

# LP3981 Micropower, 300mA Ultra Low-Dropout CMOS Voltage Regulator

Check for Samples: [LP3981](#)

## FEATURES

- Small, Space Saving VSSOP-8
- Low Thermal Resistance in WSON-6 Package Gives Excellent Power Capability
- Logic Controlled Enable
- Stable with Ceramic and High Quality Tantalum Capacitors
- Fast Turn-On
- Thermal Shutdown and Short-Circuit Current Limit

## APPLICATIONS

- CDMA Cellular Handsets
- Wideband CDMA Cellular Handsets
- GSM Cellular Handsets
- Portable Information Appliances
- Tiny 3.3V  $\pm$  5% to 2.5V, 300mA Converter

## DESCRIPTION

The LP3981's performance is optimized for battery powered systems to deliver ultra low noise, extremely low dropout voltage and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life.

Power supply rejection is better than 60 dB at low frequencies. This high power supply rejection is maintained down to lower input voltage levels common to battery operated circuits.

The device is ideal for mobile phone and similar battery powered wireless applications. It provides up to 300 mA, from a 2.5V to 6V input, consuming less than 1 $\mu$ A in disable mode.

The LP3981 is available in VSSOP-8 package. For LP3981 in WSON-6 package, contact NSC sales offices. Performance is specified for  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range. The device available in the following output voltages; 2.5V, 2.7V, 2.8V, 2.83V, 3.0V, 3.03V and 3.3V as standard. Other output options can be made available, please contact your local NSC sales office.

**Table 1. Key Specifications**

|   | VALUE                                 | UNIT                       |
|---|---------------------------------------|----------------------------|
| Input range   | 2.5 to 6                              | V                          |
| Guaranteed output   | 300                                   | mA                         |
| PSRR at 1kHz  | 60                                    | dB                         |
| Quiescent current when shut down  | $\leq 1$                              | $\mu\text{A}$              |
| (Typical) Fast Turn-On time: with $C_{\text{BYPASS}} = 0.01\mu\text{F}$ | 120                                   | $\mu\text{s}$              |
| Typical dropout with 300mA load   | 132                                   | mV                         |
| Output noise over 10Hz to 100kHz  | 35                                    | $\mu\text{V}_{\text{rms}}$ |
| Junction temperature range for operation                                | $-40$ to $+125$                       | $^{\circ}\text{C}$         |
| Outputs standard  | 2.5, 2.7, 2.8, 2.83, 3, 3.03, and 3.3 | V                          |



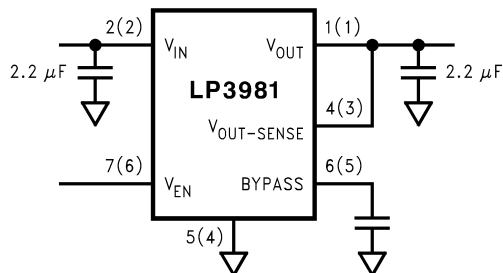
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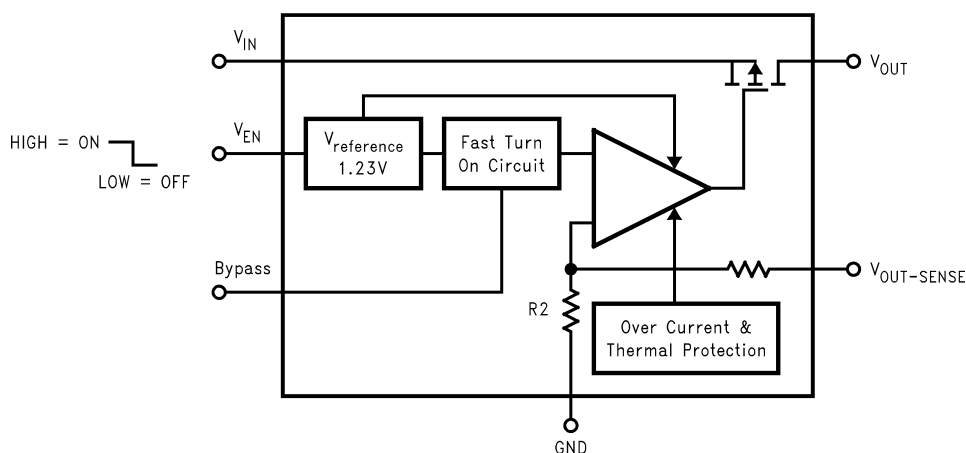
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## Typical Application Circuit



Note: Pin Numbers in parenthesis indicate WSON-6 package.

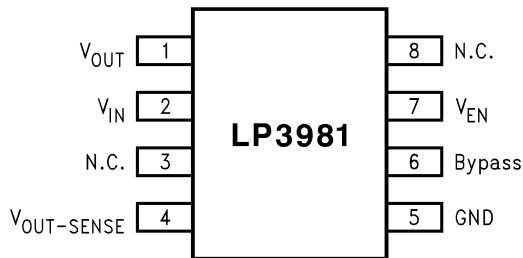
## Block Diagram



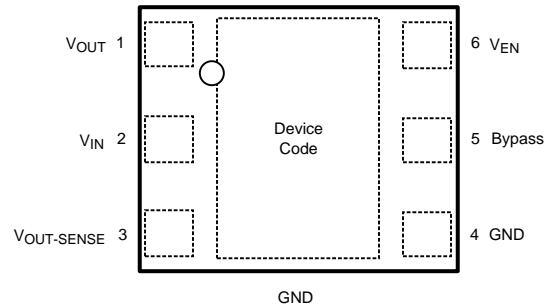
## PIN DESCRIPTIONS

| Name                   | VSSOP-8 | WSON-6 | Function   |
|------------------------|---------|--------|--|
| V <sub>EN</sub>        | 7       | 6      | Enable Input Logic, Enable High.   |
| GND                    | 5       | 4      | Common Ground. Connect to PAD.   |
| V <sub>OUT</sub>       | 1       | 1      | Output Voltage of the LDO.   |
| V <sub>IN</sub>        | 2       | 2      | Input Voltage of the LDO.  |
| Bypass                 | 6       | 5      | Optional bypass capacitor for noise reduction.   |
| V <sub>OUT-SENSE</sub> | 4       | 3      | Output. Voltage Sense Pin. Should be connected to V <sub>OUT</sub> for proper operation. |
| N.C.                   | 3, 8    |        |  |
| GND                    |         | PAD    | Common Ground. Connect to pin 4.   |

## Connection Diagrams



**Figure 1. Top View  
VSSOP-8 Package  
See Package Number DGK**



**Figure 2. Top View  
WSON-6 Package  
See Package Number NGC0006D**



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings<sup>(1)(2)(3)</sup>

|   |                                   |
|---|-----------------------------------|
| $V_{IN}$ , $V_{EN}$   | -0.3 to 6.5V                      |
| $V_{OUT}$ , $V_{OUT-SENSE}$   | -0.3 to $V_{IN} + 0.3$ , Max 6.5V |
| Junction Temperature  | 150°C                             |
| Storage Temperature   | -65°C to +150°C                   |
| Lead Temp.  |                                   |
| Pad Temp.   |                                   |
| Power Dissipation <sup>(4)</sup><br>$\theta_{JA}$ (VSSOP-8)<br>$\theta_{JA}$ (WSON-6) | 210°C/W<br>50°C/W                 |
| Maximum Power Dissipation at 25°C<br>VSSOP-8<br>WSON-6                                | 595mW<br>2.5W                     |
| ESD Rating <sup>(5)</sup><br>Human Body Model<br>Machine Model                        | 2kV<br>200V                       |

- (1) Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.
- (2) All voltages are with respect to the potential at the GND pin.
- (3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
- (4) The figures given for Absolute Maximum Power dissipation for the device are calculated using the following equations:  

$$P_D = \frac{(T_{J(MAX)} - T_A)}{\theta_{JA}}$$
 where  $T_{J(MAX)}$  is the maximum junction temperature,  $T_A$  is the ambient temperature, and  $\theta_{JA}$  is the junction-to-ambient thermal resistance. E.g. for the WSON package  $\theta_{JA}=50^\circ\text{C/W}$ ,  $T_{J(MAX)}=150^\circ\text{C}$  and using  $T_A=25^\circ\text{C}$  the maximum power dissipation is found to be 2.5W. The derating factor ( $-1/\theta_{JA}$ ) =  $-20\text{mW}/^\circ\text{C}$ , thus below  $25^\circ\text{C}$  the power dissipation figure can be increased by 20W per degree, and similarly decreased by this factor for temperatures above  $25^\circ\text{C}$
- (5) The human body model is 100pF discharged through 1.5k $\Omega$  resistor into each pin. The machine model is a 200 pF capacitor discharged directly into each pin.

## Operating Ratings<sup>(1)(2)</sup>

|  |                 |
|--|-----------------|
| $V_{IN}$   | 2.7 to 6V       |
| $V_{EN}$   | 0 to $V_{IN}$   |
| Junction Temperature   | -40°C to +125°C |
| Maximum Power Dissipation <sup>(3)</sup><br>VSSOP-8<br>WSO-6 | 476mW<br>2.0W   |

- (1) Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.
- (2) All voltages are with respect to the potential at the GND pin.
- (3) As for the Maximum Power dissipation, the maximum power in operation is dependant on the ambient temperature. This can be calculated in the same way using  $T_J=125^\circ\text{C}$ , giving 2W as the maximum power dissipation for the WSON package in operation. The same derating factor applies.

## Electrical Characteristics

Unless otherwise specified:  $V_{EN} = 1.2\text{V}$ ,  $V_{IN} = V_{OUT} + 0.5\text{V}$ ,  $C_{IN} = 2.2\ \mu\text{F}$ ,  $C_{BP} = 0.033\ \mu\text{F}$ ,  $I_{OUT} = 1\text{mA}$ ,  $C_{OUT} = 2.2\ \mu\text{F}$ . Typical values and limits appearing in standard typeface are for  $T_J = 25^\circ\text{C}$ . Limits appearing in **boldface type** apply over the entire junction temperature range for operation, -40°C to +125°C.<sup>(1)(2)</sup>

| Symbol           | Parameter                                   | Conditions  | Typ    | Limit           |               | Units               |
|------------------|---|---|--------|-----------------|---------------|---------------------|
|                  |   |   |        | Min             | Max           |                     |
| $\Delta V_{OUT}$ | Output Voltage Tolerance                    |   |        | -2<br><b>-3</b> | 2<br><b>3</b> | % of $V_{OUT(nom)}$ |
|                  | Line Regulation Error                       | $V_{IN} = V_{OUT} + 0.5\text{V}$ to 6.0V, $T_A < +85^\circ\text{C}$                                   | 0.005  | -0.1            | 0.1           | %/V                 |
|                  |   | $V_{IN} = V_{OUT} + 0.5\text{V}$ to 6.0V, $T_J \leq 125^\circ\text{C}$                                |        | <b>-0.2</b>     | <b>0.2</b>    | %/V                 |
|                  | Load Regulation Error <sup>(3)</sup>        | $I_{OUT} = 1\text{ mA}$ to 300 mA   | 0.0003 |                 | <b>0.005</b>  | %/mA                |
| PSRR             | Power Supply Rejection Ratio <sup>(4)</sup> | $V_{IN} = V_{OUT(nom)} + 1\text{V}$ ,<br>$f = 1\text{ kHz}$ ,<br>$I_{OUT} = 50\text{ mA}$ (Figure 4)  | 50     |                 |               | dB                  |
|                  |   | $V_{IN} = V_{OUT(nom)} + 1\text{V}$ ,<br>$f = 10\text{ kHz}$ ,<br>$I_{OUT} = 50\text{ mA}$ (Figure 4) | 55     |                 |               |                     |
| $I_Q$            | Quiescent Current                           | $V_{EN} = 1.2\text{V}$ , $I_{OUT} = 1\text{ mA}$  | 70     |                 | <b>120</b>    | $\mu\text{A}$       |
|                  |   | $V_{EN} = 1.2\text{V}$ , $I_{OUT} = 1\text{ to }300\text{ mA}$ ,<br>$V_{OUT} = 2.5\text{V}^{(5)}$     | 170    |                 | <b>210</b>    |                     |
|                  |   | $V_{EN} = 0.4\text{V}$  | 0.003  |                 | <b>1.5</b>    |                     |
|                  | Dropout Voltage <sup>(6)</sup>              | $I_{OUT} = 1\text{ mA}$   | 0.5    |                 | <b>5</b>      | mV                  |
|                  |   | $I_{OUT} = 200\text{ mA}$   | 88     |                 | <b>133</b>    |                     |
|                  |   | $I_{OUT} = 300\text{ mA}$   | 132    |                 | <b>200</b>    |                     |
| $I_{SC}$         | Short Circuit Current Limit                 | Output Grounded (Steady State)  | 600    |                 |               | mA                  |
| $e_n$            | Output Noise Voltage                        | BW = 10 Hz to 100 kHz,<br>$C_{BP} = 0.033\ \mu\text{F}$   | 35     |                 |               | $\mu\text{V}_{rms}$ |
| TSD              | Thermal Shutdown Temperature                |   | 160    |                 |               | $^\circ\text{C}$    |
|                  | Thermal Shutdown Hysteresis                 |   | 20     |                 |               | $^\circ\text{C}$    |
| $I_{OUT(PK)}$    | Peak Output Current                         | $V_{OUT} \geq V_{OUT(nom)} - 5\%$   | 455    | 300             |               |                     |
| $I_{EN}$         | Maximum Input Current at $V_{EN}$           | $V_{EN} = 0$ and $V_{IN}$   | 0.001  |                 |               | $\mu\text{A}$       |
| $V_{IL}$         | Logic Low Input threshold                   | $V_{IN} = 2.7$ to 6.0V  |        |                 | <b>0.4</b>    | V                   |

- (1) All limits are guaranteed. All electrical characteristics having room-temperature limits are tested during production with  $T_J = 25^\circ\text{C}$  or correlated using Statistical Quality Control (SQC) methods. All hot and cold limits are guaranteed by correlating the electrical characteristics to process and temperature variations and applying statistical process control.
- (2) The target output voltage, which is labeled  $V_{OUT(nom)}$ , is the desired voltage option.
- (3) An increase in the load current results in a slight decrease in the output voltage and vice versa.
- (4) Guaranteed by design.
- (5) For  $V_{OUT} > 2.5\text{C}$ , Increase  $I_{Q(MAX)}$  by 2.5 $\mu\text{A}$  for every 0.1V increase in  $V_{OUT(NOM)}$ . i.e.  $I_{Q(MAX)} = 210 + ((V_{OUT(NOM)} - 2.5) * 25)\mu\text{A}$
- (6) Dropout voltage is the input-to-output voltage difference at which the output voltage is 100mV below its nominal value. This specification does not apply for input voltages below 2.5V.

## Electrical Characteristics (continued)

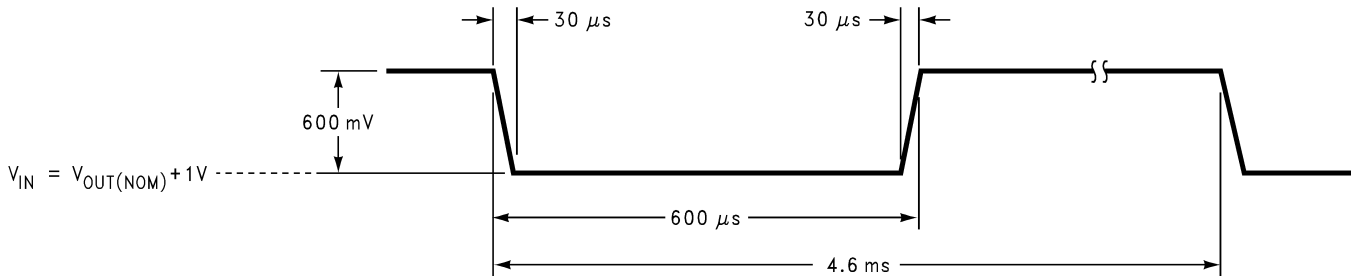
Unless otherwise specified:  $V_{EN} = 1.2V$ ,  $V_{IN} = V_{OUT} + 0.5V$ ,  $C_{IN} = 2.2 \mu F$ ,  $C_{BP} = 0.033 \mu F$ ,  $I_{OUT} = 1mA$ ,  $C_{OUT} = 2.2 \mu F$ . Typical values and limits appearing in standard typeface are for  $T_J = 25^\circ C$ . Limits appearing in **boldface type** apply over the entire junction temperature range for operation,  $-40^\circ C$  to  $+125^\circ C$ .<sup>(1)(2)</sup>

| Symbol   | Parameter                  | Conditions                 | Typ | Limit      |            | Units   |
|----------|----------------------------|----------------------------|-----|------------|------------|---------|
|          |                            |                            |     | Min        | Max        |         |
| $V_{IH}$ | Logic High Input threshold | $V_{IN} = 2.7$ to $6.0V$   |     | <b>1.4</b> |            | V       |
| $T_{ON}$ | Turn-On Time<br>(4) (7)    | $C_{BYPASS} = 0.033 \mu F$ | 240 |            | <b>350</b> | $\mu s$ |

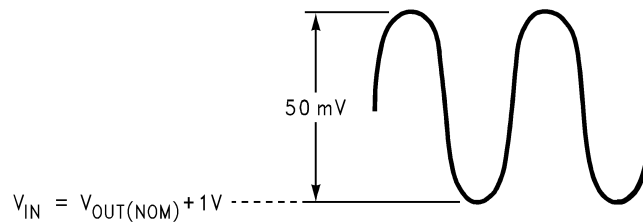
(7) Turn-on time is time measured between the enable input just exceeding  $V_{IH}$  and the output voltage just reaching 95% of its nominal value.

## Electrical Characteristics Output Capacitor, Recommended Specification

| Symbol    | Parameter        | Conditions  | Typ | Limit |     | Units      |
|-----------|------------------|-------------|-----|-------|-----|------------|
|           |                  |             |     | Min   | Max |            |
| $C_{OUT}$ | Output Capacitor | Capacitance |     | 2.2   | 22  | $\mu F$    |
|           |                  | ESR         |     | 5     | 500 | m $\Omega$ |



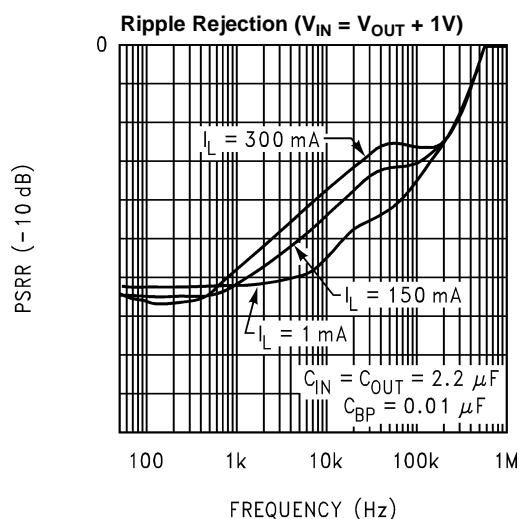
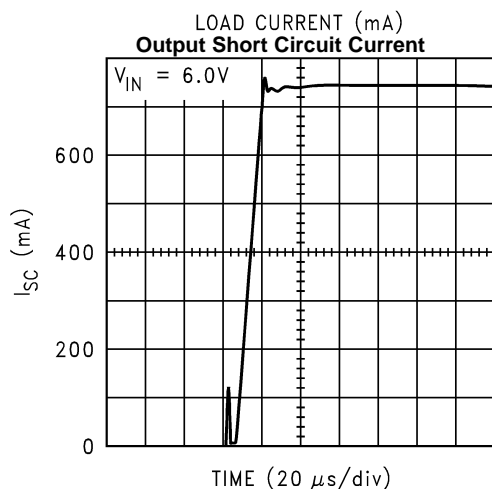
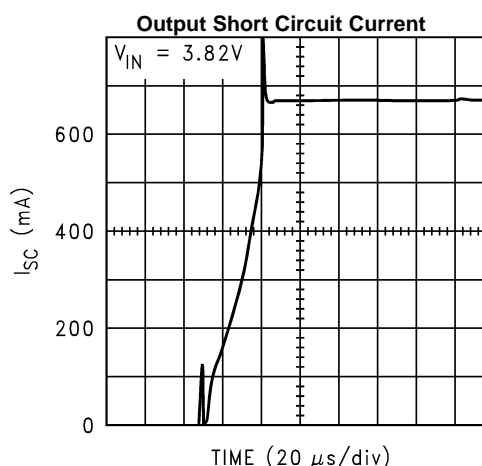
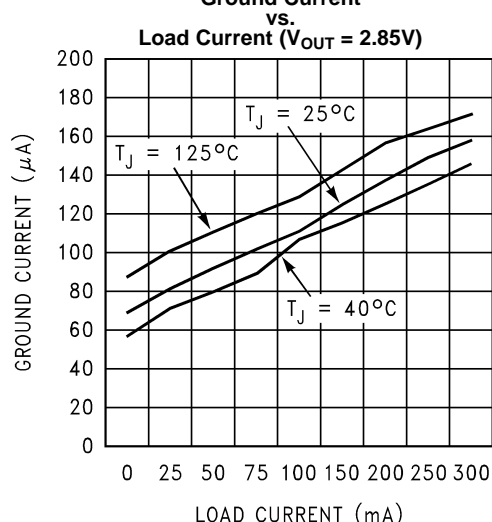
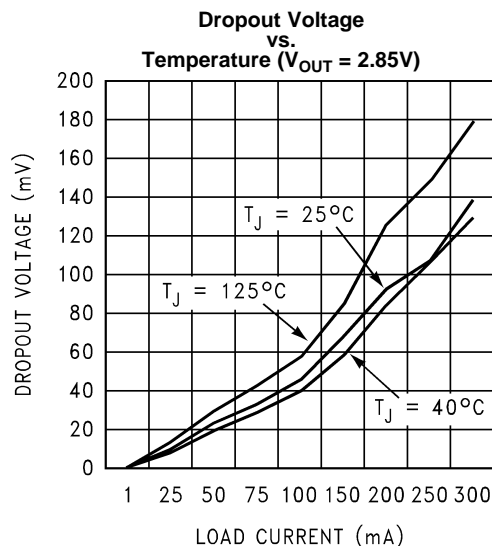
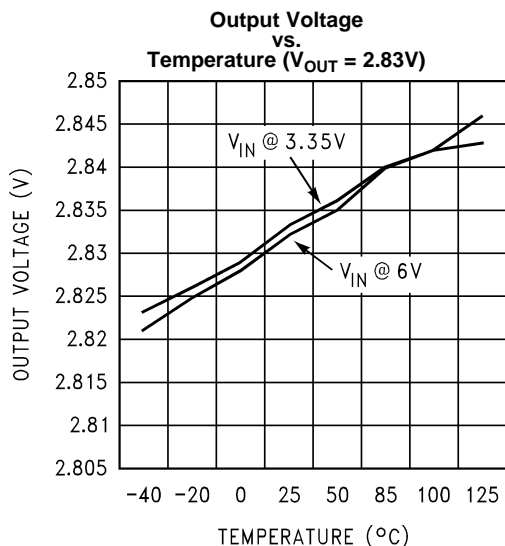
**Figure 3. Line Transient Response Input Perturbation**



**Figure 4. PSRR Input Perturbation**

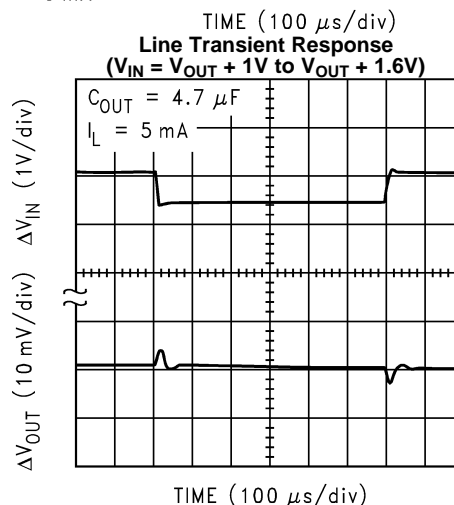
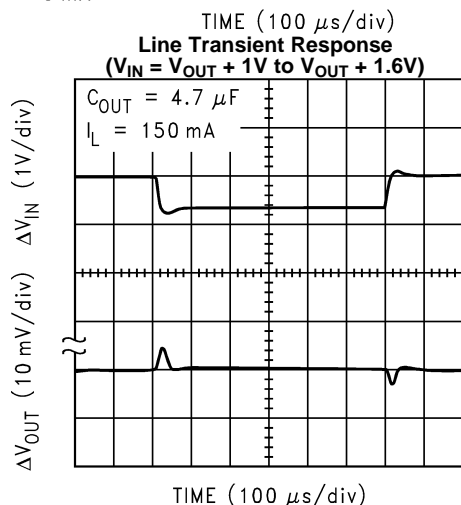
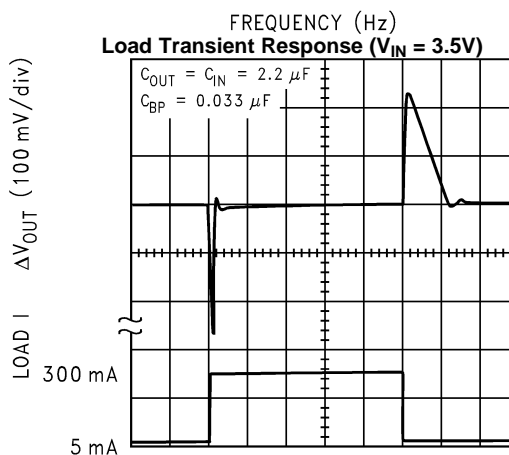
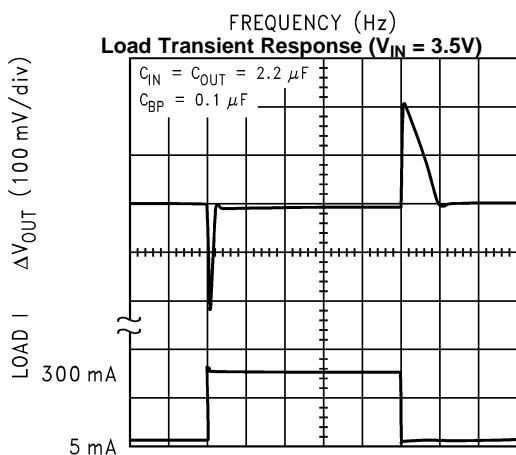
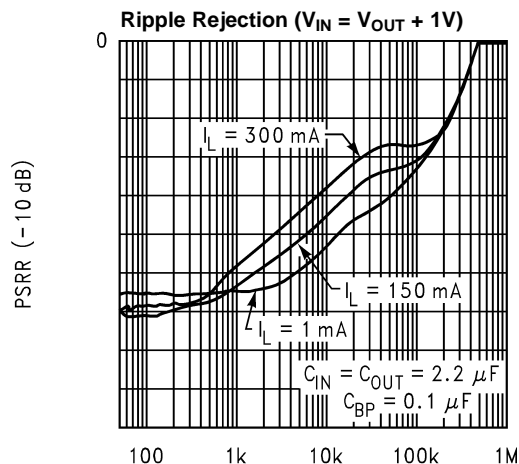
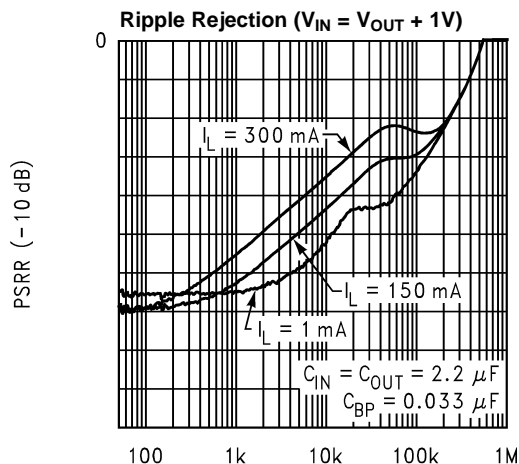
## Typical Performance Characteristics

Unless otherwise specified,  $C_{IN} = C_{OUT} = 2.2 \mu\text{F}$  Ceramic,  $C_{BP} = 0.033 \mu\text{F}$ ,  $V_{IN} = V_{OUT} + 0.5\text{V}$ ,  $T_A = 25^\circ\text{C}$ , Enable pin is tied to  $V_{IN}$ .



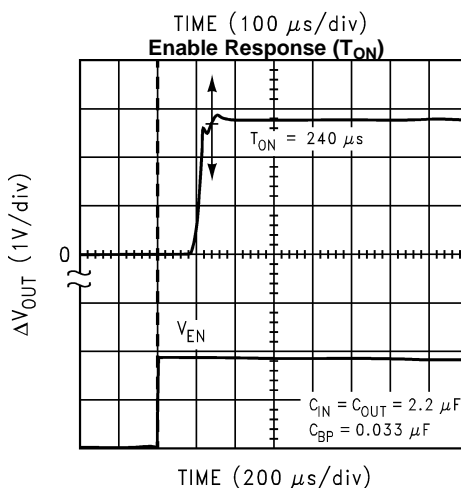
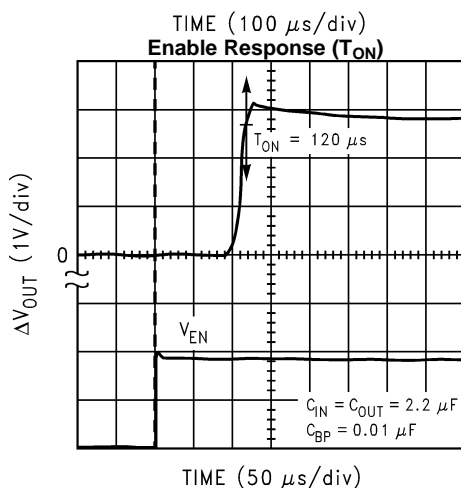
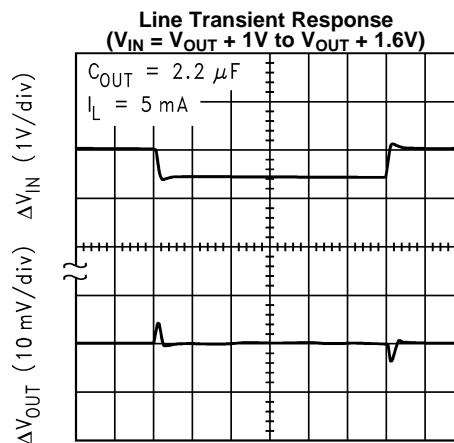
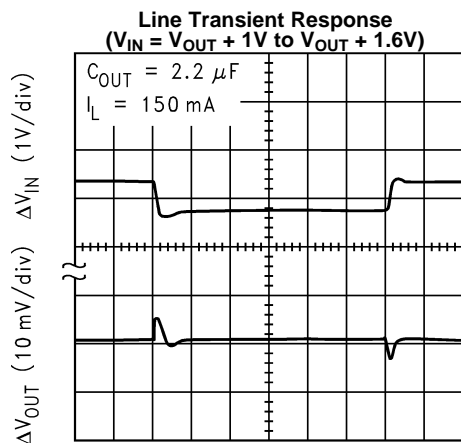
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Unless otherwise specified,  $C_{IN} = C_{OUT} = 2.2 \mu F$  Ceramic,  $C_{BP} = 0.033 \mu F$ ,  $V_{IN} = V_{OUT} + 0.5V$ ,  $T_A = 25^\circ C$ , Enable pin is tied to  $V_{IN}$ .





## APPLICATION HINTS

### POWER DISSIPATION AND DEVICE OPERATION

The permissible power dissipation for any package is a measure of the capability of the device to pass heat from the power source, the junctions of the IC, to the ultimate heat sink, the ambient environment. Thus, the power dissipation is dependant on the ambient temperature and the thermal resistance across the various interfaces between the die and ambient air.

As stated in the notes for [Absolute Maximum Ratings](#) and [Operating Ratings](#), the allowable power dissipation for the device in a given package can be calculated using the equation:

$$P_D = \frac{(T_{J(MAX)} - T_A)}{\theta_{JA}} \quad (1)$$

With a  $\theta_{JA} = 50^\circ\text{C/W}$ , the device in the WSON package returns a value of 2.0W with a maximum junction temperature of  $125^\circ\text{C}$  and an ambient temperature of  $25^\circ\text{C}$ . The device in a VSSOP package returns a figure of 0.476W, ( $\theta_{JA} = 210^\circ\text{C/W}$ ).

The actual power dissipation across the device can be represented by the following equation:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (2)$$

This establishes the relationship between the power dissipation allowed due to thermal considerations, the voltage drop across the device, and the continuous current capability of the device. The device can deliver 300mA but care must be taken when choosing the continuous current output for the device under the operating load conditions.

### EXTERNAL CAPACITORS

Like any low-dropout regulator, the LP3981 requires external capacitors for regulator stability. The LP3981 is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance.

#### INPUT CAPACITOR

An input capacitance of  $\approx 2.2\mu\text{F}$  is required between the LP3981 input pin and ground (the amount of the capacitance may be increased without limit).

This capacitor must be located a distance of not more than 1cm from the input pin and returned to a clean analog ground. Any good quality ceramic, tantalum, or film capacitor may be used at the input.

**Important:** Tantalum capacitors can suffer catastrophic failures due to surge current when connected to a low-impedance source of power (like a battery or a very large capacitor). If a tantalum capacitor is used at the input, it must be guaranteed by the manufacturer to have a surge current rating sufficient for the application.

There are no requirements for the ESR on the input capacitor, but tolerance and temperature coefficient must be considered when selecting the capacitor to ensure the capacitance will be  $\approx 2.2\mu\text{F}$  over the entire operating temperature range.

#### OUTPUT CAPACITOR

The LP3981 is designed specifically to work with very small ceramic output capacitors. A ceramic capacitor (dielectric types Z5U, Y5V or X7R) in 2.2 to 22  $\mu\text{F}$  range with 5m $\Omega$  to 500m $\Omega$  ESR range is suitable in the LP3981 application circuit.

It may also be possible to use tantalum or film capacitors at the output, but these are not as attractive for reasons of size and cost (see [CAPACITOR CHARACTERISTICS](#)).

The output capacitor must meet the requirement for minimum amount of capacitance and also have an ESR (Equivalent Series Resistance) value which is within a stable range (5 m $\Omega$  to 500 m $\Omega$ ).

### NO-LOAD STABILITY

The LP3981 will remain stable and in regulation with no external load. This is specially important in CMOS RAM keep-alive applications.

## NOISE BYPASS CAPACITOR

Connecting a 0.033 $\mu$ F capacitor between the C<sub>BP</sub> pin and ground significantly reduces noise on the regulator output. This cap is connected directly to a high impedance node in the bad gap reference circuit. Any significant loading on this node will cause a change on the regulated output voltage. For this reason, DC leakage current through this pin must be kept as low as possible for best output voltage accuracy.

The types of capacitors best suited for the noise bypass capacitor are ceramic and film. High-quality ceramic capacitors with either NPO or COG dielectric typically have very low leakage. Polypropylene and polycarbonate film capacitors are available in small surface-mount packages and typically have extremely low leakage current.

Unlike many other LDO's, addition of a noise reduction capacitor does not effect the transient response of the device.

## CAPACITOR CHARACTERISTICS

The LP3981 is designed to work with ceramic capacitors on the output to take advantage of the benefits they offer: for capacitance values in the range of 1 $\mu$ F to 4.7 $\mu$ F range, ceramic capacitors are the smallest, least expensive and have the lowest ESR values (which makes them best for eliminating high frequency noise). The ESR of a typical 1 $\mu$ F ceramic capacitor is in the range of 20 m $\Omega$  to 40 m $\Omega$ , which easily meets the ESR requirement for stability by the LP3981.

The ceramic capacitor's capacitance can vary with temperature. Most large value ceramic capacitors ( $\approx$  2.2 $\mu$ F) are manufactured with Z5U or Y5V temperature characteristics, which results in the capacitance dropping by more than 50% as the temperature goes from 25°C to 85°C.

A better choice for temperature coefficient in a ceramic capacitor is X7R, which holds the capacitance within  $\pm$ 15%.

Tantalum capacitors are less desirable than ceramic for use as output capacitors because they are more expensive when comparing equivalent capacitance and voltage ratings in the 1 $\mu$ F to 4.7 $\mu$ F range.

Another important consideration is that tantalum capacitors have higher ESR values than equivalent size ceramics. This means that while it may be possible to find a tantalum capacitor with an ESR value within the stable range, it would have to be larger in capacitance (which means bigger and more costly ) than a ceramic capacitor with the same ESR value. It should also be noted that the ESR of a typical tantalum will increase about 2:1 as the temperature goes from 25°C down to -40°C, so some guard band must be allowed.

## ON/OFF INPUT OPERATION

The LP3981 is turned off by pulling the V<sub>EN</sub> pin low, and turned on by pulling it high. If this feature is not used, the V<sub>EN</sub> pin should be tied to V<sub>IN</sub> to keep the regulator output on at all time. To assure proper operation, the signal source used to drive the V<sub>EN</sub> input must be able to swing above and below the specified turn-on/off voltage thresholds listed in the [Electrical Characteristics](#) section under V<sub>IL</sub> and V<sub>IH</sub>.

## FAST ON-TIME

The LP3981 utilizes a speed up circuitry to ramp up the internal V<sub>REF</sub> voltage to its final value to achieve a fast output turn on time.

**PACKAGING INFORMATION**

| Orderable Device    | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|---------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| LP3981ILD-2.5       | ACTIVE        | WSOP         | NGC                | 6    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LO1UB                    | <a href="#">Samples</a> |
| LP3981ILD-2.5/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1UB                    | <a href="#">Samples</a> |
| LP3981ILD-2.8/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1ZB                    | <a href="#">Samples</a> |
| LP3981ILD-3.0       | ACTIVE        | WSOP         | NGC                | 6    | 1000        | TBD                        | Call TI          | Call TI              |              | LO17B                    | <a href="#">Samples</a> |
| LP3981ILD-3.0/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  |              | LO17B                    | <a href="#">Samples</a> |
| LP3981ILD-3.3       | ACTIVE        | WSOP         | NGC                | 6    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LO1XB                    | <a href="#">Samples</a> |
| LP3981ILD-3.3/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1XB                    | <a href="#">Samples</a> |
| LP3981ILD-2.5       | ACTIVE        | WSOP         | NGC                | 6    | 4500        | TBD                        | Call TI          | Call TI              | -40 to 125   | LO1UB                    | <a href="#">Samples</a> |
| LP3981ILD-2.5/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 4500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1UB                    | <a href="#">Samples</a> |
| LP3981ILD-2.7       | ACTIVE        | WSOP         | NGC                | 6    | 4500        | TBD                        | Call TI          | Call TI              | -40 to 125   | LO1VB                    | <a href="#">Samples</a> |
| LP3981ILD-2.7/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 4500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1VB                    | <a href="#">Samples</a> |
| LP3981ILD-2.8       | ACTIVE        | WSOP         | NGC                | 6    | 4500        | TBD                        | Call TI          | Call TI              | -40 to 125   | LO1ZB                    | <a href="#">Samples</a> |
| LP3981ILD-2.8/NOPB  | ACTIVE        | WSOP         | NGC                | 6    | 4500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1ZB                    | <a href="#">Samples</a> |
| LP3981ILD-2.83/NOPB | ACTIVE        | WSOP         | NGC                | 6    | 4500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1SB                    | <a href="#">Samples</a> |
| LP3981ILD-3.03/NOPB | ACTIVE        | WSOP         | NGC                | 6    | 4500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-3-260C-168 HR  | -40 to 125   | LO1YB                    | <a href="#">Samples</a> |
| LP3981IMM-2.5       | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFKB                     | <a href="#">Samples</a> |
| LP3981IMM-2.5/NOPB  | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFKB                     | <a href="#">Samples</a> |
| LP3981IMM-2.7       | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFLB                     | <a href="#">Samples</a> |

| Orderable Device    | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Top-Side Markings<br>(4) | Samples                 |
|---------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| LP3981IMM-2.7/NOPB  | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFLB                     | <a href="#">Samples</a> |
| LP3981IMM-2.8       | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFTB                     | <a href="#">Samples</a> |
| LP3981IMM-2.8/NOPB  | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFTB                     | <a href="#">Samples</a> |
| LP3981IMM-3.0       | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              |              | LF3B                     | <a href="#">Samples</a> |
| LP3981IMM-3.0/NOPB  | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   |              | LF3B                     | <a href="#">Samples</a> |
| LP3981IMM-3.03      | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFPB                     | <a href="#">Samples</a> |
| LP3981IMM-3.03/NOPB | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFPB                     | <a href="#">Samples</a> |
| LP3981IMM-3.3       | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFNB                     | <a href="#">Samples</a> |
| LP3981IMM-3.3/NOPB  | ACTIVE        | VSSOP        | DGK                | 8    | 1000        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFNB                     | <a href="#">Samples</a> |
| LP3981IMMX-2.5/NOPB | ACTIVE        | VSSOP        | DGK                | 8    | 3500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFKB                     | <a href="#">Samples</a> |
| LP3981IMMX-3.3      | ACTIVE        | VSSOP        | DGK                | 8    | 3500        | TBD                        | Call TI          | Call TI              | -40 to 125   | LFNB                     | <a href="#">Samples</a> |
| LP3981IMMX-3.3/NOPB | ACTIVE        | VSSOP        | DGK                | 8    | 3500        | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-1-260C-UNLIM   | -40 to 125   | LFNB                     | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> Only one of markings shown within the brackets will appear on the physical device.

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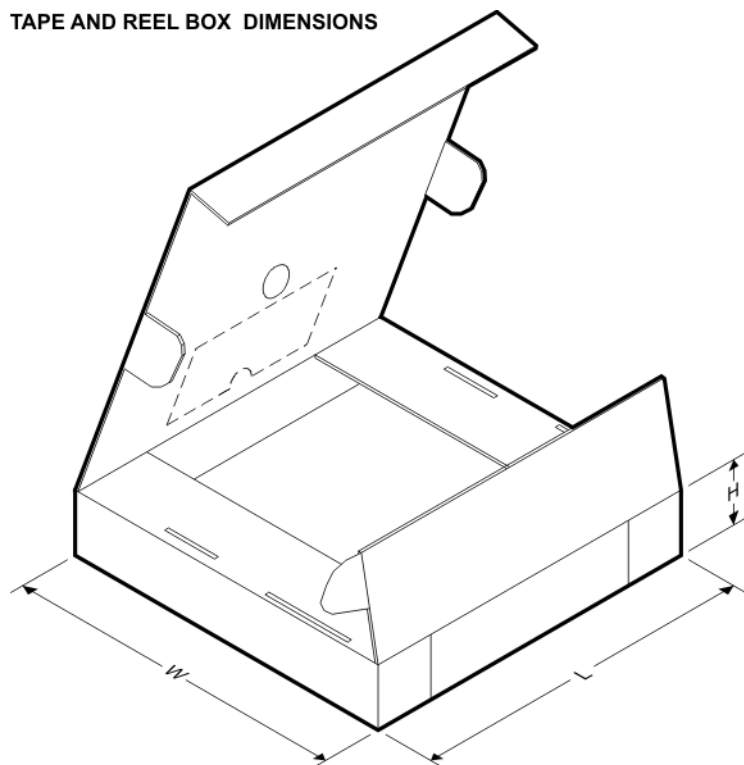
**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LP3981ILD-2.5        | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-2.5/NOPB   | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-2.8/NOPB   | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-3.0        | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-3.0/NOPB   | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-3.3        | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILD-3.3/NOPB   | WSOP         | NGC             | 6    | 1000 | 178.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.5       | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.5/NOPB  | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.7       | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.7/NOPB  | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.8       | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.8/NOPB  | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-2.83/NOPB | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981ILDX-3.03/NOPB | WSOP         | NGC             | 6    | 4500 | 330.0              | 12.4               | 4.3     | 3.3     | 1.0     | 8.0     | 12.0   | Q1            |
| LP3981IMM-2.5        | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-2.5/NOPB   | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-2.7        | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |

| Device              | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LP3981IMM-2.7/NOPB  | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-2.8       | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-2.8/NOPB  | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.0       | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.0/NOPB  | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.03      | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.03/NOPB | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.3       | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMM-3.3/NOPB  | VSSOP        | DGK             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMMX-2.5/NOPB | VSSOP        | DGK             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMMX-3.3      | VSSOP        | DGK             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LP3981IMMX-3.3/NOPB | VSSOP        | DGK             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LP3981ILD-2.5      | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-2.5/NOPB | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-2.8/NOPB | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-3.0      | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-3.0/NOPB | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |

| Device              | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LP3981ILD-3.3       | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-3.3/NOPB  | WSON         | NGC             | 6    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981ILD-2.5       | WSON         | NGC             | 6    | 4500 | 349.0       | 337.0      | 45.0        |
| LP3981ILD-2.5/NOPB  | WSON         | NGC             | 6    | 4500 | 358.0       | 343.0      | 63.0        |
| LP3981ILD-2.7       | WSON         | NGC             | 6    | 4500 | 349.0       | 337.0      | 45.0        |
| LP3981ILD-2.7/NOPB  | WSON         | NGC             | 6    | 4500 | 358.0       | 343.0      | 63.0        |
| LP3981ILD-2.8       | WSON         | NGC             | 6    | 4500 | 349.0       | 337.0      | 45.0        |
| LP3981ILD-2.8/NOPB  | WSON         | NGC             | 6    | 4500 | 358.0       | 343.0      | 63.0        |
| LP3981ILD-2.83/NOPB | WSON         | NGC             | 6    | 4500 | 358.0       | 343.0      | 63.0        |
| LP3981ILD-3.03/NOPB | WSON         | NGC             | 6    | 4500 | 358.0       | 343.0      | 63.0        |
| LP3981IMM-2.5       | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-2.5/NOPB  | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-2.7       | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-2.7/NOPB  | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-2.8       | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-2.8/NOPB  | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.0       | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.0/NOPB  | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.03      | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.03/NOPB | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.3       | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMM-3.3/NOPB  | VSSOP        | DGK             | 8    | 1000 | 203.0       | 190.0      | 41.0        |
| LP3981IMMX-2.5/NOPB | VSSOP        | DGK             | 8    | 3500 | 349.0       | 337.0      | 45.0        |
| LP3981IMMX-3.3      | VSSOP        | DGK             | 8    | 3500 | 349.0       | 337.0      | 45.0        |
| LP3981IMMX-3.3/NOPB | VSSOP        | DGK             | 8    | 3500 | 349.0       | 337.0      | 45.0        |

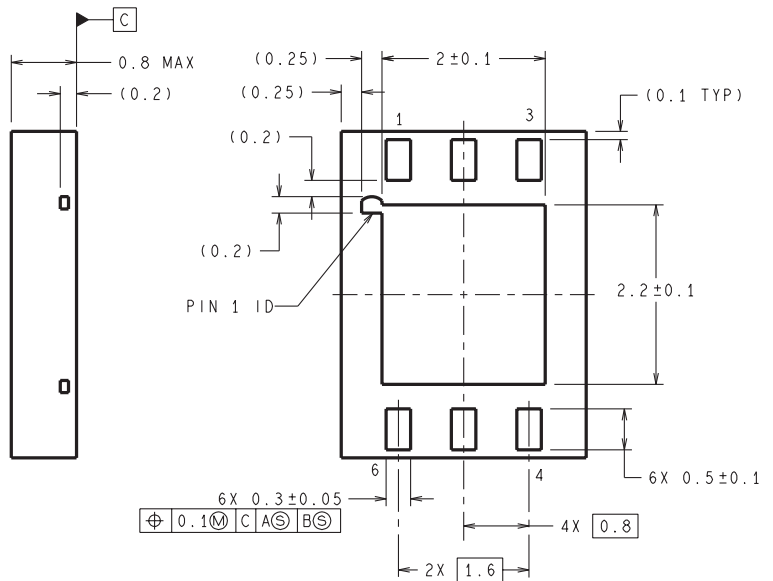


DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



4073329/E 05/06



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| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

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