



500mA, 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 0.01µA in shutdown mode and has fast turn-on time less than 50µs. The other features include ultra low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio.

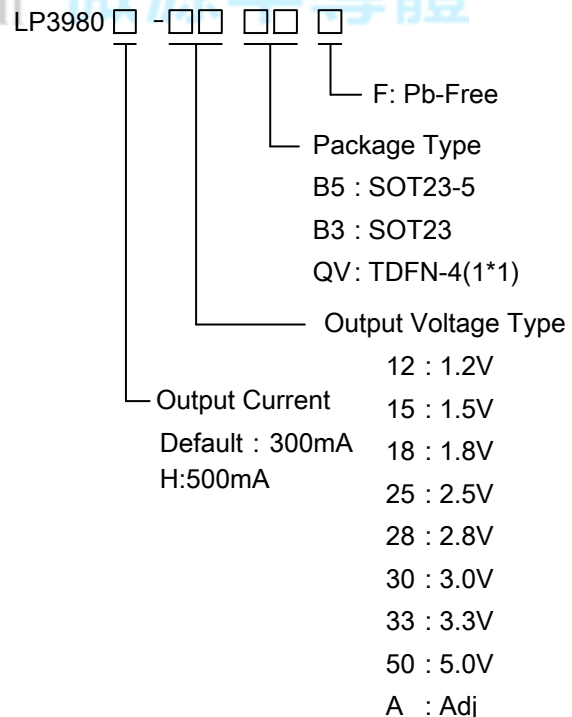
Applications

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

Features

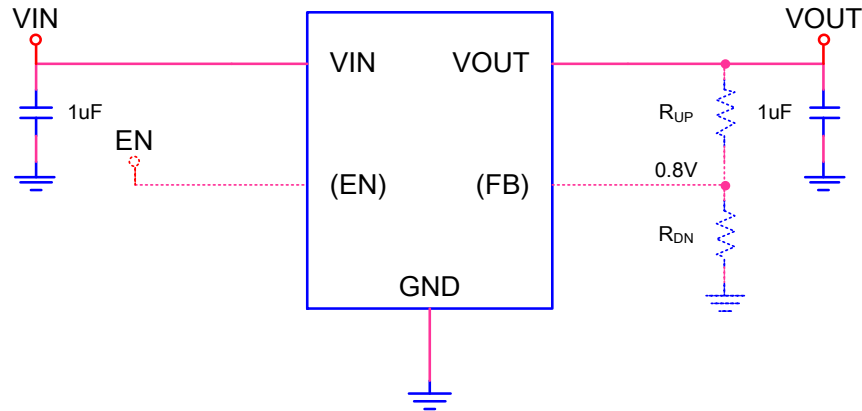
- ◆ 1.6V- 5.5V Input Voltage Range
- ◆ Low Dropout : 240mV @ 300mA
- ◆ 500mA Output Current
- ◆ High PSSR: -76dB at 1KHz
- ◆ < 1uA Standby Current When Shutdown
- ◆ Ultra-Fast Response in Line/Load transient
- ◆ Current Limiting
- ◆ Thermal Shutdown Protection
- ◆ Available in SOT23-5/SOT23/TDFN-4 Package

Order Information





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

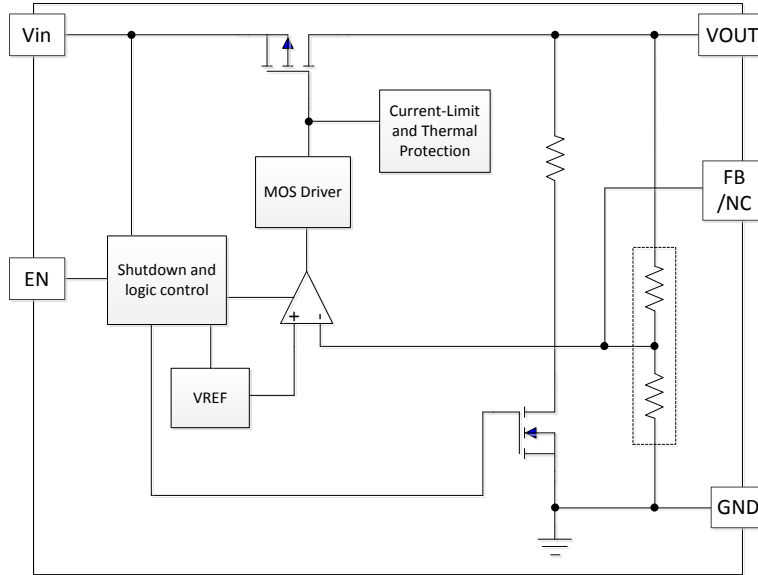
| Package Type | Pin Configurations |
|--------------|--------------------|
| SOT23-5 | |
| SOT23 | |
| TDFN-4(1*1) | |

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 | VOUT | Output voltage. |



Function Block Diagram



Absolute Maximum Ratings ^{Note 1}

- ◇ Input to GND ----- -0.3V to 6V
- ◇ EN to GND ----- -0.3V to 6V
- ◇ Output Voltage to GND ----- -0.3V to (VIN+0.3V)
- ◇ Maximum Junction Temperature ----- 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°C) ----- 400mW
- ◇ Thermal Resistance (SOT23-5, θ_{JA}) ----- 250°C/W
- ◇ Maximum Power Dissipation (SOT23, P_D, T_A=25°C) ----- 350mW
- ◇ Thermal Resistance (SOT23, θ_{JA}) ----- 350°C/W
- ◇ Maximum Power Dissipation (TDFN-4, P_D, T_A=25°C) ----- 390mW
- ◇ Thermal Resistance (TDFN-4, θ_{JA}) ----- 256°C/W

ESD Susceptibility

- ◇ HBM(Human Body Mode) ----- 2KV
- ◇ MM(Machine Mode) ----- 200V



Electrical Characteristics

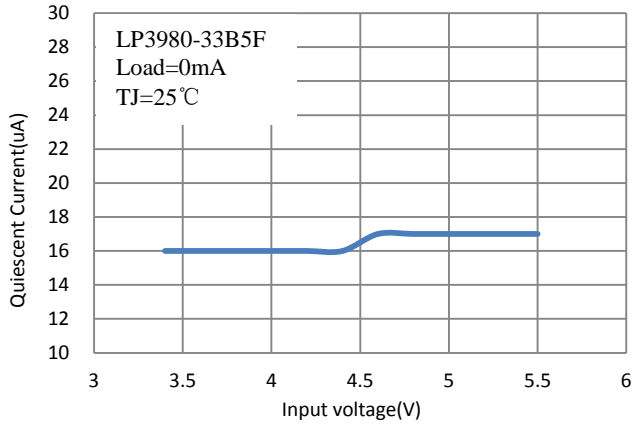
$V_{IN} = V_{OUT} + 1V$, $C_{IN} = C_{OUT} = 1\mu F$, $T_A = 25^\circ C$, unless otherwise specified.

| Symbol | Parameter | | Test Conditions | Min | Typ | Max | Units |
|-------------------|------------------------------|--------------------|---|---------|------|-------|------------|
| V_{IN} | Input Voltage | | | 1.6 | | 5.5 | |
| ΔV_{OUT} | Output Voltage Accuracy | | $I_{OUT} = 1mA$ | -2 | -- | +2 | % |
| V_{FB} | Feedback Voltage | | LP3980AB5F $I_{OUT} = 1mA$ | 0.784 | 0.8 | 0.816 | V |
| I_{max} | Maximum output Current | | $V_{EN} = V_{IN}$, $V_{IN} > 2.5V$ | LP3980 | 300 | | mA |
| | | | | LP3980A | 500 | | mA |
| I_{LIM} | Current Limit | | $R_{LOAD} = 1\Omega$ | | 650 | | mA |
| I_Q | Quiescent Current | | $V_{EN} \geq 1.2V$, $I_{OUT} = 0mA$ | | 20 | | μA |
| V_{DROP} | Dropout Voltage | | $I_{OUT} = 200mA$, $V_{OUT} > 2.8V$ | | 160 | 200 | mV |
| | | | $I_{OUT} = 300mA$, $V_{OUT} > 2.8V$ | | 240 | 300 | mV |
| | | | $I_{OUT} = 500mA$, $V_{OUT} > 2.8V$ | | 400 | 500 | mV |
| ΔV_{LINE} | Line Regulation | | $V_{IN} = (V_{OUT} + 1V)$ to 5.5V, $I_{OUT} = 1mA$ | | | 0.1 | % |
| ΔV_{LOAD} | Load Regulation | | $1mA < I_{OUT} < 300mA$ | | | 0.6 | % |
| I_{STBY} | Standby Current | | $V_{EN} = GND$, Shutdown | | 0.01 | 1 | μA |
| I_{IBSD} | EN Input Bias Current | | $V_{EN} = GND$ or V_{IN} | | 0.1 | 1 | μA |
| V_{IL} | EN Threshold | Logic-Low Voltage | $V_{IN} = 3V$ to 5.5V, Shutdown | | | 0.4 | V |
| V_{IH} | | Logic-High Voltage | $V_{IN} = 3V$ to 5.5V, Start-Up | 1.4 | | | V |
| - | Output Noise Voltage | | $f = 10Hz$ to 100kHz, $I_{OUT} = 0mA$ $V_{OUT} = 2.8V$ | | 100 | | $\mu VRMS$ |
| PSRR | Power Supply Rejection Rate | f=217Hz | $C_{OUT} = 1\mu F$, $I_{OUT} = 50mA$ | | -80 | | dB |
| | | f=1KHz | | | -76 | | dB |
| T_{SD} | Thermal Shutdown Temperature | | | | 150 | | $^\circ C$ |

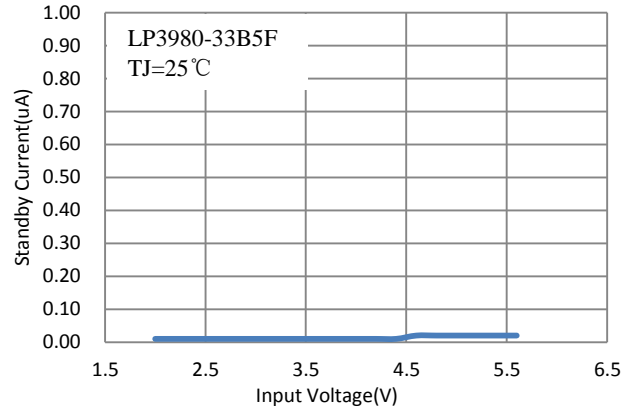


Typical Operating Characteristics

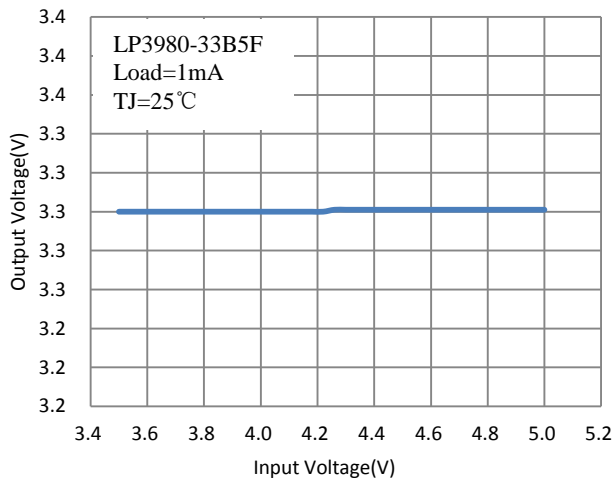
Quiescent Current VS. Input Voltage



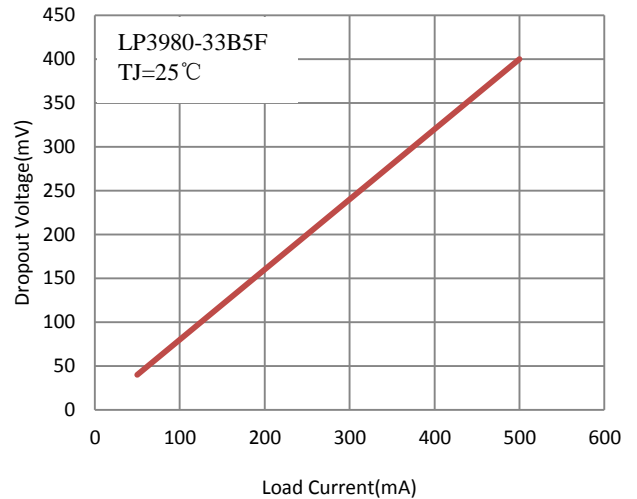
Standby Current VS. Input Voltage



Output Voltage VS. Input Voltage



Dropout Voltage VS. Load Current





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 VOUT 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°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°C . For continue operation, do not exceed absolute maximum operation junction temperature 125°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:

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



Where $T_{J(MAX)}$ is the maximum operation junction temperature $125^{\circ}C$, T_A is the ambient temperature and the θ_{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 ($125^{\circ}C$) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA} is layout dependent) for SOT23-5 package is $250^{\circ}C/W$.

$$P_{D(MAX)} = (125^{\circ}C - 25^{\circ}C) / 250 = 400mW \text{ (SOT23-5)}$$

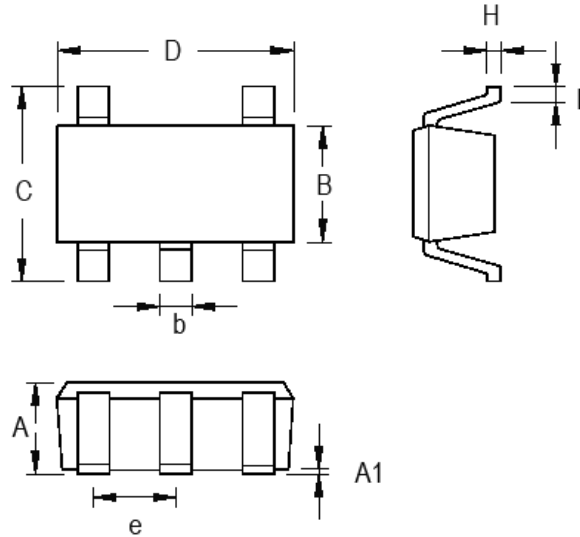
The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA} .





Packaging Information

SOT23-5

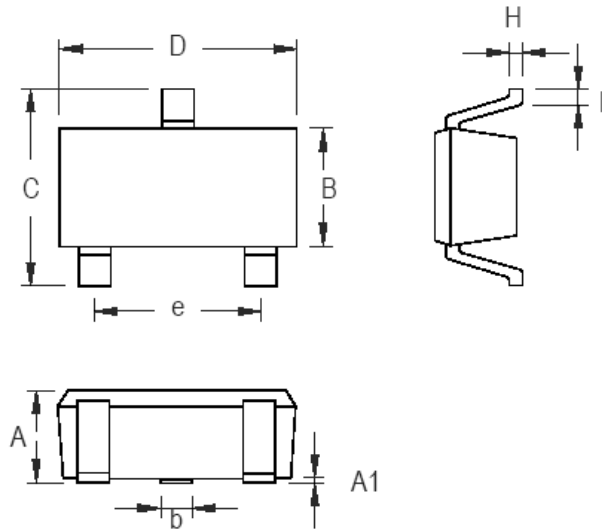


| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.889 | 1.295 | 0.035 | 0.051 |
| A1 | 0.000 | 0.152 | 0.000 | 0.006 |
| B | 1.397 | 1.803 | 0.055 | 0.071 |
| b | 0.356 | 0.559 | 0.014 | 0.022 |
| C | 2.591 | 2.997 | 0.102 | 0.118 |
| D | 2.692 | 3.099 | 0.106 | 0.122 |
| e | 0.838 | 1.041 | 0.033 | 0.041 |
| H | 0.080 | 0.254 | 0.003 | 0.010 |
| L | 0.300 | 0.610 | 0.012 | 0.024 |

SOT-23-5 Surface Mount Package



SOT23

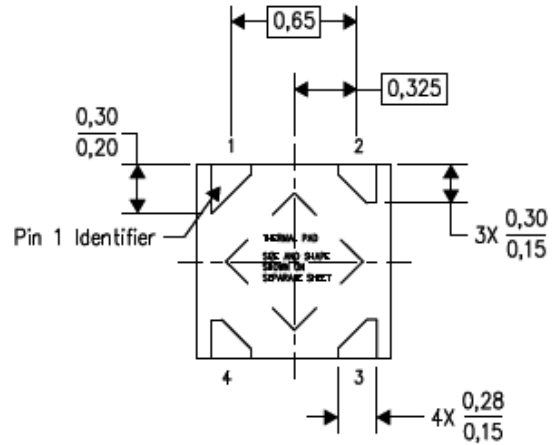
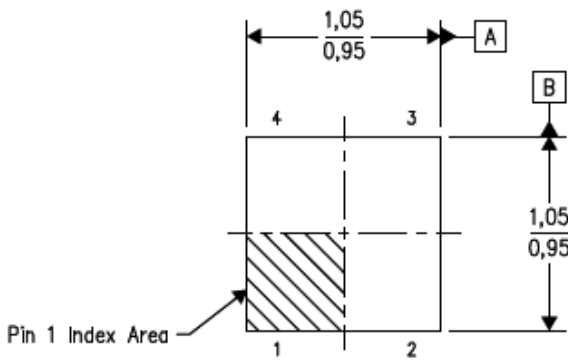


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| b | 0.356 | 0.508 | 0.014 | 0.020 |
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| e | 1.803 | 2.007 | 0.071 | 0.079 |
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| L | 0.300 | 0.610 | 0.012 | 0.024 |

SOT-23 Surface Mount Package

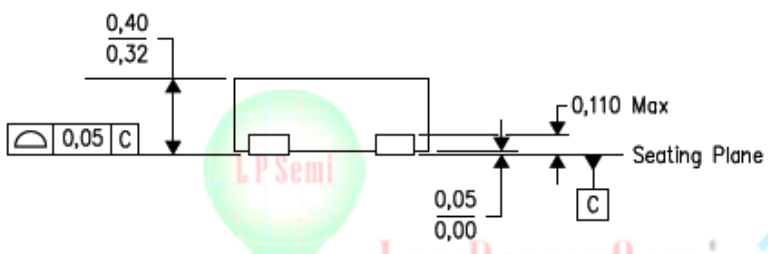


TDFN-4

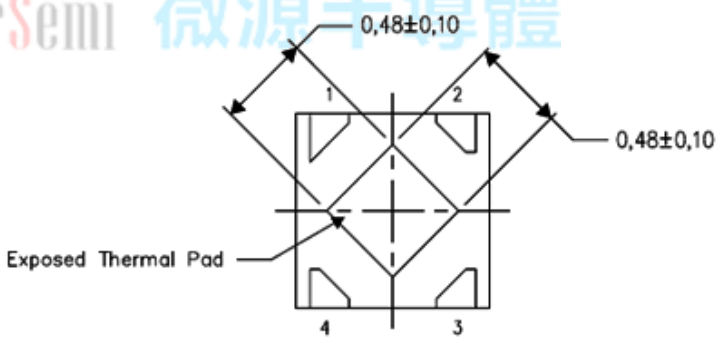


| | | | | | |
|---|------|-----|---|---|---|
| ⊕ | 0,10 | (M) | C | A | B |
| | 0,05 | (M) | C | | |

Bottom View



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Bottom View

Exposed Thermal Pad Dimensions

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[T](#) [MAX663CPA](#) [NCV4269CPD50R2G](#) [NCV8716MT30TBG](#) [AZ1117IH-1.2TRG1](#) [MP2013GQ-P](#)