Freescale Semiconductor

MP3V5004G Rev 2, 06/2010

Integrated Silicon Pressure Sensor, On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MP3V5004G series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This sensor combines a highly sensitive implanted strain gauge with advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

Features

- Temperature Compensated from 10°C to 60°C
- Available in Gauge Surface Mount (SMT) Configuration
- Durable Thermoplastic (PPS) Package

MP3V5004G Series

0 to 3.92 kPa (0 to 400 mm H₂O) 0.6 to 3.0 V Output

Typical Applications

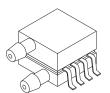
- · Washing Machine Water Level
- Ideally Suited for Microprocessor or Microcontroller-Based Systems

ORDERING INFORMATION									
Device Name	Package	Case	# of Ports		Pressure Type			Davisa Marking	
Device Name	Options	No.	None	Single	Dual	Gauge	Differential	Absolute	Device Marking
Small Outline Packag	Small Outline Package (MP3V5004 Series)								
MP3V5004GC6U	Rail	482A		•		•			MP3V5004G
MP3V5004GC6T1	Tape & Reel	482A		•		•			MP3V5004G
MP3V5004DP	Trays	1351			•		•		MP3V5004DP
MP3V5004GVP	Trays	1368		•		•			MP3V5004GV
MP3V5004GP	Trays	1369		•		•			MP3V5004GP

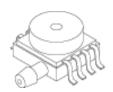
SMALL OUTLINE PACKAGES



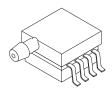
MP3V5004GC6U/6T1 CASE 482A



MP3V5004DP CASE 1351



MP3V5004GVP CASE 1368



MP3V5004GP CASE 1369



Operating Characteristics

Table 1. Operating Characteristics ($V_S = 3.0 \text{ Vdc}$, $T_A = 25 ^{\circ}\text{C}$ unless otherwise noted, P1 > P2.

Characteristic	Symbol	Min	Тур	Max	Unit
Pressure Range	P _{OP}	0	_	3.92 400	kPa mm H ₂ O
Supply Voltage ⁽¹⁾	V _S	2.7	3.0	3.3	V _{DC}
Supply Current	I _S	_	_	10	mAdc
Span at 306 mm H ₂ O (3 kPa) ⁽²⁾	V _{FSS}	_	1.8	_	V
Offset ⁽³⁾ (4)	V _{OFF}	0.45	0.6	0.75	V
Sensitivity	V/P	_	0.6 5.9	_	V/kPa mV/mm H ₂ O
Accuracy ^{(4) (5)} 0 to 100 mm H ₂ O (10 to 60°C) 100 to 400 mm H ₂ O (10 to 60°C)	<u>-</u>			±1.5 ±2.5	%V _{FSS} %V _{FSS}

- 1. Device is ratiometric within this specified excitation range.
- 2. Span is defined as the algebraic difference between the output voltage at specified pressure and the output voltage at the minimum rated pressure.
- 3. Offset (Voff) is defined as the output voltage at the minimum rated pressure.
- 4. Accuracy (error budget) consists of the following:

Linearity: Output deviation from a straight line relationship with pressure over the specified pressure range.

Temperature Hysteresis: Output deviation at any temperature within the operating temperature range, after the temperature is cycled to and

from the minimum or maximum operating temperature points, with zero differential pressure applied.

Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from the minimum

or maximum rated pressure, at 25°C.

Offset Stability: Output deviation, after 1000 temperature cycles, -30° to 100°C, and 1.5 million pressure cycles, with minimum

rated pressure applied.

TcSpan: Output deviation over the temperature range of 10° to 60°C, relative to 25°C.

TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 10° to 60°C, relative to 25°C.

Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V_{FSS}, at 25°C.

5. Auto-Zero at Factory Installation: Due to the sensitivity of the MP3V5004G, external mechanical stresses and mounting position can affect the zero pressure output reading. Auto-zeroing is defined as storing the zero pressure output reading and subtracting this from the device's output during normal operations. Reference AN1636 for specific information. The specified accuracy assumes a maximum temperature change of ±5°C between auto-zero and measurement.

Maximum Ratings

Table 2. Maximum Ratings⁽¹⁾

Rating	Symbol	Value	Units
Maximum Pressure (P1 > P2)	P _{MAX}	16	kPa
Storage Temperature	T _{STG}	-30 to +100	°C
Operating Temperature	T _A	0 to +85	°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.

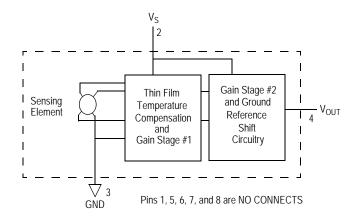


Figure 1. Fully Integrated Pressure Sensor Schematic

On-chip Temperature Compensation and Calibration

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration and signal conditioning circuitry onto a single monolithic chip.

Figure 2 illustrates the gauge configuration in the basic chip carrier (Case 482A). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MP3V5004G series sensor operating characteristics are based on the use of dry air as pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Internal reliability and qualification test for dry air, and other media, are available

from the factory. Contact the factory for information regarding media tolerance in your application.

Figure 3 shows the recommended decoupling circuit for interfacing the output of the MP3V5004G to the A/D input of the microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Figure 4 shows the sensor output signal relative to pressure input. Typical, minimum and maximum output curves are shown for operation over a temperature range of 10°C to 60°C using the decoupling circuit shown in Figure 3 The output will saturate outside of the specified pressure range.

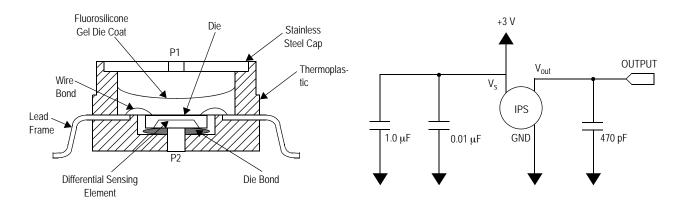


Figure 2. Cross Sectional Diagram SSOP (not to scale)

Figure 3. Recommended Power Supply Decoupling and Output Filtering.

(For additional output filtering, please refer to Application Note AN1646.)

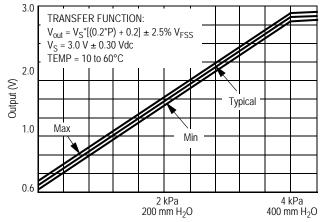


Figure 4. Output vs. Pressure Differential at ±2.5% V_{FSS} (See Note 5 in Operating Characteristics table)

PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

Freescale Semiconductor designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing silicone gel which isolates the die from the environment. The

Freescale Semiconductor pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

The Pressure (P1) side may be identified by using the table below.

Part Number	Case Type	Pressure (P1) Side Identifier		
MP3V5004GC6U/T1	482A	Side with Port Attached		
MP3V5004GP	1369	Side with Port Attached		
MP3V5004DP	1351	Side with Part Marking		
MP3V5004GVP	1368	Stainless Steel Cap		

MINIMUM RECOMMENDED FOOTPRINT FOR SMALL OUTLINE PACKAGES

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor package must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self-align when subjected to a

solder reflow process. It is always recommended to fabricate boards with a solder mask layer to avoid bridging and/or shorting between solder pads, especially on tight tolerances and/or tight layouts.

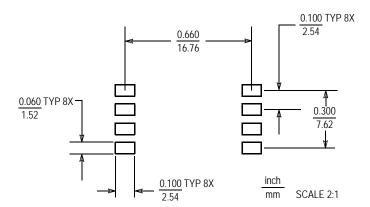
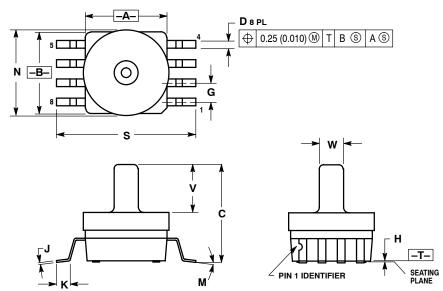


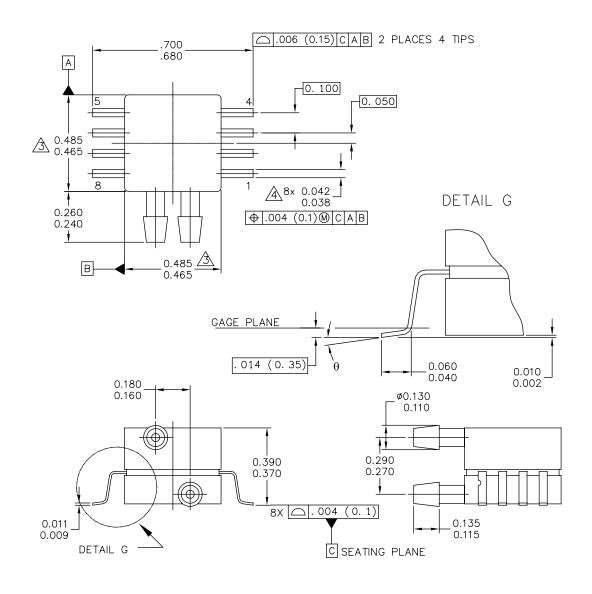
Figure 5. SOP Footprint



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
 5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	INC	HES	MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.415	0.425	10.54	10.79
В	0.415	0.425	10.54	10.79
C	0.500	0.520	12.70	13.21
ם	0.038	0.042	0.96	1.07
G	0.100	BSC	2.54	BSC
H	0.002	0.010	0.05	0.25
7	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
М	0 °	7°	0 °	7 °
N	0.444	0.448	11.28	11.38
s	0.709	0.725	18.01	18.41
٧	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

CASE 482A-01 ISSUE A SMALL OUTLINE PACKAGE



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TITLE:		DOCUMENT NO	: 98ASA99255D	REV: A
8 LD SNSR. DUAL	PORT	CASE NUMBER	2: 1351–01	27 JUL 2005
		STANDARD: NO	N-JEDEC	

CASE 1351-01 ISSUE A SMALL OUTLINE PACKAGE

NOTES:

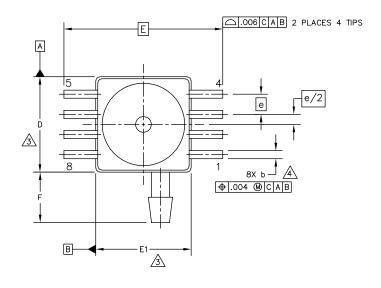
- 1. CONTROLLING DIMENSION: INCH
- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.

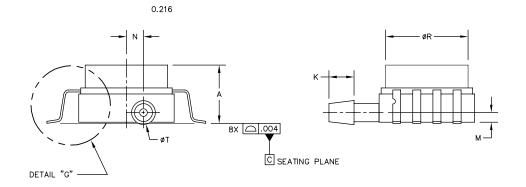
 MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.
- DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

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

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TITLE:		DOCUMENT NO	: 98ASA99255D	REV: A
8 LD SNSR, DUAL	PORT	CASE NUMBER	2: 1351–01	27 JUL 2005
		STANDARD: NO	N-JEDEC	

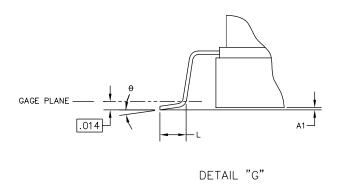
CASE 1351-01 ISSUE A SMALL OUTLINE PACKAGE





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TITLE:	DOCUMENT N	O: 98ASA99302D	REV: C
8 LD SOP, GVP	CASE NUMBE	R: 1368–01	18 DEC 2008
	STANDARD: N	ON-JEDEC	

CASE 1368-01 ISSUE C SMALL OUTLINE PACKAGE



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TITLE:	DOCUMENT N	IO: 98ASA99302D	REV: C	
8 LD SOP, GVP	CASE NUMBE	CASE NUMBER: 1368-01 18 DEG		
	STANDARD: 1	ION-JEDEC		

CASE 1368-01 ISSUE C SMALL OUTLINE PACKAGE

NOTES:

- 1. CONTROLLING DIMENSION: INCH
- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

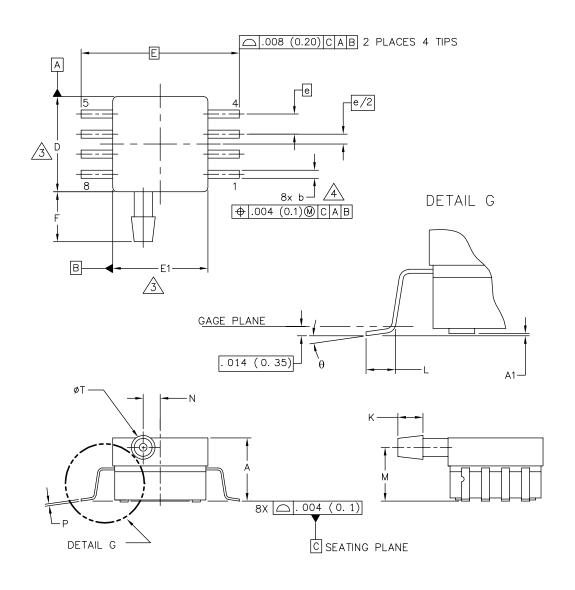
THIS DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PPROTRUSIONS. MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

 $\underline{\rlap/}\Delta$ THIS DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:	STYLE 2:		
PIN 1: GN	ND PIN	1:	N/C
PIN 2: +	Vout PIN	2:	٧s
PIN 3: Vs	s 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

		HES		IMETERS			CHES		IILLIMETERS	
DIM	MIN	MAX	MIN	MAX	DIM	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	θ	0.	7*	0.	7*	
ь	.038	.042	0.96	1.07	-					
D	.465	.485	11.81	12.32	-					
E	.690	BSC	17.	52 BSC	_					
E1	.465	.485	11.81	12.32	-					
е	.100	BSC	2.	54 BSC	_					
F	.240	.260	6.10	6.60	_					
к	.115	.135	2.92	3.43	-					
L	.040	.060	1.02	1.52	-					
м	.035	.055	0.89	1.39	_					
N	.075	.095	1.90	2.41	-					
Р	.009	.011	0.23	0.28	_					
т	.110	.130	2.79	3.30	-					
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TIT		II S RESERVED.					L D: 98ASA993	02D	REV: C	
	8	LD SOP	, GVI	D	CA	SE NUMBER	R: 1368-01		18 DEC 2008	
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CASE 1368-01 ISSUE C SMALL OUTLINE PACKAGE



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TITLE:	DOCUMENT NO	DOCUMENT NO: 98ASA99303D		
8 LD SOP, SIDE PO	ORT CASE NUMBER	CASE NUMBER: 1369-01		
·	STANDARD: N	DN-JEDEC		

CASE 1369-01 ISSUE B SMALL OUTLINE PACKAGE

NOTES:

- 1. CONTROLLING DIMENSION: INCH
- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.

 MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.
- DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

	INCHES		MILLIMETERS			INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX	DIM	MIN	MAX	MIN	MAX
Α	. 300	. 330	7. 11	7. 62	θ	0,	7°	0,	7°
A 1	. 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	-				
М	. 270	. 290	6. 86	7. 36	-				
N	. 080	. 090	2. 03	2. 28	-				
P	. 009	. 011	0. 23	0. 28	-				
Т	. 115	. 125	2. 92	3. 17	-				
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TITLE:				DOCUMENT NO: 98ASA99303D				REV: B	
8 LD SOP, SIDE PORT				CASE NUMBER: 1369-01 24 MAY 2				24 MAY 2005	
					STANDARD: NON-JEDEC				

CASE 1369-01 ISSUE B SMALL OUTLINE PACKAGE

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