Octal D Flip-Flop with Clock Enable

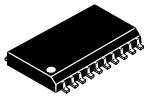
MC74AC377, MC74ACT377

The MC74AC377/74ACT377 has eight edge-triggered, D-type flip-flops with individual D inputs and Q outputs. The common buffered Clock (CP) input loads all flip-flops simultaneously, when the Clock Enable ($\overline{CE}$) is LOW. The register is fully edge-triggered. The state of each D input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output. The $\overline{CE}$ input must be stable only one setup time prior to the LOW-to-HIGH clock transition for predictable operation.

Features

- Ideal for Addressable Register Applications
- Clock Enable for Address and Data Synchronization Applications
- Eight Edge-Triggered D Flip-Flops
- Buffered Common Clock
- Outputs Source/Sink 24 mA
- See MC74AC273 for Master Reset Version
- See MC74AC373 for Transparent Latch Version
- See MC74AC374 for 3-State Version
- ACT377 Has TTL Compatible Inputs
- MSL = 1 for all Surface Mount
- Chip Complexity: 292 FETs or 73 Gates
- These are Pb−Free Devices

MARKING DIAGRAMS



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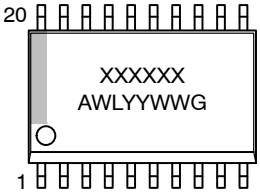
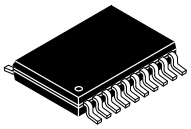
SOIC−20W
DW SUFFIX
CASE 751D





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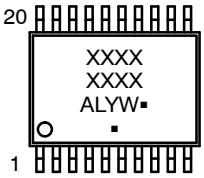
TSSOP−20
DT SUFFIX
CASE 948E



XXXXXX = Specific Device Code
A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

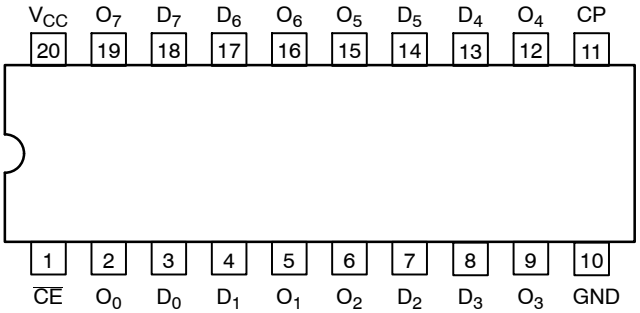


Figure 1. Pinout: 20−Lead Packages Conductors
(Top View)

PIN NAMES

PIN	FUNCTION
D_0−D_7	Data Inputs
$\overline{CE}$	Clock Enable (Active LOW)
Q_0−Q_7	Data Outputs
CP	Clock Pulse Input

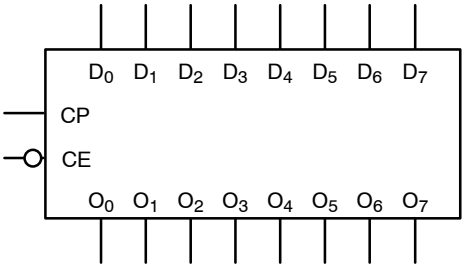


Figure 2. Logic Symbol

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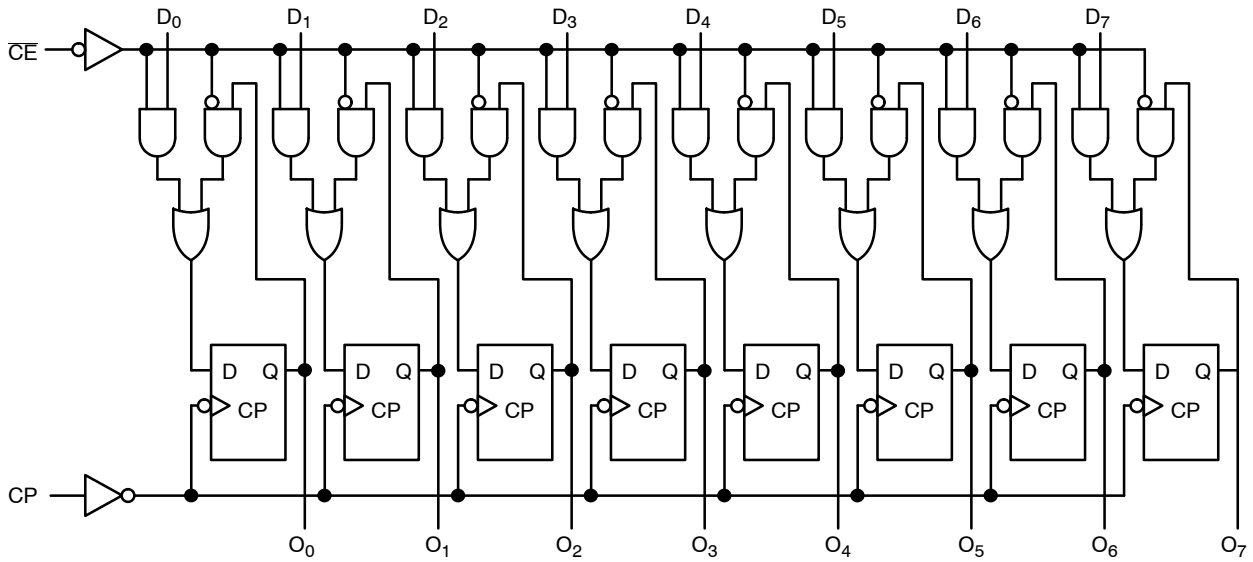
MODE SELECT-FUNCTION TABLE

Operating Mode	Inputs			Outputs
	CP	CE	D_n	Q_n
Load ′1′	⌐	L	H	H
Load ′0′	⌐	L	L	L
Hold (Do Nothing)	⌐	H	X	No Change
	X	H	X	No Change

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
⌐ = LOW-to-HIGH Clock Transition



Please 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

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)		−0.5 to +6.5	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) (Note 1)		−0.5 to V_{CC} +0.5	V
I_{IK}	DC Input Diode Current		±20	mA
I_{OK}	DC Output Diode Current		±50	mA
I_{OUT}	DC Output Sink/Source Current		±50	mA
I_{CC}	DC Supply Current, per Output Pin		±50	mA
I_{GND}	DC Ground Current, per Output Pin		±100	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction Temperature Under Bias		140	°C
θ_{JA}	Thermal Resistance (Note 2)	SOIC TSSOP	96 150	°C/W
MSL	Moisture Sensitivity		Level 1	
F_R	Flammability Rating	Oxygen Index: 30% − 35%	UL 94 V−0 @ 0.125 in	
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 3) Charged Device Model (Note 4)	> 2000 > 1000	V
$I_{Latchup}$	Latchup Performance	Above V_{CC} and Below GND at 85°C (Note 5)	±100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. I_{OUT} absolute maximum rating must be observed.
2. The package thermal impedance is calculated in accordance with JESD 51−7.
3. Tested to EIA/JESD22−A114−A.
4. Tested to JESD22−C101−A.
5. Tested to EIA/JESD78.

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 6) ′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 7) ′ACT Devices except Schmitt Inputs	V_{CC} @ 4.5 V	−	10	−	ns/V
		V_{CC} @ 5.5 V	−	8.0	−	
T_A	Operating Ambient Temperature Range		−40	25	85	°C
I_{OH}	Output Current − High		−	−	−24	mA
I_{OL}	Output Current − Low		−	−	24	mA

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

6. V_{in} from 30% to 70% V_{CC}; see individual Data Sheets for devices that differ from the typical input rise and fall times.
7. 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.

74AC – DC CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	T_A = +25°C	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	1.50 2.25 2.75	2.10 3.15 3.85	2.10 3.15 3.85	V V 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	1.50 2.25 2.75	0.90 1.35 1.65	0.90 1.35 1.65	V V 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 V 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 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 V 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 V	*V_{IN} = V_{IL} or V_{IH} –12 mA I_{OH} –24 mA –24 mA
I_{IN}	Maximum Input Leakage Current	5.5	–	±0.1	±1.0	μA	V_I = V_{CC}, GND
I_{OLD} I_{OHD}	Maximum Input Leakage Current	5.5 5.5	–	–	75 –75	mA mA	V_{OLD} = 1.65 V Max 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}.

74AC – AC CHARACTERISTICS For Figures and Waveforms, See Figures 4, 5, and 6.

Symbol	Parameter		V_{CC}* (V)	T_A = +25°C C_L = 50 pF			T_A = –40°C to +85°C C_L = 50 pF		Unit
				Min	Typ	Max	Min	Max	
f_{max}	Maximum Clock Frequency		3.3 5.0	90 140	–	–	75 125	–	MHz
t_{PLH}	Propagation Delay	CP to Q_n	3.3 5.0	3.0 2.0	–	13.0 9.0	1.5 1.5	14.0 10.0	ns
t_{PHL}	Propagation Delay	CP to Q_n	3.3 5.0	3.5 2.5	–	13.0 10.0	2.0 1.5	14.5 11.0	ns

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

74AC – AC OPERATING REQUIREMENTS

Symbol	Parameter		V_{CC}* (V)	T_A = +25°C C_L = 50 pF	T_A = –40°C to +85°C	Unit
				Typ	Guaranteed Minimum	
t_s	Setup Time, HIGH or LOW	D_n to CP	3.3 5.0	–	5.5 4.07	6.0 4.5	ns
t_h	Hold Time, HIGH or LOW	D_n to CP	3.3 5.0	–	0 1.0	0 1.0	ns
t_s	Setup Time, HIGH or LOW	$\overline{CE}$ to CP	3.3 5.0	–	6.0 4.0	7.5 4.5	ns
t_h	Hold Time, HIGH or LOW	$\overline{CE}$ to CP	3.3 5.0	–	0 1.0	0 1.0	ns
t_w	CP Pulse Width	HIGH or LOW	3.3 5.0	–	5.5 4.0	6.0 4.5	ns

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

74ACT – DC CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	T_A = +25°C		T_A = –40°C to +85°C	Unit	Conditions
			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} –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} –24 mA I_{OH} –24 mA
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_{OLD} I_{OHD}	†Minimum Dynamic Output Current	5.5	–	–	75 –75	mA	V_{OLD} = 1.65 V Max 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.

74ACT – AC CHARACTERISTICS For Figures and Waveforms — See Figures 4, 5, and 6.

Symbol	Parameter	V_{CC}* (V)	T_A = +25°C C_L = 50 pF			T_A = –40°C to +85°C C_L = 50 pF		Unit
			Min	Typ	Max	Min	Max	
f_{max}	Maximum Clock Frequency	5.0	140	–	–	125	–	MHz
t_{PLH}	Propagation Delay CP to Q_n	5.0	3.0	–	9.0	2.5	10	ns
t_{PHL}	Propagation Delay CP to Q_n	5.0	3.5	–	10	2.5	11	ns

*Voltage Range 5.0 V is 5.0 V ±0.5 V.

74ACT – AC OPERATING REQUIREMENTS

Symbol	Parameter	V_{CC}* (V)	T_A = +25°C C_L = 50 pF		T_A = –40°C to +85°C C_L = 50 pF	Unit
			Typ	Guaranteed Minimum		
t_s	Setup Time, HIGH or LOW D_n to CP	5.0	–	4.5	5.5	ns
t_h	Hold Time, HIGH or LOW D_n to CP	5.0	–	1.0	1.0	ns
t_s	Setup Time, HIGH or LOW $\overline{CE}$ to CP	5.0	–	4.5	5.5	ns
t_h	Hold Time, HIGH or LOW $\overline{CE}$ to CP	5.0	–	1.0	1.0	ns
t_w	CP Pulse Width HIGH or LOW	5.0	–	4.0	4.5	ns

*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	90	pF	V_{CC} = 5.0 V

SWITCHING WAVEFORMS

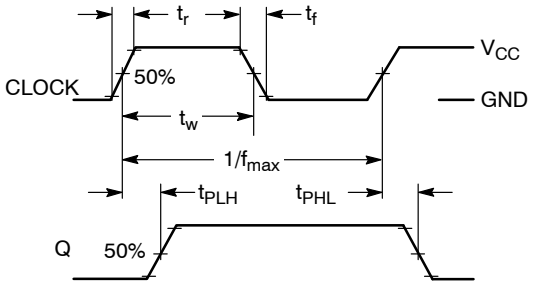
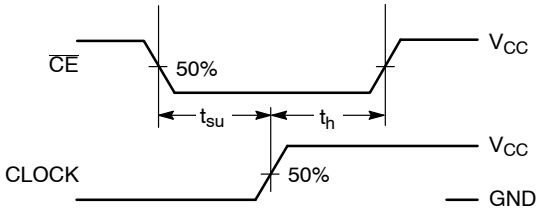


Figure 4.



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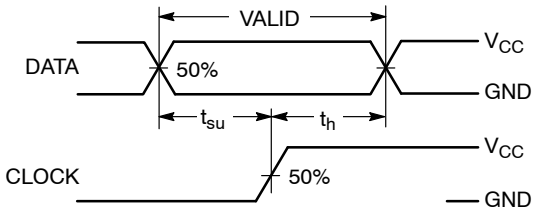
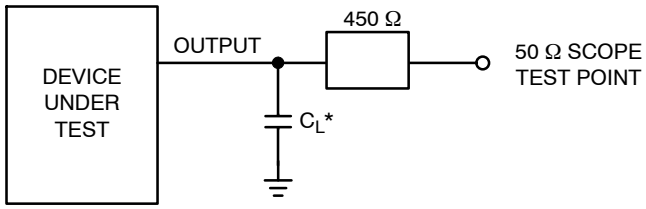


Figure 6.



*Includes all probe and jig capacitance

Figure 7. Test Circuit

ORDERING INFORMATION

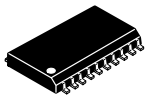
Device	Marking	Package	Shipping†
MC74AC377DWR2G	AC377	SOIC−20	1000 / Tape & Reel
MC74ACT377DWR2G	ACT377	SOIC−20	1000 / Tape & Reel
MC74AC377DTG	AC 377	TSSOP−20	75 Units / Rail
MC74AC377DTR2G	AC 377	TSSOP−20	2500 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

SOIC−20 WB
CASE 751D−05
ISSUE H

DATE 22 APR 2015



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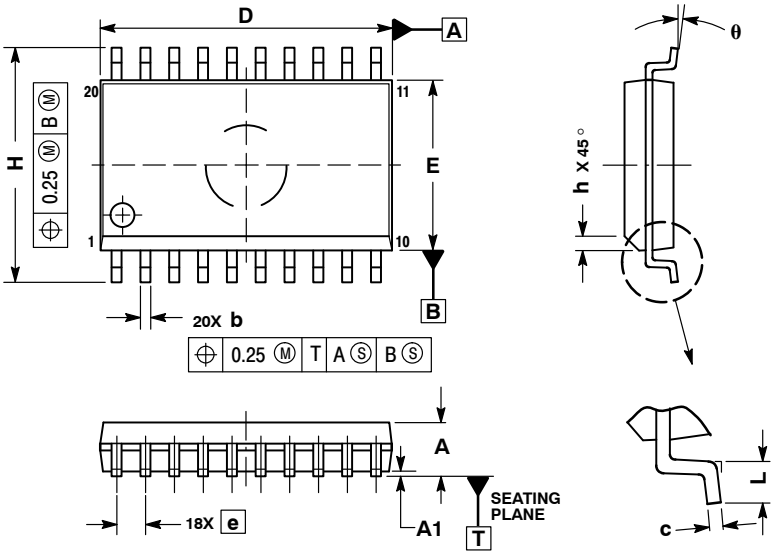
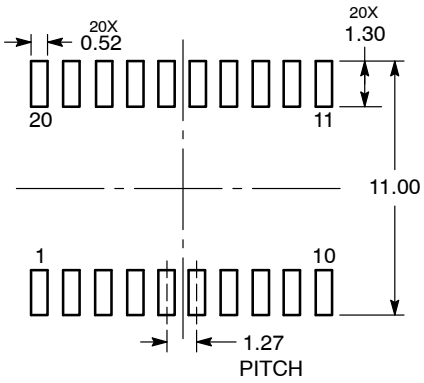


NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS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

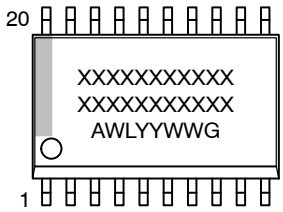
RECOMMENDED SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	**98ASB42343B**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	**SOIC−20 WB**	**PAGE 1 OF 1**

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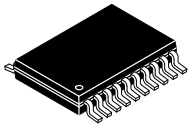
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TSSOP−20 WB
CASE 948E
ISSUE D

DATE 17 FEB 2016



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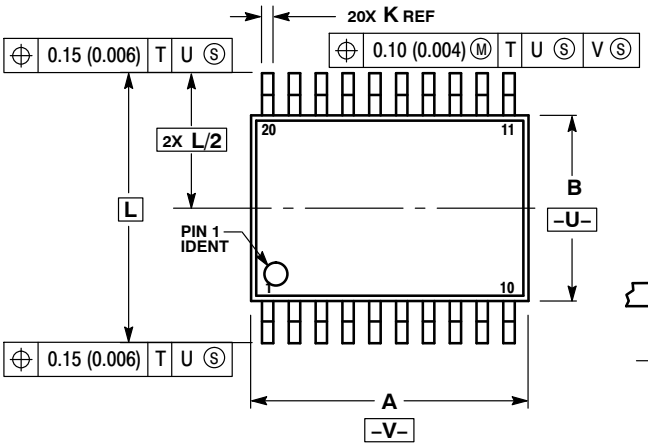
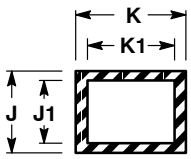
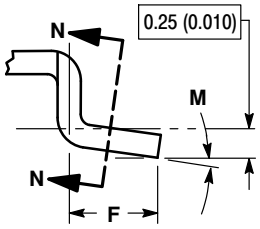
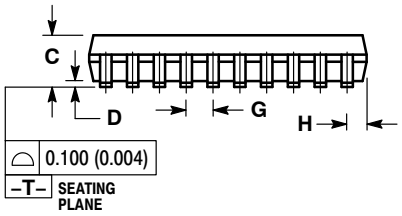


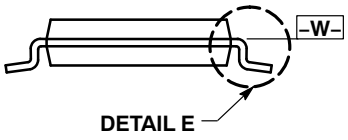


SECTION N−N



DETAIL E

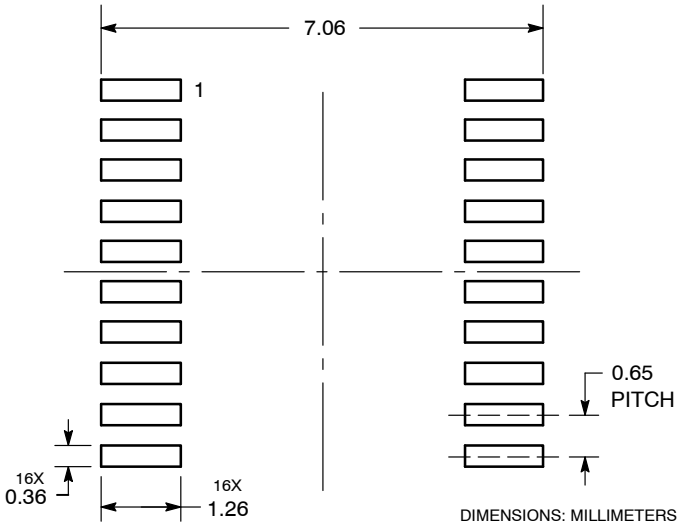




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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−.

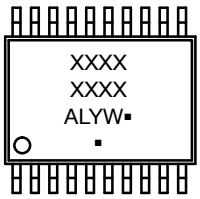
	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010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

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*



A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

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DESCRIPTION:	TSSOP−20 WB	PAGE 1 OF 1

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