

## SGM7222

# High Speed USB 2.0 (480Mbps) DPDT Analog Switch

### GENERAL DESCRIPTION

The SGM7222 is a high-speed, low-power double-pole/double-throw (DPDT) analog switch that operates from a single +3.0V to +3.6V power supply.

SGM7222 is designed for the switching of high-speed USB 2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os.

The SGM7222 has low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480 Mbps). Each switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. Its bandwidth is wide enough to pass high-speed USB 2.0 differential signals (480 Mb/s) with good signal integrity.

The SGM7222 contains special circuitry on the D+/D- pins which allows the device to withstand a  $V_{BUS}$  short to D+ or D- when the USB devices is either powered off or powered on.

SGM7222 is available in Pb-free WQFN-10 and MSOP-10 packages. It operates over an ambient temperature range of -40 to +85 °C.

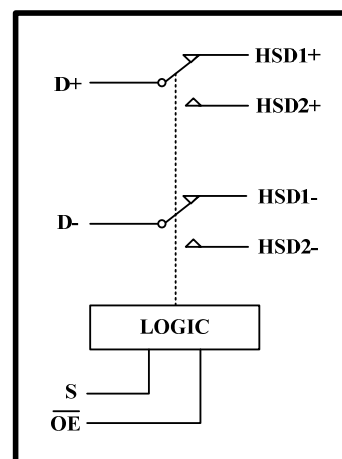
### APPLICATIONS

Route Signals for USB 2.0  
MP3 and Other Personal Media Players  
Digital Cameras and Camcorders  
Portable Instrumentation  
Set-Top Box  
PDAs

### FEATURES

- $R_{ON}$  is Typically  $4.5\Omega$  at +3.0V
- Low Bit-to-Bit Skew: 50ps (TYP)
- Voltage Operation : +3.0V to +3.6V
- Fast Switching Time:
  - $t_{ON}$  10ns
  - $t_{OFF}$  22ns
- Low Crosstalk: -41dB at 250MHz
- High Off-Isolation: -35dB at 250MHz
- Rail-to-Rail Input and Output Operation
- Break-Before-Make Switching
- Extended Industrial Temperature Range:
  - 40 to +85
- Lead (Pb) Free WQFN-10 and MSOP-10 Packages

### BLOCK DIAGRAM



ORDERING INFORMATION

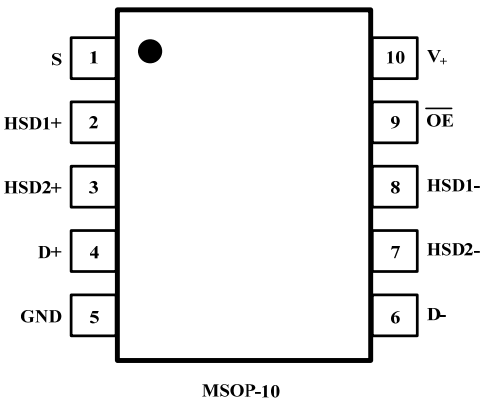
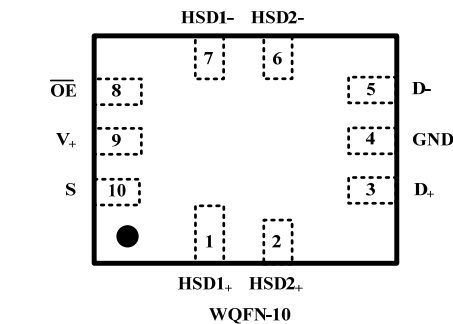
MODEL	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM7222	MSOP-10	-40 to +85	SGM7222YMS10/TR	SGM7222YMS10	Tape and Reel, 3000
	WQFN-10	-40 to +85	SGM7222YWQ10/TR	7222	Tape and Reel, 3000

ABSOLUTE MAXIMUM RATINGS

V+, IN to GND.....	0V to +4.6V	Storage Temperature.....	-65 to +150
Analog, Digital voltage range .....	-0.3V to (V+ +0.3V)	Lead Temperature (soldering, 10s).....	+260
Continuous Current NO, NC, or COM.....	±100mA	ESD Susceptibility	
Peak Current NO, NC, or COM.....	±150mA	HBM.....	4000V
Operating Temperature Range.....	-40 to +85	MM.....	400V
Junction Temperature.....	+150		

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PIN CONFIGURATIONS (TOP VIEW)



PIN DESCRIPTION

PIN		NAME	FUNCTION
WQFN-10	MSOP-10		
9	10	V+	Power Supply
4	5	GND	Ground
10	1	S	Select Input
8	9	OE	Output Enable
1,2, 7,6, 3,5	2,3, 8,7, 4,6	HSD1+, HSD2+, HSD1-, HSD2-, D+, D-	Data Ports

FUNCTION TABLE

OE	S	HSD1+ HSD1-	HSD2+ HSD2-
0	0	ON	OFF
0	1	OFF	ON
1	×	OFF	OFF

Switches Shown For Logic “0” Input

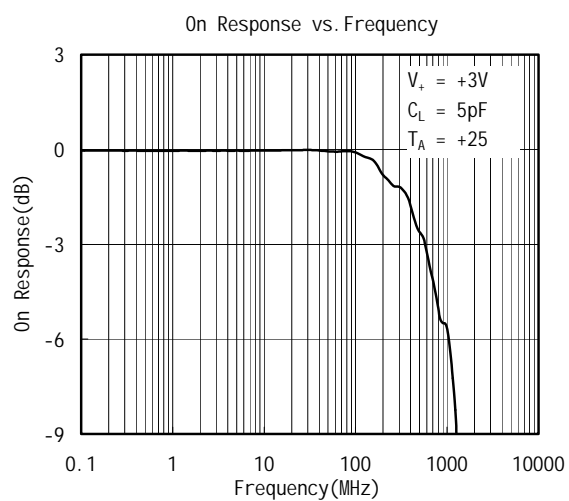
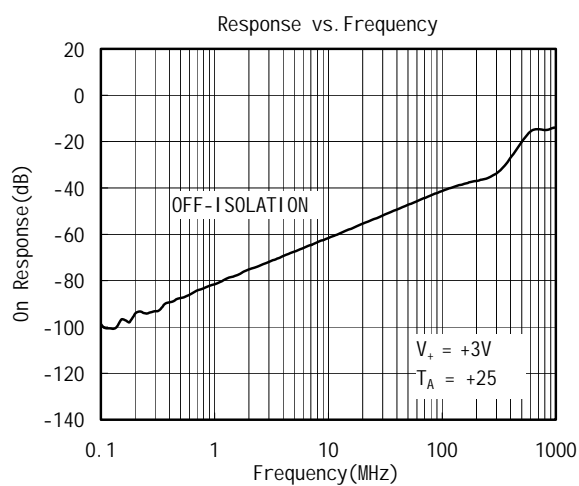
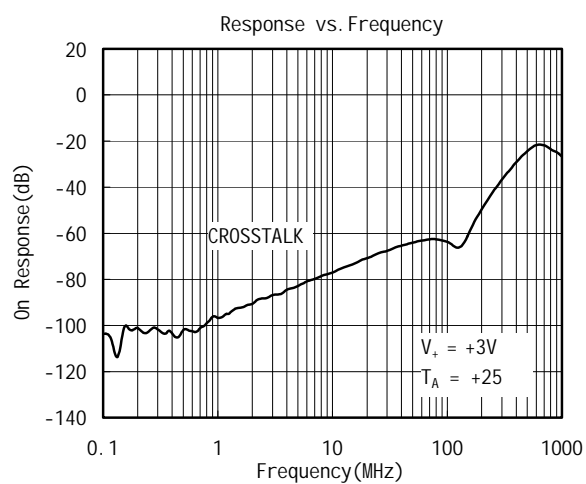
# ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = +3.0V to +3.6V, GND = 0V, V<sub>IH</sub> = +1.6V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = -40 to +85 . Typical values are at V<sub>+</sub> = +3.3V, T<sub>A</sub> = +25 , unless otherwise noted.)

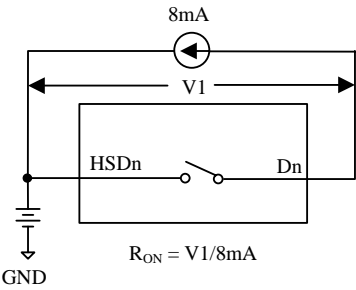
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TPY	MAX	UNITS
<b>ANALOG SWITCH</b>							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V <sub>IS</sub>		-40 to +85	0		V <sub>+</sub>	V
On-Resistance	R <sub>ON</sub>	V <sub>+</sub> = 3.0V, V <sub>IS</sub> = 0V to 0.4V, I <sub>D</sub> = 8mA, Test Circuit 1	+25		4.5		Ω
			-40 to +85				
On-Resistance Match Between Channels	ΔR <sub>ON</sub>	V <sub>+</sub> = 3.0V, V <sub>IS</sub> = 0V to 0.4V, I <sub>D</sub> = 8mA, Test Circuit 1	+25		0.15		Ω
			-40 to +85				
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	V <sub>+</sub> = 3.0V, V <sub>IS</sub> = 0V to 1.0V, I <sub>D</sub> = 8mA, Test Circuit 1	+25		1.5		Ω
			-40 to +85				
Power Off Leakage Current (D <sub>+</sub> , D <sub>-</sub> )	I <sub>OFF</sub>	V <sub>+</sub> = 0V, V <sub>D</sub> = 0V to 3.6 V, V <sub>S</sub> , V <sub>OE</sub> = 0V or 3.6 V	-40 to +85			1	μA
Increase in I <sub>+</sub> per Control Voltage	I <sub>CCT</sub>	V <sub>+</sub> = 3.6V, V <sub>S</sub> or V <sub>OE</sub> = 2.6 V	-40 to +85			5	μA
Source Off Leakage Current	I <sub>HSD2(OFF)</sub> , I <sub>HSD1(OFF)</sub>	V <sub>+</sub> = 3.6V, V <sub>IS</sub> = 3.3V/ 0.3V, V <sub>D</sub> = 0.3V/ 3.3V	-40 to +85			1	μA
Channel On Leakage Current	I <sub>HSD2(ON)</sub> , I <sub>HSD1(ON)</sub>	V <sub>+</sub> = 3.6V, V <sub>IS</sub> = 3.3V/ 0.3V, V <sub>D</sub> = 3.3V/ 0.3V or floating	-40 to +85			1	μA
<b>DIGITAL INPUTS</b>							
Input High Voltage	V <sub>IH</sub>		-40 to +85	1.6			V
Input Low Voltage	V <sub>IL</sub>		-40 to +85			0.5	V
Input Leakage Current	I <sub>IN</sub>	V <sub>+</sub> = 3.0V, V <sub>S</sub> , V <sub>OE</sub> = 0V or V <sub>+</sub>	-40 to +85			1	μA
<b>DYNAMIC CHARACTERISTICS</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>IS</sub> = 0.8V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF, Test Circuit 2	+25		10		ns
Turn-Off Time	t <sub>OFF</sub>		+25		22		ns
Break-Before-Make Time Delay	t <sub>D</sub>	V <sub>IS</sub> = 0.8V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF, Test Circuit 3	+25		4		ns
Propagation Delay	t <sub>PD</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF	+25		0.3		ns
Off Isolation	O <sub>ISO</sub>	Signal = 0dBm, R <sub>L</sub> = 50Ω, f = 250MHz, Test Circuit 4	+25		-35		dB
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	Signal = 0dBm, R <sub>L</sub> = 50Ω, f = 250MHz, Test Circuit 5	+25		-41		dB
-3dB Bandwidth	BW	Signal = 0dBm, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF Test Circuit 6	+25		550		MHz
Channel-to-Channel Skew	t <sub>SKEW</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF	+25		0.05		ns
Charge Injection Select Input to Common I/O	Q	V <sub>G</sub> = GND, C <sub>L</sub> = 1.0nF, R <sub>G</sub> = 0Ω, Q = C <sub>L</sub> × V <sub>OUT</sub> , Test Circuit 7	+25		11		pC
HSD <sub>+</sub> , HSD <sub>-</sub> , D <sub>+</sub> , D <sub>-</sub> ON Capacitance	C <sub>ON</sub>		+25		6.5		pF
<b>POWER REQUIREMENTS</b>							
Power Supply Range	V <sub>+</sub>		-40 to +85	3.0		3.6	V
Power Supply Current	I <sub>+</sub>	V <sub>+</sub> = 3.0V, V <sub>S</sub> , V <sub>OE</sub> = 0V or V <sub>+</sub>	-40 to +85			1	μA

Specifications subject to changes without notice.

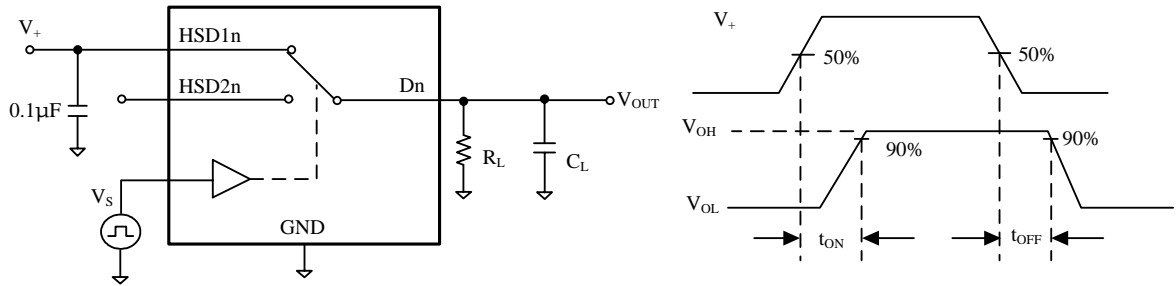
# TYPICAL PERFORMANCE CHARACTERISTICS



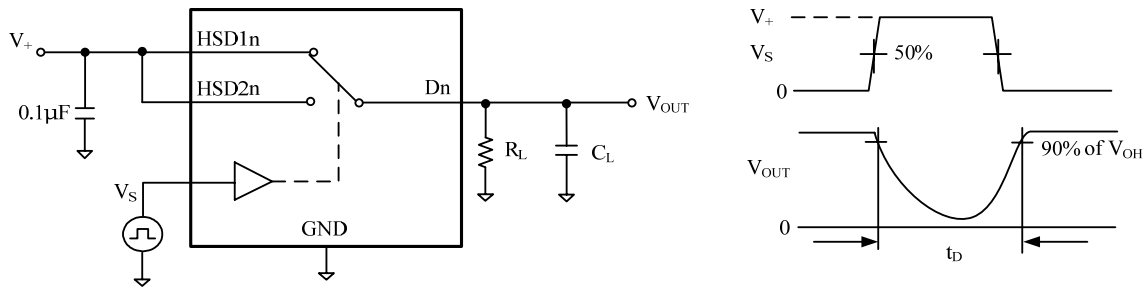
# TEST CIRCUITS



Test Circuit 1. On Resistance

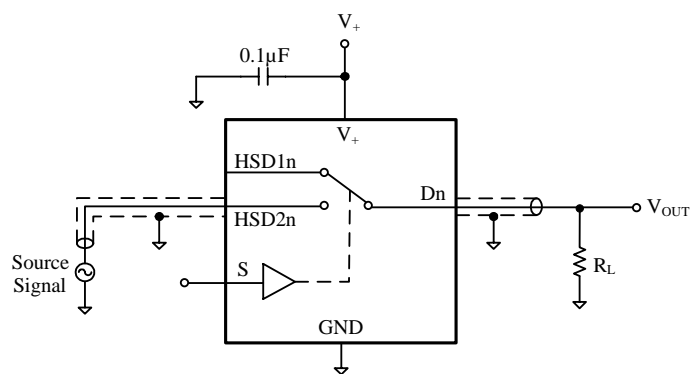


Test Circuit 2. Switching Times (t<sub>ON</sub>, t<sub>OFF</sub>)

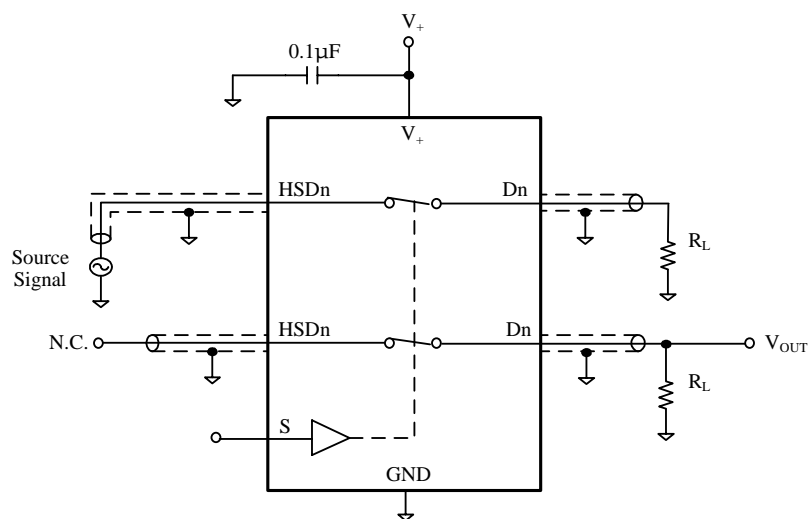


Test Circuit 3. Break-Before-Make Time (t<sub>D</sub>)

# TEST CIRCUITS (Cont.)



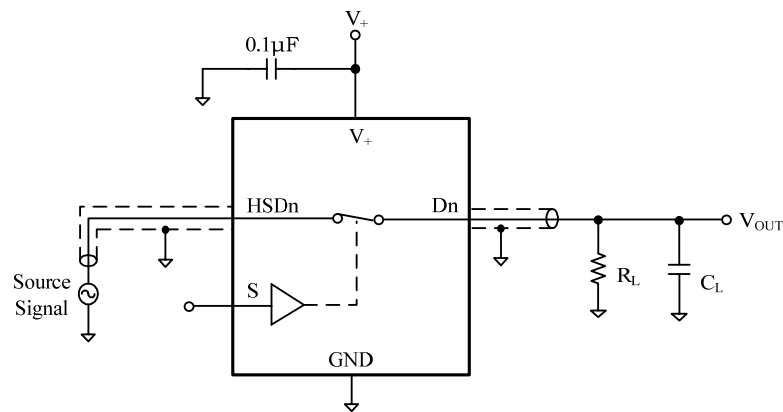
Test Circuit 4. Off Isolation



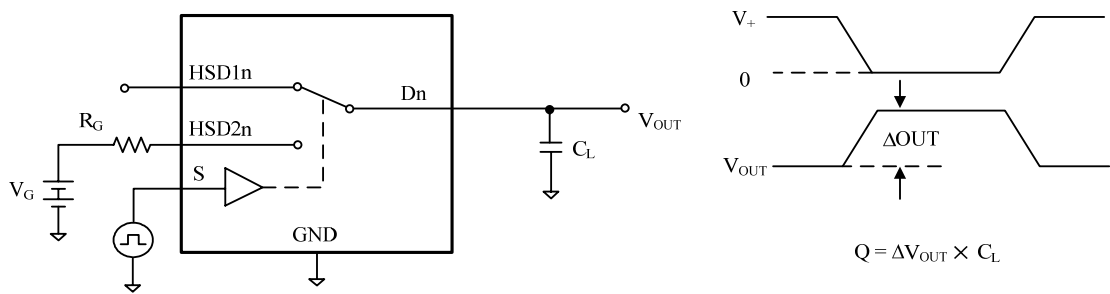
$$\text{Channel To Channel Crosstalk} = -20 \times \log \frac{V_{\text{HSDn}}}{V_{\text{OUT}}}$$

Test Circuit 5. Channel-to-Channel Crosstalk

# TEST CIRCUITS (Cont.)



Test Circuit 6. -3dB Bandwidth



Test Circuit 7. Charge Injection (Q)

# APPLICATION NOTES

## Power-Off Protection

For a  $V_{BUS}$  short circuit, the switch is expected to withstand such a condition for at least 24 hours. The SGM7222 has specially designed circuitry which prevents unintended signal bleed through as well as guaranteed system reliability during a power-down, over-voltage condition. The protection has been added to the common pins (D+, D-).

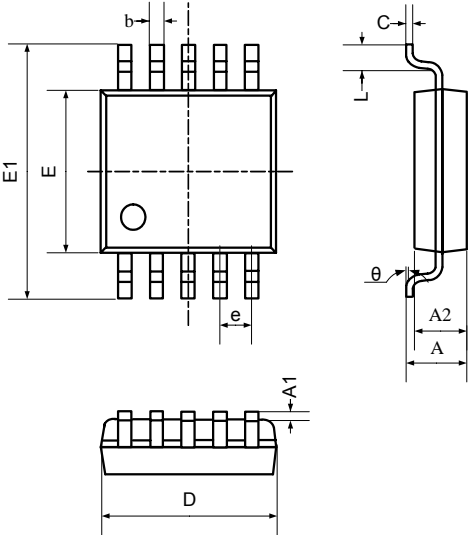
## Power-On Protection

The USB 2.0 specification also notes that the USB device should be capable of withstanding a  $V_{BUS}$  short during transmission of data. This modification works by limiting current flow back into the V+ rail during the over-voltage event so current remains within the safe operating range. In this application, the switch passes the full 5.25V input signal through to the selected output, while maintaining specified off isolation on the un-selected pins.



# PACKAGE OUTLINE DIMENSIONS

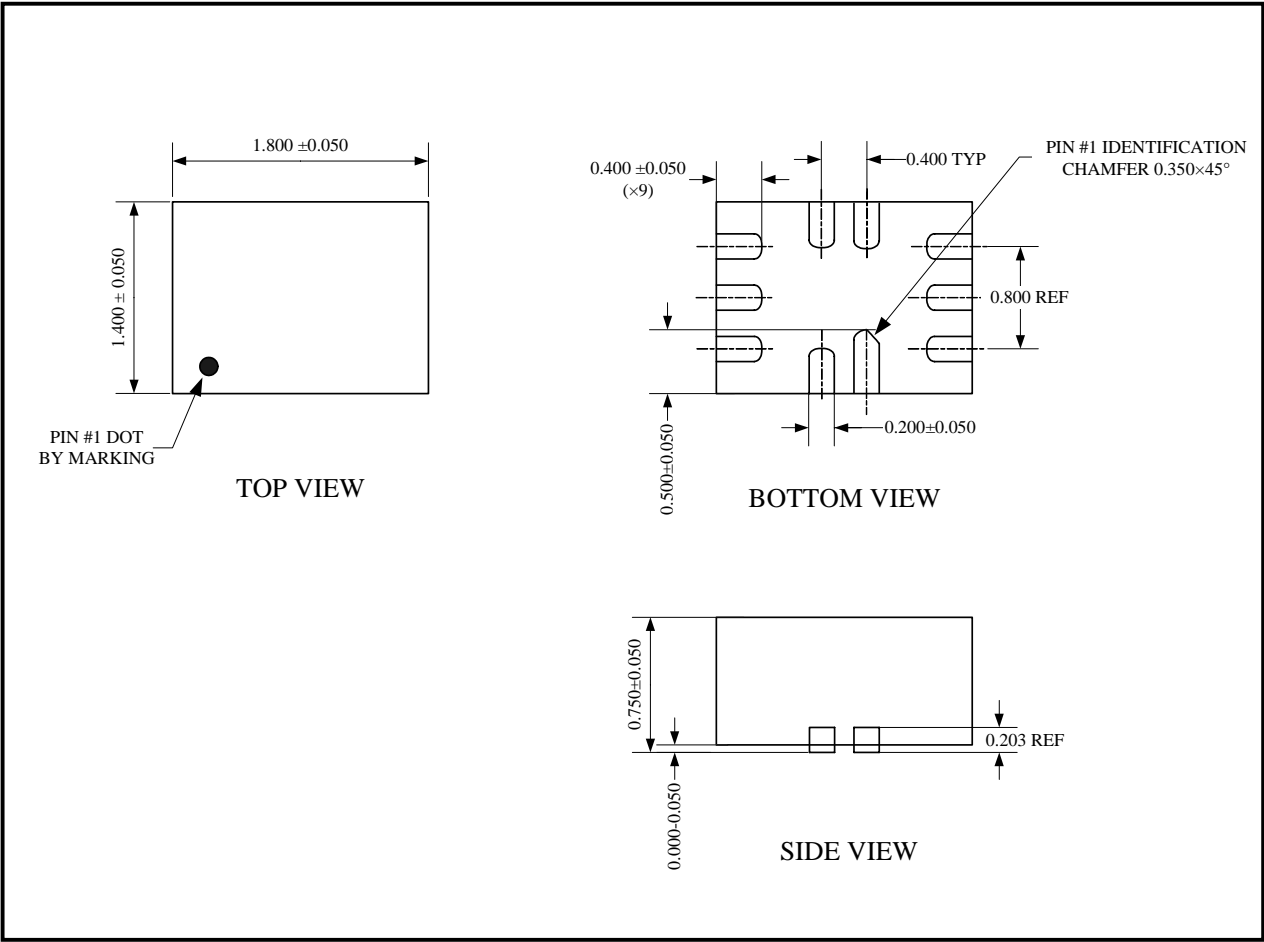
## MSOP-10



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.200	0.031	0.047
A1	0.000	0.200	0.000	0.008
A2	0.760	0.970	0.030	0.038
b	0.30 TYP		0.012 TYP	
c	0.152 TYP		0.006 TYP	
D	2.900	3.100	0.114	0.122
e	0.50 TYP		0.020 TYP	
E	2.900	3.100	0.114	0.122
E1	4.700	5.100	0.185	0.201
L	0.410	0.650	0.016	0.026
$\theta$	0°	6°	0°	6°

# PACKAGE OUTLINE DIMENSIONS

## WQFN-10



Note: All linear dimensions are in millimeters.

# REVISION HISTORY

Location

Page

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03/2008—Preliminary Datasheet

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