SGM7227
High Speed USB 2.0 (480Mbps) DPDT Analog Switch

GENERAL DESCRIPTION

The SGM7227 is a high-speed, low-power double-pole/ double-throw (DPDT) analog switch that operates from a single 1.8V to 4.3V power supply.

SGM7227 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 SGM7227 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 (480Mbps). 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 (480Mbps) with good signal integrity.

The SGM7227 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 are either powered off or powered on.

The SGM7227 is available in Green MSOP-10 and UTQFN-1.8×1.4-10L packages. It operates over an ambient temperature range of -40℃ to +85℃.

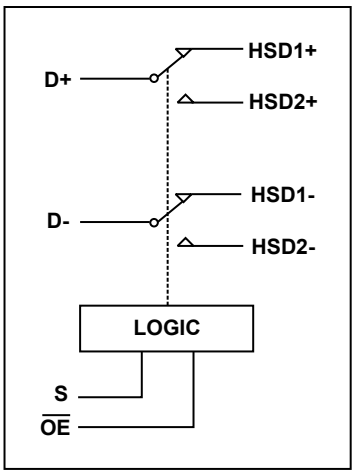
FEATURES

- **R_{ON} is Typically 5Ω at 3.0V**
- **Voltage Operation: 1.8V to 4.3V**
- **Fast Switching Times:**
  - **t_{ON} 15ns**
  - **t_{OFF} 20ns**
- **Crosstalk: -30dB at 250MHz**
- **Off-Isolation: -35dB at 250MHz**
- **Rail-to-Rail Input and Output Operation**
- **Break-Before-Make Switching**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green UTQFN-1.8×1.4-10L and MSOP-10 Packages**

APPLICATIONS

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

BLOCK DIAGRAM



PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM7227	MSOP-10	-40℃ to +85℃	SGM7227YMS10G/TR	SGM7227 YMS10 XXXXX	Tape and Reel, 3000
	UTQFN-1.8×1.4-10L	-40℃ to +85℃	SGM7227YUWQ10G/TR	7227	Tape and Reel, 3000

NOTE: XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND ..... 0V to 4.6V
Analog, Digital Voltage Range ..... -0.3V to (V_{CC}) + 0.3V
Continuous Current HSDn or Dn ..... ±50mA
Peak Current HSDn or Dn ..... ±100mA
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
MM 400V

RECOMMENDED OPERATING CONDITIONS

Operating Temperature Range ..... -40℃ to +85℃

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

ESD SENSITIVITY CAUTION

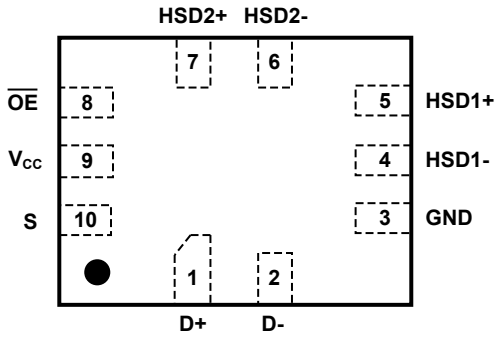
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

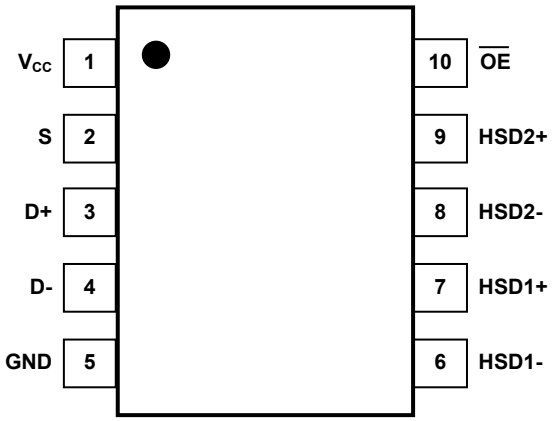
PIN CONFIGURATIONS

(TOP VIEW)



UTQFN-1.8×1.4-10L

(TOP VIEW)



MSOP-10

PIN DESCRIPTION

PIN		NAME	FUNCTION
UTQFN-1.8×1.4-10L	MSOP-10		
9	1	V_{CC}	Power Supply.
3	5	GND	Ground.
10	2	S	Select Input.
8	10	$\overline{OE}$	Output Enable.
5	7	HSD1+	Multiplexed Source Inputs.
4	6	HSD1-	Multiplexed Source Inputs.
7	9	HSD2+	Multiplexed Source Inputs.
6	8	HSD2-	Multiplexed Source Inputs.
1	3	D+	USB Data Bus.
2	4	D-	USB Data Bus.

FUNCTION TABLE

$\overline{OE}$	S	HSD1+, HSD1-	HSD2+, HSD2-
0	0	ON	OFF
0	1	OFF	ON
1	×	OFF	OFF

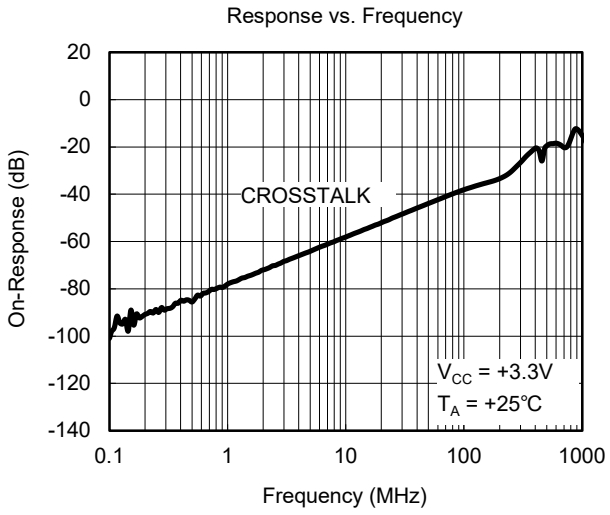
NOTE: Switches Shown for Logic “0” Input.

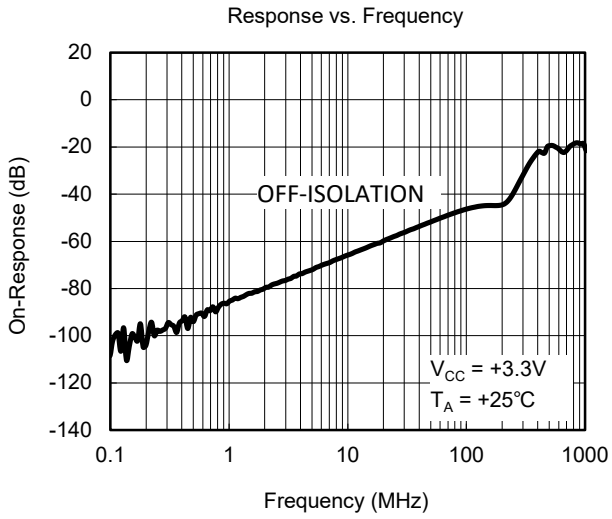
ELECTRICAL CHARACTERISTICS

(At T_A = +25℃, V_{CC} = 3.3V, unless otherwise noted.)

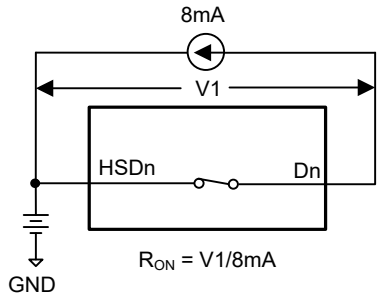
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ANALOG SWITCH						
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V_{IS}		0		V_{CC}	V
On-Resistance	R_{ON}	V_{CC} = 3.0V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1		5	9	Ω
On-Resistance Match between Channels	ΔR_{ON}	V_{CC} = 3.0V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1		0.3	0.8	Ω
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{CC} = 3.0V, V_{IS} = 0V to 1.0V, I_D = 8mA, Test Circuit 1		1	2	Ω
Power Off Leakage Current (D+, D-)	I_{OFF}	V_{CC} = 0V, V_D = 0V to 3.6V, V_S, $V_{\overline{OE}}$ = 0V or 3.6V			1	μA
Increase in I_{CC} per Control Voltage	I_{CCT}	V_{CC} = 3.6V, V_S or $V_{\overline{OE}}$ = 2.6V			5	μA
Source Off Leakage Current	$I_{HSD2(OFF)}$, $I_{HSD1(OFF)}$	V_{CC} = 3.6V, V_{IS} = 3.3V/ 0.3V, V_D = 0.3V/ 3.3V			1	μA
Channel On Leakage Current	$I_{HSD2(ON)}$, $I_{HSD1(ON)}$	V_{CC} = 3.6V, V_{IS} = 3.3V/0.3V, V_D = 3.3V/0.3V or floating			1	μA
DIGITAL INPUTS						
Input High Voltage	V_{IH}		1.6			V
Input Low Voltage	V_{IL}				0.5	V
Input Leakage Current	I_{IN}	V_{CC} = 3.0V, V_S, $V_{\overline{OE}}$ = 0V or V_{CC}			1	μA
DYNAMIC CHARACTERISTICS						
Turn-On Time	t_{ON}	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 2		15		ns
Turn-Off Time	t_{OFF}			20		ns
Break-Before-Make Time Delay	t_D	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 3		3.5		ns
Propagation Delay	t_{PD}	R_L = 50Ω, C_L = 10pF		0.5		ns
Off Isolation	O_{ISO}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 4		-35		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 5		-30		dB
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF, Test Circuit 6		550		MHz
Channel-to-Channel Skew	t_{SKEW}	R_L = 50Ω, C_L = 10pF		130		ps
Charge Injection Select Input to Common I/O	Q	V_G = GND, C_L = 1.0nF, R_G = 0Ω, Q = C_L × V_{OUT}, Test Circuit 7		10		pC
HSD+, HSD-, D+, D- On Capacitance	C_{ON}	f = 1MHz		6.5		pF
		f = 250MHz		7		
POWER REQUIREMENTS						
Power Supply Range	V_{CC}		1.8		4.3	V
Power Supply Current	I_{CC}	V_{CC} = 3.0V, V_S, $V_{\overline{OE}}$ = 0V or V_{CC}			1	μA

TYPICAL PERFORMANCE CHARACTERISTICS

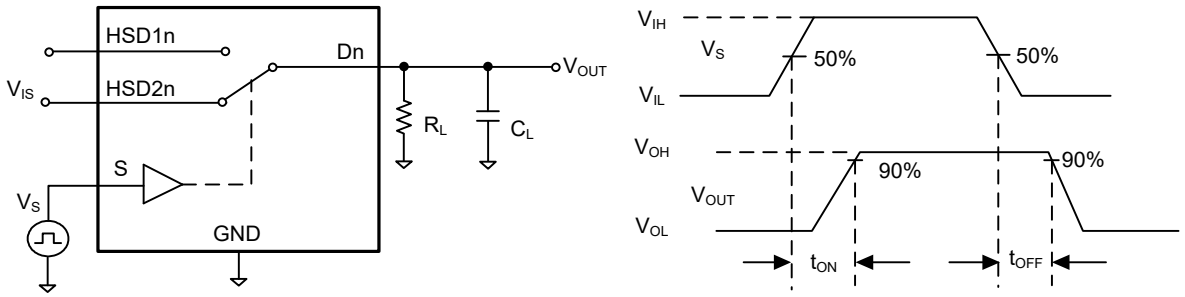




TEST CIRCUITS

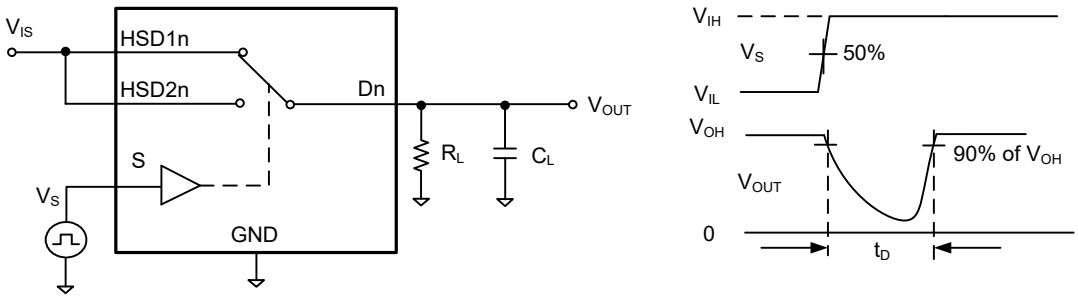


Test Circuit 1. On-Resistance

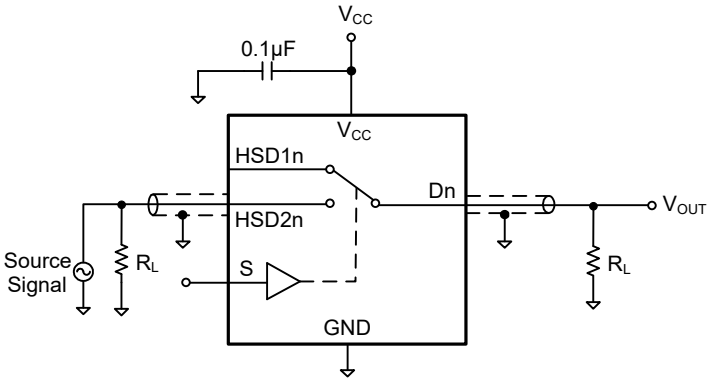


Test Circuit 2. Switching Times (t_{ON}, t_{OFF})

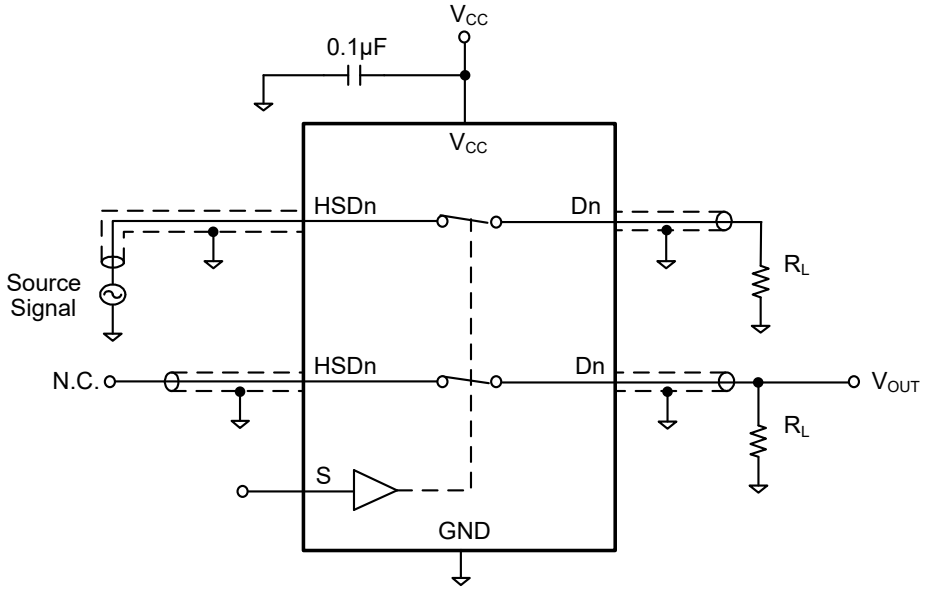
TEST CIRCUITS (Cont.)



Test Circuit 3. Break-Before-Make Time (t_D)



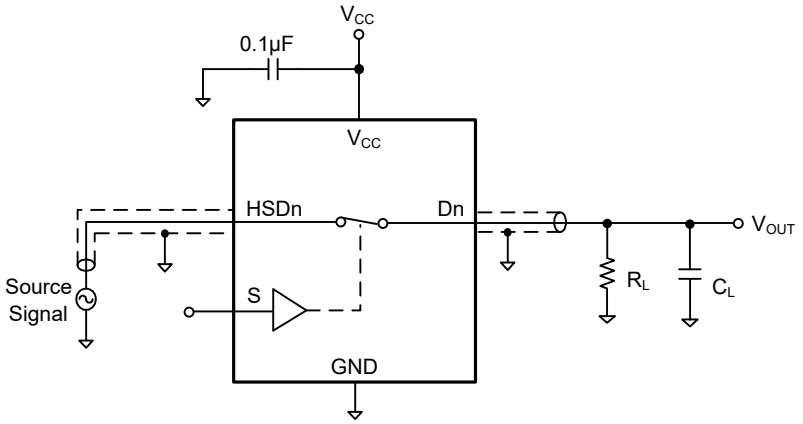
Test Circuit 4. Off Isolation



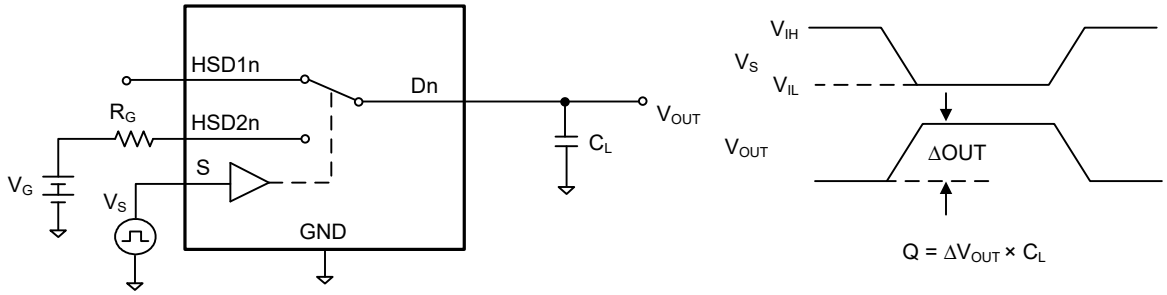
$$\text{Channel To Channel Crosstalk} = -20 \times \log \frac{V_{HSDn}}{V_{OUT}}$$

Test Circuit 5. Channel-to-Channel Crosstalk

TEST CIRCUITS (Cont.)



Test Circuit 6. -3dB Bandwidth



Test Circuit 7. Charge Injection (Q)

APPLICATION NOTES

Meeting USB 2.0 V_{BUS} Short Requirements

Power-Off Protection

For a V_{BUS} short circuit the switch is expected to withstand such a condition for at least 24 hours. The SGM7227 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_{CC} rail during the over-voltage event so current remains within the safe operating range.

APPLICATION NOTES (Cont.)

SGM7227 USB2.0 Signal Quality Compliance Test Results

Figures 1 and 2 show the test results for USB eye diagram tests.

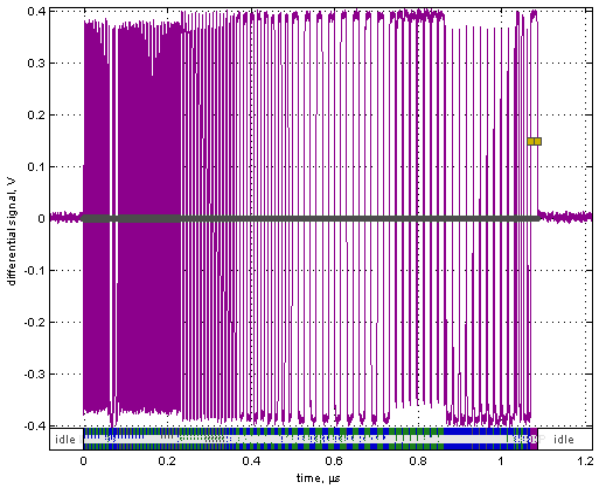


Figure 1. Waveform Plot

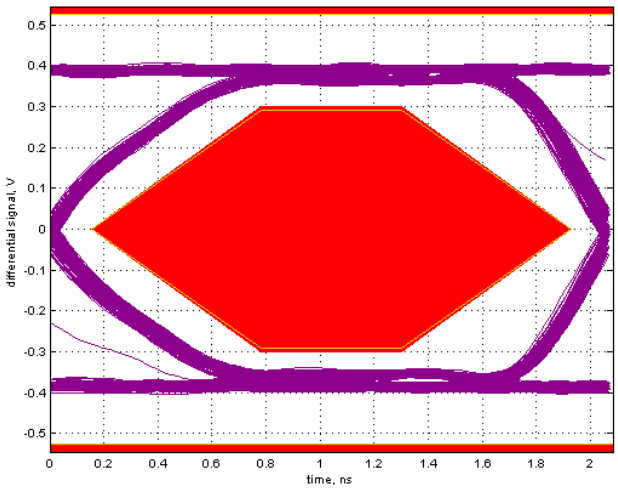


Figure 2. High Speed Signal Quality Eye Diagram Test (V_{CC} = 3.3V)

The following is a summary of the USB test Results. The SGM7227 passes the high speed signal quality, eye diagram and jitter tests.

Required Tests

- Overall result:

Pass!

- Signal eye:

Eye passes

- EOP width: 7.91 bits
  EOP width passes
- Measured signaling rate: 480.0551MHz
  Signal rate passes
- Rising Edge Rate: 901.28V/µs (710.10ps equivalent rise-time)
  Passes
- Falling Edge Rate: 889.18V/µs (719.77ps equivalent rise-time)
  Passes

Additional Information

Consecutive jitter range: -61.770ps to 39.668ps, RMS jitter 21.900ps
Paired JK jitter range: -47.800ps to 42.890ps, RMS jitter 21.591ps
Paired KJ jitter range: -50.590ps to 49.704ps, RMS jitter 23.281ps

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

MAY 2014 – REV.A.3 to REV.A.4

Updated ESD HBM value 2

DECEMBER 2012 – REV.A.2 to REV.A.3

Added ESD value of MSOP-10 package 2

MAY 2011 – REV.A.1 to REV.A.2

Updated package name..... All

MARCH 2011 – REV.A to REV.A.1

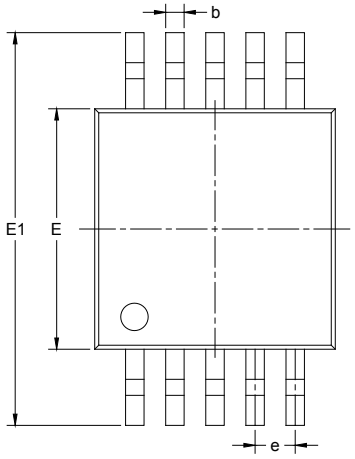
Updated PACKAGE OUTLINE DIMENSIONS section 12, 13

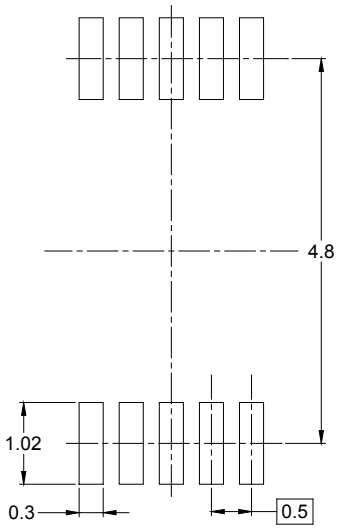
Changes from Original (MARCH 2010) to REV.A

Changed from product preview to production data..... All

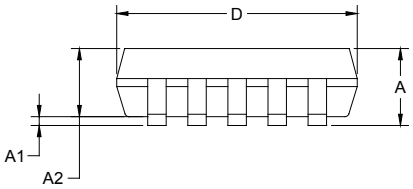
PACKAGE OUTLINE DIMENSIONS

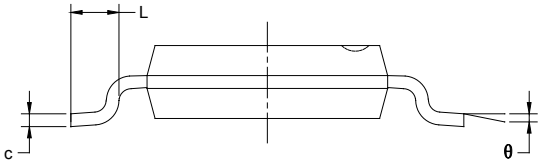
MSOP-10





RECOMMENDED LAND PATTERN (Unit: mm)

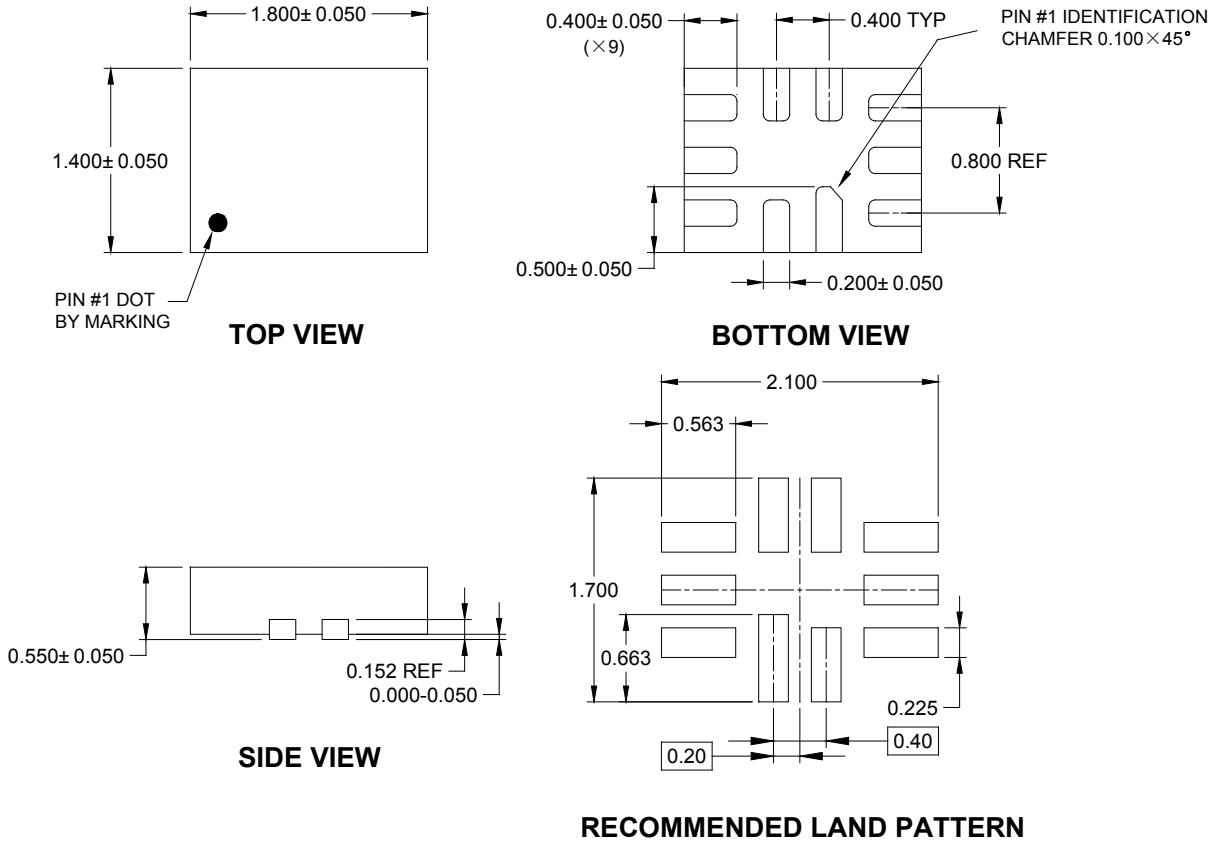




Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020 BSC	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

PACKAGE OUTLINE DIMENSIONS

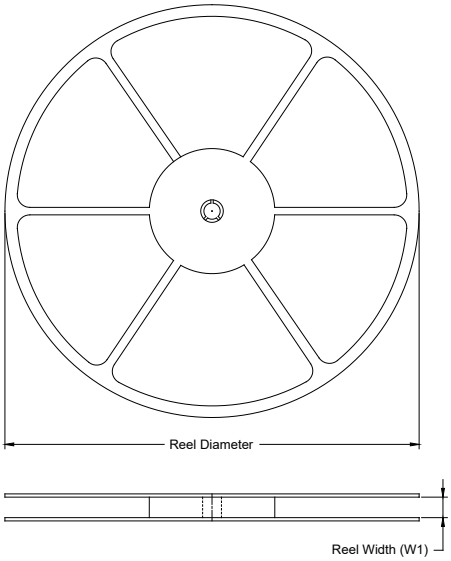
UTQFN-1.8×1.4-10L



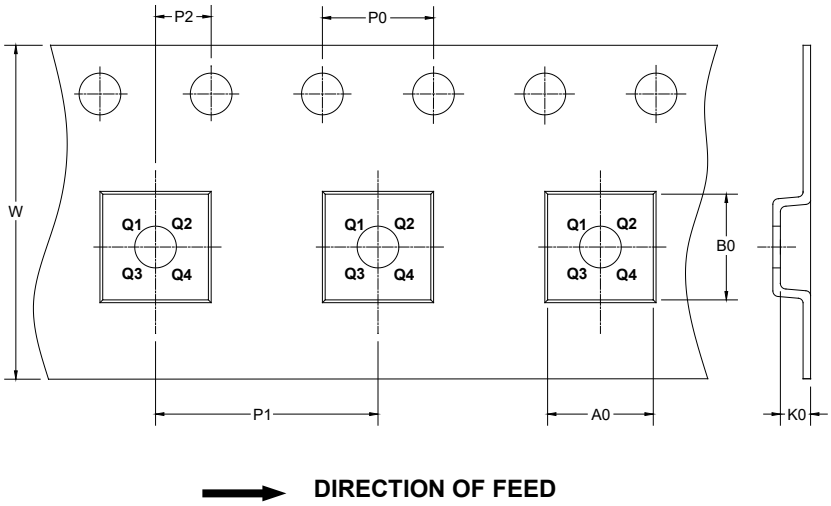
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



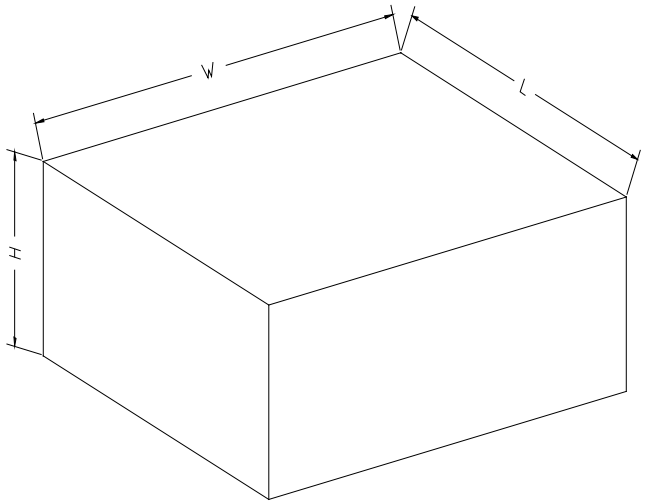
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP-10	13″	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1
UTQFN-1.8×1.4-10L	7″	9.0	1.75	2.10	0.70	4.0	4.0	2.0	8.0	Q1

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18
13″	386	280	370	5

DD0002