Power Distribution Switch

Features

- **60mΩ High-Side MOSFET**
- **Available with Current Limits with Foldback**
- **Operating Range:2.7V to 5.5V**
- **1.5mS Typical Rise Time**
- **Fast Overcurrent Response 1.5μs (TYPICAL)**
- **Under voltage Lockout**
- **Logic Level Enable Pin, Available with Active-High or Active-Low Version**
- **No Reverse Current when Power Off**
- **Deglitched Open-Drain Over-Current Flag Output (FLAG)**
- **Output Reverse Current Protection**
- **SOT-23-6, TSOT-23-6 and TDFN2x2-6 Packages (Halogen Free/Pb Free)**
- **UL 2367 Recognition-File NO. E232223**
- **IEC 62368-1 Certified**

Applications

- **High-Side Power Protection Switch**
- **USB Power Management**
- **USB Host and Self-Powered Hubs**
- **USB Bus-Powered Hubs**
- **Hot Plug-In Power Supplies**
- **Battery-Charger Circuits**

General Description

The G517AL is an integrated power switch for self-powered and bus-powered Universal Serial Bus (USB) applications.

Several Protection features include current limiting and thermal shutdown to prevent catastrophic switch failure caused by increasing power dissipation when continuous heavy loads or short circuit occurs. A built-in charge pump is used to drive the N-channel MOSFET that is free of parasitic body diode to eliminate any reversed current flow across the switch when it is powered off. The output reverse-current protection turns off the MOSFET switch whenever the unexpected continuously reverse current occurs.

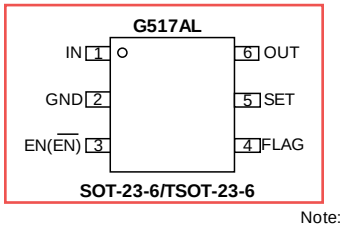
FLAG is an open-drain output report over-current or over-temperature event and has typical 9ms deglitch timeout period.

Ordering Information

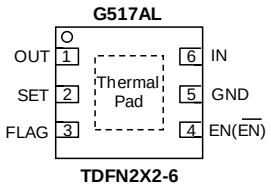
ORDER NUMBER	MARKING	ENABLE	Current Limit	Discharge Resistor	TEMP. RANGE	PACKAGE (Green)
G517AL1TP2U	5A2Ax	Active High	SET	Yes	-40°C to +85°C	TSOT-23-6
G517AL2TP2U	5A2Bx	Active Low	SET	Yes	-40°C to +85°C	TSOT-23-6
G517AL1TB2U	5A2Ax	Active High	SET	Yes	-40°C to +85°C	SOT-23-6
G517AL2TB2U	5A2Bx	Active Low	SET	Yes	-40°C to +85°C	SOT-23-6
G517AL1RB2U	5A2A	Active High	SET	Yes	-40°C to +85°C	TDFN2x2-6
G517AL2RB2U	5A2B	Active Low	SET	Yes	-40°C to +85°C	TDFN2x2-6
G517AL1RB2D	5A2A	Active High	SET	Yes	-40°C to +85°C	TDFN2x2-6
G517AL2RB2D	5A2B	Active Low	SET	Yes	-40°C to +85°C	TDFN2x2-6

Note: TB: SOT-23-6 TP:TSOT-23-6 RB:TDFN2x2-6
2: Bonding Code
U&D: Tape & Reel
Green : Lead Free / Halogen Free

Pin Configuration



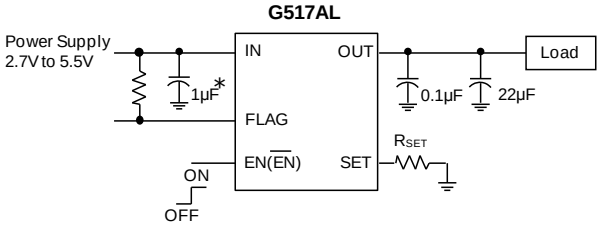
SOT-23-6/TSOT-23-6



TDFN2X2-6

Note: Recommend connecting the Thermal Pad to the GND for excellent power dissipation.

Typical Application Circuit



*: 1μF of input capacitor is enough in most application cases.
If the PCB trace of power rail to IN is long, larger input capacitor is necessary.

Absolute Maximum Ratings

Terminal Voltage (with respect to GND)
IN Pin Voltage, V_{IN} . . . . . -0.3V to +6.0V
OUT Pin Voltage, V_{OUT} . . . . . -0.3V to +6.0V
EN Pin Voltage, V_{EN} . . . . . -0.3V to +6.0V
SET Pin Voltage, V_{SET} . . . . . .-0.3V to V_{IN}+0.3V
FLAG Pin Voltage, V_{FLG}. . . . . -0.3V to +6.0V
Junction Temperature. . . . . .150°C
Storage Temperature (T_S) . . . . . .-65°C to +150°C
Reflow Temperature (soldering, 10sec) . . . . . .260°C
ESD(HBM)(1) 2KV
ESD(MM) 200V
ESD(CDM) 1KV
Output ESD Protection 4KV

Continuous Power Dissipation (T_A =+25°C)*
SOT-23-6. . . . . 0.52W
TSOT-23-6 . . . . . .0.52W
TDFN2X2-6. . . . . .0.55W
Thermal Resistance Junction to Ambient, (θ_{JA})*
SOT-23-6. . . . . 240°C/W
TSOT-23-6 . . . . . .240°C/W
TDFN2X2-6. . . . . 255°C/W
Thermal Resistance Junction to Case, (θ_{JC})
SOT-23-6. . . . . .60°C/W
TSOT-23-6. . . . . .60°C/W
TDFN2X2-6. . . . . 63°C/W

Operating Ratings

Supply Voltage (V_{IN}) . . . . 2.7V to 5.5V
Operating Temperature (T_A). . . . . .-40°C to +85°C

*Please refer to Minimum Footprint PCB Layout Section.

(1) Human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Electrical Characteristics

V_{IN} = 5V, C_{IN}=1μF, C_{OUT}=1μF, R_L=10Ω T_A = 25°C.

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified.

DESCRIPTION	SYMBOL	CONDITION		MIN	TYP	MAX	UNIT
Operation Voltage	V_{IN}			2.7	---	5.5	V
Quiescent Current	I_Q	V_{IN}=5V, I_{OUT}=0, EN($\overline{EN}$) =Active	R_{SET} =20kΩ	---	150	---	μA
			R_{SET} =100kΩ	---	135	---	
Off Supply Current	$I_{Q(OFF)}$	V_{IN}=5.5V, EN($\overline{EN}$) =Inactive		---	---	1	μA
V_{IN} Under-Voltage Lockout	V_{UVLO}			1.7	2.1	2.4	V
Output MOS $R_{DS(ON)}$	$R_{DS(ON)}$	I_{OUT}=2A, R_{SET}=10kΩ		---	60	90	mΩ
R_{SET} Resistor Range		V_{IN}=3V		20	---	100	kΩ
		V_{IN}=5V		10	---	100	
Over Current Trigger Point	I_{LIM}	R_{SET}=9.76kΩ		2.30	2.55	2.81	A
		R_{SET}=24.9kΩ		0.9	1	1.1	
		R_{SET}=100kΩ		0.175	0.25	0.325	
Short-Circuit Fold-Back Current	I_{SFB}	R_{SET}=9.76kΩ, V_{IN}>3.5V and V_{OUT}<1V		---	1.0	---	A
		R_{SET}=24.9kΩ, V_{IN}>3.5V and V_{OUT}<1V		---	0.4	---	
		R_{SET}=100kΩ, V_{IN}>3.5V and V_{OUT}<1V		---	0.1	---	
EN Input Threshold-High VIH	$V_{EN(H)}$	V_{IN}=2.7V to 5.5V		1.4	---	---	V
EN Input Threshold-Low VIL	$V_{EN(L)}$	V_{IN}=2.7V to 5.5V		---	---	0.6	V
Output Turn-on Rising Time	Tr	R_{LOAD}=100Ω, C_{OUT}=1μF, 90% Settling	V_{IN}=5V	1.0	1.5	2	ms
			V_{IN}=3.3V	1.6	2	2.4	
FLAG Deglitch	T_{FLAG}	FLAG assertion or deassertion		5	9	15	ms
Shutdown OUT Pull Low Resistance				---	600	900	Ω
t_{IOS} Response Time to Short Circuit	t_{IOS}	V_{IN}=5V, see figure 1, 2		---	1.5	---	μs
Output Reverse-Current threshold				0.2	1.9	---	A
Output Reverse-Current Deglitch Time		V_{IN}=5V		---	1.25	---	ms
Over Current Regulation Time	T_{REG}	V_{IN}=5V		---	9	---	ms
Over Current Protection Time	T_{OCP}	V_{IN}=5V		---	64	---	ms
Thermal Shutdown	OT	Rising temperature		---	150	---	°C
	OT_{HYS}	Hysteresis		---	20	---	

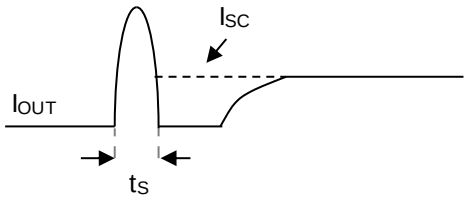


Figure 1

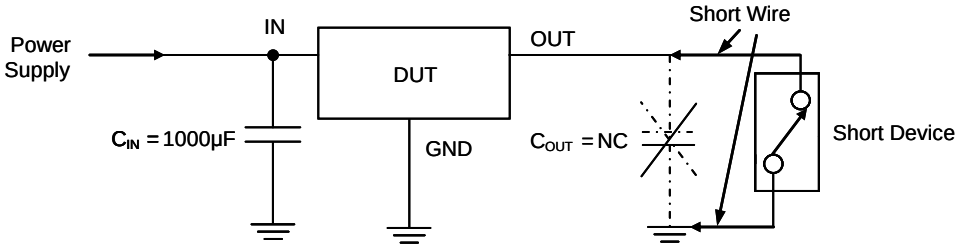


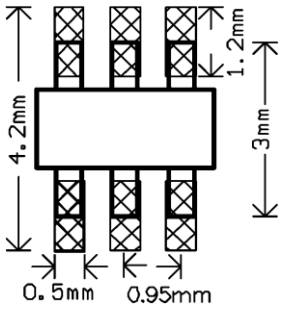
Figure 2

Note:
To exactly identify the short circuit characteristic of IC, avoid the test result interfered by parasitic inductor, output capacitor, and contact resistor. It is necessary to follow the recommendation as follows.

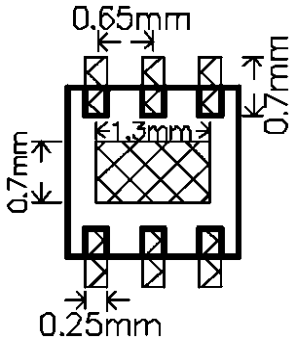
Please,
1. Add 1000μF of capacitor between V_{IN} and GND, and close to IC.
2. Remove output capacitor.
3. Shorter the short circuit device wire.
4. Measure output current (I_{OUT}).

Minimum Footprint PCB Layout Section

SOT-23-6/TSOT-23-6



TDFN2X2-6

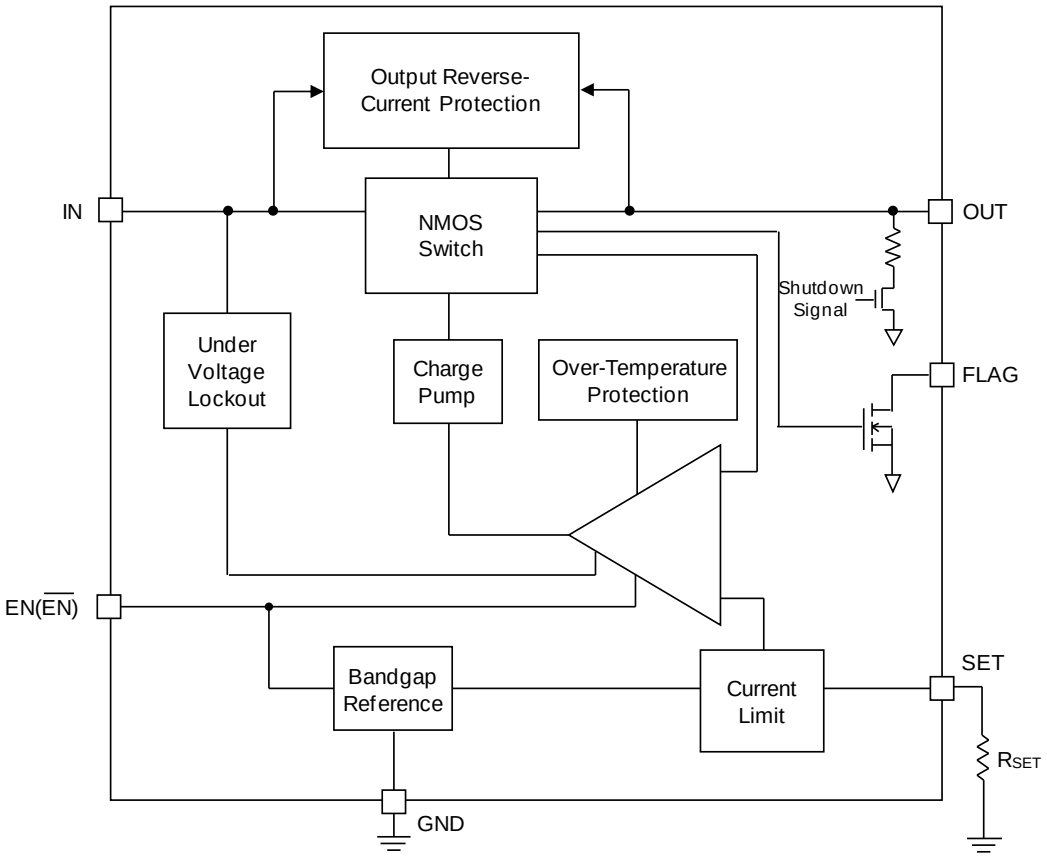


Pin Description

PIN		NAME	FUNCTION
SOT-23-6/TSOT-23-6	TDFN2x2-6		
6	1	OUT	Switch Output
2	5	GND	Ground
4	3	FLAG	Open-Drain Fault Flag (Output): Indicates overcurrent, thermal shutdown
3	4	EN($\overline{EN}$)	Enable Logic Input
5	2	SET	Current limit set input
1	6	IN	Supply Voltage
	Thermal Pad		Recommend connecting the Thermal Pad to the GND for excellent power dissipation.

Available package type is shown on the ordering formation table.

Block Diagrams



Functional Description

Input and Output

IN (input) is the power supply connection to the logic circuitry and the drain of the output MOSFET. OUT (output) is the source of the output MOSFET. In a typical application, current flows through the switch from IN to OUT toward the load. Both OUT pins must be connected together to the load.

Thermal Shutdown

Thermal shutdown protects G517AL from excessive power dissipation. If the die temperature exceeds aforementioned OT spec., the MOSFETS switch is shut off. The hystersis prevents the switch from turning on until the die temperature drops to OT_{HYS}. Thermal shutdown circuit functions only when the switch is enabled.

Undervoltage Lockout

UVLO (undervoltage lockout) prevents the output MOSFET from turning on until IN (input voltage) exceeds 2.1 typically. After the switch turns on, if the voltage drops below 2.1V typically, UVLO shuts off the output MOSFET.

Over Current Trigger Point

The G517AL over current trigger point is programmed with a resistor from SET to ground. The typical value is determined by R_{SET}. We can choose the proper R_{SET} by Table1. There is short-circuit fold-back current limit when V_{IN}>3.5V and V_{OUT}<1V.

Output Reverse Current Protection

The output reverse-current protection turns off the MOSFET switch whenever the unexpected continuously reverse current is higher than the 1.9 (typ) for 1.25ms (typ) and the MOSFET switch will turn on when output reverse-current condition is removed for 1.25ms (typ).

FLAG Function

The FLAG open-drain output is asserted (active low) when an over current condition is encountered after a 9-ms deglitch timeout. The output remains asserted until the overcurrent condition is removed. Over temperature condition is also reported immediately by FLAG open-drain output.

Over Current Regulation and Protection

In over current condition, the temperature of the chip will rise. It results in thermal shutdown of the MOSFETs switch as over current condition is not removed. Then, the device enters in over current regulation and protection modes. In over current regulation mode, the current is regulated to the desired over current level and the MOSFETs switch is turned off in over current protection mode. The over current regulation and protection modes allow the device to release high thermal dissipation within temperature operation condition.

Applications Information

Supply Filtering

A 1µF bypass capacitor from IN to GND, located near the G517AL, is strongly recommended to control supply transients. Without a bypass capacitor, an output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry.

Input transients must not exceed the absolute maximum supply voltage ($V_{IN\ max}$ = 6V) even for a short duration.

EN, the Enable Input

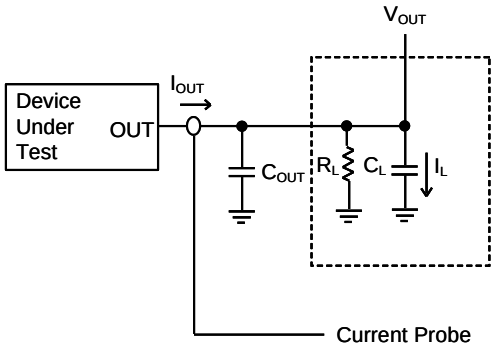
EN must be driven logic high or logic low for a clearly defined input. Floating the input may cause unpredictable operation. EN should not be allowed to go negative with respect to GND.

Table 1. Current Limit RSET Value for G517AL

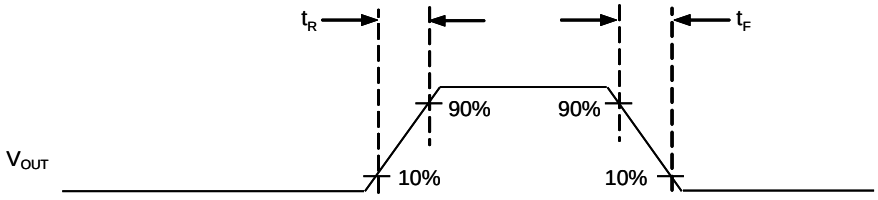
RSET(kΩ)	Current Limit Min (A)		Current Limit Typ (A)	Current Limit Max (A)	
9.76	2.30	(-10%)	2.55	2.81	(+10%)
11	2.04	(-10%)	2.26	2.49	(+10%)
24.9	0.9	(-10%)	1.0	1.1	(+10%)
37.4	0.6	(-15%)	0.7	0.8	(+15%)
49.9	0.425	(-15%)	0.5	0.575	(+15%)
100	0.175	(-30%)	0.25	0.325	(+30%)

Note: The Relationship between RSET (KΩ) and Typical Current Limit (A) is about Current Limit =24.9/(RSET)

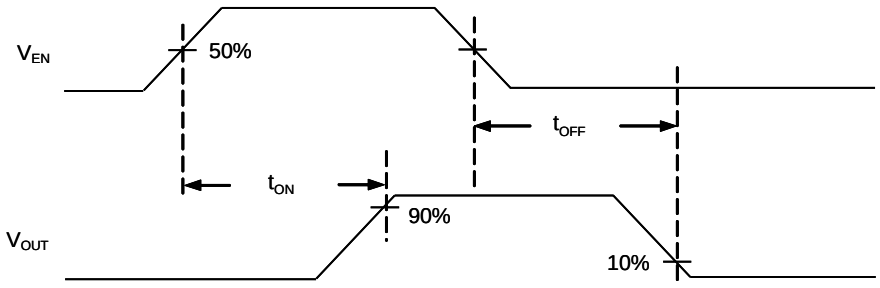
Test Circuit



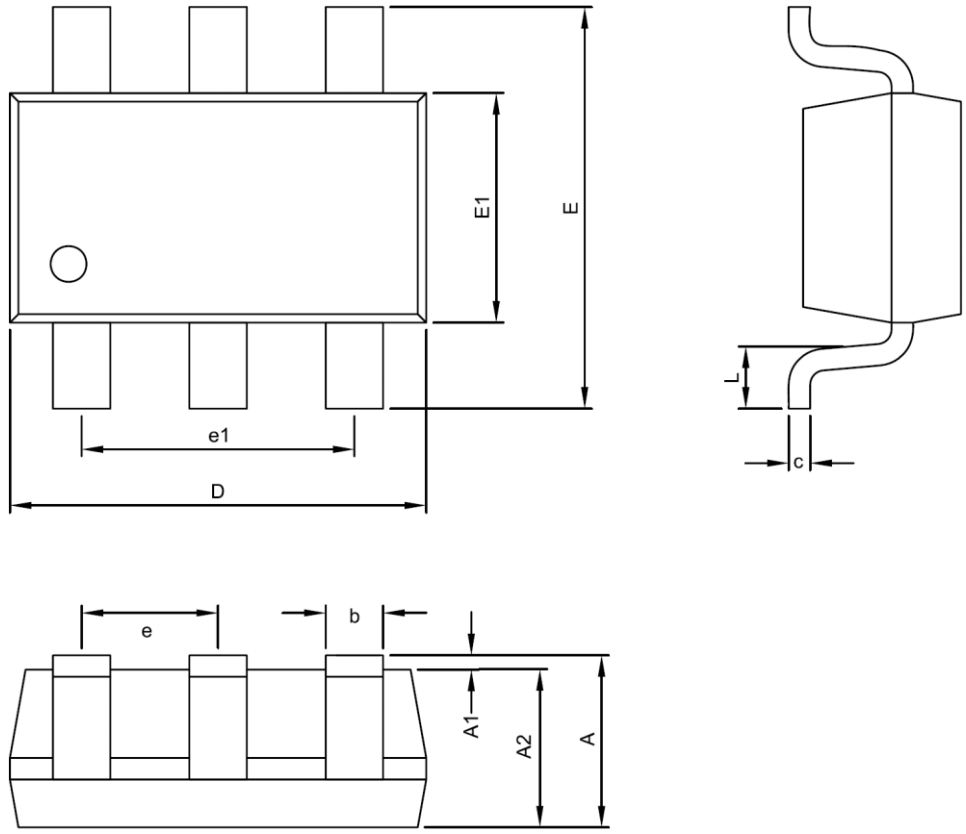
Timing Diagrams



Output Rise and Fall Times



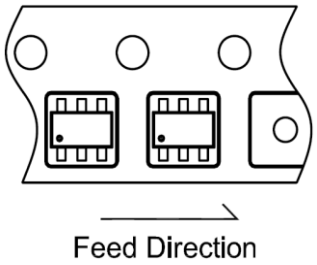
Switch Delay Times



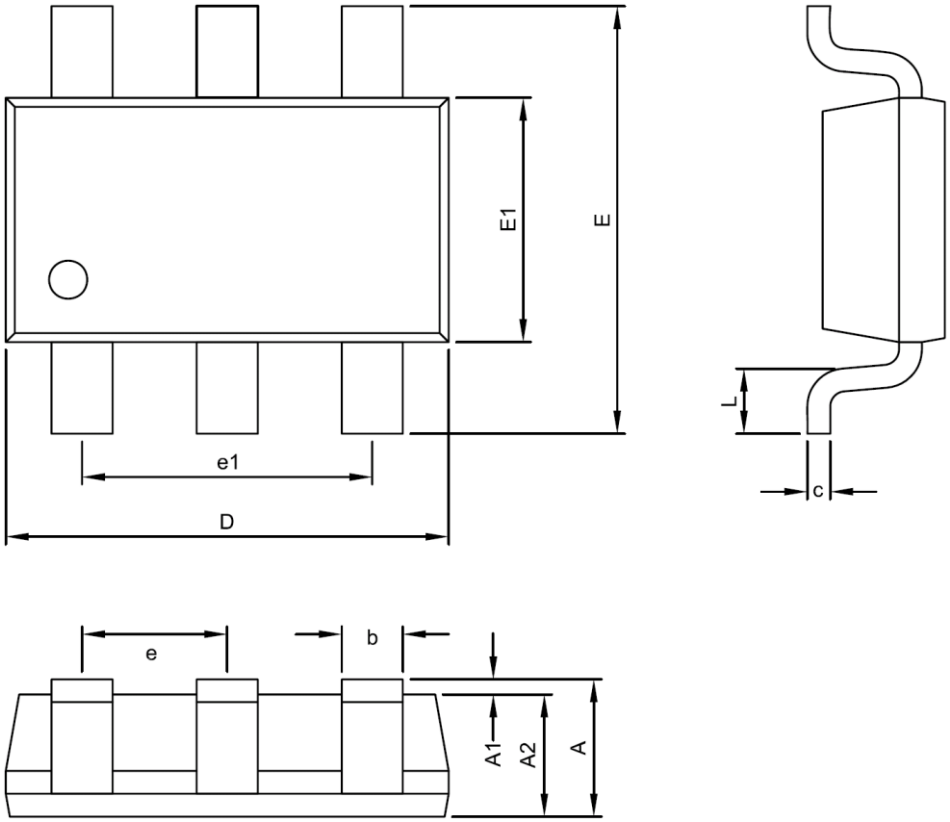
SOT-23-6 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.95	1.10	1.45	0.037	0.043	0.057
A1	0.00	- - -	0.15	0.000	- - -	0.006
A2	0.90	1.10	1.30	0.035	0.043	0.051
D	2.70	2.90	3.10	0.106	0.114	0.122
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
c	0.08	0.15	0.25	0.003	0.006	0.010
b	0.30	0.40	0.50	0.012	0.016	0.020
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	0.45	0.60	0.012	0.018	0.024

Taping Specification



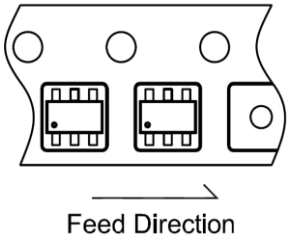
PACKAGE	Q'TY/REEL
SOT-23-6	3,000 ea



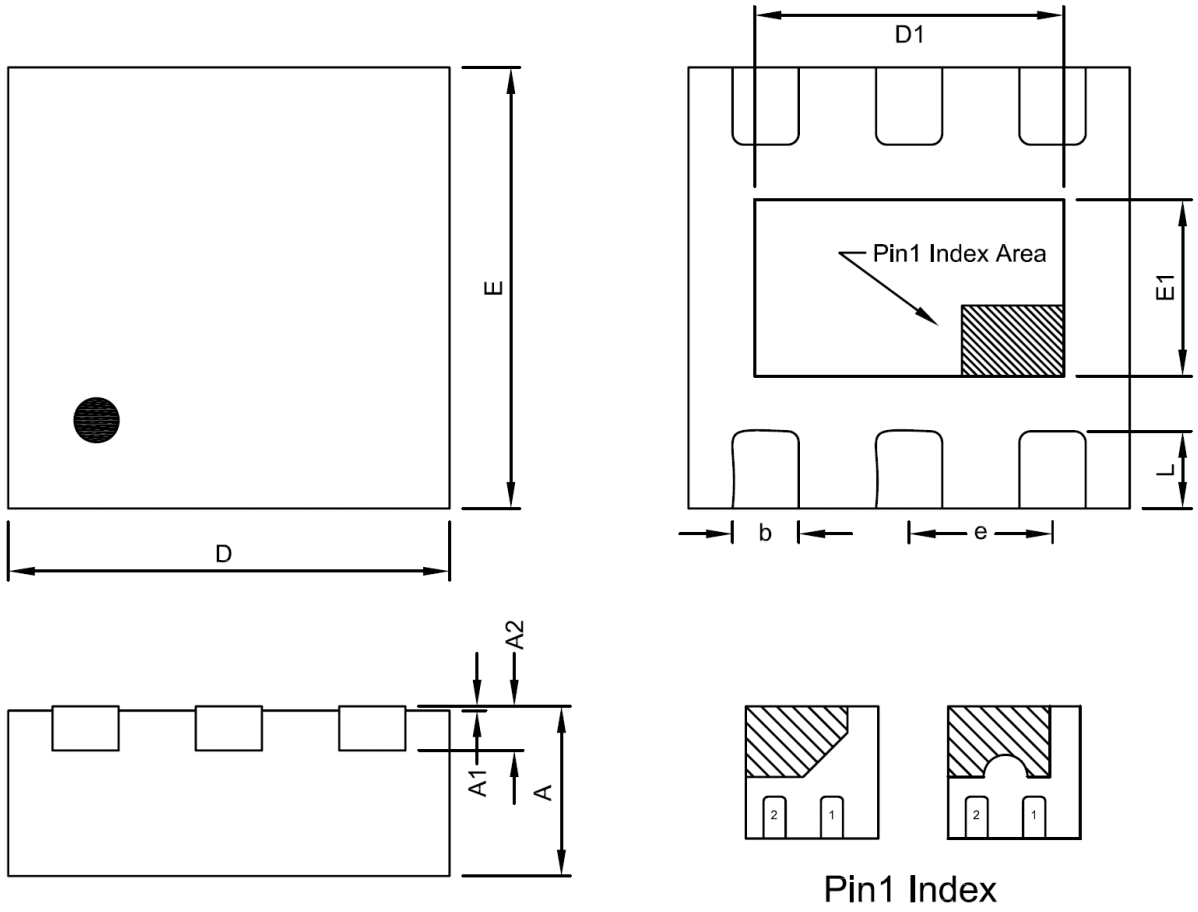
TSOT-23-6 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	- - -	- - -	0.90	- - -	- - -	0.035
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.70	0.75	0.80	0.028	0.030	0.031
D	2.70	2.90	3.10	0.106	0.114	0.122
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
c	0.08	0.15	0.25	0.003	0.006	0.010
b	0.30	0.40	0.50	0.012	0.016	0.020
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	0.45	0.60	0.012	0.018	0.024

Taping Specification



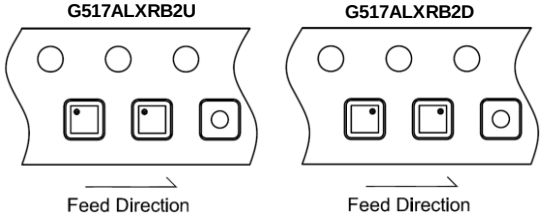
PACKAGE	Q'TY/REEL
TSOT-23-6	3,000 ea



TDFN2X2-6 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.0276	0.0295	0.0315
A1	0.00	- - -	0.05	0.0000	- - -	0.0020
A2	0.20 REF			0.0079 REF		
D	1.95	2.00	2.05	0.0768	0.0787	0.0807
E	1.95	2.00	2.05	0.0768	0.0787	0.0807
D1	1.15	1.30	1.45	0.0453	0.0512	0.0571
E1	0.55	0.70	0.85	0.0217	0.0276	0.0335
b	0.20	0.30	0.35	0.0079	0.0118	0.0138
e	0.65 BSC			0.0256 BSC		
L	0.30	0.35	0.40	0.0118	0.0138	0.0157

Taping Specification



PACKAGE	Q'TY/REEL
TDFN2X2-6	3,000 ea

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