

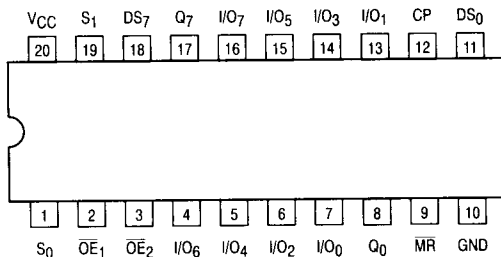


MOTOROLA

8-Input Universal Shift/Storage Register with Common Parallel I/O Pins

The MC74AC299/74ACT299 is an 8-bit universal shift/storage register with 3-state outputs. Four modes of operation are possible: hold (store), shift left, shift right and load data. The parallel load inputs and flip-flop outputs are multiplexed to reduce the total number of package pins. Additional outputs are provided for flip-flops Q₀, Q₇ to allow easy serial cascading. A separate active LOW Master Reset is used to reset the register.

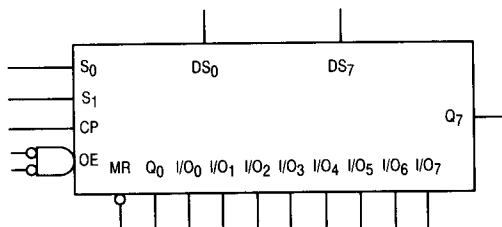
- Common Parallel I/O for Reduced Pin Count
- Additional Serial Inputs and Outputs for Expansion
- Four Operating Modes: Shift Left, Shift Right, Load and Store
- 3-State Outputs for Bus-Oriented Applications
- Outputs Source/Sink 24 mA
- 'ACT299 Has TTL Compatible Inputs



PIN NAMES

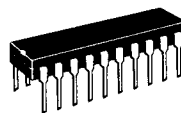
CP	Clock Pulse Input
DS ₀	Serial Data Input for Right Shift
DS ₇	Serial Data Input for Left Shift
S ₀ , S ₁	Mode Select Inputs
MR	Asynchronous Master Reset
OE ₁ , OE ₂	3-State Output Enable Inputs
I/O ₀ –I/O ₇	Parallel Data Inputs or 3-State Parallel Outputs
Q ₀ , Q ₇	Serial Outputs

LOGIC SYMBOL



MC74AC299
MC74ACT299

**8-INPUT UNIVERSAL
SHIFT/STORAGE REGISTER
WITH COMMON
PARALLEL I/O PINS**



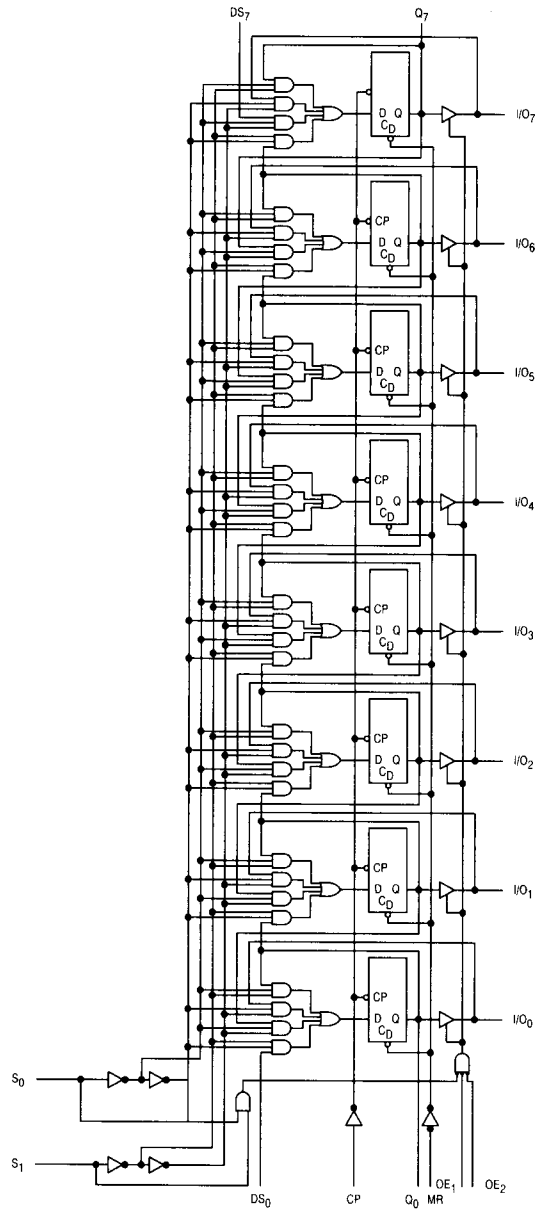
**N SUFFIX
CASE 738-03
PLASTIC**



**DW SUFFIX
CASE 751D-04
PLASTIC**

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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.

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FUNCTIONAL DESCRIPTION

The MC74AC299/74ACT299 contains eight edge-triggered D-type flip-flops and the interstage logic necessary to perform synchronous shift left, shift right, parallel load and hold operations. The type of operation is determined by S_0 and S_1 , as shown in the Truth Table. All flip-flop outputs are brought out through 3-state buffers to separate I/O pins that also serve as data inputs in the parallel load mode. Q_0 and Q_7 are also brought out on other pins for expansion in serial shifting of longer words.

A LOW signal on $\overline{MR}$ overrides the Select and CP inputs and resets the flip-flops. All other state changes are initiated by the rising edge of the clock. Inputs can change when the clock is in either state provided only that the recommended setup and hold times, relative to the rising edge of CP, are observed.

A HIGH signal on either $\overline{OE}_1$ or $\overline{OE}_2$ disables the 3-state buffers and puts the I/O pins in the high impedance state. In this condition the shift, hold, load and reset operations can still occur. The 3-state buffers are also disabled by HIGH signals on both S_0 and S_1 in preparation for a parallel load operation.

TRUTH TABLE

Inputs				Response
MR	S_1	S_0	CP	
L	X	X	X	Asynchronous Reset; Q_0 – Q_7 = LOW
H	H	H	$\neg$	Parallel Load; $I/O_n \rightarrow Q_n$
H	L	H	$\neg$	Shift Rights; $DS_0 \rightarrow Q_0$, $Q_0 \rightarrow Q_1$, etc.
H	H	L	$\neg$	Shift Left; $DS_7 \rightarrow Q_7$, $Q_7 \rightarrow Q_6$, etc.
H	L	L	X	Hold

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

$\neg$ = LOW-to-HIGH Transition

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	–0.5 to +7.0	V
V_{in}	DC Input Voltage (Referenced to GND)	–0.5 to $V_{CC} + 0.5$	V
V_{out}	DC Output Voltage (Referenced to GND)	–0.5 to $V_{CC} + 0.5$	V
I_{in}	DC Input Current, per Pin	± 20	mA
I_{out}	DC Output Sink/Source Current, per Pin	± 50	mA
I_{CC}	DC V_{CC} or GND Current per Output Pin	± 50	mA
T_{stg}	Storage Temperature	–65 to +150	°C

* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
V_{in}, V_{out}	DC Input Voltage, Output Voltage (Ref. to GND)		0		V_{CC}	V
t_r, t_f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V_{CC} @ 3.0 V		150		ns/V
		V_{CC} @ 4.5 V		40		
		V_{CC} @ 5.5 V		25		
t_r, t_f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V_{CC} @ 4.5 V		10		ns/V
		V_{CC} @ 5.5 V		8.0		
T_J	Junction Temperature (PDIP)				140	°C
T_A	Operating Ambient Temperature Range		–40	25	85	°C
I_{OH}	Output Current — High				–24	mA
I_{OL}	Output Current — Low				24	mA

1. V_{in} from 30% to 70% V_{CC} ; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2. V_{in} from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74AC		74AC		Unit	Conditions
			T _A = +25°C		T _A = –40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V	
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
V _{IL}	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	V _{OUT} = 0.1 V or V _{CC} – 0.1 V	
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
V _{OH}	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	I _{OUT} = –50 μA	
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
		3.0		2.56	2.46	V	*V _{IN} = V _{IL} or V _{IH} –12 mA I _{OH} –24 mA –24 mA	
		4.5		3.86	3.76			
		5.5		4.86	4.76			
V _{OL}	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	I _{OUT} = 50 μA	
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
		3.0		0.36	0.44	V	*V _{IN} = V _{IL} or V _{IH} 12 mA I _{OL} 24 mA 24 mA	
		4.5		0.36	0.44			
		5.5		0.36	0.44			
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V _I = V _{CC} , GND	
I _{OZT}	Maximum 3-State Current	5.5		±0.6	±6.0	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			75	mA	V _{OLD} = 1.65 V Max	
I _{OHD}		5.5			–75	mA	V _{OHD} = 3.85 V Min	
I _{CC}	Maximum Quiescent Supply Current	5.5		8.0	80	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} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

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AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74AC			74AC		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
f _{max}	Maximum Input Frequency	3.3 5.0	90 130			80 105		MHz	3-3
t _{PLH}	Propagation Delay CP to Q ₀ or Q ₇	3.3 5.0	8.5 5.5		20.5 14	7.0 4.5	22 15	ns	3-6
t _{PHL}	Propagation Delay CP to Q ₀ or Q ₇	3.3 5.0	8.5 5.5		21.5 14.5	7.0 5.0	23 16	ns	3-6
t _{PLH}	Propagation Delay CP to I/O _N	3.3 5.0	9.0 6.0		20.5 14.5	7.5 5.0	22.5 16	ns	3-6
t _{PHL}	Propagation Delay CP to I/O _N	3.3 5.0	10 6.5		23 16	8.5 6.0	24.5 17.5	ns	3-6
t _{PHL}	Propagation Delay MR to Q ₀ or Q ₇	3.3 5.0	9.0 5.5		22.5 15.5	7.5 5.0	25.0 17.0	ns	3-6
t _{PHL}	Propagation Delay MR to I/O _N	3.3 5.0	9.0 5.5		21.5 15.0	7.5 5.0	24.0 16.5	ns	3-6
t _{PZH}	Output Enable Time OE to I/O _N	3.3 5.0	7.0 4.5		18 12.5	6.0 4.0	19.5 13.5	ns	3-7
t _{PZL}	Output Enable Time OE to I/O _N	3.3 5.0	7.0 5.0		18 12.5	6.0 4.0	20.5 14	ns	3-8
t _{PHZ}	Output Disable Time OE to I/O _N	3.3 5.0	6.5 3.5		18.5 14	5.5 3.0	19.5 15	ns	3-7
t _{PLZ}	Output Disable Time OE to I/O _N	3.3 5.0	5.5 3.5		17 12.5	4.5 2.0	19 13.5	ns	3-8

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

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AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74AC		74AC		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF		T _A = -40°C to +85°C C _L = 50 pF			
			Typ	Guaranteed Minimum				
t _s	Setup Time, HIGH or LOW S ₀ or S ₁ to CP	3.3		8.0	8.5	ns	3-9	
		5.0		5.0	5.5			
t _h	Hold Time, HIGH or LOW S ₀ or S ₁ to CP	3.3		0.5	0.5	ns	3-9	
		5.0		1.0	1.0			
t _s	Setup Time, HIGH or LOW I/O _n to CP	3.3		5.5	6.0	ns	3-9	
		5.0		3.5	4.0			
t _h	Hold Time, HIGH or LOW I/O _n to CP	3.3		0	0	ns	3-9	
		5.0		1.0	1.0			
t _s	Setup Time, HIGH or LOW DS ₀ or DS ₇ to CP	3.3		6.5	7.0	ns	3-6	
		5.0		4.0	4.5			
t _h	Hold Time, HIGH or LOW DS ₀ or DS ₇ to CP	3.3		0	0.5	ns	3-6	
		5.0		1.0	1.0			
t _w	CP Pulse Width, LOW	3.3		4.5	5.0	ns	3-6	
		5.0		3.5	3.5			
t _w	MR Pulse Width, LOW	3.3		4.5	5.0	ns	3-9	
		5.0		3.5	3.5			
t _{rec}	Recovery Time MR to CP	3.3		1.5	1.5	ns	3-9	
		5.0		1.5	1.5			

* Voltage Range 3.3 V is 3.3 V ±0.3 V.

Voltage Range 5.0 V is 5.0 V ±0.5 V.

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DC CHARACTERISTICS

Symbol	Parameter	VCC (V)	74ACT		74ACT		Unit	Conditions
			TA = +25°C		TA = −40°C to +85°C			
			Typ	Guaranteed Limits				
VIH	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0	V	VOUT = 0.1 V or VCC − 0.1 V	
		5.5	1.5	2.0	2.0			
VIL	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	V	VOUT = 0.1 V or VCC − 0.1 V	
		5.5	1.5	0.8	0.8			
VOH	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	V	IOUT = −50 μA	
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76	V	*VIN = VIL or VIH −24 mA IOH −24 mA	
		5.5		4.86	4.76			
VOL	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	V	IOUT = 50 μA	
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44	V	*VIN = VIL or VIH 24 mA IOL 24 mA	
		5.5		0.36	0.44			
IIN	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	VI = VCC, GND	
IOZT	Maximum 3-State Current	5.5		±0.6	±6.0	μA	VI (OE) = VIL, VIH VI = VCC, GND VO = VCC, GND	
ΔICCT	Additional Max. ICC/Input	5.5	0.6		1.5	mA	VI = VCC − 2.1 V	
IOLD	†Minimum Dynamic Output Current	5.5			75	mA	VOLD = 1.65 V Max	
IOHD		5.5			−75	mA	VOHD = 3.85 V Min	
ICC	Maximum Quiescent Supply Current	5.5		8.0	80	μA	VIN = VCC 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.

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AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V _{CC} * (V)	74ACT			74ACT		Unit	Fig. No.
			T _A = +25°C C _L = 50 pF			T _A = -40°C to +85°C C _L = 50 pF			
			Min	Typ	Max	Min	Max		
f _{max}	Maximum Input Frequency	5.0	120			110		MHz	3-3
t _{PLH}	Propagation Delay CP to Q ₀ or Q ₇	5.0	4.0		12.5	3.0	14	ns	3-6
t _{PHL}	Propagation Delay CP to Q ₀ or Q ₇	5.0	4.0		13.5	3.5	15	ns	3-6
t _{PLH}	Propagation Delay CP to I/O _n	5.0	4.5		12.5	4.5	13.5	ns	3-6
t _{PHL}	Propagation Delay CP to I/O _n	5.0	5.0		15	4.5	16.5	ns	3-6
t _{PHL}	Propagation Delay MR to Q ₀ or Q ₇	5.0	4.0		15	4.0	18	ns	3-6
t _{PHL}	Propagation Delay MR to I/O _n	5.0	4.0		14.5	3.5	17.5	ns	3-6
t _{PZH}	Output Enable Time OE to I/O _n	5.0	2.5		12	1.5	13	ns	3-7
t _{PZL}	Output Enable Time OE to I/O _n	5.0	2.0		12	1.5	13.5	ns	3-8
t _{PHZ}	Output Disable Time OE to I/O _n	5.0	2.0		12.5	2.0	13.5	ns	3-7
t _{PLZ}	Output Disable Time OE to I/O _n	5.0	2.5		11.5	2.0	12.5	ns	3-8

* Voltage Range 5.0 V is 5.0 V ±0.5 V.

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AC OPERATING REQUIREMENTS

Symbol	Parameter	V _{CC} * (V)	74ACT		74ACT	Unit	Fig. No.
			T _A = +25°C C _L = 50 pF		T _A = −40°C to +85°C C _L = 50 pF		
			Typ	Guaranteed Minimum			
t _s	Setup Time, HIGH or LOW S ₀ or S ₁ to CP	5.0		5.0	5.5	ns	3-9
t _h	Hold Time, HIGH or LOW S ₀ or S ₁ to CP	5.0		1.0	1.0	ns	3-9
t _s	Setup Time, HIGH or LOW I/O _n to CP	5.0		4.0	4.5	ns	3-9
t _h	Hold Time, HIGH or LOW I/O _n to CP	5.0		1.0	1.0	ns	3-9
t _s	Setup Time, HIGH or LOW DS ₀ or DS ₇ to CP	5.0		4.5	5.0	ns	3-6
t _h	Hold Time, HIGH or LOW DS ₀ or DS ₇ to CP	5.0		1.0	1.0	ns	3-6
t _w	CP Pulse Width HIGH or LOW	5.0		4.0	4.5	ns	3-9
t _w	MR Pulse Width, LOW	5.0		3.5	3.5	ns	3-9
t _{rec}	Recovery Time MR to CP	5.0		1.5	1.5	ns	3-9

* Voltage Range 5.0 V is 5.0 V ±0.5 V.

CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
C _{PD}	Power Dissipation Capacitance	170	pF	V _{CC} = 5.0 V