SGM7229
High-Speed USB 2.0 (480Mbps) DPDT Analog Switch

GENERAL DESCRIPTION

The SGM7229 is a high-speed, low-power double-pole/ double-throw (DPDT) analog switch that operates from a single 1.8V to 5.5V power supply.

The SGM7229 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 SGM7229 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 SGM7229 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 SGM7229 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

- **Supply Voltage Range: 1.8V to 5.5V**
- **On-Resistance: 6Ω (TYP) at 3V**
- **Fast Switching Times at 3.3V:**
  - **t_{ON} = 30ns**
  - **t_{OFF} = 18ns**
- **Crosstalk: -20dB at 250MHz**
- **Off-Isolation: -26dB 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

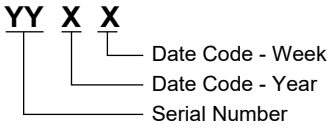
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM7229	UTQFN-1.8×1.4-10L	-40℃ to +85℃	SGM7229YUWQ10G/TR	NDXX	Tape and Reel, 3000
	MSOP-10	-40℃ to +85℃	SGM7229YMS10G/TR	SGM7229 YMS10 XXXXX	Tape and Reel, 4000

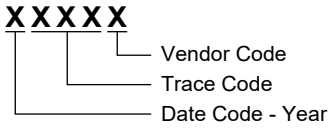
MARKING INFORMATION

NOTE: XX = Date Code. XXXXX = Date Code, Trace Code and Vendor Code.

UTQFN-1.8×1.4-10L



MSOP-10



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 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 2500V
MM 400V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

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

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

ESD SENSITIVITY CAUTION

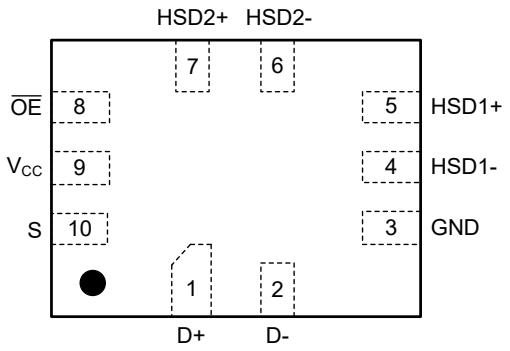
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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, or specifications without prior notice.

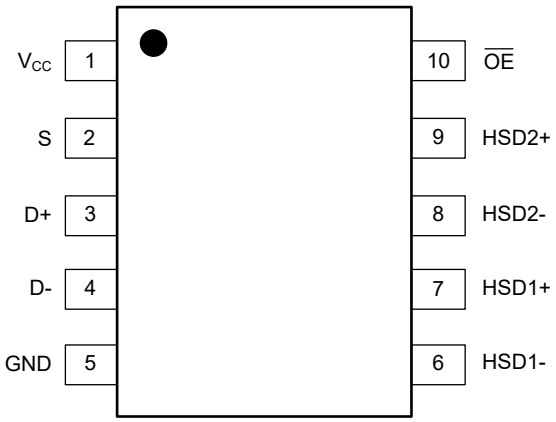
PIN CONFIGURATIONS

(TOP VIEW)



UTQFN-1.8×1.4-10L

(TOP VIEW)

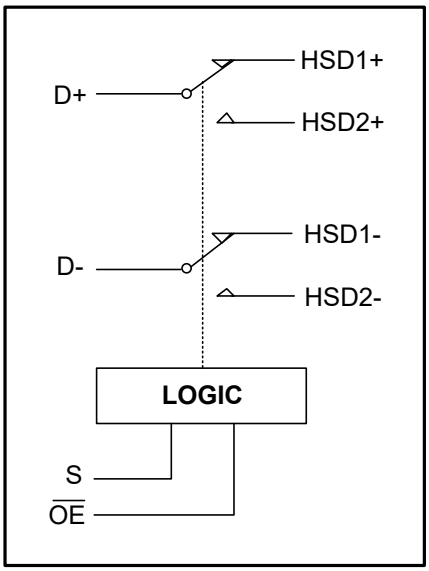


MSOP-10

PIN DESCRIPTION

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

BLOCK DIAGRAM



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

(V_{CC} = 3.3V, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V_{IS}		Full	0		V_{CC}	V
On-Resistance	R_{ON}	V_{CC} = 3V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25℃		6	7	Ω
			Full			8	
On-Resistance Match between Channels	ΔR_{ON}	V_{CC} = 3V, V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25℃		0.2	0.8	Ω
			Full			0.9	
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{CC} = 3V, V_{IS} = 0V to 1V, I_D = 8mA, Test Circuit 1	+25℃		2	3	Ω
			Full			3.5	
Increase in I_{CC} per Control Voltage	I_{CCT}	V_{CC} = 3.6V, V_S or $V_{\overline{OE}}$ = 1.8V	+25℃		2	3	μA
			Full			3.5	
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	Full			0.5	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	Full			0.5	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	Full			0.5	μA
DIGITAL INPUTS							
Input High Voltage	V_{IH}		Full	1.5			V
Input Low Voltage	V_{IL}		Full			0.4	V
Input Leakage Current	I_{IN}	V_S, $V_{\overline{OE}}$ = 0V or V_{CC}	Full			0.5	μA
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 2	+25℃		30		ns
Turn-Off Time	t_{OFF}		+25℃		18		ns
Break-Before-Make Time Delay	t_D	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 3	+25℃		14		ns
Propagation Delay	t_{PD}	R_L = 50Ω, C_L = 10pF	+25℃		0.5		ns
Off Isolation	O_{ISO}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 4	+25℃		-26		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 5	+25℃		-20		dB
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF, Test Circuit 6	+25℃		850		MHz
Channel-to-Channel Skew	t_{SKEW}	R_L = 50Ω, C_L = 10pF	+25℃		0.5		ns
Charge Injection Select Input to Common I/O	Q	V_G = GND, C_L = 1nF, R_G = 0Ω, Q = C_L × V_{OUT}, Test Circuit 7	+25℃		2.5		pC
HSD+, HSD-, D+, D- On-Capacitance	C_{ON}	f = 1MHz	+25℃		8		pF

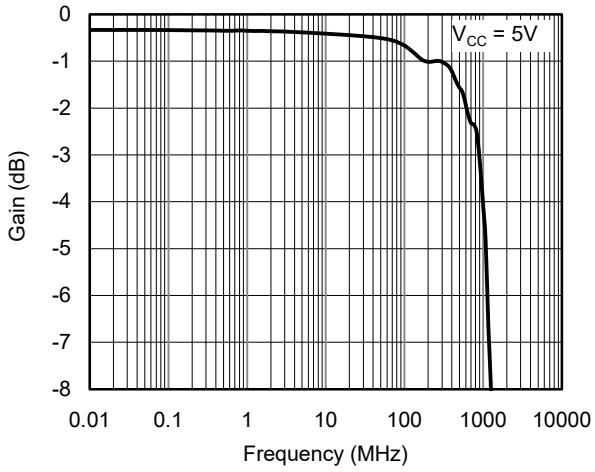
ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 5V, Full = -40℃ to +85℃, typical values are at T_A = +25℃, unless otherwise noted.)

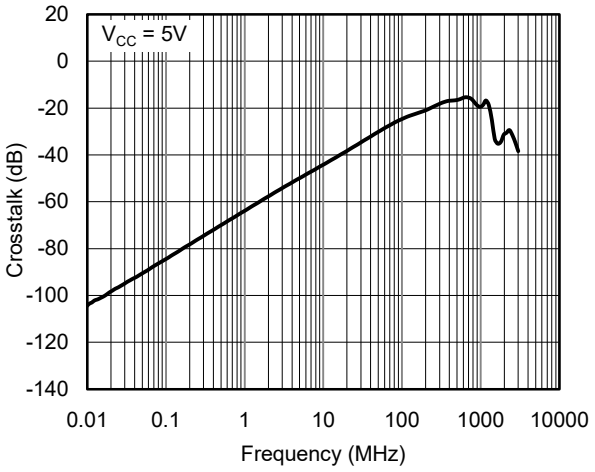
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V_{IS}		Full	0		V_{CC}	V
On-Resistance	R_{ON}	V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25℃		4.5	5.5	Ω
			Full			6.5	
On-Resistance Match between Channels	ΔR_{ON}	V_{IS} = 0V to 0.4V, I_D = 8mA, Test Circuit 1	+25℃		0.2	0.8	Ω
			Full			0.9	
On-Resistance Flatness	$R_{FLAT(ON)}$	V_{IS} = 0V to 1V, I_D = 8mA, Test Circuit 1	+25℃		0.5	0.75	Ω
			Full			0.9	
Increase in I_{CC} per Control Voltage	I_{CCT}	V_{CC} = 5.5V, V_S or $V_{\overline{OE}}$ = 1.8V	+25℃		14	18	μA
			Full			22	
Power Off Leakage Current (D+, D-)	I_{OFF}	V_{CC} = 0V, V_D = 0V to 5.5V, V_S, $V_{\overline{OE}}$ = 0V or 5.5V	Full			0.5	μA
Source Off Leakage Current	$I_{HSD2(OFF)}$, $I_{HSD1(OFF)}$	V_{CC} = 5.5V, V_{IS} = 4.5V/1V, V_D = 1V/4.5V	Full			0.5	μA
Channel On Leakage Current	$I_{HSD2(ON)}$, $I_{HSD1(ON)}$	V_{CC} = 5.5V, V_{IS} = 4.5V/1V, V_D = 4.5V/1V or floating	Full			0.5	μA
DIGITAL INPUTS							
Input High Voltage	V_{IH}	V_{CC} = 5.5V	Full	1.8			V
Input Low Voltage	V_{IL}	V_{CC} = 5.5V	Full			0.6	V
Input Leakage Current	I_{IN}	V_{CC} = 5.5V, V_S, $V_{\overline{OE}}$ = 0V or V_{CC}	Full			0.5	μA
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 2	+25℃		22		ns
Turn-Off Time	t_{OFF}		+25℃		14		ns
Break-Before-Make Time Delay	t_D	V_{IS} = 0.8V, R_L = 50Ω, C_L = 10pF, Test Circuit 3	+25℃		9		ns
Propagation Delay	t_{PD}	R_L = 50Ω, C_L = 10pF	+25℃		0.5		ns
Off Isolation	O_{ISO}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 4	+25℃		-26		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = 0dBm, R_L = 50Ω, f = 250MHz, Test Circuit 5	+25℃		-20		dB
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF, Test Circuit 6	+25℃		850		MHz
Channel-to-Channel Skew	t_{SKEW}	R_L = 50Ω, C_L = 10pF	+25℃		0.5		ns
Charge Injection Select Input to Common I/O	Q	V_G = GND, C_L = 1nF, R_G = 0Ω, Q = C_L × V_{OUT}, Test Circuit 7	+25℃		3.5		pC
HSD+, HSD-, D+, D- On-Capacitance	C_{ON}	f = 1MHz	+25℃		8		pF
POWER REQUIREMENTS							
Power Supply Range	V_{CC}		Full	1.8		5.5	V
Power Supply Current	I_{CC}	V_{CC} = 5.5V, V_S, $V_{\overline{OE}}$ = 0V or V_{CC}	Full			0.5	μA

TYPICAL PERFORMANCE CHARACTERISTICS

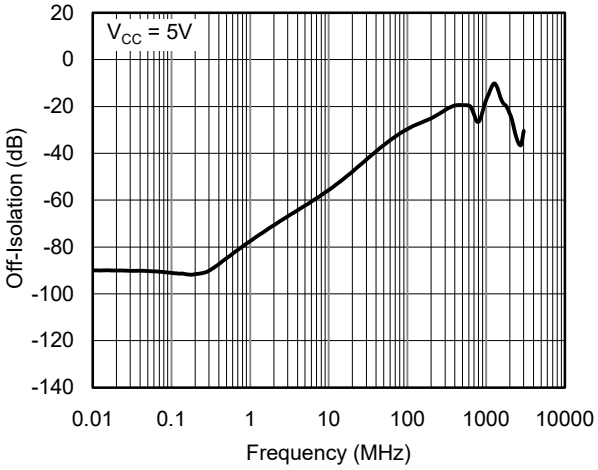
Gain vs. Frequency



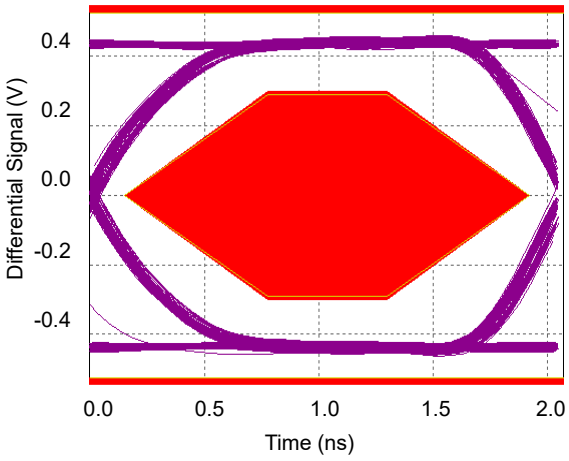
Crosstalk vs. Frequency



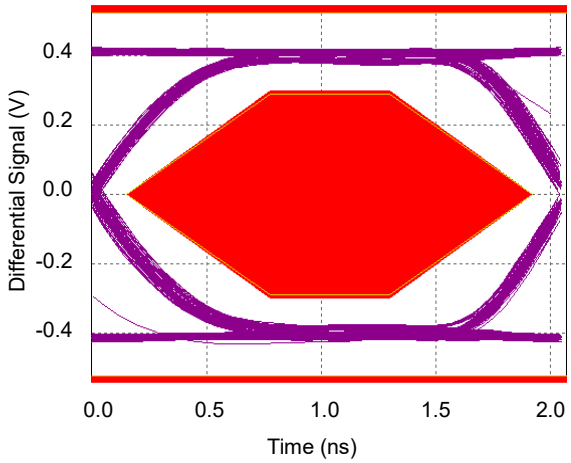
Off-Isolation vs. Frequency



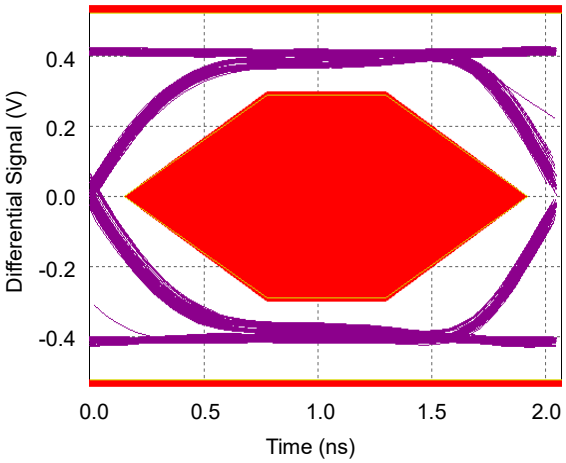
Eye Pattern: 480Mbps USB 2.0 Signal with No Switch (Through Path)



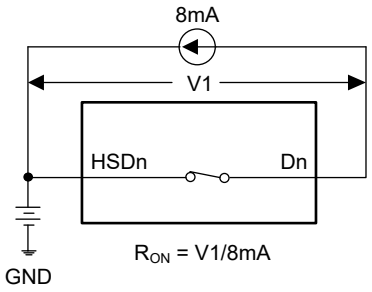
Eye Pattern: 480Mbps USB 2.0 Signal with Switch NO Path



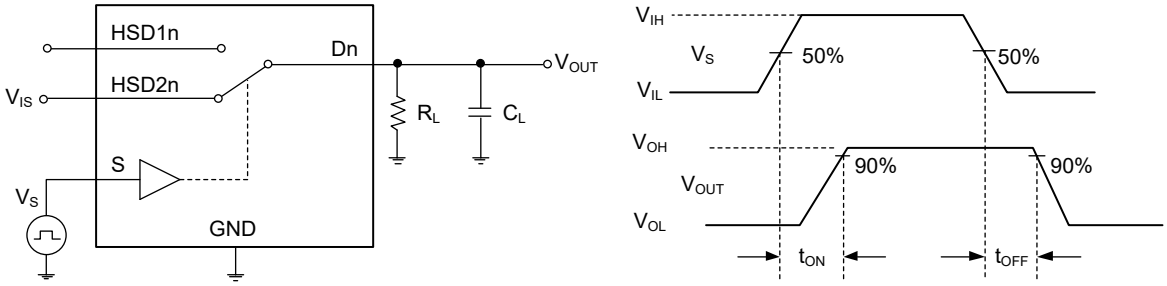
Eye Pattern: 480Mbps USB 2.0 Signal with Switch NC Path



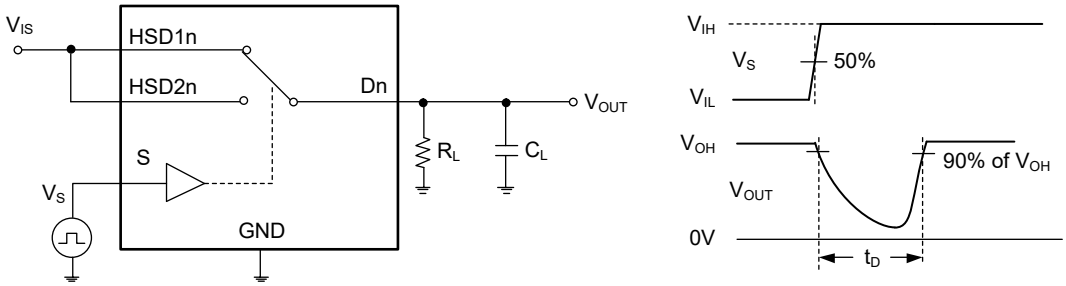
TEST CIRCUITS



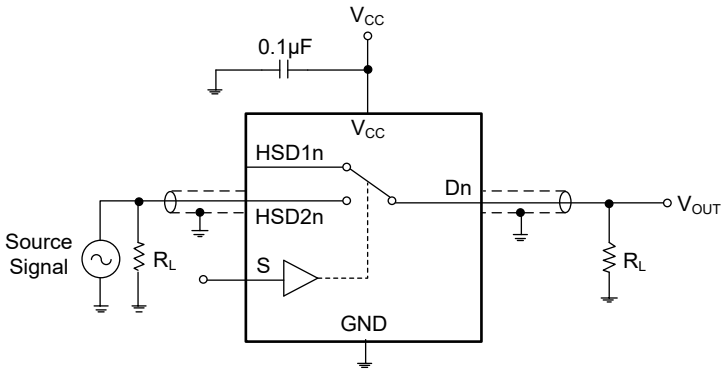
Test Circuit 1. On-Resistance



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

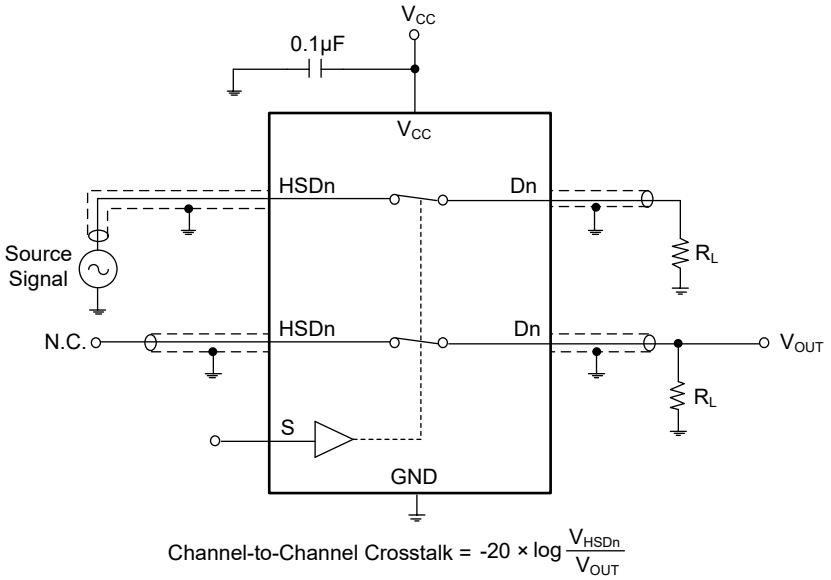


Test Circuit 3. Break-Before-Make Time Delay (t_D)

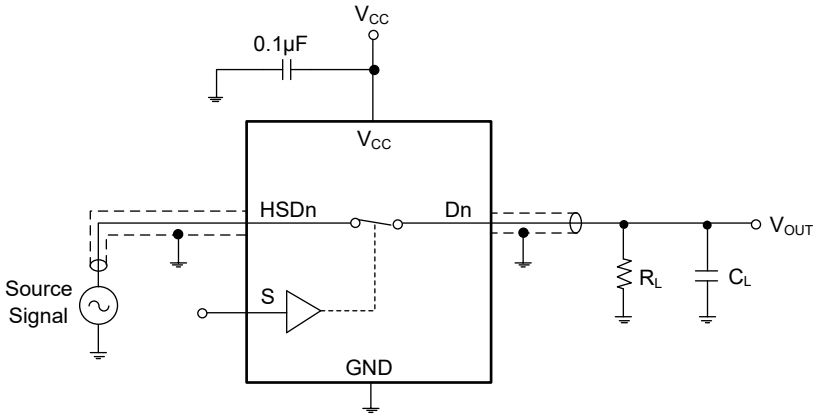


Test Circuit 4. Off Isolation

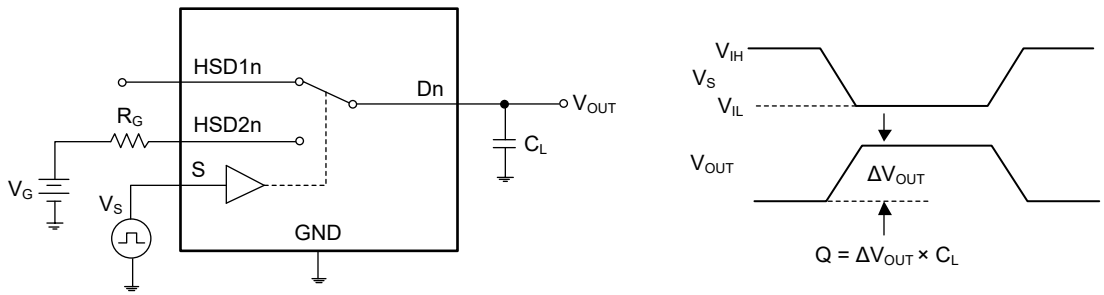
TEST CIRCUITS (continued)



Test Circuit 5. Channel-to-Channel Crosstalk



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 SGM7229 has specially designed circuitry which prevents unintended signal bleeding through as well as guarantees 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.

REVISION HISTORY

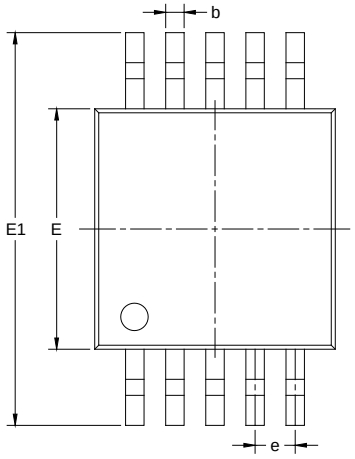
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

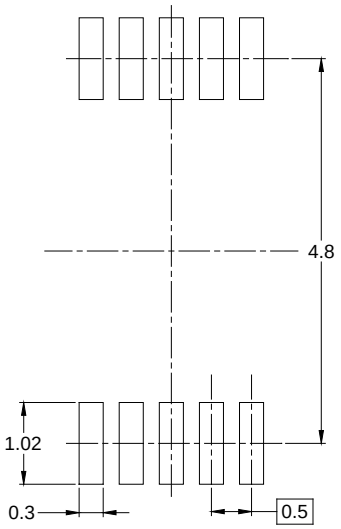
December 2021 – REV.A to REV.B	**Page**
Updated Electrical Characteristics section	5, 6

Changes from Original (DECEMBER 2018) to REV.A	
Changed from product preview to production data	All

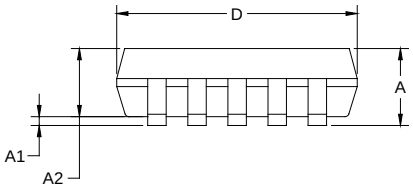
PACKAGE OUTLINE DIMENSIONS

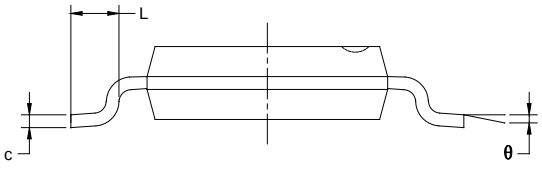
MSOP-10





RECOMMENDED LAND PATTERN (Unit: mm)



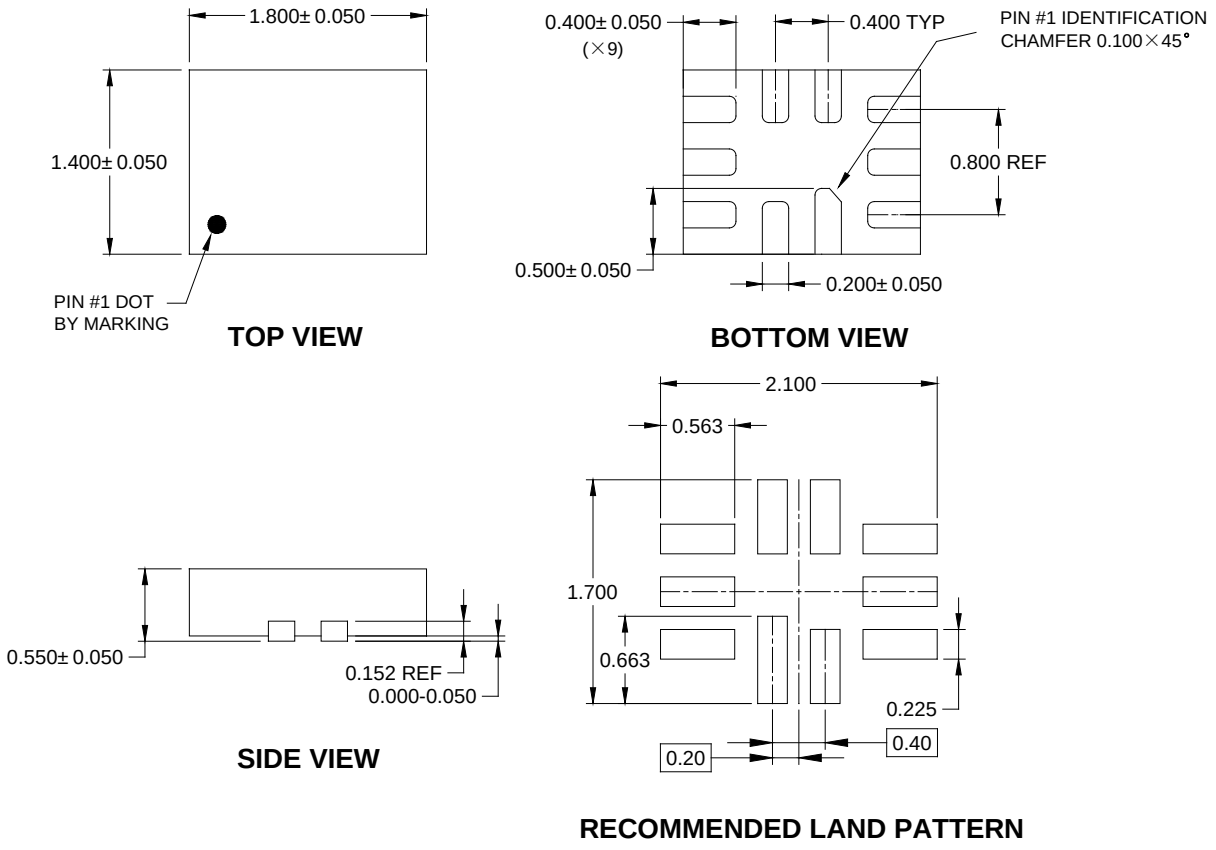


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.500 BSC		0.020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

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

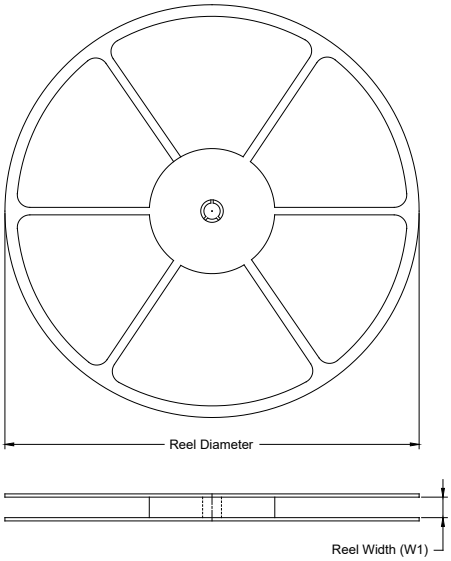
UTQFN-1.8×1.4-10L



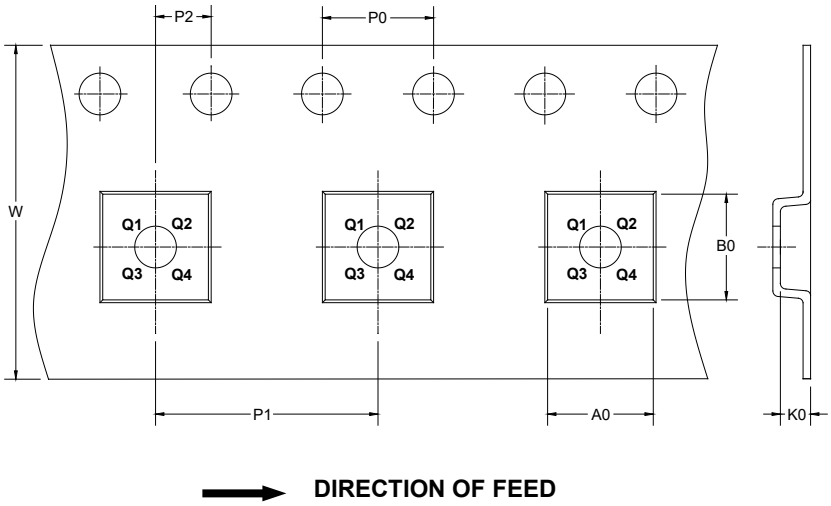
NOTES:
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



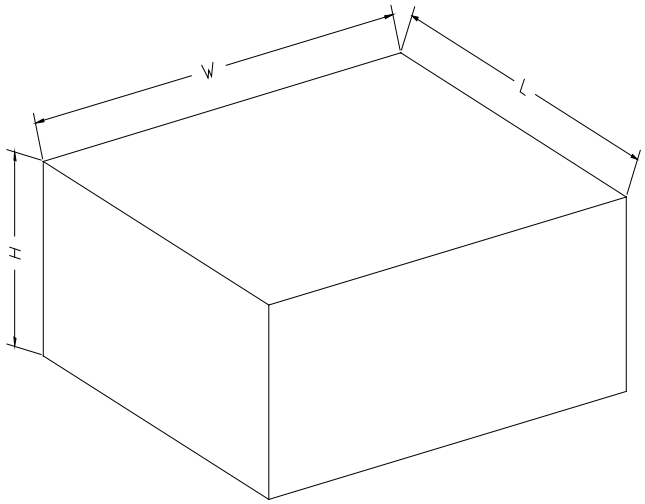
NOTE: The picture is only for reference. Please make the object as the standard.

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
UTQFN-1.8×1.4-10L	7″	9.0	1.75	2.10	0.70	4.0	4.0	2.0	8.0	Q1
MSOP-10	13″	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	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