



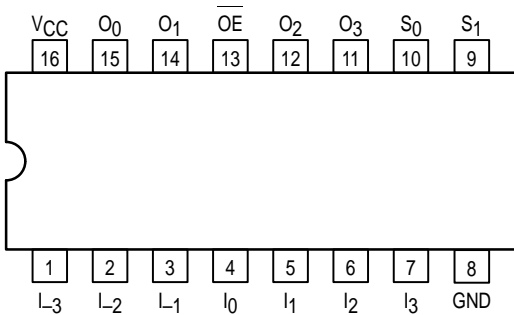
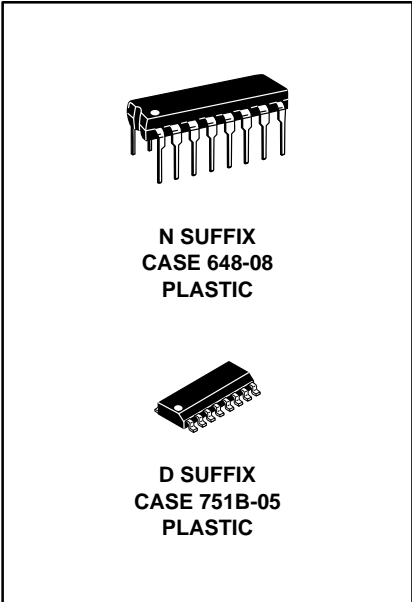
MC74AC350 MC74ACT350

4-BIT SHIFTER WITH 3-STATE OUTPUTS

4-Bit Shifter With 3-State Outputs

The MC74AC350/74ACT350 is a specialized multiplexer that accepts a 4-bit word and shifts it 0, 1, 2 or 3 places, as determined by two Select (S_0 , S_1) inputs. For expansion to longer words, three linking inputs are provided for lower-order bits; thus two packages can shift an 8-bit word, four packages a 16-bit word, etc. Shifting by more than three places is accomplished by paralleling the 3-state outputs of different packages and using the Output Enable (OE) inputs as a third Select level. With appropriate interconnections, the 'AC/ACT350 can perform zero-backfill, sign-extend or end-around (barrel) shift functions.

- Linking Inputs for Word Expansion
- 3-State Outputs for Extending Shift Range

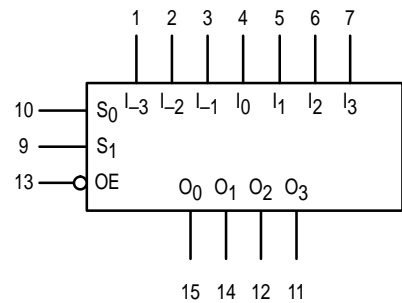


TRUTH TABLE

Inputs			Outputs			
OE	S_1	S_0	O_0	O_1	O_2	O_3
H	X	X	Z	Z	Z	Z
L	L	L	I_0	I_1	I_2	I_3
L	L	H	L_{-1}	I_0	I_1	I_2
L	H	L	L_{-2}	L_{-1}	I_0	I_1
L	H	H	L_{-3}	L_{-2}	L_{-1}	I_0

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

LOGIC SYMBOL



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FUNCTIONAL DESCRIPTION

The MC74AC350/74ACT350 is operationally equivalent to a 4-input multiplexer with the inputs connected so that the select code causes successive one-bit shifts of the data word. This internal connection makes it possible to perform shifts of 0, 1, 2 or 3 places on words of any length.

A 7-bit data word is introduced at the I_n inputs and is shifted according to the code applied to the select inputs S_0, S_1 . Outputs O_0-O_3 are 3-state, controlled by an active-LOW output enable (\overline{OE}). When \overline{OE} is LOW, data outputs will follow selected data inputs; when HIGH, the data outputs will be forced to the high-impedance state. This feature allows

shifters to be cascaded on the same output lines or to a common bus. The shift function can be logical, with zeros pulled in at either or both ends of the shifting field; arithmetic, where the sign bit is repeated during a shift down; or end around, where the data word forms a continuous loop.

LOGIC EQUATIONS

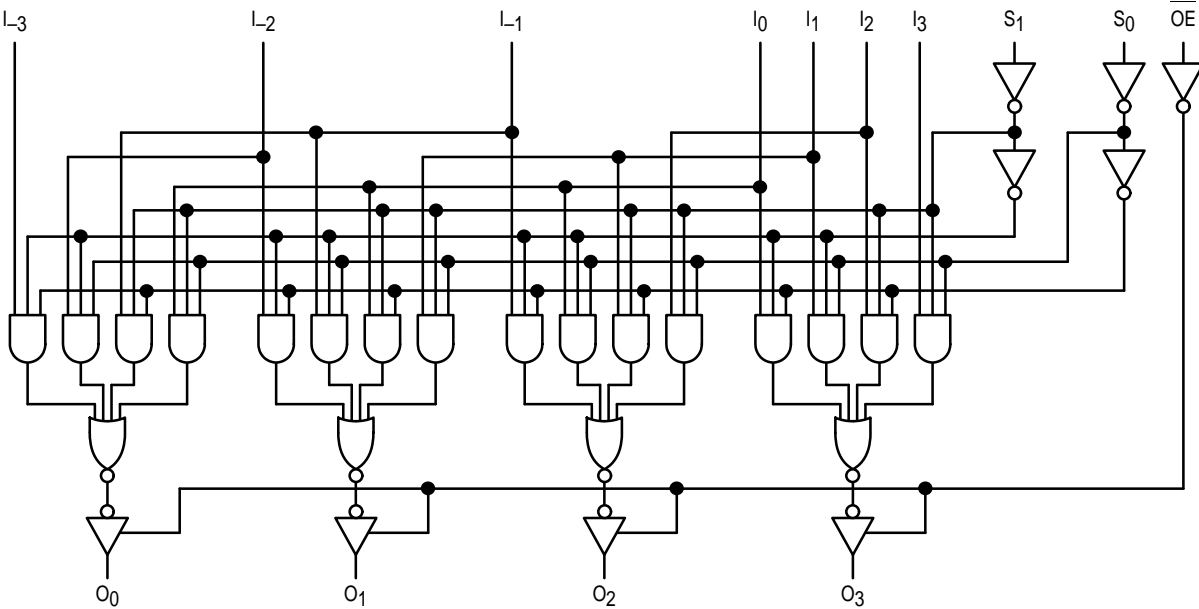
$$O_0 = \overline{S_0} \overline{S_1} I_0 + S_0 \overline{S_1} I_{-1} + \overline{S_0} S_1 I_{-2} + S_0 S_1 I_{-3}$$

$$O_1 = \overline{S_0} \overline{S_1} I_1 + S_0 \overline{S_1} I_0 + \overline{S_0} S_1 I_{-1} + S_0 S_1 I_{-2}$$

$$O_2 = \overline{S_0} \overline{S_1} I_2 + S_0 \overline{S_1} I_1 + \overline{S_0} S_1 I_0 + S_0 S_1 I_{-1}$$

$$O_3 = S_0 S_1 I_3 + S_0 \overline{S_1} I_2 + \overline{S_0} S_1 I_1 + S_0 S_1 I_0$$

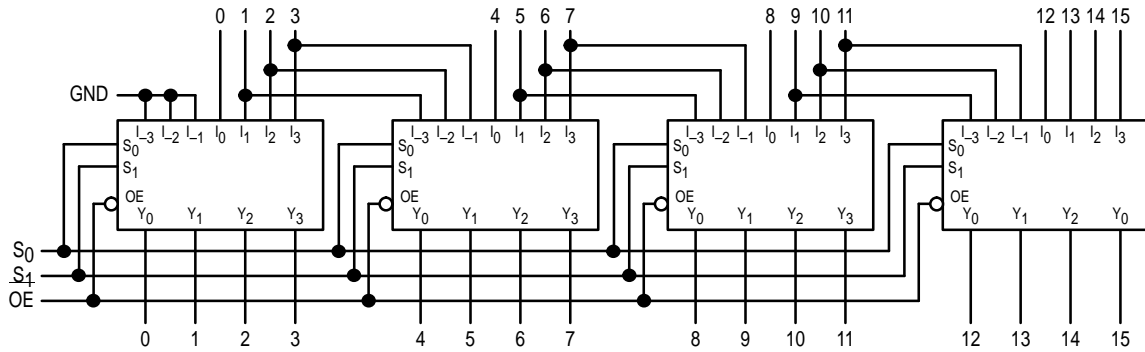
LOGIC DIAGRAM



MC74AC350 MC74ACT350

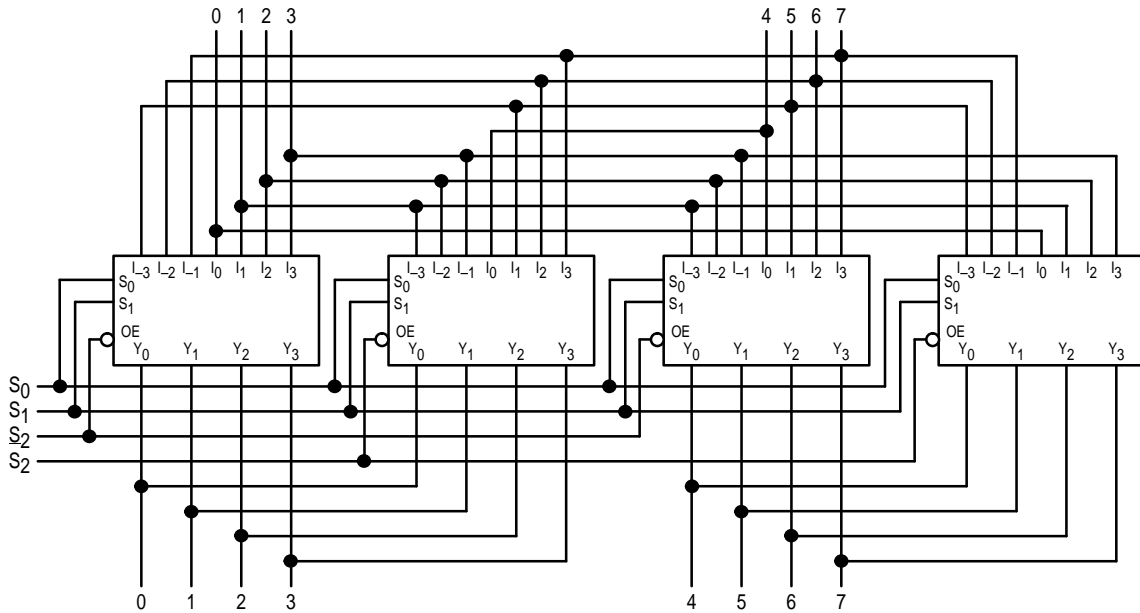
APPLICATIONS

16-Bit Shift-Up 0 to 3 Places, Zero Backfill



S ₁	S ₀	
L	L	NO SHIFT
L	H	SHIFT 1 PLACE
H	L	SHIFT 2 PLACES
H	H	SHIFT 3 PLACES

8-Bit End Around Shift 0 to 7 Places

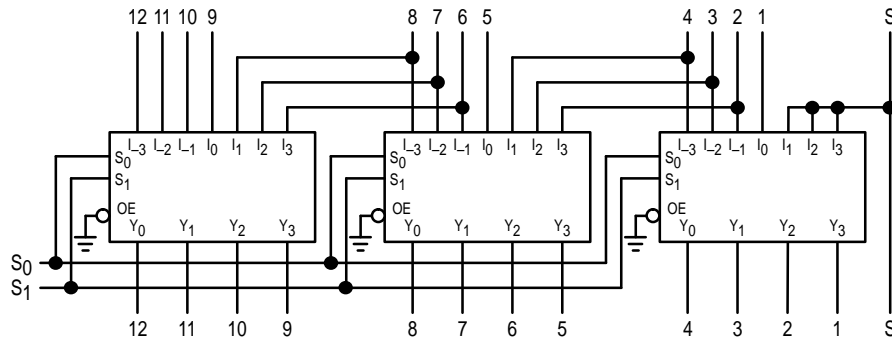


S ₂	S ₁	S ₀	
L	L	L	NO SHIFT
L	L	H	SHIFT END AROUND 1
L	H	L	SHIFT END AROUND 2
L	H	H	SHIFT END AROUND 3
H	L	L	SHIFT END AROUND 4

S ₂	S ₁	S ₀	
H	L	H	SHIFT END AROUND 5
H	H	L	SHIFT END AROUND 6
H	H	H	SHIFT END AROUND 7

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13-Bit Twos Complement Scaler



S ₁	S ₀	SCALE
L	L ÷ 8	1/8
L	H ÷ 4	1/4
H	L ÷ 2	1/2
H	H NO CHANGE	1

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 _{OZ}	Maximum 3-State Current	5.5		±0.5	±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			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		
t _{PLH}	Propagation Delay I _n to O _n	3.3 5.0	4.0 3.0		12.5 8.5	3.0 2.5	13.5 9.5	ns	3-5
t _{PHL}	Propagation Delay I _n to O _n	3.3 5.0	4.0 3.0		12.5 8.5	3.0 2.5	13.5 9.5	ns	3-5
t _{PLH}	Propagation Delay S _n to O _n	3.3 5.0	5.0 3.5		15.5 11.0	4.0 2.5	17.5 12.0	ns	3-6
t _{PHL}	Propagation Delay S _n to O _n	3.3 5.0	5.0 3.5		15.5 11.0	4.5 3.0	17.5 12.0	ns	3-6
t _{PZH}	Output Enable to O _n	3.3 5.0	3.5 2.5		8.5 6.0	3.0 2.0	9.0 6.5	ns	3-7
t _{PZL}	Output Enable to O _n	3.3 5.0	3.5 2.5		11.0 7.5	2.5 2.0	12.0 8.0	ns	3-8
t _{PHZ}	Output Enable to O _n	3.3 5.0	5.0 4.5		9.5 8.0	4.5 4.0	10.0 8.5	ns	3-7
t _{PLZ}	Output Enable to O _n	3.3 5.0	3.0 2.5		6.5 6.0	2.5 2.0	7.0 6.5	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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DC CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	74ACT		74ACT		Unit	Conditions
			T _A = +25°C		T _A = -40°C to +85°C			
			Typ	Guaranteed Limits				
V _{IH}	Minimum High Level Input Voltage	4.5	1.5	2.0	2.0	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V	
		5.5	1.5	2.0	2.0			
V _{IL}	Maximum Low Level Input Voltage	4.5	1.5	0.8	0.8	V	V _{OUT} = 0.1 V or V _{CC} - 0.1 V	
		5.5	1.5	0.8	0.8			
V _{OH}	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4	V	I _{OUT} = -50 μA	
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76	V	*V _{IN} = V _{IL} or V _{IH} -24 mA I _{OH} -24 mA	
5.5		4.86	4.76					
V _{OL}	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1	V	I _{OUT} = 50 μA	
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44	V	*V _{IN} = V _{IL} or V _{IH} 24 mA I _{OL} 24 mA	
5.5		0.36	0.44					
I _{IN}	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V _I = V _{CC} , GND	
ΔI _{CCT}	Additional Max. I _{CC} /Input	5.5	0.6		1.5	mA	V _I = V _{CC} - 2.1 V	
I _{OZ}	Maximum 3-State Current	5.5		±0.5	±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			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.

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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		
t _{PLH}	Propagation Delay I _n to O _n	5.0	4.0		11.5	3.0	13.5	ns	3-6
t _{PHL}	Propagation Delay I _n to O _n	5.0	4.0		11.5	3.0	13.5	ns	3-6
t _{PLH}	Propagation Delay S _n to O _n	5.0	4.5		13.0	3.5	15.5	ns	3-6
t _{PHL}	Propagation Delay S _n to O _n	5.0	4.5		13.0	3.5	15.5	ns	3-6
t _{PZH}	Output Enable to O _n	5.0	4.0		9.0	3.0	10.0	ns	3-7
t _{PZL}	Output Enable to O _n	5.0	4.0		10.0	3.0	11.5	ns	3-8
t _{PHZ}	Output Enable to O _n	5.0	4.0		10.0	3.0	11.0	ns	3-7
t _{PLZ}	Output Enable to O _n	5.0	4.0		8.0	3.0	9.0	ns	3-8

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

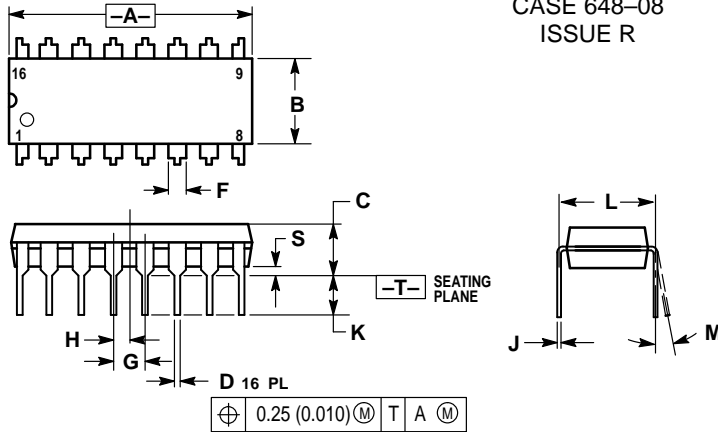
CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C _{IN}	Input Capacitance	4.5	pF	V _{CC} = 5.0 V
C _{PD}	Power Dissipation Capacitance	40.0	pF	V _{CC} = 5.0 V

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OUTLINE DIMENSIONS

N SUFFIX PLASTIC DIP PACKAGE CASE 648-08 ISSUE R

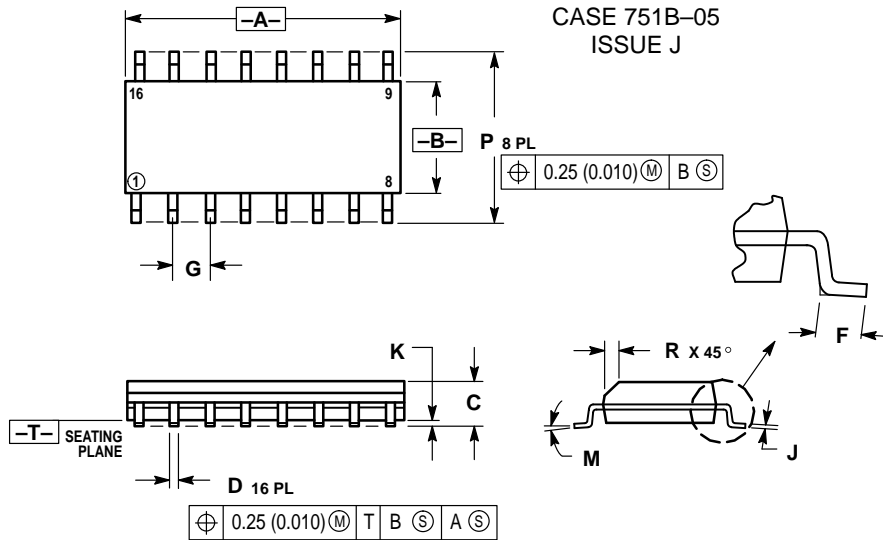


NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0°	10°	0°	10°
S	0.020	0.040	0.51	1.01


D SUFFIX PLASTIC SOIC PACKAGE CASE 751B-05 ISSUE J



NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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MC74AC350/D

