G517AH

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**
- **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 Bubs**
- **USB Bus-Powered Hubs**
- **Hot Plug-In Power Supplies**
- **Battery-Charger Circuits**

General Description

The G517AH 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.

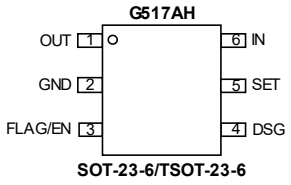
FLAG/EN is an open-drain output report over-current or over-temperature event and has typical 9ms deglitch timeout period.

Ordering Information

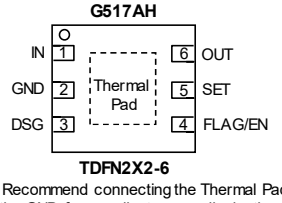
ORDER NUMBER	MARKING	ENABLE	Current Limit	Discharge Resistor	TEMP. RANGE	PACKAGE (Green)
G517AH1TP2U	5A2Cx	Active High	SET	Yes	-40°C to +85°C	TSOT-23-6
G517AH1TB2U	5A2Cx	Active High	SET	Yes	-40°C to +85°C	SOT-23-6
G517AH1RB2U	5A2C	Active High	SET	Yes	-40°C to +85°C	TDFN2x2-6

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

Pin Configuration



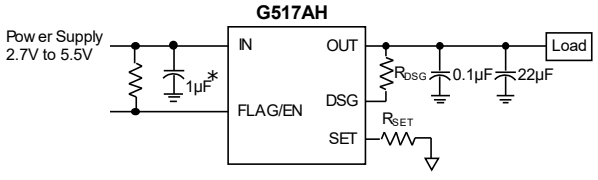
SOT-23-6/TSOT-23-6



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
SET Pin Voltage, V_{SET} . . . . . .-0.3V to V_{IN}+0.3V
FLAG/EN Pin Voltage, $V_{FLG/EN}$. . . . . -0.3V to +6.0V
DSG Pin Voltage, V_{DSG}. . . . . -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, not including I_{RSET}		---	150	200	μA
Off Supply Current	$I_{Q(OFF)}$	V_{IN}=5V, FLAG/EN=0		---	20	40	μA
V_{IN} Under-Voltage Lockout	V_{UVLO}			2.0	---	2.6	V
Output MOS $R_{DS(ON)}$	$R_{DS(ON)}$	I_{OUT}=1.5A, R_{SET}=10.5kΩ			60	90	mΩ
Over Current Trigger Point	I_{LIM}	R_{SET}=7.68kΩ		2.43	2.7	2.97	A
		R_{SET}=21kΩ		0.9	1	1.1	
		R_{SET}=42kΩ		0.4	0.5	0.6	
EN Input Threshold-High VIH	$V_{EN(H)}$	V_{IN}=2.7V to 5.5V		1.2	---	---	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}	Over Current Condition		2	3	4	ms
	T_{SCS}	Short Circuit Start		3	5	7	ms
Shutdown DSG Pull Low Resistance				---	15	30	Ω
t_{IOS} Response Time to Short Circuit	t_{IOS}	V_{IN}=5V, see figure 1, 2		---	1.5	---	μs
Output Reverse-Current Trigger Point		V_{IN}=5V		0.2	0.8	---	A
Output Reverse- Current Deglitch Time		V_{IN}=5V		---	1.25	---	ms
Thermal Shutdown	OT	Rising temperature		---	150	---	°C
	OT_{HYS}	Hysteresis		---	50	---	

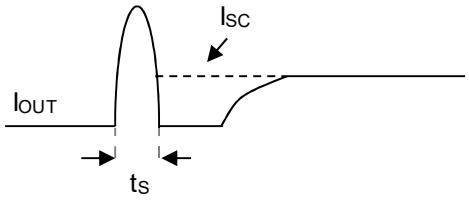


Figure 1

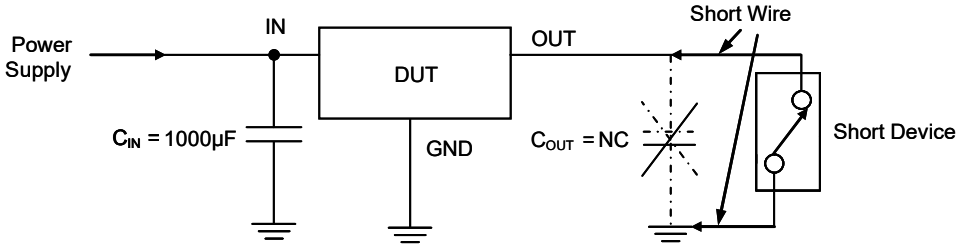


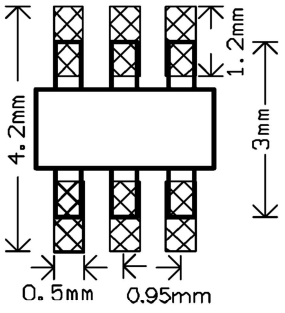
Figure 2

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.

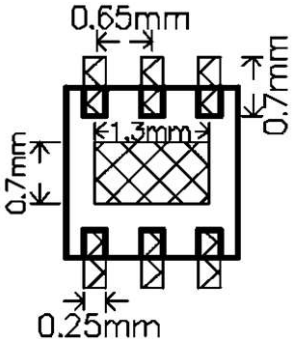
Please,
1. Add 1000μF of capacitor between V_{IN} and GND, and close to IC.
2. Remove output capacitor.
3. Shorter the short circuit device wire.
4. Measure output current (I_{OUT}).

Minimum Footprint PCB Layout Section

SOT-23-6/TSOT-23-6



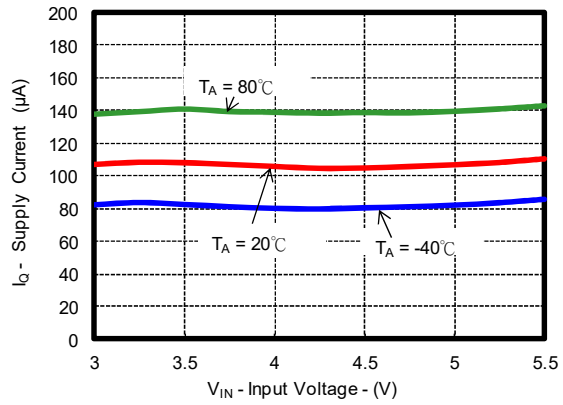
TDFN2X2-6



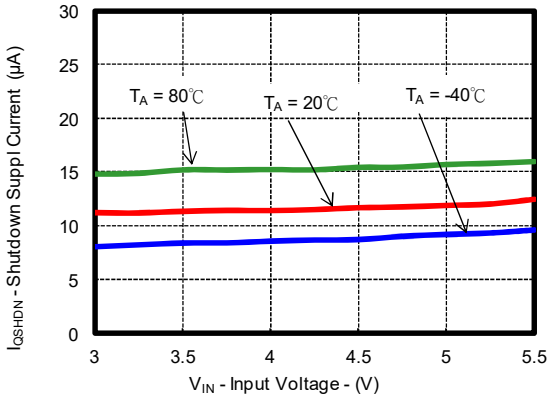
Typical Performance Characteristics

(V_{IN}=5V, C_{IN}=1μF, C_{OUT}=1μF, T_A=25℃, unless otherwise noted.)

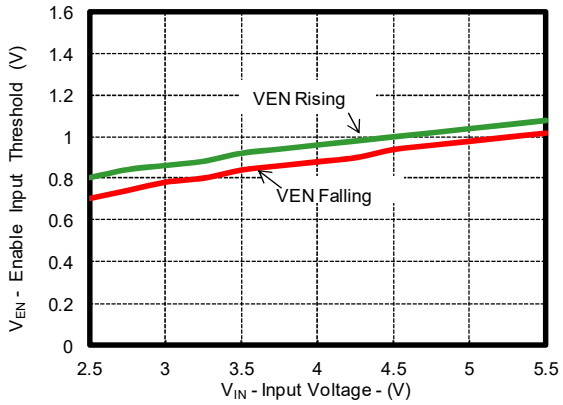
Supply Current vs. Input Voltage



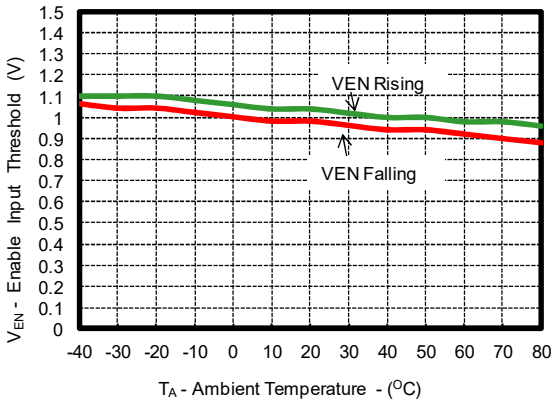
Shutdown Supply Current vs. Input Voltage



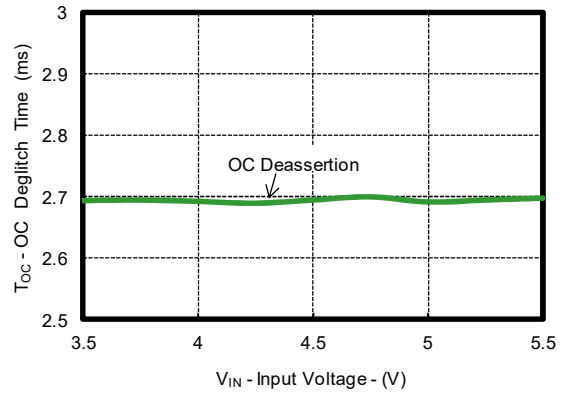
Enable Input Threshold vs. Input Voltage



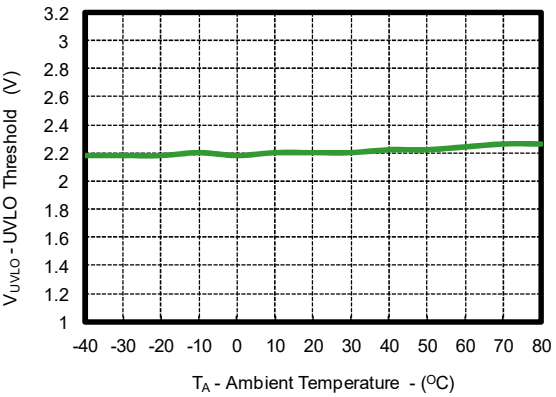
Enable Input Threshold vs. Temperature



OC Deglitch Time vs. Input Voltage

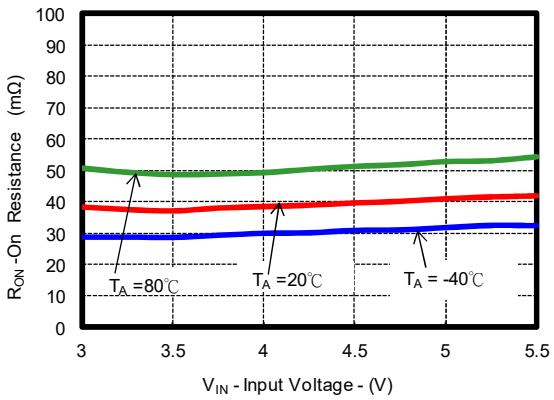


UVLO Threshold vs. Temperature

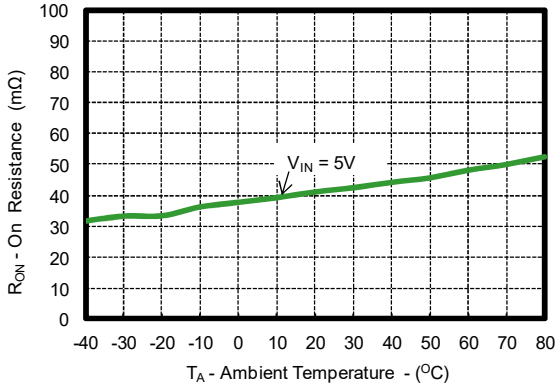


Typical Performance Characteristics (continued)

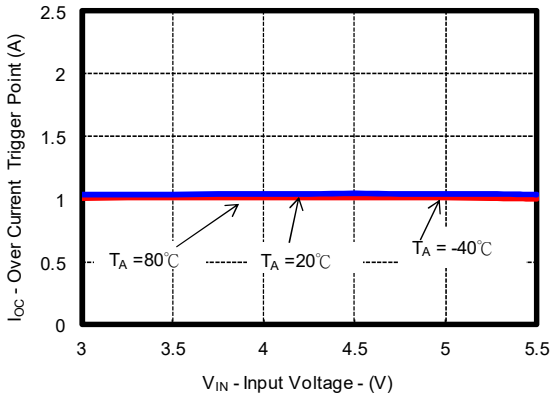
ON-Resistance vs. Input Voltage



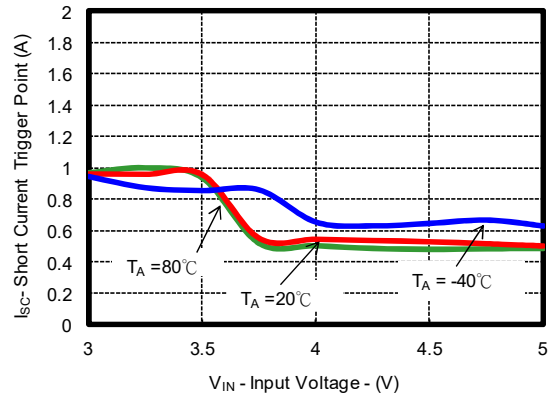
ON-Resistance vs. Temperature



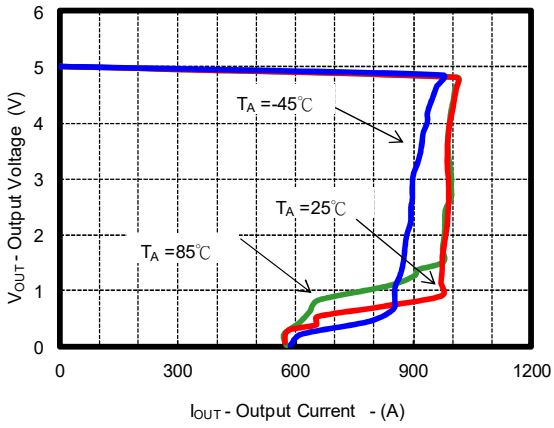
Over Current Trigger Point vs. Input Voltage



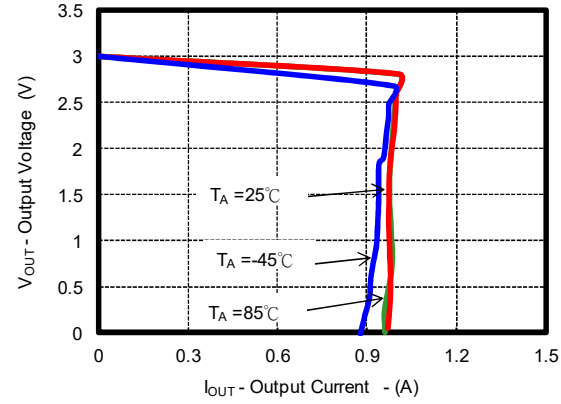
Short Circuit Current vs. Input Voltage



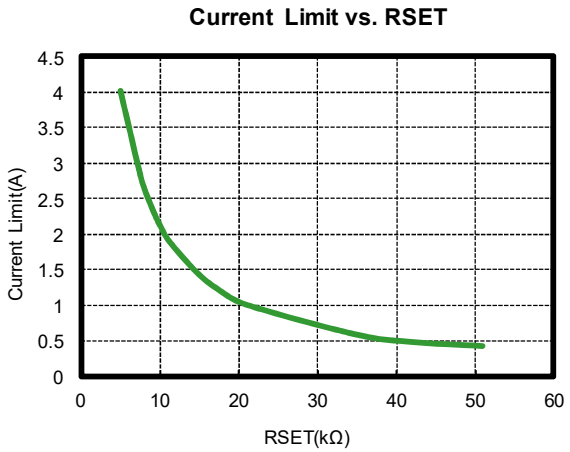
Over Current Protection Characterirtics



Over Current Protection Characterirtics

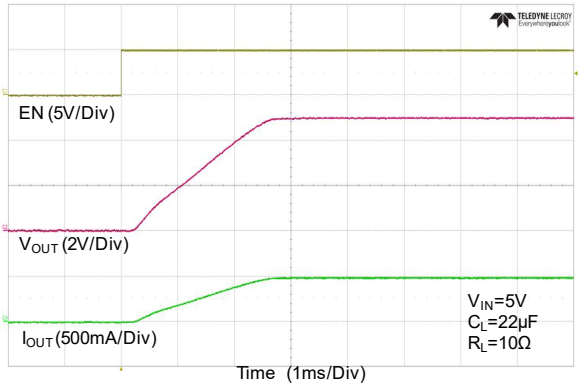


Typical Performance Characteristics (continued)

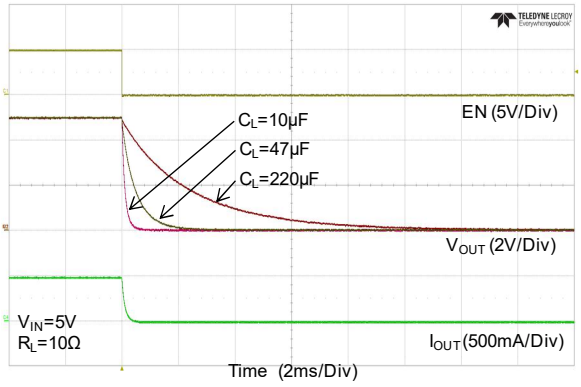


Typical Performance Characteristics (continued)

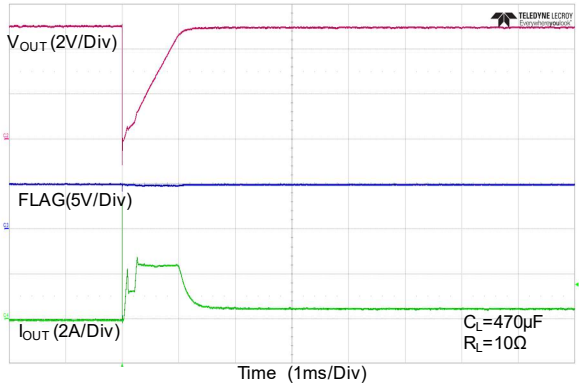
Turn on Delay Time and Rise Time



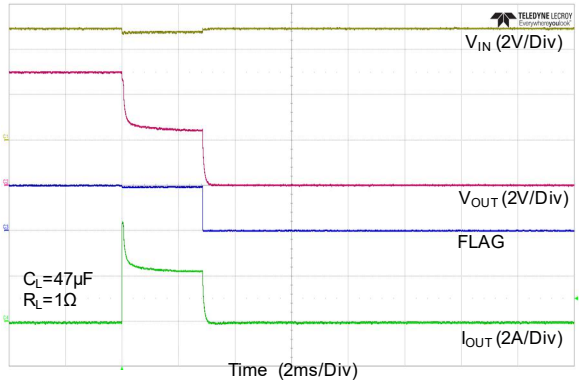
Turn off Delay Time and Fall Time



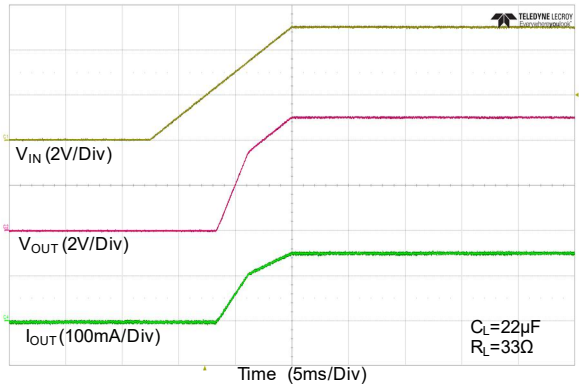
Inrush Current with Load Capacitance



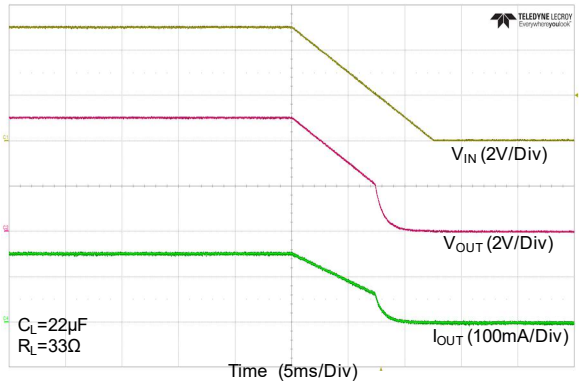
Over Current Protection



UVLO Protection at Rising

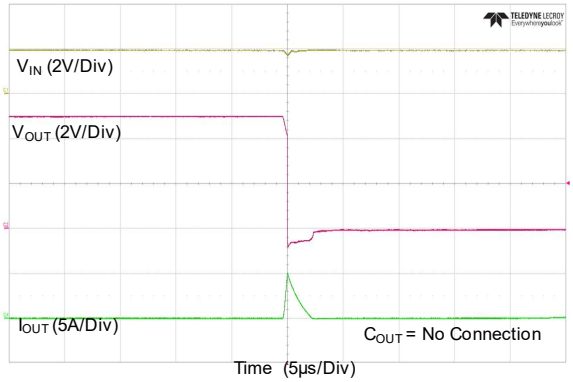


UVLO Protection at Falling

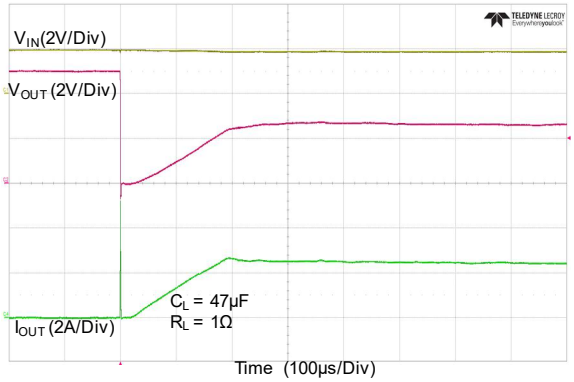


Typical Performance Characteristics (continued)

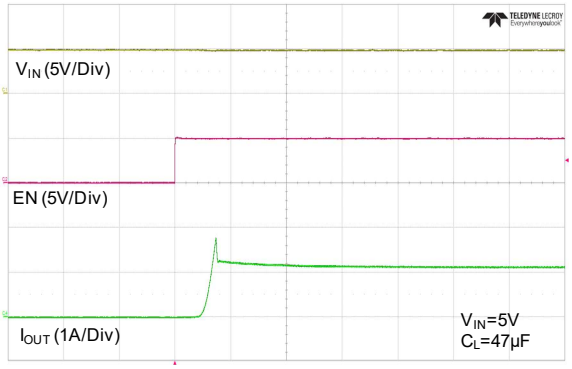
Inrush Short Circuit Response



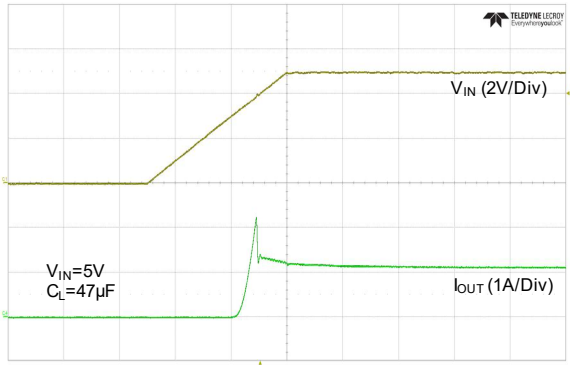
Resistance Load Inrush Response



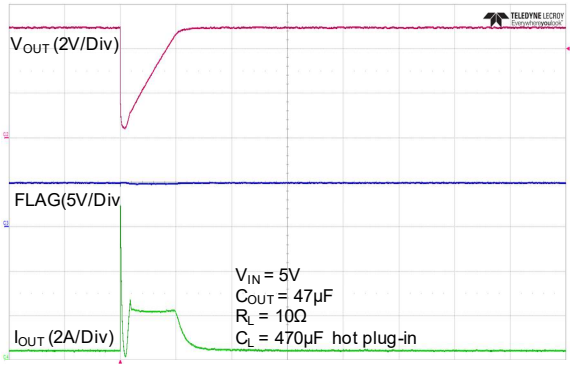
Short Circuit Current,Device Enable into Short



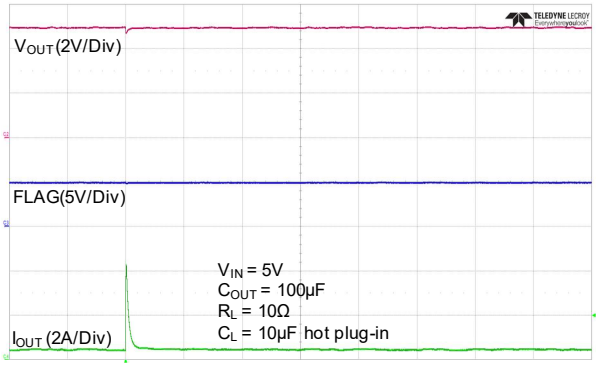
Short Circuit Response at Start up



Capacitance Load Inrush Response

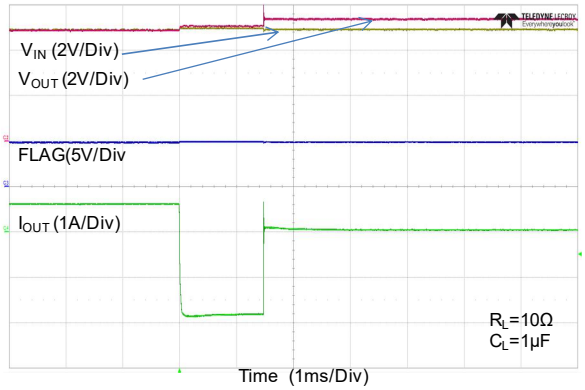


Capacitance Load Inrush Response

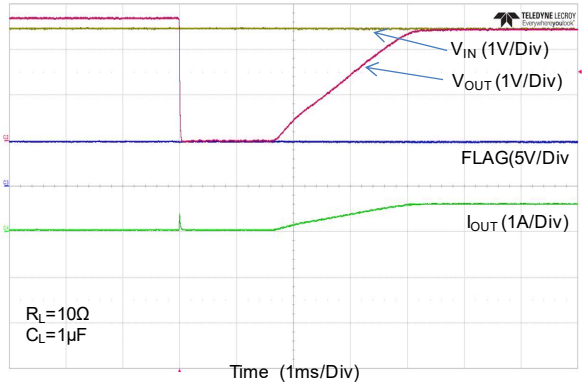


Typical Performance Characteristics (continued)

Reverse Current Protection



Reverse Current Recovery

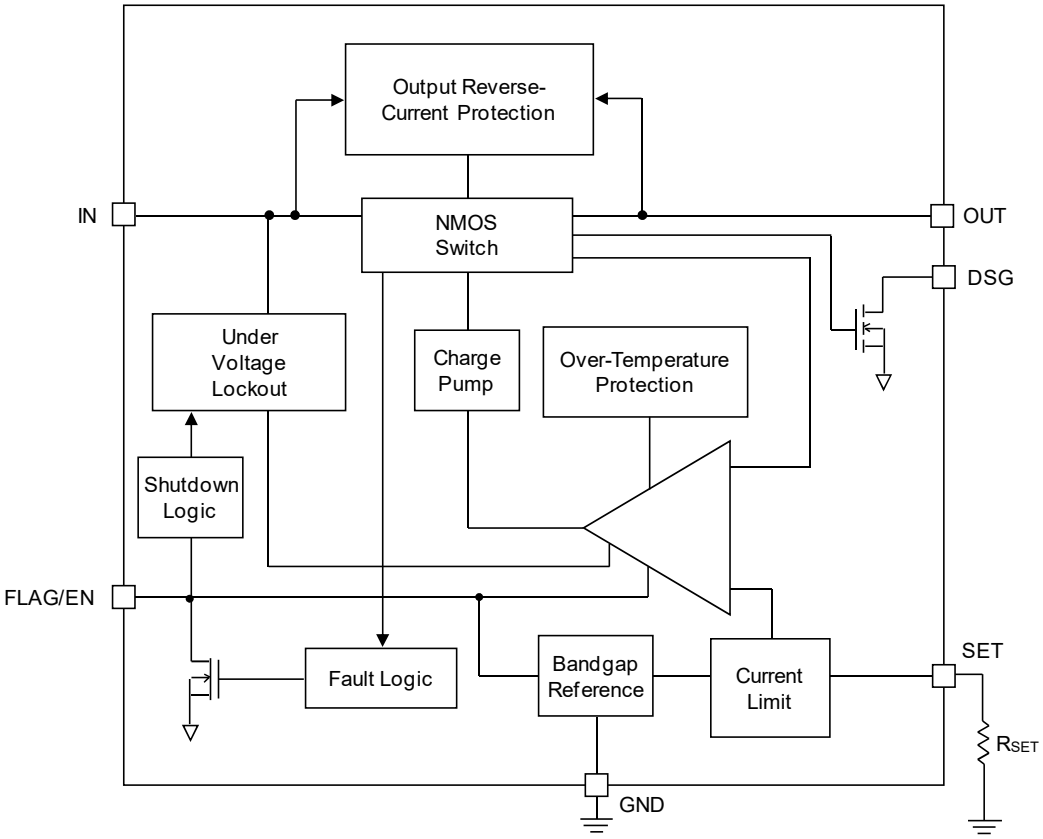


Pin Description

PIN		NAME	FUNCTION
SOT-23-6/TSOT-23-6	TDFN2x2-6		
1	6	OUT	Switch Output
2	2	GND	Ground
3	4	FLAG/EN	A bi-directional interface pin. As an output pin, voltage becomes low to indicate overcurrent and thermal shutdown. As an input pin, high voltage level enables chip and low voltage level disables chip
4	3	DSG	External resistor utilized to set output discharge current
5	5	SET	Current limit set input
6	1	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 G517AH 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 2.4V typically. After the switch turns on, if the voltage drops below 2.2V typically, UVLO shuts off the output MOSFET.

Over Current Trigger Point

The G517AH 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.

Output Reverse Current Protection

The output reverse-current protection turns off the MOSFET switch whenever the unexpected continuously reverse current is higher than the 0.8A for 1.25ms (typ) and the MOSFET switch will turn on when output reverse-current condition is removed for 1.25ms (typ).

Discharge Function

When the device is disabled or IN is below UVLO threshold, the discharge function is active. The discharge function provides a discharge path for external storage capacitor by connecting a resistor between OUT and DSG. 100/75 Ohm is minimum requirement for VIN=5/3 V application.

FLAG/EN Function

This pin serves as both an input and output pin. The FLAG/EN output is asserted (active low) when an over current condition is encountered after a 3ms deglitch timeout. The output remains asserted until the IN voltage is below UVLO to reset the switch. Over temperature condition is also reported immediately by FLAG/EN open-drain output. The FLAG/EN input is inactive with low voltage level and active with high voltage level.

Soft-Start Protection

When power switch turns on, the soft-start protection is utilized to ensure 5ms(typ) on-time of power switch and all operation of G517AH is recommended to be performed after this soft-start protection.

Applications Information

Supply Filtering

A 1µF bypass capacitor from IN to GND, located near the G517AH, 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.

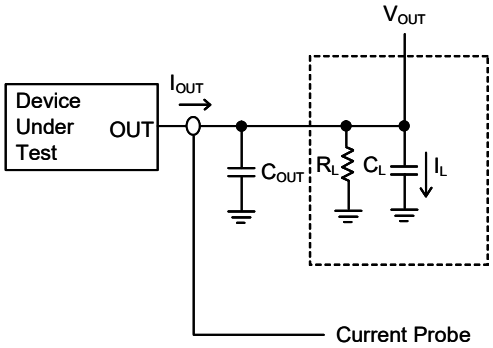
Input transients must not exceed the absolute maximum supply voltage ($V_{IN\ max}$ = 6V) even for a short duration.

Table 1. Current Limit RSET Value for G517AH

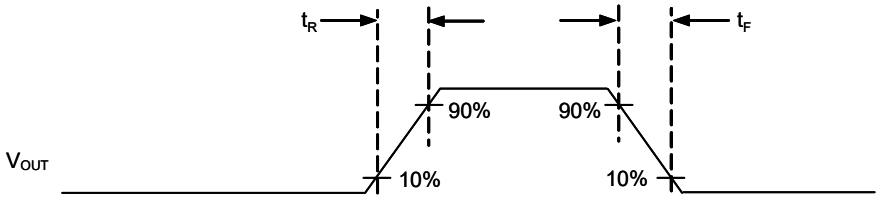
RSET(kΩ)	Current Limit Min (A)		Current Limit Typ (A)	Current Limit Max (A)	
7.68	2.43	(-10%)	2.7	2.97	(+10%)
8.25	2.25	(-10%)	2.5	2.75	(+10%)
9.53	1.98	(-10%)	2.2	2.42	(+10%)
10.5	1.8	(-10%)	2	2.2	(+10%)
11.5	1.62	(-10%)	1.8	1.98	(+10%)
14.3	1.35	(-10%)	1.5	1.65	(+10%)
17.4	1.08	(-10%)	1.2	1.32	(+10%)
21	0.9	(-10%)	1	1.1	(+10%)
34.8	0.5	(-16.7%)	0.6	0.7	(+16.7%)
42	0.4	(-20%)	0.5	0.6	(+20%)

Note: The Relationship between RSET (KΩ) and Typical Current Limit (A) is about Current Limit =21/RSET

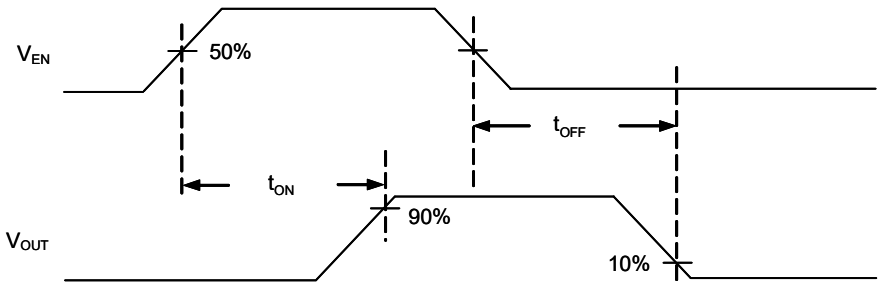
Test Circuit



Timing Diagrams



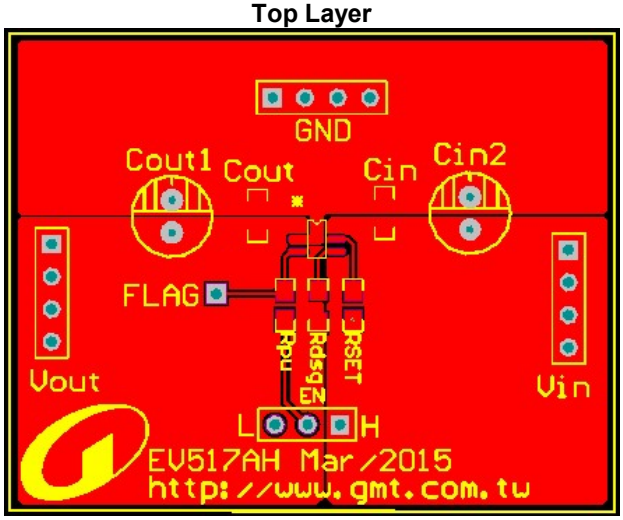
Output Rise and Fall Times



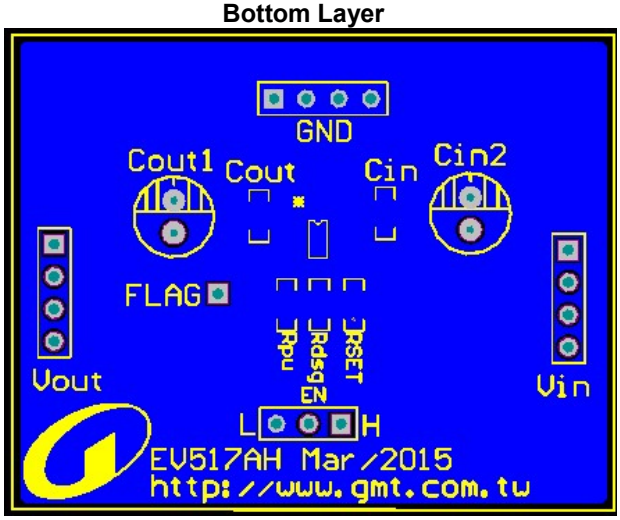
Switch Delay Times

EV Board PCB Layout Section

Top Layer

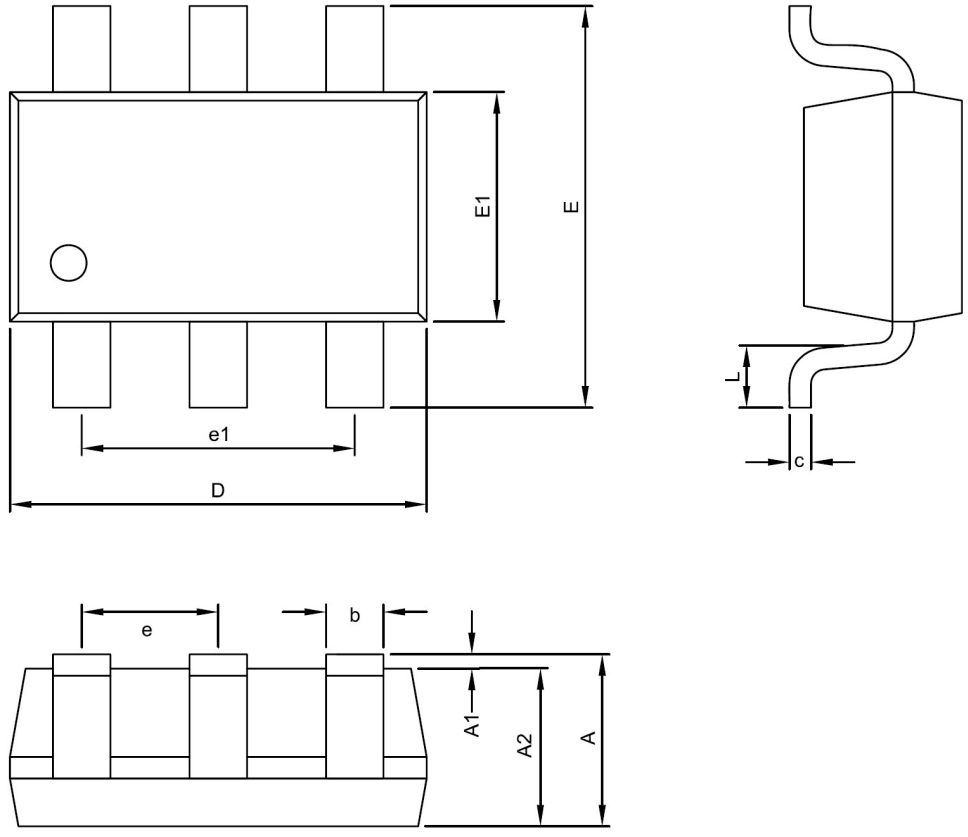


Bottom Layer



EV517AH PCB	Information
Board Material	FR4
Size	47mm×37mm
Board Thickness	1.6mm
Layers	2
Copper Thickness	1 oz.

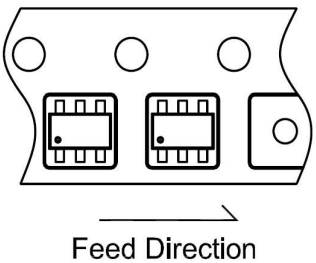
Package Information



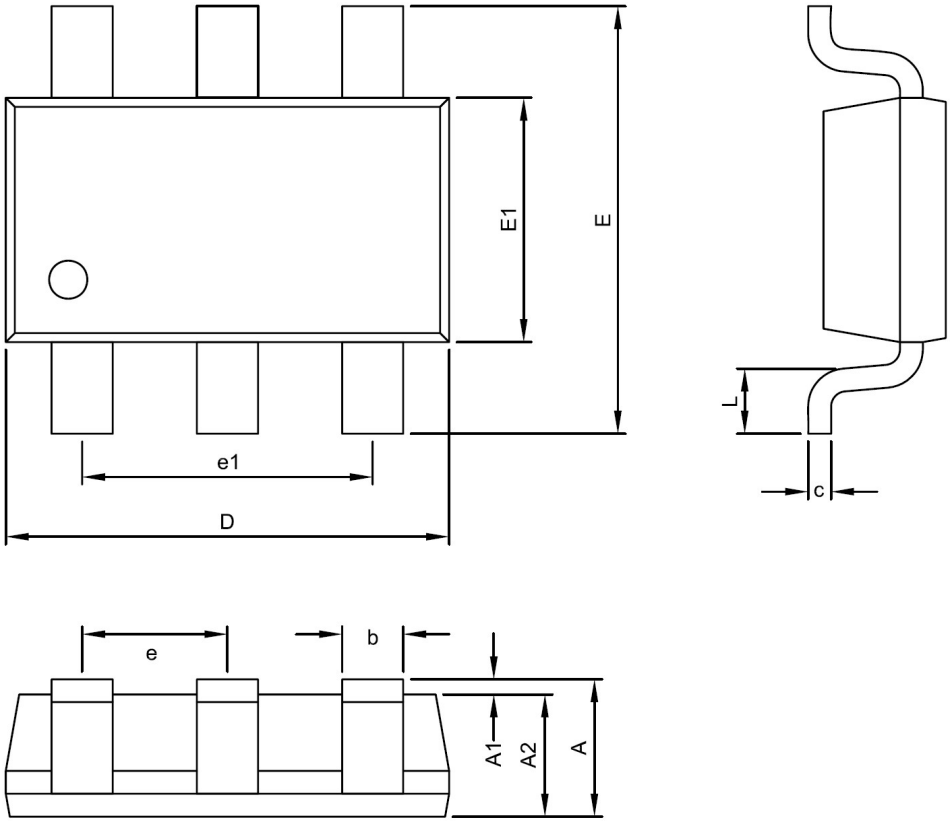
SOT-23-6 Package

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



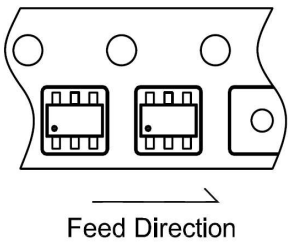
PACKAGE	Q'TY/REEL
SOT-23-6	3,000 ea



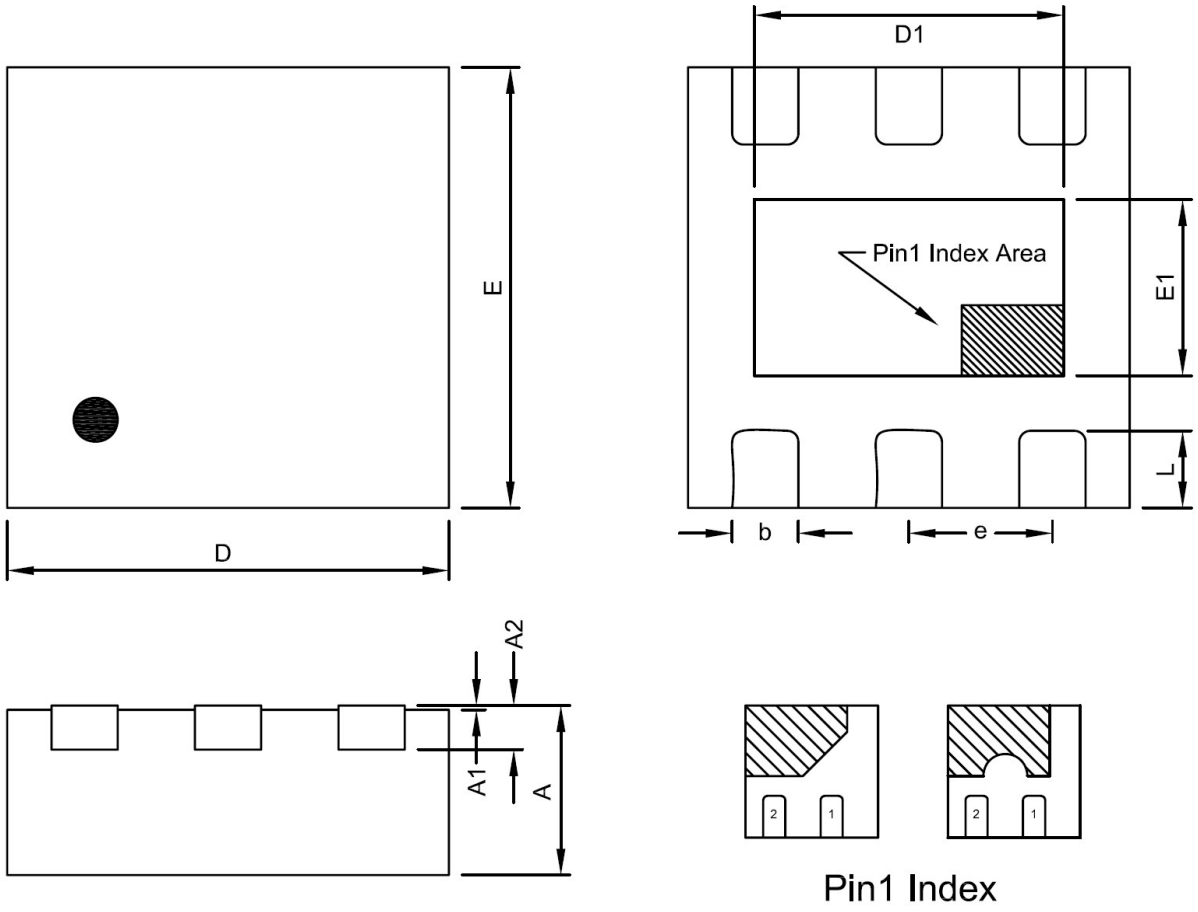
TSOT-23-6 Package

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



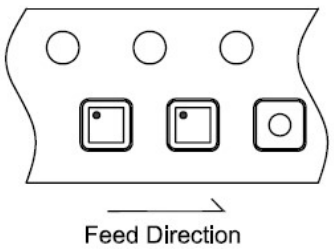
PACKAGE	Q'TY/REEL
TSOT-23-6	3,000 ea



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