

Description

The DIODES™ AP2182A and DIODES™ AP2192A are dual channel, current-limited, integrated, high-side power switches optimized for Universal Serial Bus (USB) and other hot-swap applications. The family of devices complies with USB standards and is available with both polarities of Enable input.

The devices have fast short-circuit response time for improved overall system robustness, and have integrated output discharge function to ensure a completely controlled discharging of the output voltage capacitor. They provide a complete protection solution for applications subject to heavy capacitive loads and the prospect of short circuits, and offer reverse-current blocking, overcurrent, overtemperature, and short-circuit protection, as well as controlled rise time and undervoltage lockout functionality. A 7ms deglitch capability on the open-drain Flag output prevents false overcurrent reporting and does not require any external components.

All devices are available in the SO-8, MSOP-8EP, and U-DFN3030-8 (Type E) packages.

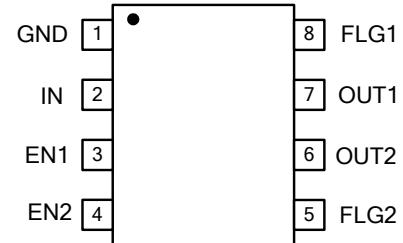
Features

- Dual Channel, Current-Limited Power Switch with Output Discharge
- Fast Short-Circuit Response Time: 2μs
- 2.0A Accurate Current Limiting
- Reverse Current Blocking
- 85mΩ On-Resistance
- Input Voltage Range: 2.7V - 5.5V
- Built-In Soft-Start with 0.6ms Typical Rise Time
- Short Circuit and Thermal Protection
- Fault Report (FLG) with Blanking Time (7ms typ)
- ESD protection: 2kV HBM, 300V MM
- Active High (AP2192A) or Active Low (AP2182A) Enable
- Ambient Temperature Range: -40°C to +85°C
- SO-8, MSOP-8EP and DFN3030E-8 (Exposed Pad): Available in "Green" Molding Compound (No Br, Sb)
- UL Recognized, File Number E322375
- IEC60950-1 CB Scheme Certified
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](mailto:contact@diodes.com) or your local Diodes representative.**
- <https://www.diodes.com/quality/product-definitions/>

- 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.

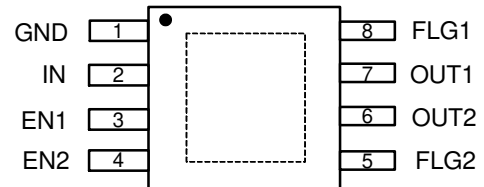
Pin Assignments

(Top View)



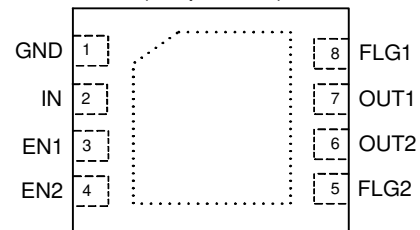
SO-8

(Top View)



MSOP-8EP

(Top View)



U-DFN3030-8

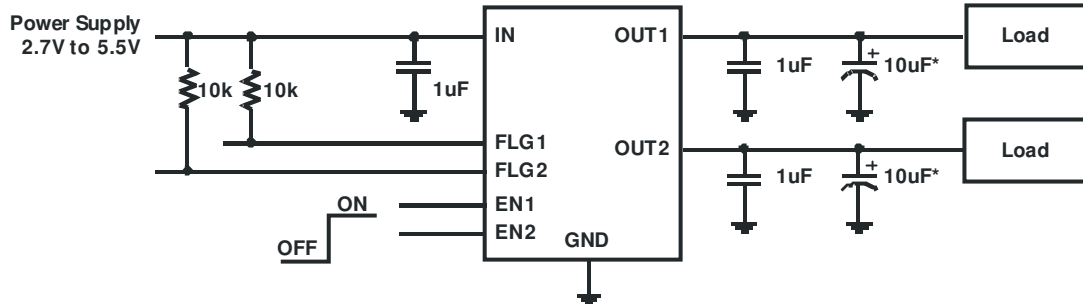
Type E

Applications

- LCD TVs and monitors
- Set-top boxes, residential gateways
- Laptops, desktops, servers
- Printers, docking stations, HUBs

Typical Applications Circuit

AP2192 A Enable Active High



Note: * USB 2.0 requires 120uF per hub

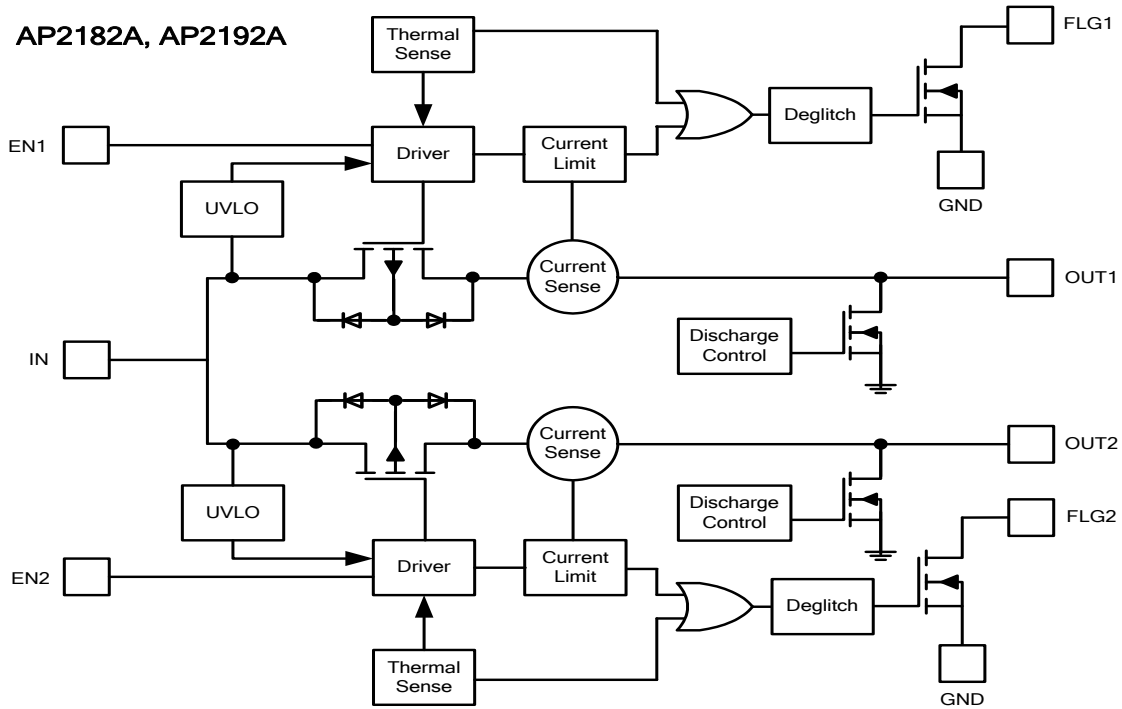
Available Options

Part Number	Channel	Enable Pin (EN)	Current Limit (typ)	Recommended Maximum Continuous Load Current
AP2182A	2	Active Low	2.0A	1.5A
AP2192A	2	Active High	2.0A	1.5A

Pin Descriptions

Pin Name	Pin Number		Function
	SO-8	MSOP-8EP, U-DFN3030-8 (Type E)	
GND	1	1	Ground
IN	2	2	Voltage input pin
EN1	3	3	Switch 1 enable input, active low (AP2182A) or active high (AP2192A)
EN2	4	4	Switch 2 enable input, active low (AP2182A) or active high (AP2192A)
FLG2	5	5	Switch 2 overcurrent and overtemperature fault report; open-drain flag is active low when triggered
OUT2	6	6	Switch 2 voltage output pin
OUT1	7	7	Switch 1 voltage output pin
FLG1	8	8	Switch 1 overcurrent and overtemperature fault report; open-drain flag is active low when triggered
Exposed Pad	—	Exposed Pad	Exposed Pad: It should be connected to GND and thermal mass for enhanced thermal impedance. It should not be used as electrical ground conduction path.

Functional Block Diagram



Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Ratings	Unit
ESD HBM	Human Body Model ESD Protection	2	kV
ESD MM	Machine Model ESD Protection	300	V
V _{IN}	Input Voltage	6.5	V
V _{OUT}	Output Voltage	V _{IN} + 0.3	V
V _{EN} , V _{FLG}	Enable Voltage	6.5	V
I _{LOAD}	Maximum Continuous Load Current	Internal Limited	A
T _{J(MAX)}	Maximum Junction Temperature	150	°C
T _{ST}	Storage Temperature Range (Note 4)	-65 to +150	°C

Note: 4. UL Recognized Rating from -30°C to +70°C (Diodes qualified T_{ST} from -65°C to +150°C).

Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V _{IN}	Input Voltage	2.7	5.5	V
I _{OUT}	Output Current	0	1.5	A
V _{IH}	High-Level Input Voltage on EN or \overline{EN}	2	V _{IN}	V
V _{IL}	Low-Level Input Voltage on EN or \overline{EN}	0	0.8	V
T _A	Operating Ambient Temperature Range	-40	+85	°C

Electrical Characteristics (@T_A = +25°C, V_{IN} = +5.0V, unless otherwise specified.)

Symbol	Parameter	Test Conditions (Note 5)	Min	Typ	Max	Unit	
V _{UVLO}	Input UVLO	-	1.6	2.0	2.4	V	
I _{SHDN}	Input Shutdown Current	Disabled, I _{OUT} = 0	-	0.1	1	μA	
I _Q	Input Quiescent Current, Dual	Enabled, I _{OUT} = 0	-	115	180	μA	
I _{LEAK}	Input Leakage Current	Disabled, OUT grounded	-	-	1	μA	
I _{REV}	Reverse Leakage Current	Disabled, V _{IN} = 0V, V _{OUT} = 5V, I _{REV} at V _{IN}	-	0.01	0.1	μA	
R _{DS(ON)}	Switch On-Resistance	V _{IN} = 5V, I _{OUT} = 1.5A, T _A = +25°C	SO-8	-	90	110	mΩ
			MSOP-8EP, U-DFN3030-8 (Type E)	-	85	105	
		V _{IN} = 5V, I _{OUT} = 1.5A, -40°C ≤ T _A ≤ +85°C		-	-	135	
		V _{IN} = 3.3V, I _{OUT} = 1.5A, T _A = +25°C	SO-8	-	110	130	
			MSOP-8EP, U-DFN3030-8 (Type E)	-	105	125	
-	-	V _{IN} = 3.3V, I _{OUT} = 1.5A, -40°C ≤ T _A ≤ +85°C	-	-	170	-	
I _{LIMIT}	Overload Current Limit	V _{IN} = 5V, V _{OUT} = 4V, C _L = 10μF	-40°C ≤ T _A ≤ +85°C	1.6	2.0	2.4	A
I _{LIMIT_G}	Ganged Overload Current Limit	V _{IN} = 5V, V _{OUT} = 4.6V, OUT1 & OUT2 tied together, C _L = 10μF	-40°C ≤ T _A ≤ +85°C	3.2	4.0	4.8	A
I _{Trig}	Current Limiting Trigger Threshold	Output Current Slew rate (<100A/s), C _L = 10μF		-	2.5	-	A
I _{Trig_G}	Ganged Current Limiting Trigger Threshold	OUT1 & OUT2 tied together, Output Current Slew rate (<100A/s), C _L = 10μF		-	5.0	-	A
I _{OS}	Short-Circuit Current per Channel	OUTx connected to ground, device enabled into short circuit, C _L = 10μF		-	2.0	-	A
I _{OS_G}	Ganged Short-Circuit Current	OUT1 & OUT2 connected to ground, device enabled into short-circuit, C _L = 10μF		3.2	4.0	4.8	A
T _{SHORT}	Short-Circuit Response Time	V _{OUT} = 0V to I _{OUT} = I _{LIMIT} (output shorted to ground)		-	2	-	μs
V _{IL}	EN Input Logic Low Voltage	V _{IN} = 2.7V to 5.5V		-	-	0.8	V
V _{IH}	EN Input Logic High Voltage	V _{IN} = 2.7V to 5.5V		2	-	-	V
I _{SINK}	EN Input Leakage	V _{EN} = 0V to 5.5V		-	-	1	μA
I _{LEAK-O}	Output Leakage Current	Disabled, V _{OUT} = 0V		-	0.5	1	μA
T _R	Output Turn-On Rise Time	C _L = 1μF, R _{LOAD} = 5Ω		-	0.6	1.5	ms
T _F	Output Turn-Off Fall Time	C _L = 1μF, R _{LOAD} = 5Ω		-	0.05	0.3	ms
T _{D(ON)}	Output Turn-On Delay Time	C _L = 100μF, R _{LOAD} = 5Ω		-	0.2	0.5	ms
T _{D(OFF)}	Output Turn-Off Delay Time	C _L = 100μF, R _{LOAD} = 5Ω		-	0.1	0.3	ms
R _{FLG}	FLG Output FET On-Resistance	I _{FLG} = 10mA		-	20	40	Ω
I _{FOH}	FLG Off Current	V _{FLG} = 5V		-	0.01	1	μA
T _{Blank}	FLG Blanking Time	C _L = 10μF		4	7	15	ms
R _{DIS}	Discharge Resistance (Note 6)	V _{IN} = 5V, disabled, I _{OUT} = 1mA		-	100	-	Ω
T _{SHDN}	Thermal Shutdown Threshold	Enabled, R _{LOAD} = 1kΩ		-	140	-	°C
T _{HYS}	Thermal Shutdown Hysteresis	-		-	25	-	°C
θ _{JA}	Thermal Resistance Junction-to-Ambient	SO-8 (Note 7)		-	115	-	°C/W
		MSOP-8EP (Note 8)		-	75	-	
		U-DFN3030-8 (Type E) (Note 8)		-	60	-	

- Notes:
- Pulse-testing techniques maintain junction temperature close to ambient temperature; thermal effects must be taken into account separately.
 - The discharge function is active when the device is disabled (when enable is de-asserted or during power-up / power-down when V_{IN} < V_{UVLO}). The discharge function offers a resistive discharge path for the external storage capacitor for limited time.
 - Test condition for SO-8: Device mounted on FR-4 substrate PCB with minimum recommended pad layout.
 - Test condition for MSOP-8EP and U-DFN3030-8 (Type E): Device mounted on 2" x 2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad on top layer and thermal vias to bottom layer ground plane.

Typical Performance Characteristics

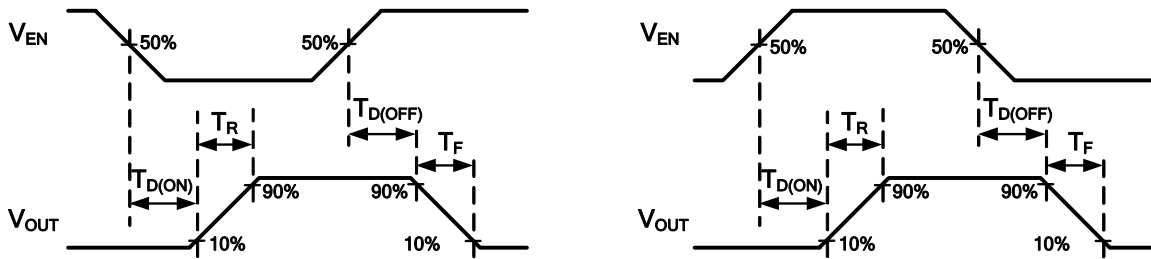


Figure 1. Voltage Waveforms: AP2182A (left), AP2192A (right)

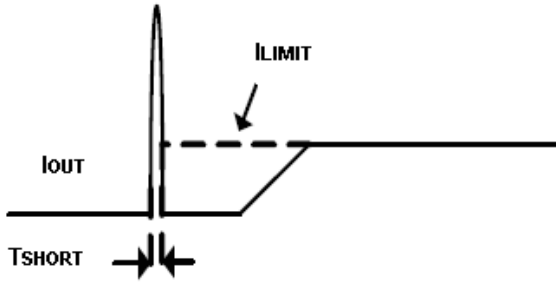
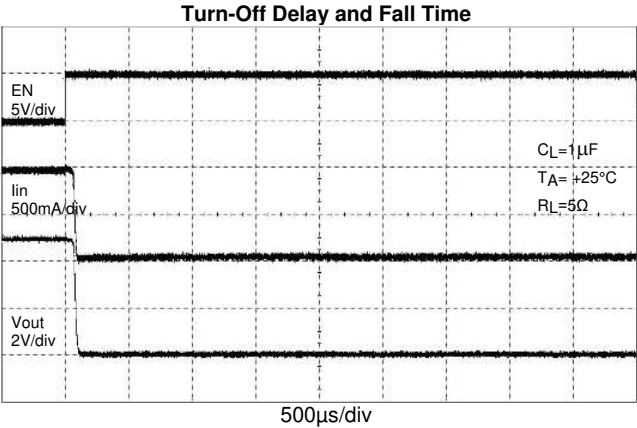
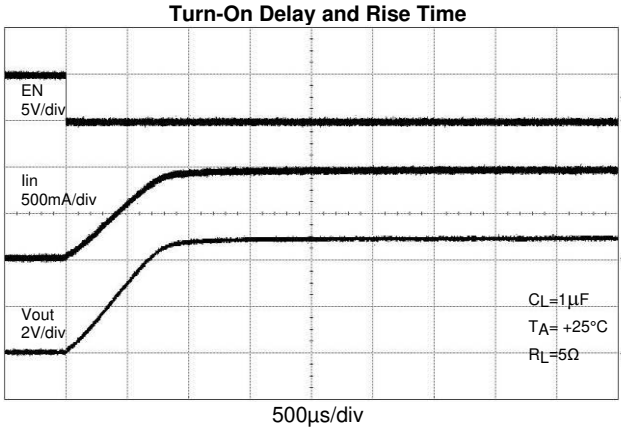


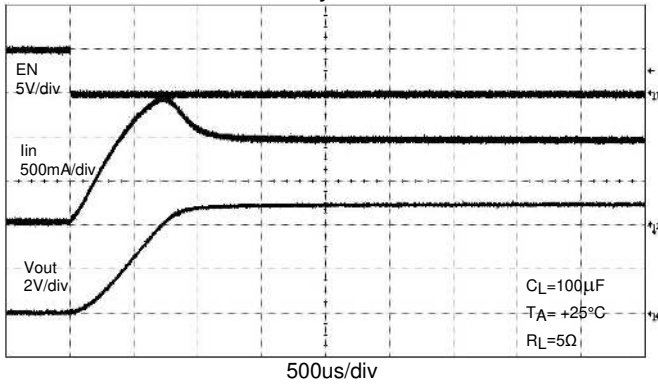
Figure 2. Response Time to Short-Circuit Waveform

All Enable Plots are for AP2182A Active Low

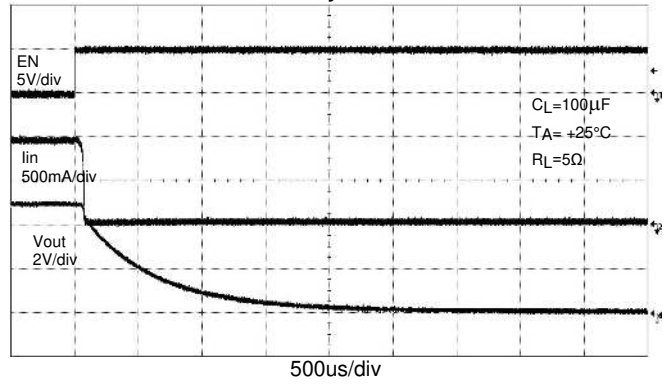


Typical Performance Characteristics (continued)

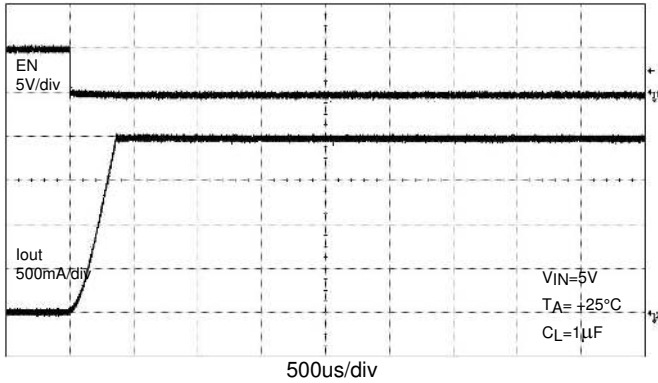
Turn-On Delay and Rise Time



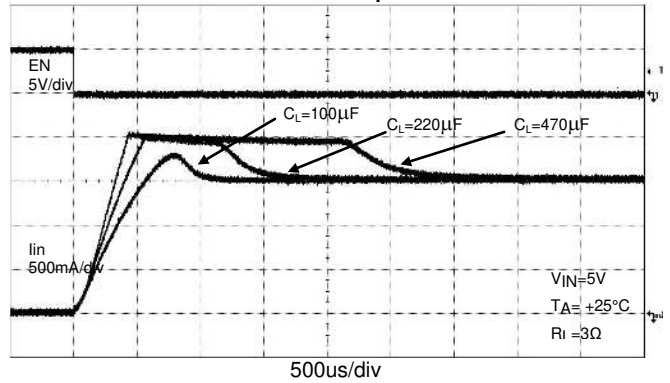
Turn-Off Delay and Fall Time



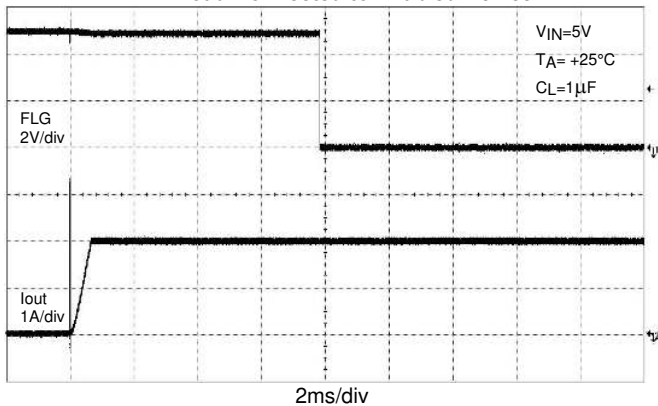
Short Circuit Current, Device Enabled Into Short



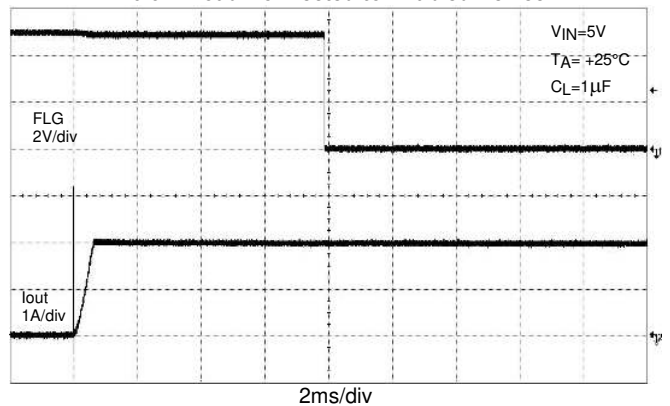
Inrush Current with Different Load Capacitance



1 Ω Load Connected to Enabled Device

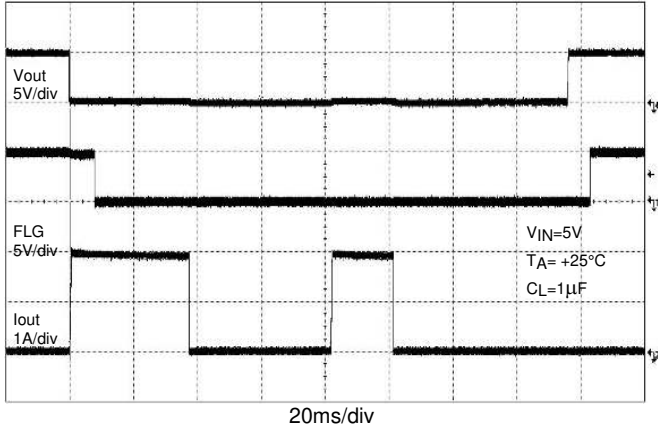


0.6 Ω Load Connected to Enabled Device

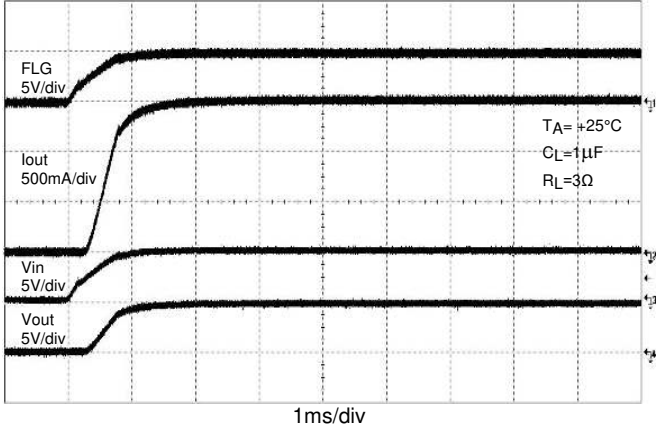


Typical Performance Characteristics (continued)

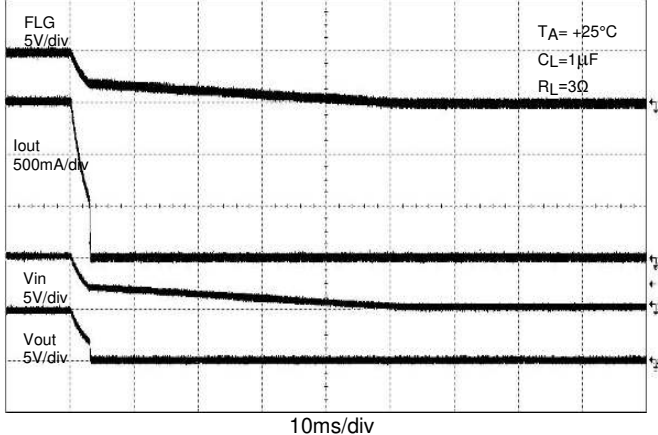
Short Circuit with Blanking Time and Recovery



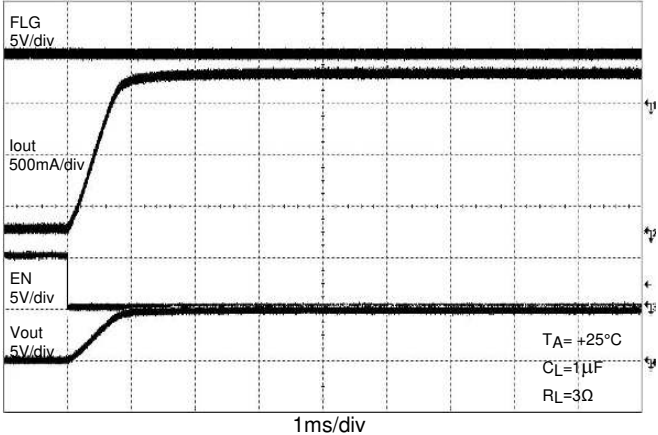
Power On



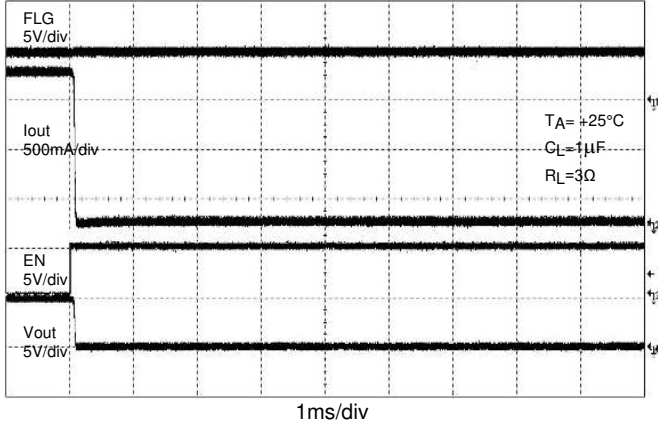
Power Off



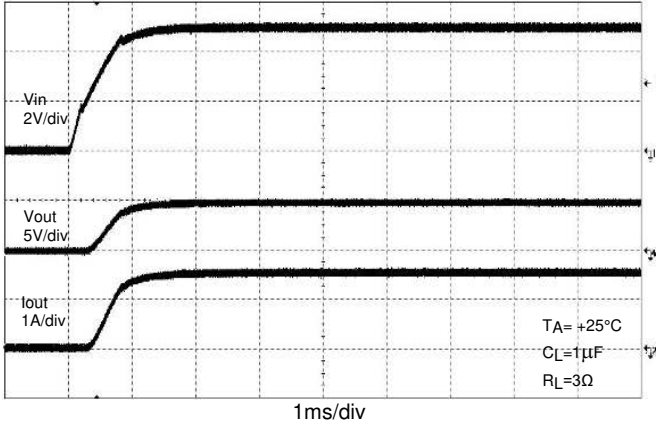
Device Enabled



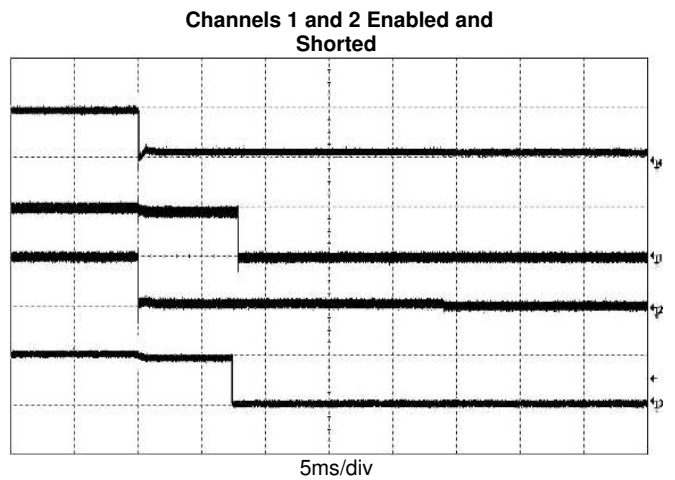
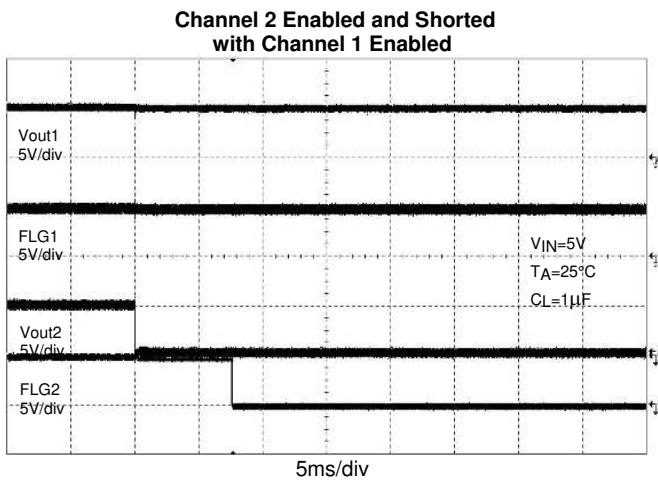
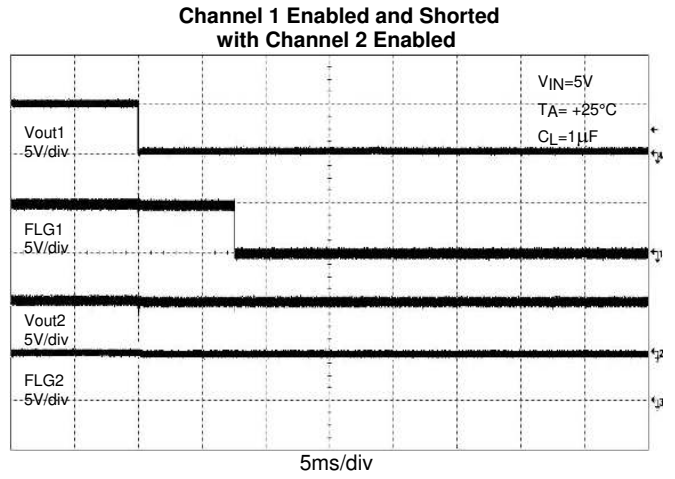
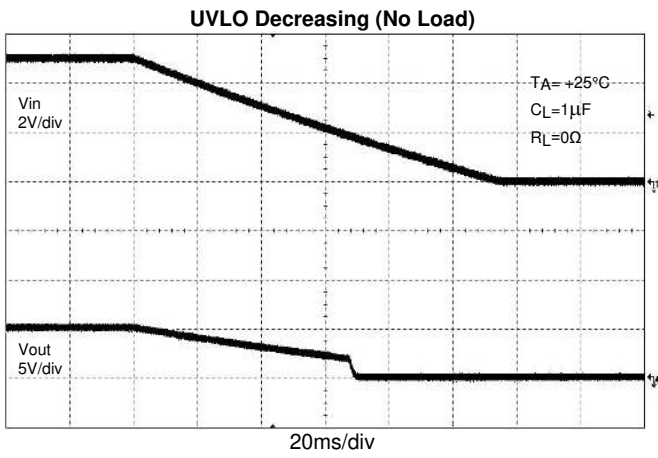
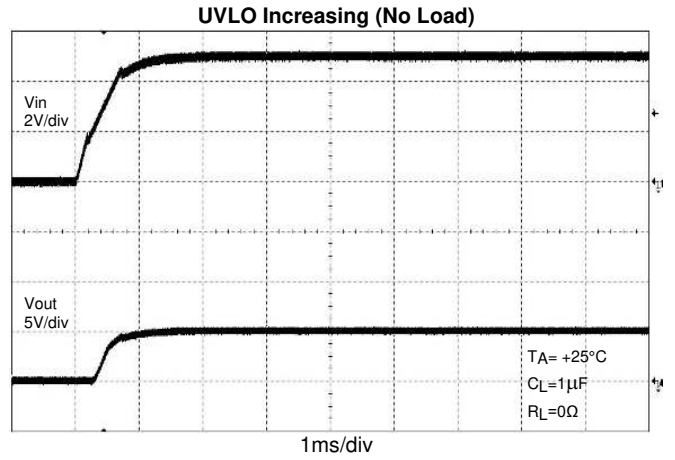
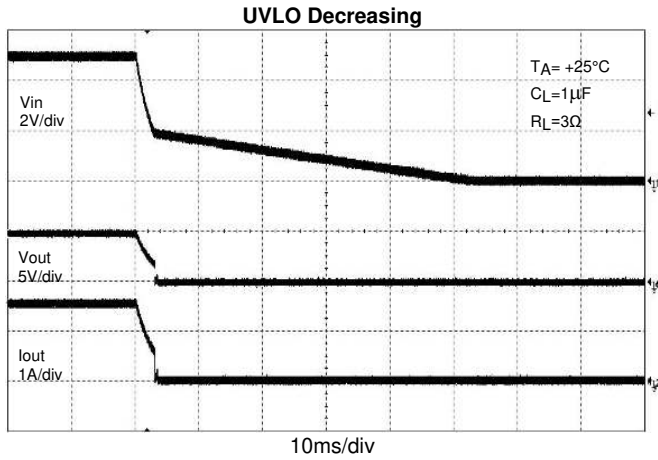
Device Disabled



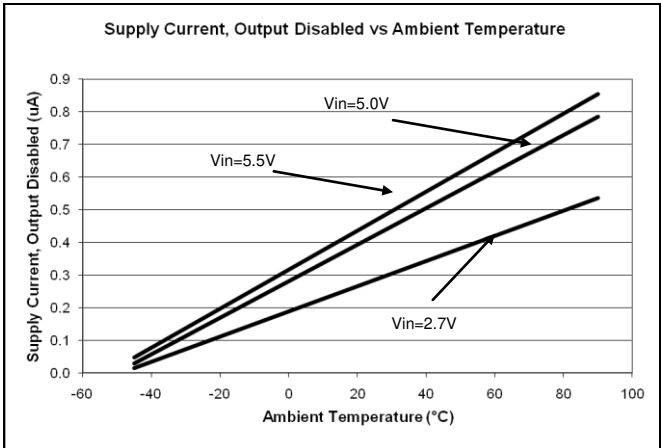
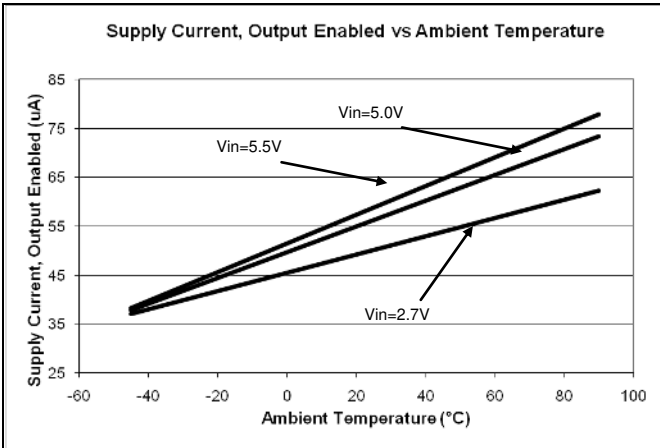
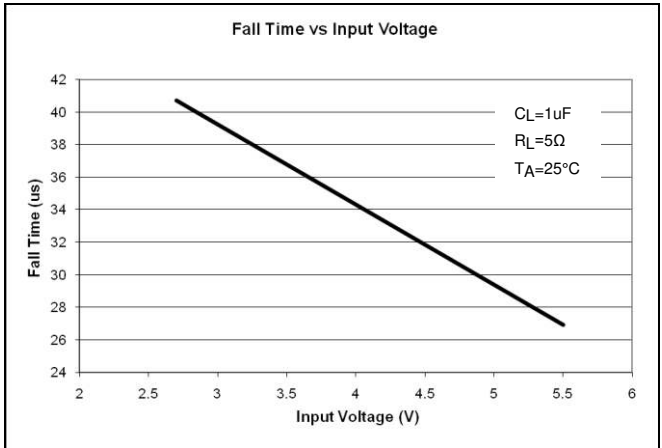
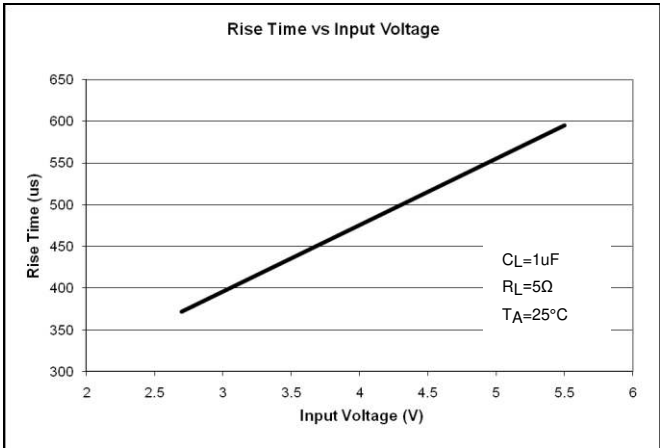
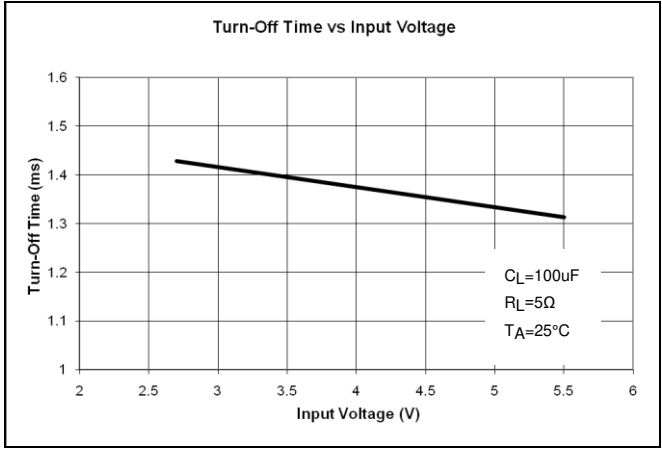
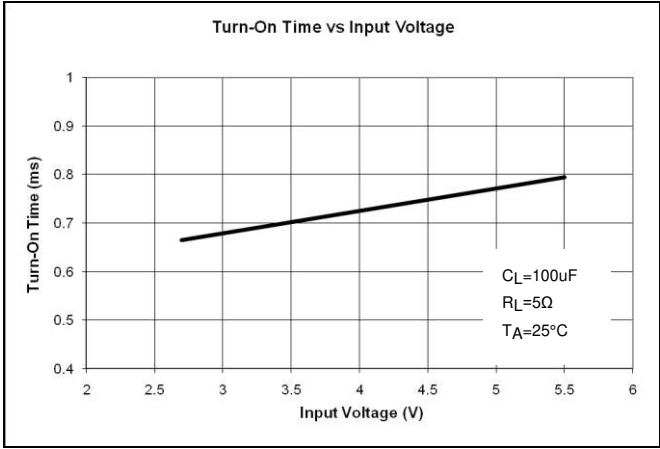
UVLO Increasing



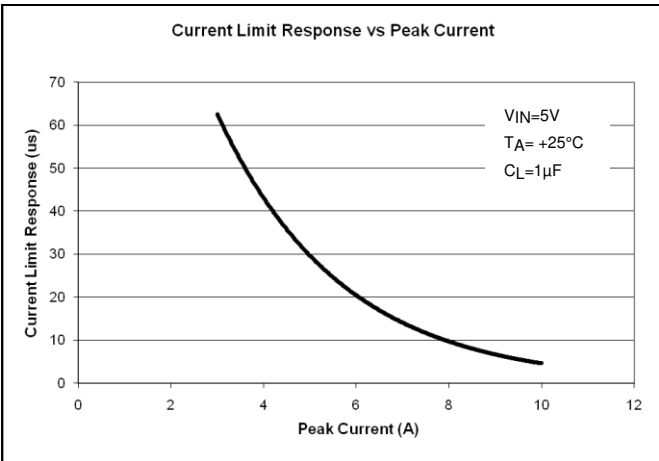
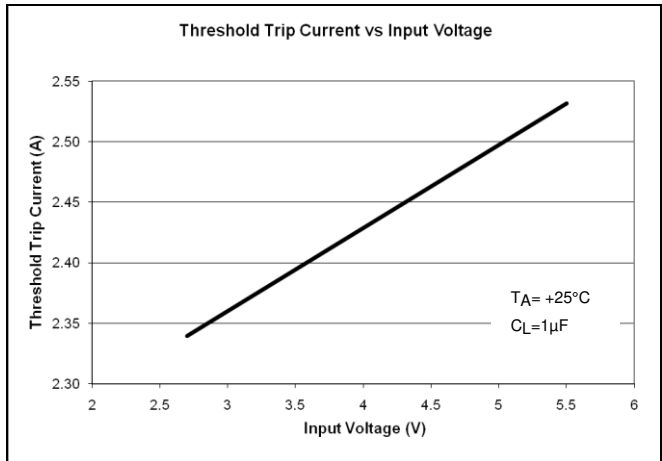
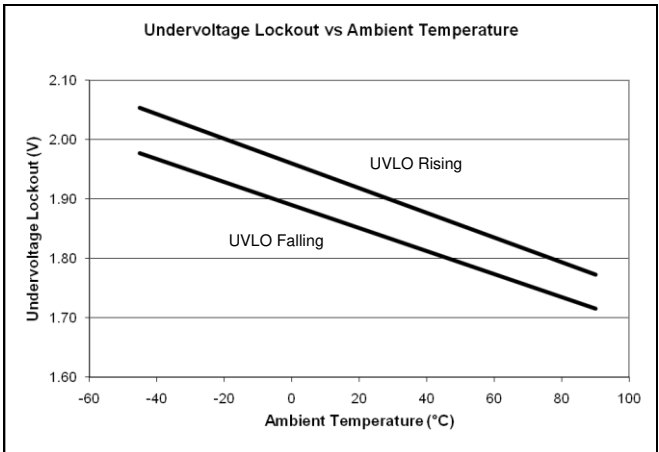
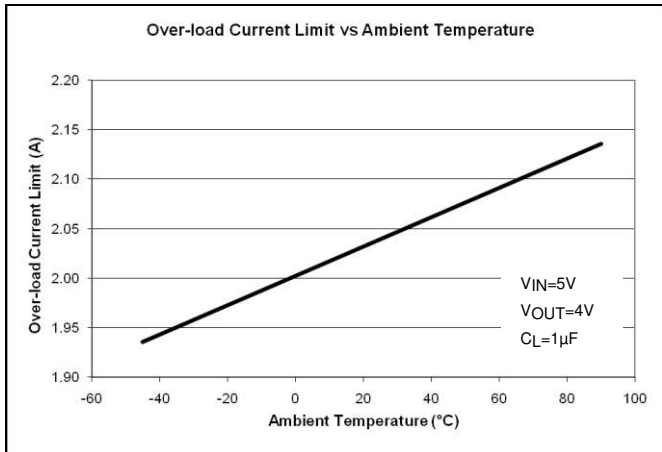
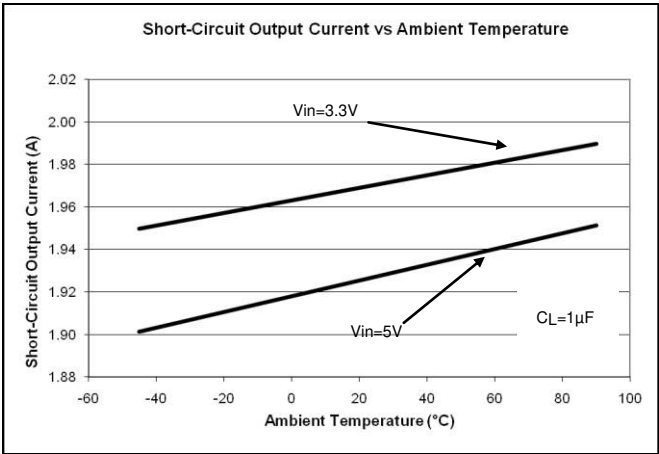
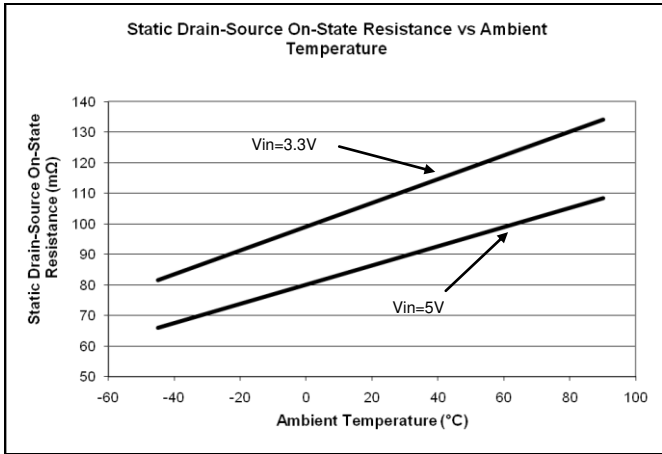
Typical Performance Characteristics (continued)



Typical Performance Characteristics (continued)



Typical Performance Characteristics (continued)



Application Information

Power Supply Considerations

A 0.1µF to 1µF, X7R, or X5R ceramic bypass capacitor between IN and GND, close to the device, is recommended. Placing a high-value electrolytic capacitor on the input and output pin(s) is recommended when the output load is heavy. This precaution reduces power-supply transients that may cause ringing on the input. Additionally, bypassing the output with a 1µF ceramic capacitor improves the immunity of the device to short-circuit transients.

Overcurrent and Short-Circuit Protection

An internal sensing FET is employed to check for overcurrent conditions. Unlike current-sense resistors, sense FETs do not increase the series resistance of the current path. When an overcurrent condition is detected, the device maintains a constant output current and reduces the output voltage accordingly. Complete shutdown occurs only if the fault stays long enough to activate thermal limiting.

Three possible overload conditions can occur. In the first condition, the output has been shorted to GND before the device is enabled or before V_{IN} has been applied. The AP2182A/AP2192A senses the short circuit and immediately clamps output current to a certain safe level namely I_{LIMIT} .

In the second condition, an output short or an overload occurs while the device is enabled. At the instance the overload occurs, higher inrush current may flow for a very short period of time before the current limit function can react. The input capacitor(s) rapidly discharge through the device, activating current limit circuitry. Protection is achieved by momentarily opening the P-MOS high-side power switch and then gradually turning it on. After the current limit function has tripped (reached the overcurrent trip threshold), the device switches into current limiting mode and the current is clamped at I_{LIMIT} . The threshold for activating current limiting is 2A typical per channel.

In the third condition, the load has been gradually increased beyond the recommended operating current. The current is permitted to rise until the current-limit threshold (I_{TRIP}) is reached or until the thermal limit of the device is exceeded. The AP2182A/AP2192A is capable of delivering current up to the current-limit threshold without damaging the device. Once the threshold has been reached, the device switches into its current limiting mode and is set at I_{LIMIT} .

FLG Response

When an overcurrent or overtemperature shutdown condition is encountered, the FLG open-drain output goes active low after a nominal 7-ms deglitch timeout. The FLG output remains low until both overcurrent and overtemperature conditions are removed. Connecting a heavy capacitive load to the output of the device can cause a momentary overcurrent condition, which does not trigger the FLG due to the 7-ms deglitch timeout. The AP2182A/AP2192A is designed to eliminate false overcurrent reporting without the need of external components to remove unwanted pulses.

Power Dissipation and Junction Temperature

The low on-resistance of the internal MOSFET allows the small surface-mount packages to pass large current. Using the maximum operating ambient temperature (T_A) and $R_{DS(ON)}$, the power dissipation can be calculated by:

$$P_D = R_{DS(ON)} \times I^2$$

Finally, calculate the junction temperature:

$$T_J = P_D \times R_{\theta JA} + T_A$$

Where:

T_A = Ambient temperature °C

$R_{\theta JA}$ = Thermal resistance

P_D = Total power dissipation

Thermal Protection

Thermal protection prevents the IC from damage when heavy-overload or short-circuit faults are present for extended periods of time. The AP2182A/AP2192A implements a thermal sensing to monitor the operating junction temperature of the power distribution switch. Once the die temperature rises to approximately 140°C due to excessive power dissipation in an overcurrent or short-circuit condition the internal thermal sense circuitry turns the power switch off, thus preventing the power switch from damage. Hysteresis is built into the thermal sense circuit allowing the device to cool down approximately 25°C before the switch turns back on. The switch continues to cycle in this manner until the load fault or input power is removed. The FLG open-drain output is asserted when an overtemperature shutdown or overcurrent occurs with 7-ms deglitch.

Application Information (continued)

Undervoltage Lockout (UVLO)

Undervoltage lockout function (UVLO) keeps the internal power switch from being turned on until the power supply has reached at least 2V, even if the switch is enabled. Whenever the input voltage falls below approximately 2V, the power switch is quickly turned off. This facilitates the design of hot-insertion systems where it is not possible to turn off the power switch before input power is removed.

Discharge Function

The discharge function of the device is active when enable is disabled or de-asserted. The discharge function with the N-MOS power switch implementation is activated and offers a resistive discharge path for the external storage capacitor. This is designed for discharging any residue of the output voltage when either no external output resistance or load resistance is present at the output.

Host/Self-Powered HUBs

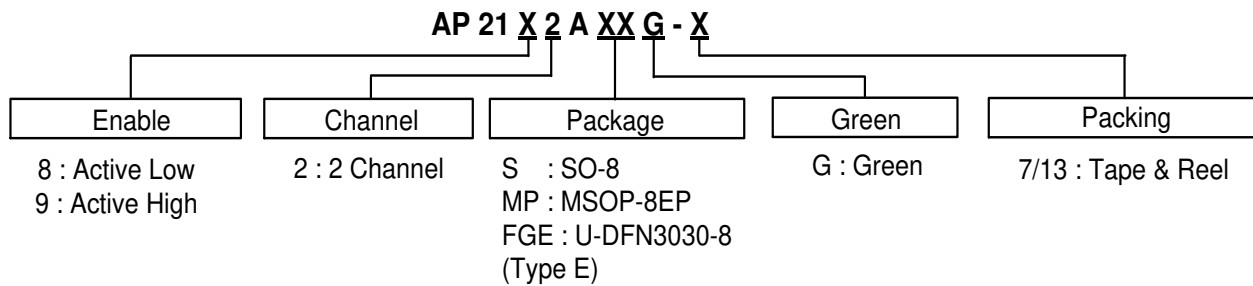
Hosts and self-powered hubs (SPH) have a local power supply that powers the embedded functions and the downstream ports. This power supply must provide from 5.25V to 4.75V to the board side of the downstream connection under both full-load and no-load conditions. Hosts and SPHs are required to have current-limit protection and must report overcurrent conditions to the USB controller. Typical SPHs are desktop PCs, monitors, printers, and stand-alone hubs.

Generic Hot-Plug Applications

In many applications it may be necessary to remove modules or pc boards while the main unit is still operating. These are considered hot-plug applications. Such implementations require the control of current surges seen by the main power supply and the card being inserted. The most effective way to control these surges is to limit and slowly ramp the current and voltage being applied to the card, similar to the way in which a power supply normally turns on. Due to the controlled rise times and fall times of the AP2182A/AP2192A, these devices can be used to provide a softer start-up to devices being hot-plugged into a powered system. The UVLO feature of the AP2182A/AP2192A also ensures that the switch is off after the card has been removed, and that the switch is off during the next insertion.

By placing the AP2182A/AP2192A between the V_{CC} input and the rest of the circuitry, the input power reaches these devices first after insertion. The typical rise time of the switch is approximately 1ms, providing a slow voltage ramp at the output of the device. This implementation controls system surge current and provides a hot-plugging mechanism for any device.

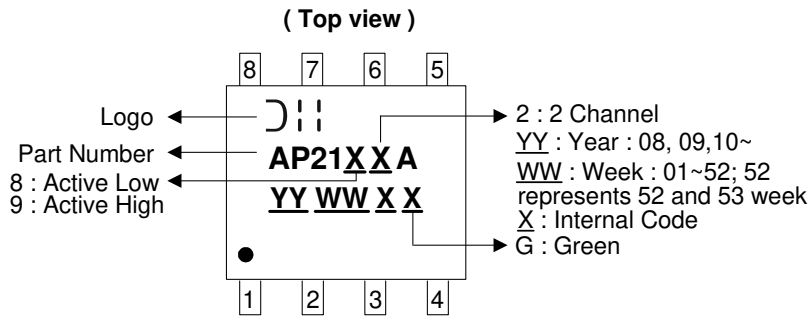
Ordering Information



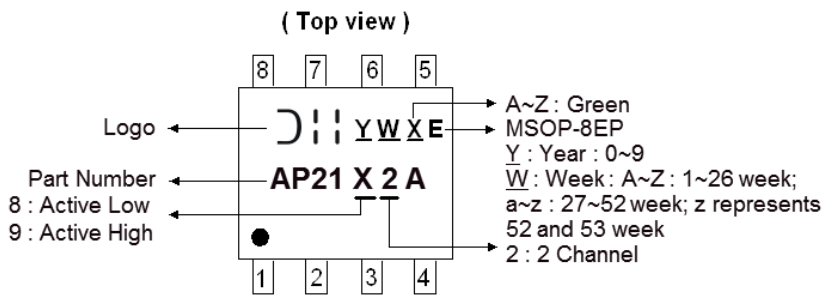
Part Number	Package Code	Packaging	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
AP21X2ASG-13	S	SO-8	250/Tape & Reel	-13
AP21X2AMPG-13	MP	MSOP-8EP	2,500/Tape & Reel	-13
AP21X2AFGEG-7	FGE	U-DFN3030-8 (Type E)	3,000/Tape & Reel	-7

Marking Information

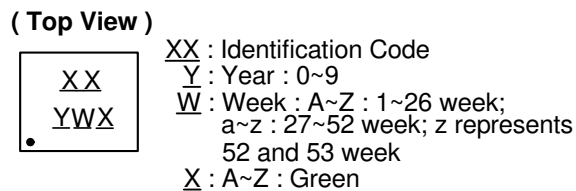
(1) SO-8



(2) MSOP-8EP



(3) U-DFN3030-8 (Type E)

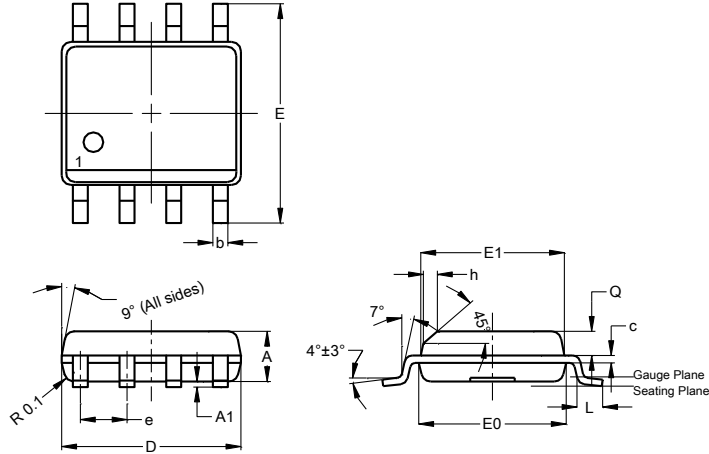


Part Number	Package	Identification Code
AP2182AFGEG-7	U-DFN3030-8 (Type E)	AE
AP2192AFGEG-7	U-DFN3030-8 (Type E)	AF

Package Outline Dimensions (All dimensions in mm.)

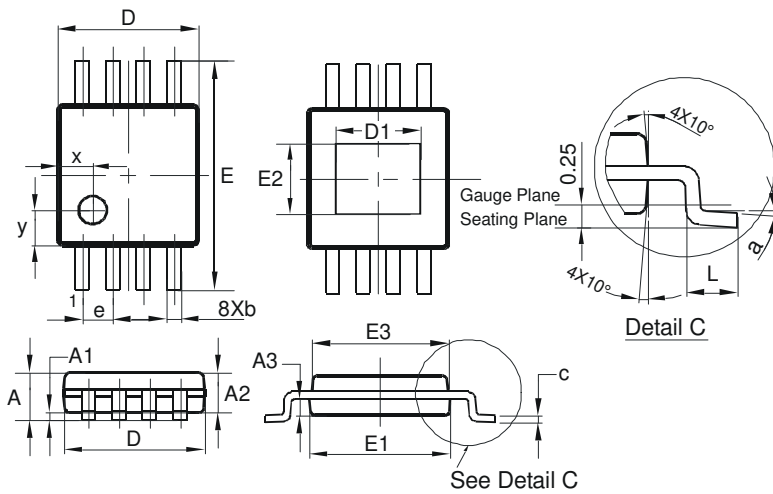
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SO-8



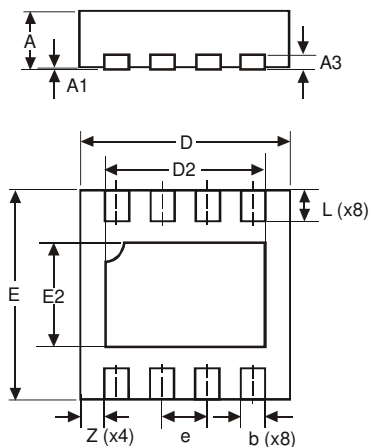
SO-8			
Dim	Min	Max	Typ
A	1.40	1.50	1.45
A1	0.10	0.20	0.15
b	0.30	0.50	0.40
c	0.15	0.25	0.20
D	4.85	4.95	4.90
E	5.90	6.10	6.00
E1	3.80	3.90	3.85
E0	3.85	3.95	3.90
e	--	--	1.27
h	-	--	0.35
L	0.62	0.82	0.72
Q	0.60	0.70	0.65
All Dimensions in mm			

(2) Package Type: MSOP-8EP



MSOP-8EP			
Dim	Min	Max	Typ
A	-	1.10	-
A1	0.05	0.15	0.10
A2	0.75	0.95	0.86
A3	0.29	0.49	0.39
b	0.22	0.38	0.30
c	0.08	0.23	0.15
D	2.90	3.10	3.00
D1	1.60	2.00	1.80
E	4.70	5.10	4.90
E1	2.90	3.10	3.00
E2	1.30	1.70	1.50
E3	2.85	3.05	2.95
e	-	-	0.65
L	0.40	0.80	0.60
a	0°	8°	4°
x	-	-	0.750
y	-	-	0.750
All Dimensions in mm			

(3) Package Type: U-DFN3030-8 (Type E)

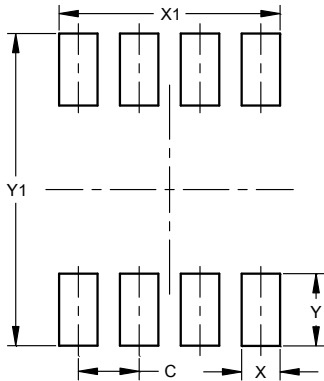


U-DFN3030-8 (Type E)			
Dim	Min	Max	Typ
A	0.57	0.63	0.60
A1	0	0.05	0.02
A3	-	-	0.15
b	0.20	0.30	0.25
D	2.95	3.05	3.00
D2	2.15	2.35	2.25
E	2.95	3.05	3.00
e	-	-	0.65
E2	1.40	1.60	1.50
L	0.30	0.60	0.45
Z	-	-	0.40
All Dimensions in mm			

Suggested Pad Layout

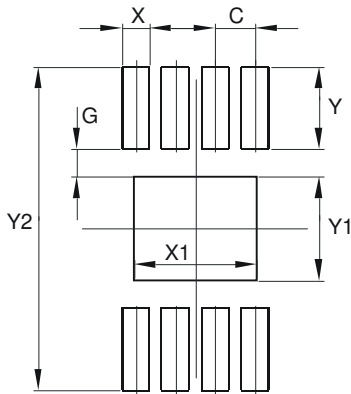
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SO-8



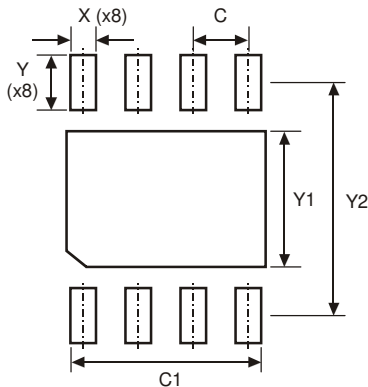
Dimensions	Value (in mm)
C	1.27
X	0.802
X1	4.612
Y	1.505
Y1	6.50

(2) Package Type: MSOP-8EP



Dimensions	Value (in mm)
C	0.650
G	0.450
X	0.450
X1	2.000
Y	1.350
Y1	1.700
Y2	5.300

(3) Package Type: U-DFN3030-8 (Type E)



Dimensions	Value (in mm)
C	0.65
C1	2.35
X	0.30
Y	0.65
Y1	1.60
Y2	2.75

IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

DIODES is a trademark of Diodes Incorporated in the United States and other countries.
The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.
© 2022 Diodes Incorporated. All Rights Reserved.

www.diodes.com