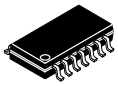
Dual Type D Flip-Flop

MC14013B


SOIC-14
D SUFFIX
CASE 751A

SOEIAJ-14
F SUFFIX
CASE 965

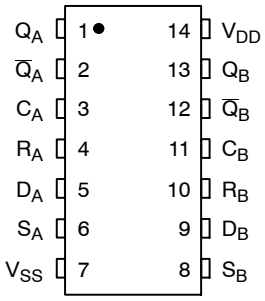
TSSOP-14
DT SUFFIX
CASE 948G

The MC14013B dual type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each flip-flop has independent Data, (D), Direct Set, (S), Direct Reset, (R), and Clock (C) inputs and complementary outputs (Q and $\overline{Q}$). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

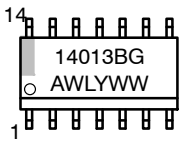
Features

- Static Operation
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Logic Edge-Clocked Flip-Flop Design
- Logic State is Retained Indefinitely with Clock Level either High or Low; Information is Transferred to the Output only on the Positive-going Edge of the Clock Pulse
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range
- Pin-for-Pin Replacement for CD4013B
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

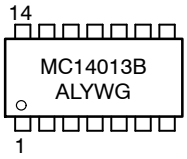
PIN ASSIGNMENT



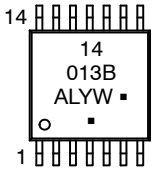
MARKING DIAGRAMS



SOIC-14



SOEIAJ-14



TSSOP-14

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)

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range	−0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient)	−0.5 to V_{DD} + 0.5	V
I_{in}, I_{out}	Input or Output Current (DC or Transient) per Pin	±10	mA
P_D	Power Dissipation, per Package (Note 1)	500	mW
T_A	Ambient Temperature Range	−55 to +125	°C
T_{stg}	Storage Temperature Range	−65 to +150	°C
T_L	Lead Temperature (8-Second Soldering)	260	°C

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. Temperature Derating: “D/DW” Packages: −7.0 mW/°C From 65 °C To 125 °C.

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.

ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 3.

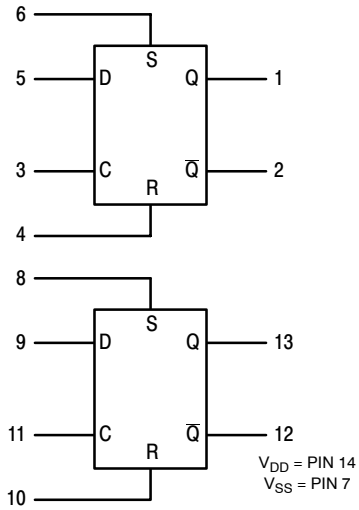
© Semiconductor Components Industries, LLC, 2014

TRUTH TABLE

Inputs				Outputs		
Clock†	Data	Reset	Set	Q	Q	
↗	0	0	0	0	1	
↗	1	0	0	1	0	
↘	X	0	0	Q	Q	No Change
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

X = Don't Care
† = Level Change

BLOCK DIAGRAM



Share Feedback
Your Opinion Matters

ORDERING INFORMATION

Device	Package	Shipping†
MC14013BDG	SOIC-14 (Pb-Free)	55 Units / Rail
MC14013BDR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
NLV14013BDR2G*	SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC14013BDTR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
NLV14013BDTR2G*	TSSOP-14 (Pb-Free)	2500 / Tape & Reel

DISCONTINUED (Note 2)

NLV14013BDG*	SOIC-14 (Pb-Free)	55 Units / Rail
MC14013BFG	SOEIAJ-14 (Pb-Free)	50 Units / Rail
MC14013BFELG	SOEIAJ-14 (Pb-Free)	2000 / 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.

* NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

2. **DISCONTINUED:** These devices are not available. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.

Share Feedback
Your Opinion Matters

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic		Symbol	V_{DD} Vdc	−55 °C Min	−55 °C Max	25 °C Min	25 °C Typ (Note3)	25 °C Max	125 °C Min	125 °C Max	Unit
Output Voltage V_{in} = V_{DD} or 0	"0" Level	V_{OL}	5.0 10 15	– – –	0.05 0.05 0.05	– – –	0 0 0	0.05 0.05 0.05	– – –	0.05 0.05 0.05	Vdc
V_{in} = 0 or V_{DD}	"1" Level	V_{OH}	5.0 10 15	4.95 9.95 14.95	– – –	4.95 9.95 14.95	5.0 10 15	– – –	4.95 9.95 14.95	– – –	Vdc
Input Voltage (V_O = 4.5 or 0.5 Vdc) (V_O = 9.0 or 1.0 Vdc) (V_O = 13.5 or 1.5 Vdc)	"0" Level	V_{IL}	5.0 10 15	– – –	1.5 3.0 4.0	– – –	2.25 4.50 6.75	1.5 3.0 4.0	– – –	1.5 3.0 4.0	Vdc
(V_O = 0.5 or 4.5 Vdc) (V_O = 1.0 or 9.0 Vdc) (V_O = 1.5 or 13.5 Vdc)	"1" Level	V_{IH}	5.0 10 15	3.5 7.0 11	– – –	3.5 7.0 11	2.75 5.50 8.25	– – –	3.5 7.0 11	– – –	Vdc
Output Drive Current (V_{OH} = 2.5 Vdc) (V_{OH} = 4.6 Vdc) (V_{OH} = 9.5 Vdc) (V_{OH} = 13.5 Vdc)	Source	I_{OH}	5.0 5.0 10 15	–3.0 –0.64 –1.6 –4.2	– – – –	–2.4 –0.51 –1.3 –3.4	–4.2 –0.88 –2.25 –8.8	– – – –	–1.7 –0.36 –0.9 –2.4	– – – –	mAdc
(V_{OL} = 0.4 Vdc) (V_{OL} = 0.5 Vdc) (V_{OL} = 1.5 Vdc)	Sink	I_{OL}	5.0 10 15	0.64 1.6 4.2	– – –	0.51 1.3 3.4	0.88 2.25 8.8	– – –	0.36 0.9 2.4	– – –	mAdc
Input Current		I_{in}	15	–	±0.1	–	±0.0000 1	±0.1	–	±1.0	μAdc
Input Capacitance (V_{in} = 0)		C_{in}	–	–	–	–	5.0	7.5	–	–	pF
Quiescent Current (Per Package)		I_{DD}	5.0 10 15	– – –	1.0 2.0 4.0	– – –	0.002 0.004 0.006	1.0 2.0 4.0	– – –	30 60 120	μAdc
Total Supply Current (Notes 4, 5) (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)		I_T	5.0 10 15	I_T = (0.75 μA/kHz) f + I_{DD} I_T = (1.5 μA/kHz) f + I_{DD} I_T = (2.3 μA/kHz) f + I_{DD}							μAdc

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.
4. The formulas given are for the typical characteristics only at 25 °C.
5. To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50\ pF) + (C_L - 50)\ Vfk$$

where: I_T is in μA (per package), C_L in pF, V = (V_{DD} − V_{SS}) in volts, f in kHz is input frequency, and k = 0.002.

Share Feedback
Your Opinion Matters

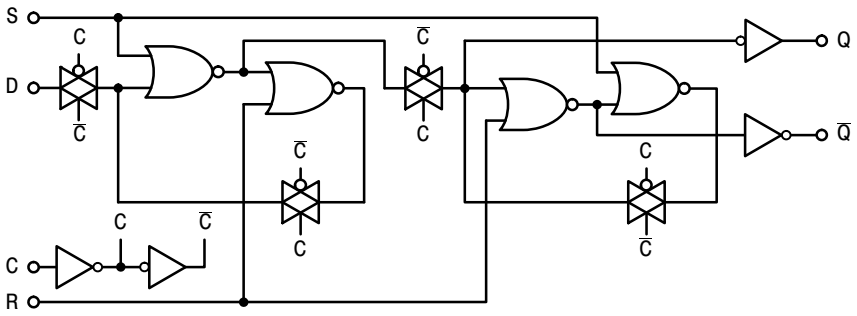
SWITCHING CHARACTERISTICS (Note 6) (C_L = 50 pF, T_A = 25 °C)

Characteristic	Symbol	V_{DD}	Min	Typ (Note 7)	Max	Unit
Output Rise and Fall Time	t_{TLH},					ns
t_{TLH}, t_{THL} = (1.5 ns/pF) C_L + 25 ns	t_{THL}	5.0	–	100	200	
t_{TLH}, t_{THL} = (0.75 ns/pF) C_L + 12.5 ns		10	–	50	100	
t_{TLH}, t_{THL} = (0.55 ns/pF) C_L + 9.5 ns		15	–	40	80	
Propagation Delay Time	t_{PLH}					ns
Clock to Q, $\overline{Q}$	t_{PHL}					
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 90 ns		5.0	–	175	350	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 42 ns		10	–	75	150	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns		15	–	50	100	
Set to Q, $\overline{Q}$						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 90 ns		5.0	–	175	350	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 42 ns		10	–	75	150	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns		15	–	50	100	
Reset to Q, $\overline{Q}$						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 265 ns		5.0	–	225	450	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 67 ns		10	–	100	200	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 50 ns		15	–	75	150	
Setup Times (Note 8)	t_{su}	5.0	40	20	–	ns
		10	20	10	–	
		15	15	7.5	–	
Hold Times (Note 8)	t_h	5.0	40	20	–	ns
		10	20	10	–	
		15	15	7.5	–	
Clock Pulse Width	t_{WL}, t_{WH}	5.0	250	125	–	ns
		10	100	50	–	
		15	70	35	–	
Clock Pulse Frequency	f_{cl}	5.0	–	4.0	2.0	MHz
		10	–	10	5.0	
		15	–	14	7.0	
Clock Pulse Rise and Fall Time	t_{TLH}	5.0	–	–	15	μs
	t_{THL}	10	–	–	5.0	
		15	–	–	4.0	
Set and Reset Pulse Width	t_{WL}, t_{WH}	5.0	250	125	–	ns
		10	100	50	–	
		15	70	35	–	
Removal Times	t_{rem}					ns
Set		5	80	0	–	
		10	45	5	–	
		15	35	5	–	
Reset		5	50	–35	–	
		10	30	–10	–	
		15	25	–5	–	

6. The formulas given are for the typical characteristics only at 25 °C.
7. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.
8. Data must be valid for 250 ns with a 5 V supply, 100 ns with 10 V, and 70 ns with 15 V.

Share Feedback
Your Opinion Matters

LOGIC DIAGRAM (1/2 of Device Shown)



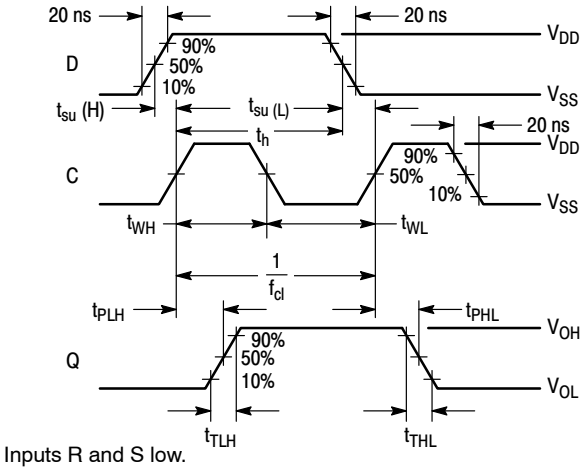


Figure 1. Dynamic Signal Waveforms (Data, Clock, and Output)

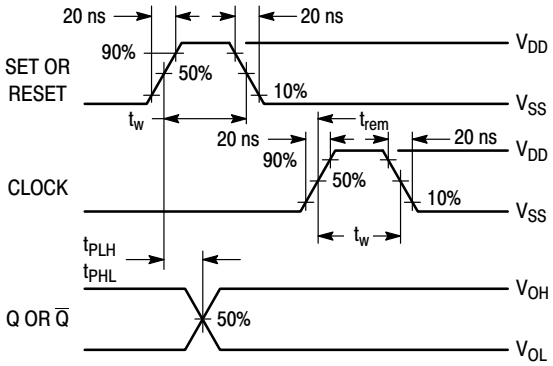
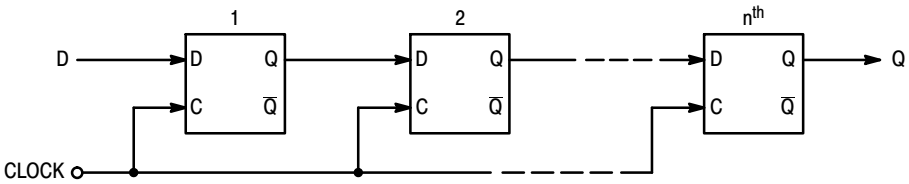


Figure 2. Dynamic Signal Waveforms (Set, Reset, Clock, and Output)

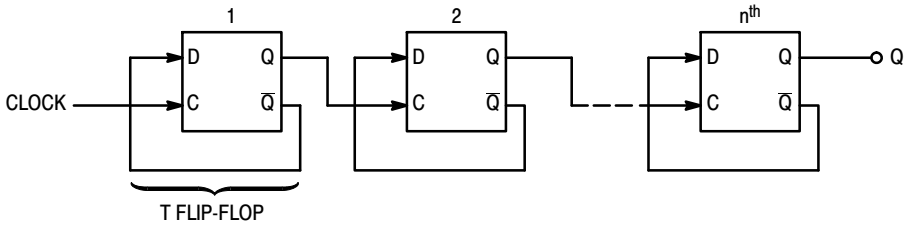
Share Feedback
Your Opinion Matters

TYPICAL APPLICATIONS

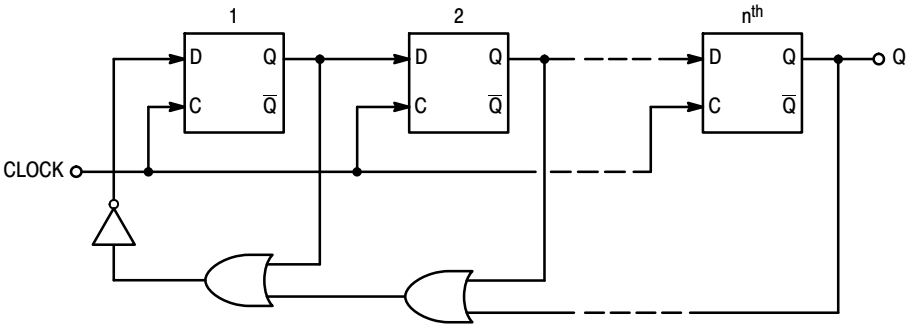
n-STAGE SHIFT REGISTER



BINARY RIPPLE UP-COUNTER (Divide−by−2^n)



MODIFIED RING COUNTER (Divide−by−(n+1))



REVISION HISTORY

Revision	Description of Changes	Date
11	Rebranded the Data Sheet to **onsemi** format. NLV14013BDG, MC14013BFG, MC14013BFELG OPNs Marked as Discontinued.	07/11/2025

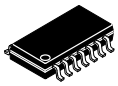
This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

Share Feedback
Your Opinion Matters

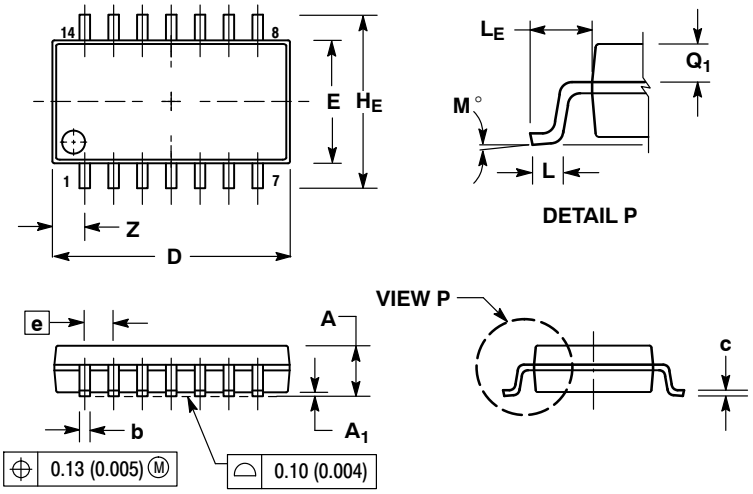
PACKAGE DIMENSIONS

SOEIAJ−14
CASE 965−01
ISSUE B

DATE 29 FEB 2008



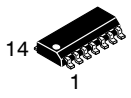
SCALE 1:1



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.10	0.20	0.004	0.008
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

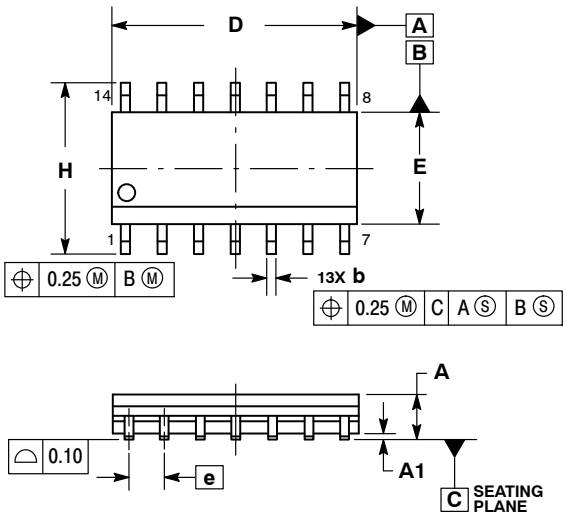
Share Feedback
Your Opinion Matters

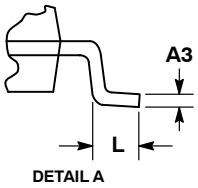


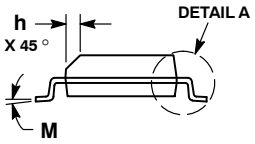
SCALE 1:1

SOIC−14 NB
CASE 751A−03
ISSUE L

DATE 03 FEB 2016



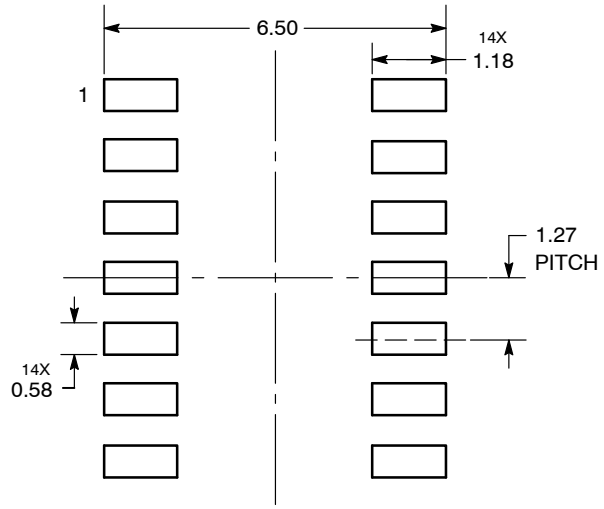




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM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

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0 °	7 °	0 °	7 °

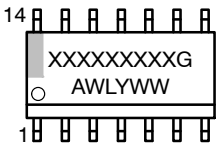
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

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

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = 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.

STYLES ON PAGE 2

DOCUMENT NUMBER:	**98ASB42565B**	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−14 NB**		**PAGE 1 OF 2**

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

SOIC−14
CASE 751A−03
ISSUE L

DATE 03 FEB 2016

STYLE 1:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. NO CONNECTION
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. NO CONNECTION
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 2:
CANCELLED

STYLE 3:
PIN 1. NO CONNECTION
2. ANODE
3. ANODE
4. NO CONNECTION
5. ANODE
6. NO CONNECTION
7. ANODE
8. ANODE
9. ANODE
10. NO CONNECTION
11. ANODE
12. ANODE
13. NO CONNECTION
14. COMMON CATHODE

STYLE 4:
PIN 1. NO CONNECTION
2. CATHODE
3. CATHODE
4. NO CONNECTION
5. CATHODE
6. NO CONNECTION
7. CATHODE
8. CATHODE
9. CATHODE
10. NO CONNECTION
11. CATHODE
12. CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 5:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. NO CONNECTION
7. COMMON ANODE
8. COMMON CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

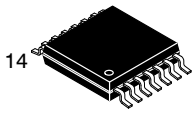
STYLE 6:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. ANODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE

STYLE 7:
PIN 1. ANODE/CATHODE
2. COMMON ANODE
3. COMMON CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. ANODE/CATHODE
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. COMMON CATHODE
12. COMMON ANODE
13. ANODE/CATHODE
14. ANODE/CATHODE

STYLE 8:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. ANODE/CATHODE
7. COMMON ANODE
8. COMMON ANODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. NO CONNECTION
12. ANODE/CATHODE
13. ANODE/CATHODE
14. COMMON CATHODE

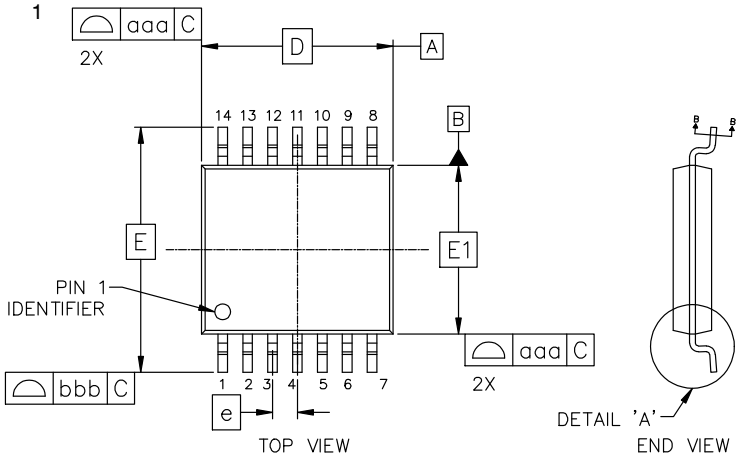
onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

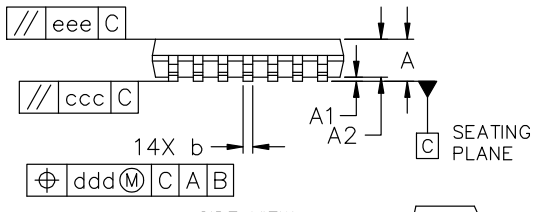
© Semiconductor Components Industries, LLC, 2019

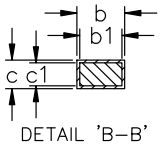


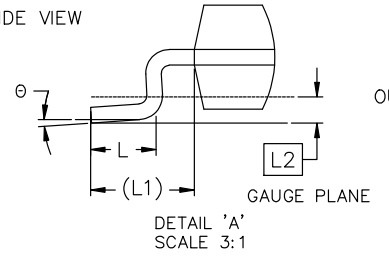
TSSOP−14 5.00x4.40x0.95, 0.65P
CASE 948G
ISSUE D

DATE 30 JUN 2026

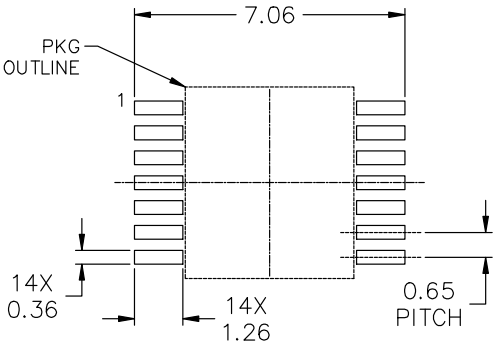








MILLIMETERS			
DIM	MIN	NOM	MAX
A	−−−	−−−	1.20
A1	0.05	0.10	0.15
A2	0.85	0.95	1.05
b	0.19	0.25	0.30
b1	0.19	0.22	0.25
c	0.09	0.15	0.20
c1	0.09	0.12	0.16
D	5.00 BSC		
E	6.40 BSC		
E1	4.40 BSC		
e	0.65 BSC		
L	0.50	0.63	0.75
L1	1.00 REF		
L2	0.25 BSC		
θ	0°	4°	8°
TOLERANCE FORM & POSITION			
aaa	0.10		
bbb	0.15		
ccc	0.08		
ddd	0.10		
eee	0.10		

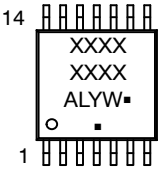


RECOMMENDED MOUNTING FOOTPRINT

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

NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D DOES NOT INCLIDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
4. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
5. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF THE b DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.

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. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	**98ASH70246A**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	**TSSOP−14 5.00x4.40x0.95, 0.65P**	**PAGE 1 OF 1**

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

onsemi, , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales