

August 1998

54AC175 • 54ACT175 Quad D Flip-Flop

General Description

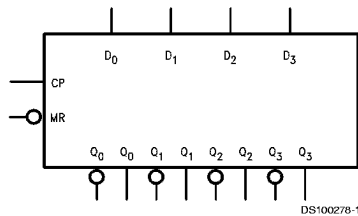
The 'AC/'ACT175 is a high-speed quad D flip-flop. The device is useful for general flip-flop requirements where clock and clear inputs are common. The information on the D inputs is stored during the LOW-to-HIGH clock transition. Both true and complemented outputs of each flip-flop are provided. A Master Reset input resets all flip-flops, independent of the Clock or D inputs, when LOW.

- Buffered positive edge-triggered clock
- Asynchronous common reset
- True and complement output
- Outputs source/sink 24 mA
- 'ACT175 has TTL-compatible inputs
- Standard Microcircuit Drawing (SMD)
 - 'AC175: 5962-89552
 - 'ACT175: 5962-89693

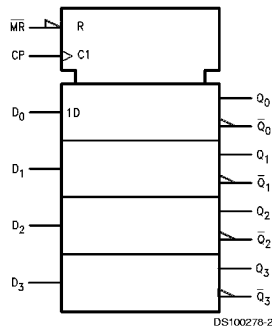
Features

- Edge-triggered D-type inputs

Logic Symbols

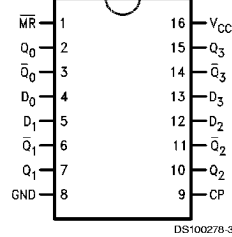


IEEE/IEC

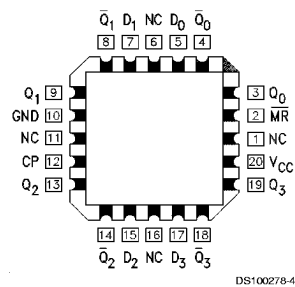


Connection Diagrams

Pin Assignment for DIP and Flatpak



Pin Assignment for LCC



Pin Names	Description
D ₀ -D ₃	Data Inputs
CP	Clock Pulse Input
MR	Master Reset Input
Q ₀ -Q ₃	True Outputs
Q ₀ -Q ₃	Complement Outputs

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Functional Description

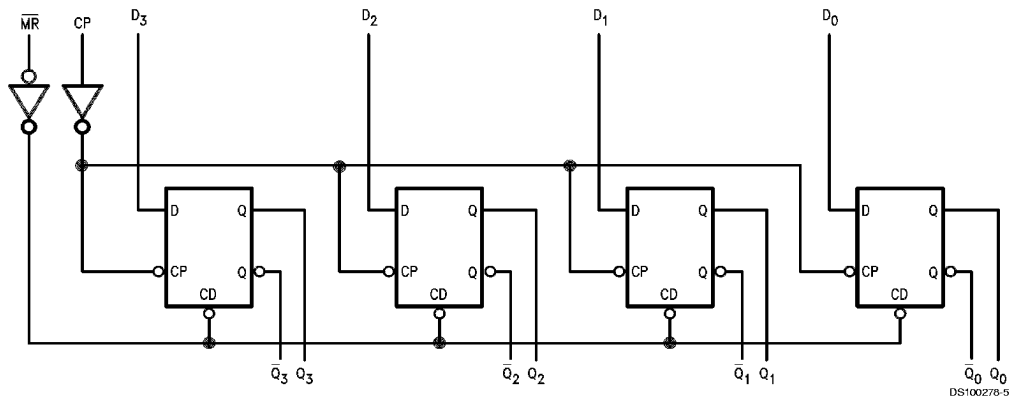
The 'AC/ACT175 consists of four edge-triggered D flip-flops with individual D inputs and Q and \bar{Q} outputs. The Clock and Master Reset are common. The four flip-flops will store the state of their individual D inputs on the LOW-to-HIGH clock (CP) transition, causing individual Q and \bar{Q} outputs to follow. A LOW input on the Master Reset (\bar{MR}) will force all Q outputs LOW and \bar{Q} outputs HIGH independent of Clock or Data inputs. The 'AC/ACT175 is useful for general logic applications where a common Master Reset and Clock are acceptable.

Truth Table

Inputs		Outputs	
@ t_n , $\bar{MR} = H$		@ t_{n+1}	
D_n		Q_n	\bar{Q}_n
L		L	H
H		H	L

H = HIGH Voltage Level
 L = LOW Voltage Level
 t_n = Bit Time before Clock Pulse
 t_{n+1} = Bit Time after Clock Pulse

Logic Diagram



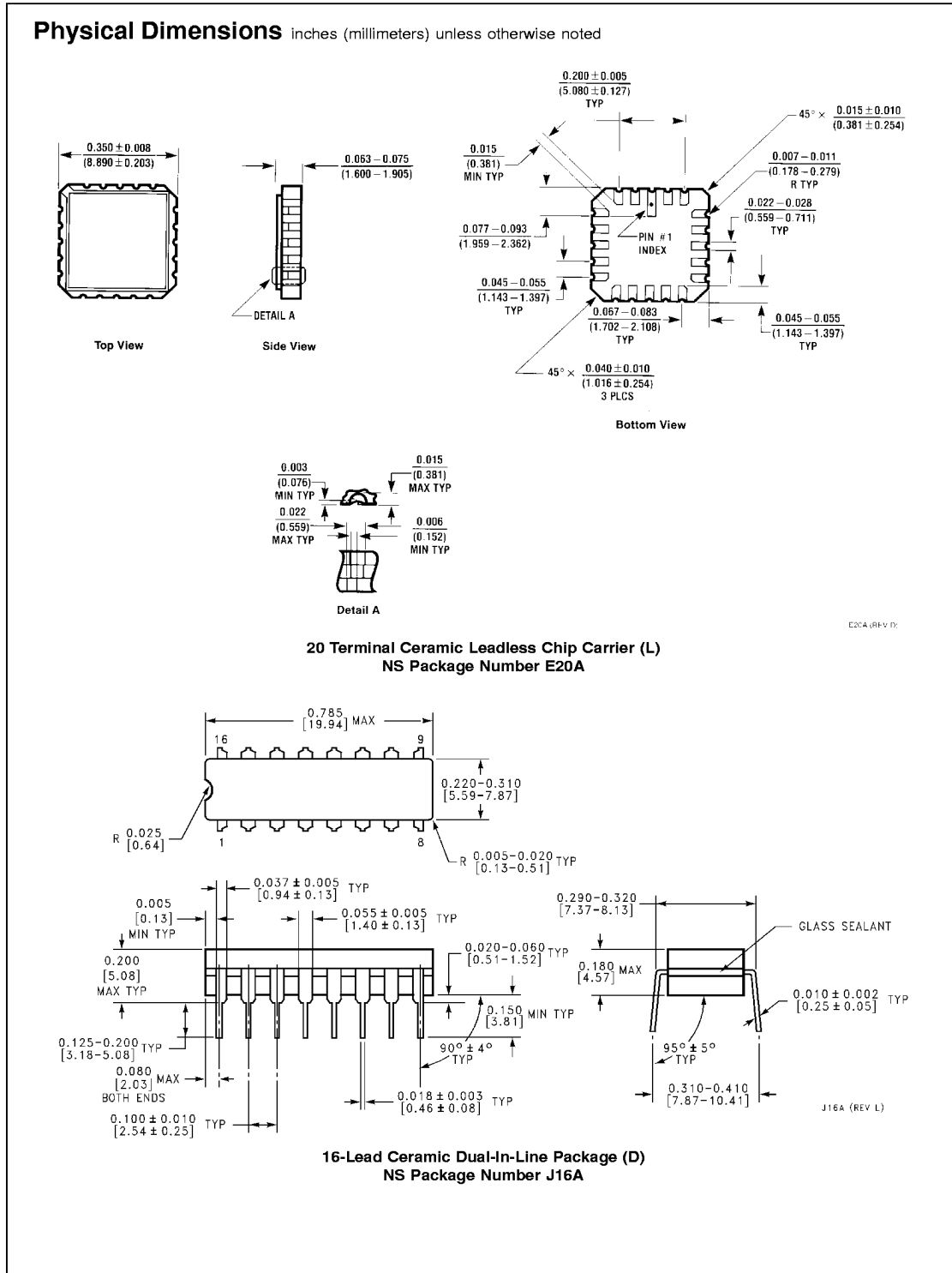
Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)		Recommended Operating Conditions			
<p>If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.</p>		<p>Supply Voltage (V_{CC}) 'AC 2.0V to 6.0V 'ACT 4.5V to 5.5V</p>			
Supply Voltage (V_{CC})	-0.5V to +7.0V	Input Voltage (V_I)	0V to V_{CC}		
DC Input Diode Current (I_{IK})	$V_I = -0.5V$ -20 mA $V_I = V_{CC} + 0.5V$ +20 mA	Output Voltage (V_O)	0V to V_{CC}		
DC Input Voltage (V_I)	-0.5V to $V_{CC} + 0.5V$	Operating Temperature (T_A)	54AC/ACT -55°C to +125°C		
DC Output Diode Current (I_{OK})	$V_O = -0.5V$ -20 mA $V_O = V_{CC} + 0.5V$ +20 mA	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		
DC Output Voltage (V_O)	-0.5V to $V_{CC} + 0.5V$	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 Output Source or Sink Current (I_O)	± 50 mA	<p>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.</p>			
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				
<h3>DC Characteristics for 'AC Family Devices</h3>					
Symbol	Parameter	V_{CC} (V)	54AC	Units	Conditions
			$T_A = -55^\circ\text{C to } +125^\circ\text{C}$ Guaranteed Limits		
V_{IH}	Minimum High Level Input Voltage	3.0	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	3.15		
		5.5	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	1.35		
		5.5	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.9	V	$I_{OUT} = -50 \mu A$
		4.5	4.4		
		5.5	5.4		
V_{OL}	Maximum Low Level Output Voltage	3.0	0.1	V	$I_{OUT} = 50 \mu A$
		4.5	0.1		
		5.5	0.1		
I_{IN}	Maximum Input Leakage Current	3.0	2.4	V	(Note 2) $V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA
		4.5	3.7		
		5.5	4.7		
I_{OLD}	Minimum Dynamic Output Current	3.0	0.1	V	(Note 2) $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 12$ mA $I_{OL} = 24$ mA $I_{OL} = 24$ mA
		4.5	0.50		
		5.5	0.50		
I_{OHD}	Output Current	5.5	± 1.0	mA	$V_I = V_{CC}, GND$
		5.5	50		
I_{OHD}	Output Current	5.5	-50	mA	$V_{OLD} = 1.65V$ Max $V_{OHD} = 3.85V$ Min
		5.5	-50		

DC Characteristics for 'AC Family Devices (Continued)					
Symbol	Parameter	V _{CC} (V)	54AC	Units	Conditions
			T _A = -55°C to +125°C		
			Guaranteed Limits		
I _{CC}	Maximum Quiescent Supply Current	5.5	160.0	μA	V _{IN} = V _{CC} or GND
<p>Note 2: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 3: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 4: 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.</p>					
DC Characteristics for 'ACT Family Devices					
Symbol	Parameter	V _{CC} (V)	54ACT	Units	Conditions
			T _A = -55°C to +125°C		
			Guaranteed Limits		
V _{IH}	Minimum High Level Input Voltage	4.5 5.5	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	0.8 0.8	V	V _{OUT} = 0.1V or V _{CC} - 0.1V
V _{OH}	Minimum High Level Output Voltage	4.5	4.4	V	I _{OUT} = -50 μA
		5.5	5.4		
		4.5 5.5	3.70 4.70	V	(Note 5) V _{IN} = V _{IL} or V _{IH} I _{OH} = -24 mA I _{OH} = -24 mA
V _{OL}	Maximum Low Level Output Voltage	4.5	0.1	V	I _{OUT} = 50 μA
		5.5	0.1		
		4.5 5.5	0.50 0.50	V	(Note 5) V _{IN} = V _{IL} or V _{IH} I _{OL} = 24 mA I _{OL} = 24 mA
I _{IN}	Maximum Input Leakage Current	5.5	±1.0	μA	V _I = V _{CC} , GND
I _{CCT}	Maximum I _{CC} /Input	5.5	1.6	mA	V _I = V _{CC} - 2.1V
I _{OLD}	(Note 6) Minimum Dynamic Output Current	5.5	50	mA	V _{OLD} = 1.65V Max
	I _{OHD}	5.5	-50	mA	V _{OHD} = 3.85V Min
I _{CC}	Maximum Quiescent Supply Current	5.5	160.0	μA	V _{IN} = V _{CC} or GND
<p>Note 5: All outputs loaded; thresholds on input associated with output under test.</p> <p>Note 6: Maximum test duration 2.0 ms, one output loaded at a time.</p> <p>Note 7: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.</p>					

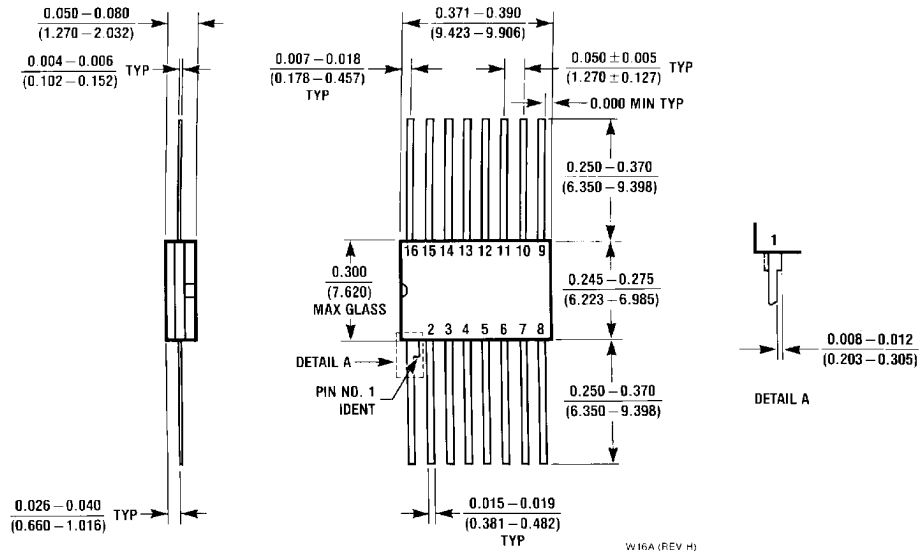
AC Electrical Characteristics						
Symbol	Parameter	V _{CC} (V) (Note 8)	54AC		Units	Fig. No.
			T _A = -55°C to +125°C			
			C _L = 50 pF			
		Min	Max			
f _{max}	Maximum Clock Frequency	3.3 5.0	95 95		MHz	
t _{PLH}	Propagation Delay CP to Q _n or \overline{Q}_n	3.3 5.0	1.0 1.5	14.5 10.5	ns	
t _{PHL}	Propagation Delay CP to Q _n or \overline{Q}_n	3.3 5.0	1.0 1.5	15.0 11.5	ns	
t _{PLH}	Propagation Delay \overline{MR} to Q _n	3.3 5.0	1.0 1.5	15.0 11.0	ns	
t _{PHL}	Propagation Delay \overline{MR} to Q _n	3.3 5.0	1.0 1.5	13.5 10.5	ns	
<p>Note 8: Voltage Range 3.3 is 3.3V ±0.3V Voltage Range 5.0 is 5.0V ±0.5V</p>						
AC Operating Requirements						
Symbol	Parameter	V _{CC} (V) (Note 9)	54AC		Units	Fig. No.
			T _A = -55°C to +125°C			
			C _L = 50 pF			
		Guaranteed Minimum				
t _s	Setup Time, HIGH or LOW D _n to CP	3.3 5.0	5.0 3.5		ns	
t _h	Hold Time, HIGH or LOW D _n to CP	3.3 5.0	2.0 2.5		ns	
t _w	CP Pulse Width HIGH or LOW	3.3 5.0	6.0 5.0		ns	
t _w	\overline{MR} Pulse Width, LOW	3.3 5.0	5.5 5.0		ns	
t _{rec}	Recovery Time \overline{MR} to CP	3.3 5.0	1.5 1.5		ns	
<p>Note 9: Voltage Range 3.3 is 3.3V ±0.3V Voltage Range 5.0 is 5.0V ±0.5V</p>						

AC Electrical Characteristics						
Symbol	Parameter	V _{CC} (V) (Note 10)	54ACT		Units	Fig. No.
			T _A = -55°C to +125°C C _L = 50 pF			
			Min	Max		
f _{max}	Maximum Clock Frequency	5.0	95		MHz	
t _{PLH}	Propagation Delay CP to Q _n or \overline{Q}_n	5.0	1.5	11.5	ns	
t _{PHL}	Propagation Delay CP to Q _n or \overline{Q}_n	5.0	1.5	12.5	ns	
t _{PLH}	Propagation Delay \overline{MR} to \overline{Q}_n	5.0	1.5	11.5	ns	
t _{PHL}	Propagation Delay \overline{MR} to Q _n	5.0	1.5	11.0	ns	
Note 10: Voltage Range 5.0 is 5.0V ±0.5V						
AC Operating Requirements						
Symbol	Parameter	V _{CC} (V) (Note 11)	54ACT		Units	Fig. No.
			T _A = -55°C to +125°C C _L = 50 pF			
			Guaranteed Minimum			
t _s (H)	Setup Time D _n to CP	5.0	3.5		ns	
t _s (L)	D _n to CP	5.0	3.5		ns	
t _h	Hold Time, HIGH or LOW D _n to CP	5.0	1.5		ns	
t _w	CP Pulse Width HIGH or LOW	5.0	5.0		ns	
t _w	\overline{MR} Pulse Width, LOW	5.0	5.0		ns	
t _{rec}	Recovery Time, \overline{MR} to CP	5.0	1.5		ns	
Note 11: Voltage Range 5.0 is 5.0V ±0.5V						
Capacitance						
Symbol	Parameter	Typ	Units	Conditions		
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = OPEN		
C _{PD}	Power Dissipation Capacitance	45.0	pF	V _{CC} = 5.0V		



54AC175 • 54ACT175 Quad D Flip-Flop

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



**16-Lead Ceramic Flatpak (F)
NS Package Number W16A**

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