

## 300mA,Ultra-low noise, Small Package Ultra-Fast CMOS LDO Regulator

### General Description

The LP3980 is designed for portable RF and wireless applications demanding performance and space requirements. The LP3980 performance is optimized for battery-powered systems to deliver ultra low noise and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life. The LP3980 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The LP3980 consumes less than 0.01 $\mu$ A in shutdown mode and has fast turn-on time less than 50 $\mu$ s. The other features include ultra low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio.

### Applications

- ✧ Portable Media Players/MP3 players
- ✧ Cellular and Smart mobile phone
- ✧ LCD
- ✧ DSC Sensor
- ✧ Wireless Card

### Features

- ◆ 1.6V- 5.5V Input Voltage Range
- ◆ Low Dropout : 240mV @ 300mA,3.3V
- ◆ 300mA Output Current
- ◆ High PSRR: -76dB at 1KHz
- ◆ < 1 $\mu$ A Standby Current When Shutdown
- ◆ Ultra-Fast Response in Line/Load transient
- ◆ Current Limiting
- ◆ Thermal Shutdown Protection
- ◆ Available in SOT23-5/SOT23/TDFN-4 Package

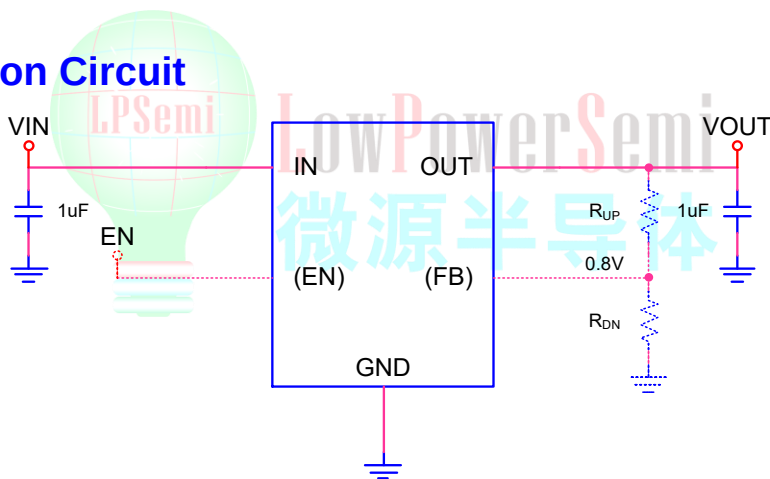
### Order Information

|        |   |   |   |                     |
|--------|---|---|---|---------------------|
| LP3980 | □ | □ | □ | □                   |
|        |   |   |   | F: Pb-Free          |
|        |   |   |   | Package Type        |
|        |   |   |   | B5 : SOT23-5        |
|        |   |   |   | B3 : SOT23          |
|        |   |   |   | QV: TDFN-4(1*1)     |
|        |   |   |   | Output Voltage Type |
|        |   |   |   | 11 : 1.1V           |
|        |   |   |   | 12 : 1.2V           |
|        |   |   |   | 15 : 1.5V           |
|        |   |   |   | 18 : 1.8V           |
|        |   |   |   | 25 : 2.5V           |
|        |   |   |   | 28 : 2.8V           |
|        |   |   |   | 30 : 3.0V           |
|        |   |   |   | 33 : 3.3V           |
|        |   |   |   | 50 : 5.0V           |
|        |   |   |   | A : ADJ             |

## Marking Information

| Device       | Marking          | Package | Shipping | Device                                                                      | Marking | Package | Shipping |
|--------------|------------------|---------|----------|-----------------------------------------------------------------------------|---------|---------|----------|
| LP3980-12B5F | LP3980<br>12 YWX | SOT23-5 | 3K/REEL  | LP3980-12QVF                                                                | BYW     | TDFN-4  | 12K/REEL |
| LP3980-18B5F | LPS<br>0CYWX     | SOT23-5 | 3K/REEL  | LP3980-18QVF                                                                | CYW     | TDFN-4  | 12K/REEL |
| LP3980-25B5F | LPS<br>1DYWX     | SOT23-5 | 3K/REEL  | LP3980-28QVF                                                                | HYW     | TDFN-4  | 12K/REEL |
| LP3980-28B5F | LPS<br>1HYWX     | SOT23-5 | 3K/REEL  | LP3980-30QVF                                                                | GYW     | TDFN-4  | 12K/REEL |
| LP3980-30B5F | LPS<br>1GYWX     | SOT23-5 | 3K/REEL  | LP3980-33QVF                                                                | EYW     | TDFN-4  | 12K/REEL |
| LP3980-33B5F | LP3980<br>33 YWX | SOT23-5 | 3K/REEL  | Marking indication:<br>Y:Production year W:Production week X: Series Number |         |         |          |
| LP3980-AB5F  | LPS<br>1FYWX     | SOT23-5 | 3K/REEL  |                                                                             |         |         |          |

## Typical Application Circuit



Note1: Only the SOT23-5/TDFN-4 package has an EN pin.

Note2: Only LP3980AB5F has an FB pin. The reference voltage is 0.8V.  $V_{OUT} = 0.8V \times \left(1 + \frac{R_{UP}}{R_{DN}}\right)$



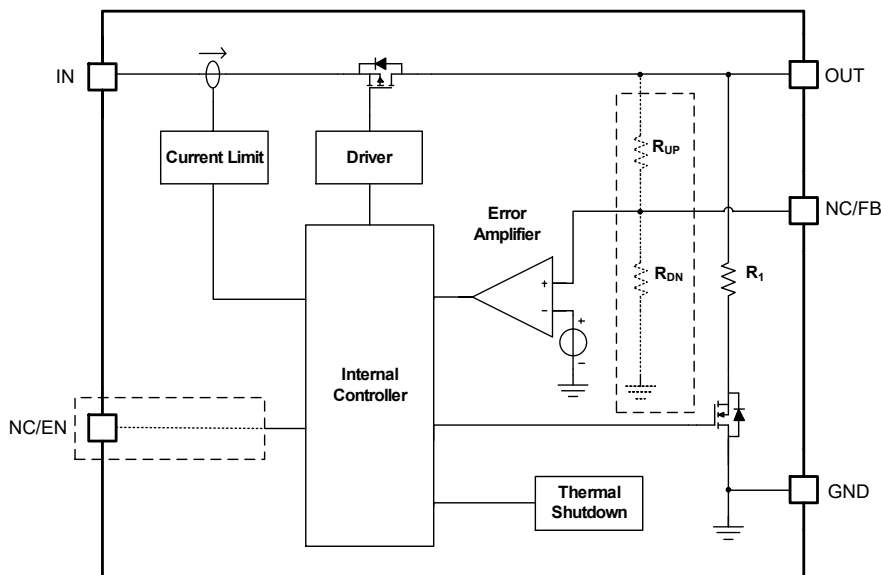
## Functional Pin Description

| Package Type                    | Pin Configurations                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOT23-5<br>SOT23<br>TDFN-4(1*1) | <p>The diagram shows three package types and their pin configurations:</p> <ul style="list-style-type: none"><li><b>SOT23-5 (Top View):</b> A 5-pin package with pins 1 (IN), 2 (GND), 3 (EN), 4 (FB / NC), and 5 (OUT).</li><li><b>SOT23 (Top View):</b> A 3-pin package with pins 1 (GND), 2 (IN), and 3 (OUT).</li><li><b>TDFN-4 (Top View):</b> A 4-pin package with pins 1 (OUT), 2 (GND), 3 (EN), and 4 (IN). The center of the package is labeled '5 EP'.</li></ul> |

## Pin Description

| Pin No. |       |        | Name         | Description                                  |
|---------|-------|--------|--------------|----------------------------------------------|
| SOT23-5 | SOT23 | TDFN-4 |              |                                              |
| 1       | 2     | 4      | VIN          | Power Input voltage.                         |
| 2       | 1     | 2      | GND          | Ground.                                      |
| 3       | -     | 3      | EN           | Enable pin.                                  |
| 4       | -     | -      | NC           | No connect.                                  |
|         |       |        | FB (LP3980A) | Feedback pin. The reference voltage is 0.8V. |
| 5       | 3     | 1      | OUT          | Output voltage.                              |

## Functional Block Diagram



## Absolute Maximum Ratings <sup>Note 1</sup>

|                                                    |       |                            |
|----------------------------------------------------|-------|----------------------------|
| ✧ Input to GND                                     | ----- | -0.3V to 6V                |
| ✧ EN to GND                                        | ----- | -0.3V to 6V                |
| ✧ Output Voltage to GND                            | ----- | -0.3V to ( $V_{IN}+0.3V$ ) |
| ✧ Maximum Junction Temperature ( $T_J$ )           | ----- | 150°C                      |
| ✧ Operating Ambient Temperature Range ( $T_A$ )    | ----- | -40°C to 85°C              |
| ✧ Maximum Soldering Temperature (At leads, 10 sec) | ----- | 260°C                      |

Note 1. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Thermal Information

|                                                                        |       |         |
|------------------------------------------------------------------------|-------|---------|
| ✧ Maximum Power Dissipation (SOT23-5, $P_D$ , $T_A=25^\circ\text{C}$ ) | ----- | 400mW   |
| ✧ Thermal Resistance (SOT23-5, $\theta_{JA}$ )                         | ----- | 250°C/W |
| ✧ Maximum Power Dissipation (SOT23, $P_D$ , $T_A=25^\circ\text{C}$ )   | ----- | 350mW   |
| ✧ Thermal Resistance (SOT23, $\theta_{JA}$ )                           | ----- | 350°C/W |
| ✧ Maximum Power Dissipation (TDFN-4, $P_D$ , $T_A=25^\circ\text{C}$ )  | ----- | 390mW   |
| ✧ Thermal Resistance (TDFN-4, $\theta_{JA}$ )                          | ----- | 256°C/W |

## ESD Susceptibility

|                         |       |      |
|-------------------------|-------|------|
| ✧ HBM(Human Body Model) | ----- | 2KV  |
| ✧ MM(Machine Model)     | ----- | 200V |

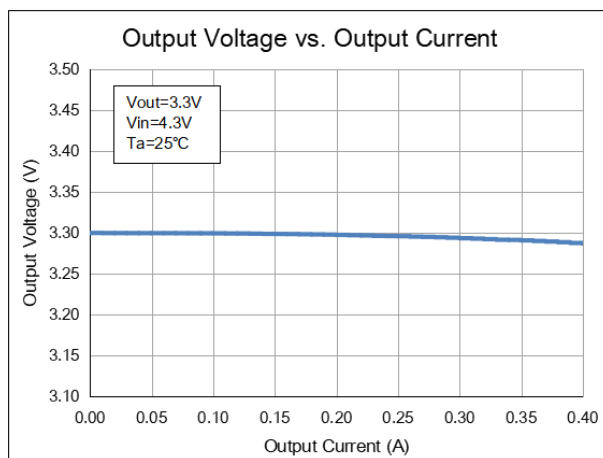
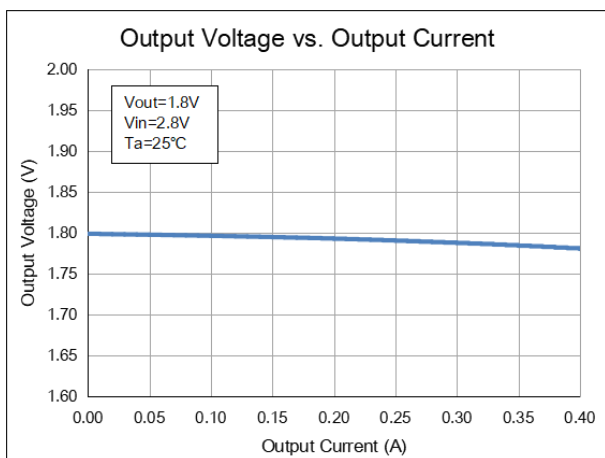
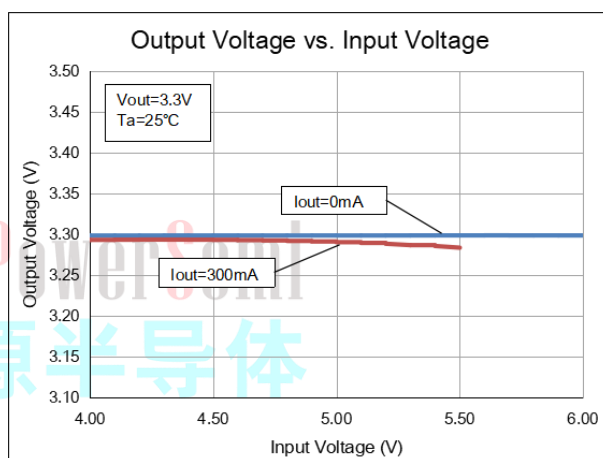
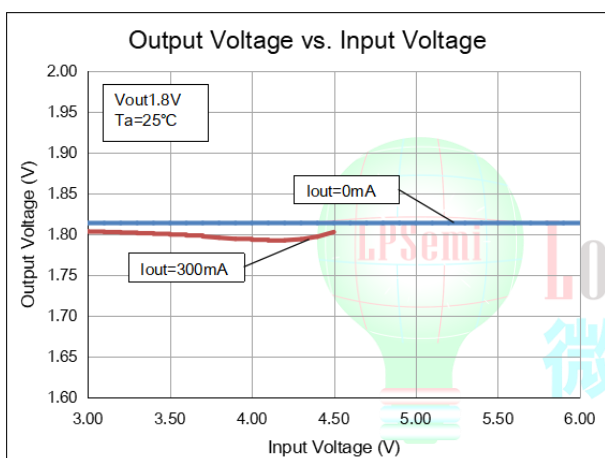
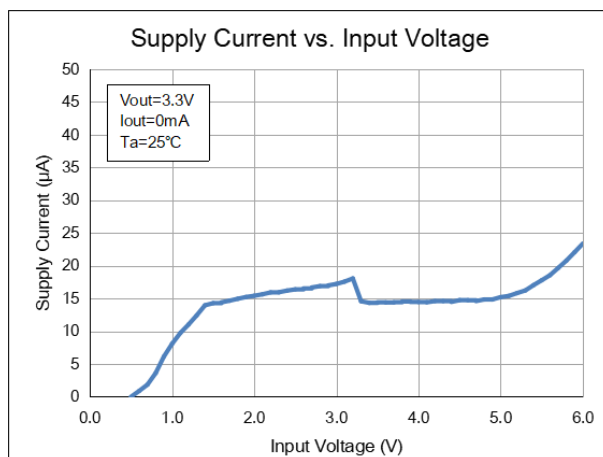
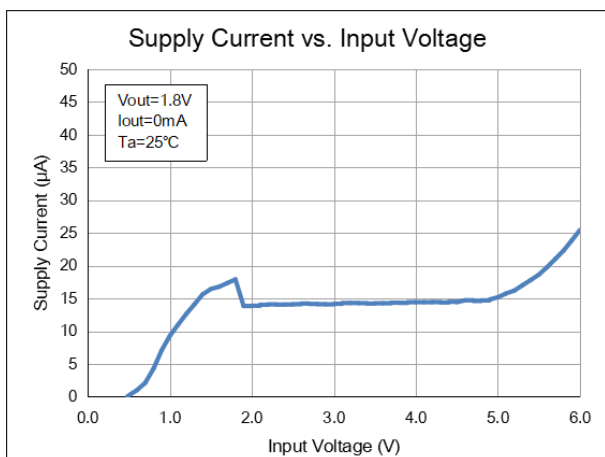
## Electrical Characteristics

( $V_{IN}=V_{OUT} + 1V$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified.)

| Parameter                    |                    | Symbol                                                | Test Conditions                                             | Min   | Typ.  | Max   | Units      |
|------------------------------|--------------------|-------------------------------------------------------|-------------------------------------------------------------|-------|-------|-------|------------|
| Input Voltage                |                    | $V_{IN}$                                              |                                                             | 1.6   |       | 5.5   | V          |
| Output Voltage Accuracy      |                    | $\Delta V_{OUT}$                                      | $I_{OUT}=1mA$                                               | -2    |       | +2    | %          |
| Feedback Voltage             |                    | $V_{FB}$                                              | LP3980AB5F, $I_{OUT}=1mA$                                   | 0.784 | 0.800 | 0.816 | V          |
| Maximum Output Current       |                    | $I_{max}$                                             | $V_{EN}=V_{IN}>2.5V$                                        |       | 300   |       | mA         |
| Current Limit                |                    | $I_{LIM}$                                             | $R_{LOAD}=1\Omega$                                          |       | 650   |       | mA         |
| Quiescent Current            |                    | $I_Q$                                                 | $V_{EN}>1.2V$ , $I_{OUT}=0mA$                               |       | 20    |       | $\mu A$    |
| Dropout Voltage              |                    | $V_{DROP}$                                            | $I_{OUT}=300mA$ , $V_{OUT}=1.2V$                            |       | 650   |       | mV         |
|                              |                    |                                                       | $I_{OUT}=300mA$ , $V_{OUT}=1.8V$                            |       | 360   |       | mV         |
|                              |                    |                                                       | $I_{OUT}=300mA$ , $V_{OUT}=2.8V$                            |       | 260   |       | mV         |
|                              |                    |                                                       | $I_{OUT}=300mA$ , $V_{OUT}=3.3V$                            |       | 240   |       | mV         |
| Line Regulation              |                    | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | $V_{OUT}=1.2V$ , $I_{OUT}=1mA$ ,<br>$V_{IN}=2.2V$ to $5.5V$ |       |       | 0.4   | %          |
|                              |                    |                                                       | $V_{OUT}=1.8V$ , $I_{OUT}=1mA$ ,<br>$V_{IN}=2.8V$ to $5.5V$ |       |       | 0.3   | %          |
|                              |                    |                                                       | $V_{OUT}=2.8V$ , $I_{OUT}=1mA$ ,<br>$V_{IN}=3.8V$ to $5.5V$ |       |       | 0.3   | %          |
|                              |                    |                                                       | $V_{OUT}=3.3V$ , $I_{OUT}=1mA$ ,<br>$V_{IN}=4.3V$ to $5.5V$ |       |       | 0.3   | %          |
| Load Regulation              |                    | $\frac{\Delta V_{OUT}}{V_{OUT}}$                      | $V_{OUT}=1.2V$ ,<br>$I_{OUT}=1mA$ to $300mA$                |       |       | 2     | %          |
|                              |                    |                                                       | $V_{OUT}=1.8V$ ,<br>$I_{OUT}=1mA$ to $300mA$                |       |       | 1.5   | %          |
|                              |                    |                                                       | $V_{OUT}=2.8V$ ,<br>$I_{OUT}=1mA$ to $300mA$                |       |       | 1     | %          |
|                              |                    |                                                       | $V_{OUT}=3.3V$ ,<br>$I_{OUT}=1mA$ to $300mA$                |       |       | 1     | %          |
| Standby Current              |                    | $I_{STBY}$                                            | $V_{EN}=0V$ , Shutdown                                      |       | 0.01  | 1     | $\mu A$    |
| EN Input Bias Current        |                    | $I_{IBSD}$                                            | $V_{EN}=0V$                                                 |       | 0.1   | 1     | $\mu A$    |
|                              |                    |                                                       | $V_{EN}=V_{IN}$                                             |       | 0.1   | 1     | $\mu A$    |
| EN Threshold                 | Logic-Low Voltage  | $V_{IL}$                                              | $V_{IN}=3V$ to $5.5V$ , Shutdown                            |       |       | 0.4   | V          |
|                              | Logic-High Voltage | $V_{IH}$                                              | $V_{IN}=3V$ to $5.5V$ , Start-Up                            | 1.4   |       |       | V          |
| Output Noise Voltage         |                    | -                                                     | $f=10Hz$ to $100kHz$ , $I_{OUT}=0mA$ ,<br>$V_{OUT}=2.8V$    |       | 100   |       | $\mu VRMS$ |
| Power Supply Rejection Rate  | $f=217Hz$          | PSRR                                                  | $C_{OUT}=1\mu F$ , $I_{OUT}=50mA$                           |       | -80   |       | dB         |
|                              | $f=1KHz$           |                                                       |                                                             |       | -76   |       | dB         |
| Auto-discharge On Resistance |                    | $R_{DIS}$                                             |                                                             |       | 40    |       | $\Omega$   |
| Thermal Shutdown Temperature |                    | $T_{SD}$                                              |                                                             |       | 150   |       | $^\circ C$ |

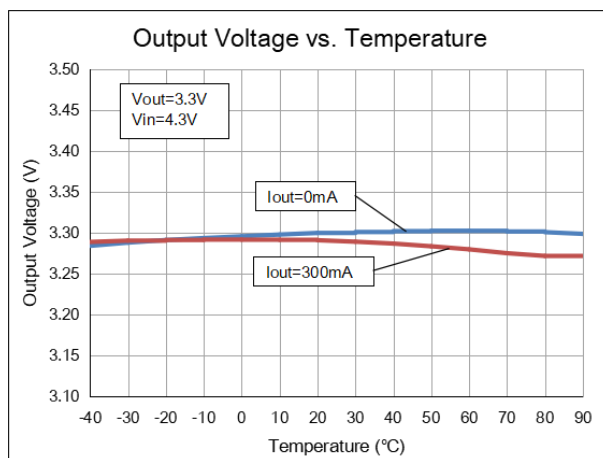
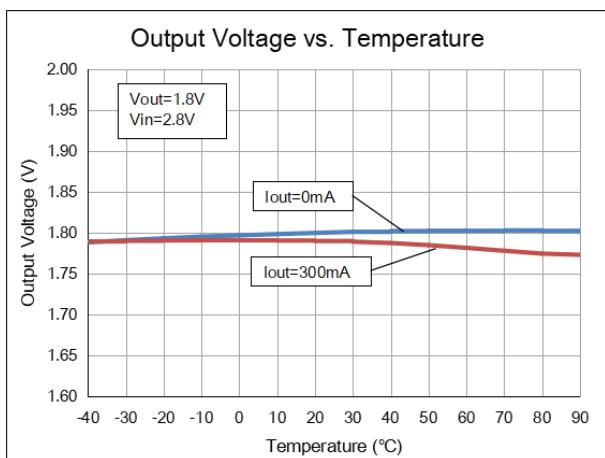
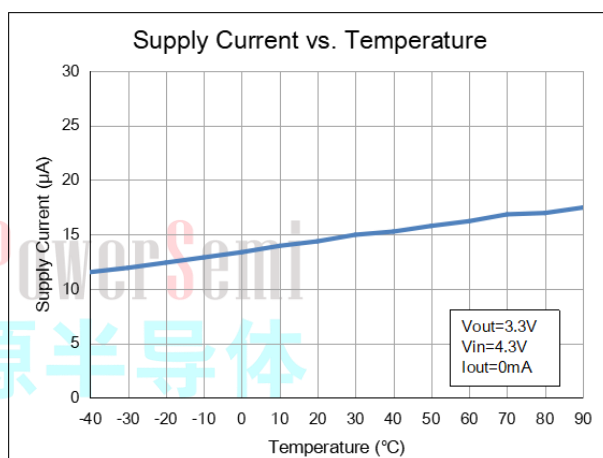
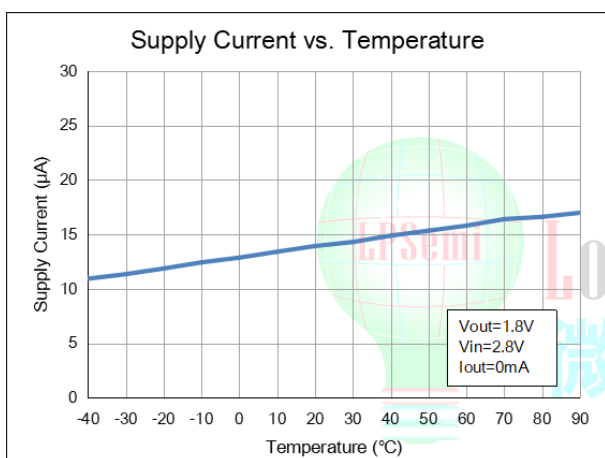
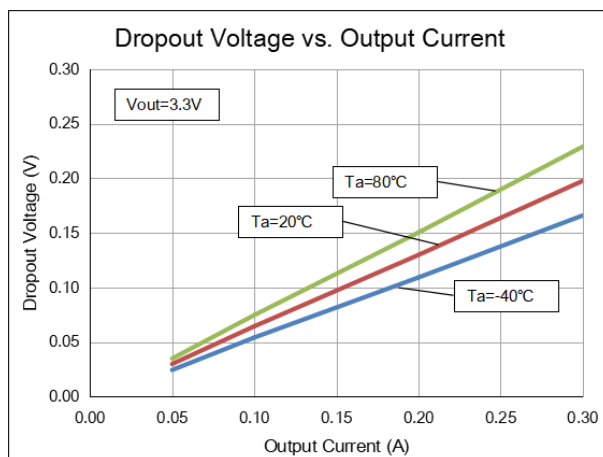
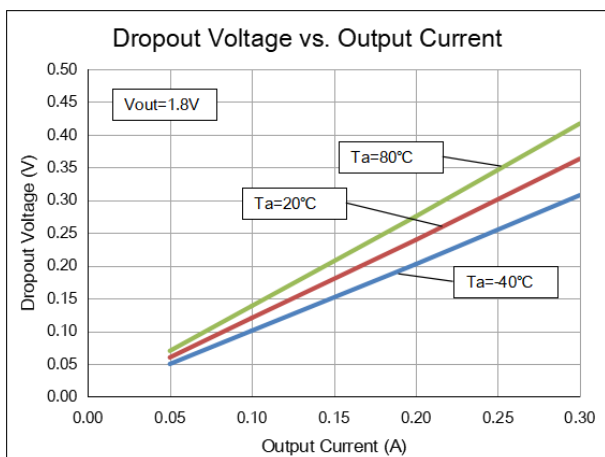
## Typical Operating Characteristics

( $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified)



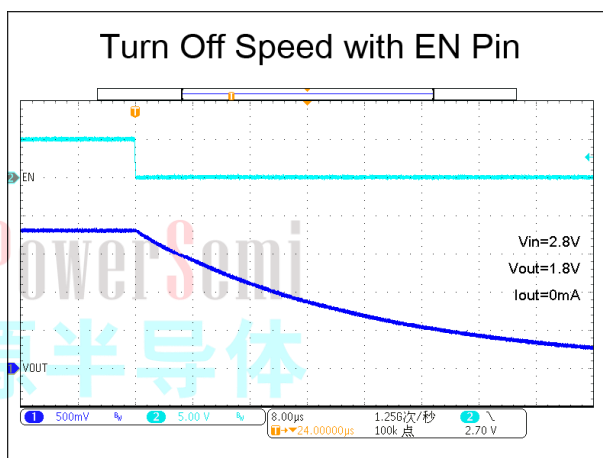
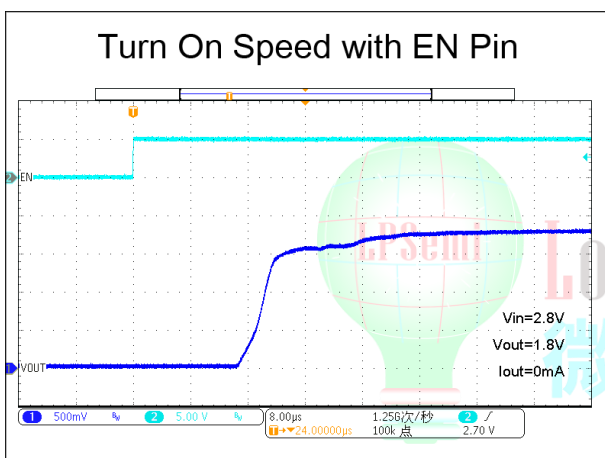
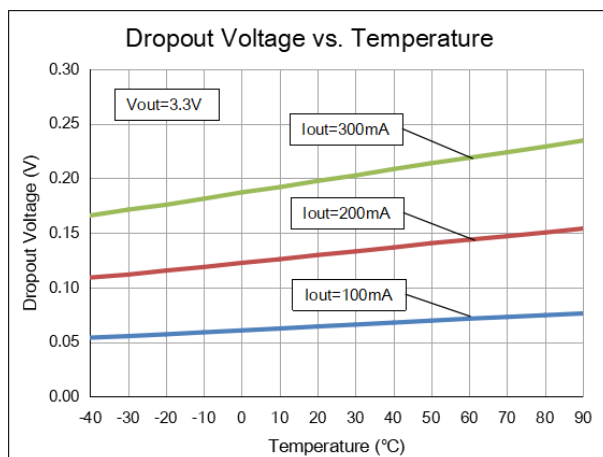
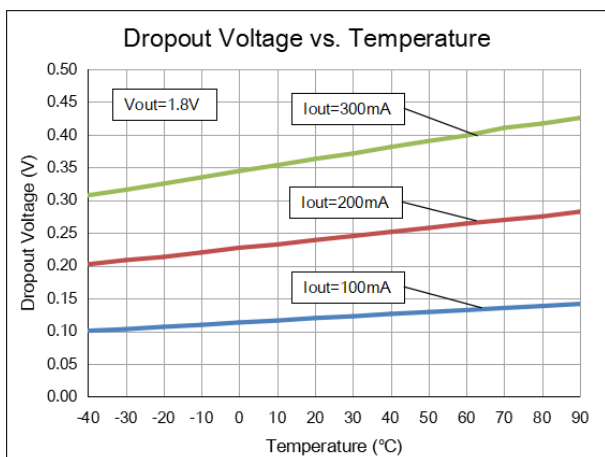
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( $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified)



## Applications Information

Like any low-dropout regulator, the external capacitors used with the LP3980 must be carefully selected for regulator stability and performance. Using a capacitor whose value is  $>1\mu\text{F}$  on the LP3980 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response. The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDOs application. The LP3980 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least  $1\mu\text{F}$  with ESR is  $>25\text{m}\Omega$  on the LP3980 output ensures stability. The LP3980 still works well with output capacitor of other types due to the wide stable ESR range. Output capacitor of larger capacitance can reduce noise and improve load transient response, stability, and PSRR. The output capacitor should be located not more than 0.5 inch from the OUT pin of the LP3980 and returned to a clean analog ground.

### Enable Function

The LP3980 features an LDO regulator enable/disable function. To assure the LDO regulator will switch on, the EN turn on control level must be greater than 1.4 volts. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.4 volts. For protecting the system, the LP3980 have a quick-discharge function. If the enable function is not needed in a specific application, it may

be tied to VIN to keep the LDO regulator in a continuously on state.

### Thermal Considerations

Thermal protection limits power dissipation in LP3980. When the operation junction temperature exceeds  $150^{\circ}\text{C}$ , the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turns on again after the junction temperature cools by  $20^{\circ}\text{C}$ . For continue operation, do not exceed absolute maximum operation junction temperature  $125^{\circ}\text{C}$ .

The power dissipation definition in device is:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_Q$$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junctions to ambient.

The maximum power dissipation can be calculated by following formula:

$$P_{D(MAX)} = \frac{(T_{J(MAX)} - T_A)}{\theta_{JA}}$$

Where  $T_{J(MAX)}$  is the maximum operation junction temperature  $125^{\circ}\text{C}$ ,  $T_A$  is the ambient temperature and the  $\theta_{JA}$  is the junction to ambient thermal resistance. For recommended operating conditions specification of LP3980, where  $T_{J(MAX)}$  is the maximum junction temperature of the die ( $125^{\circ}\text{C}$ ) and  $T_A$  is the maximum ambient temperature. The junction to ambient thermal resistance ( $\theta_{JA}$  is layout dependent) for SOT23-5 package is  $250^{\circ}\text{C/W}$ .

$$P_{D(MAX)} = \frac{(125^{\circ}\text{C} - 25^{\circ}\text{C})}{250^{\circ}\text{C/W}} = 400\text{mW}$$

The maximum power dissipation depends on operating ambient temperature for fixed  $T_{J(MAX)}$  and



thermal resistance  $\theta_{JA}$ .

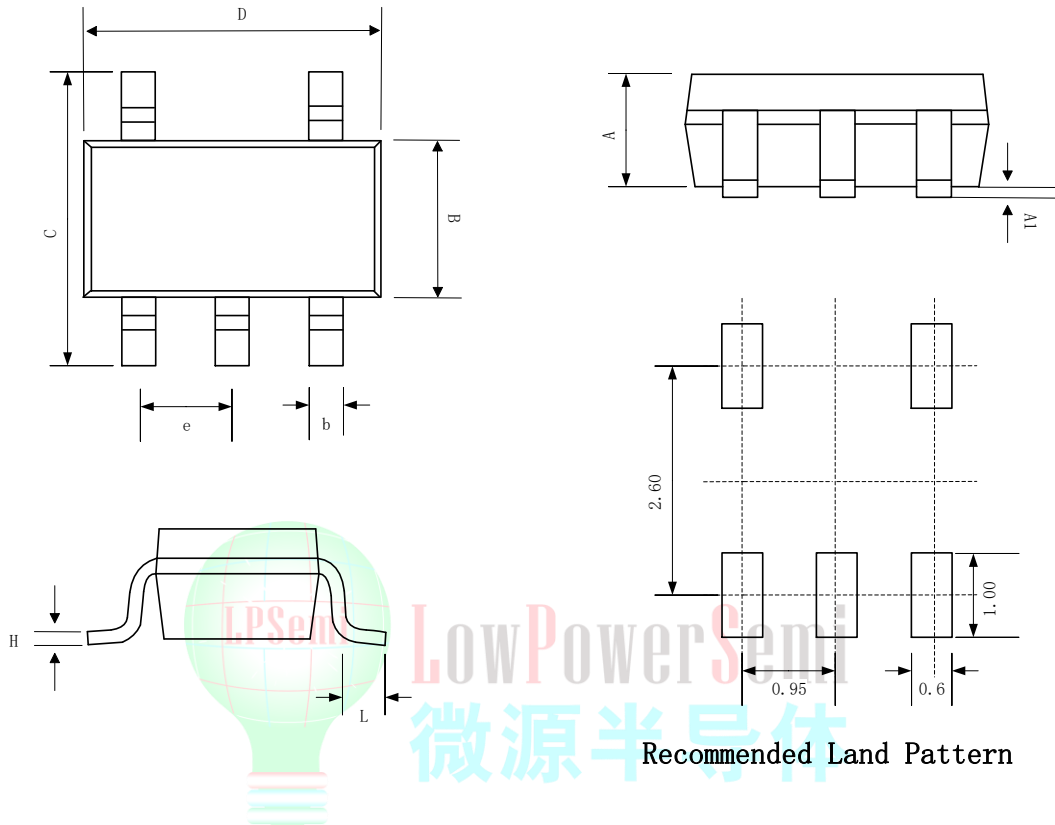


LowPowerSemi  
微源半导体



## Packaging Information

### SOT23-5



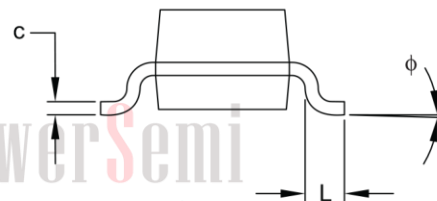
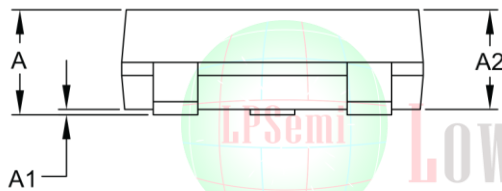
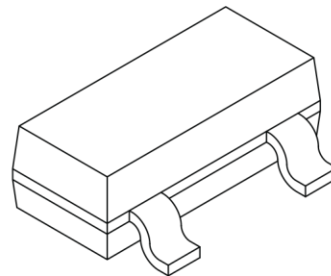
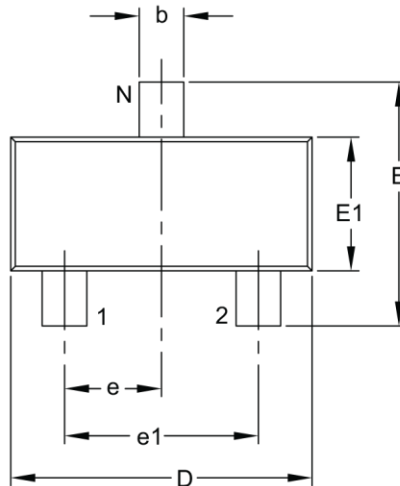
Recommended Land Pattern

| SYMBOL | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | MIN                       | NOM   | MAX   |
| A      | 0.889                     | 1.100 | 1.295 |
| A1     | 0.000                     | 0.050 | 0.152 |
| B      | 1.397                     | 1.600 | 1.803 |
| b      | 0.28                      | 0.35  | 0.559 |
| C      | 2.591                     | 2.800 | 3.000 |
| D      | 2.692                     | 2.920 | 3.120 |
| e      | 0.95BSC                   |       |       |
| H      | 0.080                     | 0.152 | 0.254 |
| L      | 0.300                     | 0.450 | 0.610 |



## Packaging Information

### SOT23

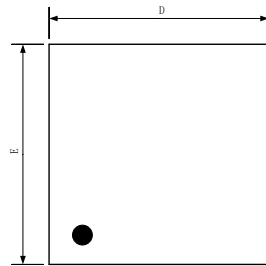


| Dimension Limits         | Units | MILLIMETERS |      |      |
|--------------------------|-------|-------------|------|------|
|                          |       | MIN         | NOM  | MAX  |
| Number of Pins           | N     | 3           |      |      |
| Lead Pitch               | e     | 0.95 BSC    |      |      |
| Outside Lead Pitch       | e1    | 1.90 BSC    |      |      |
| Overall Height           | A     | 0.89        | —    | 1.30 |
| Molded Package Thickness | A2    | 0.79        | 0.95 | 1.02 |
| Standoff                 | A1    | 0.01        | —    | 0.10 |
| Overall Width            | E     | 2.59        | —    | 3.00 |
| Molded Package Width     | E1    | 1.40        | 1.60 | 1.80 |
| Overall Length           | D     | 2.67        | 2.90 | 3.05 |
| Foot Length              | L     | 0.13        | 0.50 | 0.60 |
| Foot Angle               | φ     | 0°          | —    | 10°  |
| Lead Thickness           | c     | 0.08        | —    | 0.20 |
| Lead Width               | b     | 0.35        | —    | 0.56 |

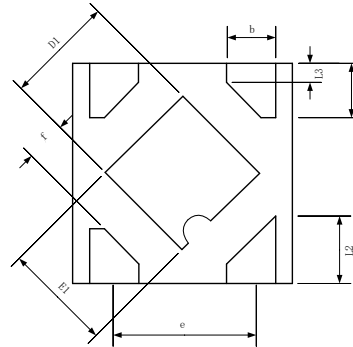


## Packaging Information

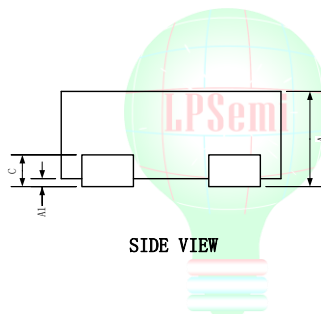
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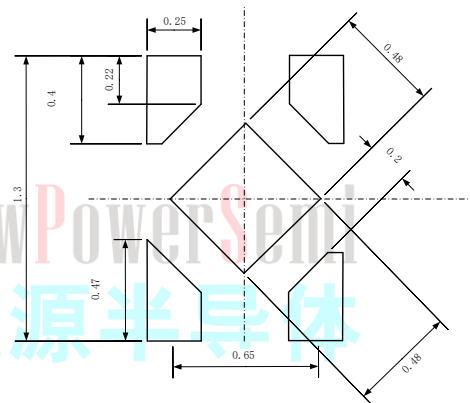
TOP VIEW



BOTTOM VIEW



SIDE VIEW



Recommended Land Pattern

| SYMBOL | MILLIMETER |      |      |
|--------|------------|------|------|
|        | MIN        | NOM  | MAX  |
| A      | 0.35       | -    | 0.40 |
| A1     | 0.00       | 0.02 | 0.05 |
| b      | 0.20       | 0.25 | 0.30 |
| c      | 0.07       | 0.12 | 0.17 |
| D      | 0.95       | 1.00 | 1.05 |
| D1     | 0.43       | 0.48 | 0.55 |
| E      | 0.95       | 1.00 | 1.05 |
| E1     | 0.43       | 0.48 | 0.55 |
| e      | 0.65BSC    |      |      |
| L1     | 0.2        | 0.25 | 0.30 |
| L2     | 0.27       | 0.32 | 0.37 |
| L3     | 0.09REF    |      |      |
| f      | 0.18REF    |      |      |