Description

The AP2822 is an integrated high-side power switch that consists of N-Channel MOSFET, charge pump, over current & temperature and other related protection circuits. The switch's low $R_{DS(ON)}$, 85mΩ is designed to meet USB voltage drop requirements. The IC includes soft-start to limit inrush current, over-current protection, load short protection with fold-back, and thermal shutdown to avoid switch failure during hot plug-in. Under voltage lockout (UVLO) function is used to ensure the device remain off unless there is a valid input voltage present. A FLAG output is available to indicate fault conditions to the local USB controller.

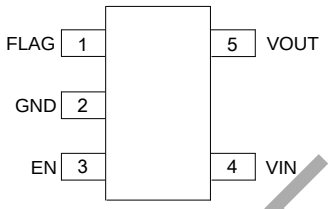
The AP2822 is available in the standard package of SOT-23-5.

Features

- Low MOSFET On Resistance: 85mΩ
- Compliant to USB Specifications
- Available 4 Versions of Continuous Load: 0.5A/1.0A/1.5A/2.0A
- Logic Level Enable Pin: Available with Active-high or Active-low Version
- Operating Voltage Range: 2.7V to 5.5V
- Low Supply Current: 68µA (Typ.)
- Low Shutdown Current: 1.0µA (Max)
- Under-voltage Lockout
- Soft Start-up
- Over-current Protection
- Over Temperature Protection
- Load Short Protection with Fold-back
- No Reverse Current When Power Off
- Deglitched FLAG Output with Open Drain
- With Output Shutdown Pull-low Resistor
  (For Auto-discharge)
  (AP2822A/AP2822B/AP2822C/AP2822D/AP2822E/AP2822F/AP2822G/AP2822H)
- Without Output Shutdown Pull-low Resistor
  (For No Auto-discharge)
  (AP2822AN/AP2822BN/AP2822CN/AP2822DN/AP2822EN/AP2822FN/AP2822GN/AP2822HN)
- **Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

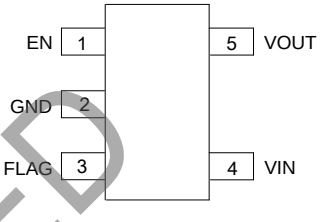
Pin Assignments

(Top View)



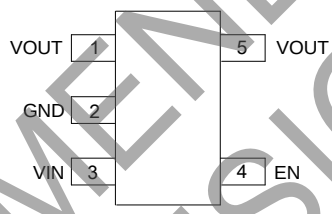
(SOT-23-5/ K Package)

(Top View)



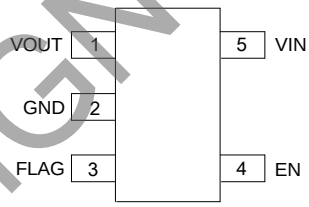
(SOT-23-5/ KA Package)

(Top View)



(SOT-23-5/ KB Package)

(Top View)



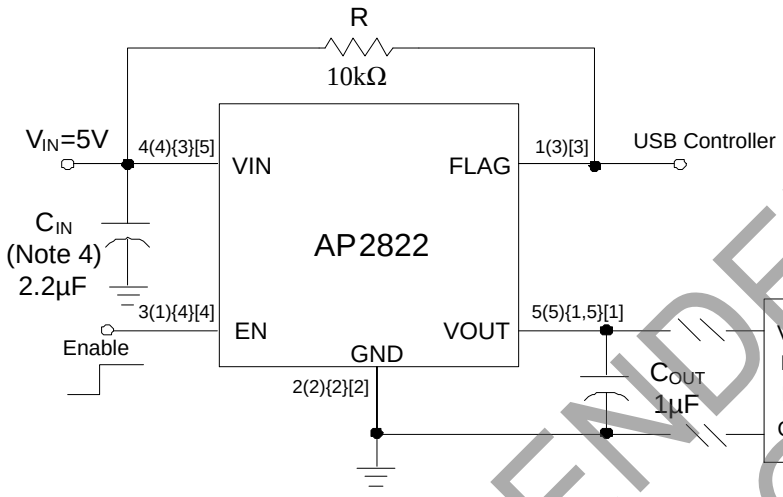
(SOT-23-5/ KE Package)

Applications

- USB Power Management
- USB Bus/Self Powered Hubs
- Hot-plug Power Supplies
- Battery-charger Circuits
- Notebooks, Motherboard PCs

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit



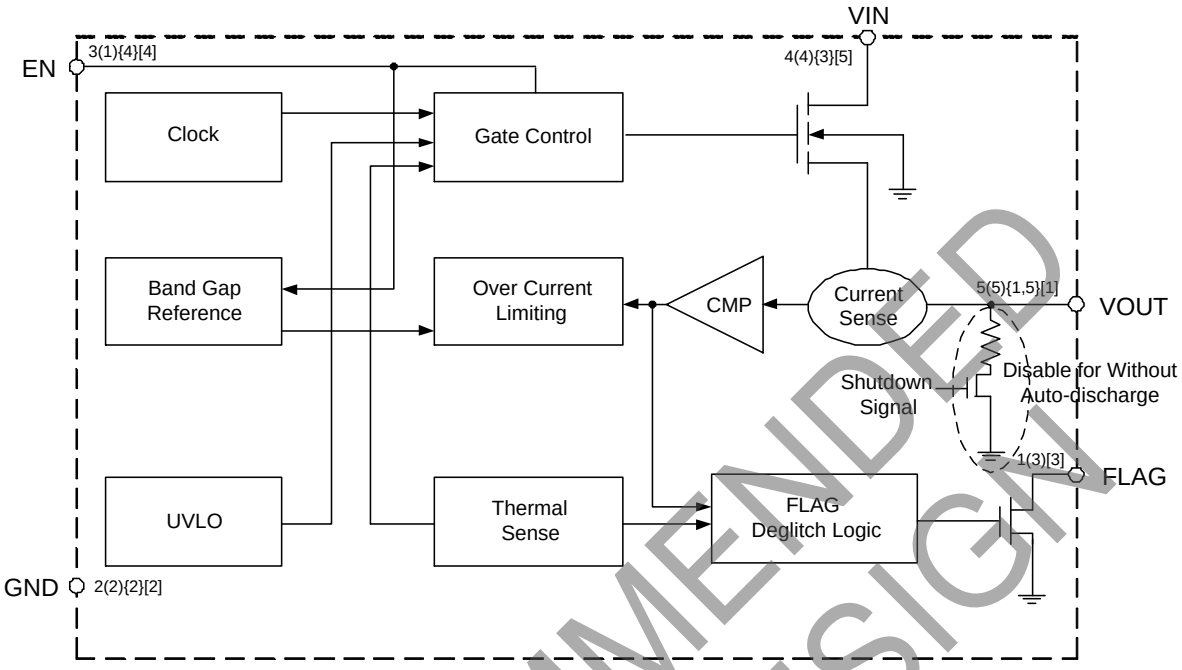
A(B){C}[D]
A: SOT-23-5(K Package)
B: SOT-23-5(KA Package)
C: SOT-23-5(KB Package)
D: SOT-23-5(KE Package)

Note 4: 2.2μF input capacitor is enough in most application cases. If the VOUT is short to ground frequently during usage, large size input capacitor is necessary, recommend 22μF.

Pin Descriptions

Pin Number	Pin Name	Function
1(K)	FLAG	Fault flag pin, output with open drain, need a pull-up resistor in application, active low to indicate OCP or OTP
3(KA/KE)		
2	GND	Ground
3(K)	EN	Chip enable control input, active low or high
1(KA)		
4(KB/KE)		
4(K/KA)	VIN	Supply input pin
3(KB)		
5(KE)		
5(K/KA)	VOUT	Switch output voltage
1,5(KB)		
1(KE)		

Functional Block Diagram



A(B){C}[D]
A: SOT-23-5(K Package)
B: SOT-23-5(KA Package)
C: SOT-23-5(KB Package)
D: SOT-23-5(KE Package)

Absolute Maximum Ratings (Note 5)

Symbol	Parameter	Rating	Unit
V_{IN}	Power Supply Voltage	6.0	V
T_J	Operating Junction Temperature Range	+150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering, 10sec)	+260	°C
θ_{JA}	Thermal Resistance (Junction to Ambient)	200	°C/W
—	ESD (Machine Model)	200	V
—	ESD (Human Body Model)	2000	V

Note 5: Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to “Absolute Maximum Ratings” for extended periods may affect device reliability.

Recommended Operating Conditions

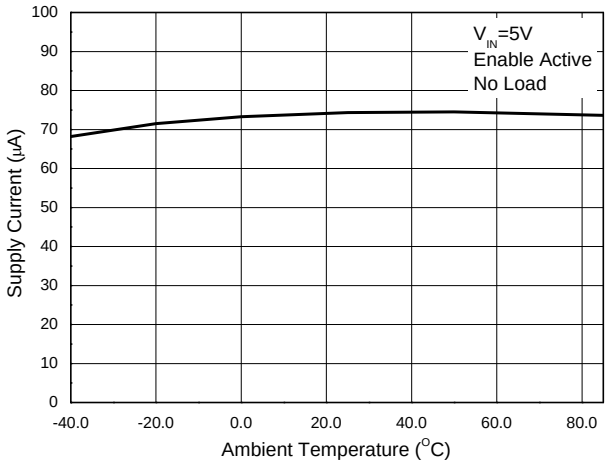
Symbol	Parameter	Min	Max	Unit
V_{IN}	Supply Voltage	2.7	5.5	V
T_A	Operating Ambient Temperature Range	-40	+85	°C

Electrical Characteristics (V_{IN} = 5.0V, C_{IN} = 2.2µF, C_{OUT} = 1.0µF, Typical T_A = +25°C, unless otherwise specified)

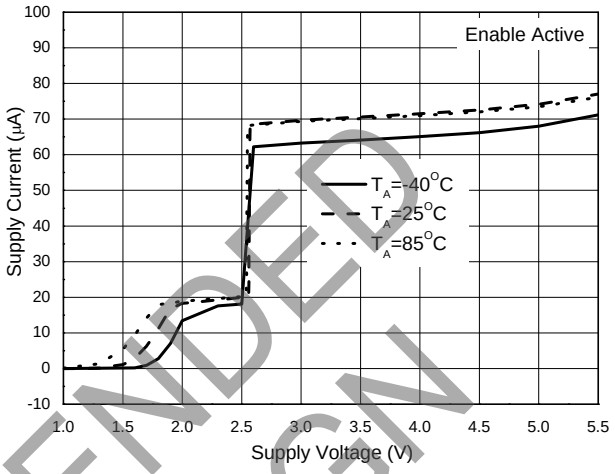
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	Supply Voltage	—	2.7	—	5.5	V
$R_{DS(ON)}$	Switch On Resistance	V_{IN} = 5.0V, I_{OUT} = 2.0A	—	85	110	mΩ
I_{LIMIT}	Current Limit	AP2822A/B(0.5A), V_{OUT} = 4.0V	0.7	1.0	1.4	A
		AP2822C/D(1.0A), V_{OUT} = 4.0V	1.1	1.5	2.1	
		AP2822E/F(1.5A), V_{OUT} = 4.0V	1.65	2.2	2.8	
		AP2822G/H(2.0A), V_{OUT} = 4.0V	2.2	2.7	3.2	
I_{SUPPLY}	Supply Current	V_{IN} = 5.0V, No Load	—	68	95	µA
I_{SHORT}	Fold-back Short Current	AP2822 A/B/C/D, V_{OUT} = 0V	—	0.7	—	A
		AP2822 E/F/G/H, V_{OUT} = 0V	—	1.1	—	
$I_{SHUTDOWN}$	Shutdown Supply Current	Chip Disable, Shutdown Mode	—	0.1	1.0	µA
V_{ENH}	Enable High Input Threshold	—	1.6	—	5.5	V
V_{ENL}	Enable Low Input Threshold	—	0	—	1.0	V
I_{EN}	Enable Pin Input Current	Force 0V to 5.0V at EN Pin	-1.0	—	1.0	µA
V_{UVLO}	Under Voltage Lockout Threshold Voltage	V_{IN} Increasing from 0V	2.2	2.5	3.0	V
V_{UVLOHY}	Under Voltage Hysteresis	—	—	0.2	—	V
$I_{REVERSE}$	Reverse Current	Chip Disable, V_{OUT} > V_{IN}	—	0.1	1.0	µA
$R_{DISCHARGE}$	Output Pull Low Resistance after Shutdown	With Auto-discharge	—	100	200	Ω
$I_{SHDN\_LEAKAGE}$	Output Leakage Current after Shutdown	Without Auto-discharge	—	—	1.0	µA
t_{ON}	Output Turn-on Time	From Enable Active to 90% of Output	—	500	—	µs
t_{DFLG}	FLAG Pin Delay Time	From Over Current Fault Condition to Flag Active	5	10	15	ms
V_{FLG}	FLAG Pin Low Voltage	I_{SINK} = 5.0mA	—	35	70	mV
$I_{LEAKAGE}$	FLAG Pin Leakage Current	FLAG Disable, Force 5.0V	—	—	1.0	µA
T_{OTSD}	Thermal Shutdown Temperature	—	—	+150	—	°C
T_{HYOTSD}	Thermal Shutdown Hysteresis	—	—	+30	—	
θ_{JC}	Thermal Resistance (Junction to Case)	—	—	93	—	°C/W

Performance Characteristics

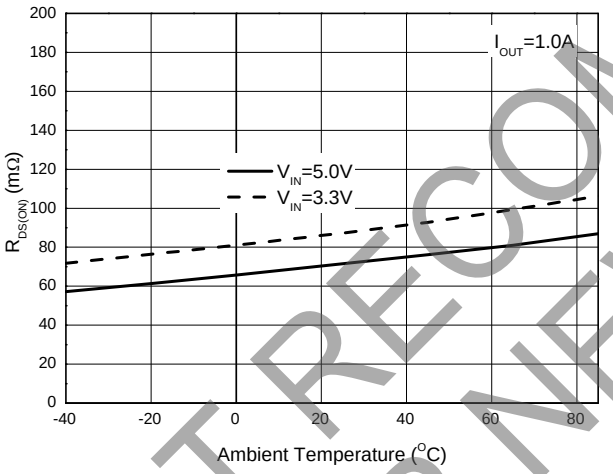
Supply Current vs. Ambient Temperature



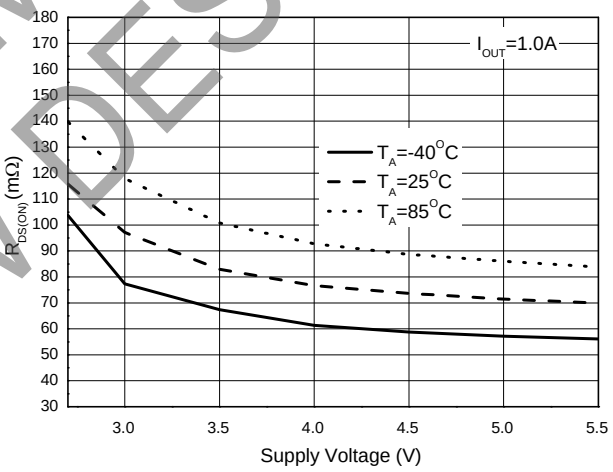
Supply Current vs. Supply Voltage



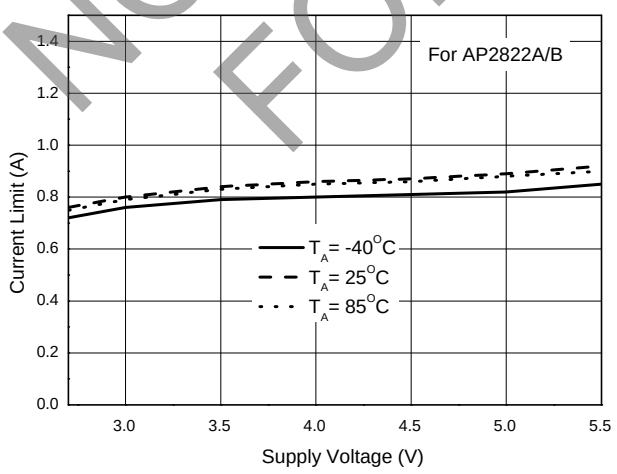
$R_{DS(ON)}$ vs. Ambient Temperature



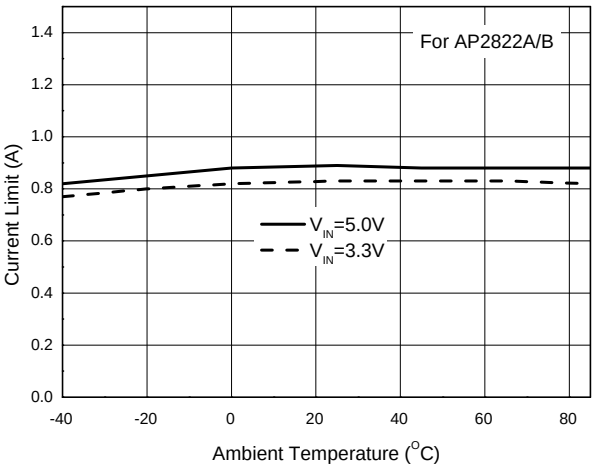
$R_{DS(ON)}$ vs. Supply Voltage



Current Limit vs. Supply Voltage

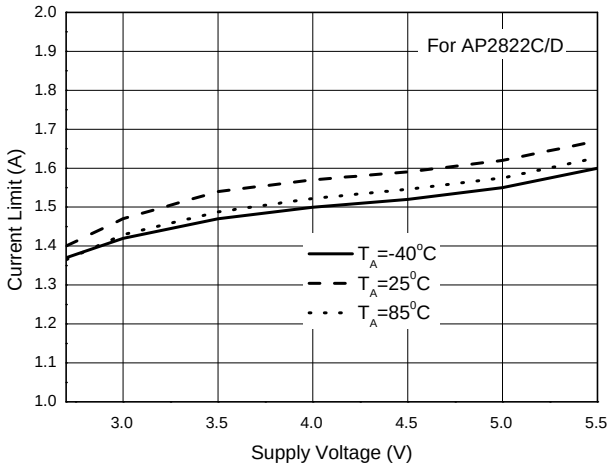


Current Limit vs. Ambient Temperature

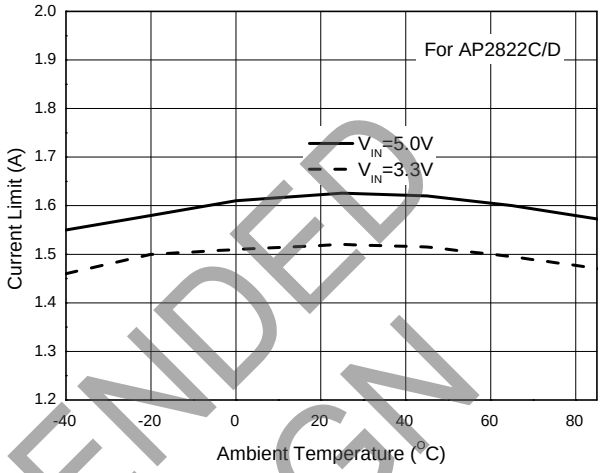


Performance Characteristics (Cont.)

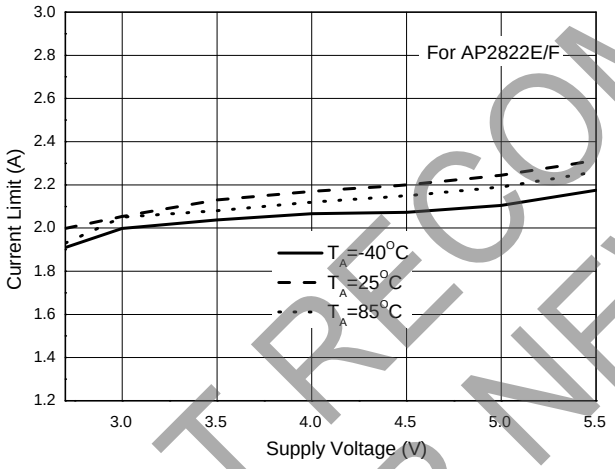
Current Limit vs. Supply Voltage



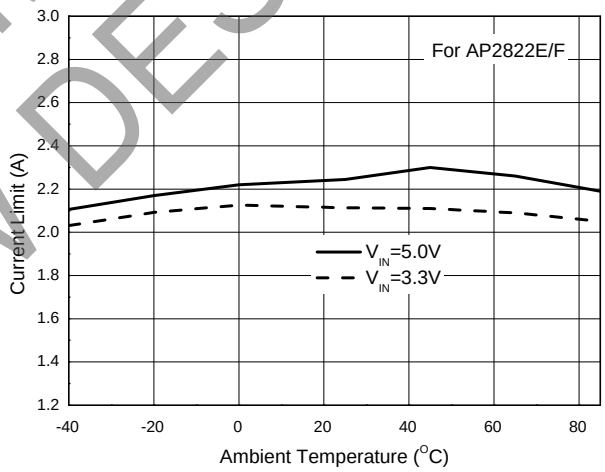
Current Limit vs. Ambient Temperature



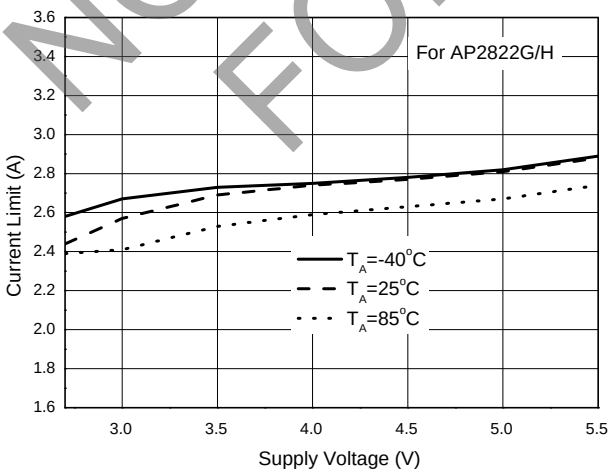
Current Limit vs. Supply Voltage



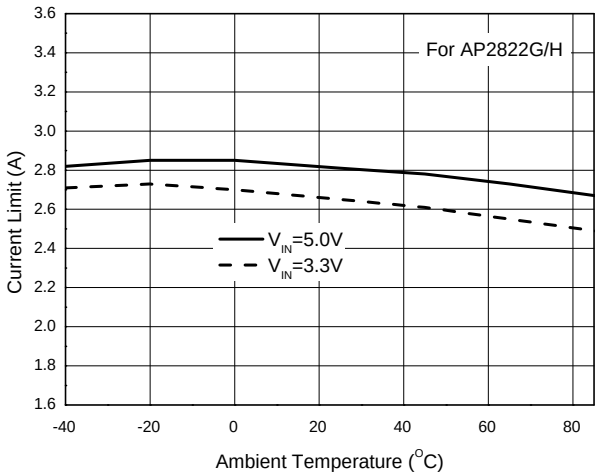
Current Limit vs. Ambient Temperature



Current Limit vs. Supply Voltage

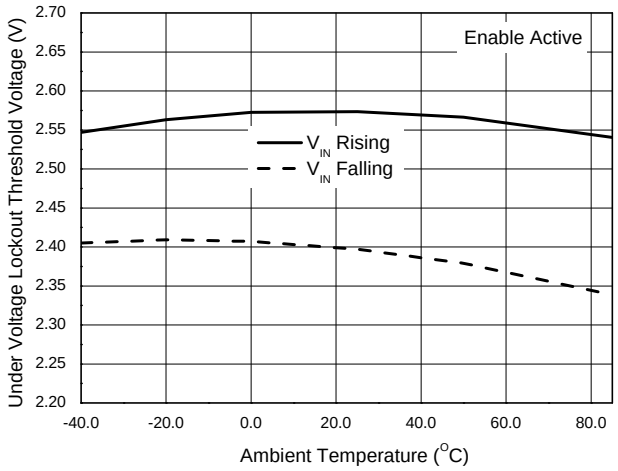


Current Limit vs. Ambient Temperature

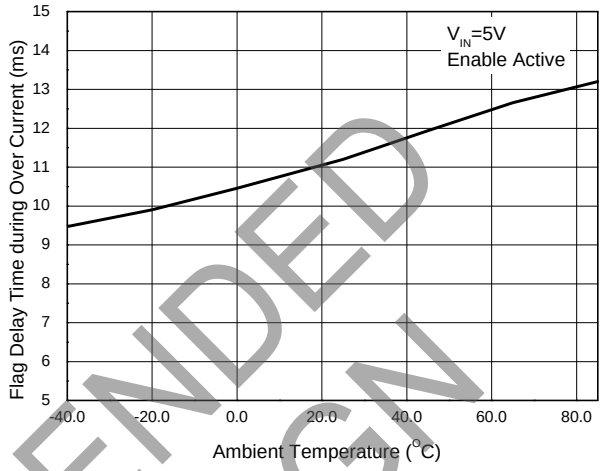


Performance Characteristics (Cont.)

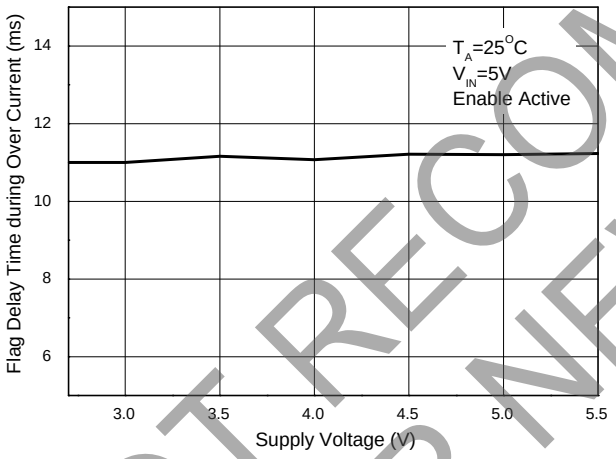
UVLO Voltage vs. Ambient Temperature



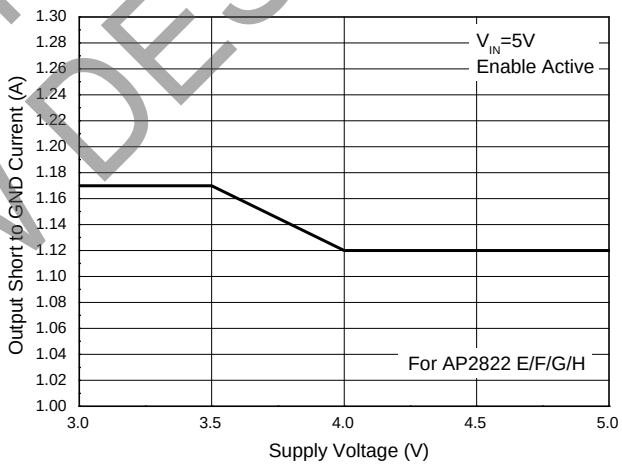
Flag Delay Time during Over Current vs. Ambient Temperature



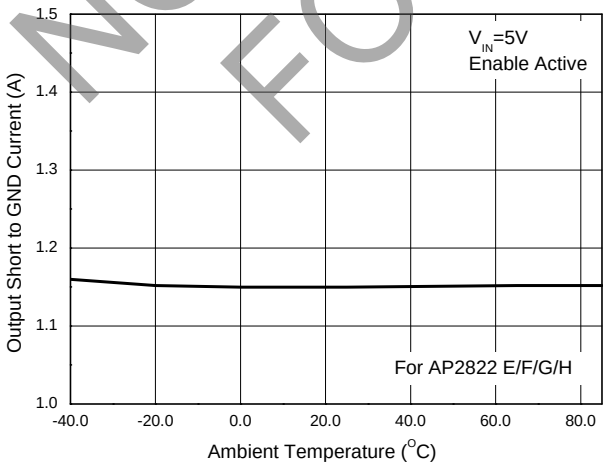
Flag Delay Time during Over Current vs. Supply Voltage



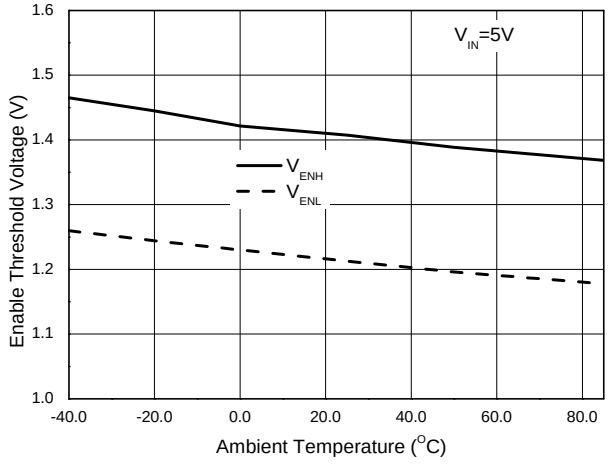
Output Short to GND Current vs. Supply Voltage



Output Short to GND Current vs. Ambient Temperature

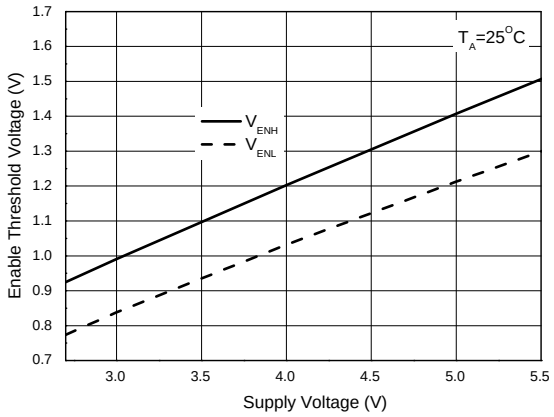


Enable Threshold Voltage vs. Ambient Temperature

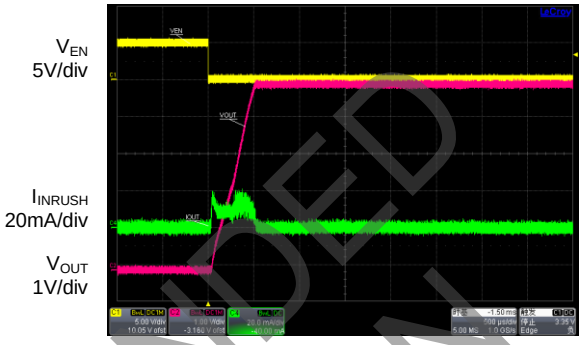


Performance Characteristics (Cont.)

Enable Threshold Voltage vs. Supply Voltage

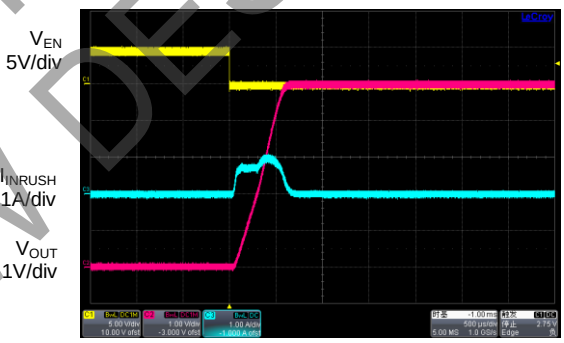


Output Turn On and Rise Time (C_{IN} = 1.0µF, C_{OUT} = 1.0µF, No Load)

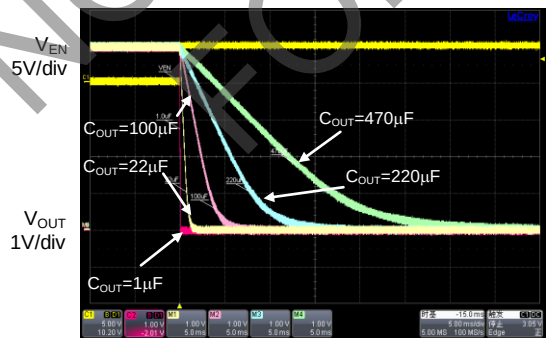


Output Turn On and Rise Time (C_{IN} = 1.0µF, C_{OUT} = 1.0µF, R_L = 3.3Ω)

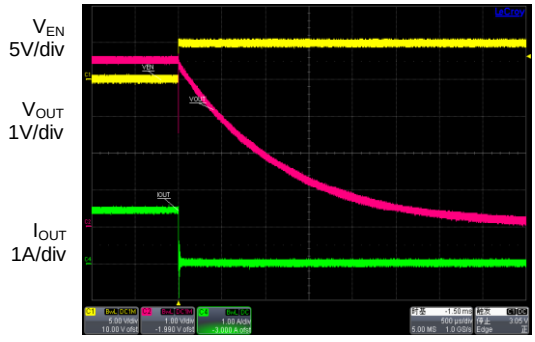
Output Turn On and Rise Time (C_{IN} = 1.0µF, C_{OUT} = 100µF, No Load)



Output Turn Off and Fall Time (V_{IN} = 5V, C_{IN} = 1.0µF, No Load)



Output Turn Off and Fall Time (V_{IN} = 5V, C_{IN} = 1.0µF, C_{OUT} = 470µF, R_L = 3.3Ω)

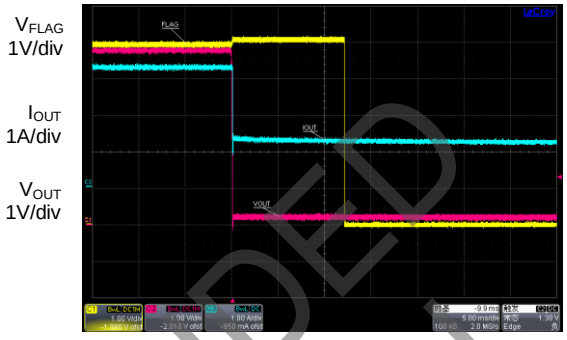


Performance Characteristics (Cont.)

Output Short to GND Current
(V_{IN} = 5V, C_{IN} = 1.0μF)

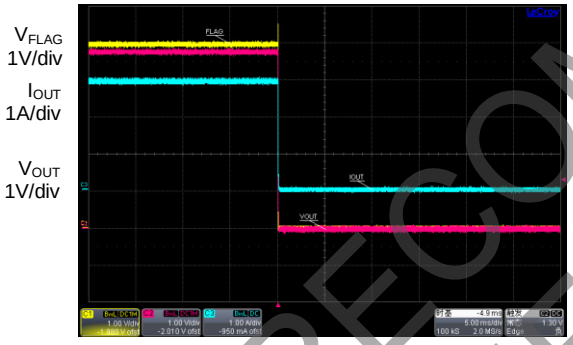
Time 20ms/div

FLAG Response during Over Current



Time 5ms/div

FLAG Response during
Over Temperature (T_A = +125°C)



Time 5ms/div

Ordering Information

AP2822 X X X - X

Product Name	Condition	Package	Packing	RoHS/Green
	A : Active High, With Auto-discharge, Continuous 0.5A B : Active Low, With Auto-discharge, Continuous 0.5A C : Active High, With Auto-discharge, Continuous 1.0A D : Active Low, With Auto-discharge, Continuous 1.0A E : Active High, With Auto-discharge, Continuous 1.5A F : Active Low, With Auto-discharge, Continuous 1.5A G : Active High, With Auto-discharge, Continuous 2.0A H : Active Low, With Auto-discharge, Continuous 2.0A AN : Active High, Without Auto-discharge, Continuous 0.5A BN : Active Low, Without Auto-discharge, Continuous 0.5A CN : Active High, Without Auto-discharge, Continuous 1.0A DN : Active Low, Without Auto-discharge, Continuous 1.0A EN : Active High, Without Auto-discharge, Continuous 1.5A FN : Active Low, Without Auto-discharge, Continuous 1.5A GN : Active High, Without Auto-discharge, Continuous 2.0A HN : Active Low, Without Auto-discharge, Continuous 2.0A	K/KA/KB/KE : SOT-23-5	TR : Tape & Reel	G1 : RoHS Compliant and Green

Package	Temperature Range	Condition	Part Number	Marking ID	Packing
SOT-23-5	-40 to +85°C	Active High, With Auto-discharge (Continuous 0.5A)	AP2822AKTR-G1	GCQ	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 0.5A)	AP2822BKTR-G1	GCR	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.0A)	AP2822CKTR-G1	GCS	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.0A)	AP2822DKTR-G1	GCT	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.5A)	AP2822EKTR-G1	GCU	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.5A)	AP2822FKTR-G1	GCV	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 2.0A)	AP2822GKTR-G1	GCW	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 2.0A)	AP2822HKTR-G1	GCZ	3000/Tape & Reel
SOT-23-5	-40 to +85°C	Active High, Without Auto-discharge (Continuous 0.5A)	AP2822ANKTR-G1	GMQ	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 0.5A)	AP2822BNKTR-G1	GMR	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.0A)	AP2822CNKTR-G1	GMS	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.0A)	AP2822DNKTR-G1	GMT	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.5A)	AP2822ENKTR-G1	GMU	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.5A)	AP2822FNKTR-G1	GMV	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 2.0A)	AP2822GNKTR-G1	GMW	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 2.0A)	AP2822HNKTR-G1	GMZ	3000/Tape & Reel

Ordering Information (Cont.)

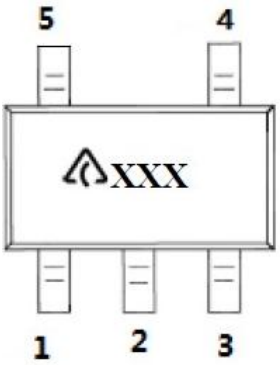
Package	Temperature Range	Condition	Part Number	Marking ID	Packing
SOT-23-5	-40 to +85°C	Active High, With Auto-discharge (Continuous 0.5A)	AP2822AKATR-G1	GDQ	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 0.5A)	AP2822BKATR-G1	GDR	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.0A)	AP2822CKATR-G1	GDS	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.0A)	AP2822DKATR-G1	GDT	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.5A)	AP2822EKATR-G1	GDU	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.5A)	AP2822FKATR-G1	GDV	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 2.0A)	AP2822GKATR-G1	GDW	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 2.0A)	AP2822HKATR-G1	GDZ	3000/Tape & Reel
SOT-23-5	-40 to +85°C	Active High, Without Auto-discharge (Continuous 0.5A)	AP2822ANKATR-G1	G5Q	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 0.5A)	AP2822BNKATR-G1	G5R	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.0A)	AP2822CNKATR-G1	G5S	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.0A)	AP2822DNKATR-G1	G5T	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.5A)	AP2822ENKATR-G1	G5U	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.5A)	AP2822FNKATR-G1	G5V	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 2.0A)	AP2822GNKATR-G1	G5W	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 2.0A)	AP2822HNKATR-G1	G5Z	3000/Tape & Reel
SOT-23-5	-40 to +85°C	Active High, With Auto-discharge (Continuous 0.5A)	AP2822AKBTR-G1	GLA	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 0.5A)	AP2822BKBTR-G1	GLB	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.0A)	AP2822CKBTR-G1	GLC	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.0A)	AP2822DKBTR-G1	GLD	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.5A)	AP2822EKBTR-G1	GLE	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.5A)	AP2822FKBTR-G1	GLF	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 2.0A)	AP2822GKBTR-G1	GLG	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 2.0A)	AP2822HKBTR-G1	GLH	3000/Tape & Reel

Ordering Information (Cont.)

Package	Temperature Range	Condition	Part Number	Marking ID	Packing
SOT-23-5	-40 to +85°C	Active High, Without Auto-discharge (Continuous 0.5A)	AP2822ANKBTR-G1	GMA	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 0.5A)	AP2822BNKBTR-G1	GMB	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.0A)	AP2822CNKBTR-G1	GMC	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.0A)	AP2822DNKBTR-G1	GMD	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.5A)	AP2822ENKBTR-G1	GME	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.5A)	AP2822FNKBTR-G1	GMF	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 2.0A)	AP2822GNKBTR-G1	GMG	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 2.0A)	AP2822HNKBTR-G1	GMH	3000/Tape & Reel
SOT-23-5	-40 to +85°C	Active High, With Auto-discharge (Continuous 0.5A)	AP2822AKETR-G1	GLI	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 0.5A)	AP2822BKETR-G1	GLJ	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.0A)	AP2822CKETR-G1	GLK	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.0A)	AP2822DKETR-G1	GLL	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 1.5A)	AP2822EKETR-G1	GLM	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 1.5A)	AP2822FKETR-G1	GLN	3000/Tape & Reel
		Active High, With Auto-discharge (Continuous 2.0A)	AP2822GKETR-G1	GLO	3000/Tape & Reel
		Active Low, With Auto-discharge (Continuous 2.0A)	AP2822HKETR-G1	GLP	3000/Tape & Reel
SOT-23-5	-40 to +85°C	Active High, Without Auto-discharge (Continuous 0.5A)	AP2822ANKETR-G1	GMI	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 0.5A)	AP2822BNKETR-G1	GMJ	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.0A)	AP2822CNKETR-G1	GMK	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.0A)	AP2822DNKETR-G1	GML	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 1.5A)	AP2822ENKETR-G1	GMM	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 1.5A)	AP2822FNKETR-G1	GMN	3000/Tape & Reel
		Active High, Without Auto-discharge (Continuous 2.0A)	AP2822GNKETR-G1	GMO	3000/Tape & Reel
		Active Low, Without Auto-discharge (Continuous 2.0A)	AP2822HNKETR-G1	GMP	3000/Tape & Reel

Marking Information

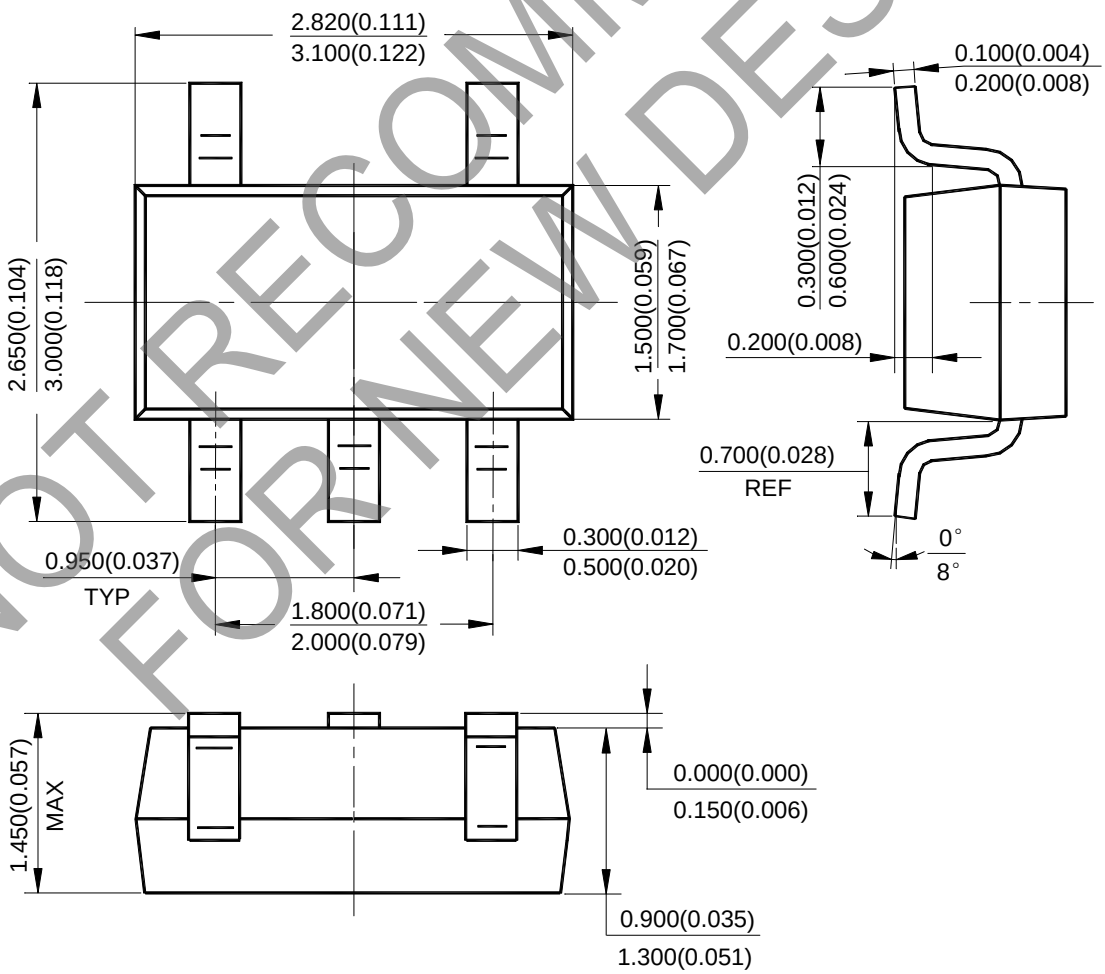
(1) SOT-23-5



: Logo
XXX: Marking ID (See Ordering Information)

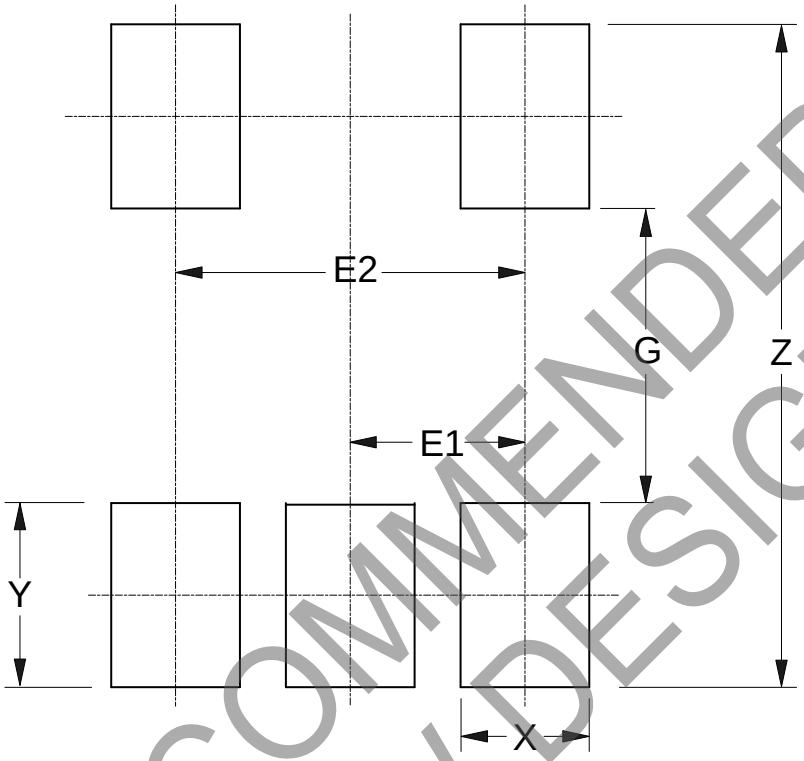
Package Outline Dimensions (All dimensions in mm(inch).)

(1) Package Type: SOT-23-5



Suggested Pad Layout

(1) Package Type: SOT-23-5



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E1 (mm)/(inch)	E2 (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037	1.900/0.075

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