



# High Accuracy Low g Inertial Sensor

## MEMS Sensing, State Machine ASIC

The MMA6700EG series is a dual axis, Low g, XY-axis sensor based on Freescale's HARMEMS technology with an embedded DSP ASIC allowing for additional processing of the digital or analog signals.

### Features

- XY-axis of sensitivity in one device
- 10- or 11-bit digital data output
- $\pm 3.5$  g or  $\pm 5$  g full-scale range per axis
  - MMA6700EG:  $\pm 3.5$  g (11-bit data sensitivity = 3.43 mg/digit typical at 25°C)
  - MMA6701EG:  $\pm 5$  g (11-bit data sensitivity = 4.91 mg/digit typical at 25°C)
- SPI-compatible serial interface
- Bidirectional internal self-test
- On-chip temperature sensor and voltage regulator
- Support for signed or unsigned output data
- Selection of integrated signal conditioning low-pass filters
- Capture/hold input for system-wide synchronization support
- 3.3 V or 5 V single supply operation
- Ratiometric analog voltage output
- Traceability through programmable registers, 3 8-bit.
- Customer-assigned one-time-programmable Registers (2 8-bit Registration)
- Minimal external component requirements
- Wide operating temperature range from -40°C to +125°C
- 20-pin SOIC wide-body RoHS-compliant package
- Minimum external components, 4 capacitors

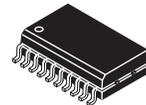
### Typical Applications

- With a +3.5 g or +5 g full scale range, the newly designed, high accuracy sensor enables electronic stability control (ESC) designers to accommodate higher original signal noise level without sacrificing resolution.
- Tilt Measurement

ORDERING INFORMATION			
Device	Temp. Range	Case No.	Package
MMA6700EGR2	- 40 to +125°C	475A-02	SOIC-20, Tape and Reel
MMA6700AEGR2	- 40 to +125°C	475A-02	SOIC-20, Tape and Reel
MMA6701EGR2	- 40 to +125°C	475A-02	SOIC-20, Tape and Reel
MMA6701AEGR2	- 40 to +125°C	475A-02	SOIC-20, Tape and Reel

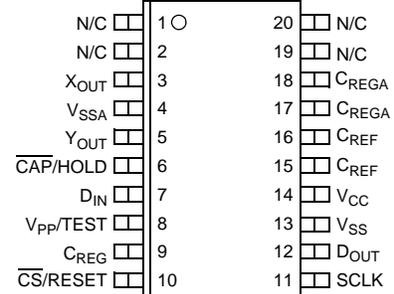
**MMA6700EG**  
**MMA6701EG**

**DUAL AXIS**  
**LOW g INERTIAL SENSOR**



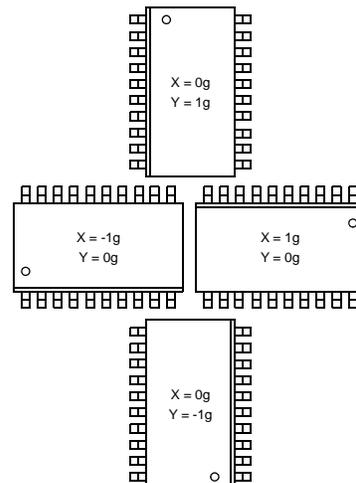
**EG SUFFIX (Pb-free)**  
**20-LEAD SOIC**  
**CASE 475A-02**

### PIN CONNECTIONS



20-PIN SOIC PACKAGE

N/C: NO INTERNAL CONNECTION



# BLOCK DIAGRAM

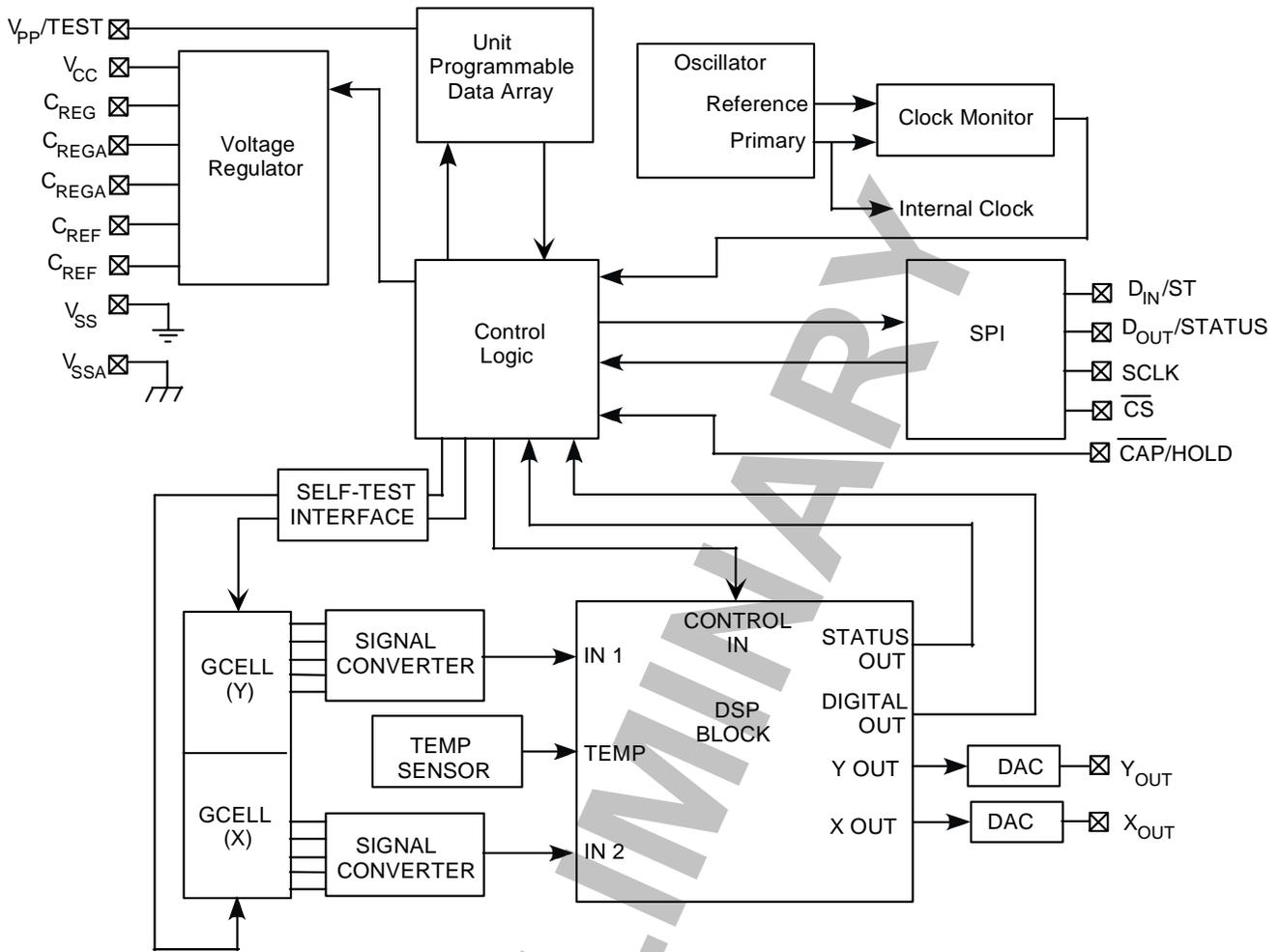


Figure 1. Block Diagram

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	$V_{CC}$	-0.3 to 7.0	Vdc
$C_{REG}, C_{REGA}, V_{REF}$	$V_{REG}$	-0.3 to 3.0	Vdc
$V_{PP}/TEST$	$V_{PP}$	-0.3 to 11.0	Vdc
SCLK, CS, $D_{IN}/ST,CAP/HOLD$	$V_{IN}$	-0.3 to $V_{CC} + 0.3$	Vdc
$D_{OUT}/STATUS$ (high impedance state)	$V_{OUT}$	-0.3 to $V_{CC} + 0.3$	Vdc
$X_{OUT}, Y_{OUT}$ (DACEN=0)	$V_{DAC}$	-0.3 to $V_{CC} + 0.3$	Vdc
Current Drain Per Pin Excluding $V_{CC}$ and $V_{SS}$	I	10	mAmps
Powered Shock (six sides, 0.5 ms duration)	$g_{pms}$	$\pm 1500$	g
Unpowered Shock (six sides, 0.5 ms duration)	$g_{shock}$	$\pm 2000$	g
Drop Shock (to concrete surface)	$h_{drop}$	1.2	m
Electrostatic Discharge			
Human Body Model (HBM)	$V_{ESD}$	$\pm 2000$	V
Charge Device Model (CDM)	$V_{ESD}$	$\pm 500$	V
Machine Model (MM)	$V_{ESD}$	$\pm 200$	V
Storage Temperature Range	$T_{stg}$	-40°C to +125°C	°C

## PERFORMANCE CHARACTERISTICS

Parameter	Symbol	Min	Typ	MAX	UNITS
Supply Voltage Standard Operating Voltage, 3.3 V Standard Operating Voltage, 5V	$V_{CC}$ $V_{CC}$	$V_L$ +3.15 +4.75	+3.3 +5.0	$V_H$ +3.45 +5.25	V V
Operating Temperature Range	$T_A$	$T_L$ -40	-	$T_H$ +125	°C
Supply Current Standard Operating Voltage, 5.0 V (Digital with Analog Enabled)	$I_{dd}$	-	-	+9.5	mAmp
Programming Voltage Applied to $V_{PP}/TEST$	$V_{PP}$	+7.5	+8.0	+8.5	V
Programming Current Applied to $V_{PP}/TEST$	$I_{PP}$	-	-	160	mAmp
Test Mode Activation Voltage Applied to $V_{PP}/TEST$	$V_{TEST}$	+6.5	+7.2	+7.5	V
Measurement Range, XY axis	g	-3.5	-	+3.5	g
Digital Sensitivity ( $D_{OUT}$ )	SENS		3.43		mg/digit
Analog Sensitivity ( $X_{OUT}$ , $Y_{OUT}$ ) Ratiometric to $V_{CC}$	SENS		115		mV/V/g
Sensitivity Error ( $D_{OUT}$ ) $T_A = +25^\circ\text{C}$ $-40^\circ\text{C} \leq T_A \leq +105^\circ\text{C}$ $+105^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	SENS SENS SENS	-3.0 -4.0 -6.0	- - -	+3.0 +4.0 +6.0	% % %
Offset at 0g, SPI, 11-Bit unsigned data Analog Output	$D_{OUT}$ $A_{OUT}$	- -	1024 0.5 $V_{CC}$	-	Digit V
Offset Error at 0g, SPI, 11-Bit Unsigned Data $T_A = +25^\circ\text{C}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	$D_{OUT}$ $D_{OUT}$	-15 -22	- -	+15 +22	Digit Digit
Offset Error at 0g, analog output $T_A = +25^\circ\text{C}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	$A_{OUT}$ $A_{OUT}$	-3 -5	- -	+3 +5	Digit Digit
DSP Low-Pass Filter (2 <sup>nd</sup> or 4 <sup>th</sup> Order Selectable) Filter Option \$00, \$13 Filter Option \$01, \$14 Filter Option \$03, \$16 Filter Option \$02, \$15 Filter Option \$04, \$17 Filter Option \$06, \$19 Filter Option \$05, \$18 Filter Option \$07 Filter Option \$1A	$f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$ $f_C(LPF)$	8.4 12.4 41.9 47.5 62.8 66.5 83.9 95 134	8.8 13.1 44.1 50.0 66.1 70.0 88.3 100 141	9.2 13.8 46.3 52.5 69.4 73.5 92.7 105 148	Hz Hz Hz Hz Hz Hz Hz Hz Hz
Cross- Axis Sensitivity		-4.0	-	+4.0	%
SPI Clock Rate	$t_{SCLK}$	8.33	-	-	MHz
Noise (1Hz – 1kHz)	$n_{SD}$	-	-	140	µg/Hz
Output Loading ( $D_{OUT}/STATUS$ ) Load Resistance Load Capacitance	$Z_{OUT}$ $C_{OUT}$	47 -	- -	- 35	k pF

## EXTERNAL COMPONENTS

The MMA6700EG requires minimum external components. Aside from a supply bypass capacitor, two 1  $\mu\text{F}$  capacitors provide filtering for the internal analog and digital power supply rails, while a third, 100 nF filter capacitor is required for the internal voltage reference. This circuit configuration is illustrated in Figure 2. Redundant pins are provided for the internal voltage reference and analog supply rails. In safety critical applications, these pins may be connected to separate external capacitors to guard against circuit malfunction in the event of a fault such as an open filter capacitor connection. An internal monitor detects an open digital supply rail filter capacitor condition, which puts the device into reset should this fault occur.

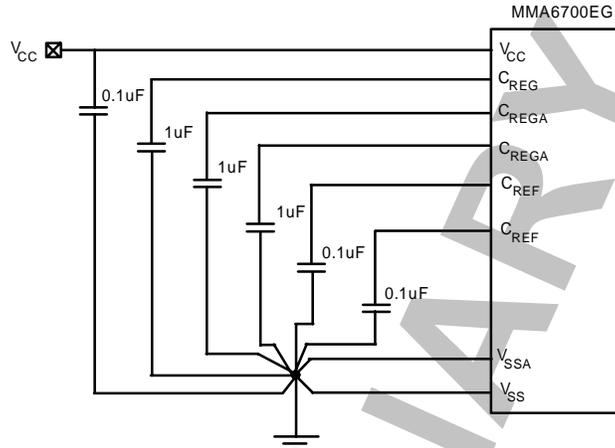
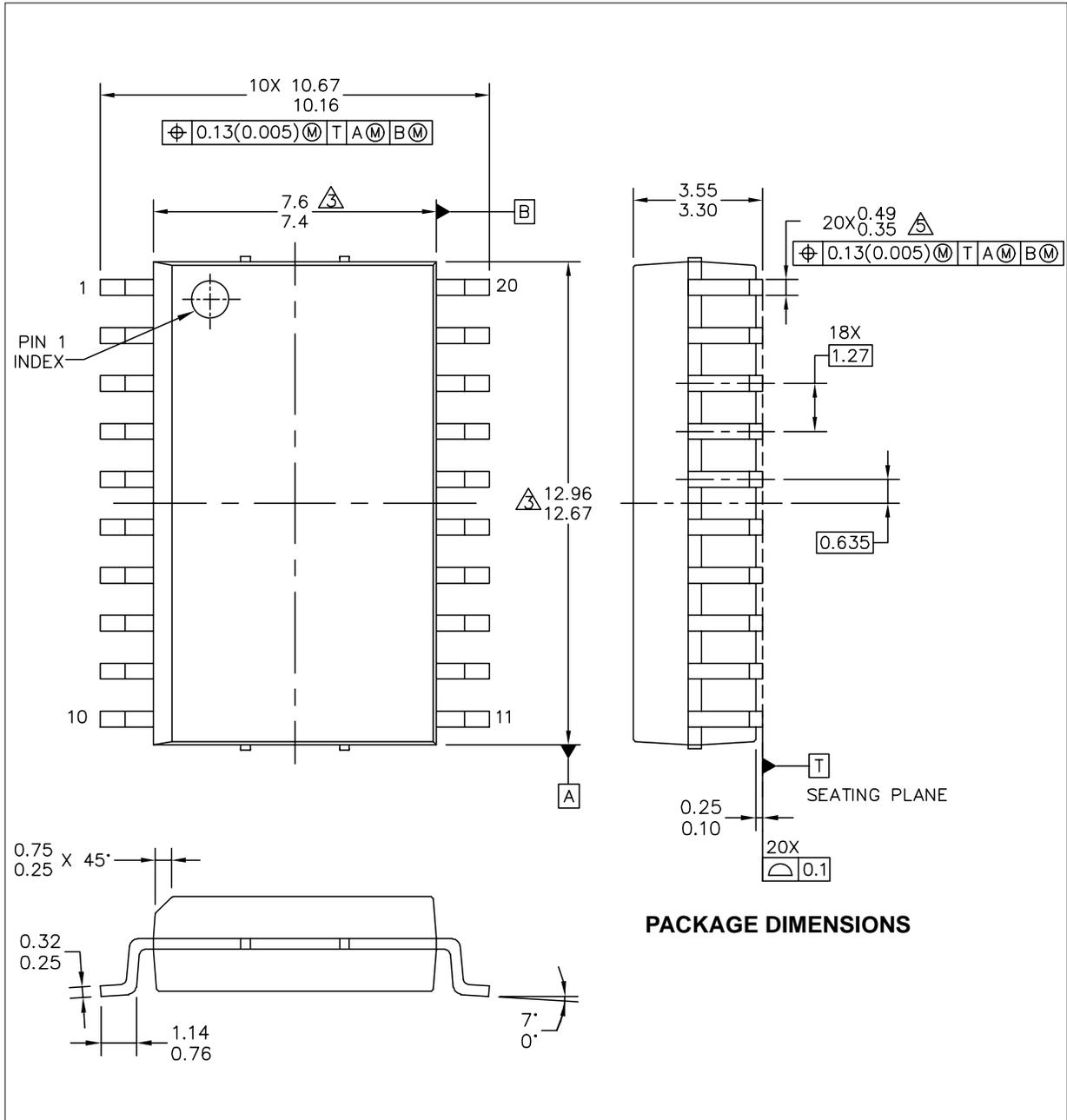


Figure 2. Recommended External Component Configuration

# PACKAGE DIMENSIONS



**PACKAGE DIMENSIONS**

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TITLE: 20LD SOIC W/B, 1.27 PITCH 7.5 X 12.8, ACCELEROMETER CASE-OUTLINE	DOCUMENT NO: 98ASB17933C	REV: C	
	CASE NUMBER: 475A-02	06 JUL 2006	
	STANDARD: NON-JEDEC		

## PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
2. DIMENSIONS ARE IN MILLIMETERS.

△3. THIS DIMENSION DO NOT INCLUDE MOLD PROTRUSION.

4. MAXIMUM MOLD PROTRUSION 0.15(0.006) PER SIDE.

△5. THIS DIMENSION DOES NOT INCLUDE DAM BAR PROTRUSION ALLOWABLE DAM BAR PROTRUSION SHALL BE 0.13(0.005) TOTAL IN EXCESS OF THIS DIMENSION AT MAXIMUM MATERIAL CONDITION.

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