

# CAT6217

## 150 mA CMOS LDO Regulator

### Description

The CAT6217 is a 150 mA CMOS low dropout regulator that provides fast response time during load current and line voltage changes.

The quick-start feature allows the use of an external bypass capacitor to reduce the overall output noise without affecting the turn-on time of just 150  $\mu$ s.

With zero shutdown current and low ground current of 55  $\mu$ A typical, the CAT6217 is ideal for battery-operated devices with supply voltages from 2.3 V to 5.5 V. An internal under voltage lockout circuit disables the output at supply voltages under 2.1 V typical.

The CAT6217 offers 1% initial accuracy and low dropout voltage, 90 mV typical at 150 mA. Stable operation is provided with a 1  $\mu$ F ceramic capacitor, reducing required board space and component cost.

Other features include output short-circuit current limit and thermal protection.

The device is available in the low profile (1 mm max height) 5-lead TSOT-23 package.

### Features

- Guaranteed 150 mA Output Current
- Low Dropout Voltage of 90 mV Typical at 150 mA
- Stable with 1  $\mu$ F Ceramic Output Capacitor
- External 10 nF Bypass Capacitor for Low Noise
- Quick-start Feature
- No-load Ground Current of 55  $\mu$ A Typical
- Full-load Ground Current of 80  $\mu$ A Typical
- $\pm 1.0\%$  Initial Accuracy ( $V_{OUT} \geq 2.0$  V)
- $\pm 2.0\%$  Accuracy Over Temperature ( $V_{OUT} \geq 2.0$  V)
- “Zero” Current Shutdown Mode
- Current Limit and Under Voltage Lockout
- Thermal Protection
- 5-lead TSOT-23 Package
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Cellular Phones
- Battery-powered Devices
- Consumer Electronics



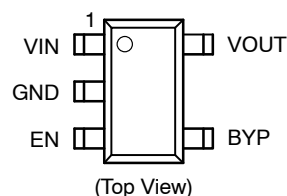
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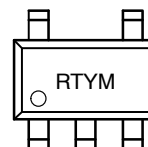


**TSOT-23  
TD SUFFIX  
CASE 419AE**

### PIN CONNECTIONS



### MARKING DIAGRAM



RT = CAT6217 Device Code  
Y = Production Year (last digit)  
M = Production Month: 1 – 9, A, B, C

### PIN FUNCTION

| Pin # | Name | Function                                                                     |
|-------|------|------------------------------------------------------------------------------|
| 1     | VIN  | Supply voltage input.                                                        |
| 2     | GND  | Ground reference.                                                            |
| 3     | EN   | Enable input (active high); a 2.5 M $\Omega$ pull-down resistor is provided. |
| 4     | BYP  | Optional bypass capacitor connection for noise reduction and PSRR enhancing. |
| 5     | VOUT | LDO Output Voltage.                                                          |

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

## CAT6217

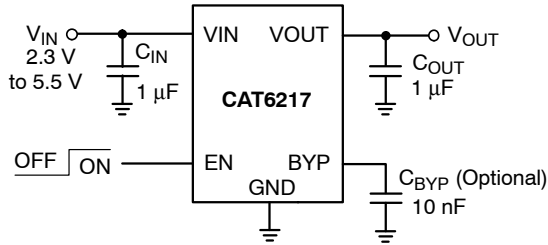


Figure 1. Typical Application Circuit

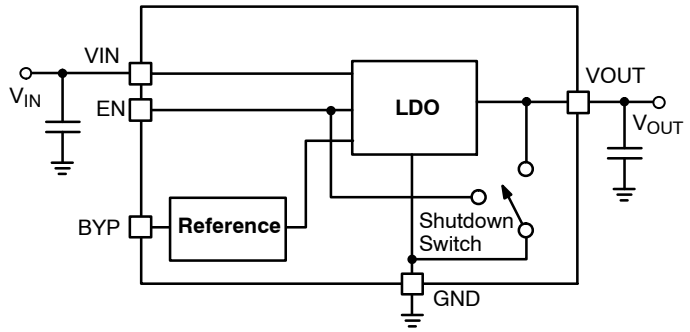


Figure 2. CAT6217 Functional Block Diagram

### Pin Function

**VIN** is the supply pin for the LDO. A small 1  $\mu\text{F}$  ceramic bypass capacitor is required between the  $V_{\text{IN}}$  pin and ground near the device. When using longer connections to the power supply,  $C_{\text{IN}}$  value can be increased without limit. The operating input voltage range is from 2.3 V to 5.5 V.

**EN** is the enable control logic (active high) for the regulator output. It has a 2.5  $\text{M}\Omega$  pull-down resistor, which assures that if EN pin is left open, the circuit is disabled.

**VOUT** is the LDO regulator output. A small 1  $\mu\text{F}$  ceramic bypass capacitor is required between the  $V_{\text{OUT}}$  pin and ground for stability. For better transient response, its value can be increased to 4.7  $\mu\text{F}$ .

The capacitor should be located near the device. ESR domain is 5  $\text{m}\Omega$  to 500  $\text{m}\Omega$ .  $V_{\text{OUT}}$  can deliver a maximum guaranteed current of 150 mA. A 250  $\Omega$  internal shutdown switch discharges the output capacitor in the no-load condition.

**GND** is the ground reference for the LDO. The pin must be connected to the ground plane on the PCB.

**BYP** is the reference bypass pin. An optional 0.01  $\mu\text{F}$  capacitor can be connected between BYP pin and GND to reduce the output noise and enhance the PSRR at high frequency.

Table 1. ABSOLUTE MAXIMUM RATINGS

| Parameter                                 | Rating                        | Unit               |
|-------------------------------------------|-------------------------------|--------------------|
| $V_{\text{IN}}$                           | 0 to 6.5                      | V                  |
| $V_{\text{EN}}, V_{\text{OUT}}$           | -0.3 to $V_{\text{IN}} + 0.3$ | V                  |
| Junction Temperature, $T_{\text{J}}$      | +150                          | $^{\circ}\text{C}$ |
| Power Dissipation, $P_{\text{D}}$         | Internally Limited (Note 1)   | mW                 |
| Storage Temperature Range, $T_{\text{S}}$ | -65 to +150                   | $^{\circ}\text{C}$ |
| Lead Temperature (soldering, 5 sec.)      | 260                           | $^{\circ}\text{C}$ |
| ESD Rating (Human Body Model)             | 3                             | kV                 |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 2. RECOMMENDED OPERATING CONDITIONS (Note 2)

| Parameter                                                  | Range                | Unit                        |
|------------------------------------------------------------|----------------------|-----------------------------|
| $V_{\text{IN}}$                                            | 2.3 to 5.5           | V                           |
| $V_{\text{EN}}$                                            | 0 to $V_{\text{IN}}$ | V                           |
| Junction Temperature Range, $T_{\text{J}}$                 | -40 to +125          | $^{\circ}\text{C}$          |
| Package Thermal Resistance (SOT23-5), $\theta_{\text{JA}}$ | 235                  | $^{\circ}\text{C}/\text{W}$ |

NOTE: Typical application circuit with external components is shown above.

1. The maximum allowable power dissipation at any  $T_{\text{A}}$  (ambient temperature) is  $P_{\text{Dmax}} = (T_{\text{Jmax}} - T_{\text{A}})/\theta_{\text{JA}}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.
2. The device is not guaranteed to work outside its operating rating.

# CAT6217

**Table 3. ELECTRICAL OPERATING CHARACTERISTICS** (Note 3)

( $V_{IN} = V_{OUT} + 1.0\text{ V}$ ,  $V_{EN} = \text{High}$ ,  $I_{OUT} = 100\text{ }\mu\text{A}$ ,  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$ , ambient temperature of  $25^{\circ}\text{C}$  (over recommended operating conditions unless specified otherwise). **Bold numbers** apply for the entire junction temperature range.)

| Symbol        | Parameter                               | Conditions                                                | Min         | Typ       | Max         | Unit                    |
|---------------|-----------------------------------------|-----------------------------------------------------------|-------------|-----------|-------------|-------------------------|
| $V_{OUT-ACC}$ | Output Voltage Accuracy                 | Initial accuracy for $V_{OUT} \geq 2.0\text{ V}$ (Note 6) | -1.0        |           | +1.0        | %                       |
|               |                                         |                                                           | <b>-2.0</b> |           | <b>+2.0</b> |                         |
| $TC_{OUT}$    | Output Voltage Temp. Coefficient        |                                                           |             | 40        |             | ppm/ $^{\circ}\text{C}$ |
| $V_{R-LINE}$  | Line Regulation                         | $V_{IN} = V_{OUT} + 1.0\text{ V}$ to $5.5\text{ V}$       | -0.2        | $\pm 0.1$ | +0.2        | %/V                     |
|               |                                         |                                                           | <b>-0.4</b> |           | <b>+0.4</b> |                         |
| $V_{R-LOAD}$  | Load Regulation                         | $I_{OUT} = 100\text{ }\mu\text{A}$ to $150\text{ mA}$     |             | 0.6       | 1.0         | %                       |
|               |                                         |                                                           |             |           | <b>1.3</b>  |                         |
| $V_{DROP}$    | Dropout Voltage (Note 4)                | $I_{OUT} = 150\text{ mA}$                                 |             | 90        | 125         | mV                      |
|               |                                         |                                                           |             |           | <b>150</b>  |                         |
| $I_{GND}$     | Ground Current                          | $I_{OUT} = 0\text{ }\mu\text{A}$                          |             | 55        | 75          | $\mu\text{A}$           |
|               |                                         |                                                           |             |           | <b>90</b>   |                         |
| $I_{GND-SD}$  | Shutdown Ground Current                 | $V_{EN} < 0.4\text{ V}$                                   |             |           | 1           | $\mu\text{A}$           |
|               |                                         |                                                           |             |           | <b>2</b>    |                         |
| PSRR          | Power Supply Rejection Ratio            | $f = 1\text{ kHz}$ , $C_{BYP} = 10\text{ nF}$             |             | 64        |             | dB                      |
|               |                                         | $f = 20\text{ kHz}$ , $C_{BYP} = 10\text{ nF}$            |             | 54        |             |                         |
| $I_{SC}$      | Output short circuit current limit      | $V_{OUT} = 0\text{ V}$                                    |             | 350       |             | mA                      |
| $T_{ON}$      | Turn-On Time                            | $C_{BYP} = 10\text{ nF}$                                  |             | 150       |             | $\mu\text{s}$           |
| $e_N$         | Output Noise Voltage (Note 5)           | $BW = 10\text{ Hz}$ to $100\text{ kHz}$                   |             | 45        |             | $\mu\text{V}_{rms}$     |
| $R_{OUT-SH}$  | Shutdown Switch Resistance              |                                                           |             | 250       |             | $\Omega$                |
| $R_{EN}$      | Enable pull-down resistor               |                                                           |             | 2.5       |             | $\text{M}\Omega$        |
| $V_{UVLO}$    | Under-voltage lock out (UVLO) threshold |                                                           |             | 2.1       |             | V                       |
| ESR           | $C_{OUT}$ equivalent series resistance  |                                                           | 5           |           | 500         | $\text{m}\Omega$        |

## ENABLE INPUT

|          |                      |                                                                                                            |            |      |            |               |
|----------|----------------------|------------------------------------------------------------------------------------------------------------|------------|------|------------|---------------|
| $V_{HI}$ | Logic High Level     | $V_{IN} = 2.3\text{ to }5.5\text{ V}$                                                                      | <b>1.8</b> |      |            | V             |
|          |                      | $V_{IN} = 2.3\text{ to }5.5\text{ V}$ , $0^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ junction temperature | 1.6        |      |            |               |
| $V_{LO}$ | Logic Low Level      | $V_{IN} = 2.3\text{ to }5.5\text{ V}$                                                                      |            |      | <b>0.4</b> | V             |
| $I_{EN}$ | Enable Input Current | $V_{EN} = 0.4\text{ V}$                                                                                    |            | 0.15 | <b>1</b>   | $\mu\text{A}$ |
|          |                      | $V_{EN} = V_{IN}$                                                                                          |            | 1.5  | <b>4</b>   |               |

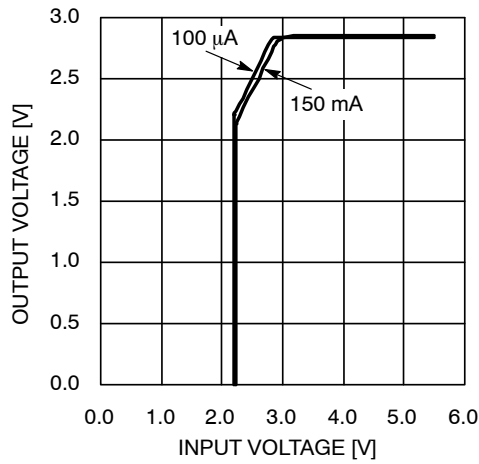
## THERMAL PROTECTION

|           |                    |  |  |     |  |                    |
|-----------|--------------------|--|--|-----|--|--------------------|
| $T_{SD}$  | Thermal Shutdown   |  |  | 160 |  | $^{\circ}\text{C}$ |
| $T_{HYS}$ | Thermal Hysteresis |  |  | 10  |  | $^{\circ}\text{C}$ |

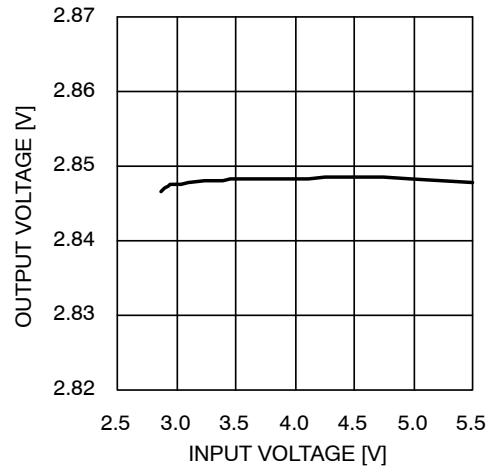
3. Specification for 2.80 V output version unless specified otherwise.
4. Dropout voltage is defined as the input-to-output differential at which the output voltage drops 2% below its nominal value. During test, the input voltage stays always above the minimum 2.3 V.
5. Specification for 1.8 V output version.
6. For  $V_{OUT} < 2.0\text{ V}$ , the initial accuracy is  $\pm 2\%$  and across temperature  $\pm 3\%$ .

**TYPICAL CHARACTERISTICS** (shown for 2.80 V output option)

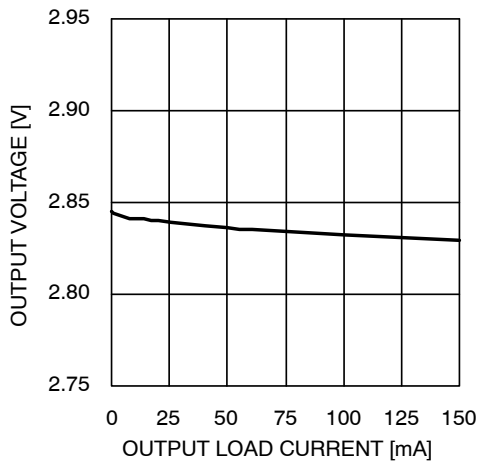
( $V_{IN} = 3.85\text{ V}$ ,  $I_{OUT} = 100\text{ }\mu\text{A}$ ,  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$ ,  $C_{BYP} = 10\text{ nF}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



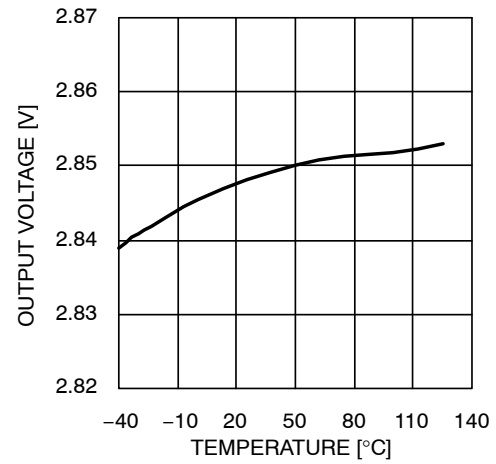
**Figure 3. Dropout Characteristics**



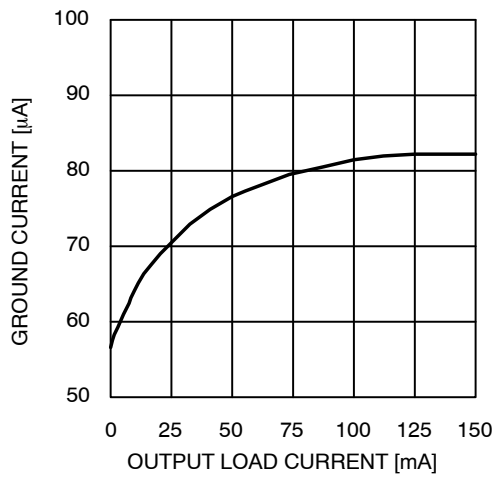
**Figure 4. Line Regulation**



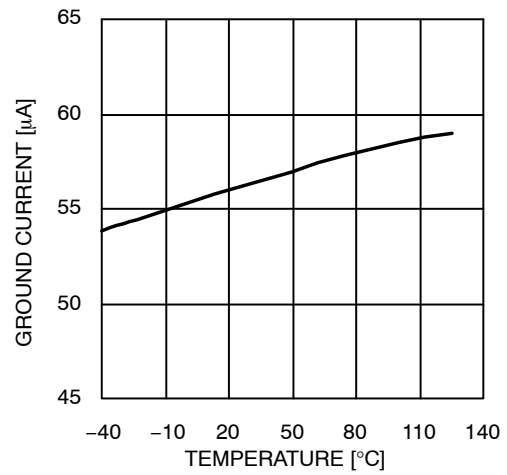
**Figure 5. Load Regulation**



**Figure 6. Output Voltage vs. Temperature**



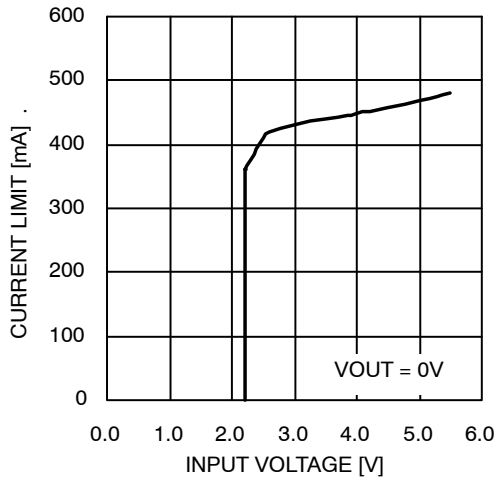
**Figure 7. Ground Current vs. Load Current**



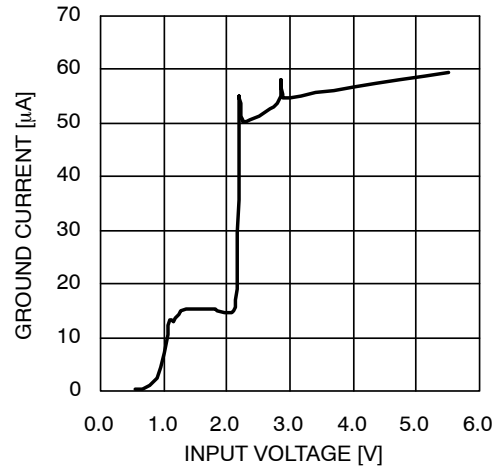
**Figure 8. Ground Current vs. Temperature**

**TYPICAL CHARACTERISTICS** (shown for 2.80 V output option)

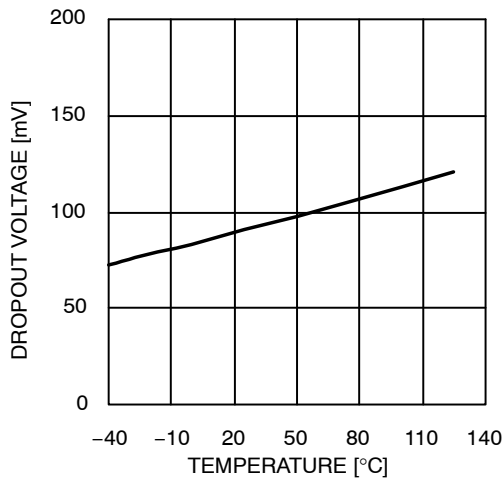
( $V_{IN} = 3.85\text{ V}$ ,  $I_{OUT} = 100\text{ }\mu\text{A}$ ,  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$ ,  $C_{BYP} = 10\text{ nF}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



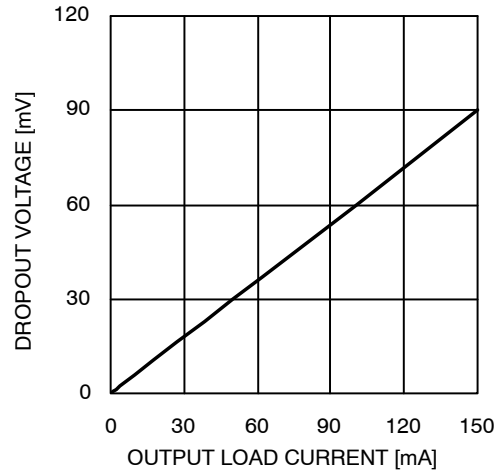
**Figure 9. Output Short-circuit Current Limit**



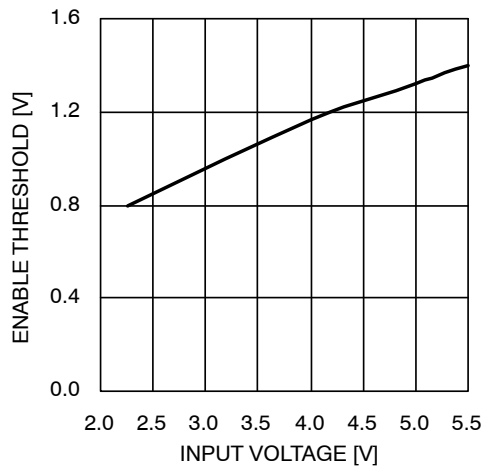
**Figure 10. Ground Current vs. Input Voltage**



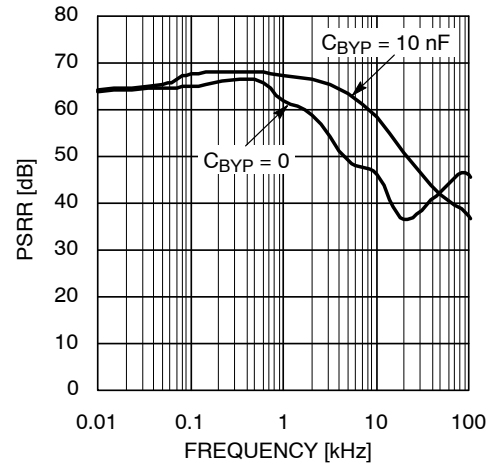
**Figure 11. Dropout vs. Temperature  
(150 mA Load)**



**Figure 12. Dropout vs. Load Current**



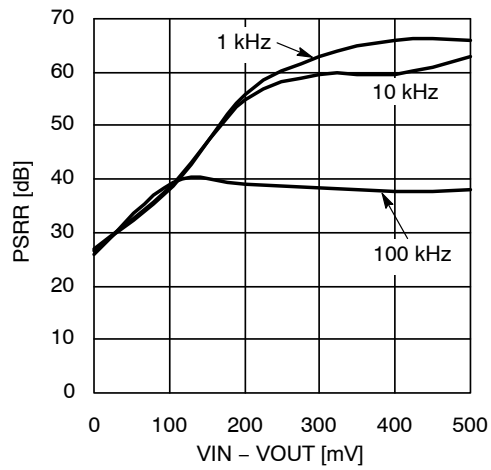
**Figure 13. Enable Threshold vs. Input Voltage**



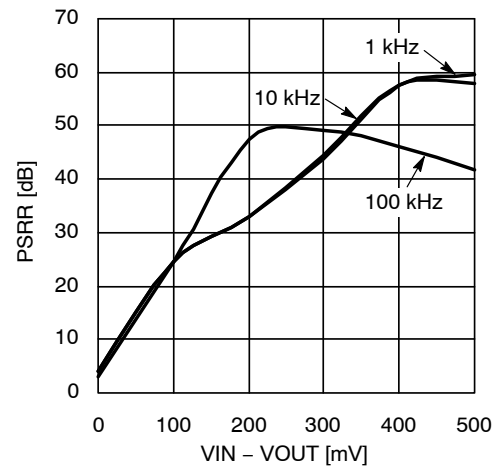
**Figure 14. PSRR vs. Frequency (10 mA Load)**

**TYPICAL CHARACTERISTICS** (shown for 2.80 V output option)

( $V_{IN} = 3.85\text{ V}$ ,  $I_{OUT} = 100\text{ }\mu\text{A}$ ,  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$ ,  $C_{BYP} = 10\text{ nF}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



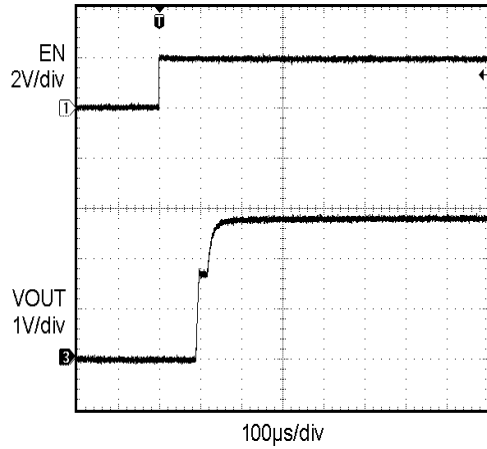
**Figure 15. PSRR (30 mA Load)**



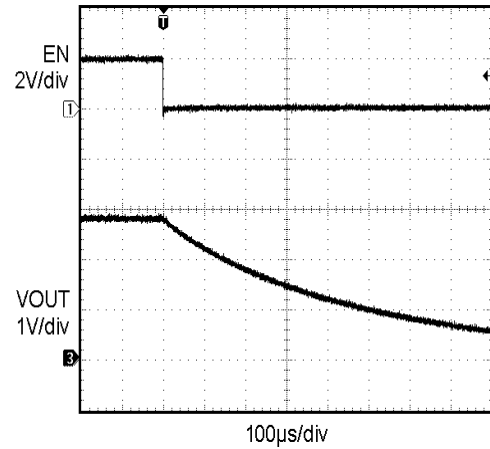
**Figure 16. PSRR (150 mA Load)**

**TRANSIENT CHARACTERISTICS** (shown for 2.80 V output option)

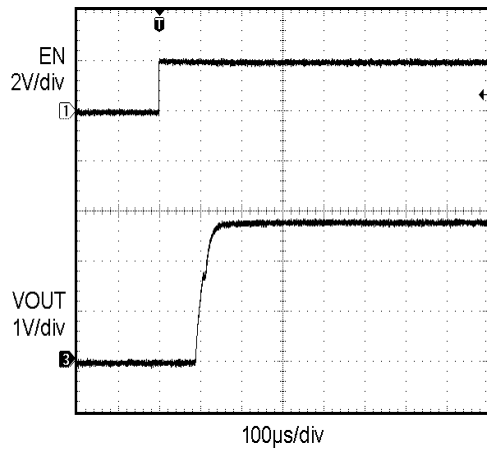
( $V_{IN} = 3.85\text{ V}$ ,  $I_{OUT} = 100\text{ }\mu\text{A}$ ,  $C_{IN} = C_{OUT} = 1\text{ }\mu\text{F}$ ,  $C_{BYP} = 10\text{ nF}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise specified.)



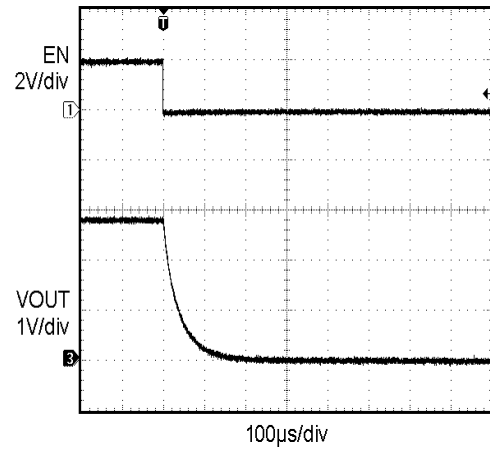
**Figure 17. Enable Turn-on (100  $\mu\text{A}$  Load)**



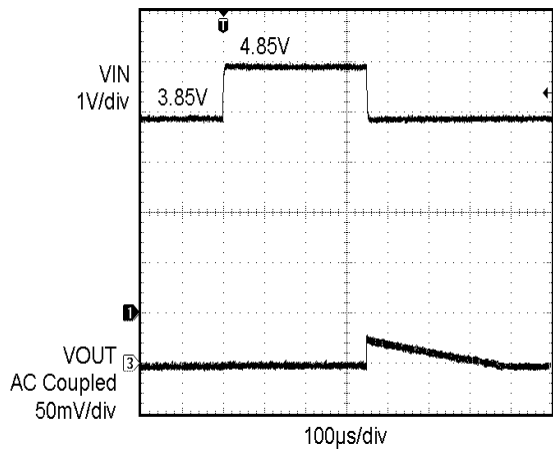
**Figure 18. Enable Turn-off (100  $\mu\text{A}$  Load)**



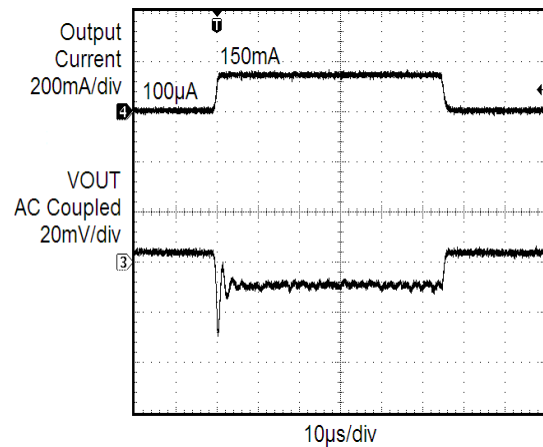
**Figure 19. Enable Turn-on (150 mA Load)**



**Figure 20. Enable Turn-off (150 mA Load)**



**Figure 21. Line Transient Response  
(3.85 V to 4.85 V)**

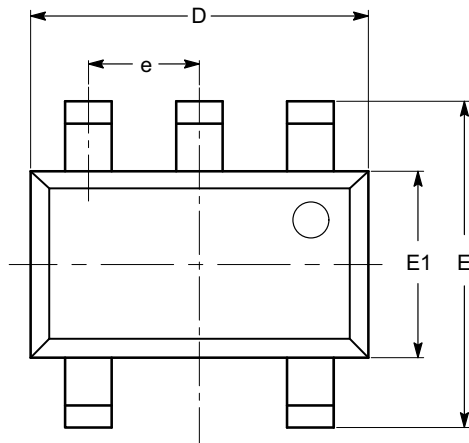


**Figure 22. Load Transient Response  
(0.1 mA to 150 mA)**

**Note:** All transient characteristics are generated using the evaluation board CAT621XEVAL1.

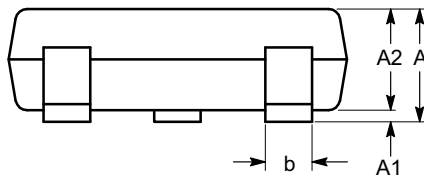
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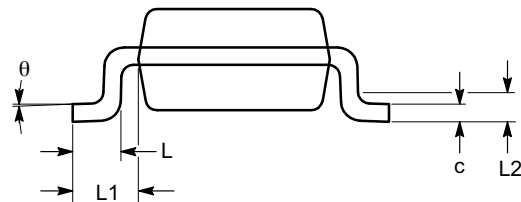


**TOP VIEW**

| SYMBOL   | MIN      | NOM  | MAX  |
|----------|----------|------|------|
| A        |          |      | 1.00 |
| A1       | 0.01     | 0.05 | 0.10 |
| A2       | 0.80     | 0.87 | 0.90 |
| b        | 0.30     |      | 0.45 |
| c        | 0.12     | 0.15 | 0.20 |
| D        | 2.90 BSC |      |      |
| E        | 2.80 BSC |      |      |
| E1       | 1.60 BSC |      |      |
| e        | 0.95 TYP |      |      |
| L        | 0.30     | 0.40 | 0.50 |
| L1       | 0.60 REF |      |      |
| L2       | 0.25 BSC |      |      |
| $\theta$ | 0°       |      | 8°   |



**SIDE VIEW**



**END VIEW**

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-193.

|                         |                        |                                                                                                                                                                                     |
|-------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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