

High-Speed USB 2.0 (480-Mbps) 1:2 Multiplexer/Demultiplexer Switch

FEATURES

- **-3dB Bandwidth: 550MHz**
- **Supply Range: +1.8V to +5.5V**
- **R_{ON} is Typically 6Ω**
- **Fast Switching Times:**
 t_{ON} 20ns
 t_{OFF} 15ns
- **Break-Before-Make Switching**
- **Low Power Consumption (1uA Maximum)**
- **Rail-to-Rail Input and Output Operation**
- **Extended Industrial Temperature Range:**
 -40°C to +85°C
- **Micro SIZE PACKAGES: UQFN1.4X1.8-10, MSOP10**

DESCRIPTION

The RS2228 is a high-speed, low-power double-pole/double-throw (DPDT) analog switch with single Enable. It is designed to operate from 1.8 V to 5.5 V.

The RS2228 has a bus-switch enable pin, \overline{OE} , that can place the signal paths in high impedance. This allows the user to isolate the bus when it is not in use and consume less current.

The RS2228 is a high-bandwidth switch specially designed for the switching of high-speed USB2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os.

The RS2228 is available UQFN1.4X1.8-10 and MSOP10 package. It operates over an ambient temperature range of -40°C to +85°C.

APPLICATIONS

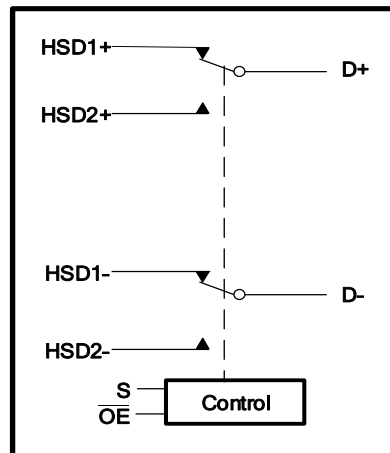
- Routes Signals for USB 1.0, 1.1, and 2.0
- MP3 and Other Personal Media Players
- Portable Instrumentation
- USB Switching
- Digital Cameras
- Set-Top Box
- Cell Phones
- PDAs

Device Information ⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS2228	UQFN1.4X1.8-10	1.80mm×1.40mm
	MSOP10	3.00mm×3.00mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Functional Block Diagram

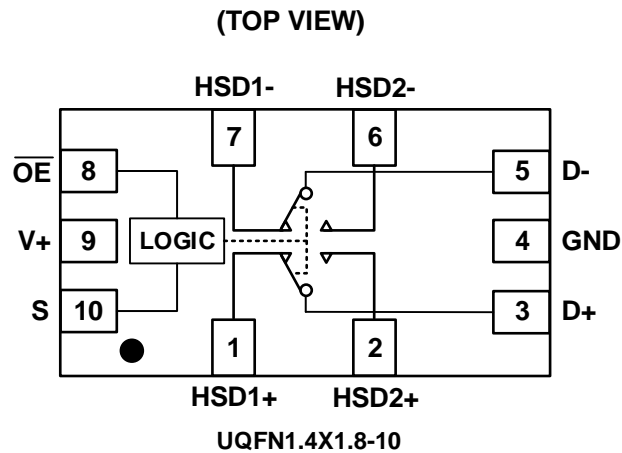


Revision History

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

Version	Change Date	Change Item
C.1	2021/07/06	Changed UQFN1.4X1.8-10 Package Marking in Page 5@B.4 Version
C.1.1	2024/03/11	1. Added the TAPE AND REEL INFORMATION 2. Modify packaging naming

PIN CONFIGURATIONS



PIN DESCRIPTION

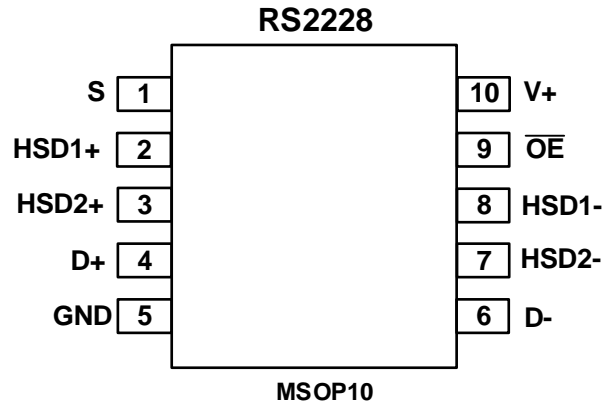
NAME	PIN	FUNCTION
V+	9	Power Supply
GND	4	Ground
S	10	Select Input
\overline{OE}	8	Output Enable
HSD1+, HSD2+	1,2	Data Port
HSD1-, HSD2-	7,6	
D+, D-	3,5	

FUNCTION TABLE

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

Note: X =Don't care

PIN CONFIGURATIONS



PIN DESCRIPTION

NAME	PIN	FUNCTION
V+	10	Power Supply
GND	5	Ground
S	1	Select Input
\overline{OE}	9	Output Enable
HSD1+, HSD2+	2,3	Data Port
HSD1-, HSD2-	8,7	
D+, D-	4,6	

FUNCTION TABLE

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

Note: X =Don't care

SPECIFICATIONS

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

SYMBOL	PARAMETER	MIN	MAX	UNIT
V ₊	Supply Voltage	-0.3	6.0	V
	Analog, Digital Voltage Range ⁽²⁾	-0.3	(V ₊)+0.3	
	Continuous Current HSDn or Dn	-100	+100	mA
I _{PEAK}	Peak Current HSDn or Dn	-150	+150	
T _J	Junction Temperature	-40	150	°C
T _{stg}	Storage temperature	-65	+150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less.

ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM)	±3000	V
		Machine Model (MM)	±200	V

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V _{CC}	Supply Voltage	1.8	5.5	V
T _A	Operating temperature	-40	+85	°C

Thermal Information

THERMAL METRIC		RS2228		UNIT
		10 PINS		
		MSOP10	UQFN1.4X1.8-10	
R _{θJA}	Junction-to-ambient thermal resistance	180.7	120	°C/W
R _{θJC(top)}	Junction-to-case(top) thermal resistance	66.2	46.0	°C/W
R _{θJB}	Junction-to-board thermal resistance	103.2	44.5	°C/W
Ψ _{JT}	Junction-to-top characterization parameter	11.2	1.5	°C/W
Ψ _{JB}	Junction-to-board characterization parameter	101.3	44.5	°C/W
R _{θJC(bot)}	Junction-to-case(bottom) thermal resistance	N/A	31.2	°C/W

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING ⁽¹⁾	PACKAGE OPTION
RS2228	RS2228XN	-40°C ~+85°C	MSOP10	RS2228	Tape and Reel,4000
	RS2228XUTQK10	-40°C ~+85°C	UQFN1.4X1.8-10	2228	Tape and Reel,4000

NOTE:

(1) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

ELECTRICAL CHARACTERISTICS

(V+ = +1.8V to +5.5V, GND = 0V, V_{IH} = +1.5V, V_{IL} = +0.5V, T_A = -40°C to +85°C. Typical values are at V+ = +3.3V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNIT
ANALOG SWITCH							
Analog I/O Voltage (HSD1+, HSD1-, HSD2+, HSD2-)	V _{IS}		-40°C to +85°C	0		V+	V
On-Resistance	R _{ON}	V+ = 3.0V, V _{IS} = 0V to 0.4V, I _D = 8mA, See Figure 1	+25°C		6	10	Ω
			-40°C to +85°C			10.5	
On-Resistance Match Between Channels	ΔR _{ON}	V+ = 3.0V, V _{IS} = 0V to 0.4V, I _D = 8mA, See Figure 1	+25°C		0.15	0.6	Ω
			-40°C to +85°C			1.6	Ω
On-Resistance Flatness	R _{FLAT(ON)}	V+ = 3.0V, V _{IS} = 0V to 1.0V, I _D = 8mA, See Figure 1	+25°C		5	7	Ω
			-40°C to +85°C			8	
Power Off Leakage Current (D+, D-)	I _{OFF}	V+ = 0V, V _D = 0V to 3.6 V, V _S , V _{OE} = 0V or 3.6 V	-40°C to +85°C			1	uA
Increase in I ₊ per Control Voltage	I _{CCT}	V+ = 3.6V, V _S or V _{OE} = 2.6 V	-40°C to +85°C			40	uA
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	-40°C to +85°C			1	uA
Channel On Leakage Current	I _{HSD2(ON)} I _{HSD1(ON)}	V+ = 3.6V, V _{IS} = 3.3V/ 0.3V, V _D = 0.3V/ 3.3V or floating	-40°C to +85°C			1	uA
DIGITAL CONTROL INPUTS⁽¹⁾							
Input High Voltage	V _{IH}		-40°C to +85°C	1.6			V
Input Low Voltage	V _{IL}		-40°C to +85°C			0.5	V
Input Leakage Current	I _{IN}	V+ = 3.0V, V _S , V _{OE} = 0V or V+	-40°C to +85°C			1	uA

(1) All unused digital inputs of the device must be held at V_{IO} or GND to ensure proper device operation.

ELECTRICAL CHARACTERISTICS (continued)

(V+ = +1.8V to +5.5V, GND = 0V, V_{IH} = +1.5V, V_{IL} = +0.5V, T_A = -40°C to +85°C. Typical values are at V+ = +3.3V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNIT
DYNAMIC CHARACTERISTICS							
Turn-On Time	t _{ON}	V _{IS} = 0.8V, R _L = 50Ω, C _L = 10pF, See Figure 2	+25°C		20		ns
Turn-Off Time	t _{OFF}		+25°C		15		ns
Break-Before-Make Time Delay	t _D	V _{IS} = 0.8V, R _L = 50Ω, C _L = 10pF, See Figure 3	+25°C		4		ns
Propagation Delay	t _{PD}	R _L = 50Ω, C _L = 10pF	+25°C		0.35		ns
Off Isolation	O _{ISO}	Signal = 0dBm, R _L = 50Ω, f = 250MHz, See Figure 4	+25°C		-35		dB
Channel-to-Channel Crosstalk	X _{TALK}	Signal = 0dBm, R _L = 50Ω, f = 250MHz, See Figure 5	+25°C		-40		dB
-3dB Bandwidth	BW	Signal = 0dBm, R _L = 50Ω, C _L = 5pF, See Figure 6	+25°C		550		MHz
Channel-to-Channel Skew	t _{SKEW}	R _L = 50Ω, C _L = 10pF	+25°C		0.05		ns
Charge Injection Select Input to Common I/O	Q	V _G = GND, C _L = 1.0nF, R _G = 0Ω, Q = C _L × V _{OUT} , See Figure 7	+25°C		11		pC
HSD+, HSD-, D+, D- ON Capacitance	C _{ON}		+25°C		7		pF
POWER REQUIREMENTS							
Power Supply Range	V ₊		-40°C to +85°C	1.8		5.5	V
Power Supply Current	I ₊	V+ = 3.0V, V _S , V _{OE} = 0V or V+	-40°C to +85°C			1	uA

Parameter Measurement Information

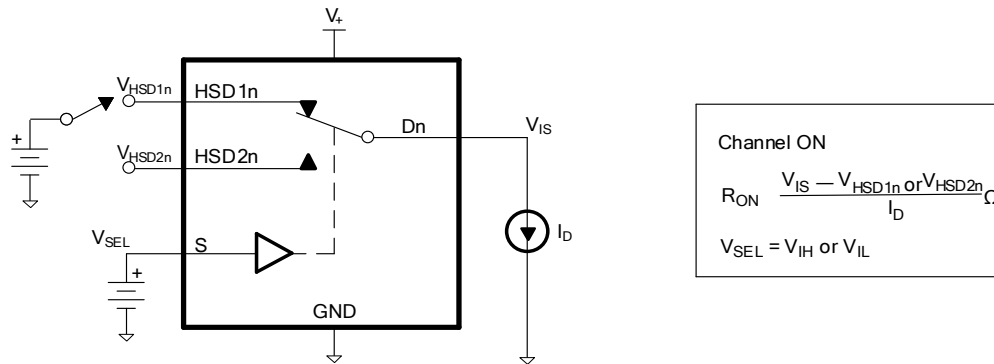


Figure 1. ON-State Resistance (R_{ON})

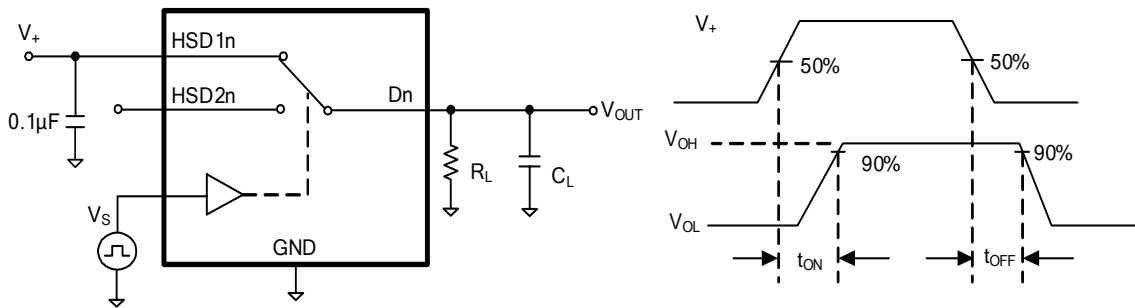


Figure 2. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

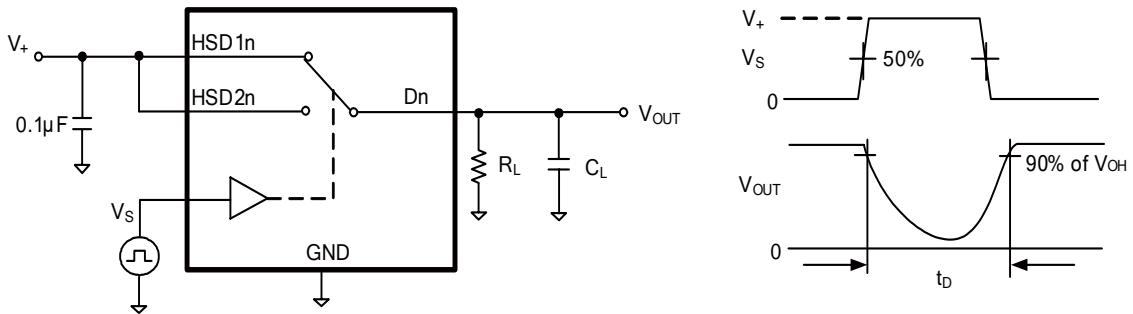


Figure 3. Break-Before-Make Time (t_D)

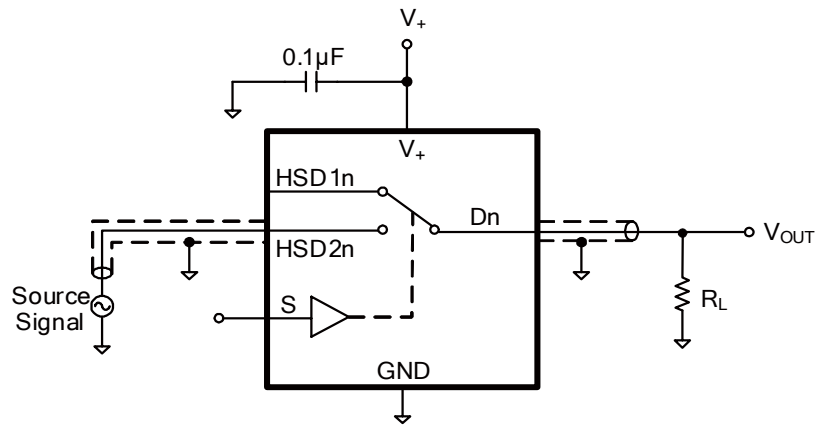
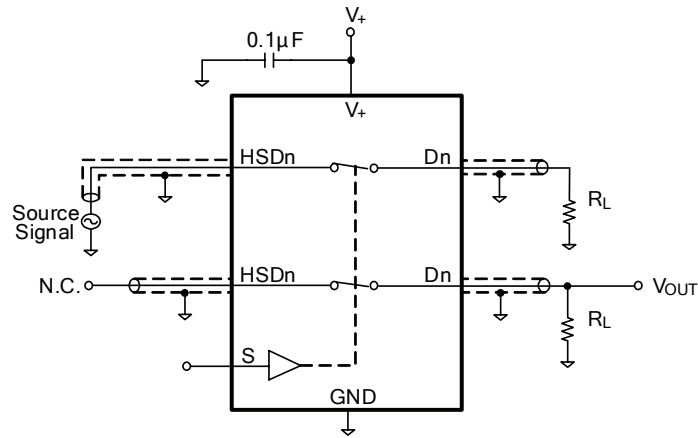


Figure 4. OFF Isolation (O_{iso})



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

Figure 5. Channel-to-Channel Crosstalk

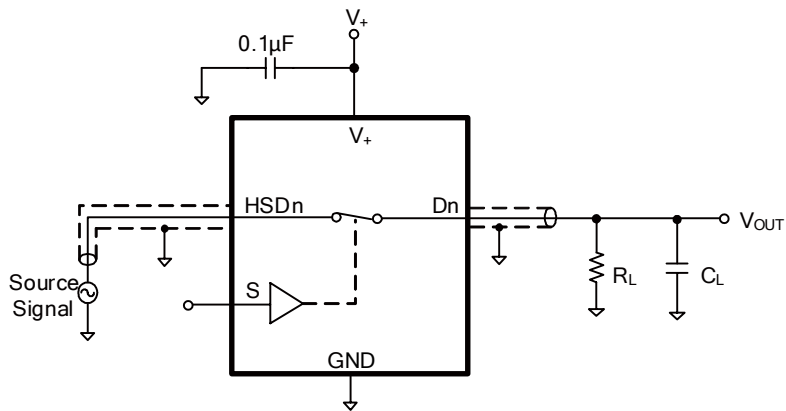


Figure 6. -3dB Bandwidth

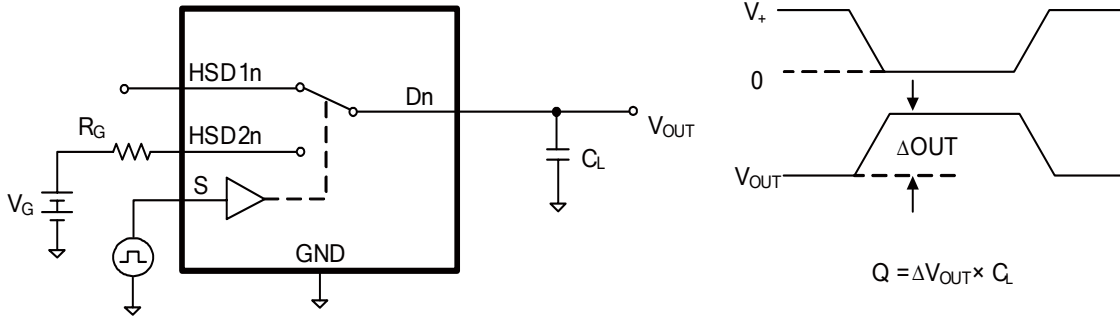


Figure 7. Charge Injection(Q)

APPLICATION NOTES

There are many USB applications in which the USB hubs or controllers have a limited number of USB I/Os. The RS2228 solution can effectively expand the limited USB I/Os by switching between multiple USB buses in order to interface them to a single USB hub or controller. RS2228 can also be used to connect a single controller to two USB connectors or controllers.

Design requirements of the USB 1.0, 1.1, and 2.0 standards should be followed. It is recommended that the digital control pins S and \overline{OE} be pulled up to V+ or down to GND to avoid undesired switch positions that could result from the floating pin.

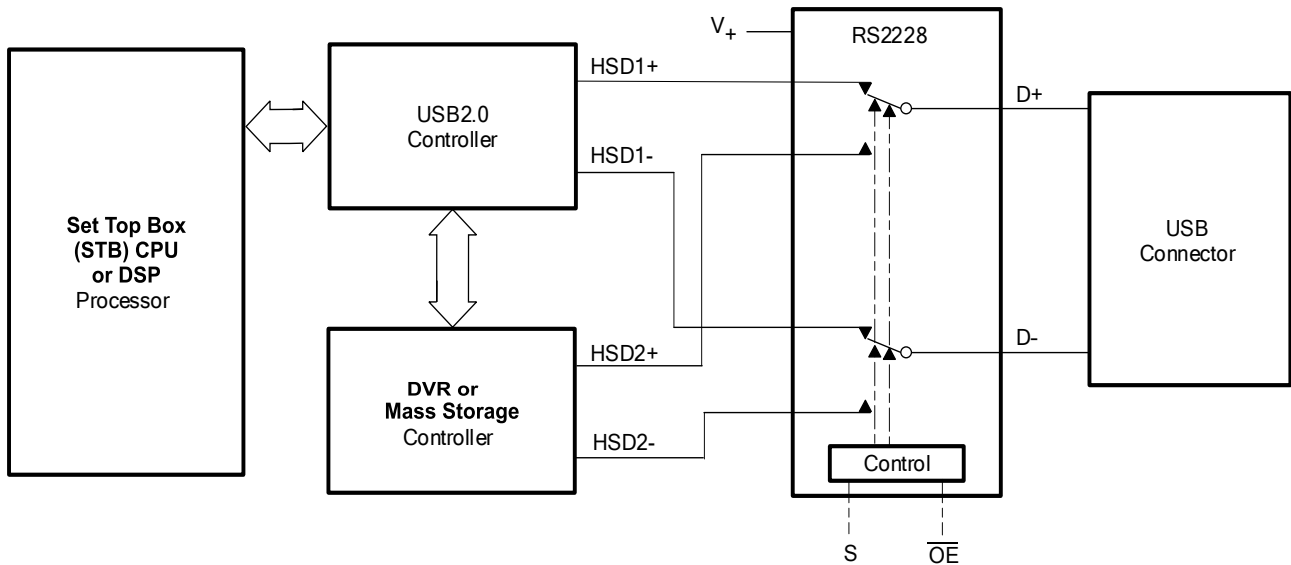
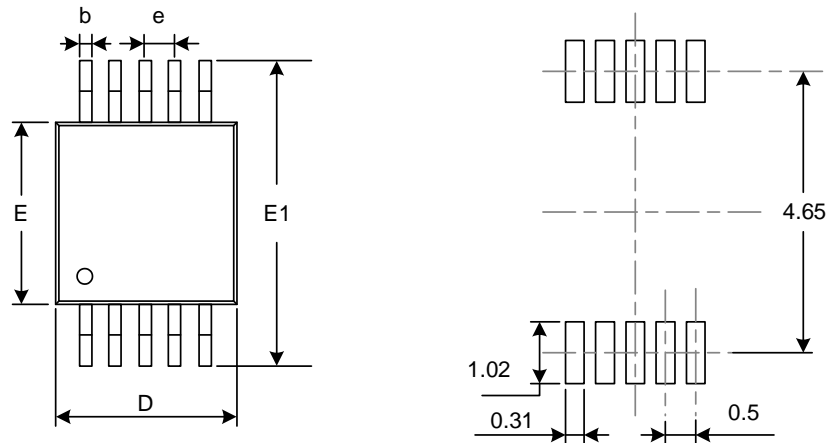
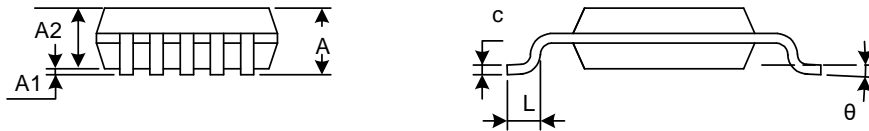


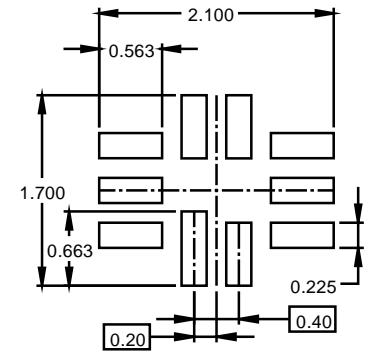
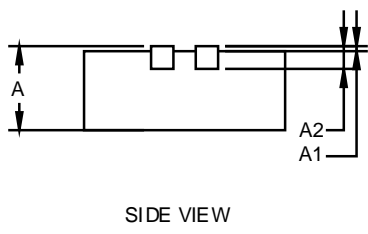
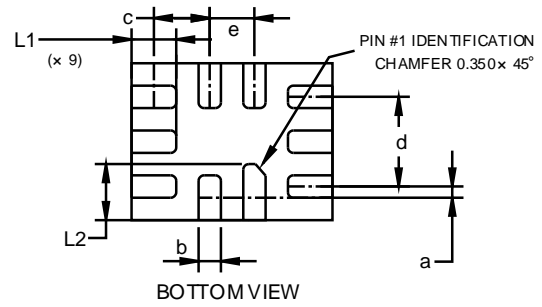
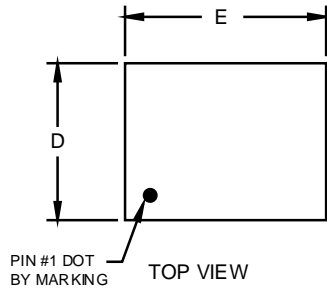
Figure 8. Application Diagram

PACKAGE OUTLINE DIMENSIONS

MSOP10


RECOMMENDED LAND PATTERN (Unit: mm)


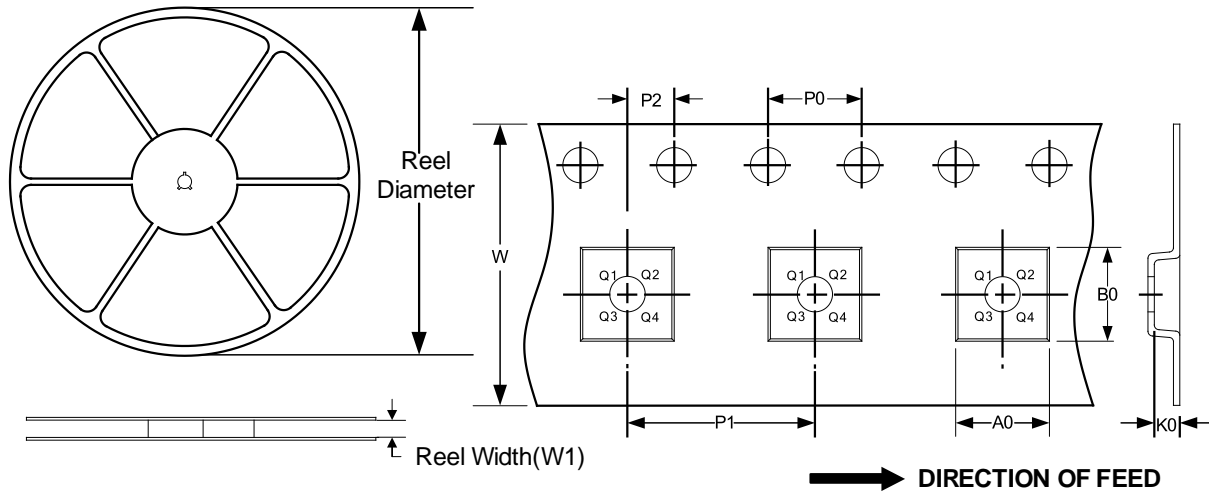
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

UQFN1.4X1.8-10


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
a	0.050	0.150	0.002	0.006
b	0.150	0.250	0.006	0.010
c	0.450	0.550	0.018	0.022
d	0.800 REF		0.031 REF	
D	1.350	1.450	0.053	0.057
E	1.750	1.850	0.069	0.073
e	0.400 TYP		0.016 TYP	
L1	0.350	0.450	0.014	0.018
L2	0.450	0.550	0.018	0.022

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSION



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(mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
MSOP10	13"	12.4	5.20	3.30	1.20	4.0	8.0	2.0	12.0	Q1
UQFN1.4X1.8-10	7"	9.0	1.60	2.00	0.85	4.0	4.0	2.0	8.0	Q1