

Single Supply Quad Comparators

LM339, LM339E, LM239, LM2901, LM2901E, LM2901V, NCV2901, MC3302

These comparators are designed for use in level detection, low-level sensing and memory applications in consumer, automotive, and industrial electronic applications.

Features

- Single Supply Operation: 3.0 V to 36 V
 Split Supply Operation: ±1.5 V to ±18 V
- Low Input Bias Current: 25 nA (Typ)
- Low Input Offset Current: ±5.0 nA (Typ)
- Low Input Offset Voltage
- Input Common Mode Voltage Range to GND
- Low Output Saturation Voltage: 130 mV (Typ) @ 4.0 mA
- TTL and CMOS Compatible
- ESD Clamps on the Inputs Increase Reliability without Affecting Device Operation
- NCV 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/BFR Free and are RoHS Compliant

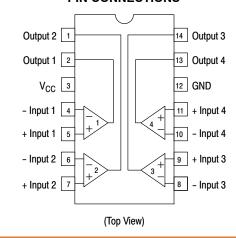


CASE 751A



TSSOP-14 DTB SUFFIX CASE 948G

PIN CONNECTIONS



ORDERING INFORMATION

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

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 8 of this data sheet.

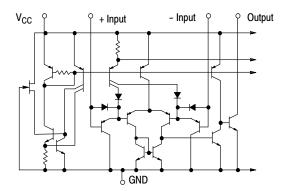
MAXIMUM RATINGS

Rating	ı	Symbol	Value	Unit	
Power Supply Voltage	LM239/LM339, E/LM2901, E, V MC3302, NCV2901	V _{CC}	+36 or ±18 +30 or ±15	Vdc	
Input Differential Voltage Range	LM239/LM339, E/LM2901, E, V MC3302, NCV2901	V _{IDR}	36 30	Vdc	
Input Common Mode Voltage Range		V _{ICMR}	-0.3 to 36	Vdc	
Output Short Circuit to Ground (Note 1)		I _{SC}	Continuous		
Power Dissipation @ T _A = 25 °C Plastic Package Derate above 25 °C		P _D	1.0 8.0	W mW/°C	
Junction Temperature		TJ	150	°C	
Operating Ambient Temperature Range	LM239 MC3302 LM2901, LM2901E LM2901V, NCV2901 LM339, LM339E	T _A	-25 to +85 -40 to +85 -40 to +105 -40 to +125 0 to +70	°C	
Storage Temperature Range		T _{stg}	-65 to +150	°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.

ESD RATINGS

Rating	НВМ	ММ	Unit
ESD Protection at any Pin (Human Body Model - HBM, Machine Model - MM)			
NCV2901	2000	200	V
LM339E, LM2901E	1500	200	V
LM339DG/DR2G, LM2901DG/DR2G	250	100	V
All Other Devices	1500	200	V



NOTE: Diagram shown is for 1 comparator.

Figure 1. Circuit Schematic

^{1.} The maximum output current may be as high as 20 mA, independent of the magnitude of V_{CC}. Output short circuits to V_{CC} can cause excessive heating and eventual destruction.

ELECTRICAL CHARACTERISTICS ($V_{CC} = +5.0 \text{ Vdc}$, $T_A = +25 \,^{\circ}\text{C}$, unless otherwise noted)

		LM2	39/339/3	339E		1/2901E NCV290			MC3302	!	
Characteristic	Symbol	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
Input Offset Voltage (Note 3)	V _{IO}	_	±2.0	±5.0	-	±2.0	±7.0	-	±3.0	±20	mVdc
Input Bias Current (Notes 3, 4)	I _{IB}	_	25	250	-	25	250	-	25	500	nA
(Output in Analog Range)											
Input Offset Current (Note 3)	I _{IO}	_	±5.0	±50	-	±5.0	±50	-	±3.0	±100	nA
Input Common Mode Voltage Range (Note 5)	V _{ICMR}	0	-	V _{CC} -1.5	0	-	V _{CC} -1.5	0	-	V _{CC} -1.5	V
Supply Current	I _{CC}										mA
R _L = ∞ (For All Comparators)		_	0.8	2.0	-	0.8	2.0	-	0.8	2.0	
$R_L = \infty$, $V_{CC} = 30 \text{ Vdc}$		_	1.0	2.5	-	1.0	2.5	-	1.0	2.5	
Voltage Gain	A _{VOL}	50	200	_	25	100	-	25	100	-	V/mV
$R_L \ge 15 \text{ k}\Omega$, $V_{CC} = 15 \text{ Vdc}$											
Large Signal Response Time	_	-	300	-	-	300	-	-	300	-	ns
V _I = TTL Logic Swing,											
V_{ref} = 1.4 Vdc, V_{RL} = 5.0 Vdc,											
$R_L = 5.1 \text{ k}\Omega$											
Response Time (Note 6)	_	-	1.3	-	-	1.3	-	-	1.3	-	μs
V_{RL} = 5.0 Vdc, R_L = 5.1 k Ω											
Output Sink Current	I _{Sink}	6.0	16	-	6.0	16	-	6.0	16	-	mA
V_{I} (-) \geq +1.0 Vdc, V_{I} (+) = 0, $V_{O} \leq$ 1.5 Vdc											
Saturation Voltage	V _{sat}	_	130	400	-	130	400	-	130	500	mV
$\begin{split} &V_I(-) \geq +1.0 \text{ Vdc}, \ V_I(+) = 0, \\ &I_{sink} \leq 4.0 \text{ mA} \end{split}$											
Output Leakage Current	l _{OL}	-	0.1	-	-	0.1	-	-	0.1	-	nA
$V_I(+) \ge +1.0 \text{ Vdc}, \ V_I(-) = 0, \ V_O = +5.0 \text{ Vdc}$											

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.

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performance may not be indicated by the Electrical Charact.

2. (LM239) T<sub>low</sub> = -25 °C, T<sub>high</sub> = +85 °C (LM339, LM339E) T<sub>low</sub> = 0 °C, T<sub>high</sub> = +70 °C (MC3302) T<sub>low</sub> = -40 °C, T<sub>high</sub> = +85 °C (LM2901), LM2901E T<sub>low</sub> = -40 °C, T<sub>high</sub> = +105 °C (LM2901V & NCV2901) T<sub>low</sub> = -40 °C, T<sub>high</sub> = +125 °C NCV2901 is qualified for automotive use.
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- 3. At the output switch point, $V_O \simeq 1.4$ Vdc, $R_S \le 100~\Omega$ 5.0 Vdc $\le V_{CC} \le 30$ Vdc, with the inputs over the full common mode range (0 Vdc to $V_{CC} 1.5$ Vdc).
- 4. The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.
- 5. Positive excursions of input voltage may exceed the power supply level. As long as one input voltage remains within the common mode range, the comparator will provide a proper output state. Refer to the Maximum Ratings table for safe operating area.
- 6. The response time specified is for a 100 mV input step with 5.0 mV overdrive. For larger signals, 300 ns is typical.

PERFORMANCE CHARACTERISTICS ($V_{CC} = +5.0 \text{ Vdc}$, $T_A = T_{low} \text{ to } T_{high}$ [Note 7])

		LM2	39/339/3	339E	LM2901/2901E/2901V /NCV2901		MC3302				
Characteristic	Symbol	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
Input Offset Voltage (Note 8)	V _{IO}	-	_	±9.0	-	-	±15	-	-	±40	mVdc
Input Bias Current (Notes 8, 9)	I _{IB}	-	_	400	-	-	500	-	-	1000	nA
(Output in Analog Range)											
Input Offset Current (Note 8)	I _{IO}	_	_	±150	_	_	±200	-	_	±300	nA
Input Common Mode Voltage Range	V _{ICMR}	0	-	V _{CC} -2.0	0	-	V _{CC} -2.0	0	_	V _{CC} -2.0	V
Saturation Voltage	V_{sat}	-	_	700	-	-	700	-	-	700	mV
$V_{I}(-) \ge +1.0 \text{ Vdc}, V_{I}(+) = 0,$ $I_{sink} \le 4.0 \text{ mA}$											
Output Leakage Current	l _{OL}	_	_	1.0	-	-	1.0	-	-	1.0	μΑ
$V_{I}(+) \ge +1.0 \text{ Vdc}, V_{I}(-) = 0,$ $V_{O} = 30 \text{ Vdc}$											
Differential Input Voltage	V_{ID}	-	-	V_{CC}	-	-	V_{CC}	-	-	V_{CC}	Vdc
All V _I ≥ 0 Vdc											

- 7. (LM239) T_{low} = -25 °C, T_{high} = +85 °C (LM339, LM339E) T_{low} = 0 °C, T_{high} = +70 °C (MC3302) T_{low} = -40 °C, T_{high} = +85 °C (LM2901, LM2901E) T_{low} = -40 °C, T_{high} = +105 °C (LM2901V & NCV2901) T_{low} = -40 °C, T_{high} = +125 °C NCV2901 is qualified for automotive use.
- 8. At the output switch point, V_O ≈ 1.4 Vdc, R_S ≤ 100 Ω 5.0 Vdc ≤ V_{CC} ≤ 30 Vdc, with the inputs over the full common mode range (0 Vdc to V_{CC} –1.5 Vdc).

 9. The bias current flows out of the inputs due to the PNP input stage. This current is virtually constant, independent of the output state.

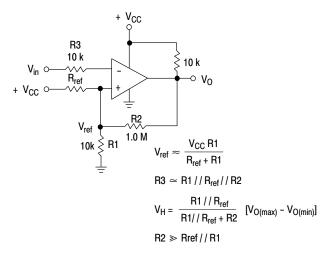


Figure 2. Inverting Comparator with Hysteresis

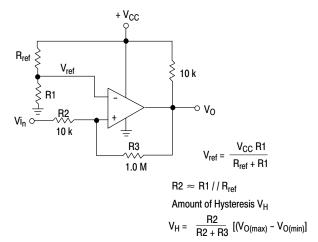
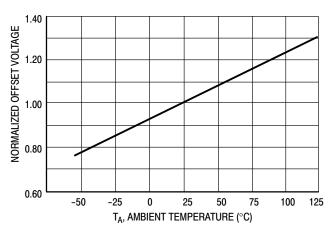


Figure 3. Noninverting Comparator with Hysteresis

Typical Characteristics

 $(V_{CC} = 15 \text{ Vdc}, T_A = +25 \,^{\circ}\text{C} \text{ (each comparator) unless otherwise noted.)}$



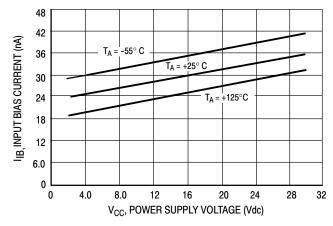


Figure 4. Normalized Input Offset Voltage

Figure 5. Input Bias Current

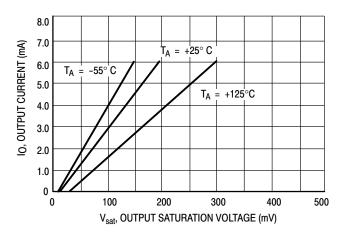
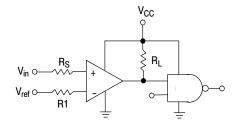


Figure 6. Output Sink Current versus
Output Saturation Voltage



 R_S = Source Resistance $R1 \simeq R_S$

Logic	Device	V _{CC} (V)	$\mathbf{R_L}$ $\mathbf{k}\Omega$
CMOS	1/4 MC14001	+15	100
TTL	1/4 MC7400	+5.0	10

Figure 7. Driving Logic

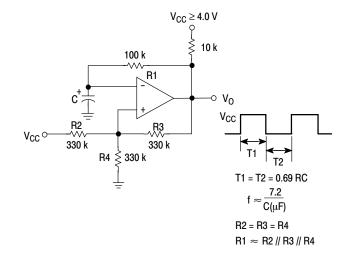


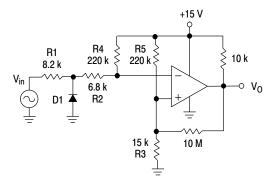
Figure 8. Squarewave Oscillator

APPLICATIONS INFORMATION

These quad comparators feature high gain, wide bandwidth characteristics. This gives device oscillation tendencies if the outputs are capacitively coupled to the inputs via stray capacitance during output transients. To minimize risk of these oscillations, avoid routing output and negative input traces in parallel or put VCC or GND trace between them for coupling reduction. It is also good to keep

input resistors as low as possible and place them close to device. The addition of positive feedback (< 10 mV) is also recommended. It is good design practice to ground all unused input pins.

Differential input voltages may be larger than supply voltages without damaging the comparator's inputs. Voltages more negative than -300 mV should not be used.



D1 prevents input from going negative by more than $\,$ 0.6 V.

R1 + R2 = R3

 $R3 \leq \; \frac{R5}{10} \; \; \text{for small error in zero crossing}$

Figure 9. Zero Crossing Detector (Single Supply)

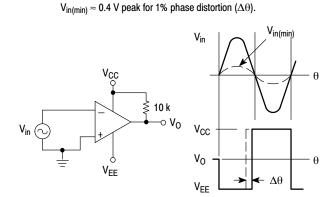


Figure 10. Zero Crossing Detector (Split Supplies)

ORDERING INFORMATION

Device	Package	Shipping [†]
LM239DR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM239DTBR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
LM339DR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM339EDR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM339DTBR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
LM2901DR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM2901EDR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM2901DTBR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
LM2901VDR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
LM2901VDTBR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
NCV2901DR2G*	SOIC-14 (Pb-Free)	2500 / Tape & Reel
NCV2901DTBR2G*	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
NCV2901CTR*	Bare Die	6000 / Tape & Reel
MC3302DR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel

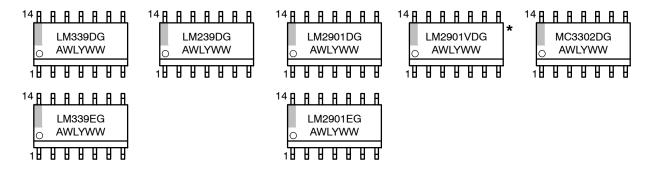
For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging

Specifications Brochure, BRD8011/D.

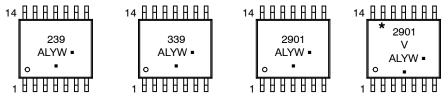
NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable

MARKING DIAGRAMS

SOIC-14 D SUFFIX CASE 751A



TSSOP-14 DTB SUFFIX CASE 948G



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)

*This marking diagram also applies to NCV2901.

REVISION HISTORY

Revis	sion	Description of Changes	Date
29	9	Update of the first paragraph of the Applications Information section (p.6) and minor update of Figure 9 (p.6)	9/16/2025

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.

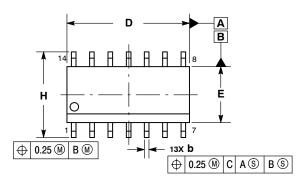


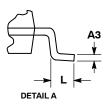


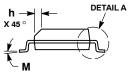
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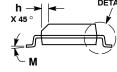
SOIC-14 NB CASE 751A-03 ISSUE L

DATE 03 FEB 2016





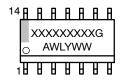




- NOTES:
 1. DIMENSIONING AND TOLERANCING PER
 - ASME Y14.5M, 1994.
 CONTROLLING DIMENSION: MILLIMETERS.
 - DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT
 - MAXIMUM MATERIAL CONDITION.
 DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
- 5.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

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	1.35	1.75	0.054	0.068	
A1	0.10	0.25	0.004	0.010	
АЗ	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	
Е	3.80	4.00	0.150	0.157	
e	1.27	BSC	0.050 BSC		
Н	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	
М	0 °	7°	0 °	7°	

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code Α = Assembly Location

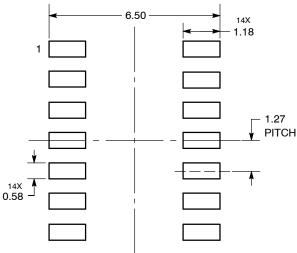
WL = Wafer Lot Υ = Year WW = Work Week = Pb-Free Package

*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.

SOLDERING FOOTPRINT*

C SEATING PLANE

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.

STYLES ON PAGE 2

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SOIC-14 CASE 751A-03 ISSUE L

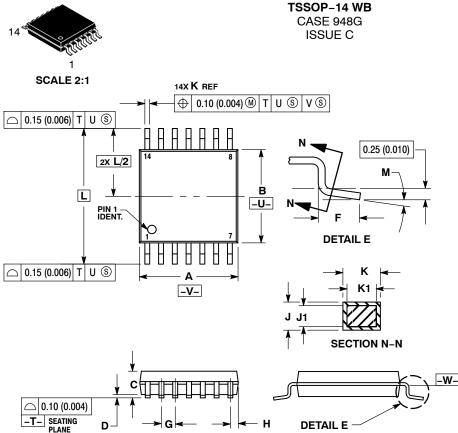
DATE 03 FEB 2016

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

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DATE 17 FEB 2016

- 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.
 DIMENSION B DOES NOT INCLUDE
- INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL
- INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

 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.

 TERMINAL NUMBERS ARE SHOWN FOR DEEEDENIC OMITY.
- REFERENCE ONLY.
 DIMENSION A AND B ARE TO BE
- DETERMINED AT DATUM PLANE -W-.

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	4.90	5.10	0.193	0.200	
В	4.30	4.50	0.169	0.177	
С		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		
Н	0.50	0.60	0.020	0.024	
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		
м	o °	8 °	o °	a °	

GENERIC MARKING DIAGRAM*



= Assembly Location

L = Wafer Lot = Year

= Work Week W

= 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.

RECOMMENDED SOLDERING FOOTPRINT*

-	7.06
1	
	
	0.65 PITCH
↓ □	
14X 0.36 126	
0.36 - 1.26	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.

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