MC1489, MC1489A

Quad Line EIA-232D Receivers

The MC1489 monolithic quad line receivers are designed to interface data terminal equipment with data communications equipment in conformance with the specifications of EIA Standard No. EIA−232D.
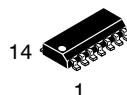
Features

- Input Resistance − 3.0 k to 7.0 kΩ
- Input Signal Range − ± 30 V
- Input Threshold Hysteresis Built In
- Response Control
    - a) Logic Threshold Shifting
    - b) Input Noise Filtering
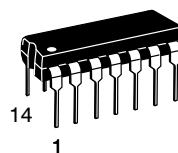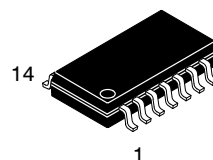- Pb−Free Packages are Available

ON Semiconductor®

http://onsemi.com

SOIC−14
D SUFFIX
CASE 751A

PDIP−14
P SUFFIX
CASE 646

SOEIAJ−14
M SUFFIX
CASE 965

PIN CONNECTIONS

Pin		Pin
Input A	1	14 V_CC
Response Control A	2	13 Input D
Output A	3	12 Response Control D
Input B	4	11 Output D
Response Control B	5	10 Input C
Output B	6	9 Response Control C
Ground	7	8 Output C

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

DEVICE MARKING INFORMATION

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

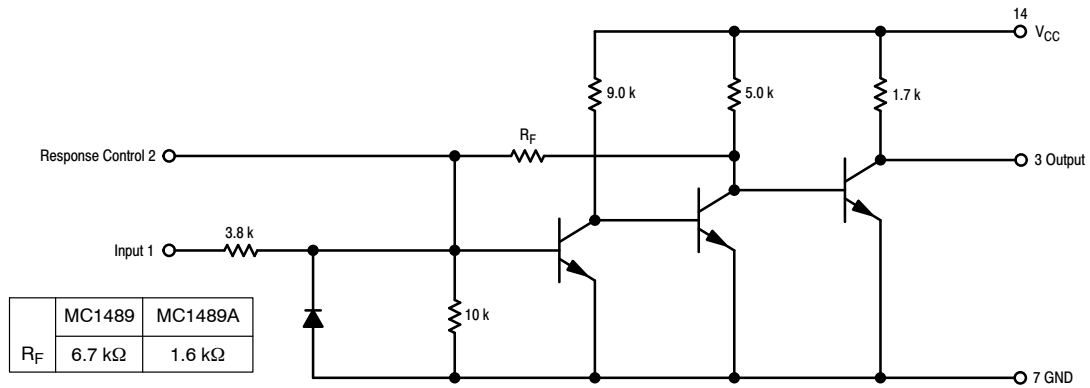**Figure 1. Simplified Application**

1

Figure 2. Representative Schematic Diagram
(1/4 of Circuit Shown)

R_F	MC1489	MC1489A
R_F	6.7 kΩ	1.6 kΩ

MC1489, MC1489A

MAXIMUM RATINGS (T_A = + 25°C, unless otherwise noted)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	10	Vdc
Input Voltage Range	V_{IR}	± 30	Vdc
Output Load Current	I_L	20	mA
Power Dissipation (Package Limitation, SOIC−14 and Plastic Dual In−Line Package) Derate above T_A = + 25°C	P_D $1/_{\theta JA}$	1000 6.7	mW mW/°C
Operating Ambient Temperature Range	T_A	0 to + 75	°C
Storage Temperature Range	T_{stg}	− 65 to + 175	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS (Response control pin is open.) (V_{CC} = + 5.0 Vdc ± 10%, T_A = 0 to + 75°C, unless otherwise noted)

Characteristics		Symbol	Min	Typ	Max	Unit
Positive Input Current	(V_{IH} = + 25 Vdc) (V_{IH} = + 3.0 Vdc)	I_{IH}	3.6 0.43	– –	8.3 –	mA
Negative Input Current	(V_{IH} = − 25 Vdc) (V_{IH} = − 3.0 Vdc)	I_{IL}	− 3.6 − 0.43	– –	− 8.3 –	mA
Input Turn−On Threshold Voltage (T_A = + 25°C, $V_{OL} \leqslant$ 0.45 V) MC1489 MC1489A		V_{IH}	1.0 1.75	– 1.95	1.5 2.25	Vdc
Input Turn−Off Threshold Voltage (T_A = + 25°C, $V_{OH} \geqslant$ 2.5 V, I_L = − 0.5 mA) MC1489 MC1489A		V_{IL}	0.75 0.75	– 0.8	1.25 1.25	Vdc
Output Voltage High	(V_{IH} = 0.75 V, I_L = − 0.5 mA) (Input Open Circuit, I_L = − 0.5 mA)	V_{OH}	2.5 2.5	4.0 4.0	5.0 5.0	Vdc
Output Voltage Low	(V_{IL} = 3.0 V, I_L = 10 mA)	V_{OL}	–	0.2	0.45	Vdc
Output Short−Circuit Current		I_{OS}	–	− 3.0	− 4.0	mA
Power Supply Current (All Gates "on," I_{out} = 0 mA, V_{IH} = + 5.0 Vdc)		I_{CC}	–	16	26	mA
Power Consumption	(V_{IH} = + 5.0 Vdc)	P_C	–	80	130	mW

SWITCHING CHARACTERISTICS (V_{CC} = 5.0 Vdc ± 1%, T_A = + 25°C, See Figure 3.)

		Symbol	Min	Typ	Max	Unit
Propagation Delay Time	(R_L = 3.9 kΩ)	t_{PLH}	–	25	85	ns
Rise Time	(R_L = 3.9 kΩ)	t_{TLH}	–	120	175	ns
Propagation Delay Time	(R_L = 390 kΩ)	t_{PHL}	–	25	50	ns
Fall Time	(R_L = 390 kΩ)	t_{THL}	–	10	20	ns

TEST CIRCUITS

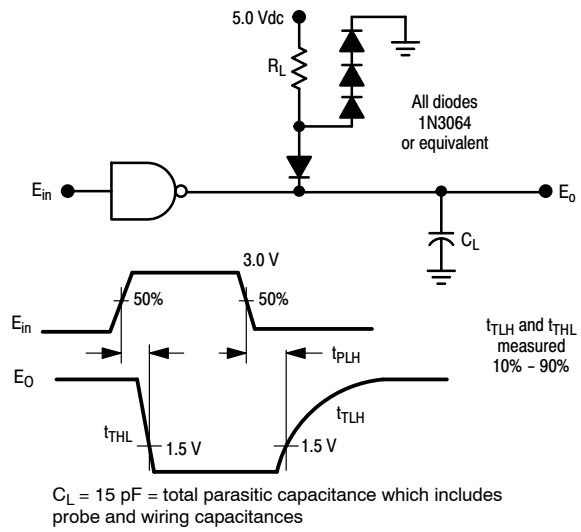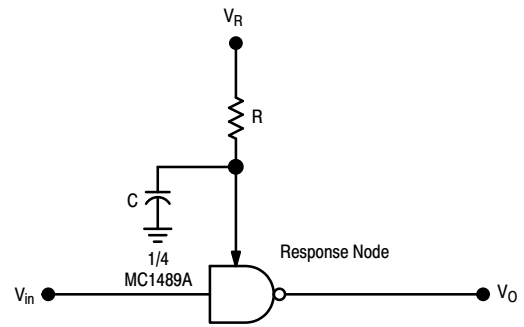C_L = 15 pF = total parasitic capacitance which includes probe and wiring capacitances

Figure 3. Switching Response

C, capacitor is for noise filtering.
R, resistor is for threshold shifting.

Figure 4. Response Control Node

MC1489, MC1489A

TYPICAL CHARACTERISTICS

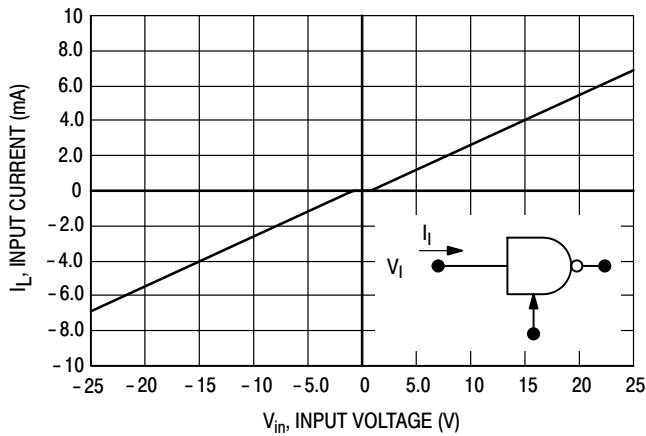(V_{CC} = 5.0 Vdc, T_A = +25°C, unless otherwise noted)

Figure 5. Input Current
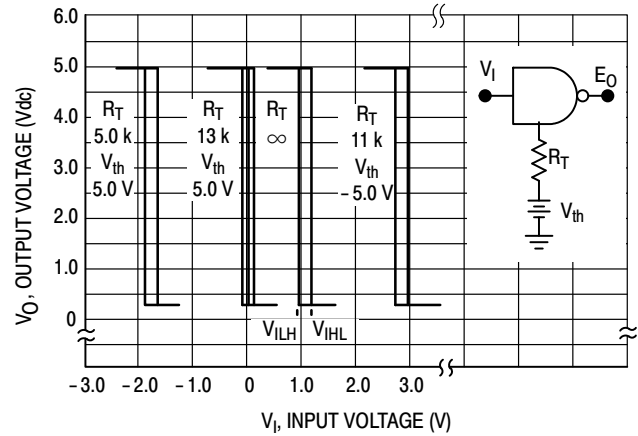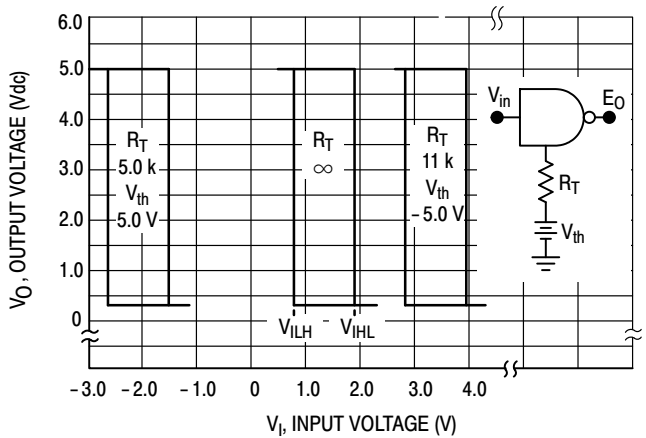

**Figure 6. MC1489 Input Threshold
Voltage Adjustment**

**Figure 7. MC1489A Input Threshold
Voltage Adjustment**
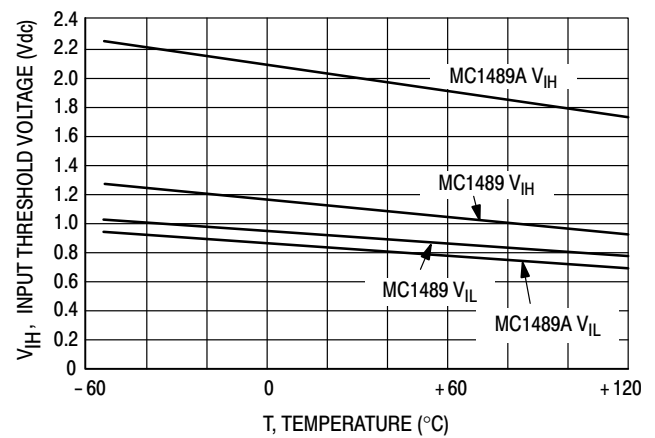
**Figure 8. Input Threshold Voltage
versus Temperature**
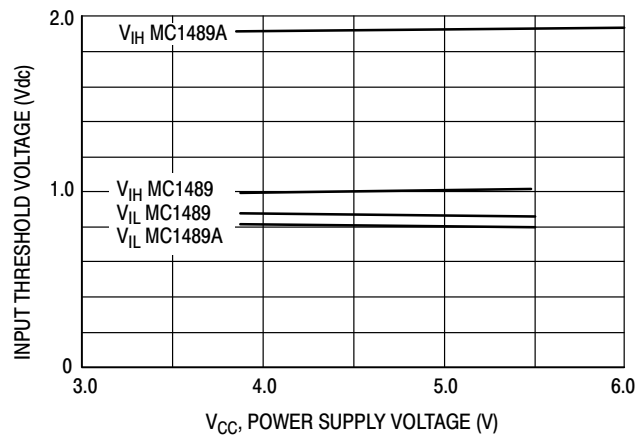
**Figure 9. Input Threshold versus
Power Supply Voltage**

APPLICATIONS INFORMATION

General Information

The Electronic Industries Association (EIA) has released the EIA−232D specification detailing the requirements for the interface between data processing equipment and data communications equipment. This standard specifies not only the number and type of interface leads, but also the voltage levels to be used. The MC1488 quad driver and its companion circuit, the MC1489 quad receiver, provide a complete interface system between DTL or TTL logic levels and the EIA−232D defined levels. The EIA−232D requirements as applied to receivers are discussed herein.

The required input impedance is defined as between 3000 Ω and 7000 Ω for input voltages between 3.0 and 25 V in magnitude; and any voltage on the receiver input in an open circuit condition must be less than 2.0 V in magnitude. The MC1489 circuits meet these requirements with a maximum open circuit voltage of one V_{BE}.

The receiver shall detect a voltage between − 3.0 and −25 V as a Logic "1" and inputs between 3.0 and 25 V as a Logic "0." On some interchange leads, an open circuit of power "OFF" condition (300 Ω or more to ground) shall be decoded as an "OFF" condition or Logic "1." For this reason, the input hysteresis thresholds of the MC1489 circuits are all above ground. Thus an open or grounded input will cause the same output as a negative or Logic "1" input.

Device Characteristics

The MC1489 interface receivers have internal feedback from the second stage to the input stage providing input hysteresis for noise rejection. The MC1489 input has typical turn−on voltage of 1.25 V and turn−off of 1.0 V for a typical hysteresis of 250 mV. The MC1489A has typical turn−on of 1.95 V and turn−off of 0.8 V for typically 1.15 V of hysteresis.

Each receiver section has an external response control node in addition to the input and output pins, thereby allowing the designer to vary the input threshold voltage levels. A resistor can be connected between this node and an external power supply. Figures 4, 6 and 7 illustrate the input threshold voltage shift possible through this technique.

This response node can also be used for the filtering of high frequency, high energy noise pulses. Figures 10 and 11 show typical noise pulse rejection for external capacitors of various sizes.

These two operations on the response node can be combined or used individually for many combinations of interfacing applications. The MC1489 circuits are particularly useful for interfacing between MOS circuits and DTL/TTL logic systems. In this application, the input threshold voltages are adjusted (with the appropriate supply and resistor values) to fall in the center of the MOS voltage logic levels (see Figure 12).

The response node may also be used as the receiver input as long as the designer realizes that he may not drive this node with a low impedance source to a voltage greater than one diode above ground or less than one diode below ground. This feature is demonstrated in Figure 13 where two receivers are slaved to the same line that must still meet the EIA−232D impedance requirement.
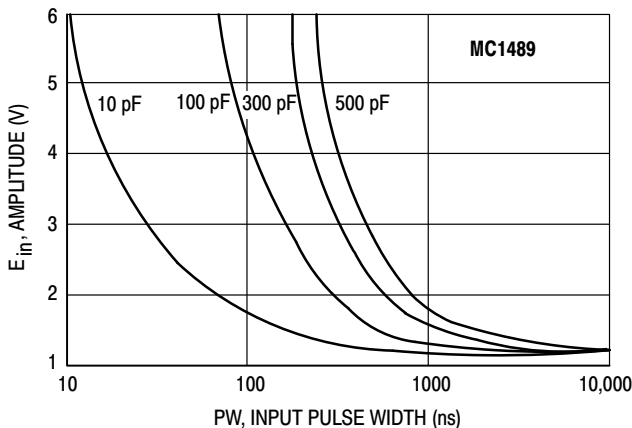

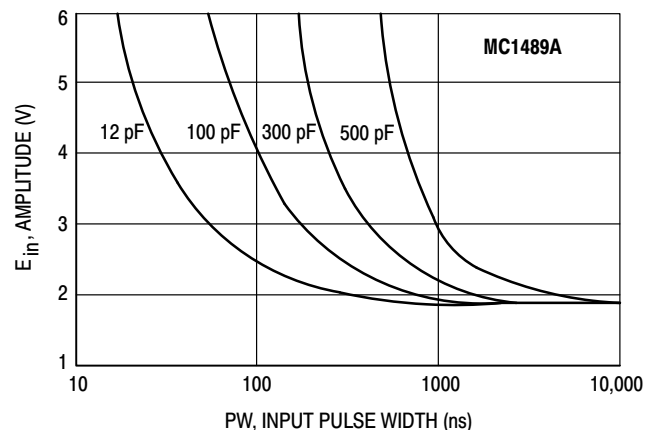**Figure 10. Typical Turn On Threshold versus Capacitance from Response Control Pin to GND**

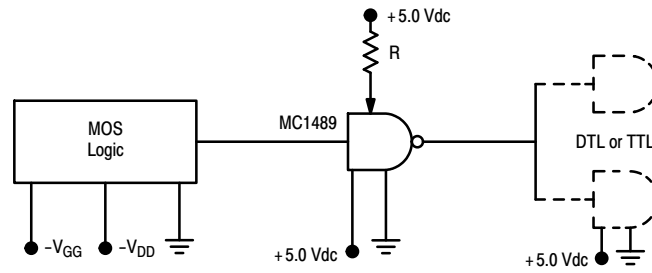**Figure 11. Typical Turn On Threshold versus Capacitance from Response Control Pin to GND**

Figure 12. Typical Translator Application − MOS to DTL or TTL

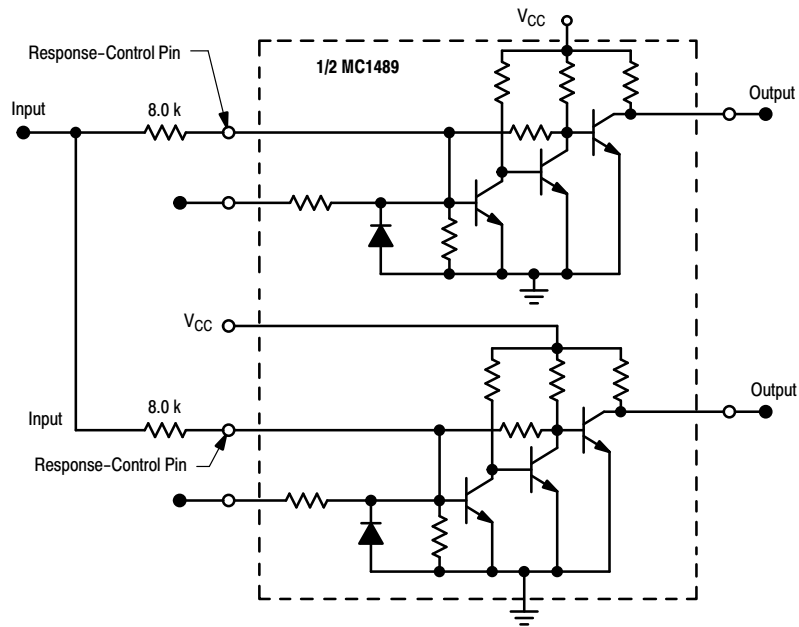**Figure 13. Typical Paralleling of Two MC1489, A Receivers to Meet EIA−232D**
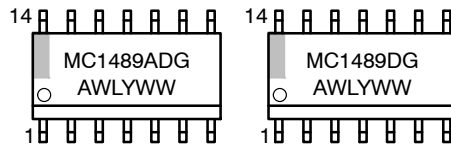
ORDERING INFORMATION

Device	Package	Operating Temperature Range	Shipping[†]
MC1489D	SOIC−14		55 Units/Rail
MC1489DG	SOIC−14 (Pb−Free)		
MC1489DR2	SOIC−14		2500 Tape & Reel
MC1489DR2G	SOIC−14 (Pb−Free)		
MC1489AD	SOIC−14		55 Units/Rail
MC1489ADG	SOIC−14 (Pb−Free)		
MC1489ADR2	SOIC−14		2500 Tape & Reel
MC1489ADR2G	SOIC−14 (Pb−Free)	T_A = 0 to +75°C	
MC1489P	PDIP−14		25 Units/Rail
MC1489PG	PDIP−14 (Pb−Free)		
MC1489AP	PDIP−14		
MC1489APG	PDIP−14 (Pb−Free)		
MC1489M	SOEIAJ−14		50 Units/Rail
MC1489MG	SOEIAJ−14 (Pb−Free)		
MC1489MEL	SOEIAJ−14		2000 Tape & Reel
MC1489MELG	SOEIAJ−14 (Pb−Free)		
MC1489AM	SOEIAJ−14		50 Units/Rail
MC1489AMG	SOEIAJ−14 (Pb−Free)		
MC1489AMEL	SOEIAJ−14		2000 Tape & Reel
MC1489AMELG	SOEIAJ−14 (Pb−Free)		

†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.

MC1489, MC1489A
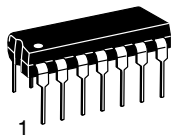
MARKING DIAGRAMS

SOIC−14
D SUFFIX
CASE 751A

14 — MC1489ADG / AWLYWW
14 — MC1489DG / AWLYWW

PDIP−14
P SUFFIX
CASE 646

14 — MC1489AP / AWLYYWWG
1

14 — MC1489P / AWLYYWWG
1

SOEIAJ−14
M SUFFIX
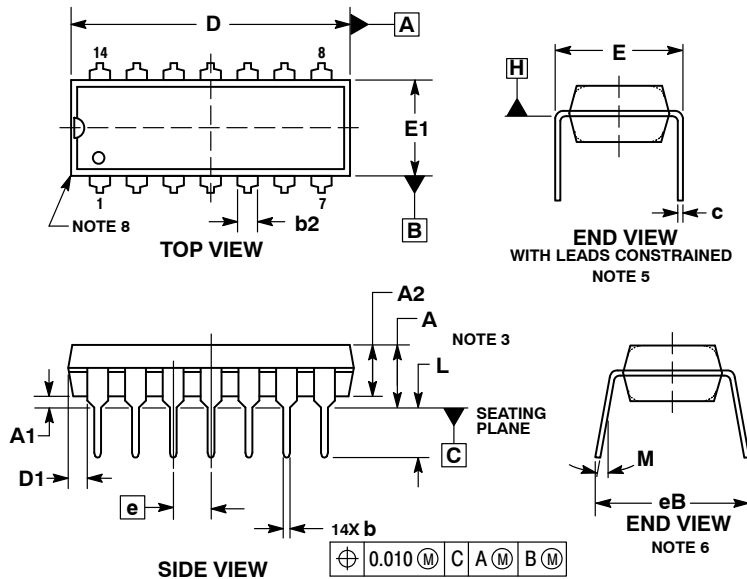**CASE 965**

MC1489A / ALYWG

MC1489 / ALYWG
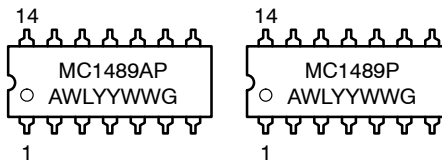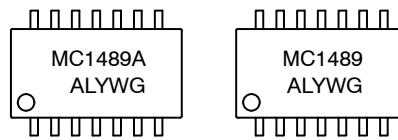
A   = Assembly Location
WL, L   = Wafer Lot
YY, Y   = Year
WW, W = Work Week
G   = Pb−Free Package

PDIP−14
CASE 646−06
ISSUE S

DATE 22 APR 2015

SCALE 1:1

1

TOP VIEW

NOTE 8

END VIEW
WITH LEADS CONSTRAINED
NOTE 5

SIDE VIEW

SEATING PLANE

14X b

$\oplus$ | 0.010 $\bigcirc{M}$ | C | A $\bigcirc{M}$ | B $\bigcirc{M}$

END VIEW
NOTE 6

STYLES ON PAGE 2

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACK-AGE SEATED IN JEDEC SEATING PLANE GAUGE GS−3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	−−−−	0.210	−−−	5.33
A1	0.015	−−−−	0.38	−−−
A2	0.115	0.195	2.92	4.95
b	0.014	0.022	0.35	0.56
b2	0.060 TYP		1.52 TYP	
C	0.008	0.014	0.20	0.36
D	0.735	0.775	18.67	19.69
D1	0.005	−−−−	0.13	−−−
E	0.300	0.325	7.62	8.26
E1	0.240	0.280	6.10	7.11
e	0.100 BSC		2.54 BSC	
eB	−−−−	0.430	−−−	10.92
L	0.115	0.150	2.92	3.81
M	−−−−	10°	−−−	10°

GENERIC
MARKING DIAGRAM*

14

XXXXXXXXXXXX
XXXXXXXXXXXX
AWLYYWWG

1
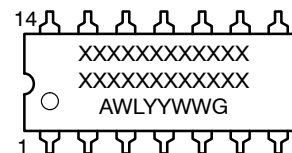
XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb−Free Package

*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.

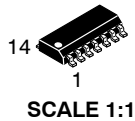| DOCUMENT NUMBER:	98ASB42428B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	PDIP−14		PAGE 1 OF 2

PDIP−14
CASE 646−06
ISSUE S

STYLE 1:
PIN 1. COLLECTOR
    2. BASE
    3. EMITTER
    4. NO
CONNECTION
    5. EMITTER
    6. BASE
    7. COLLECTOR
    8. COLLECTOR
    9. BASE
    10. EMITTER
    11. NO
CONNECTION
    12. EMITTER
    13. BASE
    14. COLLECTOR

STYLE 2:
        CANCELLED

STYLE 3:
        CANCELLED

STYLE 4:
PIN 1. DRAIN
    2. SOURCE
    3. GATE
    4. NO
CONNECTION
    5. GATE
    6. SOURCE
    7. DRAIN
    8. DRAIN
    9. SOURCE
    10. GATE
    11. NO
CONNECTION
    12. GATE
    13. SOURCE
    14. DRAIN

STYLE 5:
PIN 1. GATE
    2. DRAIN
    3. SOURCE
    4. NO CONNECTION
    5. SOURCE
    6. DRAIN
    7. GATE
    8. GATE
    9. DRAIN
    10. SOURCE
    11. NO CONNECTION
    12. SOURCE
    13. DRAIN
    14. GATE

STYLE 6:
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 7:
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 8:
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 9:
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

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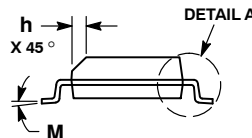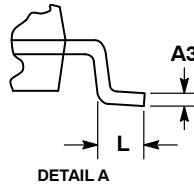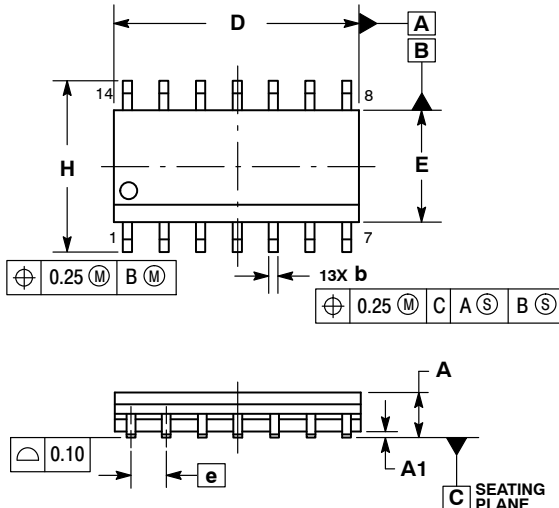   13. ANODE/CATHODE
    14. ANODE/CATHODE

DOCUMENT NUMBER:	98ASB42428B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	PDIP−14		PAGE 2 OF 2

onsemi

14

1

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.

DETAIL A

13X b

$\boxed{\oplus}$ 0.25 (M) B (M)

$\boxed{\oplus}$ 0.25 (M) C A (S) B (S)

$\boxed{\bigtriangleup}$ 0.10

e

A1

C SEATING PLANE

h X 45°

DETAIL A

M

DIM	MILLIMETERS		INCHES	
	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*

6.50

14X
1.18

1

1.27
PITCH

14X
0.58
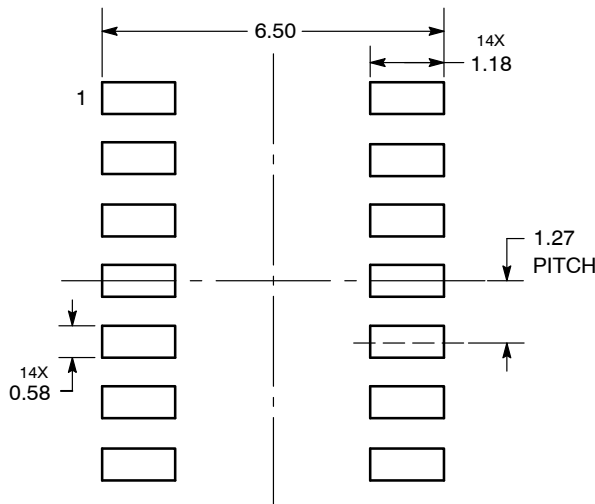
DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*

14

XXXXXXXXXG
AWLYWW

1

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.

*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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DESCRIPTION:	SOIC−14 NB		PAGE 1 OF 2

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
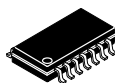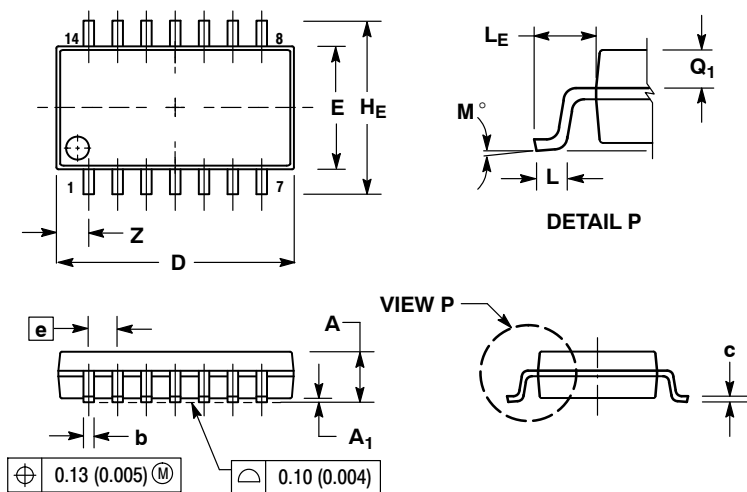12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

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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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).

DETAIL P

VIEW P

DIM	MILLIMETERS		INCHES	
	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

⊕ 0.13 (0.005) Ⓜ   △ 0.10 (0.004)

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