

3A Power Distribution Switch with Over-Voltage Protection

Features

- 50mΩ High-Side MOSFET
- 24V Absolute Ratings at VOUT
- 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
- Available with or without Output Shutdown Pull-low Resistor
- Deglitched Open-Drain Over-Current Flag Output (FLAG)
- Output Reverse-Voltage/Current Protection
- VOUT OVP: 5.6V(TYPICAL)
- TSOT-23-5 and TSOT-23-6 FC Package
- 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

Ordering Information

ORDER NUMBER	MARKING	ENABLE	Current Limit	Output Shutdown Resistor	TEMP. RANGE	PACKAGE (Green)
G518A1TO1U	5BA1x	Active High	3.5A	YES	-40°C to +85°C	TSOT-23-5 FC
G518A2TO1U	5BA2x	Active Low	3.5A	YES	-40°C to +85°C	TSOT-23-5 FC
G518A3TO1U	5BA3x	Active High	3.5A	NO	-40°C to +85°C	TSOT-23-5 FC
G518A4TO1U	5BA4x	Active Low	3.5A	NO	-40°C to +85°C	TSOT-23-5 FC
G518B1TP1U	5BB1x	Active High	RSET	YES	-40°C to +85°C	TSOT-23-6 FC
G518B2TP1U	5BB2x	Active Low	RSET	YES	-40°C to +85°C	TSOT-23-6 FC
G518B3TP1U	5BB3x	Active High	RSET	NO	-40°C to +85°C	TSOT-23-6 FC
G518B4TP1U	5BB4x	Active Low	RSET	NO	-40°C to +85°C	TSOT-23-6 FC
G518B1TP2U	5BBAx	Active High	RSET	YES	-40°C to +85°C	TSOT-23-6 FC
G518C1TO1U	5BC1x	Active High	2.5A	YES	-40°C to +85°C	TSOT-23-5 FC
G518C2TO1U	5BC2x	Active Low	2.5A	YES	-40°C to +85°C	TSOT-23-5 FC

Note: TO: TSOT-23-5 FC TP TSOT-23-6 FC

1 & 2: Bonding Code

U: Tape & Reel

Green : Lead Free / Halogen Free.

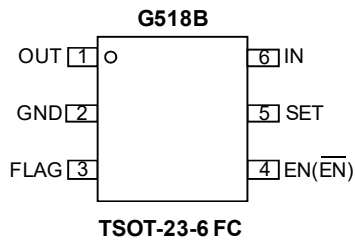
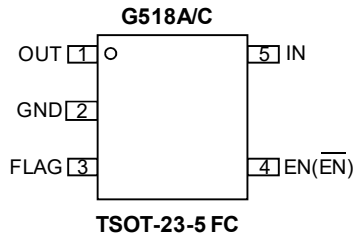
General Description

The G518 is an integrated power switch for self-powered and bus-powered Universal Serial Bus (USB) applications with high output absolute rating of 24V.

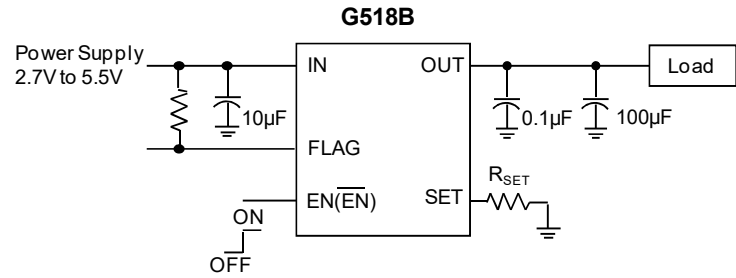
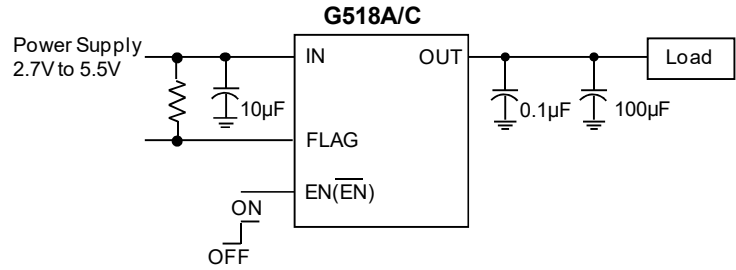
Several Protection features include current limiting and thermal shutdown to prevent catastrophic switch failure caused by increasing power dissipation when continuous heavy loads or short circuit occurs. A built-in charge pump is used to drive the N-channel MOSFET that is free of parasitic body diode to eliminate any reversed current flow across the switch when it is powered off. When the output voltage/current is higher than input voltage, the power switch is turned off by internal output reverse-voltage/current comparator.

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

Pin Configuration



Typical Application Circuit



Absolute Maximum Ratings

Supply Voltage (V_{IN}) -0.3V to 6V
 Output Voltage (V_{OUT}) -0.3V to 24V
 Output Current (I_{OUT}) Internally Limited
 Enable Input (V_{EN}) -0.3V to 6V
 SET Pin Voltage, V_{SET} -0.3V to $V_{IN}+0.3V$
 FLAG Output (FLAG) -0.3V to 6V
 Thermal Resistance Junction to Ambient, (θ_{JA})*
 TSOT-23-5/6 FC. 148°C/W
 Continuous Power Dissipation ($T_A = +25^\circ\text{C}$)*
 TSOT-23-5/6 FC. 0.8W
 Thermal Resistance Junction to Case, (θ_{JC})
 TSOT-23-5/6 FC. 33°C/W
 Junction Temperature 150°C

Storage Temperature (T_S) -65°C to +150°C
 Reflow Temperature (soldering, 10sec) 260°C
 HBM ESD Protection 2kV
 CDM ESD Protection 2.5kV
 SYSTEM LEVEL ESD Protection (AIR).....15kV
 SYSTEM LEVEL ESD Protection (Contact).....8kV

Operating Ratings

Supply Voltage (V_{IN}) 2.7V to 5.5V
 Output Voltage (V_{OUT}) 4V to 22V
 Operating Temperature (T_A) -40°C to +85°C

*HBM: JESD22-A114, CDM: JESD22-C101, SYSTEM LEVEL: IEC61000-4-2.

*Please refer to Minimum Footprint PCB Layout Section.

Electrical Characteristics

$V_{IN} = 5V$, $C_{IN}=1\mu F$, $C_{OUT}=1\mu F$, $R_L=10\Omega$, $T_A = 25^\circ\text{C}$.

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.

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Input Voltage Range	V_{IN}		2.7	---	5.5	V
Quiescent Current	I_Q	G518A/C	---	100	160	μA
		G518B	$R_{SET}=6k\Omega$	---	150	μA
			$R_{SET}=21k\Omega$	---	120	μA
		G518B1TP2U	$R_{SET}=2k\Omega$	---	220	μA
			$R_{SET}=6.8k\Omega$	---	140	μA
Off Supply Current	$I_{Q(OFF)}$	$V_{IN}=5V$, $EN(\overline{EN})$ =Inactive	---	4	10	μA
V_{IN} Under Voltage Lockout	V_{UVLO}		2.0	2.2	2.4	V
V_{OUT} Over-Voltage Protection(OVP)	V_{OUT_OVP}	V_{OUT} Rising Threshold	---	5.6	---	V
		V_{OUT} Falling Threshold	---	5.5	---	V
V_{OUT} OVP Hysteresis	V_{OUT_HYS}	V_{OUT} Falling Threshold	---	0.1	---	V
OVP Response Time	t_{OVP}	$V_{OUT}=5.5V$ to 6V	---	1	---	μs
Output MOS $R_{DS(ON)}$	$R_{DS(ON)}$	G518A, $I_{OUT}=3A$	---	50	--	m Ω
		G518B,	$I_{OUT}=3A$ with $R_{SET}=6k\Omega$	---	50	m Ω
			$I_{OUT}=0.8A$ with $R_{SET}=21k\Omega$	---	50	m Ω
		G518B1TP2U	$I_{OUT}=3A$ with $R_{SET}=2k\Omega$	---	50	m Ω
			$I_{OUT}=0.8A$ with $R_{SET}=6.8k\Omega$	---	50	m Ω
		G518C, $I_{OUT}=1.5A$	---	50	--	m Ω
Over Current Trigger Point	I_{LIM}	G518A	3.1	3.5	4	A
		G518B	$R_{SET}=6k\Omega$	3.1	3.5	A
			$R_{SET}=21k\Omega$	0.8	1	A
		G518B1TP2U	$R_{SET}=2k\Omega$	3.1	3.5	A
			$R_{SET}=6.8k\Omega$	0.8	1	A
		G518C	1.6	2.0	2.4	A
Short-Circuit Fold-Back Current	I_{SFB}	G518A, $V_{IN}>3.5V$ and $V_{OUT}<1V$	--	2.3	--	A
		G518B	$R_{SET}=6k\Omega$	---	2.3	A
			$R_{SET}=21k\Omega$	---	0.67	A
		G518B1TP2U	$R_{SET}=2k\Omega$	---	2.3	A
			$R_{SET}=6.8k\Omega$	---	0.67	A
		G518C, $V_{IN}>3.5V$ and $V_{OUT}<1V$	---	1.3	---	A
EN Input Threshold-High V_{IH}	$V_{EN(H)}$		1.2	---	---	V
EN Input Threshold-Low V_{IL}	$V_{EN(L)}$		---	---	0.6	V

Electrical Characteristics (Continued)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Output Turn-on Rising Time	T_r	$R_{LOAD}=10\Omega$, $C_{OUT}=10\mu F$, 90% Settling	$V_{IN}=5V$ 1	1.5	2	ms
			$V_{IN}=3.3V$ 1.6	2.2	2.8	
FLAG Deglitch	T_{FLAG}	FLAG assertion or deassertion	6	9	12	ms
Shutdown OUT Pull Low Resistance			---	150	225	Ω
t_{IOS} Response Time to Short Circuit	t_{IOS}	$V_{IN}=5V$, see figure 1,2	---	1.5	---	μs
Output Leakage Current		EN="0", $V_{OUT}=5V$	---	0.5	1	μA
Output Reverse-Current threshold			0.2	---	---	A
Output Reverse-Current Deglitch Time	T_{OCP}	$V_{IN}=5V$, G518A/B/C	---	5	---	ms
Thermal Limit	OT		---	140	---	$^{\circ}C$
Thermal Limit Hysteresis	OT_{HYS}		---	20	---	$^{\circ}C$
Discharge Time	T_{DS}		---	130	---	ms

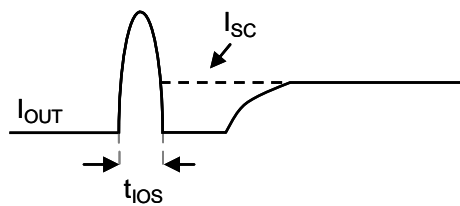


Figure 1

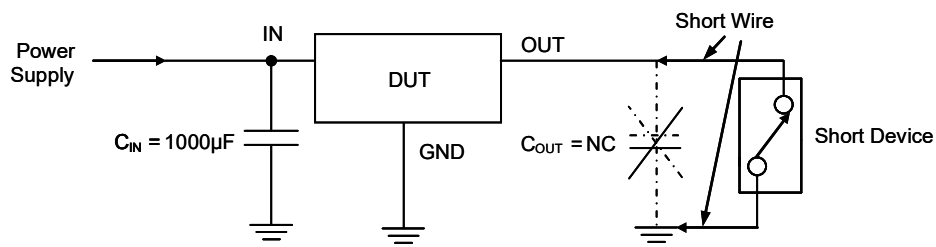


Figure 2

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.

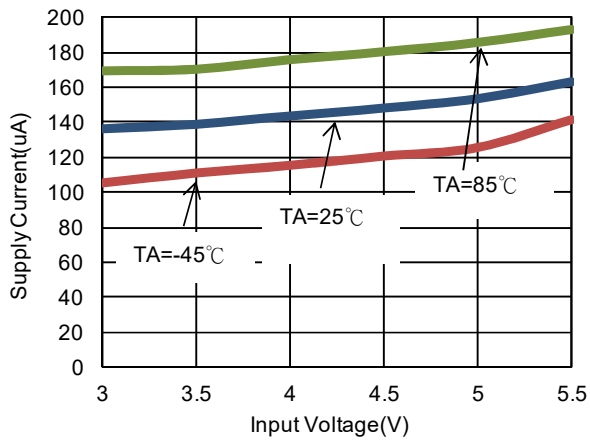
Please,

1. Add 1000 μF 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}).

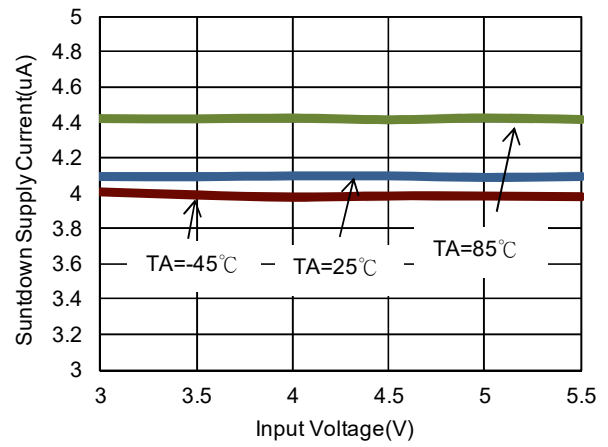
Typical Performance Characteristics

G518A, $V_{IN}=5V$, $C_{IN}=10\mu F$, $C_{OUT}=100\mu F$, $T_A=25^\circ C$, unless otherwise noted.)

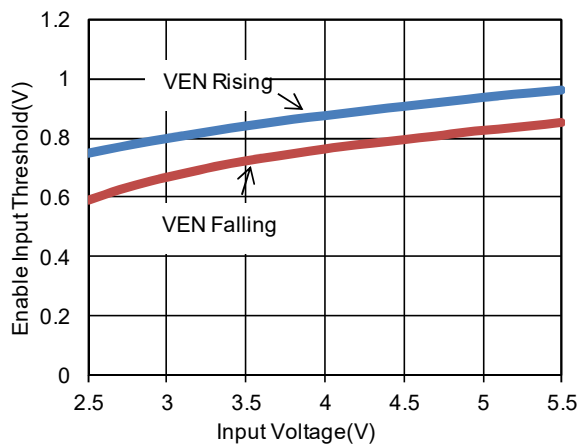
Supply Current vs. Input Voltage



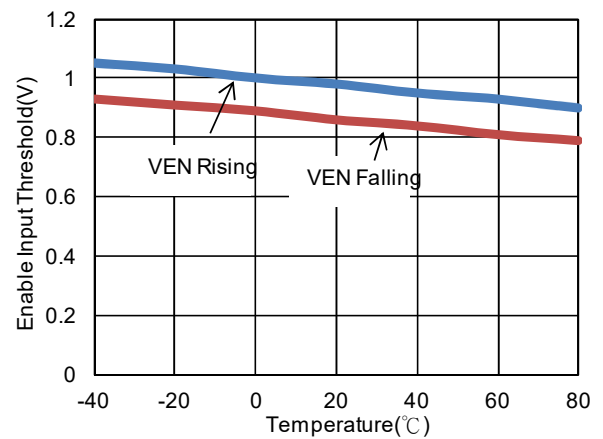
Shutdown Supply Current vs. Input Voltage



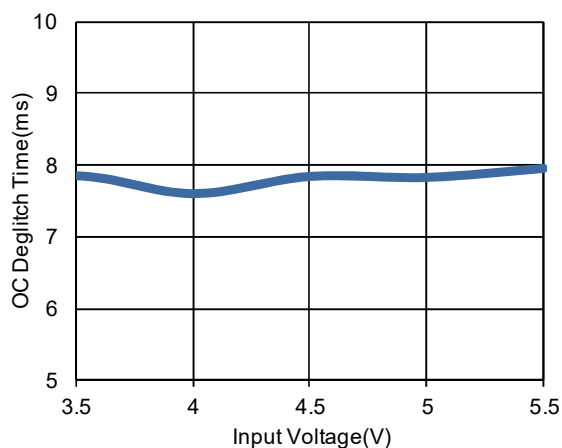
Enable Input Threshold vs. Input Voltage



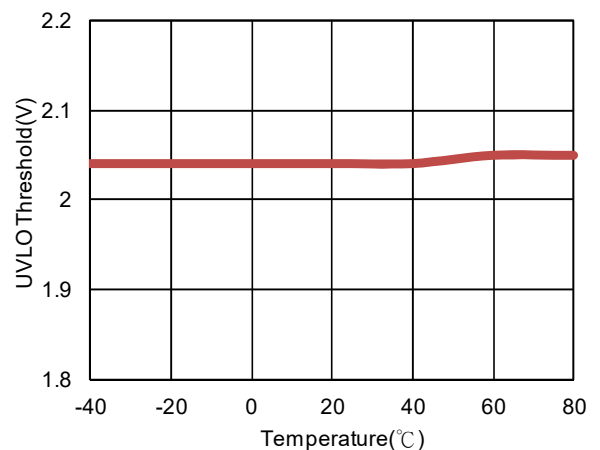
Enable Input Threshold vs. Temperature



OC Deglitch Time vs. Input Voltage

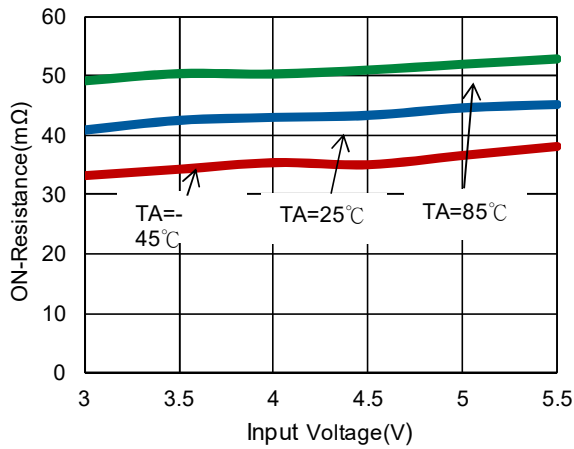


UVLO Threshold vs. Temperature

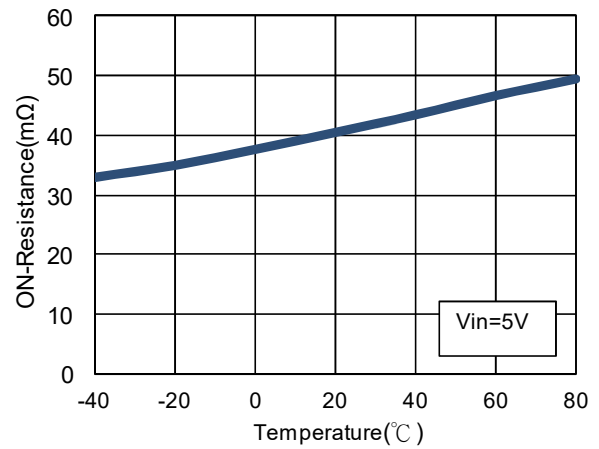


Typical Performance Characteristics (continued)

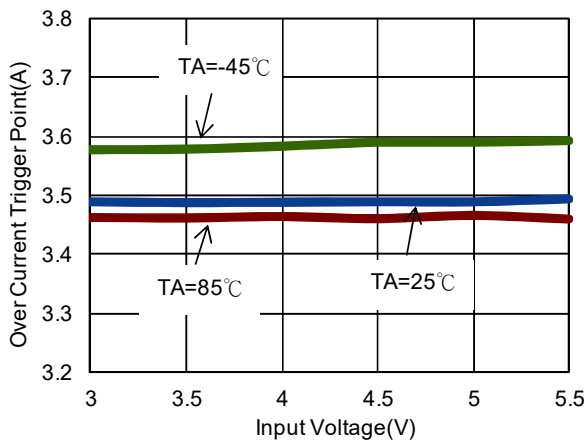
ON-Resistance vs. Input Voltage



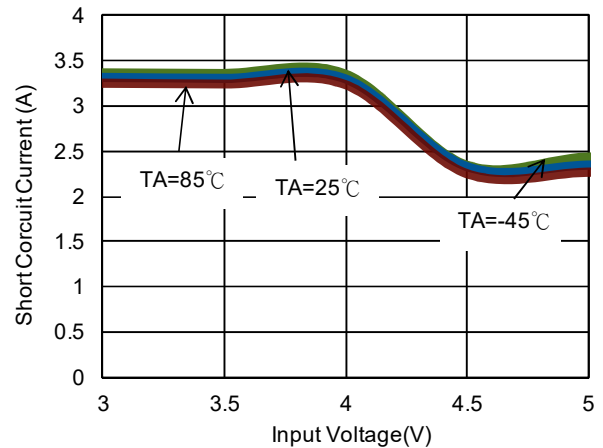
ON-Resistance vs. Temperature



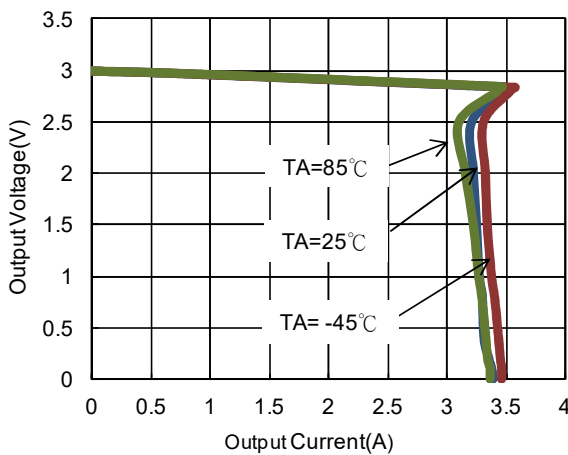
Over Current Trigger Point vs. Input Voltage



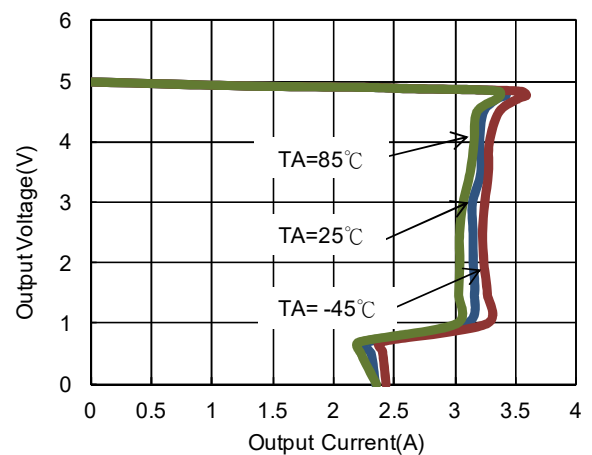
Short Circuit Current vs. Input Voltage



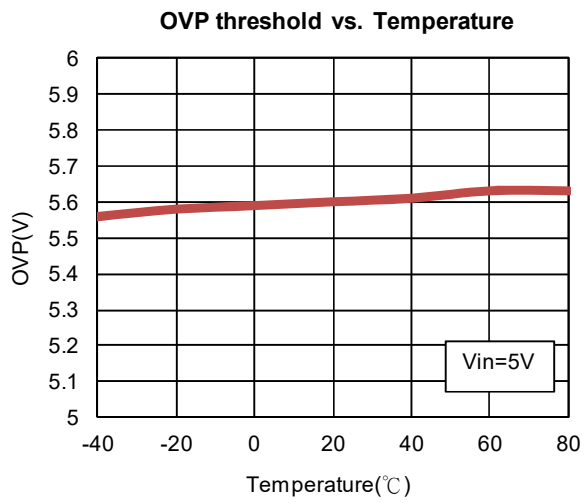
Overcurrent Protection Characteristics



Overcurrent Protection Characteristics



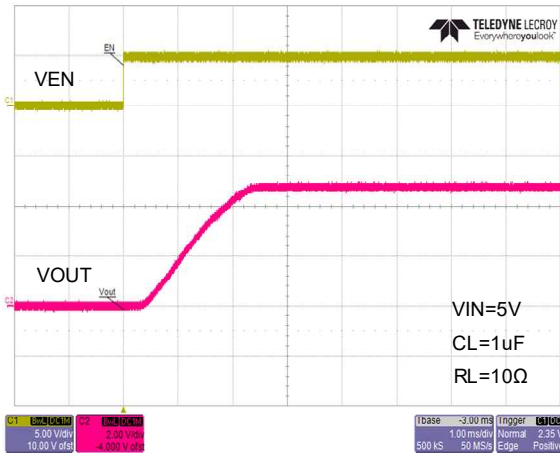
Typical Performance Characteristics (continued)



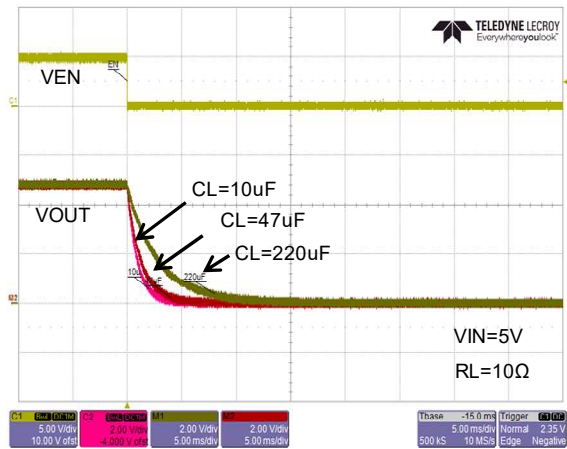
Typical Performance Characteristics (continued)

G518A, $V_{IN}=5V$, $C_{IN}=10\mu F$, $C_{OUT}=100\mu F$, $T_A=25^\circ C$, unless otherwise noted.)

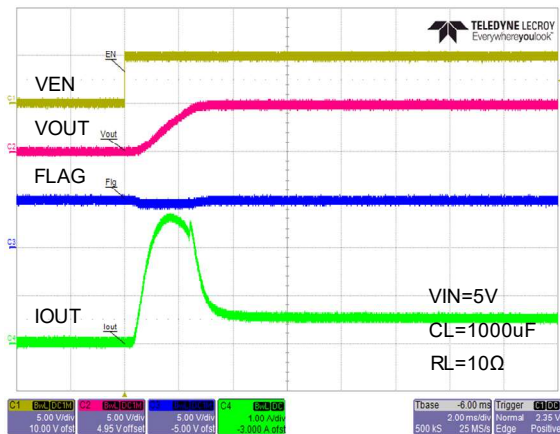
Turn on Delay Time and Rise Time



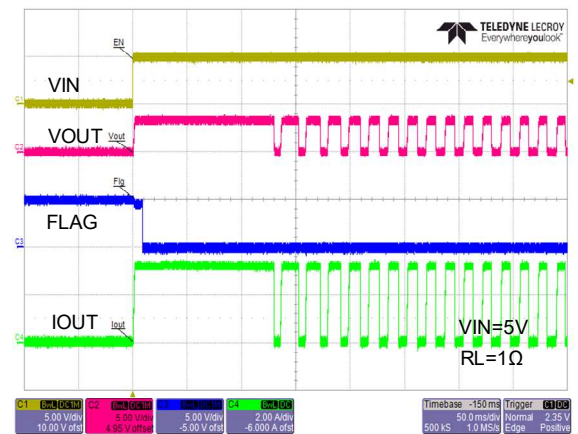
Turn off Delay Time and Fall Time



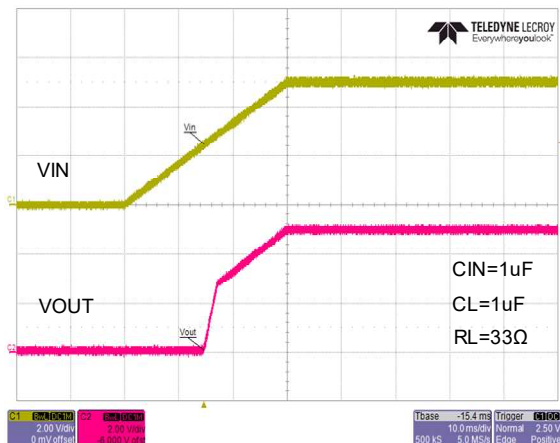
Inrush Current with Load Capacitance



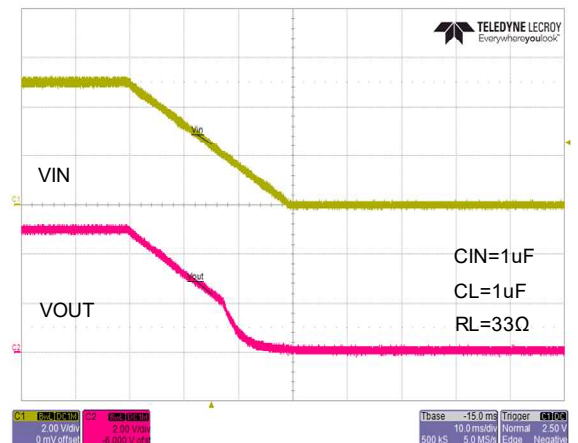
Thermal shutdown Reponse



UVLO Protection at Rising

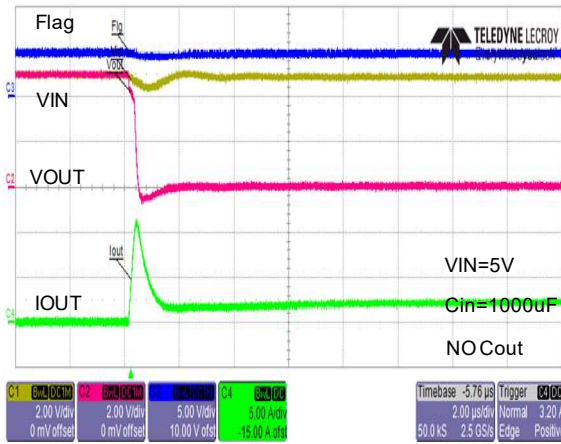


UVLO Protection at Falling

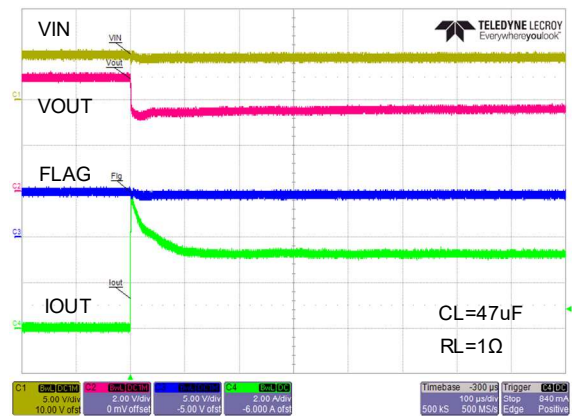


Typical Performance Characteristics (continued)

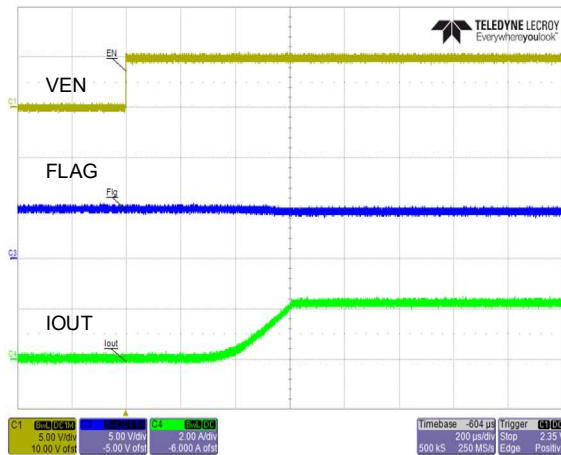
Inrush Short Circuit Response



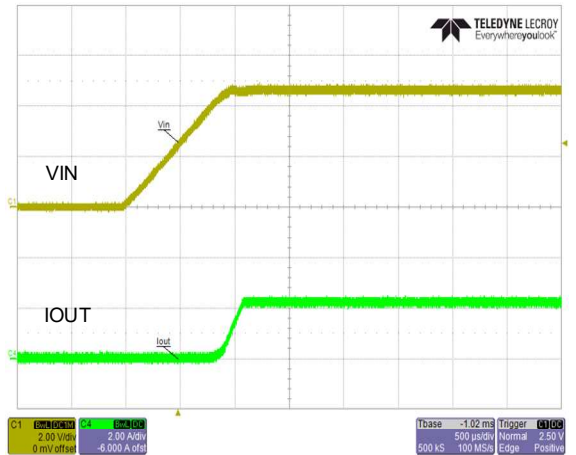
Resistance Load Inrush Response



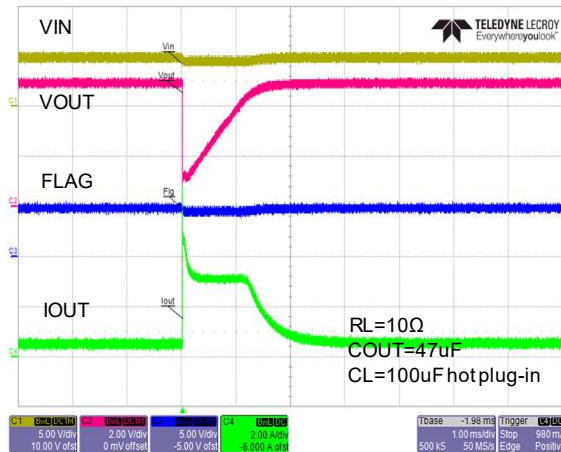
Short-Circuit Current, Device Enable into Short



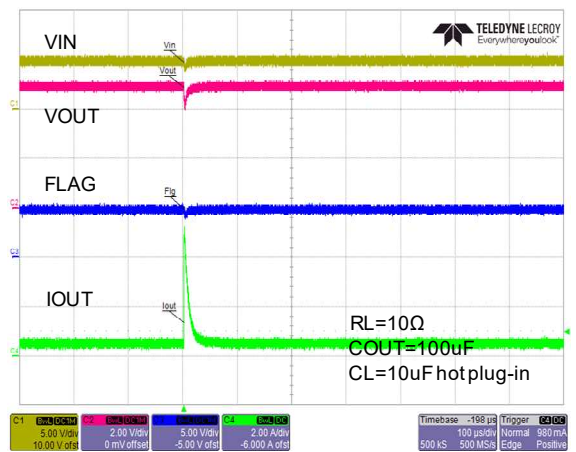
Short Circuit Response at Start up



Capacitance Load Inrush Response

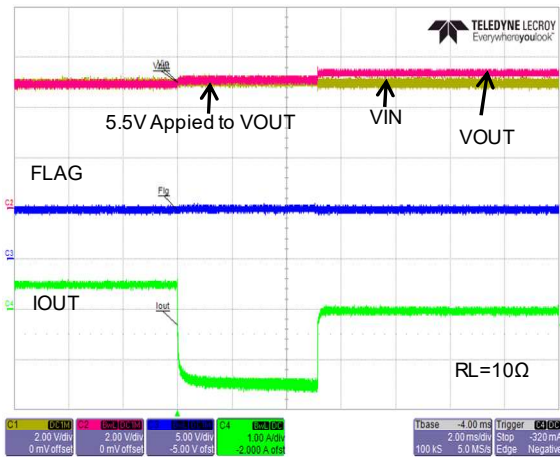


Capacitance Load Inrush Response

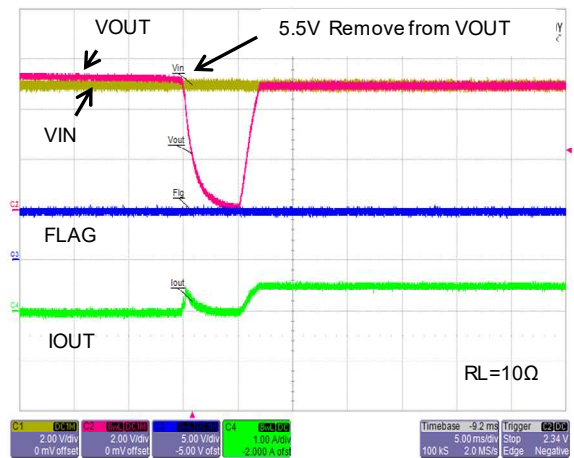


Typical Performance Characteristics (continued)

Reverse-Voltage Protection Response

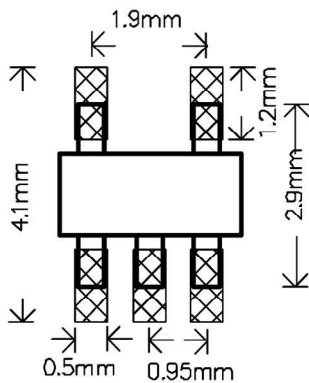


Reverse-Voltage Protection Recovery

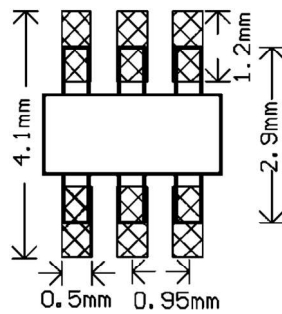


Minimum Footprint PCB Layout Section

TSOT-23-5



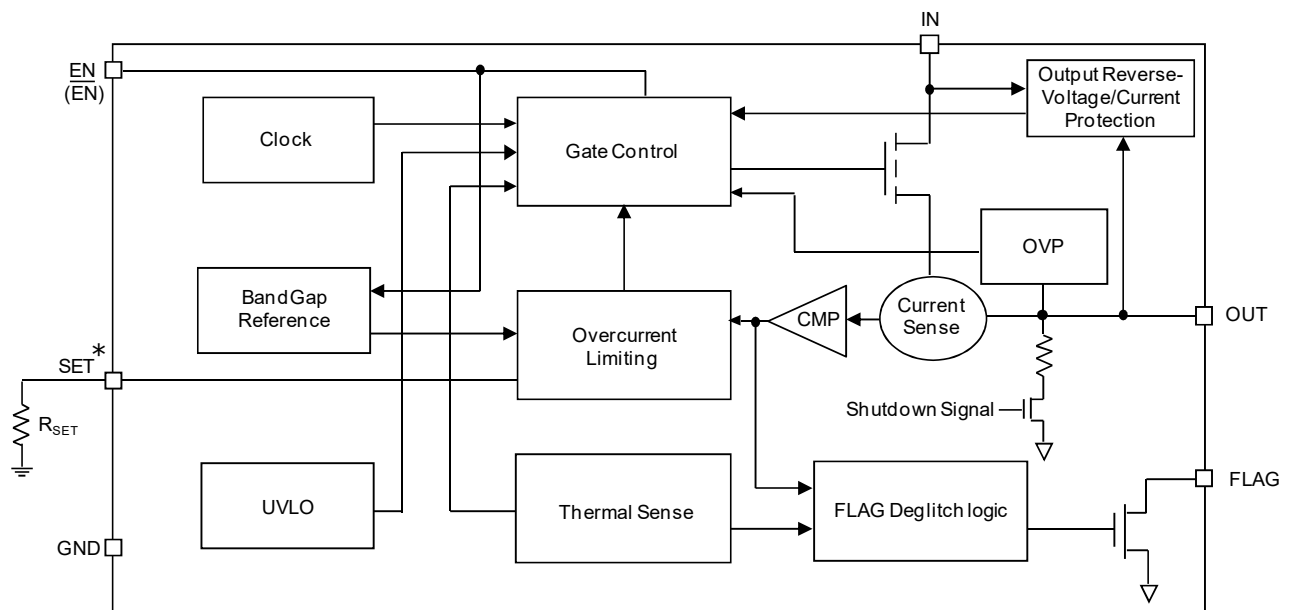
TSOT-23-6



Pin Description

PIN		NAME	FUNCTION
TSOT-23-5 FC	TSOT-23-6 FC		
1	1	OUT	Switch Output: Output MOSFET Source of switch. Typically connect to switched side of load.
2	2	GND	Ground
3	3	FLAG	Over-Current: Open-Drain FLAG output.
4	4	EN($\overline{\text{EN}}$)	Enable: Logic level enable input. Make sure EN pin never floating.
5	6	IN	Input Supply: Output MOSFET Drain, which also supplies IC's internal circuitry. Connect to positive supply.
---	5	SET	Current limit set input

Block Diagram



*:G518Bonly

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 G518 from excessive power dissipation. If the die temperature exceeds aforementioned OT spec., the MOSFETS switch is shut off. The hysteresis 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 2.2V 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 typical over current trigger point of G518A/C is 3.5A/2A. There is short-circuit fold-back current when $V_{IN} > 3.5V$ and $V_{OUT} < 1V$. (See Typical Performance Characteristics)

The G518B over current trigger point is programmed with a resistor from SET to ground. The typical value is determined by RSET. We can choose the proper RSET by Table1. Table 2 is for G518BTP2U. There is short-circuit fold-back current limit when $V_{IN} > 3.5V$ and $V_{OUT} < 1V$.

Output Reverse-Voltage/Current Protection

The output reverse-voltage/current protection turns off the MOSFET switch whenever the output voltage is higher than the input voltage by 40mV (typ) for 5ms and the MOSFET switch will turn on when output reverse-voltage/current condition is removed for 5ms.

V_{OUT} Over-Voltage Protection (OVP)

When output voltage is higher than 5.6V (typ), the MOSFET switch is turned off to prevent IN from high-voltage stress.

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 1 μ F bypass capacitor from IN to GND, located near the G518, 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 G518B

RSET(k Ω)	Current Limit Min (A)	Current Limit Typ (A)	Current Limit Max (A)
6	3.1	3.5	4
7	2.7	3	3.3
10.5	1.7	2	2.3
21	0.8	1	1.2

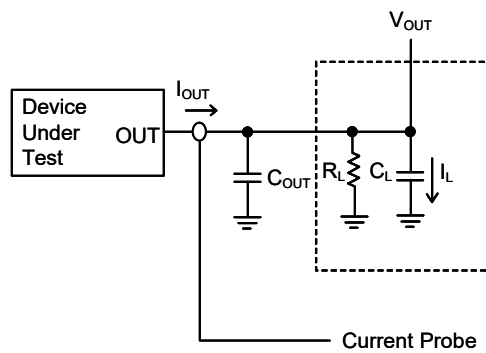
Note: The Relationship between RSET (K Ω) and Typical Current Limit (A) is about Current Limit =21/RSET

Table 2. Current Limit RSET Value for G518BTP2U

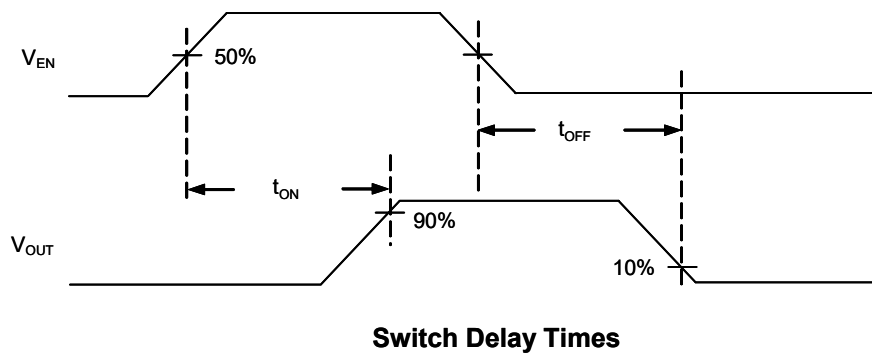
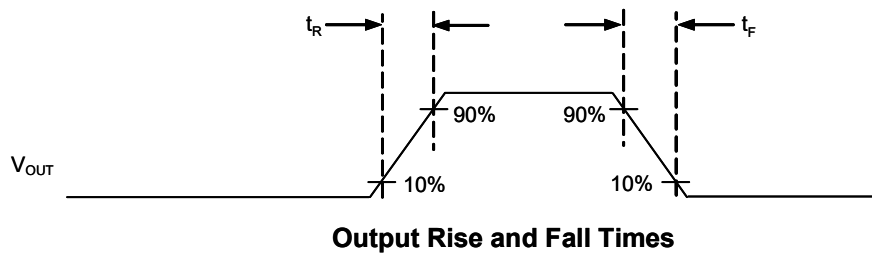
RSET(k Ω)	Current Limit Min (A)	Current Limit Typ (A)	Current Limit Max (A)
2	3.1	3.5	4
2.3	2.7	3	3.3
3.5	1.7	2	2.3
6.8	0.8	1	1.2

Note: The Relationship between RSET (K Ω) and Typical Current Limit (A) is about Current Limit =6.8/RSET

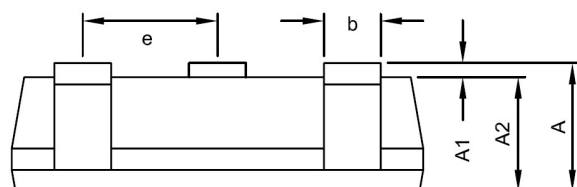
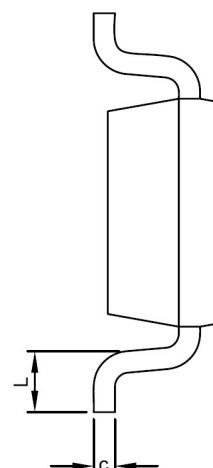
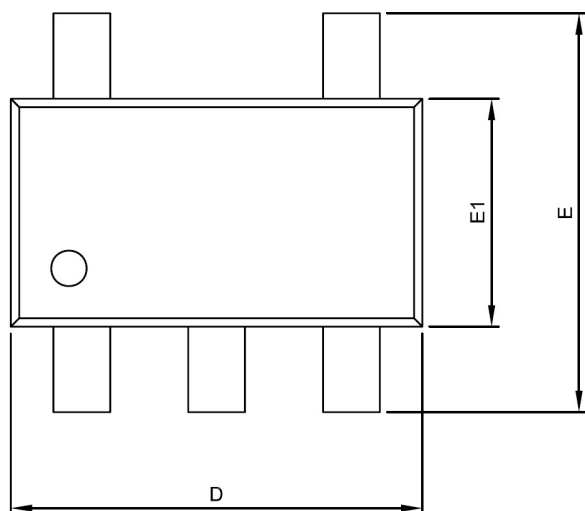
Test Circuit



Timing Diagrams



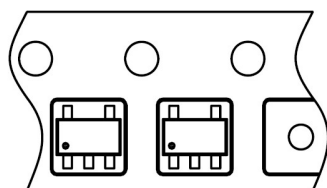
Package Information



TSOT-23-5 Package

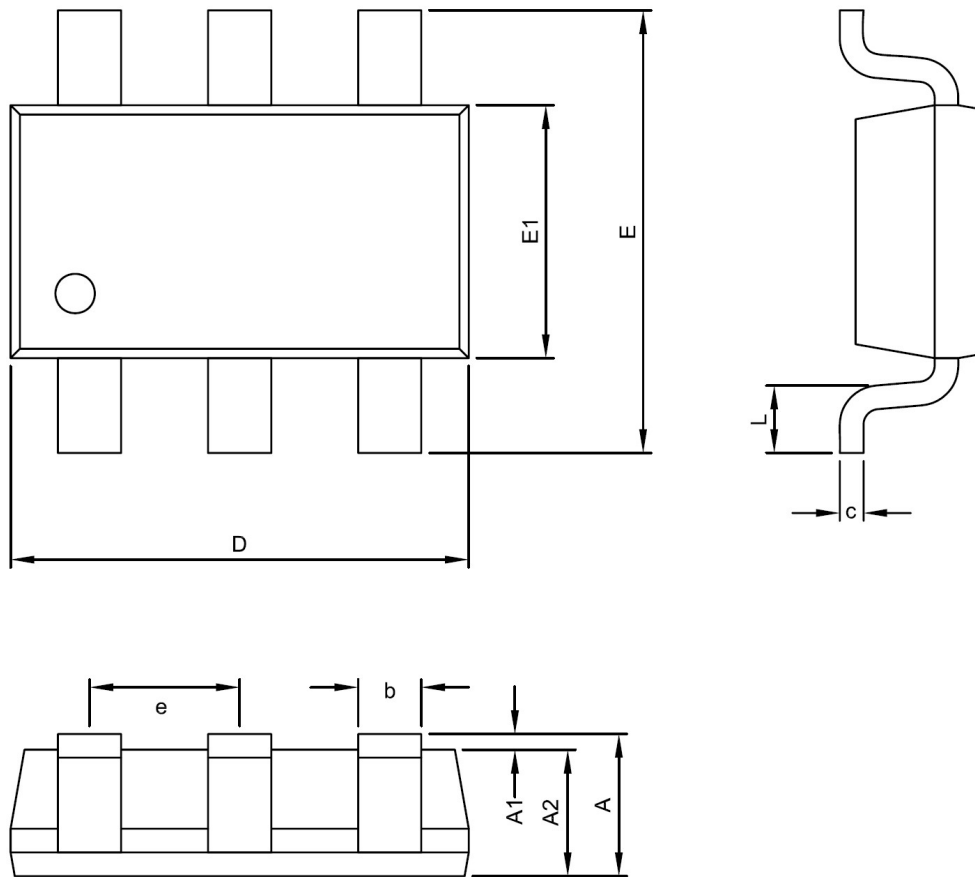
Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.80	0.90	0.028	0.031	0.035
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.70	0.75	0.80	0.028	0.030	0.031
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.70	2.80	2.90	0.106	0.110	0.114
E1	1.50	1.60	1.70	0.059	0.063	0.067
c	0.08	0.15	0.25	0.003	0.006	0.010
b	0.30	0.40	0.50	0.012	0.016	0.020
e	0.85	0.95	1.05	0.033	0.037	0.041
L	0.30	0.45	0.60	0.012	0.018	0.024

Taping Specification



Feed Direction

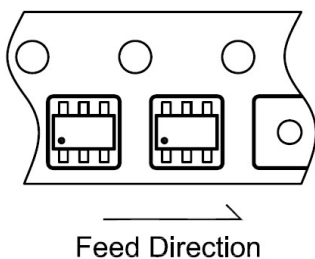
PACKAGE	Q'TY/REEL
TSOT-23-5	3,000 ea



TSOT-23-6 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.80	0.90	0.028	0.031	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	2.80	2.90	3.00	0.110	0.114	0.118
E	2.70	2.80	2.90	0.106	0.110	0.114
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	0.85	0.95	1.05	0.033	0.037	0.041
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

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