

## Description

The DIODES™ AP22816/17/18 is a single-channel, current-limited, integrated high-side power switch 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 device has fast short-circuit response time for improved overall system robustness, and has an integrated output discharge function to ensure 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 circuit, and offer reverse current blocking, overcurrent, overtemperature and short-circuit protection, as well as controlled rise time and undervoltage lockout functionality. A 6ms deglitch capability on the open-drain flag output prevents false overcurrent reporting and does not require any external components.

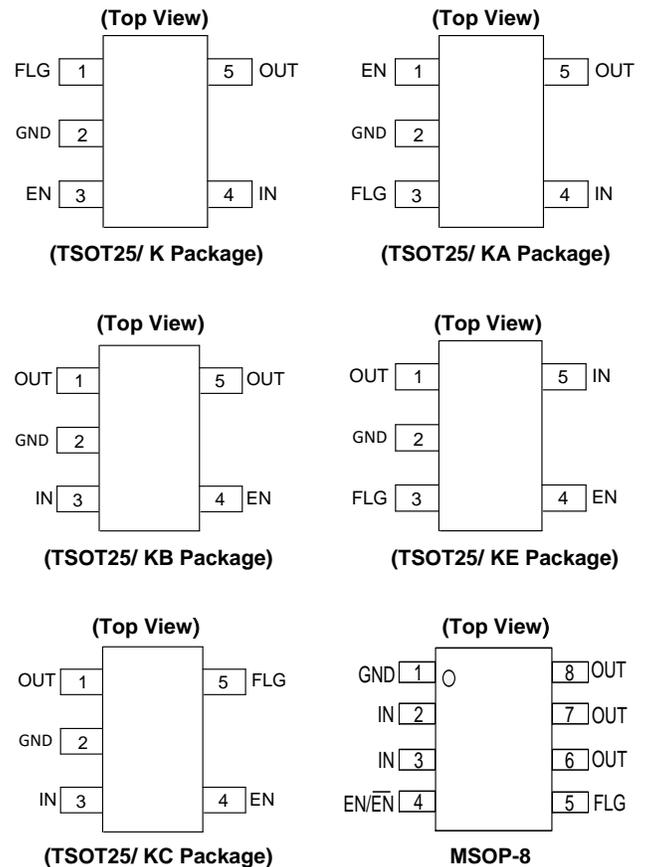
The AP22816/17/18 is available in the standard Green and RoHS compliant TSOT25 and MSOP-8 packages.

## Features

- Input Voltage Range: 2.7V to 5.5V
- 75mΩ On-resistance
- Built-in Soft-start with 0.6ms Typical Rise Time
- Fault Report (FLG) with Blanking Time (6ms Typ.)
- ESD Protection: 2kV HBM, 500V CDM
- Logic Level Enable Pin: Available with Active-high or Active-low Versions
- Protections:
  - Overcurrent Protection with Auto Recovery
  - Short-Circuit Protection with Auto Recovery
  - Overtemperature Protection with Auto Recovery
  - Output Reverse Current / Voltage Protection
- Thermally-Efficient Low Profile Package
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals:
  - TSOT-25: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
  - MSOP-8: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
- Weight:
  - TSOT25: 0.013 grams (Approximate)
  - MSOP-8: 0.027grams(Approximate)
- 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.

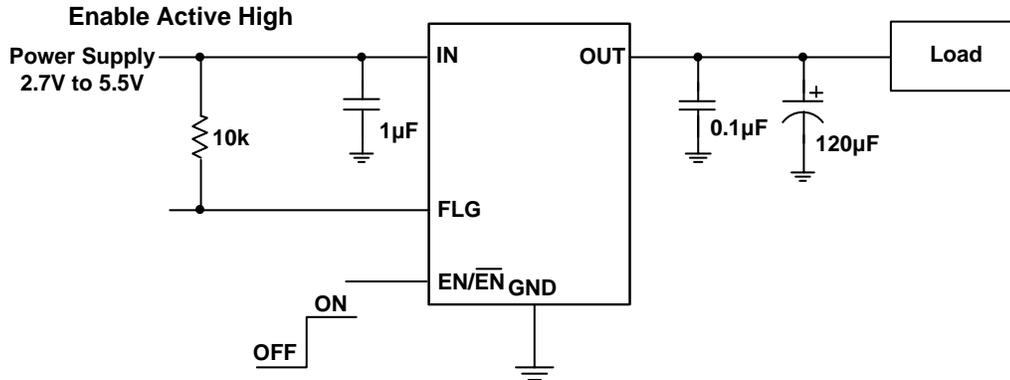
## Pin Assignments



## Applications

- Integrated load switches in Ultrabook PCs
- Power up/down sequencing in Ultrabook PCs
- Notebooks
- Netbooks
- Set-top boxes
- SSD (solid state drives)
- Consumer electronics
- Tablet PCs
- Telecom systems

**Typical Applications Circuit**

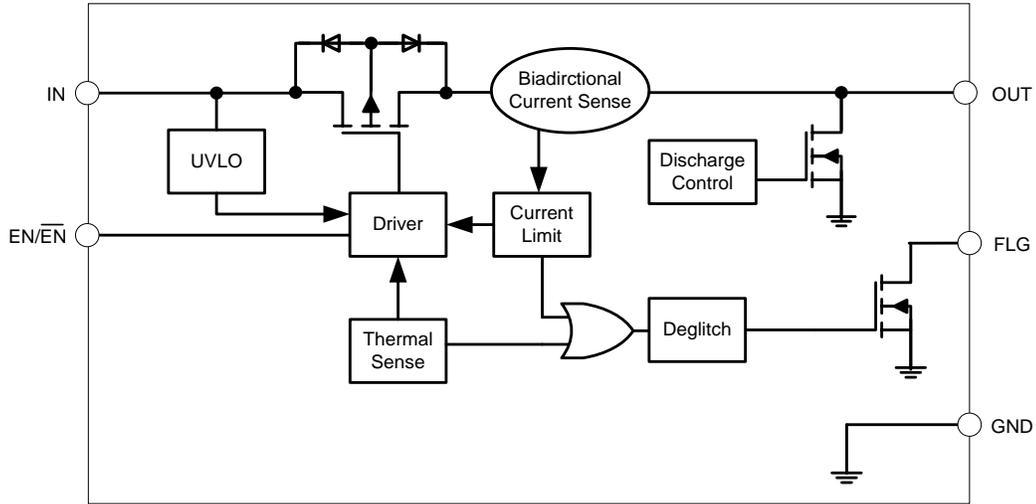


Note: If 1µF input cap. Will lead to large  $V_{IN}$  spike, it's recommended to use 10µF capacitor instead.

**Pin Descriptions**

| Pin Number |         | Pin Name                   | Function  |
|------------|---------|----------------------------|---|
| TSOT25     | MSOP-8  |                            |   |
| 5(K/KA)    | 6, 7, 8 | OUT                        | Voltage Output Pin, connect a 0.1µF bypass capacitor and a high-value capacitor to GND, close to IC. (At least 10µF in USB applications.) |
| 1, 5(KB)   |         |                            |   |
| 1(KE)      |         |                            |   |
| 2          | 1       | GND                        | Ground pin of the circuitry   |
| 1(K)       | 5       | FLG                        | Overcurrent and Overtemperature fault report; Open-Drain flag is active-low when triggered.   |
| 3(KA/KE)   |         |                            |   |
| 5(KC)      |         |                            |   |
| 3(K)       | 4       | EN/ $\overline{\text{EN}}$ | Enable input  |
| 1(KA)      |         |                            | AP22816A/17A/18A: Active-High   |
| 4(KB/KE)   |         |                            | AP22816B/17B/18B: Active-Low  |
| 4(K/KA)    | 2, 3    | IN                         | Voltage Input Pin, connect a 1µF low ESR capacitor to GND, close to IC.   |
| 3(KB)      |         |                            |   |
| 5(KE)      |         |                            |   |

**Functional Block Diagram**



**Absolute Maximum Ratings** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.) (Note 4)

| Symbol          | Parameter                               |   | Ratings                    | Units              |
|-----------------|---|---|----------------------------|--------------------|
| ESD             | HBM                                     | Human Body ESD Protection   | 2000                       | V                  |
|                 | CDM                                     | Charged Device Model ESD Protection                                       | 500                        | V                  |
|                 | IEC System Level                        | Surges per IEC61000-4-2, 1999 Applied to Output Terminals of EVM (Note 6) | 15                         | kV                 |
| $V_{IN}$        | Input Voltage                           |   | -0.3 to 6.0                | V                  |
| $V_{OUT}$       | Output Voltage                          |   | -0.3 to ( $V_{IN} + 0.3$ ) | V                  |
| $V_{EN/EN-}$    | Enable Voltage                          |   | -0.3 to ( $V_{IN} + 0.3$ ) | V                  |
| $I_L$           | Load Current                            |   | Internal Limited           | $^\circ\text{C}$   |
| $T_{J(max)}$    | Maximum Junction Temperature            |   | +150                       | $^\circ\text{C}$   |
| $T_{ST}$        | Storage Temperature                     |   | -65 to +150                | $^\circ\text{C}$   |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | MSOP-8 (Note 5, 7)  | 165                        | $^\circ\text{C/W}$ |
|                 | Thermal Resistance, Junction to Case    | TSOT25 (Note 6, 7)  | 123                        |                    |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | MSOP-8 (Note 5, 7)  | 33                         |                    |
|                 |   | TSOT25 (Note 6, 7)  | 32                         |                    |

- Notes:
- Stresses greater than the 'Absolute Maximum Ratings' specified above may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.
  - External capacitors need to be connected to the output, EVM board was tested with external capacitor. This level is a pass test only and not a limit.
  - Test condition for TSOT25/MSOP-8: Device mounted on 1"x1 1/2"x2" FR-4 substrate PC board, 2oz copper with minimum recommended pad layout.
  - $R_{\theta JA}$  and  $R_{\theta JC}$  are measured at  $T_A = 25^\circ\text{C}$  on a high effective thermal conductivity four-layer test board per JEDEC 51-7.

**Recommended Operating Conditions** (@  $T_A = +25^\circ\text{C}$ , unless otherwise specified.) (Note 8)

| Symbol    | Parameter                                    |         | Min | Max      | Unit             |
|-----------|--|---------|-----|----------|------------------|
| $V_{IN}$  | Input Voltage                                |         | 2.7 | 5.5      | V                |
| $I_{OUT}$ | Output Current                               | AP22816 | 0   | 1.0      | A                |
|           |  | AP22817 | 0   | 1.5      |                  |
|           |  | AP22818 | 0   | 2.0      |                  |
| $V_{IL}$  | $\overline{EN/EN-}$ Input Logic Low Voltage  |         | 0   | 0.5      | V                |
| $V_{IH}$  | $\overline{EN/EN-}$ Input Logic High Voltage |         | 1.5 | $V_{IN}$ | V                |
| $T_A$     | Operating Ambient Temperature                |         | -40 | +85      | $^\circ\text{C}$ |

Note: 8. Refer to the typical application circuit.

**Electrical Characteristics** ( $V_{IN} = 5V @ T_A = +25^{\circ}C$ ,  $C_{IN} = 1\mu F$ ,  $C_L = 100nF$ , unless otherwise specified.)

| Symbol                      | Parameter  | Test Conditions   | Min  | Typ  | Max | Unit        |
|-----------------------------|--|---|------|------|-----|-------------|
| $V_{UVLO}$                  | Input UVLO   | $V_{IN}$ Rising   | 1.8  | 2.3  | 2.6 | V           |
| $\Delta V_{UVLO}$           | Input UVLO Hysteresis                                  | $V_{IN}$ Decreasing   | —    | 180  | —   | mV          |
| $I_{SHDN}$                  | Input Shutdown Current                                 | Disabled, OUT = Open  | —    | 0.1  | 1   | $\mu A$     |
| $I_Q$                       | Input Quiescent Current                                | Enabled, OUT = Open   | —    | 80   | —   | $\mu A$     |
| $I_{LEAK}$                  | Input Leakage Current                                  | Disabled, OUT Grounded  | —    | 0.1  | 1   | $\mu A$     |
| $I_{REV}$                   | Reverse Leakage Current                                | Disabled, $V_{IN} = 0V$ , $V_{OUT} = 5V$ , $I_{REV}$ at $V_{IN}$          | —    | 0.01 | 1   | $\mu A$     |
| $R_{DS(ON)}$                | Switch On-Resistance                                   | $V_{IN} = 5V$ , $I_{OUT} = 1A$   $T_A = +25^{\circ}C$                     | —    | 75   | 95  | m $\Omega$  |
| $I_{LIMIT}$                 | Over Load Current Limit                                | $V_{IN} = 5V$ , $V_{OUT} = 4.5V$ (AP22818)                                | 2.2  | 2.7  | 3.2 | A           |
|                             |  | $V_{IN} = 5V$ , $V_{OUT} = 4.5V$ (AP22817)                                | 1.65 | 2.2  | 2.8 | A           |
|                             |  | $V_{IN} = 5V$ , $V_{OUT} = 4.5V$ (AP22816)                                | 1.1  | 1.5  | 2.1 | A           |
| $I_{SHORT}$                 | Short-Circuit Current Limit                            | Enabled, Output short to ground   | —    | 0.5  | —   | A           |
| $V_{IL}$                    | EN/ $\overline{EN}$ Input Logic Low Voltage            | $V_{IN} = 2.7V$ to $5.5V$   | —    | —    | 0.5 | V           |
| $V_{IH}$                    | EN/ $\overline{EN}$ Input Logic High Voltage           | $V_{IN} = 2.7V$ to $5.5V$   | 1.5  | —    | —   | V           |
| $I_{LEAK-EN/\overline{EN}}$ | EN/ $\overline{EN}$ Input Leakage                      | $V_{IN} = 5V$ , $V_{EN/\overline{EN}} = 0V$ and $5.5V$                    | —    | 0.01 | 1   | $\mu A$     |
| $I_{LEAK-O}$                | Output Leakage Current                                 | Disabled, $V_{OUT} = 0V$  | —    | 0.5  | 1   | $\mu A$     |
| $t_{D(ON)}$                 | Output Turn-On Delay Time                              | $C_L = 4.7\mu F$ , $R_{LOAD} = 10\Omega @ V_{IN} = 3.3V$ Figure 1         | —    | 1.5  | —   | ms          |
| $t_R$                       | Output Turn-On Rise Time                               | $C_L = 4.7\mu F$ , $R_{LOAD} = 10\Omega @ V_{IN} = 3.3V$ Figure 1         | 1.0  | 2.1  | 3.5 | ms          |
| $t_{D(OFF)}$                | Output Turn-Off Delay Time                             | $C_L = 4.7\mu F$ , $R_{LOAD} = 10\Omega @ V_{IN} = 3.3V$ Figure 1         | —    | 20   | —   | $\mu s$     |
| $t_F$                       | Output Turn-Off Fall Time                              | $C_L = 4.7\mu F$ , $R_{LOAD} = 10\Omega @ V_{IN} = 3.3V$ Figure 1         | —    | 0.15 | —   | ms          |
| $R_{FLG}$                   | FLG Output FET On-Resistance                           | $I_{FLG} = 10mA$  | —    | 30   | 60  | $\Omega$    |
| $I_{FOH}$                   | FLG Off Current  | $V_{FLG} = 5V$  | —    | 0.01 | 1   | $\mu A$     |
| $t_{BLANK}$                 | FLG Blanking Time                                      | Assertion or deassertion due to overcurrent and overtemperature condition | 2    | 5    | 15  | ms          |
| $t_{DIS}$                   | Discharge Time   | $C_L = 1\mu F$ , $V_{IN} = 5V$ , disabled to $V_{OUT} < 0.5V$             | —    | 0.4  | —   | ms          |
| $R_{DIS}$                   | Discharge Resistance                                   | $V_{IN} = 5V$ , Disabled, $I_{OUT} = 1mA$                                 | —    | 140  | 200 | $\Omega$    |
| $T_{SHDN}$                  | Thermal Shutdown Threshold                             | Enabled   | —    | +150 | —   | $^{\circ}C$ |
| $T_{HYS}$                   | Thermal Shutdown Hysteresis                            | —   | —    | +40  | —   | $^{\circ}C$ |
| $V_{RVP}$                   | Reverse-Voltage Comparator Trip Point                  | $V_{OUT} - V_{IN}$  | 35   | 70   | 105 | mV          |
| $I_{ROCP}$                  | Reverse Current Limit                                  | $V_{OUT} - V_{IN} = 150mV$  | —    | 350  | —   | mA          |
| $t_{TRIG}$                  | Time from Reverse-Voltage Condition to MOSFET Turn off | $V_{IN}$  | 2    | 5    | 15  | ms          |

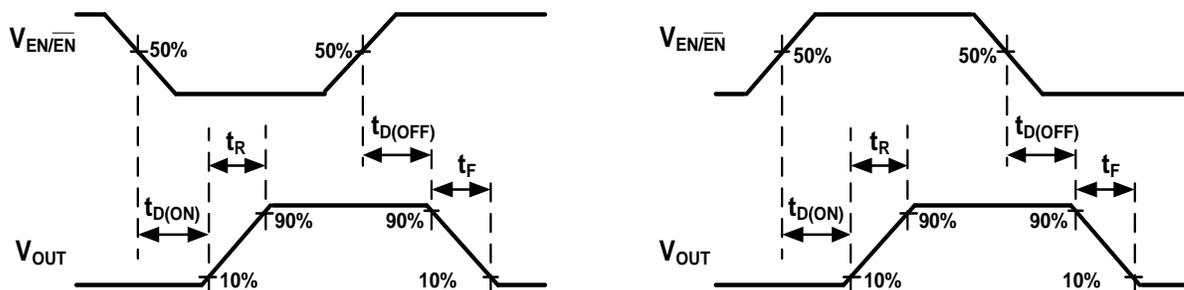
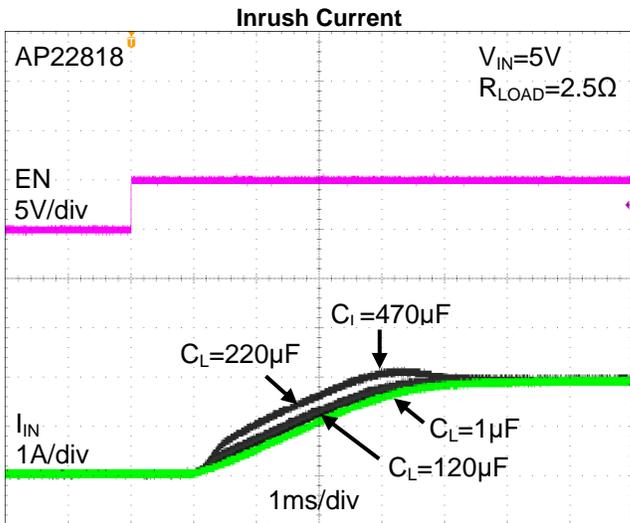
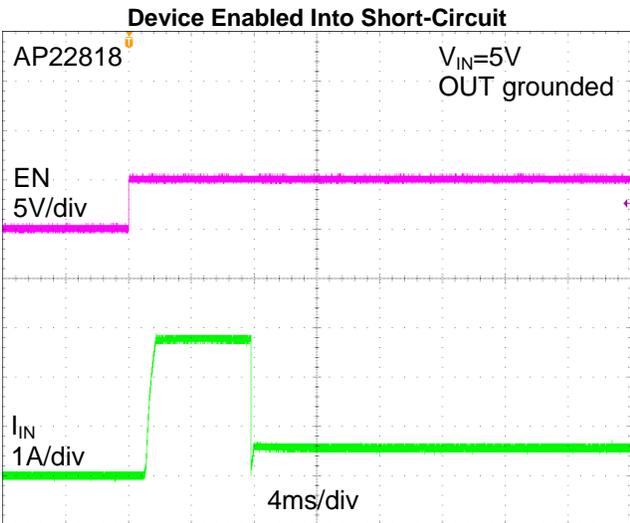
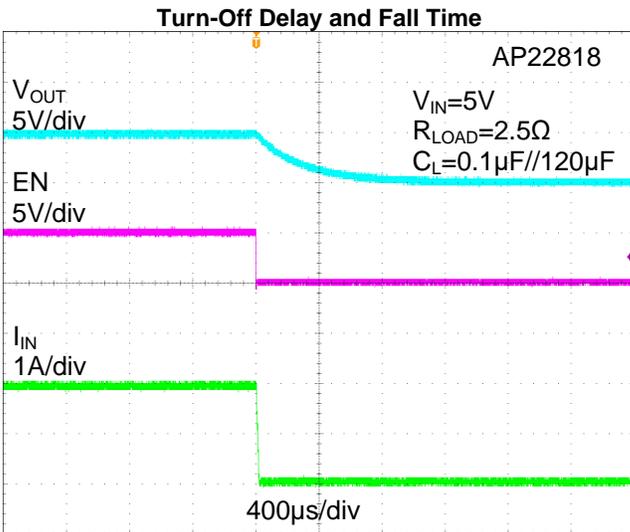
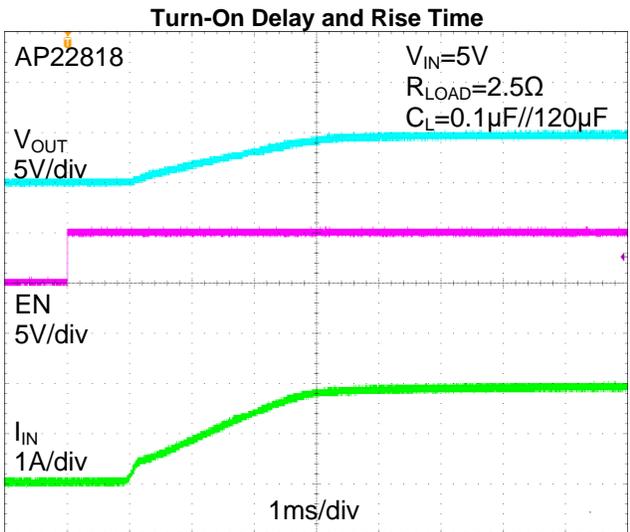
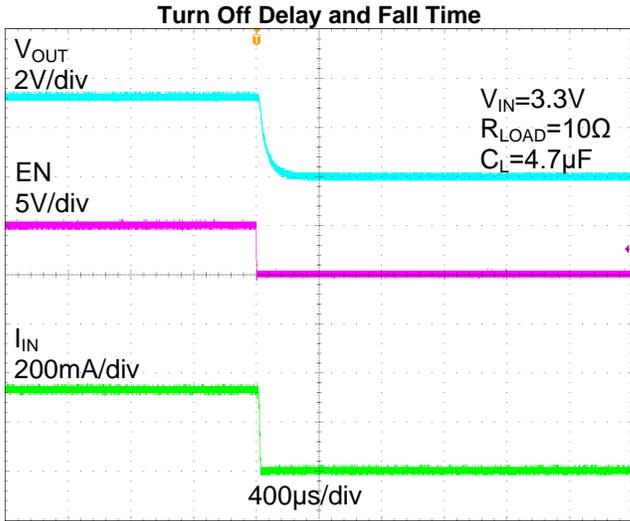
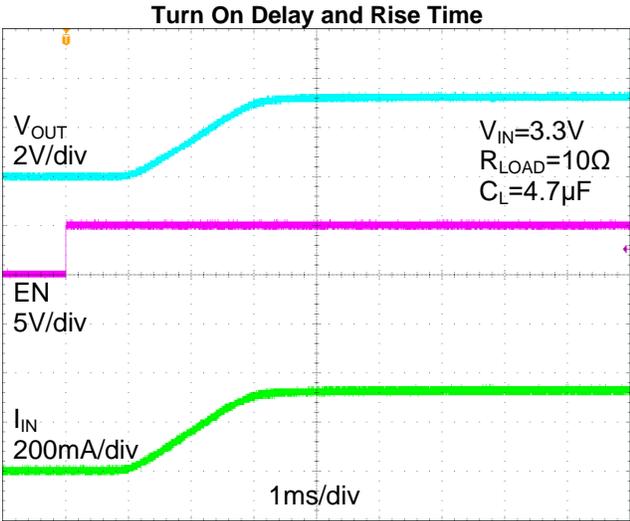
**Performance Characteristics**


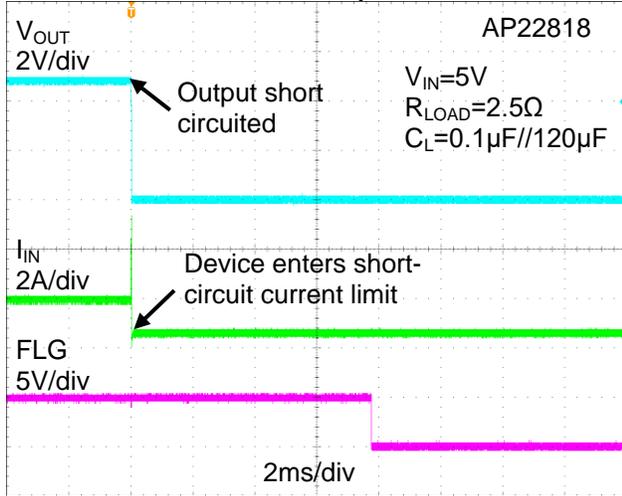
Figure 1. Voltage Waveforms: AP22816B (Active Low, Left), AP22816A (Active High, Right)

**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

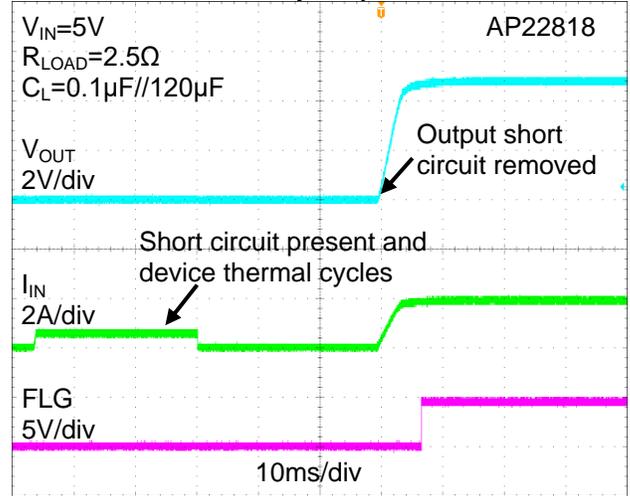


**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

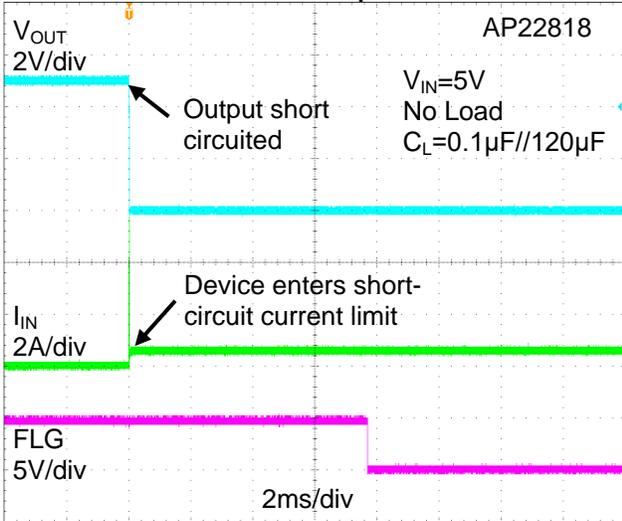
**Full-Load to Short-Circuit Transient Response**



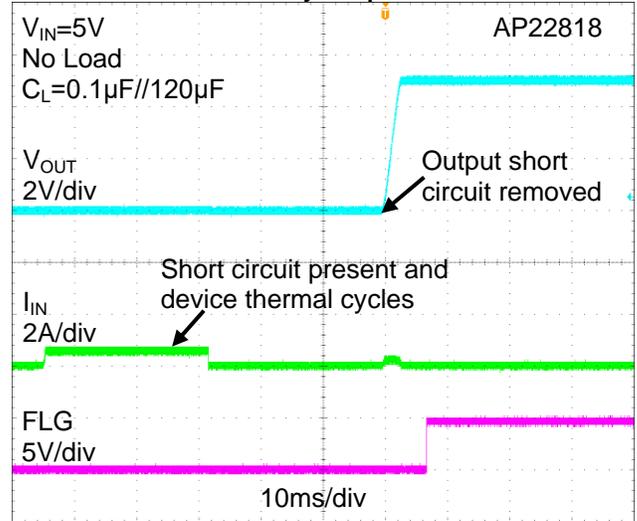
**Short-Circuit to Full-Load Recovery Response**



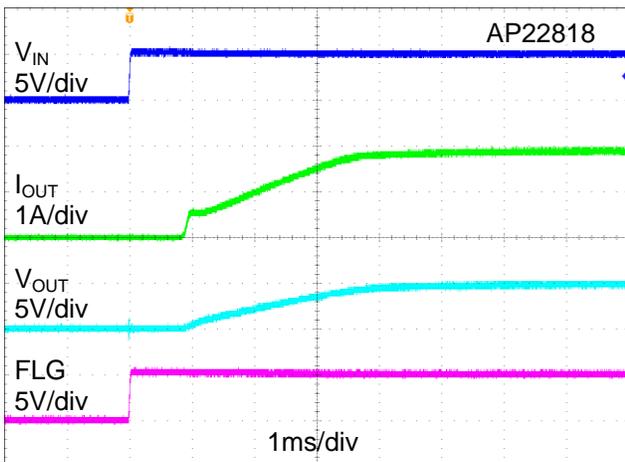
**No-Load to Short-Circuit Transient Response**



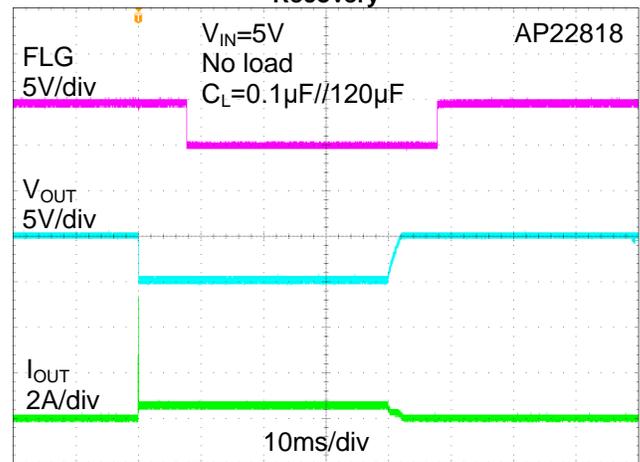
**Short-Circuit to No-Load Recovery Response**



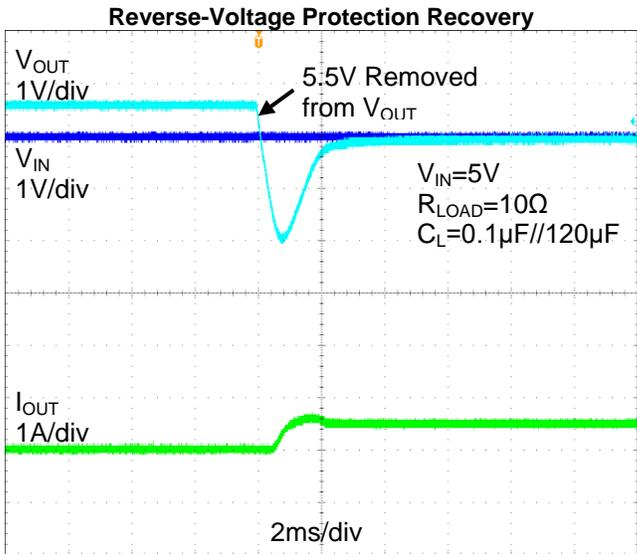
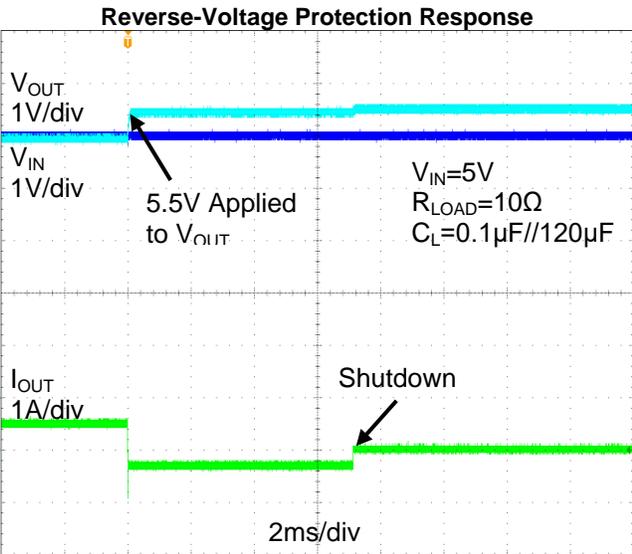
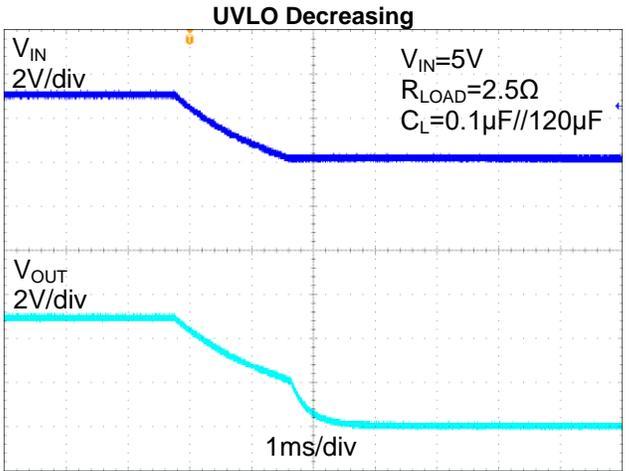
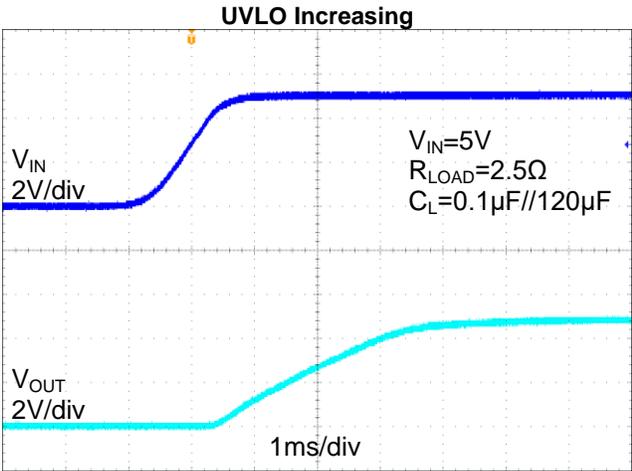
**Power ON**



**Short-Circuit with Blanking Time and Recovery**

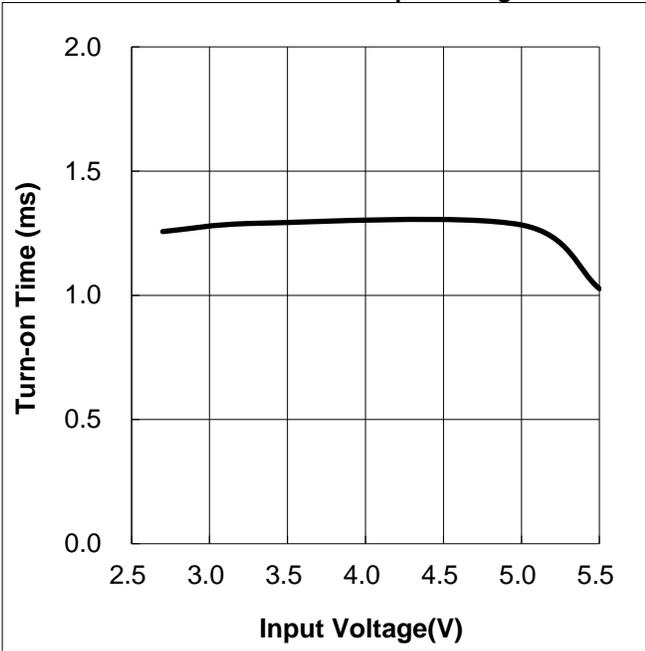


**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

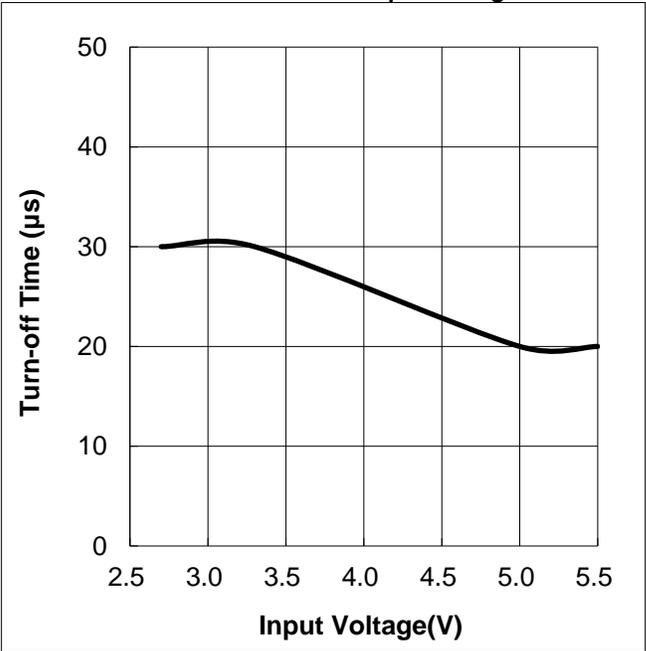


**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

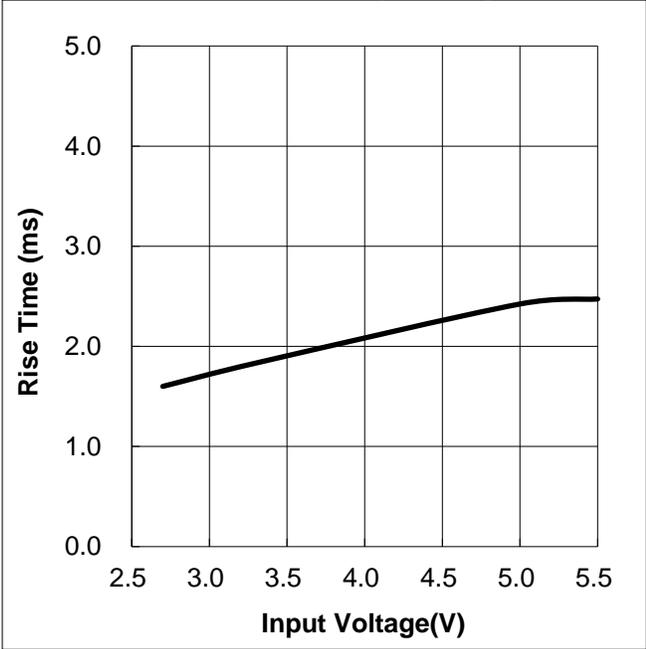
**Turn-on Time vs. Input Voltage**



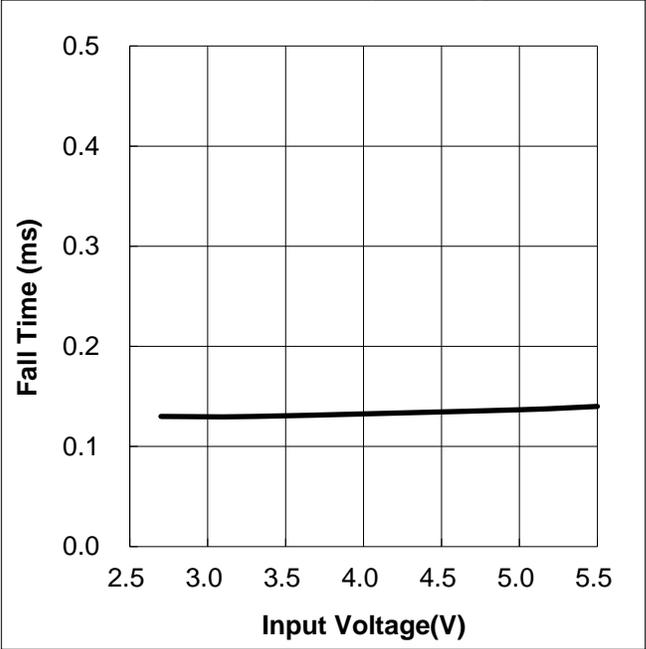
**Turn-off Time vs. Input Voltage**



**Rise Time vs. Input Voltage**



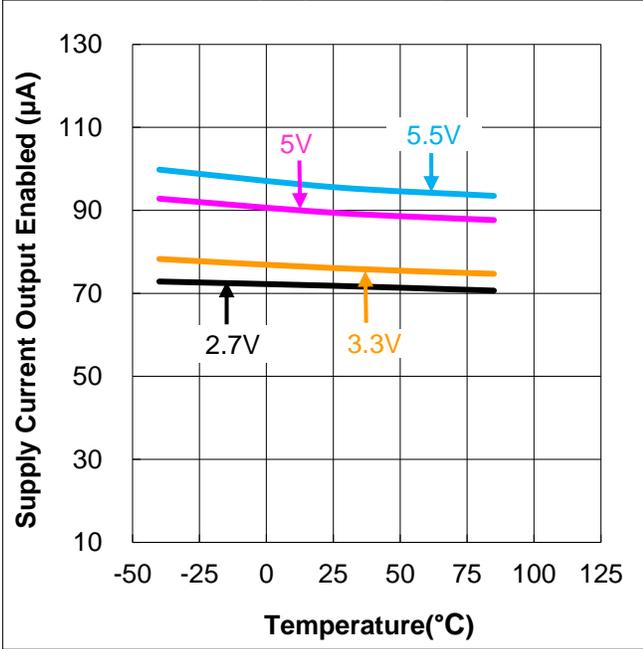
**Fall Time vs. Input Voltage**



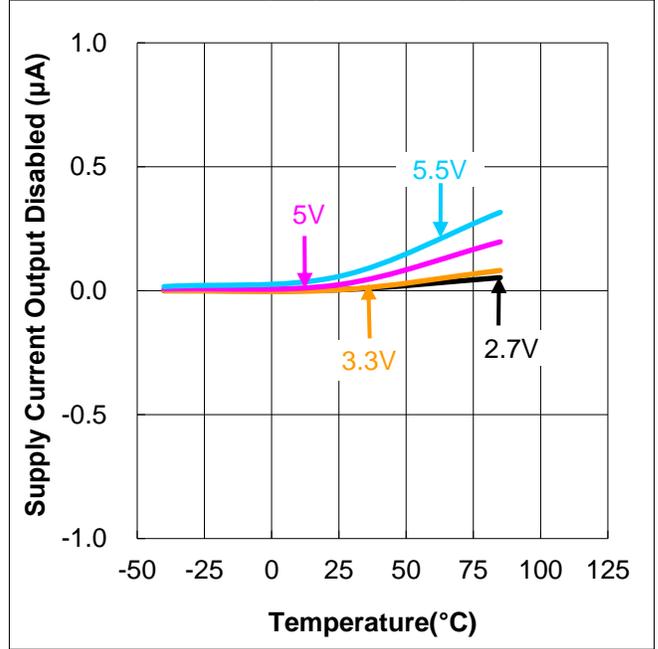


**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

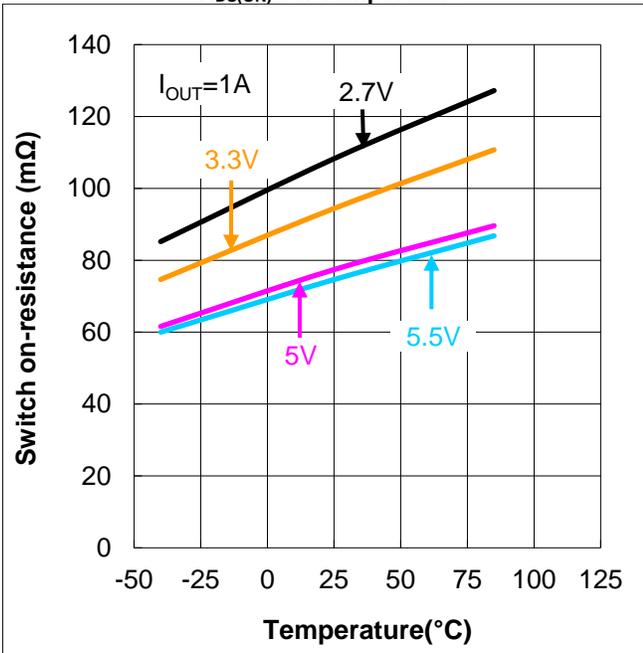
**Supply Current vs. Temperature (Output Enabled)**



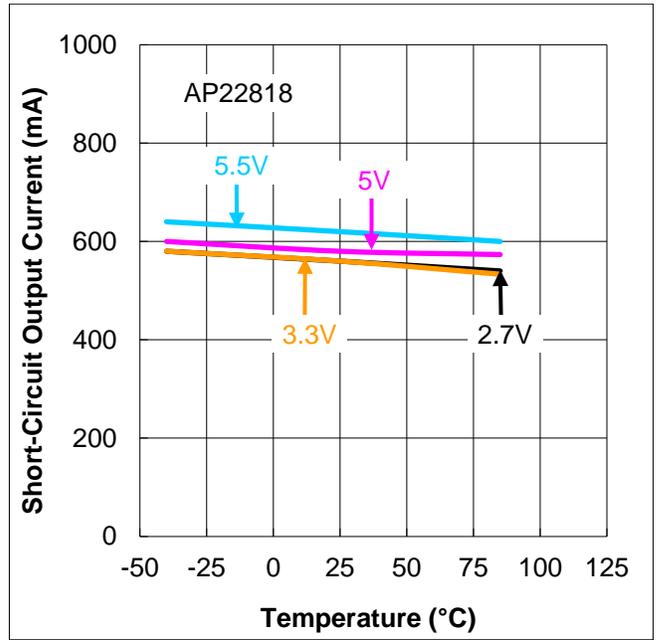
**Supply Current vs. Temperature (Output Disabled)**



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

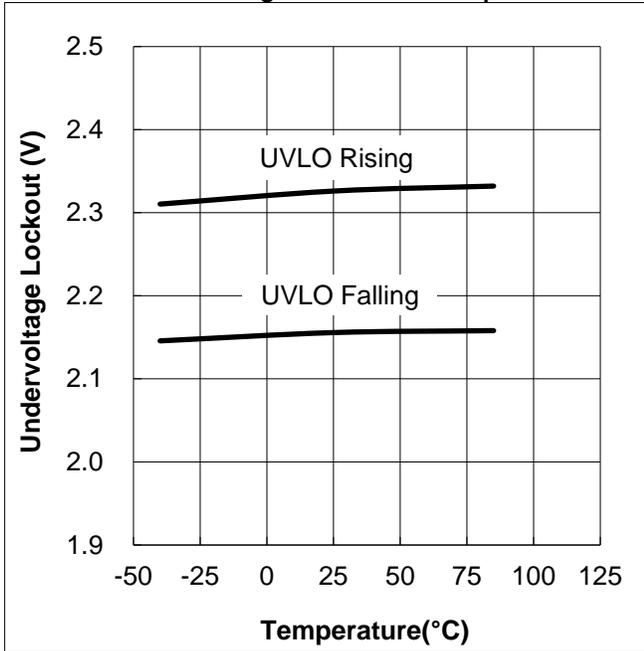


**Short-Circuit Output Current vs. Temperature**

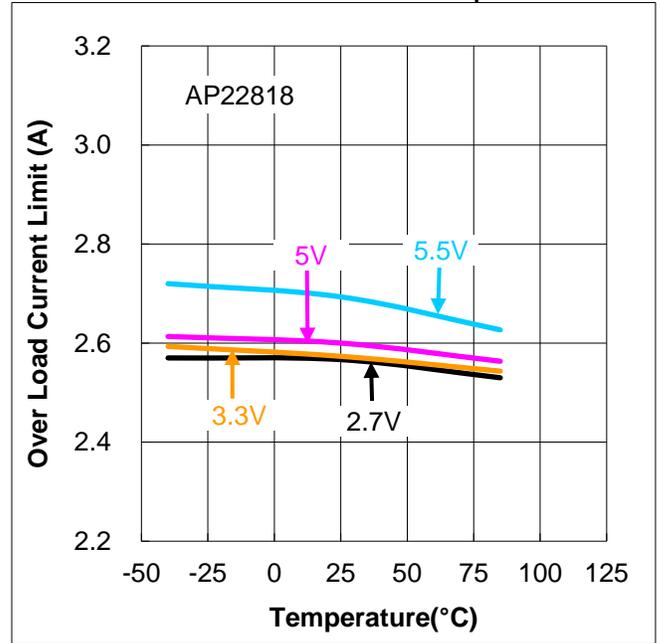


**Performance Characteristics** ( $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 0.1\mu\text{F}$ , unless otherwise specified.) (continued)

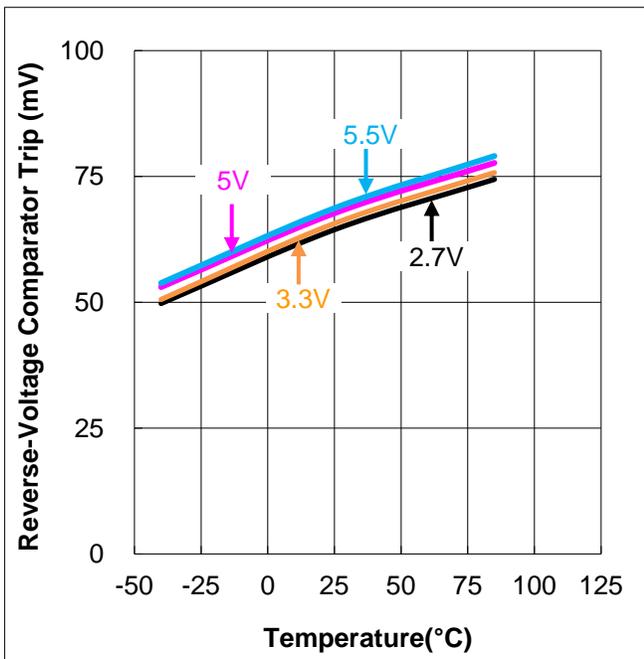
**Under Voltage Lockout vs. Temperature**



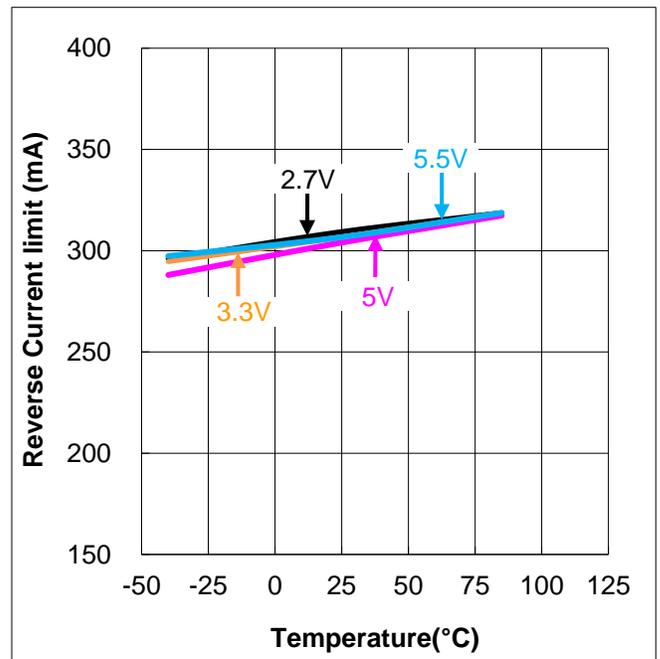
**Over Load Current Limit vs. Temperature**



**Reverse-Voltage Comparator Trip vs. Temperature**



**Reverse Current Limit vs. Temperature**



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## Application Information

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### Input and Output Capacitors

It is needed to place a 1 $\mu$ F X7R or X5R ceramic bypass capacitor between the IN and GND, close to the device. Placing a high-value capacitor (10 $\mu$ F or 47 $\mu$ F) close to the input pin is also recommended when the output transient load is heavy. This precaution reduces power-supply transients that may cause ringing on the input.

Also needed for hot-plug applications is the connection of a minimum 100 $\mu$ F low ESR electrolytic or tantalum capacitor (or 10 $\mu$ F MLCC) between OUT and GND is. It is necessary to bypass the output with a 0.1 $\mu$ F ceramic capacitor, which improves the immunity of the device to short-circuit transients. The Bulky 100 $\mu$ F or larger capacitors help to reduce output droop voltage when a device is plugged in. When abnormal short-circuit condition happens, these capacitors can also reduce output negative voltage due to parasitic inductive effect and avoid device damage.

Please note that without the bypass capacitors, an output short may cause ringing on the input; if the voltage is over the maximum voltage rating, it will destroy the internal control circuitry even if the duration is short.

### FLG Response

When an overcurrent or overtemperature shutdown condition is encountered, the FLG open-drain output goes active low after a nominal 6ms 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 6ms deglitch timeout. The AP22816(1.0A)/17(1.5A)/18(2.0A) is designed to eliminate false overcurrent reporting without the need of external components to remove unwanted pulses.

### 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 AP22816(1.0A)/17(1.5A)/18(2.0A) senses the short circuit and immediately clamps output current to a certain safe level.

In the second condition, an output short or an overload occurs while the device is enabled. At the instance the overload occurs, higher current may flow for a very short period of time before the current limit function can react. After the current limit function has tripped, the device switches into current limiting mode and the current is clamped at  $I_{LIMIT}$ , or  $I_{SHORT}$ .

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 ( $I_{TRIG}$ ) is reached or until the thermal limit of the device is exceeded. The AP22816(1.0A)/17(1.5A)/18(2.0A) 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  $I_{LIMIT}$ .

### Thermal Protection

Thermal protection prevents the IC from damage when heavy-overload or short-circuit faults are present for extended periods of time. The AP22816(1.0A)/17(1.5A)/18(2.0A) 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 +35°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 6ms deglitch.

### ON/OFF Input Operator

The  $\overline{EN/EN}$  input allows the output current to be switched on and off using a GPIO compatible input. The high signal (switched on) should be at least 1.5V, and the low signal (switch off) no higher than 0.65V. This pin should not be left floating. It is advisable to hold the  $\overline{EN/EN}$  signal low when applying or removing power.

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**Application Information** (continued)

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**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 the 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.

**Output Reverse-Voltage/Current Protection**

The output reverse-voltage protection turns off the MOSFET switch whenever the output voltage is higher than the input voltage by 50mV for 6ms. The MOSFET switch will turn on when output reverse-voltage/current conditions are removed.

**Power Dissipation and Junction Temperature**

The low on-resistance of the internal MOSFET allows the small surface-mount packages to pass large currents. 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

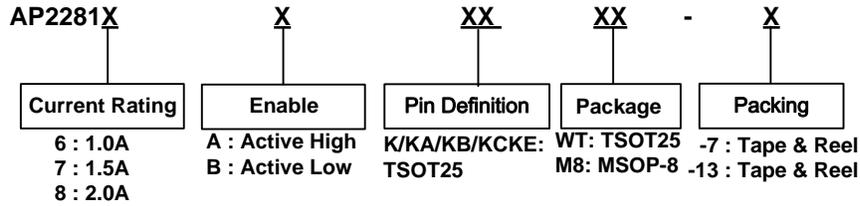
$R_{\theta JA}$  = Thermal resistance

$P_D$  = Total power dissipation

**Board Layout Instruction**

To minimize the effects of parasitic inductance, place input and output capacitors (1 $\mu$ F and 0.1 $\mu$ F+100 $\mu$ F respectively) close and next to the device's pins. For the best performance, all trace lengths should be kept as short as possible and the input and output PCB traces should be as wide as possible. Use a ground plane to enhance the power dissipation capability of the device. For TOS25 Type KB and MSOP-8, it is recommended to connect all IN pins together and all OUT pins together to improve overall resistance value.

## Ordering Information

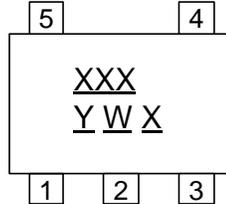


| Part Number    | Package Code | Package | 7" and 13" Tape and Reel |                    |
|----------------|--------------|---------|--------------------------|--------------------|
|                |              |         | Quantity                 | Part Number Suffix |
| AP22816AKWT-7  | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816BKWT-7  | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816AKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816BKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816AKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816BKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816AKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816BKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816AKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22816BKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817AKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817BKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817AKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817BKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817AKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817BKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817AKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22817BKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AKWT-7  | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818BKWT-7  | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818BKAWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818BKBWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818BKCWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818BKEWT-7 | WT           | TSOT25  | 3000/Tape & Reel         | -7                 |
| AP22818AM8-13  | M8           | MSOP-8  | 2500/Tape & Reel         | -13                |
| AP22818BM8-13  | M8           | MSOP-8  | 2500/Tape & Reel         | -13                |

## Marking Information

### (1) TSOT25

(Top View)



XXX : Identification Code

Y : Year 0 to 9

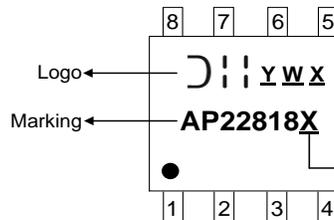
W : Week : A to Z : 1 to 26 week;  
a to z : 27 to 52 week; z represents 52 and 53 week

X : Internal Code

| Part Number    | Package | Identification Code |
|----------------|---------|---------------------|
| AP22816AKWT-7  | TSOT25  | F2A                 |
| AP22816BKWT-7  | TSOT25  | F2B                 |
| AP22816AKAWT-7 | TSOT25  | F2C                 |
| AP22816BKAWT-7 | TSOT25  | F2D                 |
| AP22816AKBWT-7 | TSOT25  | F2E                 |
| AP22816BKBWT-7 | TSOT25  | F2F                 |
| AP22816AKCWT-7 | TSOT25  | F2G                 |
| AP22816BKCWT-7 | TSOT25  | F2H                 |
| AP22816AKEWT-7 | TSOT25  | F2J                 |
| AP22816BKEWT-7 | TSOT25  | F2K                 |
| AP22817AKAWT-7 | TSOT25  | F2M                 |
| AP22817BKAWT-7 | TSOT25  | F2N                 |
| AP22817AKBWT-7 | TSOT25  | F2P                 |
| AP22817BKBWT-7 | TSOT25  | F2R                 |
| AP22817AKCWT-7 | TSOT25  | F2S                 |
| AP22817BKCWT-7 | TSOT25  | F2T                 |
| AP22817AKEWT-7 | TSOT25  | F2U                 |
| AP22817BKEWT-7 | TSOT25  | F2V                 |
| AP22818AKWT-7  | TSOT25  | F2W                 |
| AP22818BKWT-7  | TSOT25  | F2X                 |
| AP22818AKAWT-7 | TSOT25  | F2Y                 |
| AP22818BKAWT-7 | TSOT25  | F2Z                 |
| AP22818AKBWT-7 | TSOT25  | F22                 |
| AP22818BKBWT-7 | TSOT25  | F23                 |
| AP22818AKCWT-7 | TSOT25  | F24                 |
| AP22818BKCWT-7 | TSOT25  | F25                 |
| AP22818AKEWT-7 | TSOT25  | F26                 |
| AP22818BKEWT-7 | TSOT25  | F27                 |

### (2) MSOP-8

(Top View)



Y : Year : 0~9

W : Week : A~Z : 1~26 week;  
a~z : 27~52 week; z represents 52 and 53 week

X : Internal Code

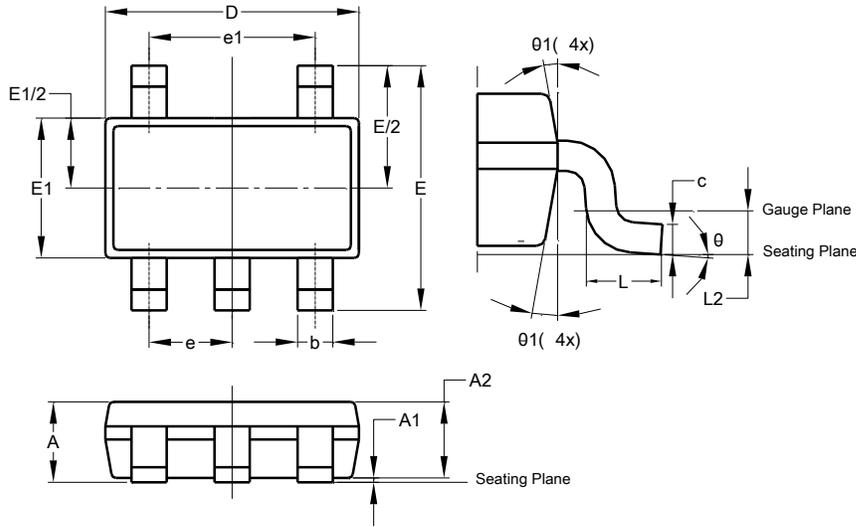
A : Active High  
B : Active Low

| Part Number   | Package | Identification Code |
|---------------|---------|---------------------|
| AP22818AM8-13 | MSOP-8  | AP22818A            |
| AP22818BM8-13 | MSOP-8  | AP22818B            |

**Package Outline Dimensions**

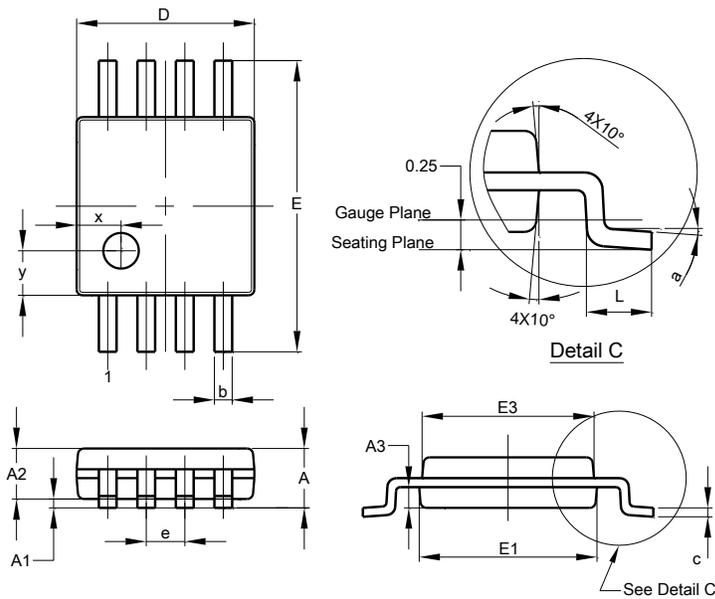
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**TSOT25**



| TSOT25               |          |      |      |
|----------------------|----------|------|------|
| Dim                  | Min      | Max  | Typ  |
| A                    | -        | 1.00 | -    |
| A1                   | 0.01     | 0.10 | -    |
| A2                   | 0.84     | 0.90 | -    |
| b                    | 0.30     | 0.45 | -    |
| c                    | 0.12     | 0.20 | -    |
| D                    | 2.80     | 3.00 | 2.90 |
| E                    | 2.70     | 2.90 | 2.80 |
| E1                   | 1.50     | 1.70 | 1.60 |
| e                    | 0.95 BSC |      |      |
| e1                   | 1.90 BSC |      |      |
| L                    | 0.30     | 0.50 |      |
| L2                   | 0.25 BSC |      |      |
| theta                | 0°       | 8°   | 4°   |
| theta1               | 4°       | 12°  | -    |
| All Dimensions in mm |          |      |      |

**MSOP-8**

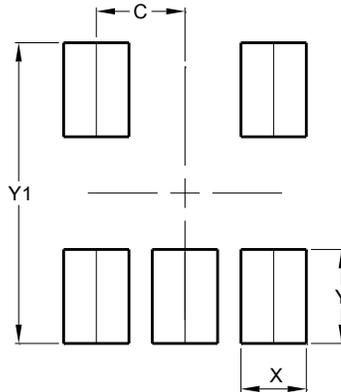


| MSOP-8               |      |      |       |
|----------------------|------|------|-------|
| Dim                  | Min  | Max  | Typ   |
| A                    | -    | 1.10 | -     |
| A1                   | 0.05 | 0.15 | 0.10  |
| A2                   | 0.75 | 0.95 | 0.86  |
| A3                   | 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  |
| E                    | 4.70 | 5.10 | 4.90  |
| E1                   | 2.90 | 3.10 | 3.00  |
| 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 |      |      |       |

**Suggested Pad Layout**

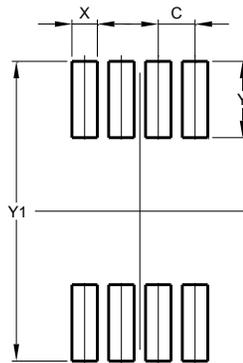
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

**TSOT25**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.950         |
| X          | 0.700         |
| Y          | 1.000         |
| Y1         | 3.199         |

**MSOP-8**



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.650         |
| X          | 0.450         |
| Y          | 1.350         |
| Y1         | 5.300         |



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