55°C to +125°C
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'AC Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

DC Characteristics for 'AC Family Devices

Symbol	Parameter	V_{CC} (V)	74AC T_A = +25°C	74AC	54AC T_A = −55°C to +125°C	74AC T_A = −40°C to +85°C	Units	Conditions
			Typ	Guaranteed Limits				
V_{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	I_{OUT} = −50 μA
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
		3.0		2.56	2.4	2.46	V	*V_{IN} = V_{IL} or V_{IH} I_{OH} −12 mA
		4.5		3.86	3.7	3.76		
		5.5		4.86	4.7	4.76		−24 mA −24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	I_{OUT} = 50 μA
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
		3.0		0.36	0.50	0.44	V	*V_{IN} = V_{IL} or V_{IH} I_{OL} 12 mA
		4.5		0.36	0.50	0.44		
		5.5		0.36	0.50	0.44		24 mA 24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V_I = V_{CC}, GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	74AC $T_A = +25°C$ Typ	74AC $T_A = +25°C$ Guaranteed Limits	54AC $T_A = -55°C$ to $+125°C$	74AC $T_A = -40°C$ to $+85°C$	Units	Conditions
I_{OZ}	Maximum TRI-STATE® Current	5.5		±0.5	±10.0	±5.0	μA	V_I (OE) = V_{IL}, V_{IH} V_I = V_{CC}, GND V_O = V_{CC}, GND
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0	μA	V_{IN} = V_{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.

I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C.

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	74ACT $T_A = +25°C$ Typ	74ACT $T_A = +25°C$ Guaranteed Limits	54ACT $T_A = -55°C$ to $+125°C$	74ACT $T_A = -40°C$ to $+85°C$	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	2.0 2.0	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	0.8 0.8	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	4.4 5.4	V	I_{OUT} = −50 μA
		4.5 5.5		3.86 4.86	3.70 4.70	3.76 4.76	V	*V_{IN} = V_{IL} or V_{IH} I_{OH} −24 mA I_{OH} −24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	0.1 0.1	V	I_{OUT} = 50 μA
		4.5 5.5		0.36 0.36	0.50 0.50	0.44 0.44	V	*V_{IN} = V_{IL} or V_{IH} I_{OL} 24 mA I_{OL} 24 mA
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	±1.0	μA	V_I = V_{CC}, GND
I_{OZ}	Maximum TRI-STATE® Current	5.5		±0.5	±10.0	±5.0	μA	V_I = V_{IL}, V_{IH} V_O = V_{CC}, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.6	1.5	mA	V_I = V_{CC} − 2.1V
I_{OLD}	†Minimum Dynamic Output Current	5.5			50	75	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5			−50	−75	mA	V_{OHD} = 3.85V Min
I_{CC}	Maximum Quiescent Supply Current	5.5		8.0	160.0	80.0	μA	V_{IN} = V_{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics: See Section 2 for waveforms

Symbol	Parameter	V_{CC}* (V)	74AC $T_A = +25°C$, $C_L = 50$ pF			54AC $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74AC $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
f_{max}	Maximum Clock Frequency	3.3 5.0	60 100	110 155		60 95		60 100		MHz	
t_{PLH}	Propagation Delay CP to O_n	3.3 5.0	3.0 2.5	11.0 8.0	13.5 9.5	1.0 1.0	16.5 12.0	1.5 1.5	15.5 10.5	ns	2-3, 4
t_{PHL}	Propagation Delay CP to O_n	3.3 5.0	2.5 2.0	10.0 7.0	12.5 9.0	1.0 1.0	15.0 11.0	2.0 1.5	14.0 10.0	ns	2-3, 4
t_{PZH}	Output Enable Time	3.3 5.0	3.0 2.0	9.5 7.0	11.5 8.5	1.0 1.0	14.0 10.5	1.5 1.0	13.0 9.5	ns	2-5
t_{PZL}	Output Enable Time	3.3 5.0	2.5 2.0	9.0 6.5	11.5 8.5	1.0 1.0	14.0 10.5	1.5 1.0	13.0 9.5	ns	2-6
t_{PHZ}	Output Disable Time	3.3 5.0	3.0 2.0	10.5 8.0	12.5 11.0	1.0 1.0	16.0 12.5	2.0 2.0	14.5 12.5	ns	2-5
t_{PLZ}	Output Disable Time	3.3 5.0	2.0 1.5	8.0 6.5	11.5 8.5	1.0 1.0	13.0 10.5	1.0 1.0	12.5 10.0	ns	2-6

*Voltage Range 3.3 is 3.3V ±0.3V
Voltage Range 5.0 is 5.0V ±0.5V

AC Operating Requirements: See Section 2 for waveforms

Symbol	Parameter	V_{CC}* (V)	74AC $T_A = +25°C$, $C_L = 50$ pF		54AC $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF	74AC $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF	Units	Fig. No.
			Typ	Guaranteed Minimum				
t_s	Setup Time, HIGH or LOW D_n to CP	3.3 5.0	2.0 1.0	5.5 4.0	6.5 5.0	6.0 4.5	ns	2-7
t_h	Hold Time, HIGH or LOW D_n to CP	3.3 5.0	−1.0 0	1.0 1.5	1.0 1.5	1.0 1.5	ns	2-7
t_w	CP Pulse Width, HIGH or LOW	3.3 5.0	4.0 2.5	5.5 4.0	6.5 5.0	6.0 4.5	ns	2-3

*Voltage Range 3.3 is 3.3V ±0.3V
Voltage Range 5.0 is 5.0V ±0.5V

AC Electrical Characteristics: See Section 2 for waveforms

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$, $C_L = 50$ pF			54ACT $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF		74ACT $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units	Fig. No.
			Min	Typ	Max	Min	Max	Min	Max		
f_{max}	Maximum Clock Frequency	5.0	100	160		70		90		MHz	
t_{PLH}	Propagation Delay CP to O_n	5.0	2.0	8.5	10.0	1.0	12.0	2.0	11.5	ns	2-3, 4
t_{PHL}	Propagation Delay CP to O_n	5.0	2.0	8.0	9.5	1.0	11.5	1.5	11.0	ns	2-3, 4
t_{PZH}	Output Enable Time	5.0	2.0	8.0	9.5	1.0	11.5	1.5	10.5	ns	2-5
t_{PZL}	Output Enable Time	5.0	1.5	8.0	9.0	1.0	11.5	1.5	10.5	ns	2-6
t_{PHZ}	Output Disable Time	5.0	1.5	8.5	11.5	1.0	13.0	1.0	12.5	ns	2-5
t_{PLZ}	Output Disable Time	5.0	1.5	7.0	8.5	1.0	11.0	1.0	10.0	ns	2-6

*Voltage Range 5.0 is 5.0V ±0.5V

AC Operating Requirements: See Section 2 for waveforms

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$, $C_L = 50$ pF		54ACT $T_A = -55°C$ to $+125°C$, $C_L = 50$ pF	74ACT $T_A = -40°C$ to $+85°C$, $C_L = 50$ pF	Units	Fig. No.
			Typ	Guaranteed Minimum				
t_s	Setup Time, HIGH or LOW D_n to CP	5.0	1.0	5.0	8.5	5.5	ns	2-7
t_h	Hold Time, HIGH or LOW D_n to CP	5.0	0	1.5	1.5	1.5	ns	2-7
t_w	CP Pulse Width, HIGH or LOW	5.0	2.5	5.0	8.5	5.0	ns	2-3

*Voltage Range 5.0 is 5.0V ±0.5V

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	$V_{CC} = 5.0V$
C_{PD}	Power Dissipation Capacitance	80.0	pF	$V_{CC} = 5.0V$