



SGM7222

High Speed USB 2.0 (480Mbps) DPDT Analog Switch

GENERAL DESCRIPTION

The SGM7222 is a DPDT (double-pole/double-throw) analog switch. It operates from a 1.8V to 4.3V single power supply. Each switch of the SGM7222 is bidirectional, which can ensure that the high speed signals have little or no attenuation at the outputs.

The SGM7222 features high speed, low bit-to-bit skew and wide bandwidth. The high performances make it very suitable for multiple applications, such as cellular phones and computer peripherals, etc.

The SGM7222 has a power-off protection. It can prevent accidental signal leakage and ensure system reliability under power-down and over-voltage conditions. In addition, the device is capable of withstanding a V_{BUS} short to D+ or D- when the device is either powered on or powered off because of the special circuitry on the D+/D- pins.

The SGM7222 is available in Green TQFN-1.8×1.4-10L, MSOP-10 and UTQFN-1.8 × 1.4-10L packages. It operates over an ambient temperature range of -40°C to +85°C.

APPLICATIONS

Cellular Phones
Digital Cameras
Portable Equipment
Computer Peripherals
Battery-Powered Systems
Routes Signals for USB 2.0 Full-Speed

FEATURES

- **Supply Voltage Range:** 1.8V to 4.3V
- **On-Resistance:** 4.5Ω (TYP) at 3V
- **High Off-Isolation:** -35dB ($R_L = 50\Omega$, $f = 250\text{MHz}$)
- **Low Crosstalk:** -41dB ($R_L = 50\Omega$, $f = 250\text{MHz}$)
- **Low Bit-to-Bit Skew:** 50ps (TYP)
- **-3dB Bandwidth:** 550MHz
- **Fast Switching Times:**
 - t_{ON} : 10ns (TYP)
 - t_{OFF} : 22ns (TYP)
- **Break-Before-Make Switching**
- **Rail-to-Rail Input and Output Operation**
- **Power-Off and Power-On Protections**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green MSOP-10, TQFN-1.8×1.4-10L and UTQFN-1.8×1.4-10L Packages**

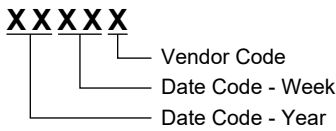
PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM7222	MSOP-10	-40°C to +85°C	SGM7222YMS10/TR	SGM7222 YMS10 XXXXX	Tape and Reel, 3000
	TQFN-1.8×1.4-10L	-40°C to +85°C	SGM7222YWQ10/TR	7222	Tape and Reel, 3000
	UTQFN-1.8×1.4-10L	-40°C to +85°C	SGM7222YUWQ10/TR	CAA XXX	Tape and Reel, 3000

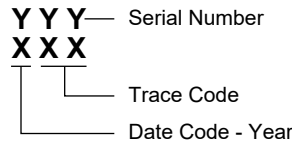
MARKING INFORMATION

NOTE: XXX = Date Code and Trace Code. XXXXX = Date Code and Vendor Code.

MSOP-10



UTQFN-1.8×1.4-10L



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₊ to GND0V to 4.6V
- Analog, Digital Voltage Range -0.3V to (V₊) + 0.3V
- Continuous Current HSDn or Dn ±100mA
- Peak Current HSDn or Dn ±150mA
- Junction Temperature +150°C
- Storage Temperature Range -65°C to +150°C
- Lead Temperature (Soldering, 10s) +260°C
- ESD Susceptibility
- HBM..... 8000V
- MM..... 400V

RECOMMENDED OPERATING CONDITIONS

- Operating Temperature Range -40°C to +85°C

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.

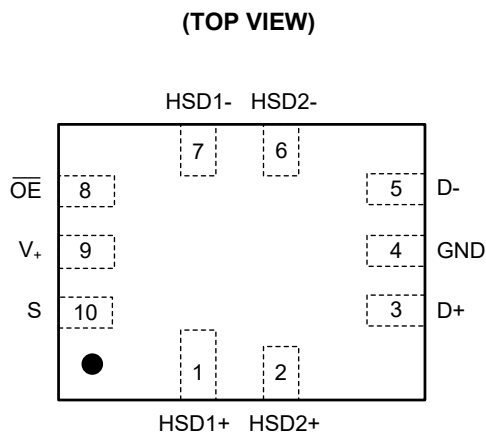
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. 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 even small parametric changes could cause the device not to meet the published specifications.

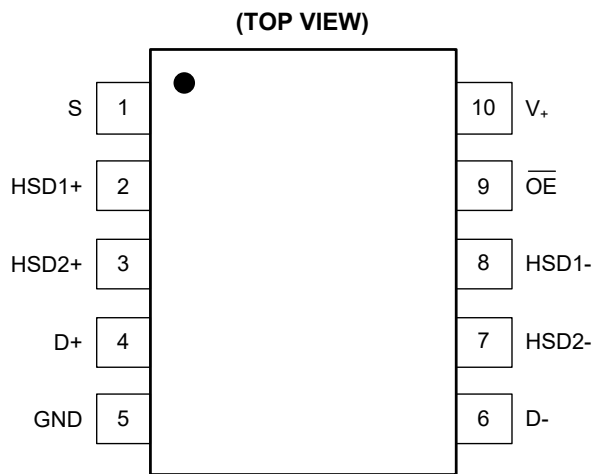
DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS



TQFN-1.8x1.4-10L/UTQFN-1.8x1.4-10L



MSOP-10

PIN DESCRIPTION

PIN		NAME	FUNCTION
TQFN-1.8x1.4-10L/ UTQFN-1.8x1.4-10L	MSOP-10		
1, 2	2, 3	HSD1+, HSD2+	Data Ports.
3, 5	4, 6	D+, D-	
7, 6	8, 7	HSD1-, HSD2-	
4	5	GND	Ground.
8	9	OE	Enable Control Pin.
9	10	V+	Positive Power Supply.
10	1	S	Select Input Pin.

FUNCTION TABLE

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

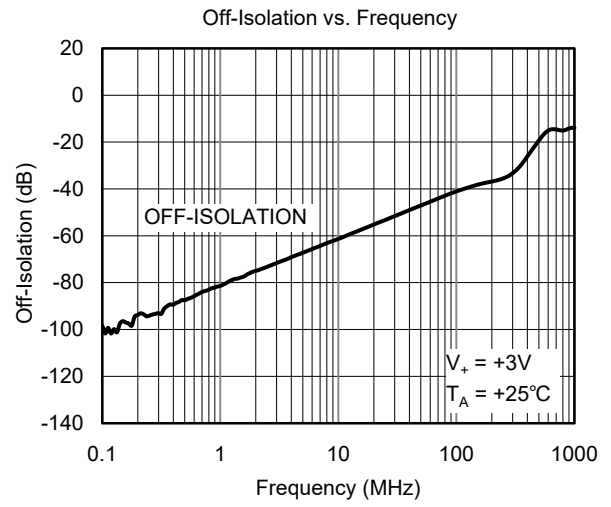
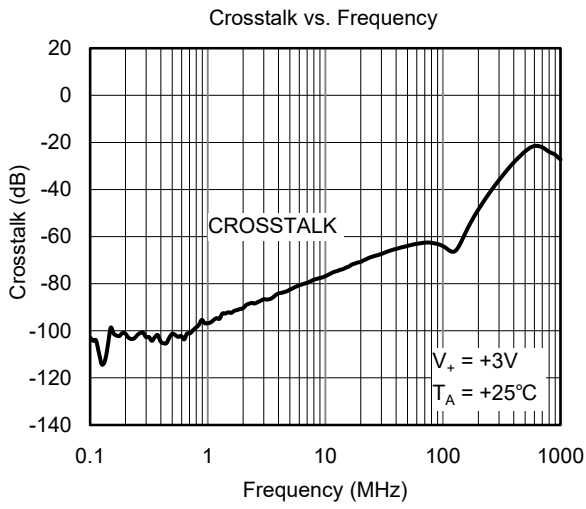
NOTE: Switches shown for logic "0" input.

ELECTRICAL CHARACTERISTICS

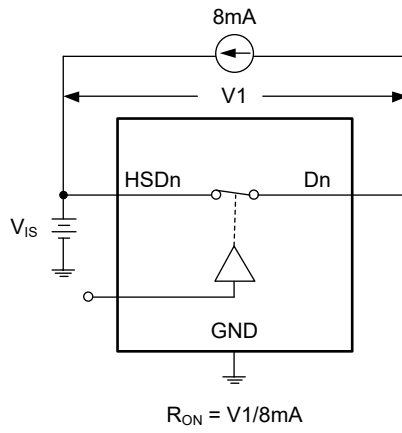
($V_+ = 1.8V$ to $4.3V$, $GND = 0V$, $V_{IH} = 1.6V$, $V_{IL} = 0.5V$, Full = $-40^\circ C$ to $+85^\circ C$. Typical values are at $V_+ = 3.3V$, $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
Analog Switch							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V_{IS}		Full	0		V_+	V
On-Resistance	R_{ON}	$V_+ = 3V$, $V_{IS} = 0V$ to $0.4V$, $I_D = 8mA$, Test Circuit 1	$+25^\circ C$		4.5	8.5	Ω
			Full			9	
On-Resistance Match Between Channels	ΔR_{ON}	$V_+ = 3V$, $V_{IS} = 0V$ to $0.4V$, $I_D = 8mA$, Test Circuit 1	$+25^\circ C$		0.15	0.6	Ω
			Full			1.6	
On-Resistance Flatness	$R_{FLAT(ON)}$	$V_+ = 3V$, $V_{IS} = 0V$ to $1V$, $I_D = 8mA$, Test Circuit 1	$+25^\circ C$		1.5	2.0	Ω
			Full			2.6	
Power Off Leakage Current (D+, D-)	I_{OFF}	$V_+ = 0V$, $V_D = 0V$ to $3.6V$, V_S , $V_{OE} = 0V$ or $3.6V$	Full			1	μA
Increase in I_+ per Control Voltage	I_{CCT}	$V_+ = 3.6V$, V_S or $V_{OE} = 2.6V$	Full			5	μA
Source Off Leakage Current	$I_{HSD2(OFF)}$, $I_{HSD1(OFF)}$	$V_+ = 3.6V$, $V_{IS} = 3.3V/0.3V$, $V_D = 0.3V/3.3V$	Full			1	μA
Channel On Leakage Current	$I_{HSD2(ON)}$, $I_{HSD1(ON)}$	$V_+ = 3.6V$, $V_{IS} = 3.3V/0.3V$, $V_D = 3.3V/0.3V$ or floating	Full			1	μA
Digital Inputs							
Input High Voltage	V_{IH}		Full	1.6			V
Input Low Voltage	V_{IL}		Full			0.5	V
Input Leakage Current	I_{IN}	$V_+ = 3V$, V_S , $V_{OE} = 0V$ or V_+	Full			1	μA
Dynamic Characteristics							
Turn-On Time	t_{ON}	$V_{IS} = 0.8V$, $R_L = 50\Omega$, $C_L = 10pF$, Test Circuit 2	$+25^\circ C$		10		ns
Turn-Off Time	t_{OFF}		$+25^\circ C$		22		ns
Break-Before-Make Time Delay	t_D	$V_{IS} = 0.8V$, $R_L = 50\Omega$, $C_L = 10pF$, Test Circuit 3	$+25^\circ C$		4		ns
Propagation Delay	t_{PD}	$R_L = 50\Omega$, $C_L = 10pF$	$+25^\circ C$		0.3		ns
Off Isolation	O_{ISO}	Signal = $0dBm$, $R_L = 50\Omega$, $f = 250MHz$, Test Circuit 4	$+25^\circ C$		-35		dB
Channel-to-Channel Crosstalk	X_{TALK}	Signal = $0dBm$, $R_L = 50\Omega$, $f = 250MHz$, Test Circuit 5	$+25^\circ C$		-41		dB
-3dB Bandwidth	BW	Signal = $0dBm$, $R_L = 50\Omega$, $C_L = 5pF$, Test Circuit 6	$+25^\circ C$		550		MHz
Channel-to-Channel Skew	t_{SKEW}	$R_L = 50\Omega$, $C_L = 10pF$	$+25^\circ C$		0.05		ns
Charge Injection Select Input to Common I/O	Q	$V_G = GND$, $C_L = 1nF$, $R_G = 0\Omega$, $Q = C_L \times V_{OUT}$, Test Circuit 7	$+25^\circ C$		11		pC
HSD+, HSD-, D+, D- On Capacitance	C_{ON}		$+25^\circ C$		6.5		pF
Power Requirements							
Power Supply Range	V_+		Full	1.8		4.3	V
Power Supply Current	I_+	$V_+ = 3V$, V_S , $V_{OE} = 0V$ or V_+	Full			1	μA

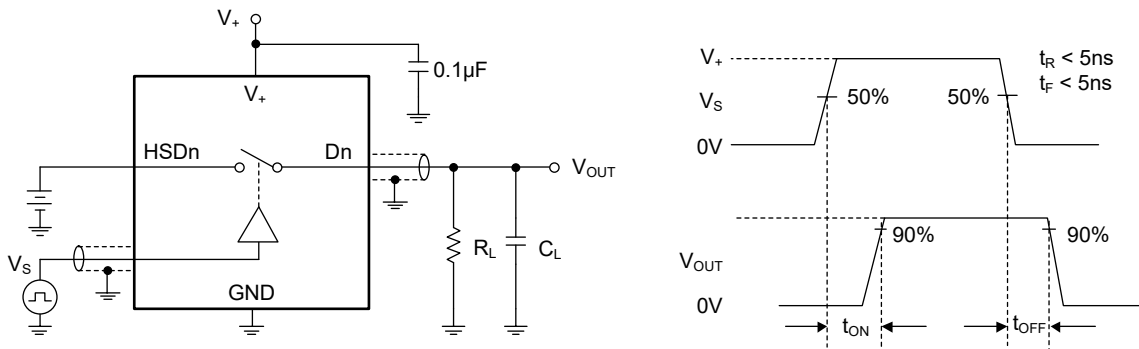
TYPICAL PERFORMANCE CHARACTERISTICS



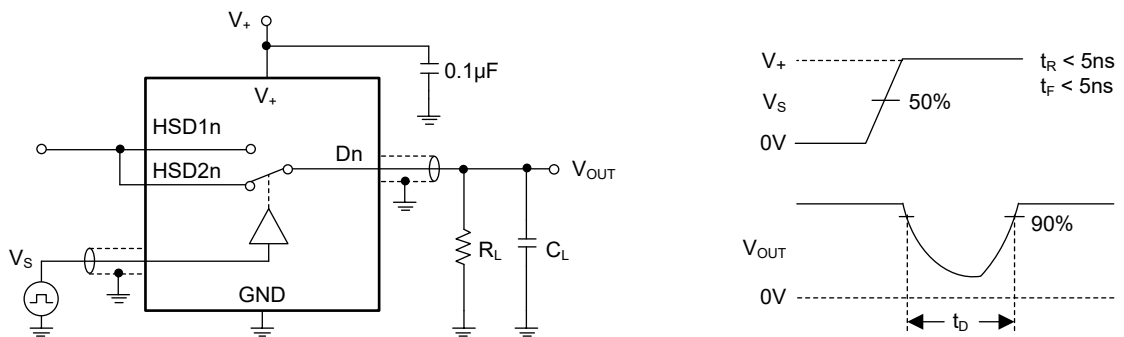
TEST CIRCUITS



Test Circuit 1. On-Resistance

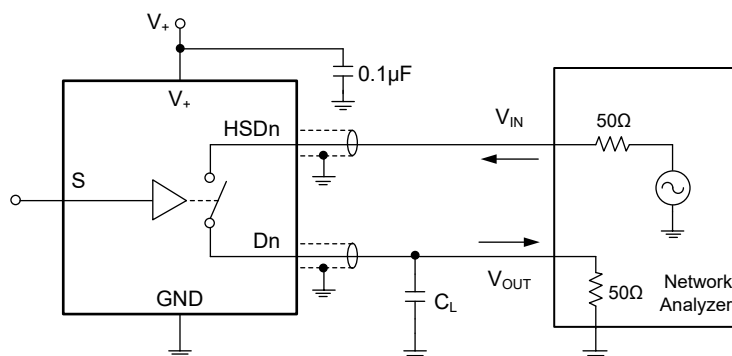


Test Circuit 2. Switching Times (t_{ON} , t_{OFF})

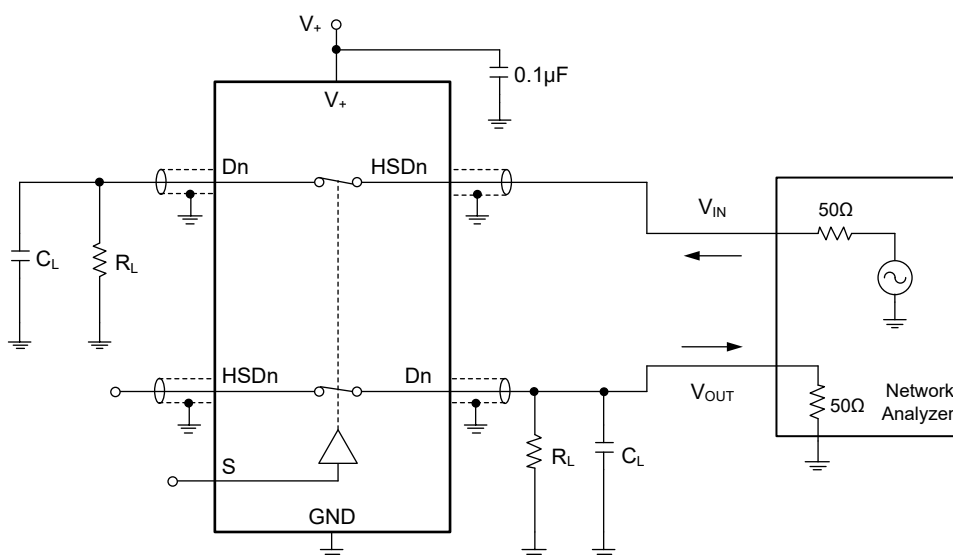


Test Circuit 3. Break-Before-Make Time (t_D)

TEST CIRCUITS (continued)



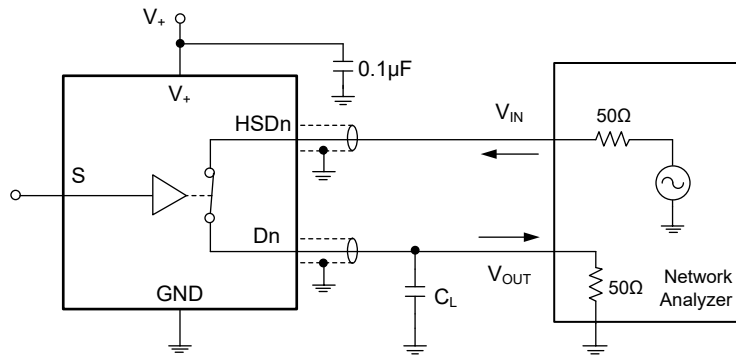
Test Circuit 4. Off Isolation



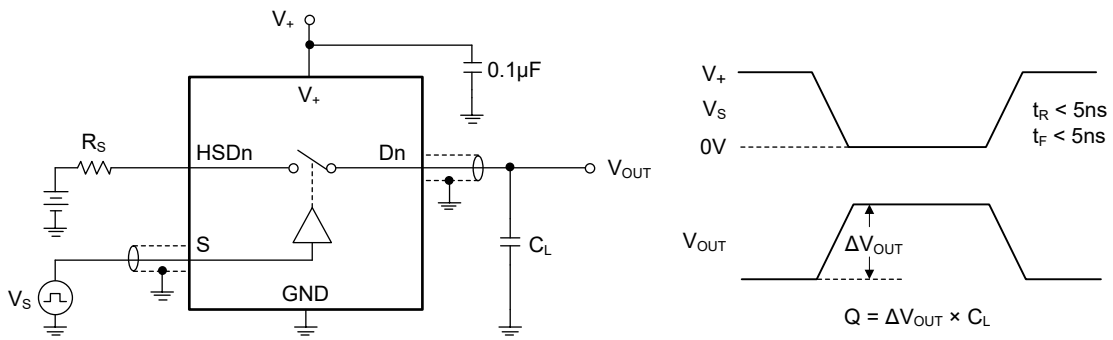
$$\text{Channel-to-Channel Crosstalk} = -20 \log (V_{\text{HSDn}}/V_{\text{OUT}})$$

Test Circuit 5. Channel-to-Channel Crosstalk

TEST CIRCUITS (continued)



Test Circuit 6. -3dB Bandwidth



Test Circuit 7. Charge Injection (Q)

APPLICATION INFORMATION

Meet the Short Requirements of USB 2.0

V_{BUS}

According to Section 7.1.1 of the USB 2.0 specification, USB devices must be able to withstand a V_{BUS} short to D+ or D- when powered on or off. The SGM7222 can fully meet these two requirements

Power-Off Protection

When D+ or D- is shorted to V_{BUS}, there is a special protection circuit inside the SGM7222, so that the device will not be damaged within 24 hours. In case of power-down or over-voltage event, the protection circuit can prevent the leakage signal on D+/D- pins to ensure the reliability of the system.

Power-On Protection

The USB 2.0 specification requires USB device to ensure that the device will not be damaged even if V_{BUS} short-circuit occurs during data transmission. Therefore, under over-voltage conditions, the SGM7222 will limit the current flowing back to the V₊ track, and the current will not exceed the safe operating range.

USB2.0 Signal Quality Compliance Test Results

The results of USB eye map test are shown in Figure 1 and Figure 2. Table 1 gives a summary of the USB tests.

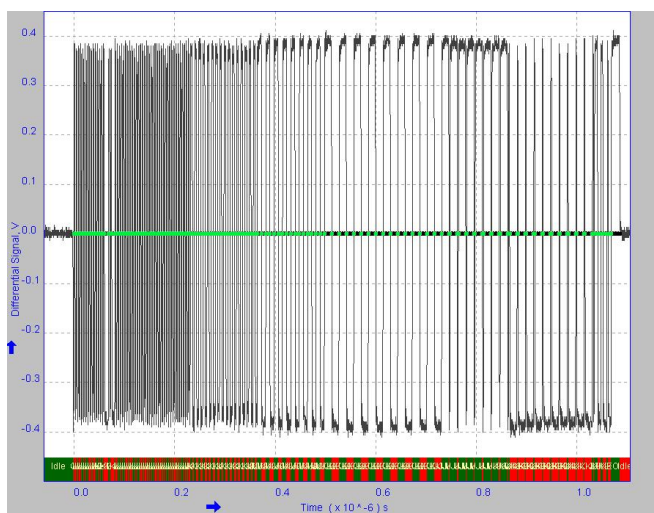


Figure 1. Waveform Plot

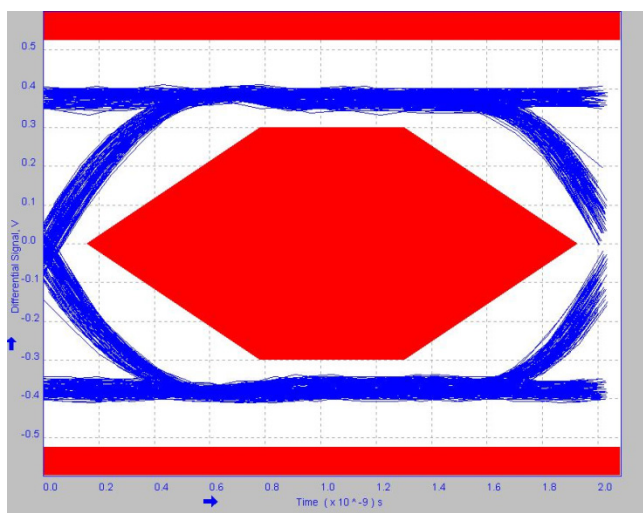


Figure 2. High Speed Signal Quality Eye Diagram Test (V₊ = 3.3V)

Table 1. Summary of the USB 2.0 Signal Quality Tests Results

Measurement Name	MIN	MAX	Mean	pk-pk	Standard Deviation	RMS	Population	Status
Eye Diagram Test	-	-	-	-	-	-	-	Pass
Signal Rate	469.9358 Mbps	493.4413 Mbps	479.9700 Mbps	0.0000 bps	5.586580 Mbps	480.4200 Mbps	512	Pass
EOP Width	-	-	16.58804ns	-	-	-	1	Pass
EOP Width (Bits)	-	-	7.961762	-	-	-	1	Pass
Falling Edge Rate	1.064231 kV/μs	1.228955 kV/μs	1.143136 kV/μs	164.7235 V/μs	35.43800 V/μs	1.143680 kV/μs	107	Pass
Rising Edge Rate	1.063269 kV/μs	1.227966 kV/μs	1.136558 kV/μs	164.6970 V/μs	31.49494 V/μs	1.136990 kV/μs	108	Pass

Additional Information:

Consecutive Jitter range: -82.97ps to 72.87ps RMS Jitter 35.08ps

KJ Paired Jitter range: -25.05ps to 23.05ps RMS Jitter 9.259ps

JK Paired Jitter range: -20.96ps to 30.12ps RMS Jitter 9.734ps

- Rising Edge Rate: 1.136558kV/μs (Equivalent Rise Time = 563.10ps)
- Falling Edge Rate: 1.143136kV/μs (Equivalent Fall Time = 559.86ps)

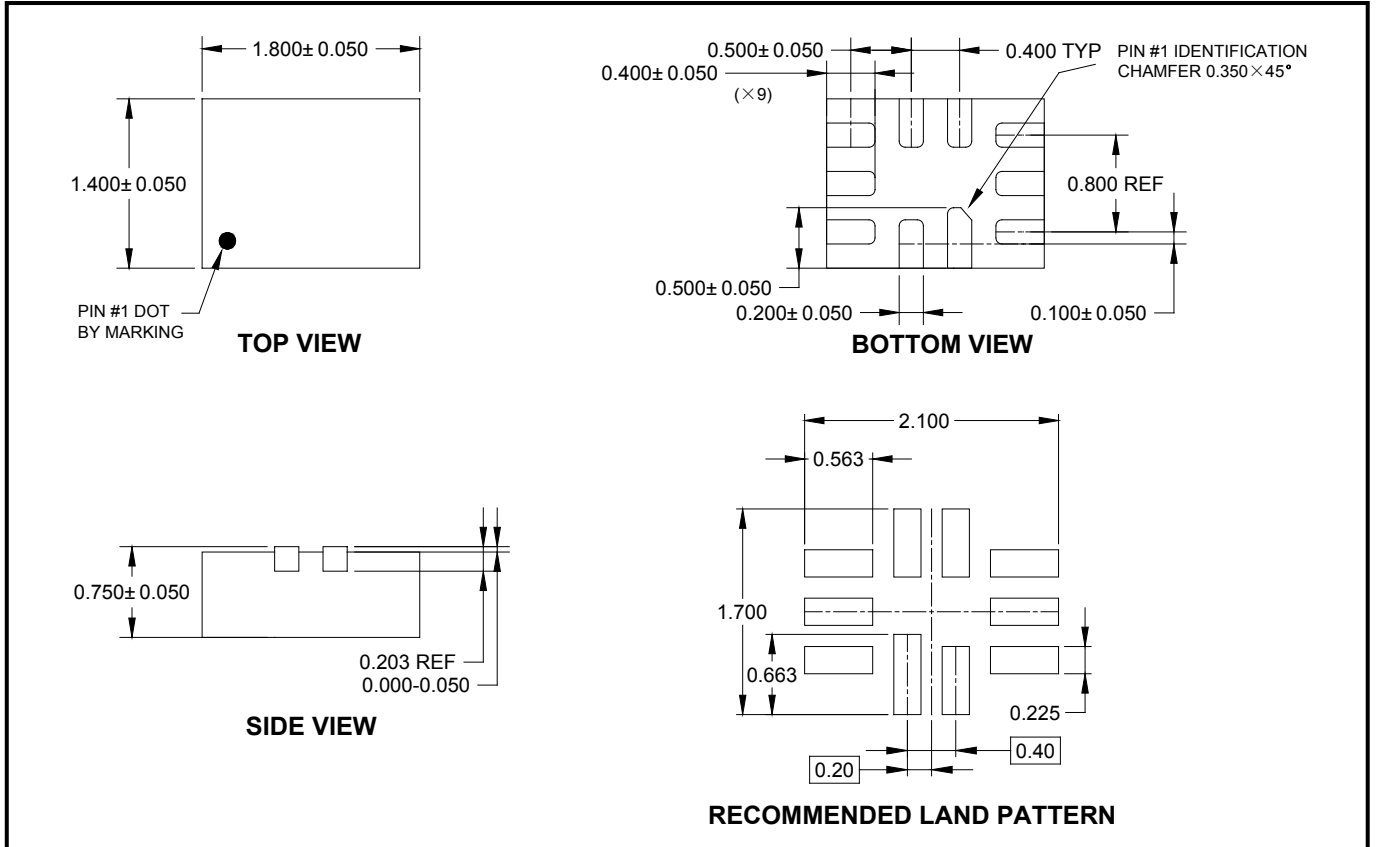
REVISION HISTORY

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

	Page
JUNE 2021 – REV.B.3 to REV.B.4	
Updated Package Outline Dimensions section	13
APRIL 2019 – REV.B.2 to REV.B.3	
Updated Package/Ordering Information section	2
MAY 2014 – REV.B.1 to REV.B.2	
Updated Absolute Maximum Ratings section	2
JANUARY 2013 – REV.B to REV.B.1	
Added Recommended Land Pattern section	12, 13, 14
Added Tape and Reel Information section	15, 16
MAY 2011 – REV.A.3 to REV.B	
Updated package option	All
MARCH 2011 – REV.A.2 to REV.A.3	
Updated Package Outline Dimensions section	12, 13, 14
FEBRUARY 2010 – REV.A.1 to REV.A.2	
Updated Test Circuits section	6, 8
SEPTEMBER 2009– REV.A to REV.A.1	
Added new package	All
Updated Absolute Maximum Ratings section	2
Changes from Original (DECEMBER 2008) to REV.A	
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

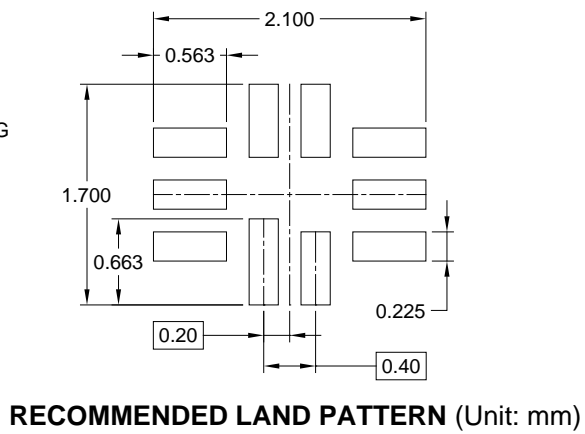
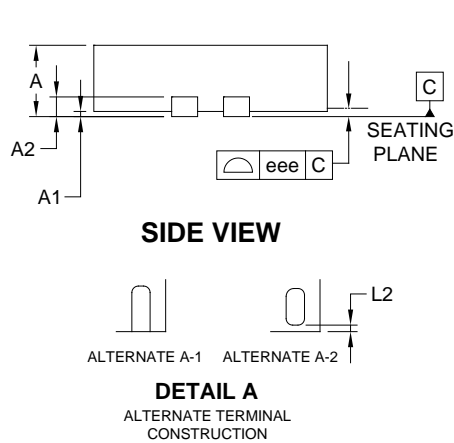
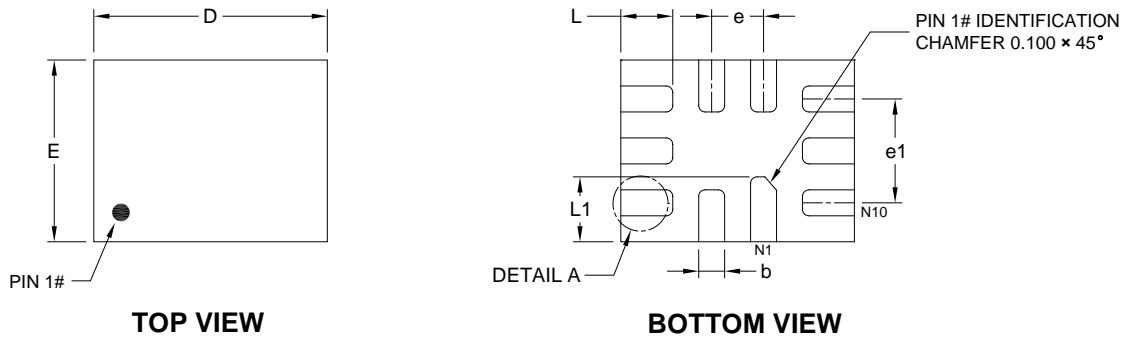
TQFN-1.8×1.4-10L



NOTE: All linear dimensions are in millimeters.

PACKAGE OUTLINE DIMENSIONS

UTQFN-1.8x1.4-10L

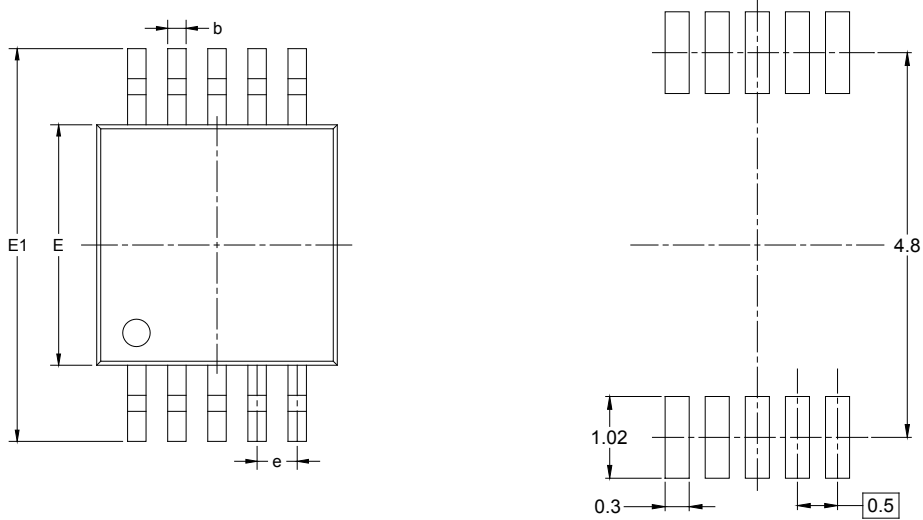


Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.450	-	0.600
A1	0.000	-	0.050
A2	0.152 REF		
b	0.150	0.200	0.250
D	1.750	1.800	1.850
E	1.350	1.400	1.450
e	0.400 TYP		
e1	0.800 REF		
L	0.350	0.400	0.450
L1	0.450	0.500	0.550
L2	0.000	-	0.100
eee	-	0.080	-

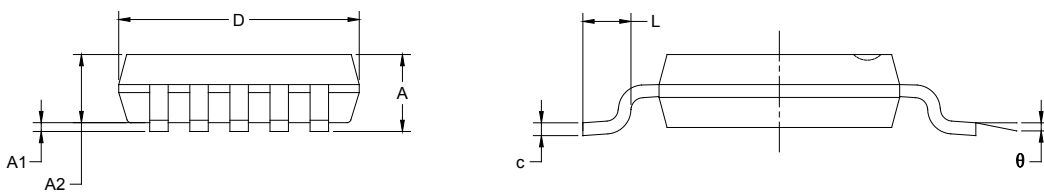
NOTE: This drawing is subject to change without notice.

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 INFORMATION

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
TQFN-1.8×1.4-10L	7"	9.0	1.75	2.10	1.00	4.0	4.0	2.0	8.0	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
MSOP-10	13"	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1

DD0001

PACKAGE INFORMATION

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