MC74AC299, MC74ACT299

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 Q_0, Q_7 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

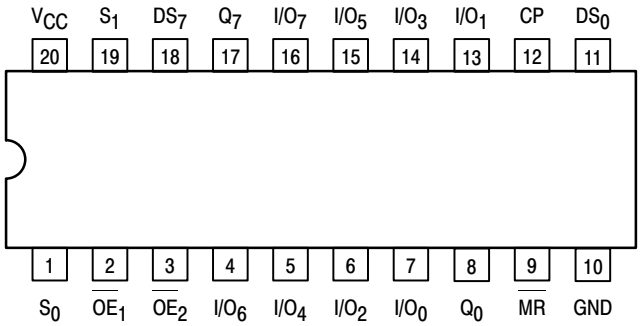

Figure 1. Pinout: 20–Lead Packages Conductors
(Top View)

PIN ASSIGNMENT

PIN	FUNCTION
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
$\overline{MR}$	Asynchronous Master Reset
$\overline{OE_1}$, $\overline{OE_2}$	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

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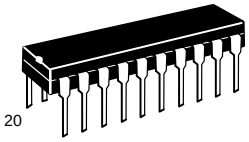
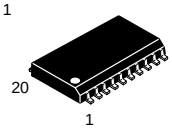
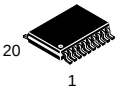


PDIP–20
N SUFFIX
CASE 738



SO–20
DW SUFFIX
CASE 751



TSSOP–20
DT SUFFIX
CASE 948E

ORDERING INFORMATION

Device	Package	Shipping
MC74AC299N	PDIP–20	18 Units/Rail
MC74ACT299N	PDIP–20	18 Units/Rail
MC74AC299DW	SOIC–20	38 Units/Rail
MC74AC299DWR2	SOIC–20	1000 Tape & Reel
MC74ACT299DW	SOIC–20	38 Units/Rail
MC74ACT299DWR2	SOIC–20	1000 Tape & Reel
MC74AC299DT	TSSOP–20	75 Units/Rail
MC74AC299DTR2	TSSOP–20	2500 Tape & Reel
MC74ACT299DT	TSSOP–20	75 Units/Rail
MC74ACT299DTR2	TSSOP–20	2500 Tape & Reel

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 9 of this data sheet.

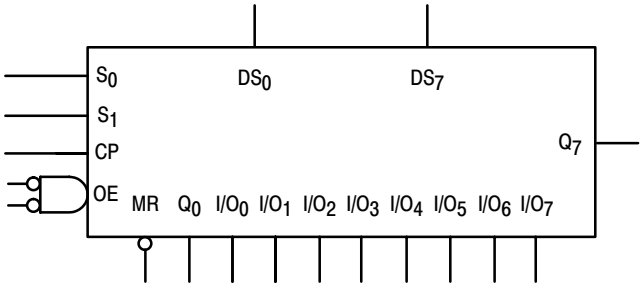
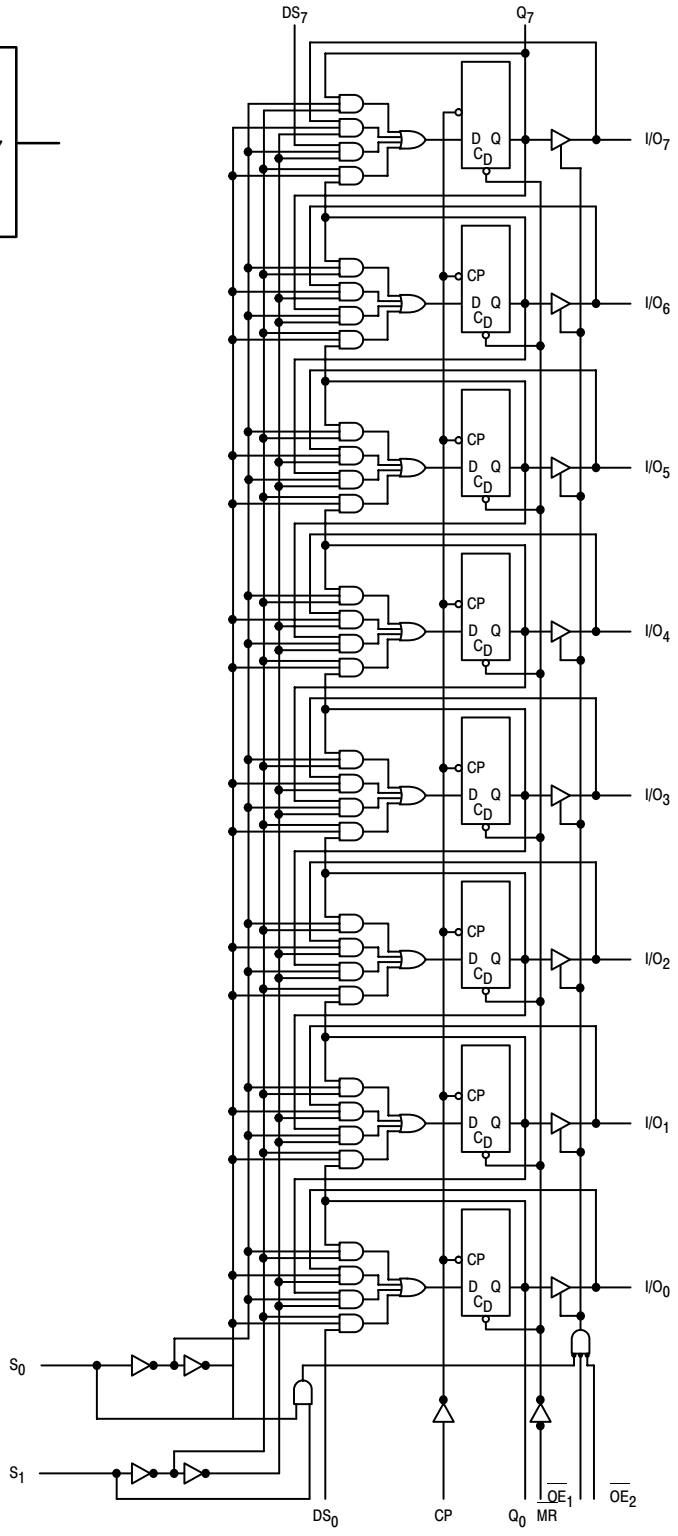


Figure 2. Logic Symbol



NOTE: That this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Figure 3. Logic Diagram

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 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
$\overline{MR}$	S_1	S_0	CP	
L	X	X	X	Asynchronous Reset; Q_0–Q_7 = LOW
H	H	H	⌐¬	Parallel Load; $I/O_n \rightarrow Q_n$
H	L	H	⌐¬	Shift Rights; $DS_0 \rightarrow Q_0$, $Q_0 \rightarrow Q_1$, etc.
H	H	L	⌐¬	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
⌐¬ = 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.

DC CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	74AC T_A = +25°C		74AC T_A = –40°C to +85°C	Unit	Conditions
			Typ	Guaranteed Limits			
V_{IH}	Minimum High Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	2.1 3.15 3.85	2.1 3.15 3.85	V	V_{OUT} = 0.1 V or V_{CC} – 0.1 V
V_{IL}	Maximum Low Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	0.9 1.35 1.65	0.9 1.35 1.65	V	V_{OUT} = 0.1 V or V_{CC} – 0.1 V
V_{OH}	Minimum High Level Output Voltage	3.0 4.5 5.5	2.99 4.49 5.49	2.9 4.4 5.4	2.9 4.4 5.4	V	I_{OUT} = –50 μA
		3.0 4.5 5.5	– – –	2.56 3.86 4.86	2.46 3.76 4.76	V	*V_{IN} = V_{IL} or V_{IH} –12 mA I_{OH} –24 mA –24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0 4.5 5.5	0.002 0.001 0.001	0.1 0.1 0.1	0.1 0.1 0.1	V	I_{OUT} = 50 μA
		3.0 4.5 5.5	– – –	0.36 0.36 0.36	0.44 0.44 0.44	V	*V_{IN} = V_{IL} or V_{IH} 12 mA I_{OL} 24 mA 24 mA
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}.

AC CHARACTERISTICS (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

Symbol	Parameter	V_{CC}* (V)	74AC T_A = +25°C, C_L = 50 pF			74AC T_A = –40°C to +85°C, C_L = 50 pF		Unit	Fig. No.
			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

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

AC CHARACTERISTICS (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

Symbol	Parameter	V_{CC}* (V)	74AC T_A = +25°C, C_L = 50 pF			74AC T_A = –40°C to +85°C, C_L = 50 pF		Unit	Fig. No.
			Min	Typ	Max	Min	Max		
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.

AC OPERATING REQUIREMENTS

Symbol	Parameter	V_{CC}* (V)	74AC T_A = +25°C, C_L = 50 pF		74AC T_A = –40°C to +85°C, C_L = 50 pF	Unit	Fig. No.
			Typ	Guaranteed Minimum			
t_s	Setup Time, HIGH or LOW S_0 or S_1 to CP	3.3 5.0	– –	8.0 5.0	8.5 5.5	ns	3–9
t_h	Hold Time, HIGH or LOW S_0 or S_1 to CP	3.3 5.0	– –	0.5 1.0	0.5 1.0	ns	3–9
t_s	Setup Time, HIGH or LOW I/O_n to CP	3.3 5.0	– –	5.5 3.5	6.0 4.0	ns	3–9
t_h	Hold Time, HIGH or LOW I/O_n to CP	3.3 5.0	– –	0 1.0	0 1.0	ns	3–9
t_s	Setup Time, HIGH or LOW DS_0 or DS_7 to CP	3.3 5.0	– –	6.5 4.0	7.0 4.5	ns	3–6
t_h	Hold Time, HIGH or LOW DS_0 or DS_7 to CP	3.3 5.0	– –	0 1.0	0.5 1.0	ns	3–6
t_w	CP Pulse Width, LOW	3.3 5.0	– –	4.5 3.5	5.0 3.5	ns	3–6
t_w	$\overline{MR}$ Pulse Width, LOW	3.3 5.0	– –	4.5 3.5	5.0 3.5	ns	3–9
t_{rec}	Recovery TIme MR to CP	3.3 5.0	– –	1.5 1.5	1.5 1.5	ns	3–9

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

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 5.5	1.5 1.5	2.0 2.0	2.0 2.0	V	V_{OUT} = 0.1 V or V_{CC} – 0.1 V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	V_{OUT} = 0.1 V or V_{CC} – 0.1 V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	I_{OUT} = –50 μA
		4.5 5.5	– –	3.86 4.86	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	V	I_{OUT} = 50 μA
		4.5 5.5	– –	0.36 0.36	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	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
ΔI_{CCT}	Additional Max. I_{CC}/Input	5.5	0.6	–	1.5	mA	V_I = V_{CC} – 2.1 V
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.

AC CHARACTERISTICS (For Figures and Waveforms – See Section 3 of the ON Semiconductor FACT Data Book, DL138/D)

Symbol	Parameter	V_{CC}* (V)	74ACT T_A = +25°C C_L = 50 pF			74ACT T_A = –40°C to +85°C C_L = 50 pF		Unit	Fig. No.
			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.

AC OPERATING REQUIREMENTS

Symbol	Parameter	V_{CC}* (V)	74ACT T_A = +25°C C_L = 50 pF		74ACT T_A = –40°C to +85°C C_L = 50 pF	Unit	Fig. No.
			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	$\overline{MR}$ 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

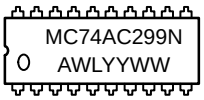
*Voltage Range 5.0 V is 5.0 V ±0.5 V.

CAPACITANCE

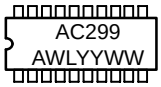
Symbol	Parameter	Value Typ	Unit	Test Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = 5.0 V
C_{PD}	Power Dissipation Capacitance	170	pF	V_{CC} = 5.0 V

MARKING DIAGRAMS

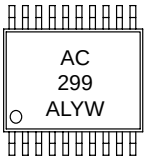
PDIP–20

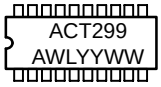


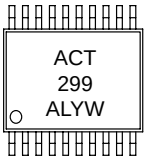
SO–20



TSSOP–20



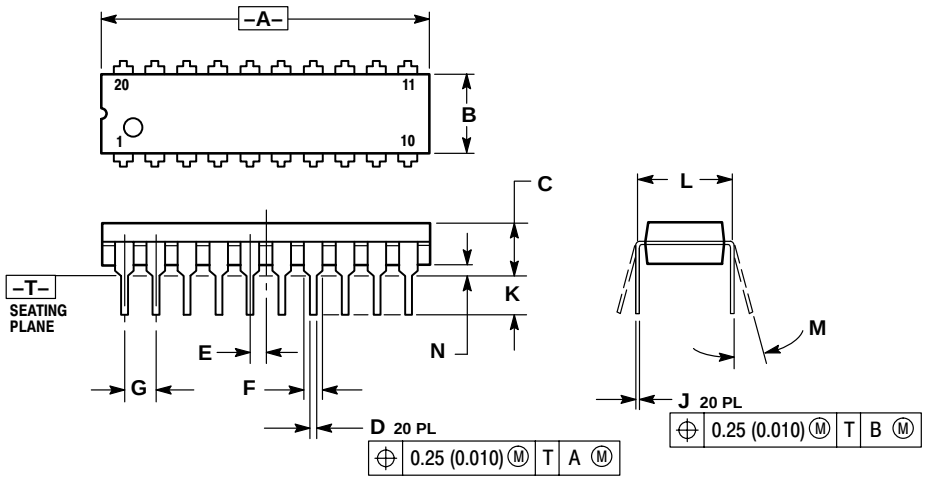




A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

PACKAGE DIMENSIONS

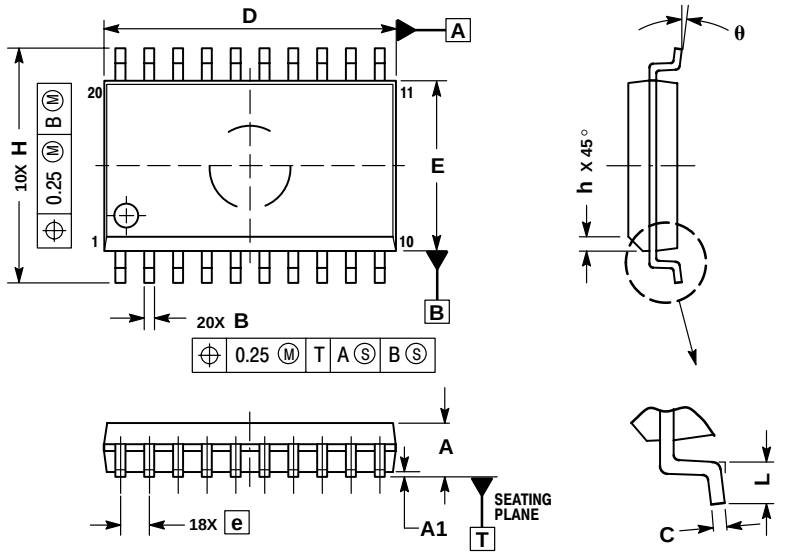
PDIP–20
N SUFFIX
20 PIN PLASTIC DIP PACKAGE
CASE 738–03
ISSUE E



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.010	1.070	25.66	27.17
B	0.240	0.260	6.10	6.60
C	0.150	0.180	3.81	4.57
D	0.015	0.022	0.39	0.55
E	0.050 BSC		1.27 BSC	
F	0.050	0.070	1.27	1.77
G	0.100 BSC		2.54 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.140	2.80	3.55
L	0.300 BSC		7.62 BSC	
M	0 °	15 °	0 °	15 °
N	0.020	0.040	0.51	1.01

SO–20
DW SUFFIX
20 PIN PLASTIC SOIC PACKAGE
CASE 751D–05
ISSUE F

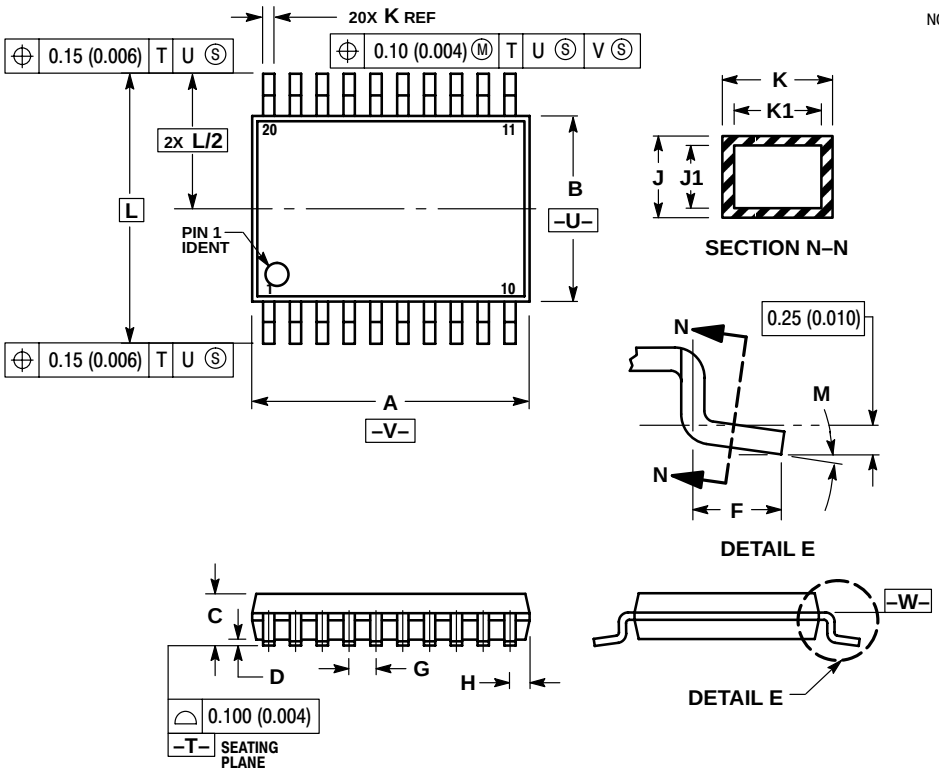


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
B	0.35	0.49
C	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0 °	7 °

PACKAGE DIMENSIONS

TSSOP–20
DT SUFFIX
20 PIN PLASTIC TSSOP PACKAGE
CASE 948E–02
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

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