

50 kPa On-Chip Temperature Compensated and Calibrated Silicon Pressure Sensors

The MPX2053 series devices are silicon piezoresistive pressure sensors that provide a highly accurate and linear voltage output directly proportional to the applied pressure. A single, monolithic silicon diaphragm with the strain gauge and an integrated thin-film resistor network. Precise span and offset calibration with temperature compensation are achieved by laser trimming.

Features

- Temperature Compensated Over 0°C to +85°C
- Easy-to-Use Chip Carrier Package Options
- Ratiometric to Supply Voltage
- Gauge Ported and Non Ported Options
- Available in Easy-to-Use Tape & Reel
- Differential and Gauge Pressure Options

MPX2053 Series

0 to 50 kPa (0 to 7.25 psi)
40 mV Full Scale
(Typical)

Application Examples

- Pump/Motor Control
- Robotics
- Level Detectors
- Medical Diagnostics
- Pressure Switching
- Blood Pressure Measurement

ORDERING INFORMATION

Device Name	Case No.	# of Ports			Pressure Type			Device Marking
		None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXV2053G Series)								
MPXV2053GP	1369		•		•			MPXV2053GP
MPXV2053DP	1351			•		•		MPXV2053DP
MPXV2053GVP	1368		•		•			MPXV2053GV
Unibody Package (MPX2053 Series)								
MPX2053D	344	•				•		MPX2053D
MPX2053DP	344C			•		•		MPX2053DP
MPX2053GP	344B		•		•			MPX2053GP
MPAK Package (MPXM2053 Series)								
MPXM2053D	1320	•				•		MPXM2053D
MPXM2053DT1	1320	•				•		MPXM2053D
MPXM2053GS	1320A		•		•			MPXM2053GS
MPXM2053GST1	1320A		•		•			MPXM2053GS

UNIBODY PACKAGES



MPX2053D
CASE 344-15

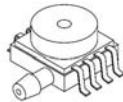


MPX2053GP
CASE 344B-01

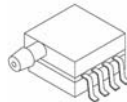


MPX2053DP
CASE 344C-01

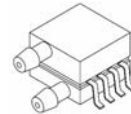
SMALL OUTLINE PACKAGES



MPXV2053GVP
CASE 1368-01

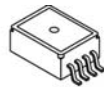


MPXV2053GP
CASE 1369-01

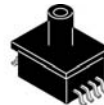


MPXV2053DP
CASE 1351-01

MPAK PACKAGES



MPXM2053D/DT1
CASE 1320-02



MPXM2053GS/GST1
CASE 1320A-02

Operating Characteristics

Table 1. Operating Characteristics ($V_S = 10 V_{DC}$, $T_A = 25^\circ C$ unless otherwise noted, $P1 > P2$)

Characteristic	Symbol	Min	Typ	Max	Units
Pressure Range ⁽¹⁾	P_{OP}	0	—	50	kPa
Supply Voltage ⁽²⁾	V_S	—	10	16	V_{DC}
Supply Current	I_O	—	6.0	—	mAdc
Full Scale Span ⁽³⁾	V_{FS}	38.5	40	41.5	mV
Offset ⁽⁴⁾	—	-1.0	—	1.0	mV
Sensitivity	—	$\Delta V/\Delta P$	—	0.8	—
Non-Linearity	—	-0.6	—	0.4	% V_{FS}
Pressure Hysteresis (0 to 50 kPa)	—	—	± 0.1	—	% V_{FS}
Temperature Hysteresis (-40° to 125°C)	—	—	± 0.5	—	% V_{FS}
Temperature Coefficient of Full Scale	TCV_{FS}	-2.0	—	2.0	% V_{FS}
Temperature Coefficient of Offset	TCV_{OFF}	-1.0	—	1.0	mV
Input Impedance	Z_{IN}	1000	—	2500	Ω
Output Impedance	Z_{OUT}	1400	—	3000	Ω
Response Time ⁽⁵⁾ (10% to 90%)	t_R	—	1.0	—	ms
Warm-Up Time	—	—	20	—	ms
Offset Stability ⁽⁶⁾	—	—	± 0.5	—	% V_{FS}

1. 1.0 kPa (kiloPascal) equals 0.145 psi.

2. Device is ratiometric within this specified excitation range. Operating the device above the specified excitation range may induce additional error due to device self-heating.

3. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.

4. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.

5. Response Time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.

6. Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Maximum Ratings

Table 2. Maximum Ratings⁽¹⁾

Rating	Max Value	Unit
Supply Voltage	16	V
Pressure ($P1 > P2$)	200	kPa
Storage Temperature	-40 to +125	$^\circ C$
Operating Temperature Range	-40 to +125	$^\circ C$

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

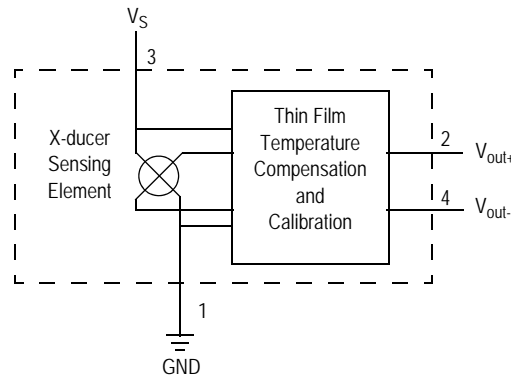


Figure 1. Temperature Compensated Pressure Sensor Schematic

Voltage Output versus Applied Differential Pressure

The differential voltage output of the sensor is directly proportional to the differential pressure applied.

The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure

side relative to the vacuum side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum side relative to the pressure side.

On-Chip Temperature Compensation and Calibration

Figure 2 shows the minimum, maximum and typical output characteristics of the MPX2053 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

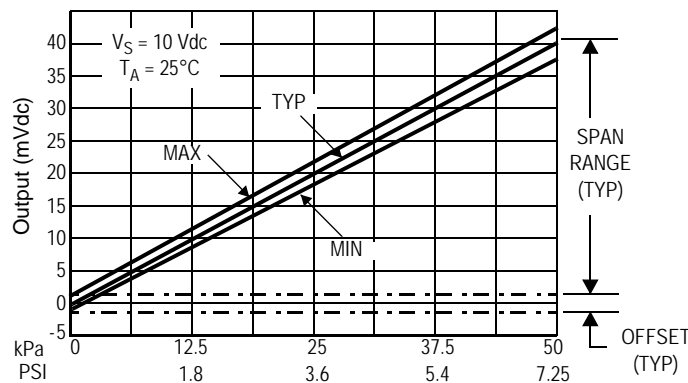


Figure 2. Output vs. Pressure Differential

LINEARITY

Linearity refers to how well a transducer's output follows the equation: $V_{out} = V_{off} + \text{sensitivity} \times P$ over the operating pressure range. There are two basic methods for calculating nonlinearity: (1) end point straight line fit (see Figure 3) or (2) a least squares best line fit. While a least squares fit gives the "best case" linearity error (lower numerical value), the calculations required are burdensome.

Conversely, an end point fit will give the "worst case" error (often more desirable in error budget calculations) and the calculations are more straightforward for the user. The specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

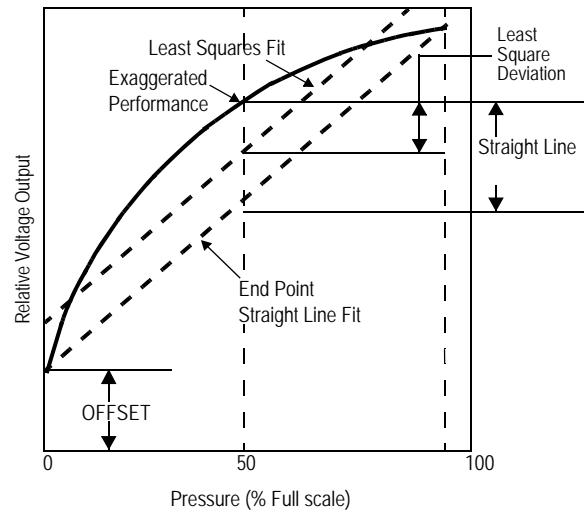


Figure 3. Linearity Specification Comparison

Figure 4 illustrates the differential or gauge configuration in the basic chip carrier (Case 344). A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPX2053 series pressure sensor operating characteristics and internal reliability and qualification tests

are based on use of dry air as the pressure media. Media other than dry air may have adverse effects on sensor performance and long term reliability. Contact the factory for information regarding media compatibility in your application. Refer to application note AN3728, for more information regarding media compatibility.

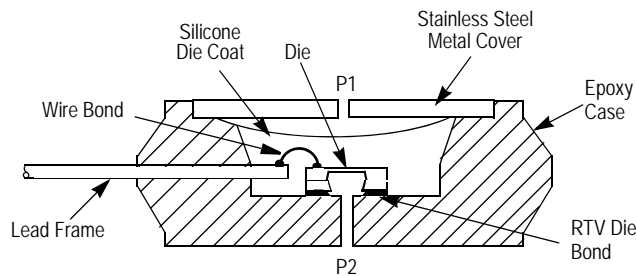
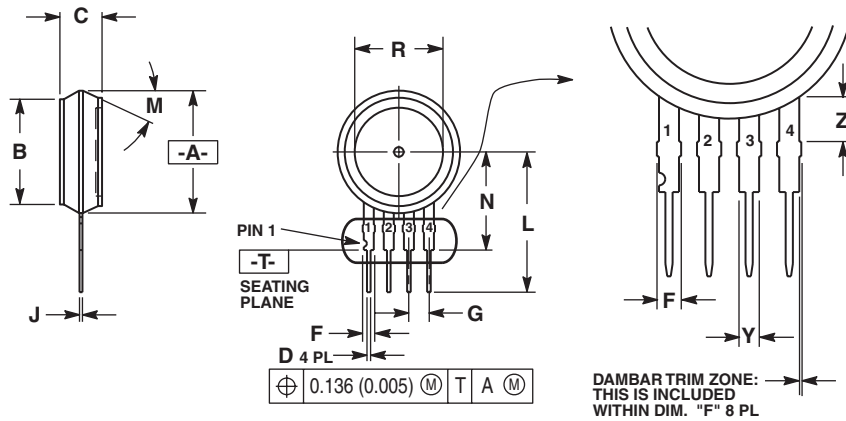


Figure 4. Unibody Package — Cross-Sectional Diagram (Not to Scale)

PACKAGE DIMENSIONS

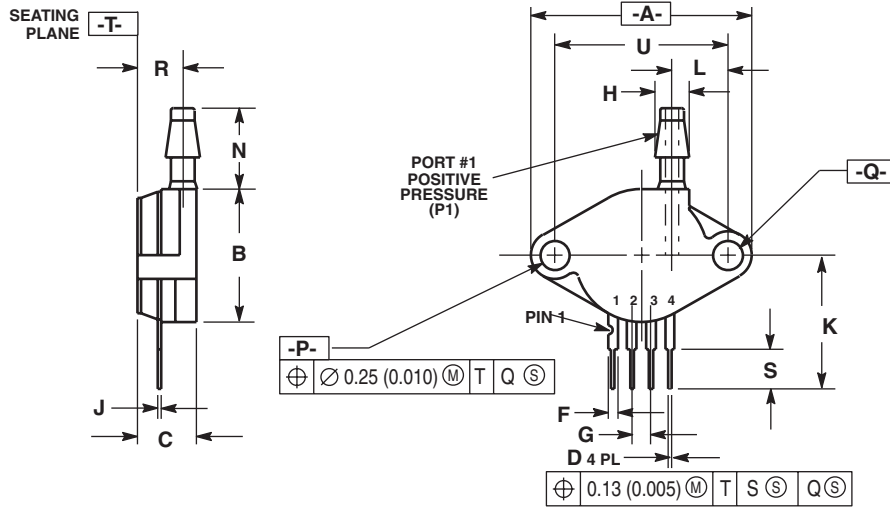


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION -A- IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	11.43
Y	0.048	0.052	1.22	1.32
Z	0.106	0.118	2.68	3.00

- STYLE 1:
 PIN 1. GROUND
 2. + OUTPUT
 3. + SUPPLY
 4. - OUTPUT
- STYLE 2:
 PIN 1. V_{CC}
 2. - SUPPLY
 3. + SUPPLY
 4. GROUND
- STYLE 3:
 PIN 1. GND
 2. -VOUT
 3. VS
 4. +VOUT

CASE 344-15 ISSUE AA UNIBODY PACKAGE



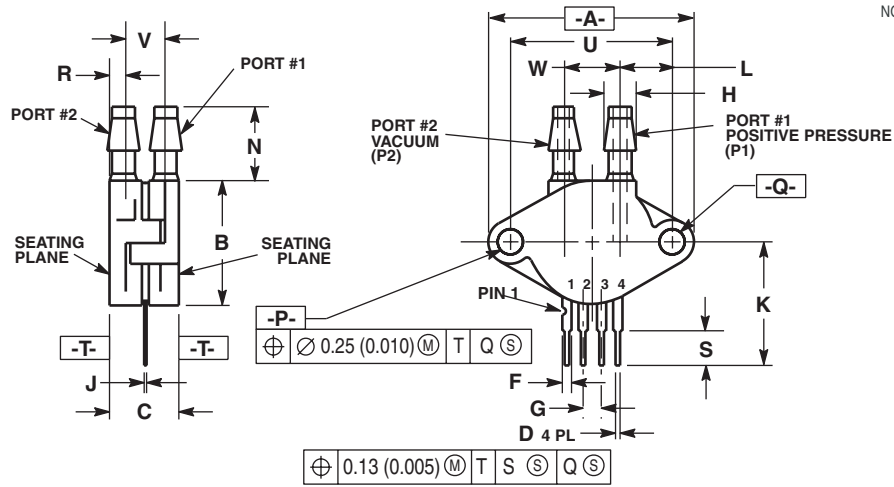
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.145	1.175	29.08	29.85
B	0.685	0.715	17.40	18.16
C	0.305	0.325	7.75	8.26
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.93
J	0.014	0.016	0.36	0.41
K	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.159	3.89	4.04
R	0.230	0.250	5.84	6.35
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	

- STYLE 1:
 PIN 1. GROUND
 2. + OUTPUT
 3. + SUPPLY
 4. - OUTPUT

CASE 344B-01 ISSUE B UNIBODY PACKAGE

PACKAGE DIMENSIONS



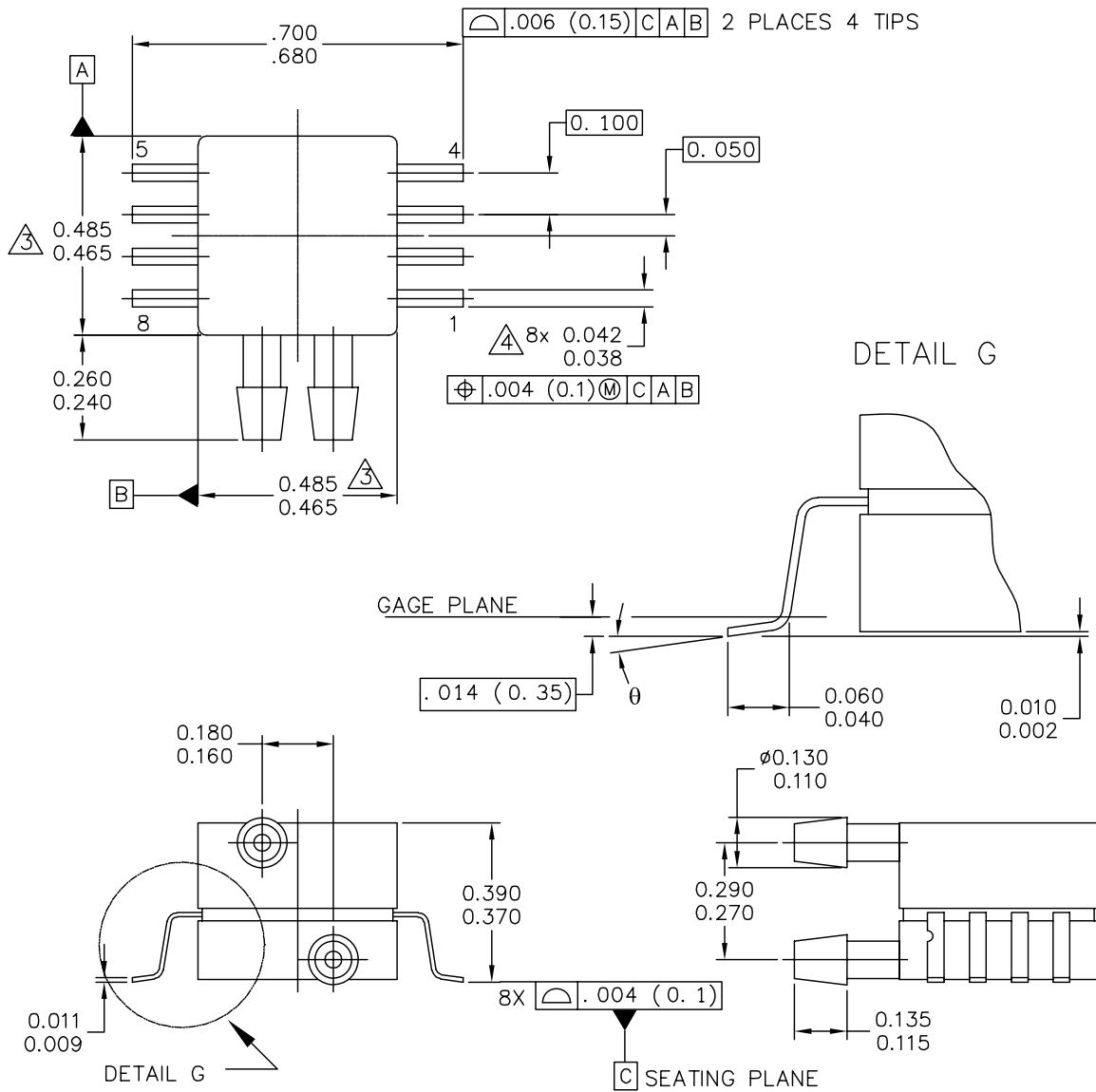
- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.145	1.175	29.08	29.85
B	0.685	0.715	17.40	18.16
C	0.405	0.435	10.29	11.05
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.93
J	0.014	0.016	0.36	0.41
K	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.159	3.89	4.04
R	0.063	0.083	1.60	2.11
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	
V	0.248	0.278	6.30	7.06
W	0.310	0.330	7.87	8.38

- STYLE 1:
 PIN 1: GROUND
 2. + OUTPUT
 3. + SUPPLY
 4. - OUTPUT

CASE 344C-01 ISSUE B UNIBODY PACKAGE

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: A
	CASE NUMBER: 1351-01	27 JUL 2005
	STANDARD: NON-JEDEC	

PAGE 1 OF 2

**CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE**

MPX2053

PACKAGE DIMENSIONS

NOTES:

1. CONTROLLING DIMENSION: INCH
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.
4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:

PIN 1: GND
 PIN 2: +Vout
 PIN 3: Vs
 PIN 4: -Vout
 PIN 5: N/C
 PIN 6: N/C
 PIN 7: N/C
 PIN 8: N/C

STYLE 2:

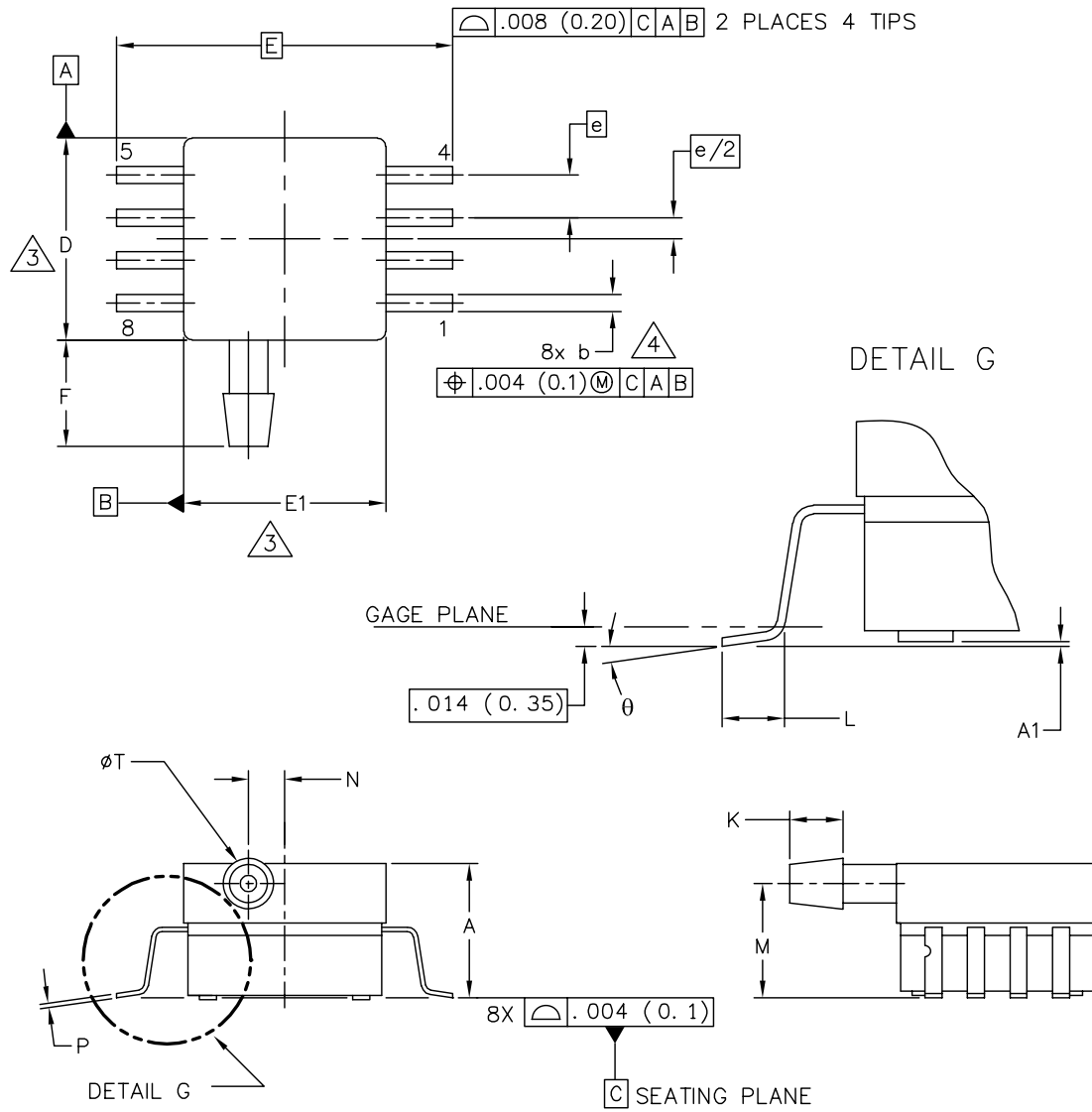
PIN 1: N/C
 PIN 2: Vs
 PIN 3: GND
 PIN 4: Vout
 PIN 5: N/C
 PIN 6: N/C
 PIN 7: N/C
 PIN 8: N/C

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: A	
	CASE NUMBER: 1351-01	27 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: 8 LD SOP, SIDE PORT	DOCUMENT NO: 98ASA99303D	REV: B
	CASE NUMBER: 1369-01	24 MAY 2005
	STANDARD: NON-JEDEC	

**CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE**

PACKAGE DIMENSIONS

NOTES:

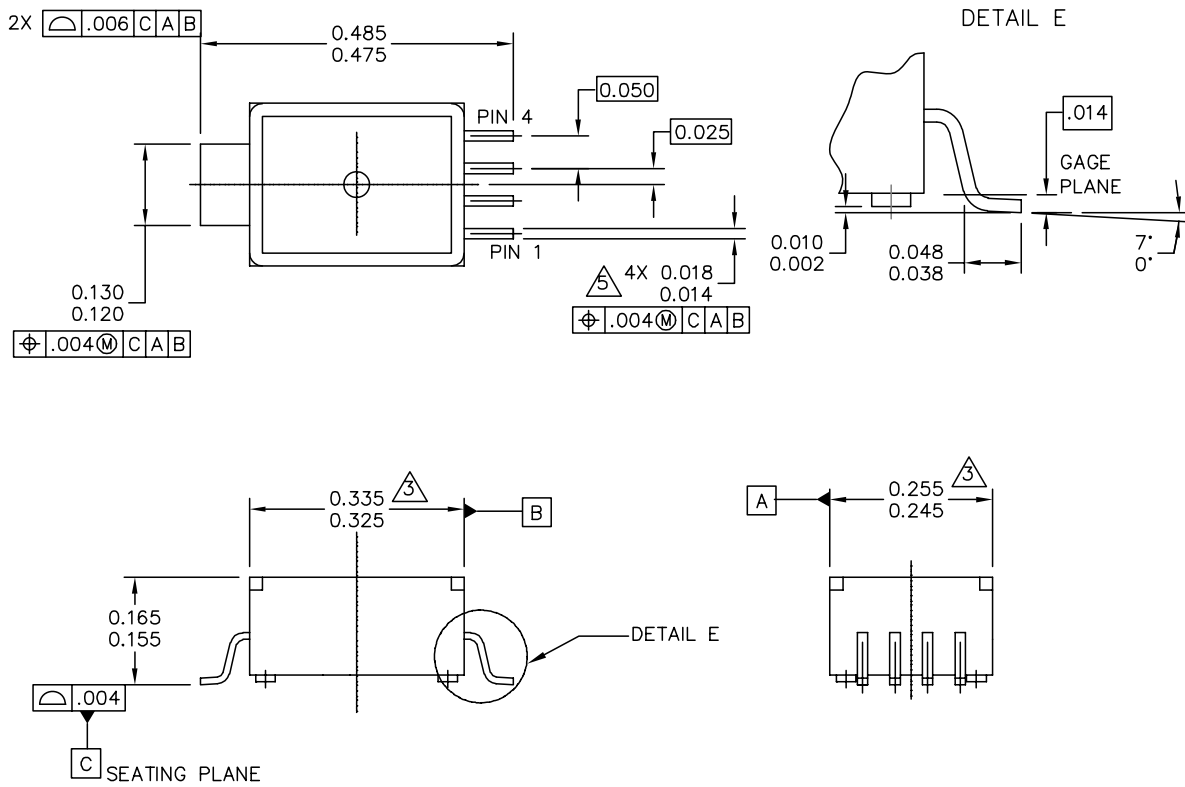
1. CONTROLLING DIMENSION: INCH
 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- ③ DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.
- ④ DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

DIM	INCHES		MILLIMETERS		DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.300	.330	7.11	7.62	θ	0°	7°	0°	7°
A1	.002	.010	0.05	0.25	-	---	---	---	---
b	.038	.042	0.96	1.07	-	---	---	---	---
D	.465	.485	11.81	12.32	-	---	---	---	---
E	.717 BSC		18.21 BSC		-	---	---	---	---
E1	.465	.485	11.81	12.32	-	---	---	---	---
e	.100 BSC		2.54 BSC		-	---	---	---	---
F	.245	.255	6.22	6.47	-	---	---	---	---
K	.120	.130	3.05	3.30	-	---	---	---	---
L	.061	.071	1.55	1.80	-	---	---	---	---
M	.270	.290	6.86	7.36	-	---	---	---	---
N	.080	.090	2.03	2.28	-	---	---	---	---
P	.009	.011	0.23	0.28	-	---	---	---	---
T	.115	.125	2.92	3.17	-	---	---	---	---
© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.			MECHANICAL OUTLINE			PRINT VERSION NOT TO SCALE			
TITLE: 8 LD SOP, SIDE PORT					DOCUMENT NO: 98ASA99303D			REV: B	
					CASE NUMBER: 1369-01			24 MAY 2005	
					STANDARD: NON-JEDEC				

PAGE 2 OF 2

**CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE**

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.		MECHANICAL OUTLINE		PRINT VERSION NOT TO SCALE	
TITLE: 5 LD M-PAC		DOCUMENT NO: 98ARH99088A		REV: B	
		CASE NUMBER: 1320-02		22 JUL 2005	
		STANDARD: NON-JEDEC			

PAGE 1 OF 2

**CASE 1320-02
ISSUE B**

MPX2053

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN INCHES.

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.

4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.

5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

PIN 1: GND
PIN 2: +Vout
PIN 3: Vs
PIN 4: -Vout

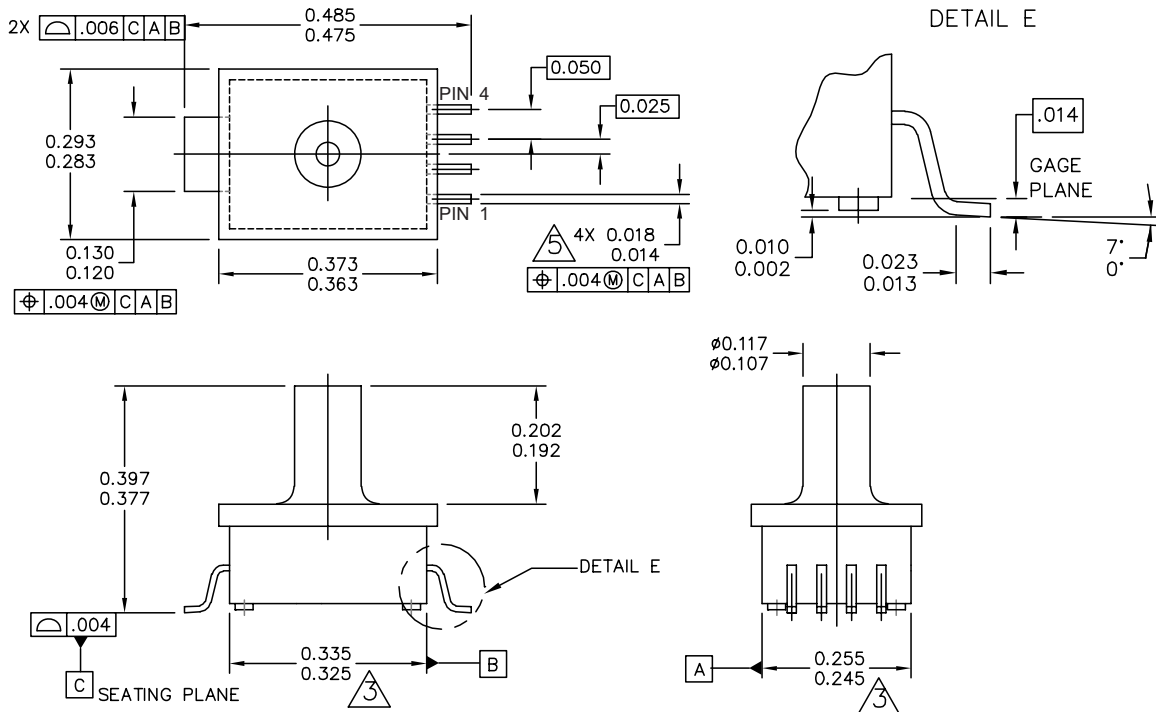
© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 5 LD M-PAC	DOCUMENT NO: 98ARH99088A	REV: B	
	CASE NUMBER: 1320-02	22 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

**CASE 1320-02
ISSUE B**

MPX2053

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE
TITLE: 5 LD M-PAC, PORTED	DOCUMENT NO: 98ARH99087A	REV: A
	CASE NUMBER: 1320A-02	22 JUL 2005
	STANDARD: NON-JEDEC	

PAGE 1 OF 2

**CASE 1320A-02
ISSUE A**

MPX2053

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN INCHES.

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.

4. ALL VERTICAL SURFACES TO BE 5" MAXIMUM.

5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

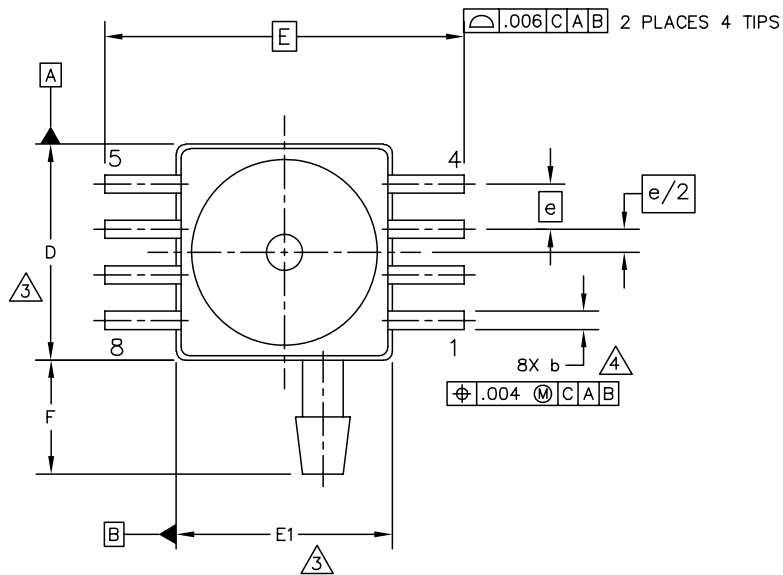
© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 5 LD M-PAC, PORTED	DOCUMENT NO: 98ARH99087A	REV: A	
	CASE NUMBER: 1320A-02	22 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

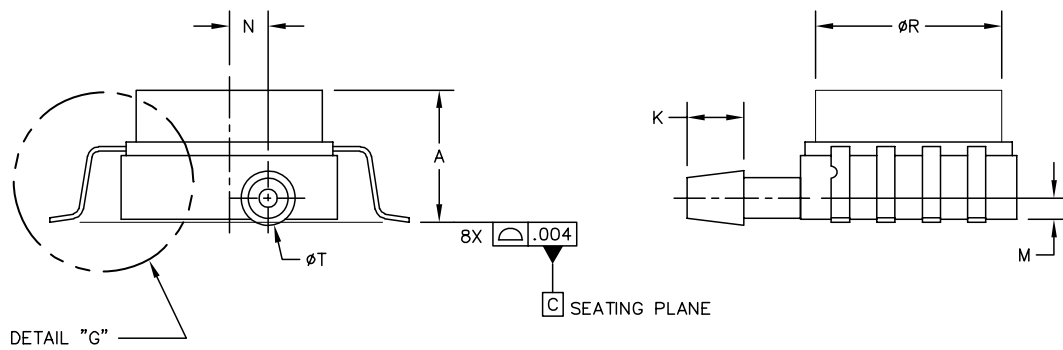
**CASE 1320A-02
ISSUE A**

MPX2053

PACKAGE DIMENSIONS



0.216

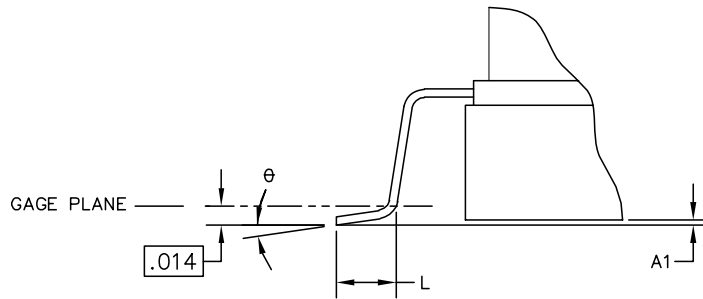


© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 8 LD SOP, GVP	DOCUMENT NO: 98ASA99302D	REV: B	
	CASE NUMBER: 1368-01	23 MAY 2005	
	STANDARD: NON-JEDEC		

**CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT**

MPX2053

PACKAGE DIMENSIONS



DETAIL "G"

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: 8 LD SOP, GVP	DOCUMENT NO: 98ASA99302D	REV: B	
	CASE NUMBER: 1368-01	23 MAY 2005	
	STANDARD: NON-JEDEC		

**CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT**

PACKAGE DIMENSIONS

NOTES:

1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

3. THIS DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

4. THIS DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:	STYLE 2:
PIN 1: GND	PIN 1: N/C
PIN 2: +Vout	PIN 2: Vs
PIN 3: Vs	PIN 3: GND
PIN 4: -Vout	PIN 4: Vout
PIN 5: N/C	PIN 5: N/C
PIN 6: N/C	PIN 6: N/C
PIN 7: N/C	PIN 7: N/C
PIN 8: N/C	PIN 8: N/C

DIM	INCHES		MILLIMETERS		DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.280	.300	7.11	7.62	R	.405	.415	10.28	10.54
A1	.002	.010	0.05	0.25	Ø	0"	7"	0"	7"
b	.038	.042	0.96	1.07	-	---	---	---	---
D	.465	.485	11.81	12.32	-	---	---	---	---
E	.690 BSC		17.52 BSC		-	---	---	---	---
E1	.465	.485	11.85	12.32	-	---	---	---	---
e	.100 BSC		2.54 BSC		-	---	---	---	---
F	.240	.260	6.10	6.60	-	---	---	---	---
K	.115	.135	2.92	3.43	-	---	---	---	---
L	.040	.060	1.02	1.52	-	---	---	---	---
M	.035	.055	1.90	2.41	-	---	---	---	---
N	.075	.095	0.89	1.39	-	---	---	---	---
P	.009	.011	0.23	0.28	-	---	---	---	---
T	.110	.130	2.79	3.30	-	---	---	---	---

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: <div style="text-align: center; font-size: 1.2em;">8 LD SOP, GVP</div>	DOCUMENT NO: 98ASA99302D CASE NUMBER: 1368-01 STANDARD: NON-JEDEC	REV: B 23 MAY 2005	

CASE 1368-01
ISSUE B
SMALL OUTLINE PACKAGE
SURFACE MOUNT

How to Reach Us:

Home Page:

www.freescale.com

Web Support:

<http://www.freescale.com/support>

USA/Europe or Locations Not Listed:

Freescale Semiconductor, Inc.
Technical Information Center, EL516
2100 East Elliot Road
Tempe, Arizona 85284
1-800-521-6274 or +1-480-768-2130
www.freescale.com/support

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
www.freescale.com/support

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor China Ltd.
Exchange Building 23F
No. 118 Jianguo Road
Chaoyang District
Beijing 100022
China
+86 010 5879 8000
support.asia@freescale.com

For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or +1-303-675-2140
Fax: +1-303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor 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 consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor 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. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor 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 Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2009. All rights reserved.

